MARINE BOUNDARIES AND GOOD GOVERNANCE OF MARINE SPACES

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PREFACE

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Abstract

In consideration of the fact that marine spaces have been recognized to be valuable and are under stress from human population and activities, terms such as "ocean governance" have become "buzz words". Many authors have recognized the need for the good governance of marine spaces but their work focuses mainly on the United Nations convention on the Law of the Sea (UNCLOS) and is presented mainly from the perspective of economic development, national security and sustainable development. The importance of marine boundaries is dealt with, but mainly focuses on those boundaries specified by UNCLOS and their conformity to specifications set out by UNCLOS. Even then, the impact of the quality of those boundaries upon the governance of marine spaces is not explicitly dealt with in any depth.

In Canada many academic, legal, government and other works have addressed the need to clarify the complexities surrounding federal and provincial jurisdiction in marine spaces, and therefore have addressed the need to accurately determine the positions of federal and provincial coastal and marine boundaries. The issues dealt with have focused mainly on the legal definition of boundaries and the rights associated with them. By implication, the governance of marine spaces is alluded to but specific focus on the relationship between marine boundaries and governance has been not forthcoming until quite recently. This thesis explicitly addresses issues associated with the relationship between marine boundaries (and marine boundary information) and the good governance of marine spaces. From this perspective, some solutions to (and recommendations in relation to) the problems facing marine boundaries and good governance of marine spaces are offered.

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- Respondents to my questionnaire from Australia, Canada, the United States and Britain

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CHAPTER 1
INTRODUCTION

1.0 Introduction

This research is about the relationship among marine boundaries, marine boundary information, and the good governance of marine spaces. This dissertation demonstrates (and offers solutions to) the fact that boundary characteristics and the quality of boundary information can positively or negatively affect the governance of marine spaces by adequately or inadequately informing the governance decision-making process, and by supporting or undermining governance objectives.

In this thesis, certain terms are used, and others are avoided. For instance, the term "ocean governance" is avoided. The author does not necessarily object to the term. However, although the work specifically focuses on Canada (which is adjacent to "oceans") it is intended to have broader applications to other sovereignties that may be situated adjacent to water bodies identified as "seas." Therefore the author is at this time more comfortable with the term "governance of marine spaces" intending to include both "oceans" and "seas."

Additionally in this thesis, many references are made to sovereignty, jurisdiction, and administration with relation to boundaries. These terms are used based on the following understandings:

- **Sovereignty:** According to Black [1979], sovereignty is the "supreme, absolute, and uncontrollable power by which any independent state is governed. Sovereign-rights as related to real property rights are supreme rights of ownership".

- **Jurisdiction:** Jurisdiction[1] is authority (as of a state) to govern or legislate. In other words, jurisdiction refers to the ambit of power where rights, responsibilities and restrictions in relation to social, cultural, economic and political behaviour are defined, and wherein it is determined how and when those rules are applied and enforced [Moore, 1997; Black, 1979].
- **Administration:** Administration means managing or conducting [Black, 1979]. It refers to discharging of the duties of an office in order to manage affairs by applying things to their uses[2]. These things and their uses are jurisdictionally defined and therefore administration obtains its power by delegation from the sphere of jurisdiction. Administration is therefore the means by which jurisdictionally defined rules are applied and enforced.

1.0.1 The basic logic of this thesis

Governance is the process whereby a society, polity, economy, or organization (private, public or civic) steers itself as it pursues its objectives [Paquet, 1994, 2000a, and 2000b; Rosell, 1999; deBlios and Paquet, 1998; Manning, 1998]. It is the process of decision-making with a view to managing change as societies and organizations pursue their objectives. Better decision-making requires access to appropriate information in order to increase the probability that targeted objectives may be achieved. Good governance therefore requires information of all types continually feeding into

1 "Jurisdiction" is also defined by Black [1979] as the "legal right by which judges exercise their authority" or the "power and authority of a court to hear and determine a judicial proceeding" but this definition is irrelevant in application to boundaries.

2 Administration, in public law, as defined by Black [1979] means "the practical management and direction of the executive department, or of the public machinery or functions, or of the operations of the various organs or agencies."

knowledge of the *status quo* and *future possible,* since both the *status quo* and the *future possible* are subject to changes, for example, in terms of time, nature, society, the economy, the polity, and science and technology developments [Kyriakou and Di Pietro, 2000].

Contemporary governance is often faced with managing many changes that are the result of a combination of human actions interacting with the environment. There is evidence that global warming, resource depletion, and other negative human impacts on the environment are affecting the Earth's capacity to meet human needs [Manning, 1998]. Economic growth is desirable but, without attention to sustainability it may be problematic for some ill-fated groups of society and may seriously limit any region's aspiration for prosperity. The dynamic and negative repercussions of unsustainable actions upon society may be significant [Bohlin, 1999]. Therefore the concept of sustainable development (a balance among economic, social, and environmental factors) has become of great importance both in land and marine spaces.

To strike this balance between economic, social, cultural, and environmental concerns is a major challenge for governance. This is especially true considering the realities of the information age and globalization. Globalization and the information society are forcing jurisdictions to deal with ever-faster rates of change, along with increasingly short-term profit-orientation and increased deregulation which (in some cases) make sustainability harder to achieve [vanDijk, 1999].

To allow for equitable allocation of benefits from the exploitation of resources, while minimizing irreversible effects caused by such exploitation, requires that stakeholders in governance have access to well-managed information. Better decisions rely upon more up-to-date, complete, accurate and useful information including information on what resources exist, the spatial extent of the resources, and who have the rights, responsibilities, and restrictions in relation to the spatial extents and resources [Sutherland, Wilkins and Nichols, 2002; Nichols, Monahan and Sutherland, 2000]. Thus governance of land and marine spaces benefits from access to well-managed information.

Marine spaces are ever increasing in value to the welfare of countries, communities and regions. These areas provide natural, social and economic functions that contribute to increased quality of life including habitat for endangered species, species breeding and resting areas, water treatment, tourism, commercial and recreational fishing, oil and gas development, and construction [Eckert, 1979; Prescott, 1985; Payoyo, 1994; Gomes, 1998].

The good governance of marine spaces is therefore of critical importance and relies in part upon appropriate and well-managed information for good governance to be achieved. Human activities in marine spaces are generally linked to rights sanctioned by at least one jurisdiction, and those rights are associated with spatial extents that imply boundaries and limits. Boundary information is therefore one kind of information needed to support the governance of marine spaces. This is especially important since the rights existing in marine spaces are complex and often overlap [Nichols, Monahan and Sutherland, 2000; Ng'ang'a et al, 2004]. In this thesis, discussions related to boundaries will also include "limits" (e.g., custom limits appearing on CHS charts). The term "limit" is treated as the maximum or minimum expanse of a spatial extent. A boundary, if it is imprecise will have a maximum limit. In Canada a sample of these marine boundaries and limits might include [Nichols and Monahan, 1999]:

- Limits of private and public ownership (e.g., ordinary high water mark);
- Limits of private rights below high water (e.g., aquaculture sites, oil and gas);
- Municipal, county, provincial, and territorial limits of jurisdiction and administration;
- National and international boundaries, including national coastal baselines;
- Government departmental limits;
- Environmental protection areas (e.g., wetlands, marine protected areas);
- Pipeline and cable rights-of-way.

1.1 Summary of Similar and Contributory Research

The major fields of study impacting upon this work are those related to governance and boundaries, specifically marine boundaries. Until approximately 2000, the science of governance was considered to be ‘new’ even though governance has been a fact of human life for millennia [Paquet, 2000b].

Works such as Paquet [1997 and 1999a], Rosell [1999], Manning [1998], de Blois and Paquet [1998], Savoie [1993] have significantly contributed to inspiring a new perspective on what governance means and have investigated new forms of governance. These works focus mainly on the impact of political, social and economic organizations on governance. Other authors, Keough [2000], Kyriakou and Di Pietro [2000], Popp [2000], Bohlin [1999], van Dijk [1999] and Savoie [1993] among others, investigate the impact of science and technology on good governance. These works deal with the importance of information to governance but the body of work and the depth of thought on this topic are still in need of attention.

The importance of spatial information, in particular, to governance has not received adequate attention. Some authors in the fields of human territoriality and geography, such as Jackson [1976], Starkie [1976], Tuan [1978], Wilbanks [1980] and Malberg [1980], have over the years recognized that human activities have spatial dimensions. However, the focus is often on human behavior and not necessarily on the impacts of appropriate spatial information on governance.

In recent years as marine spaces have been recognized as valuable and under stress from human population and activities, words and terms such as "governance" and "ocean governance" have become "buzz words." Lane [2000], Crowe [2000], Grant [1999], Hoogsteden, Robertson and Benwell [1999], Friedheim [1999], Miles [1998], Mann Borgese [1996], Payoyo [1994], Van Dyke [1994], Vallejo [1994], among others, have recognized the need for the good governance of ocean spaces but their work focuses mainly on the United Nations convention on the Law of the Sea (UNCLOS). Their works are presented mainly from the perspective of economic development, national security and sustainable development. The importance of marine boundaries is dealt with but mainly those boundaries specified by UNCLOS and their conformity to specifications set out by UNCLOS. The impact of the quality of those boundaries upon ocean governance is not dealt with in any depth.

In Canada many academic, legal, government and other works have addressed the need to clarify the complexities surrounding federal and provincial jurisdiction in marine spaces, and therefore have addressed the need to accurately determine federal and provincial coastal and marine boundaries and limits. The issues dealt with have focused mainly on the legal definition of boundaries and the rights associated with them. By implication, the governance of marine spaces is alluded to but the specific focus of the relationship between boundaries and governance (as defined in this thesis) has not been forthcoming until quite recently**.**

The point of all the foregoing is that intuitively it is understood that boundaries and boundary information affect the governance of land and marine spaces, but until recently that thought has not been explicitly expressed in academic and other literature (with the exception of a limited focus in UNCLOS). A significant catalyst for the recent awareness of the relationship between boundaries and governance (and specifically the relationship between marine boundaries and the governance of marine spaces) was a project entitled "Good Governance of Canada's Oceans: The Use and Value of Marine Boundary Information"[3] supported by the Geomatics for Informed Decisions (GEOIDE) Center of Excellence.

Many conference and journal publications have resulted from participation in that project by researchers, graduate students (including the author) and partners from Canadian business, and provincial and federal government. Research papers emanating from the project have been presented in many countries including Canada, the United States, Monaco, Kenya, France, China, Australia, Jamaica and the Netherlands. These papers include Monahan et al [1999], Nichols, Monahan and Sutherland [2000], Sutherland and Nichols [2001], Sutherland, Wilkins and Nichols [2002], Sutherland, Ng'ang'a and Nichols [2002], Ng'ang'a et al [2004], Sutherland [2004], Sutherland and Nichols [2004] among many others. The research and publications associated with the project have had worldwide impact and have, for example, sparked research in Australia, the Netherlands, and Southeast Asia on issues related to marine cadastre and marine governance.

[3] See the website for more information (http://www.unb.ca/web/GGE/Research/OceanGov/)

However, none of the publications and presentations has so far addressed the issues of specific requirements for boundaries and boundary information to support the various social, cultural, economic and political activities that form the totality of governance over marine spaces. This thesis addresses these issues and therefore significantly adds to the increase in knowledge bearing on the governance of marine spaces.

1.2 Research Hypotheses

It has been said that good decision-making requires good information. Since governance is also about decision-making this thesis hypothesizes that boundary characteristics and the quality of boundary information can positively or negatively affect the good governance of marine spaces by adequately or inadequately informing the decision-making process, and by supporting or undermining governance objectives.

1.3 Research Objectives

The primary objective of this research is to design boundary information framework models that will aid in the good governance of marine spaces. The term "good" is subjective. However, this thesis considers good governance to be decision-making based upon up-to-date, timely, complete, accurate, and accessible information that facilitates the attainment of set objectives in the management of stakeholder relationships as these stakeholders relate to one another and their socioeconomic, political, and physical environments. This thesis also aims to:

- Demonstrate that boundaries are spatially 3-dimensional, and that a 2-dimensional perception of boundaries, especially in marine spaces is inadequate;
- Demonstrate the importance of the role of geomatics and spatial information, boundary information in particular, as contributory factors in the attainment of society's greater social, cultural, economic and political goals;
- Assist those involved in geomatics research in understanding that geomatics technology is more than an end in itself, and that an awareness of how geomatics contributes to the quality human life needs to be reflected in the nature and quality of engineering designs that are proffered by this profession;
- Demonstrate that, although it is usual for humans to deconstruct reality with the aim of understanding the whole by understanding the parts, it may be better to understand systems as a whole (i.e. systems thinking) especially in the marine context;
- Demonstrate that we are all stakeholders in the governance of land and marine spaces, and that cooperation, integration and collaboration of stakeholders that result in the sharing of information among all stakeholders is beneficial to good governance;

1.4 Methodology

A part of this research is based upon work done by the author as a student-researcher in the project entitled "Good Governance of Canada's Oceans: The Use and Value of Marine Boundary Information"[4] supported by the Geomatics for Informed Decisions (GEOIDE) Center of Excellence. One part of this research relevant to that project relates to marine boundaries' roles in the governance of marine spaces, with

[4] See the website for more information (http://www.unb.ca/web/GGE/Research/OceanGov/)

particular reference to a determination by this researcher of one possible maximum spatial extent of New Brunswick's marine policy area. Some of the results of that research are presented in this work as a case study (see Chapter 6, Case Study 1).

Research results from work done on that project by other team members (e.g., with relation to marine cadastre and marine protected areas), but of which this researcher was also a part, contributed to this thesis. Some of the results of the analysis of a multibeam survey of a proposed marine protected area that affected the importance of boundary placement in support of good governance are included in this work as a case study (see Chapter 6, Case Study 2).

However, this research goes much further than described above as the aforementioned project had a narrow focus (i.e. the province of New Brunswick) while this research is concerned with concepts of marine boundaries and limits, and governance, applicable to Canada, with possible international application. As such, the results of research accomplished by this researcher for the Canadian Hydrographic Service (CHS) contribute to this work. That research involved the identification and categorization of marine boundaries and limits, and the design of a conceptually logical marine boundary database framework for Canadian marine boundary and limits. This research also examines the role of marine boundaries in the governance of marine space beyond the scope of UNCLOS.

Additionally, all of the foregoing is synthesized with concepts from a wide variety of fields of study to produce the original concepts (e.g., the definition of governance), perspectives, and designs that are part of this research. These fields of study include:

- General governance principles and concepts;

- Ocean governance;
- Coastal zone management;
- Sustainable development;
- Human behavior and territoriality;
- Aboriginal studies;
- Property and survey law and concepts;
- Land and marine cadastral studies;
- Law of the Sea;
- Marine and land boundary delimitation;
- Geographic Information Systems (GIS);
- Land Information Systems (LIS);
- Hydrography;
- Social, political and economic geography;
- Political science;
- Sociology;
- Public policy and planning;
- Paradox and uncertainty studies.

A number of data sources were accessed to accomplish this synthesis. The data sources include:

- Published and unpublished papers;
- Books, both academic and otherwise;
- Conference proceedings.

Additionally, other data sources were used to support this work, beyond the works of others. The data sources include:

- Personal experiences;
- Spatial and other data accumulated from past research by the author;
- Canadian and international coastal and marine legal cases;
- Canadian and international coastal and marine policies and laws;
- Property law and other legislation/regulations/treaties affecting jurisdictions, individuals and groups;
- Project documents;
- Government documents;
- Internet searches;
- Data from site visits;
- Interviews and statistical output;
- Meetings;
- UNCLOS;
- Analog and digital spatial data (charts, maps, plans, multi-beam and other hydrographic data etc.);
- A small sample survey (questionnaire) of organizations dealing with marine boundaries. The survey report is at Appendix III.

To meet the objectives of this thesis a number of designs and discussions are presented. These include:

- A classification of Canadian marine boundaries to assist in the identification of marine boundary information requirements;

- A design of marine boundary information framework models;
- Case studies that underscore some of the problems in Canada in meeting boundary information requirements to support the good governance of marine spaces;
- A discussion of some ways to improve the management of marine boundary information and good governance in Canada, with possible application worldwide (i.e., marine cadastre, marine geospatial data infrastructure, and the design of a data model to improve Canadian Hydrographic Service's management of boundary information).

1.5 Research Contributions

Knowledge from a variety of academic disciplines may from this research. It specifically contributes to various academic disciplines by:

- Producing a new definition of what is a boundary, that is more appropriate in application to marine spaces and thereby adding to the body of knowledge relating to boundary concepts;
- Producing a fresh synthesis of previous governance research as well as a new definition of governance, thereby adding to the body of knowledge relating to general governance principles;
- Accentuating the importance of geomatics and spatial information in the achievement of political, social, and economic governance objectives, thereby contributing to the body of knowledge related to the fields of geomatics and governance;
- Highlighting the importance of appropriately comprehending the complexity of marine boundaries' spatial and temporal configurations and their other unique

characteristics, thereby contributing to the body of knowledge related to the field of geomatics;

- Identifying and classifying marine boundaries not currently shown on CHS charts, thereby adding to the body of knowledge related to the fields of geomatics, and the governance of marine spaces;
- Designing a logical national marine boundary database model, and making appropriate applicable recommendations to Canadian federal government, thereby adding to the body of knowledge related to geomatics, and Canadian (and possibly international) governance of marine spaces;
- Outlining boundary and boundary information requirements that will support the good governance of marine spaces, thereby contributing to the body of knowledge related to geomatics, and Canadian (and possibly international) marine governance;
- Furthering discussions on marine cadastre concepts and design, thereby contributing to the body of knowledge related to geomatics, and Canadian (and possibly international) marine governance;
- Designing boundary information framework models that will aid in the good governance of marine spaces, thereby contributing to the body of knowledge related to geomatics, and Canadian (and possibly international) marine governance.

1.6 The Organization of This Thesis

The research in this thesis is organized to first build a solid ground upon which to design of a marine boundary information framework model to support the governance of marine spaces. The main objectives of this work will be more appropriately appreciated if a consolidation of concepts and principles not apparently and obviously linked to marine boundaries and geomatics are first presented. A short description of each chapter, except this one, is presented below.

1.6.1 Chapter 2

Chapter 2 discusses concepts and perceptions related to boundaries and offers a new and more appropriate definition of the term “boundary”. This new boundary definition is one major contribution of this thesis, and is important in changing the perceptions of what is a boundary, especially considering the 3-dimensional spatial extent to which rights are attached in human societies. The governance of marine spaces stands to benefit from this new definition of boundaries as this perception can be applied to the design of boundary databases and visualizations, and can better inform policies and administration in marine spaces.

1.6.2 Chapter 3

Chapter 3 demonstrates that governance is affected by the combination of stakeholders and stakeholder value systems, organizations and organizational structures, institutional design, policies, legislation and laws, governance forms (e.g. collaboration, integration, cooperation etc.), information, and information infrastructures. Concepts of governance in general will first be presented and discussed. Thereafter, the governance of marine spaces is discussed. At the end of this chapter the reader should have a better understanding of what is entailed in the governance of marine spaces. This chapter demonstrates the benefit of systems thinking, and that all are stakeholders in the governance of land and marine spaces, and that cooperation, integration and collaboration of stakeholders that result in the sharing of information among all stakeholders is beneficial to good governance. The major contributions of this chapter are a new synthesis, critique, and development of governance concepts in addition to a new definition of governance.

1.6.3 Chapter 4

This chapter examines the complexity of rights existing in marine spaces and the importance of managing these rights to achieve 'good' governance. The unique characteristics of marine boundaries are also discussed. Also examined are the boundary information requirements to enhance good governance of marine spaces. The discussion on boundary information requirements to enhance good governance of marine spaces is an important contribution of this thesis to the fields of geomatics and the governance of marine spaces. By implication the reader should better understand the importance of spatial information, especially marine boundary information, to the good governance of marine spaces and the need to pay more attention to marine boundaries in order to improve the governance of Canadian marine spaces. This chapter is based in part on research done by the author on behalf of the CHS.

1.6.4 Chapter 5

In Chapter 5 Canadian marine boundaries are identified in accordance with the need for the inclusion of now exempt boundaries on CHS charts to improve the governance of Canadian marine spaces. These boundaries are then classified according to functions they serve. The identification and classification of Canadian marine boundaries are major contributions of this research to the fields of geomatics and the governance of marine spaces. At the end of this chapter the reader should better understand how CHS charts can aid in improving the governance of Canadian marine spaces. This chapter is also based in part on research done by the author on behalf of the CHS. It underscores the fact that spatial information is an important contributing factor in the good governance of marine spaces.

1.6.5 Chapter 6

Chapter 6 presents three Canadian case studies undertaken in this research and is designed to emphasize some of the points brought out in the previous chapters. The first case study is based upon the delineation of one possible maximum extent of New Brunswick's submerged lands. Legal and technical implications of the spatial data used to produce the final product are discussed, in addition to the governance implications emanating from the quality of the input data and the final product. This section is based on research done by the author on behalf of Service New Brunswick (SNB).

The second case study relates to the proposed Musquash Marine Protected Area and is based upon research done by graduate students (including the author) in the Department of Geodesy and Geomatics Engineering, University of New Brunswick with the support of GEOIDE. This case study highlights the importance of how the right choice of boundary position, among other things, can affect the governance of marine spaces.

The third case study deals with the proposed New Brunswick Coastal Protection Policy. This case looks at the implications of boundary choice on the good governance of coastal spaces, as well as discussing some of the shortfalls of policy formulation.

These case studies underscore the fact that:

- Geomatics is not an end in itself but contributes to good governance;
- Boundary characteristics and boundary information play an important role in the governance of marine spaces;
- Collaboration, cooperation, and integration of stakeholders and stakeholder resources is beneficial to the good governance of marine spaces;
- Systems thinking is beneficial to good governance;

1.6.6 Chapter 7

Chapter 7 addresses the question of what boundary characteristics are required to give adequate support to the good governance of marine spaces. This chapter outlines designed models of boundary information frameworks that are derived from governance functions and boundary classifications determined in Chapter 5. The designs and discussions are drawn from a Canadian perspective, but many of the arguments and models could be applicable in other national jurisdictions. The reader should thereafter appreciate some of the boundary information requirements necessary to improve governance of marine spaces. This chapter is based in part on research done by the author on behalf of the CHS.

1.6.7 Chapter 8

Chapter 8 offers three methods of improving the management of marine boundary information and the governance of marine spaces in Canada and possibly internationally. A logical national marine boundary database framework is designed then presented as both a generic object-relational model and as a version applicable to the International Hydrographic Organization's (IHO) S57 standard for Electronic Nautical Charts (ENC). This underscores the argument that CHS charts can be used as more than navigation instruments. They can be viewed as appropriate media for the communication of boundary information to users of Canadian marine spaces with interests beyond navigation.

Thereafter Canada's Marine Geospatial Data Infrastructure initiative and the concept of a marine cadastre will be discussed. These are two concepts that can make a significant contribution to the management of boundary information, and therefore also on the governance of marine spaces.

1.6.8 Chapter 9

Chapter 9 summarizes all of the appropriate points that were presented in the previous chapters is presented. Additionally, conclusions and recommendations are discussed and presented.

CHAPTER 2

BRIEF DISCUSSIONS ON BOUNDARIES

> Space, like law, is not an empty or objective category, but has direct bearing on the way that power is deployed, and social life structured [Blomey, 1994].

2.0 Introduction

This chapter discusses concepts and viewpoints related to boundaries and subsequently offer a new and more appropriate definition of the term "boundary". This new definition is important in changing the perceptions of what is a boundary, especially considering the 3-dimensional spatial extent to which rights are attached in human societies. In this thesis, discussions related to boundaries will also include "limits" (e.g., custom limits appearing on CHS charts). The term "limit" is treated as the maximum or minimum expanse of a spatial extent. A boundary, if it is imprecise (e.g., a general boundary), will have a maximum limit.

Additionally, this chapter explains the term "human-interactive boundary", the only type of boundary that is the focus of this thesis. This is done from a Canadian perspective. Human-interactive boundaries are then defined in terms of the frameworks of sovereignty, jurisdiction, administration, other rights, and interests. These definitions will form the basis of boundary classification schemes presented in Chapter 5.

2.1 Human Territoriality and Boundaries

According to Sack [1992] territoriality is defined as "the act of creating territories", i.e. the control of areas of space or "the geographical exercise of power." A territory is then controlled space. As human beings we, through forces of biology and socialization, segment space according to meanings we ascribe to those segments and territoriality maintains those meanings. In other words territoriality facilitates the overlaying of meaning on an otherwise neutral, even unknown, environment [Sack, 1992; Malmberg, 1980; Goodey, 1974].

This application of meaning to controlled space transforms that space to a place. Place, according to Tuan [1978] is structured space. Through this structuring, neutral space (from a human perspective) is ordered and becomes a home, a field, a city, real property, etc. "Space must be ordered to be livable" [Tuan, 1978]. Territories are usually organized as either fixed (i.e., staked out geographically and attached to a claimant whose claim is supported in law) or situational where resources are claimed while they are in use, and the resources are available to both public and private entities [Malmberg, 1980; Goffman, 1972].

The act of ordering space in this manner produces an emotional bond between individuals and groups and that space, and that bond is often demonstrated by applying, in some manner, bounds to that space. Altman [1975] supports this by stating that "territorial behavior is a self/other boundary-regulation mechanism that involves personalization of or marking of a place or object and communication that it is 'owned' by a person or group." These boundaries could be natural or cultural (i.e., evidenced by some cultural markings) [Malmberg, 1980; Cox, 1972; Miller, 1965]. According to Malmberg [1980] and Keith [1948] the human urge to organize space, give it meaning and form a bond with it, and to defend it is intense and therefore the concept of boundaries is central to territoriality.

This concept of territoriality is applicable to all groups of humanity. In Western societies the concept of boundaries has strong links to the concept of property in land (or real property). In the developed world of Western cultures it is sometimes thought that other groups (labeled as primitive, nomadic, hunter-gatherer, native etc.) do not have, or have not had, ideas of real property. This perspective is disputed by many authors including Van Dyke [1994], as well as Malmberg [1980] who quotes Eyre [1845][5] as saying that it is incorrect to assume that 'natives' have "no idea of property in land, or proprietary rights connected with it. Nothing could be further from the truth than this assumption." On this basis, it can be assumed that territoriality is practiced by all groups of humans and therefore boundaries or one kind or another is required by all groups of humans in relation to 4-dimensional space (i.e. the 3 dimensions of length, width, and height plus time) [Bohannan, 1963].

In Canada aboriginal proprietary connection to real estate is evidenced by numerous court cases and land claims. Although the root of aboriginal title and rights to land and marine spaces are based upon different principles than those ascribed to other groups of later settlers, aboriginal connection to bounded spatial extents is just as strong as with other groups [Bartlett, 1988; Muir, 1999; McNeil, 2001].

[5] Eyre, E. J. (1845). *Journals of Expiditions of Discovery into Central Australia and over Land from Adelaide to King George Sound, in the years 1840-1841: sent by the colonists of South Australia, with the Sanction and Support of the Government: including an Account of the Manners and Customs of the Aborigines and the State of their Relations with Europe 2.* T. and W. Boone, London. This document is a report on his journeys in Central Australia in which he confirmed that the tribes had separate hunting grounds and a sense of bounded territories.

2.2 Boundary Implications of State Requirements

Paquet [1999] refers to the Boulding Triangle[6] model (Figure 2.1) of human interaction that shows the fluid relationship among the three major sectors of human endeavor (i.e, society, polity and economy). Each sector influences and affects the other two [Paquet, 1999a; Sutherland, 1998]. However, it is generally accepted that it is the polity (at least in the Western world) that is legislated with the power to provide sovereign direction, as well as provide facilitation for social and economic activities in relation to all resources within sovereign borders. Therefore, the discussion here will approach the subject of the spatial dimensions of state requirements from the perspective of political agency. Examples relative to the marine environment will be discussed.

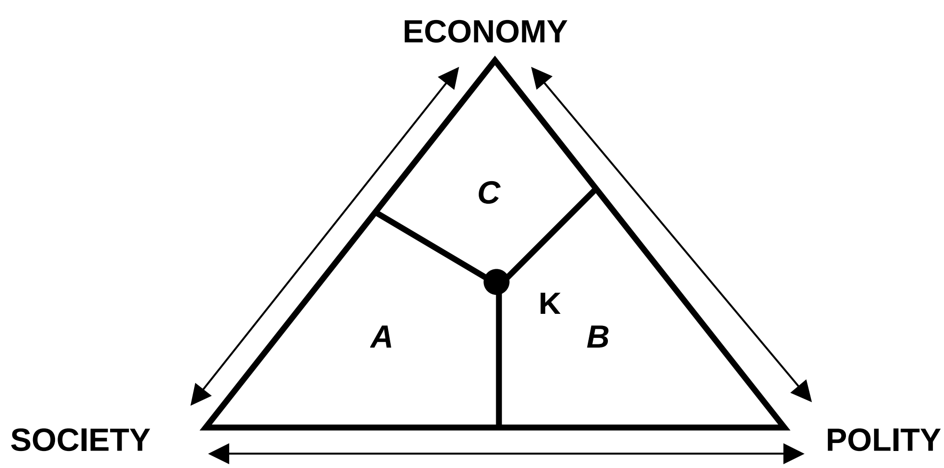


FIGURE 2.1 – A MODIFIED BOULDING TRIANGLE
[*after Paquet, 1999a*]

[6] The Boulding Triangle shows the relationships among the political, economic and social sectors in a state. The proportions of influence is determined by the point K. The point K is not stable and always moves, thereby providing varying proportions of the totality to economy, society and polity.

Politics is the art and science of government or the management and administration of state affairs [Pettman, 1975; Eldridge, 1976; Doern, 1985; Webster's Dictionary, 1986; Funk & Wagnalls Canadian College Dictionary, 1989; Tansey, 1995; Watts, 1997]. Government has a number of requirements with regard to state affairs. These include the requirement to have, among other things:

- security of its sovereign borders;
- maintenance of socio-economic and political relations with other states;
- enforcement of its jurisdictional powers;
- exercise of its administrative powers and enforcement of policies;
- facilitation of the positive development of its economy;
- facilitation of the socio-cultural well-being of its citizens;
- facilitation of the management of its natural resources.

All of the above possess spatial dimensions. This is obvious when dealing with the security of sovereign borders. The dimensions of the borders must be known in order to for it to be defended. Also when one state maintains relations with another, borders and boundaries become important in relation to, among other things:

- cross-border trading of goods and services, and the application of custom duties and trading agreements;
- application of diplomatic immunity;
- settlement of disputes over territorial space;
- application of immigration rules and regulations.

Legislation, laws, regulations, and policies are applicable to citizens (and to varying extents non-citizens) living within the confines of a jurisdictional unit. This jurisdictional unit can be spatially defined and therefore jurisdiction is tied to a spatial extent. The administrative exercising of policies and jurisdictional directives through regulations and the enforcement of those regulations is also tied to spatial extents (administrative units) in the same manner [Sutherland, 2002; Clarke and McCool, 1996; Kirby, 1982; Lowi, 1970].

Key to government's facilitation of economic activities and development in western democracies is the protection of property (real and personal). Real property definitely has spatial dimensions. Economic activity occurs in 4-dimensional space (land or marine). Resource extraction, resource processing, transaction processing and other market activities occur in 4-dimensional space and all these activities are tied to real property and therefore to boundaries [Dowson and Sheppard, 1952; Paterson, 1972; Simpson, 1976; Weaver, 1979; Wilbanks, 1980; Harari and Garcia-Bouza, 1982; Dale and McLaughlin, 1988; Larsson, 1991; Stanbury 1993; Thurow, 1998; Covey, 1998].

Government's facilitation of socio-cultural activities also has spatial dimensions. The legal framework maintained by the polity applies to specific spatial extents (provinces, municipalities etc.) within which the citizens carry out their socio-cultural activities. Living spaces and spaces for recreational activities among other things are tied to private, public and community property rights and therefore are linked to boundaries. In order for the polity to provide public services as demanded by its citizens the spatial positioning of communities is required knowledge and therefore boundaries are important in this regard [Ford and Zussman, 1997; MacNair, 1995; Sack, 1992; Malmberg, 1980; Wilbanks, 1980; Tuan, 1978; Goffman, 1972; Kristof, 1959]. Kirby [1982] underscores this by stating that "changes in the spatial economy and the inequitable distribution of phenomena between locations have important (often deleterious) impacts upon populations."

Socio-cultural, economic and political activities depend upon the availability of resources (human, natural etc.) for exploitation to achieve targeted objectives. All of the activities require, at some point in time, access to natural resources existing in exposed land, submerged land, or in water covering (or covered by) land. The management and protection of these natural resources has become extremely important to sovereignties as sustainable development becomes more important [Manning, 1998; Young, 1994; Stanbury, 1993]. In order to manage or protect the natural resources it is necessary to know where they are located as well as their spatial extents. It is also necessary to know who has rights to these resources and the spatial extents of their rights [Nichols, Monahan and Sutherland, 2000; Grant, 1999; Nichols and Monahan, 1999; Food and Agriculture Organization, 1998; Pinto, 1994; Richardson, 1994]. Furthermore, if there are phenomena that negatively, or potentially negatively, affect the resources the 4-dimensional position and spatial extent of the source of the phenomena needs to be ascertained in order to address the problem [Starkie, 1976]. It is clear then that if they are to be effective, government policies aimed at managing or protecting natural resources must consider the spatial dimensions of those resources as well as phenomena of potential risks to the resources.

The spatial nature of politics has long ago been recognized and this is underscored by Wagner [1960] who states that "political organization and political action have always a territorial basis" which implies action within or in relation to borders and boundaries. Boundaries have a political form that defines a "meeting place" [Kristof, 1959] for at least two socio-political entities along with their respective interests, structures and ideologies [Kristof, 1959; Malmberg, 1980; Johnston, 1988].

The spatial dimensions of a state's territory can comprise land as well as marine spaces. The general political requirements with respect to the marine environment are more or less the same as the land requirements (i.e., strategic and military security, social well-being, economic development and environmental protection) [Crowe, 2000; United Nations, 1998; Johnston, 1988; Sanger, 1987; Sohn and Gustafson, 1984]. Furthermore, it is essential to manage the increasing number and complex rights to marine spaces (at the international, national, regional and local levels) because the importance of these spaces to human life on Earth makes the Grotian Notion[7] increasingly implausible [Friedheim, 1999 and 1993; Miles, 1998; United Nations, 1998; Pinto, 1994; Prescott, 1985; Ekert, 1979]. These rights are evidenced by the existence of sovereign, jurisdictional, administrative, private, and community marine boundaries and represent an aspect of the spatial dimensions of state requirements in marine spaces [Reed, 2000; Lane, 2000; La Forest, 1973]. There is not the assumption in this thesis that all the foregoing represents exclusive use of space.

2.3 What is a boundary?

It is not within the scope of this work to discuss boundaries in detail. However, in order to develop a workable definition of what is meant by "boundary" with regard to this thesis, some basic concepts will be described. This thesis is also primarily concerned with

7 The right of ocean users to do as they please as long as the rights of others are not violated. According to Friedheim [1993] this is becoming increasingly difficult because of increasing use of ocean spaces.

boundaries related to the spatial extents of individual and group rights in the marine environment.

2.3.1 A more appropriate boundary concept

According to Malmberg [1980] "boundaries indicate certain well-established limits or bounds of a given unit" unifying all that lies inside these bounds. It is reasonable to assume that this "unit" could refer to personal space or to a spatial extent that is a subset of land or marine space. In personal space the unit includes the human body and possibly some 4-dimensional and culturally defined area of personal comfort surrounding the human body. The degree of personal comfort is affected by the trespass of unwanted intersection of that area of personal comfort by what is perceived to be bounds of another personal space (i.e., someone physically comes "too close"). In other words, a transgression of personal rights of comfort is perceived to occur because the boundaries of personal comfort were trespassed, even though these boundaries may not be demarcated. The point is that these "boundaries" are associated with "rights" regardless of whether the rights are sanctioned by societal laws. The perception a human being has of personal space is affected by both biology and socialization, but may or may not be well established [Malmberg, 1980; Tuan, 1978; Goodey, 1974].

The human being also perceives rights with regard to spatial extents of land and marine spaces. These rights are normally sanctioned by legislation, common law, or by some other culturally relevant framework of rights, responsibilities and restrictions that shape the nature of a person's perception of his/her connection to 4-dimensional land or marine spaces. Associated with these spaces are ideas of consumption, interests, structures and ideologies among other things. In the world of geomatics the outer edges of these 4-dimensional spaces are termed "boundaries" [Sack, 1992; Lamden and de Rijcke, 1985; Altman, 1975; Goffman, 1972; Cox, 1972; Miller, 1965; Prescott, 1965; Kristof, 1959; Keith, 1948].

However, what exactly is a boundary? Lamden and de Rijcke [1985 and 1989], Allred [1989] and Prescott [1965] describe a boundary as a line. Lamden and de Rijcke [1985 and 1989] take an apparently topographic view by defining a boundary as an 'invisible line between two contiguous parcels of land." Prescott [1965] simply states that a "*Boundary* refers to a line, while *frontier* refers to a zone."

While it is understood that this "line" might be the delimitation in 2-dimensional space of the limits of rights to a spatial extent (as on a map, plan or chart) or a demarcation on the surface of the Earth with the same meaning, there are certain inadequacies with the definition. Firstly, a boundary is more than just a line; it is division of space and time as perceived by at least two human entities based on a shared mental map of the physical environment. Secondly, that division of space and time is rarely 2-dimensional and is more likely to be 4-dimensional even in the land environment. Rights to the land environment, even if airspace rights to the "heavens" are not included, will include some rights to airspace in order to erect a building. Furthermore, even if mineral rights in the subsoil are absent from a person's estate it is usually accepted (at least in Western society) that one has the right to build a basement or a septic tank in the subsoil.

The definition of a boundary as a line is certainly inadequate in the marine environment where even the public right of "surface" navigation technically involves some other portion of the water column. Furthermore, the very nature of the marine environment and the rights associated therewith requires an at-least 3-dimensional perspective [Ng'ang'a et al, 2004].

The perception of a boundary as a line has surely been influenced by the traditional nature of the modeling media. Maps, plans and charts even in the digital age are mostly 2-dimensional models, and even though there are 3-dimensional renderings of land and marine spaces boundaries have mostly been overlaid upon the rendered surfaces as lines. Ng'ang'a et al [2004] have challenged this perspective especially of marine boundaries and have put forward a data model more appropriate to the marine environment than the traditional layered approach.

How then shall a boundary be adequately defined? Considering the at least 3-dimensional nature of the bounded spatial extent, a boundary is more adequately described as a *plane* sectioning 3-dimensional (and probably more accurately 4-dimensional) space (Figure 2.2). That plane represents an agreement between owners of rights to contiguous spatial extents as sanctioned by legislation, law or by some other culturally relevant framework of rights, responsibilities and restrictions that shape the nature of a person's perception of his/her connection to 4-dimensional land or marine spaces. A boundary is therefore a plane of separation between at least two spatial extents to which are attached certain characteristics or norms of human interaction with other humans and the natural environment. The plane will have width depending on the level of precision (i.e., depending on whether it is a precise or general boundary).

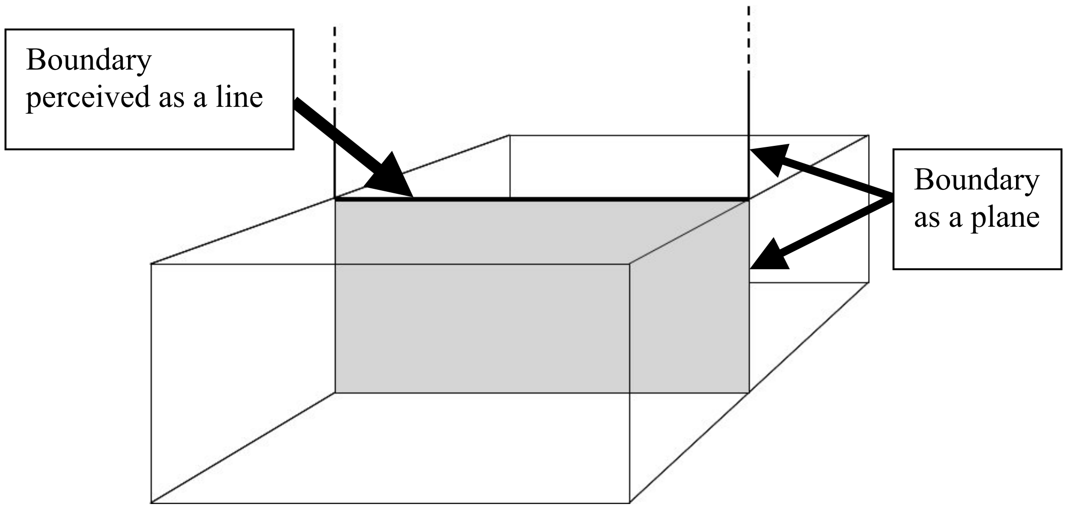


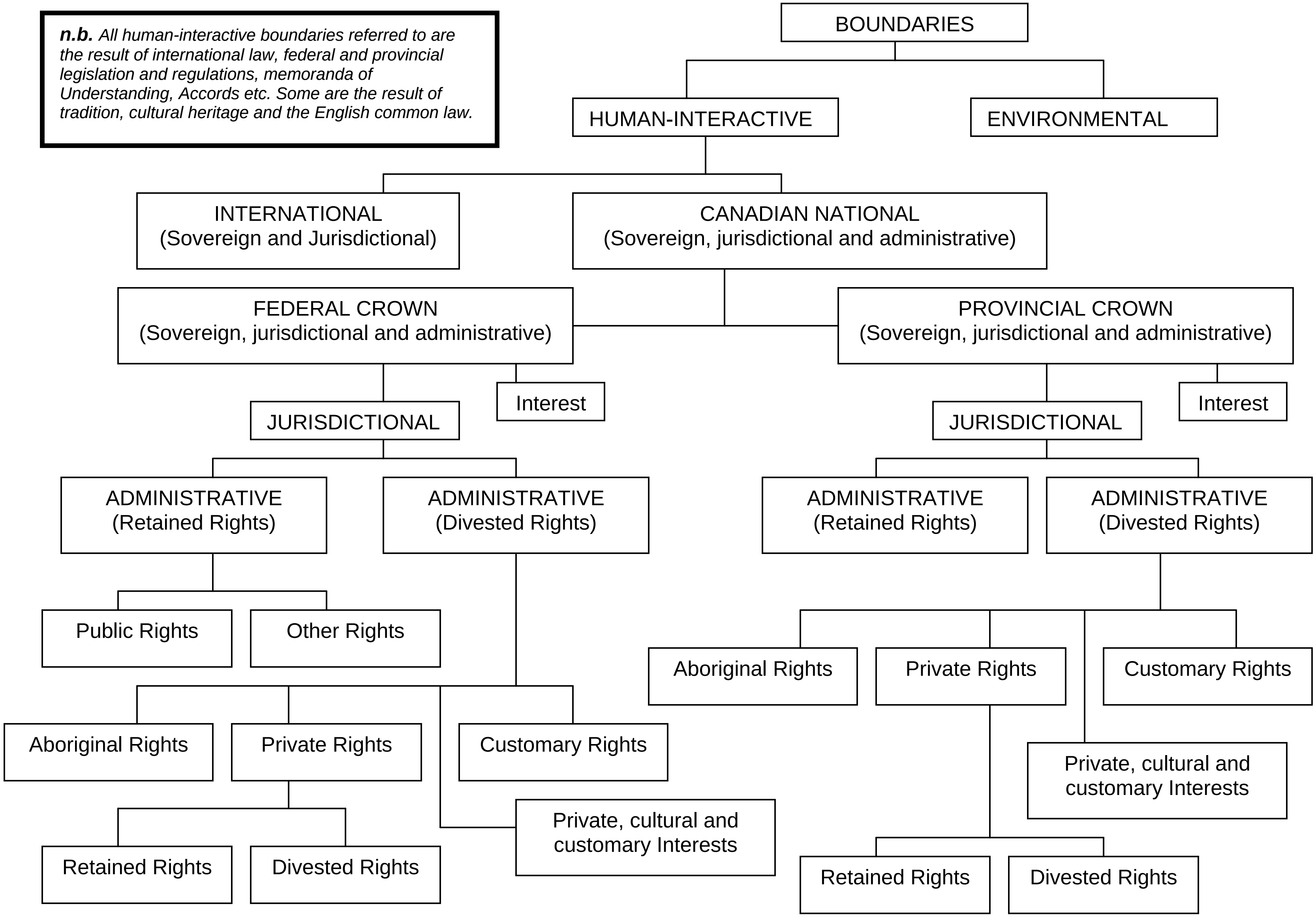
FIGURE 2.2 – A BOUNDARY AS A PLANE SECTIONING 3-DIMENSIONAL SPACE

2.4 Human Interactive Boundaries

In general, boundaries may be categorized as environmental or human-interactive. Environmental boundaries are biological, ecological etc. in nature and are not part of the focus of this thesis. Human-interactive boundaries are so described because human consciousness of them serves as frameworks for interaction with either the environment or other humans [Malmberg, 1980]. The discussions will assume Canadian boundaries.

Human-interactive boundaries in Canada are generally sovereign-rights (i.e., implying supreme rights of ownership), jurisdictional, administrative, rights-based (less than sovereign) and interest-based (see Figure 2.3). These boundaries occur within the framework of legislation, common law, civil law, memoranda of understandings, Accords, traditions and cultural heritage that each defines the nature of human interaction with each other and with the spatial extent delimited by the boundaries. Although Figure 2.3 does not explicitly show use rights, these rights are implied by the presence of the rights shown.

FIGURE 2.3 – CATEGORIZATION OF BOUNDARIES IN CANADA



2.4.1 Sovereign-rights boundaries

All real property ownership rights originate from the entity holding sovereign rights. Entities holding sovereign rights in real property (e.g., the Crown, represented by the Canadian federal government, or represented by a provincial government) usually reserve the right to usurp the ownership rights of other legal persons (e.g., by expropriation) under specific criteria. Also, ownership rights lost to legal persons and that do not pass to another legal person usually revert to the Crown.

An example of a sovereign boundary (in terms of real property) is a plane representing the political-geographic limits of a country wherein the highest authority representing that country holds supreme ownership rights to land. Sovereign boundaries may be land or marine.

2.4.2 Jurisdictional Boundaries

A jurisdictional boundary is a plane of separation that defines a limit of a spatial extent within which a jurisdictional authority has the power to define rights, responsibilities and restrictions and how those rights, responsibilities and restrictions are applied and enforced. A jurisdictional boundary may be land or marine. When delimiting its maximum spatial extent a jurisdictional boundary can coincide with a sovereign boundary.

2.4.3 Administrative Boundaries

An administrative boundary may be defined as a plane of separation that defines a limit of a spatial extent within which an administrative entity has been delegated the power to ensure the application and enforcement of certain jurisdictionally defined rights, responsibilities and restrictions. The spatial extents of administrative geographic areas are subsets of the spatial extents of jurisdictional geographic areas. An administrative boundary may be land or marine.

2.4.4 Other rights-based boundaries

In Canada there are many types of rights that relate to real property, whether land or marine. In real property law rights to real estate may relate to rights of private ownership, or private and public use rights. Aboriginal and (possibly community rights) in relation to spatial extents are also a reality in Canada. These rights and the boundaries that define their spatial extents will be examined in this section.

2.4.4.1 Boundaries for private ownership rights

Ownership rights in real estate are tied to spatial extents (land or marine) defined by boundaries [Nichols, Monahan and Sutherland, 2000]. These spatial extents are subsets of administrative and jurisdictional geographic areas (though they can overlap two jurisdictions). Depending on the jurisdiction, ownership rights may be termed as "absolute" (civil code) or "freehold" (common law) [Simpson, 1976]. Both types of ownership rights (subject to overarching restrictions and responsibilities, and the right reserved to jurisdictions to usurp those rights) give title to the owner of the rights. The term "title" in real property law refers to the means whereby the owner of the rights to the object of property has the just possession of that object. It is both the right to ownership of the object of property and the evidence of such ownership. The nature of the just possession is the legal right, for example, to [Simpson, 1976]:

- benefit from the use of the resources within the limits of the spatial extent;
- exclude others from the use of resources within the limits of the spatial extent;
- convey use rights to other persons;
- convey ownership rights to other persons;
- bequeath ownership rights to other persons.

Private ownership rights in the land environment generally include surface, subsurface, and air rights, although sometimes subject to overarching restrictions in those dimensions. Consequently boundaries associated with private ownership rights inherently are at least 3-dimensional. A boundary of private ownership rights is therefore a plane of separation that defines a limit of a spatial extent to over which a legal person (i.e. an individual, a group, a company, a government etc.) can legally exercise the exclusive ownership rights.

2.4.4.2 Use-Rights Boundaries

In real property law, use rights are part of the totality of absolute/freehold rights. A legal person holding absolute/freehold rights or sovereign rights (e.g., use rights on Crown land) may grant use rights to another person. Use rights may also be granted by a legal person that has been delegated the authority to give use rights (e.g. a tenant with the right to sublet). Rights granted in this manner are subject to restrictions in terms of the nature of the use rights (e.g. type and temporal aspects of use) and the spatial extent linked to the use rights (sometimes defined by boundaries). Use rights may also be gained in some jurisdictions by unobstructed use of another person's object of property (real estate) over time [Simpson, 1976].

There are public use rights and private use rights. Public use rights in relation to the marine environment include the right of public access to the shore, the right of navigation and fishing rights [Muir, 1999; Lamden and de Rijcke, 1996; Goldfarb, 1988; Maloney, Plager and Baldwin, 1968]. These are rights gained from the Crown (in the case of Canada) who has sovereign rights. Private use rights include easements that are gained from persons with sovereign rights (in the case of Crown Lands) or from persons with private ownership rights under real property law.

The use rights may relate to any subset of the spatial extent of the object of property to which ownership rights are linked. Use rights may relate to land or marine geographic space. A use-right boundary is therefore a plane of separation that defines a limit of a spatial extent that is a subset of real estate to which a legal person, other than the holder of the use rights, have ownership rights or has been delegated the authority to grant use rights.

2.4.4.3 Boundaries for customary rights

Specific communities in Canada may have certain rights in relation to land by virtue of tradition and custom [McNeil, 2001; Muir, 1999; Bartlett, 1988]. Examples of these would include fishing and hunting rights. A customary-right boundary may be defined as a plane of separation that defines a limit of a spatial extent to which is attached certain rights from which a member of a community cannot be excluded.

2.4.4.4 Boundaries for aboriginal rights

Aboriginal peoples in Canada enjoy special status because of their historical relationship with the land [Speck, 1915; Whitehead and McGee, 1983]. Their rights to marine and land spatial extents relate to Indian reserves and as well to comprehensive land claims already processed and being processed by Canadian federal courts [McNeil, 2001; Muir, 1999; Bartlett, 1988; Johnston, 1988]. An aboriginal right boundary is therefore a plane of separation that defines a limit of a spatial extent to which members of aboriginal groups have certain rights defined by their historical cultural heritage or by virtue of treaties signed with the government.

2.4.5 Interest-Based Boundaries

There are instances when persons or groups in society have concerns in relation to certain spatial extents. For instance, a community may have concerns about a government process that will change the status of a particular spatial extent (e.g., in the process of designating an area a marine protected area) that will affect their interaction with the geographic area. They may have other rights in the spatial extent, both as a group, as groups and as individuals but as a whole they have an interest in the geographic area. Their influence or relevance may make it important to have their interest and the spatial extent of their interest recognized [Simpson, 1976]. An interest-based boundary is therefore a plane of separation that defines a limit of spatial extent in which a legal person (or persons) has an interest recognized by a larger community.

2.5 Summary and Conclusions

Human territorial behavior and the human urge to organize space span all cultures and have been reported by researchers as a characteristic spanning time and place. The concept of a boundary is integral to territoriality and therefore it is reasonable to assume that we define boundaries to implement political, socio-cultural and economic activities. Certainly in today's Western societies there is a spatial dimension to political, socio-cultural and economic activities. Since all of these activities are part of the totality of governance, boundaries and boundary information are essential components of the governance of both land and marine spaces.

Human-interactive boundaries (versus environmental boundaries) may be classified as sovereign, jurisdictional, administrative, public/private rights-based, or public/ private interest-based. These classifications are applicable to both land and marine environments and represent the governance functions of the various boundaries.

Most, if not all, literature describes a boundary as a line. A line is a 2-dimensional object, and while a line is an indicator of the position of a boundary the spatial extent to which the line is attached is fully 3-dimensional. The definition of a boundary as a line is inadequate in the 4-dimensional land environment where rights can be associated with air space, the land surface, and the subsoil. It is also an inadequate definition in the 4-dimensional marine environment where rights can be associated with the water surface, water column, bed and subsoil. A boundary is therefore more adequately defined as a plane of separation between at least two spatial extents to which are attached certain characteristics or norms of human interaction with other humans and the natural environment. These norms and characteristics of interaction are framed by law or custom, sometimes represent environmental features, and facilitate socio-cultural, economic and political endeavors.

With appropriate technology available today, the perception of a boundary as a plane can motivate more adequate visualizations of spatial extents to which rights are attached and thereby assist in the formulation of relevant land and marine policies, as well as improve the efficiency of land and marine administration processes through more accurate descriptions of administered spatial extents. In this regard the perception of boundaries as a plane can improve the governance of land and marine spaces by more adequately informing the decision-making process that supports the pursuit of governance objectives.

Table 2.1
Summary of Major Points in Chapter 2

The definition of a boundary as a line is inadequate and is more appropriately defined as a plane of separation between at least two spatial extents to which are attached certain characteristics or norms of human interaction with other humans and the natural environment.
The definition of a boundary as a line is inadequate, especially in relation to marine spaces.
Human beings are territorial and the boundary concept is essential to territoriality. Human territorial behavior is not limited to Western societies
Human social, cultural, economic and political activities in land and marine spaces have spatial dimensions and therefore boundaries are relevant to all these activities.
Human-interactive boundaries in Canada are generally sovereign-rights (i.e. implying supreme rights of ownership), jurisdictional, administrative, rights-based (less than sovereign) and interest-based.

CHAPTER 3

THE GOVERNANCE OF MARINE SPACES

> For several centuries, the bounty of the oceans was so vast that it was believed to be limitless … however, it became clear that scarcity ─ the general economic fact of life ─ applies even to the oceans [Ekert, 1979].

3.0 Introduction

Manning [1998] stated: "good governance is essential for all societies to ensure the provision of public services and the control of behaviours [sic] which affect the common good." Good governance of coastal and marine spaces is therefore of vital importance since coastal and marine spaces are of tremendous importance to life on Earth, and are at the same time extremely sensitive to human activities [Payoyo, 1994; Lutz and Munasinghe, 1994; BoFEP, 1996; Gomes, 1998; Crowe, 2000; CNPA, 2000].

Coastal and marine areas are ever increasing in value to the welfare of countries, communities and regions. These areas provide natural, social and economic functions that contribute to increased quality of life. The oceans are instrumental in determining climate that beneficially affects all life on Earth [Payoyo, 1994]. Other natural functions include habitat for endangered species, species breeding and resting areas, water treatment, groundwater recharge, and flood attenuation. Some social and economic functions include tourism, commercial and recreational fishing, oil and gas development, and construction [Eckert, 1979; Prescott, 1985; Gomes, 1998]. Additionally these spaces are sources of wealth for humankind by providing [Eckert, 1979; Payoyo, 1994]:

- Sources of food from animals, plants and fish;
- Means of transportation;
- Sources of minerals and petroleum resources;

- Means of communication (e.g. cables);
- Areas for implanting fixed navigational installations (e.g. lighthouses and piers);
- Areas for the dumping of waste materials;
- Areas for scientific research on Earth's basic physical and biological processes.

It is clear that coastal and marine areas are of vital importance to human life. Yet human activities have proven to have deleterious effects on these areas. According to CNPA [2000] the major threats to the health, productivity and bio-diversity of the marine environment result from human activity in the coastal areas and further inland. Approximately 80 percent of marine area contamination results from land-based activities such as municipal, industrial and agricultural waste and run-off, in addition to the deposition of atmospheric contaminants resulting from human industrial activities [CNPA, 2000; Sanger, 1987].

The previously held belief that marine spaces are infinite in their resources has in recent times proven to be a myth, because while living marine resources are renewable their production is finite. For example, the negative effects of over-fishing on the social and economic welfare of communities dependent on fishery in the Canadian Maritimes are well documented. This is just one example of a failure to manage commonly held resources [anon., n.d.; Miles, 1998; Felt, 2005].

Coastal and marine environments are also always subject to change. This change results from factors ranging from geology and climate, to human land, coastal and marine activities. It is almost impossible to control geology and climate though human activities affect both these phenomena [USACE, 2002a and 2002b], and it is very difficult to avoid human impact on coastal and marine environments as these environments play such an integral role in the quality of human life. The challenge is to use the oceans for human benefit while ensuring that those marine resources will be available for future generations. The current pattern of the use of coastal and marine spaces is not sustainable and there is an urgent need to make sustainability a fundamental norm in the use of these areas [Miles, 1998].

The dilemma facing humankind with regard to marine and coastal spaces may be a tragedy of the coastal commons [anon., n.d.], but not all areas of the commons are subject to abuse (only those not subject to management rules) [Ekert, 1979; Friedheim, 1999]. There is a need for a wider dissemination of knowledge relevant to the importance of coastal and marine areas to the world's well-being, and a re-evaluation of societies' attitudes towards these spaces. Good coastal and marine governance is therefore a key factor in the sustainable use of these environments and will require an integrated, coordinated and equitable approach [Crowe, 2000].

This chapter will demonstrate that governance is affected by the combination of stakeholders and stakeholder value systems, organizations and organizational structures, institutional design, policies, legislation and laws, governance forms (e.g. collaboration, integration, cooperation etc.), information, and information infrastructures. Concepts of governance in general will first be presented and discussed. Thereafter, and based on the foregoing, the governance of marine spaces and the complexity of rights will be discussed. This chapter only looks at the basics of coastal and marine governance. These topics are extensive and many other sources deal exclusively with them.

3.1 What is Governance?

Although governance itself is not new, the *science* of governance is a fairly new discipline [Paquet, 2000b]. According to Paquet [1999b] there currently exists no agreement on a lexicon or vocabulary for formulating questions in relation to governance studies. Consequently, many persons and organizations have tendered various, if sometimes overlapping, definitions. These definitions may be general in perspective, specific to government, society or objective, or made from a national or international perspective. Some of these definitions of governance are as follows:

- "The science of effective coordination in the steering of an organization, where knowledge and power are distributed" [Paquet, 2000a and 2000b].
- The process whereby a society, polity, economy, or organization (private, public or civic) steers itself as it pursues its objectives [Centre on Governance, 2000; Paquet, 1994; Paquet, 1997; Rosell, 1999].
- The process of decision-making with a view to managing change in order to "promote people's wellbeing" [Kyriakou and Di Pietro, 2000].
- "The set of processes and traditions which determine how a society steers itself thereby according citizens a voice on issues of public concern, and how decisions are made on these issues" [Meltzer, 2000].
- "The exercise of economic, political and administrative authority to manage a country's affairs at all levels. It comprises the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences" [Manning (quoting the UNDP), 1998].

- "The guidance of national systems shared by ensembles of organizations rooted in the three sectors (economy, polity, civil society and community)" [deBlios and Paquet, 1998].
- The means by which local, regional, national and international communities organize themselves and subsequently respond to issues of interest to members of those communities. It involves leadership on the part of government and the use of policy and programs to control and influence activities within communities [Manning, 1998].

Apart from the various perspectives, a number of other things essential to governance are alluded to in the governance literature referenced above. Firstly, governance is all encompassing, touching virtually every area of human existence. Secondly, governance can take many forms, and takes place on many levels [Masson and Farlinger, 2000]. Each form of governance makes use of facilitative processes, mechanisms and systems to pursue goals. Thirdly, governance is about the provision of *direction* towards the achievement of objectives. The direction taken must take cognizance of the interests, rights, responsibilities, and differences among the stakeholders in governance communities [Manning, 1998; deBlios and Paquet, 1998]. Finally, governance requires information continually feeding into knowledge of the jurisdictional *status quo*[8] and *future possible*[9], since both the *status quo* and the *future possible* are subject to changes in terms of time, nature, society, the economy, the polity, and science and technology developments [Kyriakou and Di Pietro, 2000].

[8] The *status quo* of a jurisdiction comprises the current elements it's economic, social and political realities.
[9] The *future possible* of a jurisdiction is comprised of possible (and probable) realizations of achievable economic, social and political goals.

3.2 Forms of Governance

Traditional governance models have been based on a management science approach where the premise is that leadership of organizations (public, private or civic) is strong, and have good understanding of their environment (future trends, rules of the game, and the organization's goals) [Paquet, 1999b]. As such, the leaders provide direction for the groups they represent.

A hierarchical governance model is one such example. This form of governance, usually practiced by the state or some other governing authority, is usually enacted through policies, laws and regulations [Hoogsteden, Robertson and Benwell, 1999; Paquet, 1999b; Savoie 1999]. This hierarchical model assumes a top-down approach is always best, whereas subsidiarity (i.e., the principle based on the assumption that individuals are better able to take care of themselves than any third party) might alternatively provide a better solution in some circumstances. Subsidiarity would support, for instance, the devolution of responsibilities to citizens by provincial/state authority (or to states/provinces by federal authority) as much as possible unless they were unable to manage [Paquet, 2000b; Rosell, 1999; Chiarelli, Dammeyer and Munter, 1999].

The management science approach also assumes that organizations are operating in "a world of deterministic, well-behaved mechanical processes" [Paquet, 1999b]. However, life is full of paradoxes, contradictions, and surprises [Handy, 1996], so the management science approach has been inadequate, continually faced with situations that are ill-defined, uncertain, unstable, or unreliable [Paquet, 1999b]. As a result of the failure of the management science approach to governance to adequately handle all the complexities of life, other models have been proffered. These models are based on cooperation, coordination, collaboration, integration or other principles of shared responsibilities. The similarities or overlaps in the definitions of these models again underscore the absence of general principles to help guide in the design of good governance structures [Paquet, 2000b]. Among these models are:

- Distributed governance which is embedded in a set of organizations and institutions built on market forces, the state, and civil society, and which deprives the leadership of the exercise of monopoly in the direction of the organization. [Paquet, 1999b; Meltzer, 2000; Lane 2000];
- Co-governance (e.g. practiced on a state-civic level) that comprises mutual organization by two or more involved groups [Charette and Graham, 1999; Hoogsteden, Robertson and Benwell, 1999; Paquet, 2000a, 2000b; Payoyo, 1994];
- Triangle-wide governance that consists of the integration of the three families of institutions (economy, society and polity) into a sort of neural network [Paquet, 1999b; Meltzer, 2000];
- Transversal and meso-innovation systems of governance that employ "consensus and inducement-oriented systems to achieve coordination among network players" [Paquet, 1999b];
- Renaissance-style independency forms of governance that utilize informal terms, and the devolution and decentralization of decision-making to achieve its objectives [Paquet, 1999a, 1999b, 2000c; Lane, 2000].

These models are by nature subversive to those organizational structures based on traditional models of governance. They challenge the view that an "omnipresent person or group has monopoly on useful knowledge and can govern top down" [Paquet, 2000a].

3.3 Governance and the Government

For the purpose of this thesis any reference to "government" relates to, generally or with clarification as to the level, government in a democratic country. That government at all levels is a pervasive player in governance is obvious in daily life. Government is a provider of political, economic and social direction [Stanbury, 1993; Savoie, 1993]. Government facilitates economic and social activities as part of society's steering itself [Paquet, 1999b; Stanbury, 1993]. As well, it is the provider of determined public services [Tims, 2000; Spicer, 2000]. Government also acts as a stakeholder in governance through the exercise of its own rights and responsibilities.

It should be understood, however, that government roles, as director, facilitator, provider of services, and stakeholder in governance, significantly overlap. For example, when government acts as facilitator it is also acting as service provider, stakeholder, and to some extent, director. Also, when government engages in the protection of jurisdictional borders, it is acting as a stakeholder, facilitator of economic and social activities, and provider of protection services to its citizens. Notwithstanding such overlapping, these aspects of government's participation in governance are analytically distinct and will be examined in separate sections below to bring out certain points.

3.3.1 Government as provider of direction

In theory, government provides direction in the form of policies[10], translated into laws and regulations that are supported by monitoring and enforcement mechanisms. Every area of daily life is subject to these policies, laws and regulations. Government policies, laws and regulations affect our lives whether our activities take place in the air, land, in coastal or wholly marine areas. These policies affect us on the personal, commercial, community, municipal, provincial/state, national, and international levels. Government policies, laws and regulations impact upon us culturally, socially, economically, and obviously politically [Paquet, 1999b; Doern and Phidd, 1983; Stanbury, 1993; Savoie, 1993; Tims, 2000; Spicer, 2000].

Standard models of formal policymaking presume a "guiding macro-rationale" [Paquet, 1999b] from which a set of priorities (objectives and actions) is developed. The objectives are based on knowledge of the state of nature, the future state of nature, and the rules of the game. However, nature is not yet fully describable and the future state of nature only a best guess [Harmon, 1995; Paquet, 1999b; Doern and Phidd, 1983]. Consequently, goals set are often ambiguous and in conflict, and the means-end schema taken to attain the goals often prove to be uncertain and unreliable [Paquet, 1997, 1999b; Nadel, 1975; Senge, 1994].

Additionally, public policies are often not defined in operational terms and are therefore difficult to determine intended consequences [Paquet, 1997; Nadel, 1975]. Furthermore, stated policy goals may not be the real goals [Jasanoff, 2000; Stanbury, 1993; Nadel, 1975]. An example might be an environmental policy that provides

[10] An example of where this theory breaks down is the implementation of the *Canadian Oceans Act* (1996) before the appropriate policy was fully developed.

leniency to support aquaculture. Also, some policies pursue unachievable objectives (e.g., sustainable development) as there is no way to measure the attainment of these objectives [Nichols, 2004]. All of the foregoing contributes in part to the non-achievement of policy objectives.

In order to deal with failures to achieve stated objectives many policy reforms have been rationally attempted. However reformers tend to forget that, like previous reforms, the rationalist reformer's high-level view is often irrational from "the perspective of those charged with implementing reforms" [Harmon, 1995]. These paradoxes exist in life, and sometimes two opposing thoughts can be true. Policy and policy reform must satisfactorily take these paradoxes into account [Harmon, 1995; Handy, 1996]. Also, considering the paradoxes and uncertainties in life, excellent approximations rather than absolute perfection might be more desirable a goal [Covey, 1998; Smith and Berg, 1990]. An example of such paradoxes in the marine environment could be, for example, a coastal zone policy that requires the curtailing of certain activities in the coastal zone that administrators know has no real chance of being implemented without causing serious socioeconomic disruption within coastal communities.

Therefore the role of government as absolute leader is being challenged since government cannot possess a monopoly on all questions as well as answers. Life may not be currently totally knowable but the answers and potential answers that we have are spread throughout the political, economic and social sectors. It is therefore worth making investments in frameworks of co-governance (e.g. cooperative/collaborative leadership). This realization is leading to a tendency to develop new mixed institutions (e.g. public-private-social partnering) [Rosell, 1999; Paquet, 1999b, 2000c; Barksdale, 1998; Crowe, 2000; Senge 1994, 1996; deBlois and Paquet, 1998].

Additionally, no society is monolithic. Competition and confrontation are built into our institutions, as well as correspond to our more natural instinct as humans [Paquet, 2000a]. Also, the fact that society is comprised of both movers and shakers on one side, and the complacent and unwilling on the other, may provide another obstacle to truly cooperative/collaborative governance [Süssmuth, 1998].

3.3.2 Government as provider of services

One of the most important functions of government as a participant in the governance of a jurisdiction is as the provider of services defined as *public* (i.e., those functions that are performed in the interest of the common good) [Manning, 1998]. In order to fulfil this role, government makes use of organizational structures and service delivery mechanisms.

3.3.2.1 Government organizational structures and governance

Typically, government is structured into sectors with each sector responsible for some aspect of a jurisdiction's daily life (e.g. defense, justice, agriculture, environment etc.). Each sector is divided into levels, with each level responsible for either the setting of goals and policies, strategic planing, or operational implementation. The structure of each sector is usually hierarchical, with a ministerial level at the top providing objectives and policies that are communicated to the next levels that are responsible for implementing strategic plans geared towards attaining policy objectives [Vallejo, 1994].

Sectors may also be divided into functional departments. For instance, a sector concerned with oceans affairs may be divided into departments based on functions related to fisheries, ports, tourism, *et cetera*. If there is poor communications among the various functional departments then there is danger of fragmentation of governmental responsibilities and duplication of effort. This fragmentation of views on a system (e.g., the ocean) that is essentially a whole can have adverse effects on, say, ocean governance [Vallejo, 1994]. Additionally, sectors may not be ideally sited to address its primary concern (e.g., fisheries and aquaculture falling under an agriculture ministry as in New Brunswick).

Also, there needs to be adequate vertical communication within sectors, as well as horizontal communication across sectors and functional departments for effective governance. As well, there needs to be partnerships and coordination horizontally across functional departments, and across sectors. Figure 3.1 demonstrates this concept in terms of vertical and horizontal coordination, as well as in terms of temporal coordination. This perspective may also be applied to partnership needs across government levels (i.e., municipal, state/provincial, federal etc.). Organizational and institutional designs significantly affect performance and quality of service delivery, and thereby affect governance [Trebilcock, 1999; Paquet, 1997; Senge, 1996; Charette and Graham, 1999; Vallejo, 1994; Ford and Zussman, 1997]. Organizational design should be based on shared visions instead of on segmented views and perspectives of reality enclosed by departmental mandates [Senge, 1994].

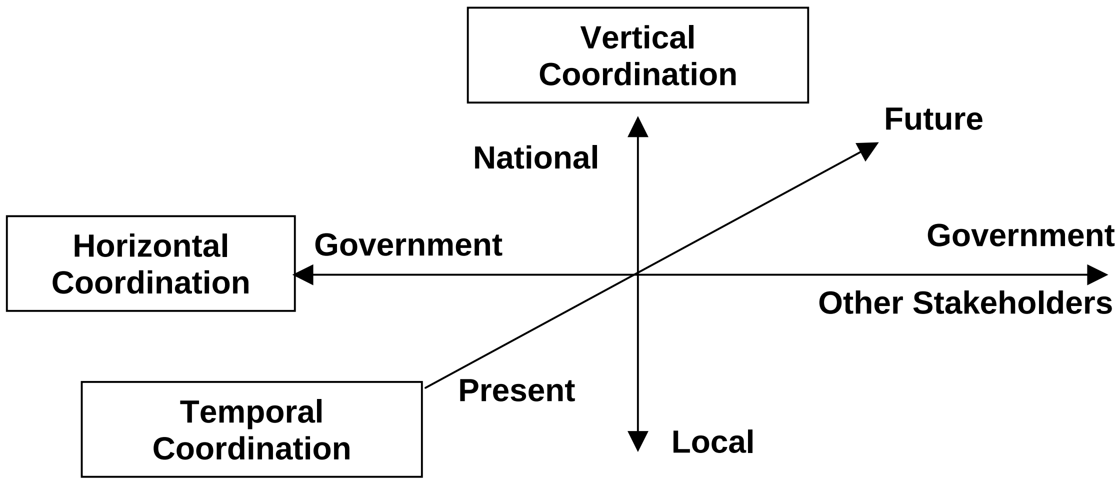


FIGURE 3.1 - VERTICAL, HORIZONTAL AND TEMPORAL COORDINATION
(from FAO [1998])

Table 3.1
Models of Service Delivery Depending on Government Responsibilities
After Langford [1997]

LEVEL OF GOVERNMENT RESPONSIBILITY	MODEL
Little or no responsibility for the outcome	Devolution; Recognition; Privatization; Franchising; Licensing; Self-regulation; De-regulation.
Joint responsibility for outcome with other government departments or private sector partners	Separate service agency; Crown corporation; Special purpose body; Community corporation; Mixed enterprise; Joint venture; Regulated monopoly; Regulatory agency; Community board; Collaborative partnership; External purchase of service; Joint financing.
Full responsibility for outcome	Commercialization; cost recovery; Internal delegation; Internal partnership; Special operating agency; Single-window service; Co-location; Community offices; Merging systems; Electronic delivery; Self-service

Organizational structures affect service delivery but considerations in this regard should also take into account the degree of government involvement [Langford, 1997; Trebilcock, 1999]. Langford [1997] suggests some models of service delivery that may be relevant depending on the degree of government responsibility. These models are outlined in Table 3.1.

To change organizations from being purely hierarchical and segmented in view, to organizations cognizant of reality *as a whole* (i.e., systems thinking) and their part in it, requires that they become learning organizations [Rosell, 1999; Paquet, 1999b; Senge, 1994, 1996]. These organizations will have to construct new and shared mental maps (i.e., shared frameworks and objectives) and be prepared to be guided by those mental maps [Paquet, 1994, 2000a; Rosell, 1999]. There are, however, a number of challenges facing this proposed new governance arrangement including, but not limited to [Masson and Farlinger, 2000; Paquet, 1997; Tims 2000; Juillet and Roy, 1999]:

- The challenge of learning new goals and the means to reach them;
- The challenge of acknowledging all stakeholders and accessing their knowledge;
- The challenge of engaging citizens, and the private and civic sectors in new models of policy making and service delivery;
- The challenge of achieving adaptive management;
- The challenge of achieving shared decision-making;
- The challenge of tradeoffs between inclusivity and efficiency.

In order to increase efficiency, some governments (e.g., the provincial government of New Brunswick) are experimenting with new types of organizational structures (such as the "front-office back-office" organizational structure). The "front-office back-office" organizational structure is however an operational arrangement and at this time the author is unaware of any assessment of that arrangement's efficiency in meeting all the stakeholders' needs.

3.3.2.2 Government responsibility and governance

The quality of government's service delivery depends not only on organizational structure, but also on them being in the right business. According to Ford and Zussman [1997], increasing citizens' demands over the past 50 years have caused government to participate in more and more sectors of society, and to take responsibility for things that traditionally have been resolved by the family, the community, and the marketplace. These demands have over time revealed government bureaucracies' inability to cope in many instances [Paquet, 1999b]. Governments have responded by attempting to change governance structures to more diffuse, horizontal, modular structures with some improvements [Paquet, 1999b; Ford and Zussman, 1997].

However, to further improve governance through efficient service delivery, government may also have to reconsider the business it engages in. For instance, Paquet [2000b] mentions six tests, in the form of questions, imposed via the 1994 program review that should guide the federal government [of Canada] in determining whether an activity should be undertaken by them. These questions are:

- Does the activity serve the public interest?
- Is there a necessary government role?
- Could it be done better by another level of government?
- Could it be usefully transferred to the private or voluntary sector?
- Could the federal government do the job more efficiently?

- Could the federal government afford to do the job?

These questions could, and should be asked of every level of government, with regard to the levels of governance below them. This would ensure that each level of government is indeed involved with tasks that are in the public's interest and that the tasks can be efficiently done. Constraints to this efficient devolution of service delivery include, for example, history, tradition, geography, and law (e.g., Canadian Constitution which defined federal and provincial jurisdiction in the mid 1800s and may not reflect efficiency and effectiveness today in terms of an increased geographic coverage), new issues such as offshore oil and gas, or a clear definition of modern administrative responsibilities in marines spaces for activities such as aquaculture.

3.3.3 Government as facilitator of economic and social activities

Facilitation of economic and social activities is a very important function of government as a participant in governance. Economic activities are facilitated in a number of ways including, but not limited to [Stanbury, 1999]:

- The provision of monetary and fiscal policies;
- The promotion of a firms' export activities (e.g. information services, trade fairs, favorable taxation, advertising, diplomatic efforts etc.);
- The financing of private enterprises;
- The formation of government-private partnerships;
- The provision of markets for businesses.

Government also facilitates social activities. These include:

- The provision of social policies;

- The provision of laws and services to protect citizen's rights;
- The provision of information services to support social activities;
- The provision of social services;
- The provision of physical and other infrastructure.

One of the most important functions of government as facilitator is the provision of information services both within government and to citizens. The consideration of appropriate and well-managed information is a necessary input to better decision-making that affects a jurisdiction at all levels (i.e. locally, nationally, regionally, internationally etc.), and within the economic, social and political realms.

3.3.4 Government as stakeholder in governance

Government's participation in the governance of a jurisdiction is also as a stakeholder. From one perspective, government demonstrates its stake in the wellbeing of a jurisdiction by ensuring that the other stakeholders are provided with direction and services (thereby facilitating social and economic activities). From another perspective, government needs to be *able* to function as a *government-entity* with its own rights, responsibilities and restrictions.

Both perspectives require that government, just like the other participants in governance, have access to infrastructure and services. Also important to both perspectives is information. Government needs, for example, social, economic, and environmental information to support policy- and decision-making with regard to its jurisdictional and administrative duties. The socioeconomic (and other) marketplace is accessed for relevant information that is also stored for use by the social and economic communities. Additionally, government requires information relevant to the spatial extent of their jurisdictional and administrative powers (e.g. national, provincial, municipal, county boundaries etc.). This spatial information is needed for the protection of borders, the spatial placement offices and military bases, and the exercise of governmental property, jurisdictional, and administrative rights among other things.

3.4 The Importance of Information to Governance

Kyriakou and Di Pietro [2000] define governance as being "… all about decision-making with a view to managing … change [in societies], making [change] a friend, not a foe, in order to promote people's wellbeing" although in many jurisdictions it is only the well-being of a few that is of interest to governing authorities. That aside, if governance is about decision-making (or steering for that matter), then the decision maker is better equipped to make the decisions with more up-to-date, accurate, complete, usable information. The quality of the decision made is still dependent upon the decision maker to making appropriate assessments and use of the information. Also, a degree of near-perfection in the quality of information is not always necessary to support the attainment of governance objectives. For instance, in the marine environment boundaries do not necessarily have to be accurate to millimetres to serve their purpose. Notwithstanding the foregoing, information is indispensable for knowing where we are, and for deciding where we can, and want to go. Therefore, as stated before, governance requires information continually feeding into knowledge of the jurisdictional *status quo*, as well as the jurisdictional *future possible*.

More up-to-date, accurate, complete, and usable information is very important to governance, but a number of factors underscore the importance of those qualities of information to governance in today's world. Among them is the emergence of the information society and the information age, advances in technological and scientific developments, globalization, and the concept of sustainable development. However, it is to be noted that science is not the only source of appropriate information. Community and traditional knowledge is often valuable to governance, provides complementary perspectives for better decision-making, adds to the quantity and quality of information (i.e., more up-to-date, usefulness, completeness, accuracy etc.), and facilitates community involvement in the decision-making process.

3.4.1 The Information Age and Governance

The information age has been characterized by huge increases in the availability and proliferation of information, as well as accelerated developments in information technologies. These include information infrastructure (i.e., databases, information exchange standards, metadata standards etc.) and communications technologies. Additionally, there are more workers in data and knowledge industries than any other employment sector, and the workforce (and general population) is more educated and aware than before [Rosell, 1999; vanDijk, 1999; Paquet, 1999b]. Today, jurisdictions have to contend with an accelerated pace of change in all aspects of life caused by these developments. These changes are, according to Rosell [1999], "overwhelming methods of organizing and governing designed for a world of clearer boundaries and more limited flows of information."

3.4.2 Information, globalization and governance

One of the most significant contemporary changes to occur, aided by the information revolution and its consequent developments in information technology, is globalization [Ford and Zussman, 1997]. According to vanDijk [1999], "the world is now integrated into one *single world-wide market*" due to political will and the ability to eliminate distance as a result of technological progress. The globalization of markets for goods, services, capital and labor was forecasted from as far back as 1991 [Reich, 1991]. It is also forecast that trading blocks and bilateral trade agreements will become more important [Reich, 1991; Stanbury, 1993]. By 1998 international trade in goods and services was more than US$6 trillion [Cattavi, 1998].

Today, globalization seems an unstoppable force and integral to the world economy. As such, governments are going to have to learn its advantages and learn also to manage it as it intersects with most aspects of jurisdictions [vanDijk, 1999]. New worldwide networks and increased international competition have caused local firms to engage in cross-border investments, and companies to become internationalized [Paquet, 1999b; Savoie, 1993]. National economies have become more interdependent and increasingly influenced by supranational institutions and trade agreements [Savoie, 1993]. International forums on global warming and sustainable development have impacted on local social, economic, and political institutions and activities as local rights, responsibilities and restrictions are modified to conform to international conventions. The *United Nations Convention on the Law of the Sea* [UNCLOS, 1982] for example, has caused countries to rewrite local laws relating to offshore rights, responsibilities, and restrictions and to reach bilateral and multilateral agreements regarding marine boundaries and spaces.

One major effect of the foregoing is that there are now higher expectations from government by the social and economic sectors that depend on government for direction, and the provision of information and other services. The issues facing government are increasingly complex and require decisions that have profound impacts on societies and economies as the public, with more information available to them, exhibit concerns about their health, safety, and long-term wellbeing [Keough, 2000].

The challenge therefore is how to enact governance in an environment where change is rapid, interconnection is rapidly increasing, all stakeholders have information increasingly available to them, and the workforce (including the general population) is characterized by higher levels of education, expectation and mobility [Juillet and Roy, 1999; Rosell, 1999]. Achieving success in good governance will more than likely depend on models based on stakeholder relationships with human and electronic connections (aiding the exchange of needed information) to a much broader community [Rosell, 1999; Barksdale, 1998; Paquet, 1997; Covey, 1998].

Government, society, and the economy therefore all require access to more current, complete, accurate, and useful information in order to play their parts in the evolving globalization. However, there is ample evidence to suggest that usable knowledge, gained from more up-to-date, accurate, complete and useful information, must be gleaned from scattered data stores that were built to support narrow public and private mandates. Consequently, incompatible data formats and structures, as well as a lack of capacity for horizontal and vertical integration among governance stakeholders, pose significant obstacles to obtaining usable knowledge from these scattered stores of information. Governance research indicates that stakeholders with common interests should form relationships of information sharing (i.e. collaboration, cooperation, integration etc.) that is beneficial to all concerned [Paquet, 1999a and 1999b; Lane 2000; Charette and Graham, 1999; Hoogsteden, Robertson and Benwell; 1999]. This is especially true in terms of information sharing in situations where each shareholder is in need of information held and maintained by another and each stakeholder desires the best available quality data.

The social and economic potential of information and communication technologies will depend not only on a balance between the accumulation of new skills and investment in equipment and infrastructure. It will also depend on changes made in governance compatible with local, regional and global conditions [Ford and Zussman, 1997; Mansell et al, 1999].

It is to be noted that, although rapid developments in information technology may create many opportunities related to service delivery (and other aspects of governance) [Ford and Zussman, 1997], technological progress is not necessarily an avenue to greater understanding [Senge, 1996]. Service delivery tends to focus more on the technology than on the rationale for the program or the procedures [Paquet, 1997; Kaufmann and Steudler, 1998]. However, it may be that "we are out of control, driving down a dark road with little or no light, and most technological progress amounts to is speeding up" [Senge, 1996]. It may not, therefore, be sufficient to do the thing right and cheaply, but to ensure that the right thing is done [Paquet, 1997]. However, access to up-to-date, complete, accurate, and useful information can also aid in assessing what right thing is to be done.

3.4.3 Information, sustainable development and governance

More and more, doing the right thing has become important, especially considering the known and potential negative impacts of industrialization, and other human activities, on the environment. There is evidence that global warming, resource depletion, and other negative human impacts on the environment are apparently affecting the Earth's capacity to meet human needs [Manning, 1998; Malmberg, 1980]. The concept of sustainable development has therefore become very important, and "has been rising on the scene as one of the most central issues for the future of mankind" [Bohlin, 1999]. Industrialization and growth is economically desirable, but as Bohlin [1999] states:

> Industrialization and growth without attention to sustainability may not only be problematic for some ill-fated groups of society, but may seriously limit any region's aspiration for prosperity, as the dynamic repercussions of unsustainability [sic] on its citizens may be significant and take unexpected turns.

To strike this balance between political, economic, social, and environmental concerns is essentially a challenge for governance within the realities of the information age and globalization. As globalization becomes more of a reality, jurisdictions are faced not only with ever-faster rates of change, but also with increasingly short-term profit-orientation and increased deregulation which (in some cases) make sustainability harder to achieve [vanDijk, 1999]. However, to achieve sustainability, allowing equitable allocation of benefits from the exploitation of resources, while avoiding (or minimizing) irreversible effects caused by such exploitation, requires the regulation of access to the resources [Pinto, 1994]. To achieve this type of resource sustainability, management requires that stakeholders in governance have access to more up-to-date, complete, accurate, useful information in relation to the resources [Reeve and Petch, 1999; Masser, 1998; Star, Estes and McGwire, 1996]. This will include information from both science and community knowledge on what resources exist, the spatial extent of the resources, and who has rights, responsibilities, and restrictions in relation to the spatial extents and resources [Nichols, Monahan and Sutherland, 2000].

3.5 Good Governance

Every operation of every organization (social, political or economic) is based on a perception or particular construction of reality. The perceptions or theories of reality contribute significantly to the creation and maintenance of value systems. The social, economic, and political spheres within a jurisdiction are influenced by (and influences) the value systems that guide the actions of stakeholders in governance. The value systems are frameworks that provide a shared consciousness of the distribution of rights, responsibilities and restrictions that impact upon stakeholders' relationships with one another, as they relate to their reality [Paquet, 1999b; Friedmann, 1976]. Continued increase in human population and their attendant socioeconomic needs place ever more pressures on the finite resources of the physical environment upon which all life depends. Aided by globalization and advances in technologies and science, this situation is compounded by the increased ability of human societies to exploit these finite resources. This increased ability is sometimes accompanied by a willingness to accommodate perceptions of reality and related value systems that support short-term socioeconomic and political goals and make the exploitation of these limited resources psychologically easier to perform.

Needs vary, as well as overlap, from group to group and the challenge to governance in a world of increased interdependence and limited resources is to address problems caused by collective actions [Friedmann, 1976; Friedheim, 1999; Young, 1994]. Good governance requires that stakeholders cooperate, although there is evidence that negotiations among stakeholders may result in each stakeholder obtaining less than the ideal supply of any collective good [Friedheim, 1999; Olson, 1971]. However, in a world of increasingly limited resources stakeholders must cooperate for the common good [Friedheim, 1999; Ostrom, 1990], if the common good is the genuine objective of governance. In this context good governance is therefore essential and will ensure that reasonable needs (i.e. social, economic, cultural, political) are met, public services are efficiently provided, and behaviors that affect the common good are controlled [Manning, 1998].

According to the Centre on Governance [1999] there are four criteria for good governance: efficiency, accountability, preservation of identity, and the capacity to change. Efficiency in governance requires the delivery of high quality services at low costs while ensuring a fair sharing of economic and social benefits and obligations.

For governance to be accountable, governments must be understandable. Citizens must understand who is representing them, and government officials must be held accountable for their actions. Governance should also preserve the social identities of communities by respecting and working to preserve them, while giving citizens opportunities to participate in decision-making and services relevant to their communities [Centre on Governance, 1999; Samaranayake, 2000]. Considering that change in reality is constant, good governance must be flexible, adapting to changing conditions and the unique needs of communities [Centre on Governance, 1999].

3.6 What is Coastal and Marine Governance?

It has been pointed out that governance is the management of stakeholder relationships as they relate to their current and possible-future social, economic, political and physical environments through the dictates of value systems. The previous section outlined the importance of coastal and marine environments to human societies and our reliance on these environments for many of the resources we need to maintain and improve our ways of life.

What has not been pointed out is the diversity of stakeholders and users who compete for, or have an interest in, coastal and marine spaces and the associated resources. In many instances, a large number and variety of stakeholders compete for the use of the same coastal and marine spatial extent, either in entirety or as a result of overlapping rights [Richardson, 1994; Nichols and Monahan, 1999; Sutherland, Ng'ang'a and Nichols, 2002]. In addition to the management of physical and biological resources the many, complex and overlapping rights existing in the coastal and marine environments also require the application of good governance.

Technically there are differences between the governance of coastal spaces and the governance of wholly marine spaces. This is because of the nature of the environments and hence the uses to which they are put. The difference is also due to the different types of stakeholders and jurisdictional issues. There may be overlaps between a coastal zone and a wholly marine environment (i.e. the near-shore[11] marine spaces) but the combination of the marine, foreshore and land elements of the coastal zone mean that the governance of coastal spaces may require different policy objectives and strategies from those applied to a wholly marine environment.

3.6.1 The Governance of coastal and marine spaces

The Atlantic Coastal Zone Information Steering Committee (ACZISC) defines the coastal zone as "those land and aquatic (fresh and saltwater) regions which [sic] influence, or are influenced by, the coastal land-water interface" [ACZISC, 1997]. La Forest [1973] while discussing aspects of Canadian common law defines "coastal waters" as including the shore, tidal waters, inland waters and territorial waters although the author points out that the common law does not recognize a technical category of "coastal waters." The Food and Agriculture Organization (FAO) of the United Nations defines coastal areas as the "interface or transition between land and sea" [Food and Agriculture Organization, 1998] and Ketchum [1972] supports this by defining the coast as a "junction of two environments."

All of the foregoing definitions might seem intuitive but it is essential to the governance of coastal spaces that it is understood that, depending on the jurisdiction, three different environments may be involved: (1) a wholly marine environment (2) a land-water interface and (3) a wholly land environment. For instance in some jurisdictions the defined coastal zone includes a wholly marine environment that begins at the land-water intersection and extends seaward (or away from the land-water

[11] The area between some defined coastline and the most seaward boundary of a defined coastal zone.

interface) to some defined distance. This is the case in the United States (US) where the coastal zone extends in the Great Lakes to the Canada-US border, and in other areas to the outer limits of the US territorial sea, i.e. 12 nautical miles [NOAA, 2000 and 2001; USACE, 2002a and 2002b]. On the other hand, in New Brunswick (NB), Canada there is a proposed coastal policy relating to lands beginning at the intersection of the Lower Low Water Large Tide (LLWLT) datum with the shore and extending landward for least 30 metres [New Brunswick Environment and Local Government, 2002], while the marine environment commencing at some coastline still yet to be defined and extending seaward is affected by a proposed marine policy. Food and Agriculture Organization [1998] includes in its definition of a coastal zone all upland areas that can affect coastal waters and resources, as well as those wholly marine areas that can affect coastal lands and even suggests that the Exclusive Economic Zone[12] (EEZ) may be included. All coastal zones, however, include the land-water intersection (or the transition area).

This consciousness of the various environments that may be included in a defined coastal zone is important because at the very least there are different resources to exploit, manage or protect existing in each of these environments, as well as a variety of property and other rights that are affected in law depending on the environment(s) intersected by the spatial extent to which the rights apply [Nichols and Monahan, 1999; Pinto, 1994; Goldfarb, 1988; La Forest, 1973]. Also the contents of the applicable policies are also affected by the nature of the environment targeted for management or protection [Hildreth and Johnson, 1983; Vallejo, 1994].

[12] The EEZ is defined as 200 nautical miles seaward from coastal baselines

3.6.1.1 The need for good governance of coastal and marine spaces

Purely social values associated with the coastal zone would include those values related to recreational and residential use. According to Food and Agriculture Organization [1998] one-quarter of the world's population live in coastal areas and the population is expected to double in the next 20-30 years. Crowe [2000] puts the population figure at 40%. Regardless of the disagreement between both sources it is generally accepted that a great proportion of the world's population live in coastal spaces. Increases in this population will ultimately bring greater demand for the resources that are offered by coastal spaces [Ekert, 1979].

Aboriginal and non-aboriginal groups ascribe cultural values to coastal regions based on long association. Non-aboriginal groups, through historical events have for centuries occupied coastal regions and have gained rights thereto. Consequently they have in many instances come to link those spatial extents with their cultural identities. Aboriginal groups, who are considered in North America to have aboriginal rights and title based on occupation "from time immemorial" have strong cultural ties to coastal spaces and require the continued traditional uses of these spaces in order to maintain their cultural identities [Bartlett, 1988; McNeil, 2001]. Coastal regions are therefore of significant cultural value. The proximity of marine environments to the coastal zone means that aboriginal and non-aboriginal peoples also form cultural links to them [Muir, 1999; VanDyke, 1994; Bartlett, 1988].

Economic values are linked to resource exploitation and the generation of income. Lutz and Munasinghe [1994] outline a conceptual framework for the economic valuation of wetland benefits that may be also appropriate for application to a coastal zone. The economic value of the environment is divided into use values and non-use values. Direct use values would include outputs like fish and the economic outcome of other activities like transportation and even recreation [Hildebrand, 1989]. According to Ekert [1979] more than 90% of the world's catch of fish "is taken within 200 miles of coastlines." Indirect use and non-use values would include the savings from the coastal space's functional benefits including flood control and storm protection. Non-use economic values are linked to the economic benefit of the fact of the coastal zone's existence among other things [Lutz and Munasinghe, 1994]. In Canada it is estimated that the total value of economic activities (use and nonuse) in coastal areas is 135 billion dollars per year [Wilkins, 2000]. In terms of economics marine environments are also rich sources of renewable and non-renewable resources. These environments are worth billions of dollars to nations and other jurisdictions of the world that are able to take advantage of the resources [Wilkins, 2000; Mandale Consulting, 2000; Lutz and Munasinghe, 1994]. For example according to Wilkins [2000] the ocean sector contributed almost 20 billion dollars to Canada's 1996 gross domestic product (GDP). The potential economic value of yet untapped marine resources is estimated to be worth even more than what is currently being exploited [Nichols and Monahan, 1999; Prescott, 1985]. Coastal and marine spaces are of significant economic value.

Political values associated with coastal regions have to do with issues of sovereignty, title, jurisdiction and administration. A political entity claiming or granted self-determination through recognized sovereignty status may claim coastal regions as part of its territory over which it exercises rights in title, jurisdiction or administration in the exploitation, protection or management of the available resources in the interest of its citizens [Hildebrand, 1989; Sorensen, McCreary and Hershman, 1984]. Coastal regions are therefore of significant political value and this is evidenced by governmental attempts in North America and other parts of the world to utilize and protect these spaces [Hildreth and Johnson, 1983; Flushman, 2002; New Brunswick Environment and Local Government, 2002]. Politically the marine environment has become even more important in recent times because of an increased understanding of its ecological importance to human societies as well as a result of local, national and international initiatives to divide marine spaces in order to obtain security and economic benefits [Sanger, 1987]. The discovery of marine resources or attempts to secure access to known resources has prompted State and Provincial jurisdictions to pursue the division of marine spaces within the political borders of countries. Additionally, international regimes like the United Nations Convention on the Law of the Sea (UNCLOS) facilitate the claiming of political rights to ocean spaces by nations in pursuit of access to marine resources [United Nations, 1997].

Because coastal spaces are of such high and varied values to so many groups of stakeholders the spaces are subject to sustained and intensive use that often has negative impacts on the environment. The "complex interaction between biological and geophysical forces make coastal areas the most fertile for fisheries" [Ekert, 1979] and therefore fishing activities in these areas are intensive and have been known to cause the depletion of fish and other aquatic stocks. Also, the inefficient use of other coastal resources, together with tourism and transportation activities among other things serves to negatively impact coastal spaces.

In addition, coastal spaces are subject to the deleterious impact of human land-based activities. Uncontrolled discharge of industrial by-products and municipal and household wastes, the polluting run-off from farming activities, the erosion of banks from logging activities, the destruction of marshes to support residential activities, and the destruction of riparian zones by domestic livestock are just some of the land-based activities that negatively impact coastal spaces [Department of Fisheries and Oceans, 2002; CNPA, 2000; Food and Agriculture Organization, 1998; Linden and Lundin, 1995; Payoyo, 1994; Prescott, 1985; Ekert, 1979; Ketchum, 1972].

The dilemma is that these negative impacts are from activities that are considered to be essential and also of social, economic and even political importance to societies. Hildebrand [1989] supports this by stating that the "coastal zone satisfies a variety of needs, but its uses are often competitive or mutually exclusive, individually or in combination." However, when there is clear evidence that coastal resources are decreasing in value, coastal uses are in conflict, or the coastal environment is facing destruction from natural hazards or human activities it is time to implement good coastal governance [Sorensen, McCreary and Hershman, 1984; Harrison and Parkes, 1983; Harrison and Kwamena, 1980].

Marine environments are important to jurisdictions is often translated into intra- and inter-jurisdictional competition for the resources [Hoogsteden, Robertson and Benwell, 1999]. This competition for access to, and use of, marine resources have had some negative effects on the marine environment. Some of these negative effects include [Food and Agriculture Organization, 1998; Linden and Lundin, 1995; Sanger, 1987; Ekert 1979]:

- The over-fishing of local and migrating stocks;
- Pollution of the marine environment from oil, sewerage, trace metals, pesticides etc.

Due to the need to address conflicting rights, and ameliorate as well as control the negative effects of human use (and other causes) on marine spaces it has become imperative develop new ways of thinking about the governance of these precious areas [Crowe, 2000; Friedheim, 1999; United Nations, 1998]. Good governance of coastal and marine spaces is absolutely essential [Richarson, 1994; Mann Borgese, 1996].

3.6.1.2 Coastal zone governance

There are obviously conflicts between the need to utilize coastal resources in ways that might negatively affect those resources, and the need to manage and protect the very resources upon which stakeholders are dependent. The governance of coastal spaces is therefore more than resource management or protection. It is also the management of many and sometime conflicting stakeholder rights to the use of those spaces, as well as management of stakeholder behaviours based upon perceptions of their rights [Sutherland, Wilkins and Nichols, 2002]. The need to balance economic exploitation with management and protection of coastal resources has made the concept of sustainable development an important part of any coastal governance scheme [Department of Fisheries and Oceans, 2002; Crowe, 2000; Bohlin, 1999; Food and Agriculture Organization, 1998].

The governance of coastal spaces is usually framed in terms of “management” or “protection” depending on the nature of the value of the resources to the stakeholders. Therefore the governance of coastal spaces is usually accomplished through coastal zone management (CZM) and coastal zone protection policies and programs [New Brunswick Environment and Local Government, 2002; Hildebrand, 1989]. Both perspectives are usually based upon the principles of sustainable development through the regulation of access to, and impact upon, coastal resources [Pinto, 1994].

Coastal zone protection is geared towards ensuring the future social and economic viability of the coastal areas through advances in environmental protection. Although framed as "protection" the basis of the operational aspects is management [New Brunswick Environment and Local Government, 2002]. Coastal zone management, according to Ketchum [1972], is a process designed to achieve the following objectives:

- The maintenance and improvement of the coastal zone's "usefulness for man by ensuring the quality and extent of the natural system upon which he depends";
- The development of an understanding of the coastal zone;
- The use of the knowledge to create a dynamic plan for the zone's best use;
- The implementation and enforcement of the created plan.

Depending on the jurisdiction, different levels of government may be responsible for the implementation of coastal zone management policies. In the U.S. Federal and State governments cooperate to accomplish coastal zone management. The Federal government offers financial assistance and the promise of federal consistency, while the State governments exercise their full authority over the resources and use of the coastal zone [Hildebrand, 1989]. In New Brunswick, it is municipal governments that are charged with managing the coastal zone and its resources, under the direction of the Provincial government [New Brunswick Environment and Local Government, 2002]. There is no federal policy, legal, or economic framework for CZM in Canada.

Integrated coastal zone management (IZCM) recognizes the many stakeholders and users with rights and interests in coastal spaces and the need to balance their often competing demands for the same resources. ICZM is defined as "the process of combining all aspects of the human, physical and biological aspects of the coastal zone within a single framework" [Food and Agriculture Organization, 1998]. It is a continuous planning process, according to Department of Fisheries and Oceans [2002] where "stakeholders and regulators reach general agreement on the best mix of conservation, sustainable resource use and economic development for coastal areas."

Regardless of whether the technique is coastal zone management or protection there are certain elements that must be in place for the policies and management schemes to be effective. These include among other things [Department of Fisheries and Oceans, 2002; Food and Agriculture Organization, 1998]:

- Appropriate laws, legislation and regulations;
- Institutional arrangements;
- Stakeholder involvement;
- Education, research and communication;
- Access to information and regulatory processes;
- Monitoring, evaluation and feedback.

All the concepts and principles of governance that were expounded in the previous chapter also apply to the governance of coastal resources (i.e concepts and principles of subsidiarity, vertical and horizontal institutional arrangements, methods of service delivery, stakeholder cooperation, collaboration and coordination as new forms of governance etc.) [Paquet, 2000a, 2000b; Rosell, 1999; Chiarelli, Dammeyer and Munter, 1999; Trebilcock, 1999; Senge, 1994].

3.6.1.3 Governance frameworks for marine spaces

The governance of wholly marine spaces is affected in part by CZM and ICZM that have local or national foci. In terms of national marine governance there are a number of things that have to be taken into consideration. These include [Hoogsteden, Robertson and Benwell, 1999]:

- The balancing of diverse users and uses;
- The possible role of the local, regional, national and market forces among other things;
- The types of necessary institutions (i.e. legal, jurisdictional, administrative etc.);
- The institutional arrangements and changes, including informal arrangements;
- The establishment of a marine spatial data infrastructure to facilitate the better management of marine spatial information.

Additionally, under UNCLOS countries have rights to the edge of their juridical continental shelves (or seaward to 200 nautical miles if they have no physical continental shelf) that implicitly incur international governance concerns. Due to the effect of international law, the role of national property systems in the marine environment has become more complex. This is the case where, for example, international fleets operate in areas where fish stocks straddle jurisdictions [Hoogsteden, Robertson and Benwell, 1999; United Nations, 1997]. Therefore the marine environment is impacted by the totality of applicable national sovereign and international rights.

There are frameworks in place and under consideration to regulate and control access to marine resources. Some of these frameworks include UNCLOS, Agenda 21 of the United Nations Conference on Environment and Development (UNCED), the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, and the United Nations Agreement on Straddling fish Stocks and Highly Migratory Fish Stocks. [Friedheim, 1999; Miles, 1998].

Even within jurisdictions, and apart from CZM and ICZM that have specific coastal orientations, many laws and legislation exist to manage and control access to, and use rights over, marine water bodies. Apart from the resources within the water column, on the bed covered by the water, and in the subsoil beneath the bed, the water itself is a resource that requires management and control. Groups and individuals within a particular jurisdiction are constantly in competition (sometimes violently) for access to and use of the resources in marine environment [Sutherland, 2002; Ng'ang'a et al, 2004; McNeil 2001; Nichols, Monahan and Sutherland, 2000; Maloney, Plager and Baldwin Jr., 1968].

As previously stated, all the concepts and principles of governance that were expounded in the previous sections also apply to the governance of marine spaces, although in this regard there are international considerations to be taken cognizance of. These include concepts and principles of subsidiarity, vertical and horizontal institutional arrangements, methods of service delivery, stakeholder cooperation, collaboration and coordination as new forms of governance etc. Government (regardless of the level of government) is the most pervasive player in the governance of marine spaces [Paquet, 2000a, 2000b; Rosell, 1999; Chiarelli, Dammeyer and Munter, 1999; Trebilcock, 1999; Senge, 1994].

3.7 Summary and Conclusions

Governance affects every area (e.g., social, economic and political) of human existence. Although governance itself is not new, the *science* of governance is a fairly new discipline. Consequently, there are many definitions of governance but it is commonly agreed that governance involves the provision of direction (i.e., steering, guiding, decision-making, change management, and the exercise of authority etc.) as organizations pursue various social, economic and political goals.

Governance can take many forms and utilizes various processes, mechanisms, institutions and traditions *et cetera* to distribute knowledge and power among stakeholders. Traditional forms of governance rooted in the management science realm have been inadequate in handling the changes in reality that are ill-defined, uncertain, unstable, or unreliable. Good governance based on new models of cooperation, coordination, collaboration and integration are now required especially in the information age with its attendant rapid changes and interconnectivity.

Government is the most pervasive player in governance. Government acts as provider of social, economic, and political direction. Additionally (and apart from acting as a stakeholder in its own right) government also acts as facilitator of social and economic activities, and as the provider of public services. However, government should always re-evaluate the business it engages in as many tasks may be more efficiently done by other entities.

If governance is about decision-making and steering, then more up-to-date, accurate, complete, usable information (which feeds into the acquisition of knowledge) is indispensable to better decision-making and governance. Apart from information about the physical environment, all stakeholders in governance require all levels of social, economic, environmental and political information in order to understand the *status quo* and the *future possible*. This is especially critical in the information age of rapid changes and interconnectivity, and globalization that have brought more information to more people making them acutely aware of the unsustainable nature of current trends.

Value systems are frameworks that provide a shared consciousness of the distribution of rights, responsibilities and restrictions that impact upon stakeholders' relationships with one another, as they relate to their reality [Paquet, 1999b; Friedmann, 1976]. It is these relationships that governance must manage. Governance then is the management of stakeholder relationships as they impact on their current and possible future social, economic, political and physical environments through the dictates of value systems (Figure 3.2). Good governance will ensure that the relationships are made optimal. This would be achieved by the provision of the necessary organizational structures, institutional arrangements, human resources, physical and communications infrastructure, and the most up-to-date, accurate, complete, timely and useful information to facilitate decision-making and steering at all levels.

The value of coastal and marine spaces to human societies is translated into intensive use thereof with resulting deleterious effects on the environments. Governance mechanisms such as UNCLOS, CZM and ICZM among others target different spatial extents of coastal and marine spaces and thereby affect a variety of property and other rights that give human beings access to resources. Governance of these spaces must therefore take into account the management of the various rights affected by implementation of governance mechanisms.

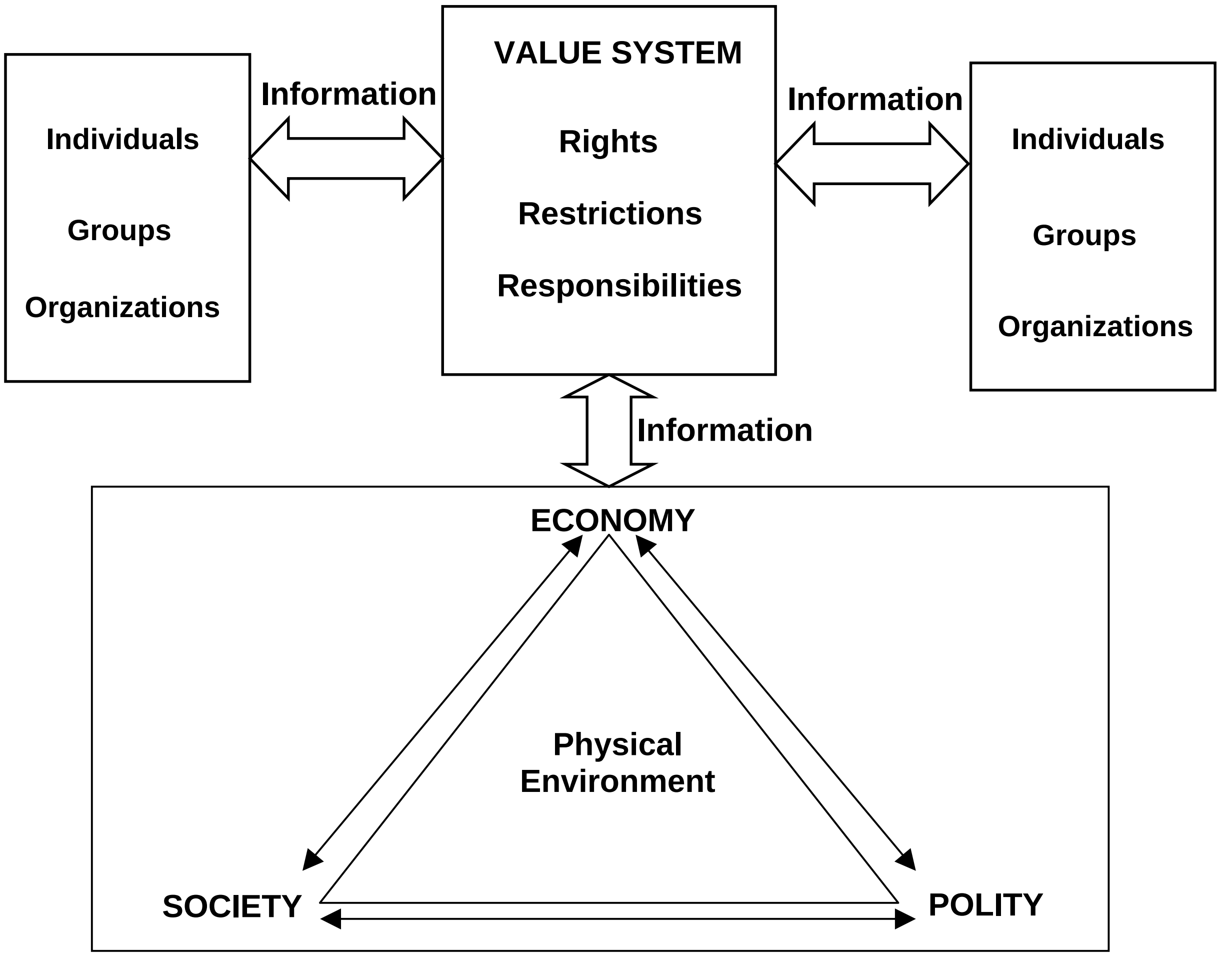


FIGURE 3.2 – GOVERNANCE AS THE MANAGEMENT OF RELATIONSHIPS AMONG STAKEHOLDERS AS THEY RELATE TO THEIR ENVIRONMENTS.

The rights existing in relation to coastal and marine environments are owned by many stakeholders and can be surface rights, rights to the water column, bed or subsoil or a combination of these. The 3-dimensional nature of the marine environment increases the complexity of the rights in that the rights themselves refer to 3-dimensional spaces. In other words the rights most often relate to volumes of marine space. At the same time these rights can overlap and that overlap increases the complexity of the management of the rights. Currently the public rights prevail in the marine environment and private rights are not yet the norm, but these categories of rights often are in conflict as a direct result of competition for the use of marine spaces to achieve certain social, political, economic, and environmental objectives.

Any CZM / ICZM or marine policy or scheme by itself cannot ensure the protection of coastal and marine resources. As human beings we tend to fragment reality in order to understand the whole, but ecological systems are very complex and share equally complex relationships among themselves. We can administratively and jurisdictionally separate the coastal and marine environments into zones but have to keep in mind that the land, coastal and wholly marine environments affect and are affected by each other. A more efficient approach may be that of the holistic approach of systems thinking discussed in the Section 3.3.2.1 [Paquet, 1999b; Food and Agriculture Organization, 1998; Senge 1996; Hildebrand, 1989; Hildreth and Johnson, 1983].

Considering all of the foregoing, good governance will ideally have certain characteristics. These include:

- Efficiency;
- Accountability;
- Preservation of community identity, and subsidarity;
- Flexibility and the capacity for change.

Table 3.2 summarizes the major points made in this chapter.

Table 3.2
Summary of Major Points in the Chapter 3

Governance is not new but the science of governance is fairly new. It is all-encompassing touching every area of human existence. There are many definitions of governance. Governance takes many forms and takes place on many levels.
Government is the most pervasive player in governance but government ought to evaluate its role in governance and not automatically assume that it is the primary player.
Governance is the management of stakeholder relationships as they relate to their current and possible future social, economic, political and physical environments through the dictates of value systems.
Science, technology and community knowledge are all very important to governance
Governance is affected by the combination of stakeholders and stakeholder value systems, organizations and organizational structures, institutional design, policies, legislation and laws, governance forms (e.g. collaboration, integration, cooperation etc.), information and information infrastructures.
Access to more complete, up-to-date, timely, accurate and useful information provides opportunity for better decision-making that supports good governance.
Humanity is faced with the dilemma of exploitation as well as conservation of coastal and marine spaces and therefore sustainable development is an essential concept in the governance of coastal and marine spaces.
Many types of possible, complex and overlapping rights are affected by coastal and marine governance and these rights must be taken into consideration in the formulation and execution of any governance mechanism so as to determine who has the right to make decisions about access to, and allocation of resources, and whose rights are affected by those decisions.
Currently the public has more rights in the marine environment and private rights are not yet the norm.
The nature of especially the marine environment and consequently the rights associated therewith are at least 3-dimensional and any modeling of these rights should take this into account.
Stakeholders with interests in the same marine spaces must recognize the benefit of collaboration, cooperation or integration of information resources.

CHAPTER 4

MARINE BOUNDARIES AND THE GOVERNANCE OF MARINE SPACES

4.0 Introduction

Accurate and up-to-date spatial information (on many levels) regarding the resources that currently exist, the nature of the environment within which those resources exist, as well as on the users and uses of those resources is always a requirement for effective evaluation and monitoring of coastal and marine areas. Information on, for example, living and non-living resources, bathymetry, spatial extents (boundaries), shoreline changes, marine contaminants, seabed characteristics, water quality, and property rights all contribute to the sustainable development and good governance of coastal and marine resources. This implies that boundaries are important to the good governance of marine spaces [Sutherland, Wilkins and Nichols, 2002; Nichols, Monahan and Sutherland, 2000; Popp, 2000; Nichols and Monahan, 1999].

This chapter emphasizes the importance of spatial information, especially boundary information, to the good governance of coastal and marine spaces. The subject will be presented within the context of the complexities related to the rights, responsibilities and restrictions associated with the use of these spaces. Additionally, boundary information requirements to support good governance are also discussed. Legal, technical and scientific problems associated with Canadian marine boundaries will then be discussed. Some unique characteristics of marine boundaries will, however, first be clarified.

4.1 Five Unique Characteristics of Marine Boundaries

In this section all boundaries from the land-water interface (coastal boundaries) that form the coastline boundaries of private rights seaward to the outer limits of continental shelf claims are considered to be marine boundaries. Marine boundaries have at least five unique characteristics. They are:

- Likely to affect a significant portion of the world's population, especially in an international context;
- More likely to be adjacent to or encompass valuable natural resources;
- Subject to ambiguity or uncertainty in definition, and positioning in reality;
- Difficult to demarcate in relation to wholly marine boundaries;
- Ambulatory in terms of tidal coastal boundaries and baselines to which other boundaries may be referenced.

More and one-quarter of the world's population live in coastal areas and a great percentage of the world's population make use of and benefit from marine spaces. The use of marine spaces is tied to rights that themselves are tied to boundaries. Marine boundaries therefore significantly affect the lives of a great many persons [Crowe, 2000; Food and Agriculture Organization, 1998; Sanger, 1987; Boyce, 1978]. Also, currently, in the marine environment there is more public- than private rights. Marine boundaries are therefore more likely to affect, and be affected by, public rights [Flushman, 2002; Goldfarb, 1988; Ekert, 1979; La Forest, 1973]. Land boundaries are not more likely to be affected by public rights.

The total economic value of coastal and marine resources is yet to be ascertained but the estimates are calculated to be higher than natural land resources. Coastal and marine boundaries are therefore more likely to be adjacent to, or encompass valuable economic resources [Prescott, 1985; Hildreth and Johnson, 1983; Ekert, 1979].

Tidal boundaries along coasts in North America are defined in law either by the "intersection of a specific tidal datum with the shore" or by "tide marks left on the shore by the receding waters of a particular stage of tide" [Nichols, 1983]. Because tidal datums are related to specific sea levels and therefore subject to temporal and spatial variations, and because the marks left by tidal actions on shores also vary with the changes in sea level and tides, boundaries defined by these methods are sometimes subject to ambiguous positioning in 3-dimensional space [Flushman, 2002; Food and Agriculture Organization, 1998; Lamden and de Rijcke, 1985; Nichols, 1983].

Constant tidal action against the shore can cause the deposit of material on the shore or the erosion of shore material and thereby the physical configurations of shorelines are subject to constant change. This directly affects boundaries defined along the shore. Taking this into consideration, in North America tidal boundaries are deemed to be ambulatory [Flushman, 2002; Reed, 2000; Lamden and de Ricjke, 1996; Nichols, 1983]. Land boundaries do not move in the same way.

Due to the very nature of water, wholly marine boundaries are difficult to demarcate with any degree of precision. Buoys are tied to anchors that are used in some instances in shallower waters to demarcate the corners of spatial extents, but the anchors are subject to drift caused by tidal actions [Stewart, 1996]. This makes this method of boundary demarcation subject to much uncertainty in areas of significant tidal action. Land boundaries lend themselves more easily to demarcation.

All of the foregoing points deserve consideration when dealing with boundaries in marine spaces. This is especially true when (as will be demonstrated below) marine boundaries must be an important part of marine policy design and administration [Nichols, Monahan and Sutherland, 2000; Kirby, 1982; Jackson, 1976].

4.2 Rights, Spatial Information and the Governance of Coastal and Marine Spaces

Apart from the management of physical and biological marine entities, coastal and marine governance relate to the management of rights, restrictions and responsibilities. This means that the governance of coastal and marine spaces (as well as of land spaces) must address questions of who has rights of use, occupation, ownership, and stewardship as well as who has rights to make and enforce decisions regarding these spaces [Sutherland, 2002; Ng'ang'a et al, 2004; Nichols, Monahan and Sutherland, 2000; Nichols and Monahan, 1999]. Figure 4.1 shows some possible rights that might exist in relation to a riparian[13] or littoral[14] parcel. Figure 4.2 shows some of the many possible and potentially complex combinations of rights that might exist within one marine parcel.

There are many different types of rights that may be affected by the various governance mechanisms. For instance, according to Nichols and Monahan [1999], coastal zone policies have been primarily based on biological and geomorphologic criteria with no account made of private rights (e.g., as in NB Coastal Policy) , and this lack of recognition can affect upland owners significantly. The implementation of CZM / ICZM policies can severely restrict the development rights of upland owners, preventing these

[13] The region of a river or stream.
[14] The region of a lake, ocean, or sea.

owners from deriving benefits associated with ownership of their real properties. If the real properties are commercial in use, then there can be negative effects not only on the upland owners' economic development, but also on that of the particular implementing jurisdiction.

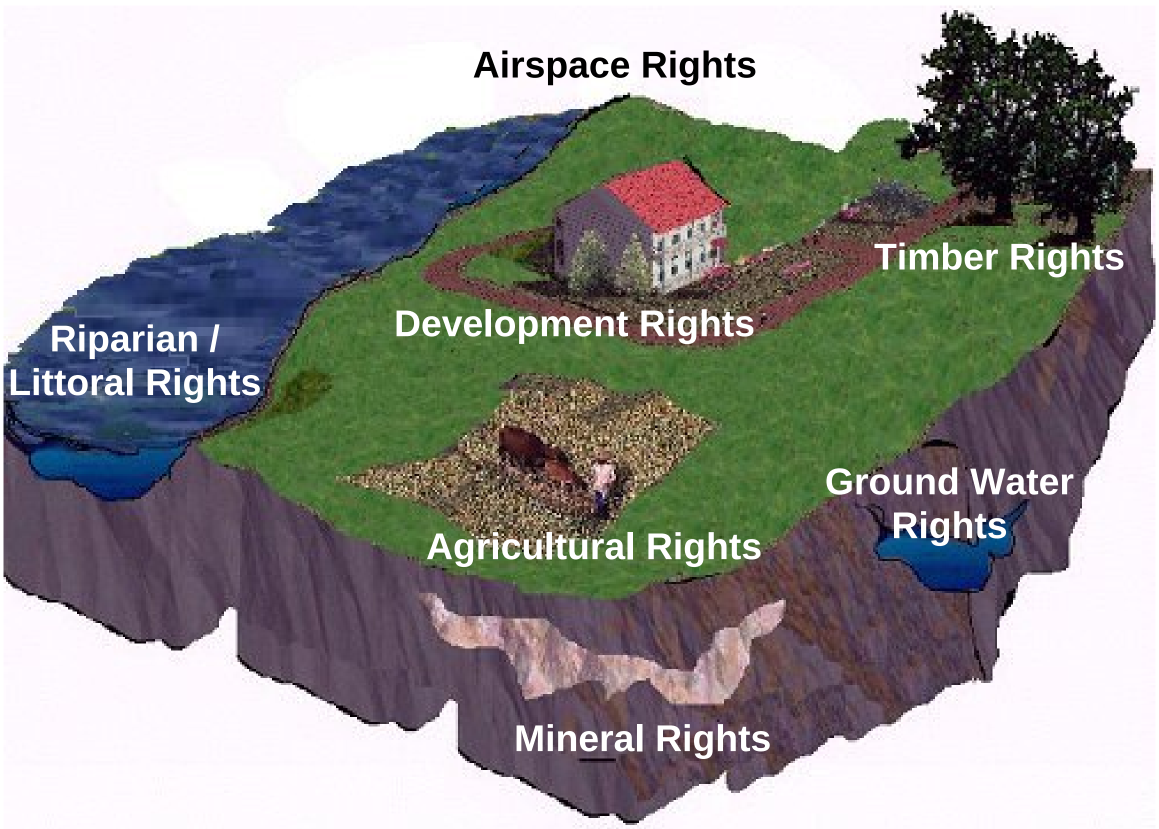


FIGURE 4.1 - RIPARIAN / LITTORAL PARCEL WITH SOME POSSIBLE ASSOCIATED RIGHTS
(*After Nichols [1983]*)

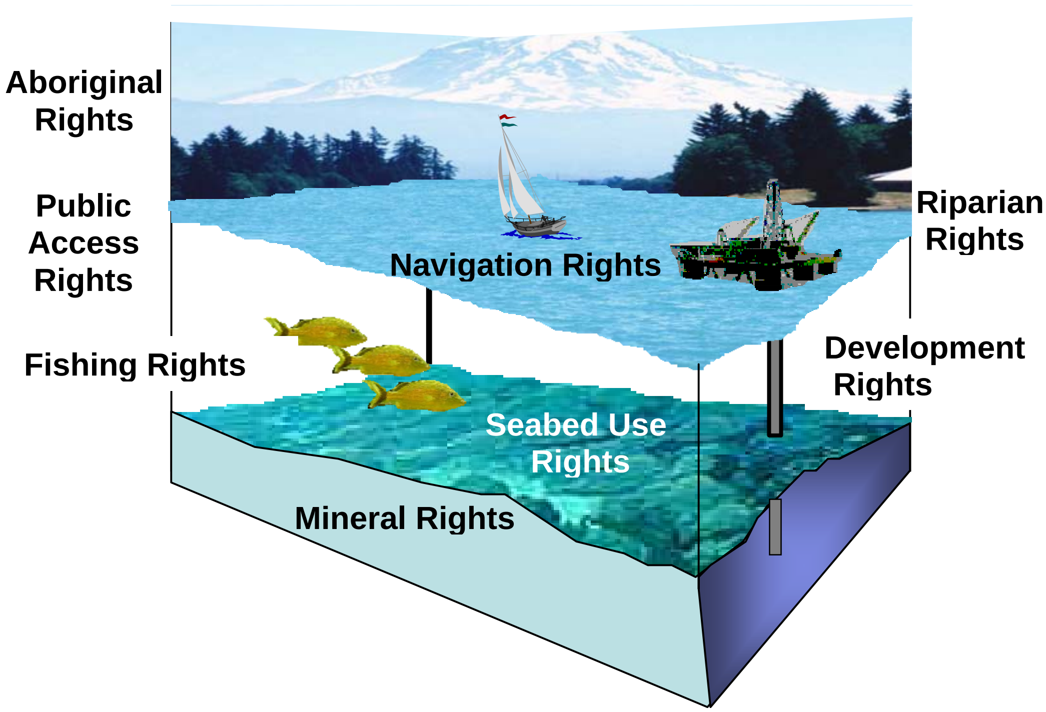


FIGURE 4.2 - SOME COMPLEX AND POSSIBLY OVERLAPPING RIGHTS WITHIN A MARINE PARCEL

In wholly marine environments under a jurisdiction's influence (i.e. from the land-water interface seaward to the outer limits of the continental shelf or other applicable outer limits) there are a plethora of other rights to be taken into consideration in the governance of these spaces. There are rights that fall under national jurisdictions and there are rights associated with UNCLOS zones (See Tables 4.1 and 4.2) [Cockburn, 2002; Sutherland, 2002; United Nations, 1997; Sohn and Gustafson, 1984].

<u>Within Territorial Waters</u> **(These can be rearranged depending on the nation's laws, regulations, etc.)**	*<u>Paramount Rights</u>* (jurisdiction dependent)	• Navigation; • Access.
	<u>Licenses, Leases, Miscellaneous Rights of Individuals</u> (jurisdiction-dependent)	• Rights to the seabed for wharves and other structures; • Aquaculture lease grantees have rights in their sites, including rights to security and exclusive use; • Mineral Lessees have rights in those leases, which may include security and exclusive use among others; • Dump site lessees may have similar rights in their respective leases; • Licensed fishers have the right to fish within the limits imposed by the license; • Leases or other grants may give a right to develop or explore a marine parcel in some way; • Other leases may exist in the water-column, in the seabed, or in the subsoil, depending on the jurisdiction.
	<u>Local Population</u> (jurisdiction-dependent)	• Access rights; • Fishing rights; • Use of the foreshore; • Ownership of bed by local populations may exist in certain areas, depending on title, local regulations, laws, etc.; • Environmental rights or interests may exist, such as a right to or interest in clean drinking water, or rights and interests in environmental quality in general; • Riparian rights may exist vis-à-vis upstream and upland owners.
	<u>Aboriginal/ Native</u> (jurisdiction-dependent)	• Access rights; • Fishing rights, including sea plants; • Title. (These rights or interests depend on the jurisdiction)
	<u>National/State/ Local Government</u> (jurisdiction-dependent)	• Right to direct Innocent Passage/ Navigation. Right to legislate/ administer: • Fishing licenses; • Environmental concerns; • Criminal laws; • Oil and Gas leases; • Other water leases such as water lots; • Aquaculture; • Customs, fiscal, immigration and sanitary laws; • Harbours. Ownership of bed in certain areas depending on title, local regulations, laws, etc. May be revenue-sharing rights between the levels of or branches of government

Table 4.1 - Rights within Territorial Waters (*after Cockburn 2002*)

	Territorial Sea (Up to 12 nm)	**Contiguous Zone (Up to 24 nm)**	**Exclusive Economic Zone (Up to 200 nm)**	**Continental Shelf (Up to outer edge of continental margin or 200 nm from territorial sea baselines, no more than 350 nm from baselines or 100 nm from the 2500m isobath)**
International Rights	• All States have rights to Innocent Passage.	• All States have rights to Innocent Passage.	• All States have freedom of navigation; • All States have rights to construct pipelines or cables.	• All States have freedom of navigation; • All States have rights to construct pipeline or cables.
Coastal State Rights	• Sovereignty over Air, Water, Seafloor and Subsurface • Coastal State can direct innocent passage; • Coastal state must publicize hazards to navigation.	Coastal State may exercise control to: • Prevent infringement of customs, fiscal, immigration or sanitary laws and regulations within its territory or territorial sea; • Punish infringement of above laws and regulations committed within its Territorial Sea.	• Sovereignty over Water, Seafloor and Subsurface; • Coastal State may exercise Jurisdiction over: • Construction of artificial islands • Control of pollution.	• Sovereignty over seafloor and subsurface, and sedentary species; • Must pay royalties to UN on resource recovery.

Table 4.2 - Rights Relative to UNCLOS (*after Cockburn 2002*)

It is not so much that there are many rights existing in the offshore, but that these rights in many cases overlap. Furthermore, in one column of the marine environment, there are rights to the surface of the water column (e.g. navigation), to the water column it self (e.g. fishing), to the seabed (e.g. fishing and mineral resources), and to the subsoil (e.g. mineral resources). The very nature of the marine environment requires that rights be considered in terms of at least three dimensions. This means that the overlapping of rights is made more complex in that they overlap in at least 3-dimensional space and possibly also in the temporal dimension [Ng'ang'a et al, 2004; Nichols, Monahan and Sutherland, 2000; Nichols and Monahan, 1999; McDorman, 1996].

Adding to this situation is another layer of complexity regarding the question of who has sovereignty, title, jurisdiction or administrative rights, and to what aspect of the particular marine column those rights relate. There are legal uncertainties associated with the boundaries of those spatial extents. Undefined aboriginal rights, conflicting public and private rights, jurisdictional uncertainty, problems associated with the definition of the continental shelf are just some of the contributors to the governance problem [Nichols and Monahan, 1999; Miles 1998].

From the foregoing, it is clear that the management of spatial information (i.e. the management of who has rights to what spatial extent, and the dimensions of those spatial extents) is an asset to the efficient management of coastal and marine resources and to avoid (or more precisely minimize) conflict among the many stakeholders to whom rights belong. The implication is that marine boundary information is very important to the governance of marine spaces. This is not withstanding that in some cases it may be better not to focus on boundaries, as boundary uncertainties (e.g., as with federal and provincial boundary uncertainties in some coastal regions) are sometimes the cause of social and administrative conflicts in coastal and marine spaces. Recent governance research supports the relevance of imprecise or ill-defined boundaries insofar as the existence of these boundaries is not a catalyst for dispute [Nichols, Monahan and Sutherland, 2001]. The precise delimitation of boundaries usually become important in relation to the need to allocate equitable resources perceived to be dissected by the potential boundary [Hildreth and Johnson, 1983]. Such is the case with the boundary dispute between Nova Scotia and Newfoundland [Arbitration Tribunal, Nova Scotia-Newfoundland Dispute, 2002].

4.3 Marine Boundary Information Requirements for Governance Objectives

The existence of marine boundaries is important to the governance of marine spaces by facilitating the allocation of marine resources. However, if information about the boundaries is not communicated to those who make decisions about the governance of marine spaces, or who utilize marine spaces to pursue socio-cultural, economic, political, and environmental management objectives, then good governance can be undermined. Boundary information is at least physical, graphical and textual in nature. Physical information or notice relates to physical markers referencing where the boundary is located. Graphical boundary information is multi-dimensional graphical information displayed on analog or digital maps, plans and charts. Textual boundary information includes legible descriptions of the boundary itself, and attributes associated with the boundary (e.g. ownership, type of boundary, metadata etc.).

Governance is about decision-making and the decision-making process sometimes requires access to boundary information that is [Federal Geographic Data Committee, 2002c; Struck and Dilks, 1998; Altheide, 1998; Aronoff; 1993]:

- Up-to-date;
- Accurate (in terms of both position and attributes);
- Logically consistent;
- Complete;
- Useful.

Marine boundary information that is up-to-date models the current physical, legal, mathematical etc. characteristics of the boundary being represented. This is essential especially in relation to boundaries along coasts that are subject to change in positions in tandem with physical coastal changes. It may not be critical to governance if boundary information reflects slight disparities with the true position of the boundary, depending on the use of the information. If however planning or other decisions are being based on features or dimensions in the model it is more than desirable for the information to be up-to-date as defined above. Accuracy of information is implied.

Boundary information accuracy refers to the correctness of information in terms of both the graphical representation of the boundary's position in multi-dimensional space, as well as the correctness of the boundary's descriptive themes [Struck and Dilks, 1998; Altheide, 1998; Aronoff; 1993]. Thematic accuracy means that information on coordinates, ownership, classification, associated laws, associated rights etc. is correct. However, if the graphical and attribute information reflects verbatim the boundary as located 'on ground,' but the boundary itself is incorrectly positioned, or does not reflect the legal definition of the boundary then the location or spatial information is still inaccurate. Therefore boundary information accuracy must include a reflection of the legal definition of the boundary. The accuracy of marine boundaries must also include a more faithful representation of the multi-dimensional nature of the rights existing in marine spaces.

Boundary information is also required, or at least desired, to be logically consistent [Aronoff; 1993]. Logical inconsistency can occur, for instance, when coastlines are partially mapped and at different times. Due to the dynamic nature of coastlines and tidal variations the ordinary high water mark (OHWM), for instance, may not occur at the same location in time and space and mapping a particular stretch of coast in parts and at different times can produce OHWM positions for different instances in time [Nichols, 1983]. The data would therefore be logically inconsistent if the results of the various mapping exercises are combined. Logical consistency is an aspect of accuracy.

Boundary information is also required to be complete [Aronoff, 1993]. The term 'complete' has multiple dimensions. Information on all the mathematical and physical dimensions of the boundary is required to fulfill the requirement of completion (i.e. the entire boundary is represented graphically or described textually). Boundary information is also required to be thematically complete. Thematically, complete boundary information implies the availability of all needed descriptive information, even if the information comes from various sources. In many instance, therefore, complete information is dependent upon stakeholder cooperation, collaboration, integration etc.

Complete information that is inaccurate or out of date is a hindrance to good governance because of the possibility of supporting faulty decision-making.

Usefulness is the quality of adequacy in relation to a desired function. The usefulness of boundary information also has many dimensions. First the information has to be accessible to appropriate stakeholders to be useful. A number of factors impact upon accessibility. The mandate of stakeholders who maintain boundary information must allow for other stakeholders to have access. Shared mental maps of stakeholders' objectives in the marine environment, the willingness to share information, appropriate organizational structures to facilitate the sharing of information, qualified human resources to manipulate the information, affordable access mechanisms, appropriate geographic information technologies, efficient database management systems, and efficient data infrastructures are all required to facilitate access to up-to-date, accurate and complete information. Data standards and metadata also contribute to usefulness of boundary information. Reliable output in the form of analog or digital maps and charts at appropriate scales, referenced to useful datums, and having boundary and other spatial information displayed in useful formats (e.g. vector, raster, multibeam etc.) is also a necessity depending on the use of the information (e.g. tenure management, resource management etc.).

4.4 Problems with Canadian Marine Boundaries

This section will briefly examine the current general state of Canadian marine boundaries and the impact of their current state on Canadian governance of marine spaces. Legal, technical, and scientific problems associated with Canadian marine boundaries will be examined and discussed.

4.4.1 Three types of problems with Canadian marine boundaries

Marine boundary problems include both problems with the boundary itself (e.g., the legal definition of the boundary) as well as problems associated with the quality and availability of boundary information. This section will discuss both aspects.

Canadian federal, provincial and community concerns have produced, among other things, efforts to define and claim its continental shelf, implement coastal zone and marine policies and laws (e.g. the *Oceans Act* [1996], *New Brunswick's Aquaculture Act* [1998], New Brunswick's Coastal Areas Protection Policy, 2002 etc.) and establish marine protected areas (e.g., at Race Rocks, the Gully, and the Musquash Estuary). Common to all efforts is the requirement to define and secure accurate knowledge of affected jurisdictional, administrative, aboriginal, private, and community boundaries [Lane, 2000; Monahan et al, 1999; Nichols and Monahan, 1999; Lamden and de Rijcke, 1996; Hildrebrand, 1989; Nichols, 1983; Jackson, 1976; La Forest, 1973].

Nichols and Monahan [1999] and Nichols [1983] have grouped marine boundary problems as legal, scientific, and technical problems. All these problems have bearing on the good governance of marine spaces and affect not only Canada but other jurisdictions as well [Flushman, 2002; Reed, 2000; Lane, 2000; Crowe, 2000; Food and Agriculture Organization, 1998; Pinto, 1994; Vallejo, 1994; Hildreth and Johnson, 1983; Ekert, 1979; Ketchum, 1972]. Additionally, the nature of marine boundaries, as discussed in the immediately preceding section also impacts upon marine boundary problems. A very brief review of some of these problems follows.

4.4.1.1 Legal problems

Chapter 4, Section 4.2 outlined the fact that there are many rights associated with marine spaces and that not only are there many types but also that they overlap in many instances. This is certainly true in Canada where boundaries associated with federal and provincial jurisdiction and administration, public and private rights, and aboriginal title and rights etc. in some instances require clarification for the effective governances of marine spaces. Nichols and Monahan [1999] identified a number of legal problems associated with marine boundaries in Canada. These include:

- Uncertainty regarding the spatial limits of federal and provincial jurisdiction as defined in law;
- Undefined spatial limits of aboriginal rights in the offshore;
- Issues of conflict between the spatial extents of public and private rights;
- Ill-defined or inappropriately defined boundaries for many rights and special interests, leading to ambiguities and conflicts.

These problems, among others, are not new and remain contemporary issues [McNeil, 2001; Lamden and de Rijcke, 1985 and 1996; Bartlett, 1988; Nichols, 1983; Hildebrand, 1983; Jackson, 1976]. Good governance of marine spaces requires that these issues be addressed.

4.4.1.2 Technical problems

Technical problems related to marine boundaries are both in relation to the boundaries themselves, as well as in relation to the quality and availability of marine boundary information. The problem of locating a coastal or marine boundary on the Earth is a survey problem. Methods of locating coastal boundaries range from subjective observations of tidal marks on the shore, to locating the intersection of a particular tidal datum with the shore from periods of tidal observations. Whichever method is utilized, there is always the probability of errors or zones of uncertainty in locating the spatial position of the boundaries [Flushman, 2002; Nichols and Monahan, 1999; Nichols, 1983; Hildreth and Johnson, 1983].

Other technical problems relate to boundary information. As was demonstrated in Chapter 3, the totality of collected boundary information resides with many agencies (community, public and private) and they all do not all collect boundary data to the same measurement quality. Marine boundary information collected by the various agencies are referenced to different datums, collected at various scales and for many different purposes, and are at various stages of accuracy, precision, completeness, currency etc. Adding to this are legal uncertainties that are translated into inaccurate boundary information, and technical uncertainties resulting from datum transformations among other things. The result is that the integration of marine boundary information is greatly impaired and this is a hindrance to the quality of spatial information required to effect good governance of marine spaces [Sutherland, Ng'ang'a and Nichols, 2002; Sutherland and Nichols; Sutherland, Wilkins and Nichols, 2002; Monahan et al, 2001].

4.4.1.3 Scientific problems

Nichols [1983] identified the lack of scientific knowledge regarding tidal processes as negatively affecting the definition of tidal datums, and that in turn affecting the positioning on ground of boundaries related to coastal land tenure, as well as federal and provincial jurisdictional and administrative limits. In particular, the sparse network of tidal stations along the Canadian coasts has led to approximations of coastline boundaries in many areas. Even where boundaries have been defined on the basis of tidal information, they may not be based on up-to-date information. Similarly some environmental boundaries (e.g., for MPAs) may not scientifically best represent the area to be protected [Byrne, Hughes-Clarke et al, 2002]. The importance of science and scientific knowledge to governance, including the spatial aspect of governance has been identified by other sources [Popp, 2000; Kyriakou and Di Pietro, 2000; Keough, 2000; Nichols and Monahan, 1999; Goldfarb, 1988].

4.5 Summary and Conclusions

Coastal and marine spaces are of tremendous value to life on Earth and accurate, up-to-date, useful, complete and timely information of all types about the environment is essential for these spaces' governance. Spatial information (and by implication boundary information) is as much a requirement for the governance of coastal and marine spaces as is information on the environments' geomorphology, biological characteristics, oceanographic features and processes, hydrology etc. Adequately supplied, spatial information (especially boundary information) will support the controlled access to and use of coastal and marine spaces by facilitating the adjudication and allocation of rights, the design and implementation of appropriate regulations, and the enforcement of those regulations (Figure 4.3) [Ng'ang'a et al, 2004; Sutherland, 2002; Nichols, Monahan and Sutherland, 2000; Nichols and Monahan, 1999].

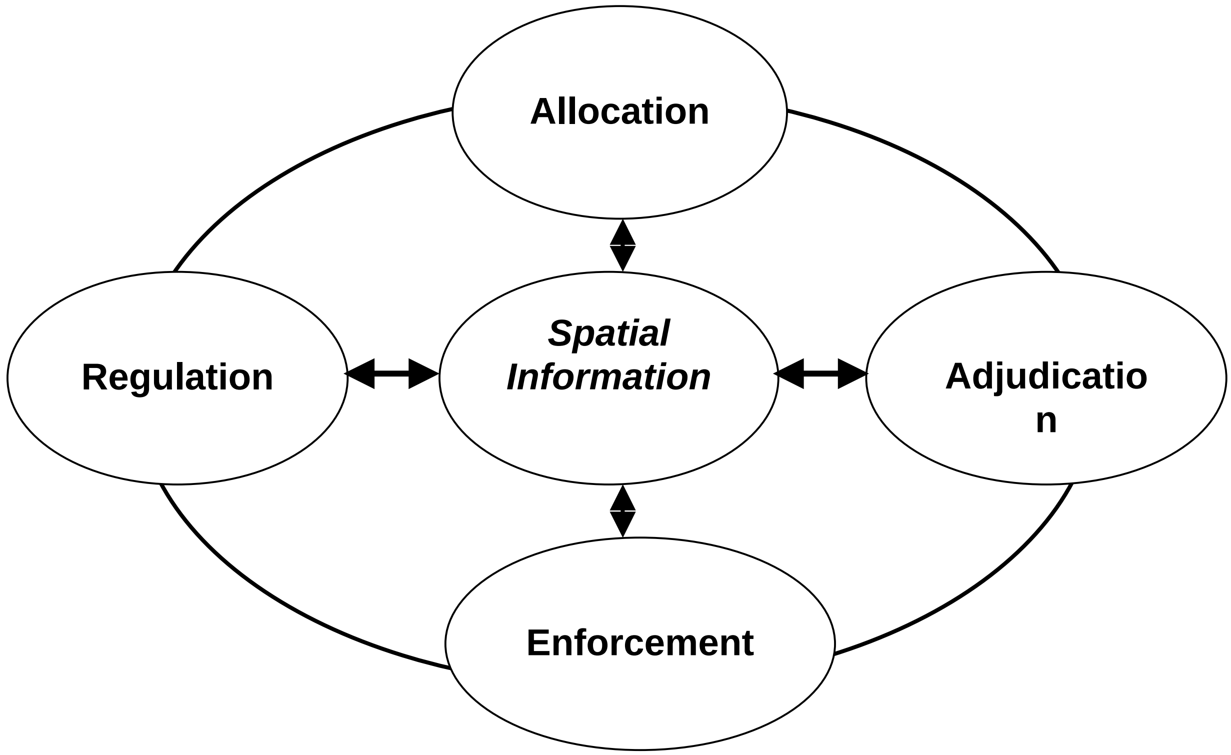


FIGURE 4.3 – THE ROLE OF SPATIAL INFORMATION IN GOVERNANCE
(*after Nichols, Monahan and Sutherland ,2000*)

Marine boundaries have certain unique characteristics. These include the fact that they are:

- Likely to affect a significant portion of the world's population, especially in an international context;
- More likely to be adjacent to or encompass valuable natural resources;
- Subject to ambiguity or uncertainty in definition, and positioning in reality;
- Difficult to demarcate in relation to wholly marine boundaries;
- Ambulatory in terms of tidal coastal boundaries and baselines to which other boundaries may be referenced.

There are certain qualities of boundary information that are required to increase the probability of enacting good governance. Although much of the information in this section is not new in terms of what is required of data quality in general, the discussions on boundary requirements to support the good governance of marine spaces would be incomplete without this examination. The synthesis of points in relation to the specifics of the support of quality marine boundary information for good governance is, however, new. A number of points were brought out in the discussions, including:

- Desirable marine boundary information is “up-to-date”, “accurate”, “complete”, and “useful” (These “loaded” terms were defined in Section 4.3);
- Usefulness of information depends upon a number of factors including:
  - Accuracy, currency, and completeness of the information;
  - Stakeholder access to the information, facilitated by:
    - Shared mental maps of stakeholders’ objectives in the marine environment;
    - The willingness to share information;
    - Appropriate organizational structures to facilitate the sharing of information;
    - Qualified human resources to manipulate the information;
    - Affordable data access mechanisms;
    - Appropriate geographic information and other technologies;
    - Efficient database management systems;
    - Efficient spatial data infrastructures.
  - The existence and application of data standards and metadata;
  - Reliable output formats and appropriate scales for the intended use of the information.

In Canada there are legal, technical and scientific problems associated with marine boundaries. Legal problems include the spatial dimensions of federal-provincial jurisdiction conflicts, unclear aboriginal rights, and sometimes ill-defined rights associated with public and private utility of marine spaces. Technical problems are associated with datum definitions and transformation, survey problems linked to locating marine boundaries "on ground," and the quality of boundary information in scattered databases that inhibit the easy integration of boundary information to support good governance of marine spaces. The lack of scientific knowledge of tidal processes and other environmental factors to support the definition of tidal datums and their consequent boundaries is also a problem that needs to be addressed.

These legal, technical, and scientific problems detract from the factors of efficiency, accountability, and preservation of identity that are some criteria for good governance (Section 3.5). A lack of accurate information associated with ill-defined boundaries affect the efficiency of the decision-making process that depends on higher quality information. Ill-defined boundaries affect the factor of accountability since stakeholders often make decisions in pursuit of their objectives related to spatial extents according to their understanding of the limits of those spatial extents. Persons are often held accountable for actions that violate the rights of another that are linked to defined boundaries. Finally, as discussed in Chapter 2, communities associate parts of their identity to perceived spatial extents. Therefore ill-defined or undefined boundaries can have negative effects upon community identity and hence violate the good governance criteria of "preservation of identity".

Although well-defined boundaries enhance good governance by providing more accurate information to the decision-making process that is part of the pursuit of governance objectives, research has indicated that it is sometimes better to leave some boundaries ill-defined or undefined if the existence of those boundaries is a catalyst for dispute. The aim of good governance is the achievement of social, political, economic, and environmental objectives within the framework of social order. Boundaries should therefore not contribute to the problems, but instead contribute to the peaceful achievement stakeholder objectives. It is well known, however, that ill-defined or undefined boundaries are sources of dispute and therefore the adequate definition of boundaries more often than not support good governance. Table 4.3 summarizes the major points made in this chapter.

Table 4.3
Summary of Major Points in the Chapter 4

Good governance of coastal and marine spaces can benefit from better decision-making that is based upon more up-to-date, timely, accurate, complete and useful information of all kinds.
Rights in the coastal and marine environments are linked to spatial extents and therefore the management spatial information (and by implication boundary information) is crucial to coastal and marine governance.
A holistic approach to coastal and marine governance is necessary since the land, coastal and marine environments all affect, and are affected by one another.
Marine boundaries and marine boundary information are of great importance to the governance of marine spaces. Marine and other boundaries support how rights are distributed in a society, and how responsibilities are assigned for governmental administration of social, cultural, economic and political activities.
Marine boundaries have certain unique characteristics.
Canadian marine boundaries have certain legal, technical and scientific problems that need to be addressed so that good governance of Canadian marine spaces can be attained.
In some instances, an undefined or ill-defined boundary is not necessarily a hindrance to the governance of marine spaces.
Certain qualities of marine boundary information (i.e. accuracy, completeness, up-to-date, usefulness) have multiple dimensions, and are important in enhancing good governance of marine spaces.

CHAPTER 5
CLASIFICATION OF CANADIAN MARINE BOUNDARIES

5.0 Introduction

It has been shown in Chapter 4 that there are many, varying and complex rights existing in the marine environment. These rights are linked to spatial extents that imply that they are bounded. It was also shown that the management of these rights is of much importance to the governance of marine spaces. By implication the boundaries associated with these rights, and the information about these boundaries, are also of great importance to the good governance of marine governance.

In this chapter many of the marine boundaries existing in the Canadian marine environment will be identified and described. These boundaries will then be classified according to the functions they serve. The purpose of this exercise is to highlight the fact that not only are there many explicit boundaries existing in the Canadian marine environment, but also that many other boundaries are implied by the nature of stakeholder actions within the marine environment. The final discussions will concern problems associated with boundary and boundary information characteristics and quality.

The main purpose of this chapter is to assist in the identification of marine boundary information requirements and to emphasize the need for adequate boundary information to support good governance of marine spaces. The discussion will be from a Canadian perspective, but many of the arguments could be applicable to other national jurisdictions.

5.1 CHS Charts and Marine Boundaries

Canadian Hydrographic Service (CHS) charts are good initial sources for the identification of many of the possible marine boundaries within Canadian waters [Nichols and Monahan, 2000]. Therefore the Canadian marine boundaries (explicit, implied and potential) dealt with in this chapter will be identified from the perspective of CHS charts (i.e., whether or not they appear on charts).

5.1.1 Marine boundaries on CHS charts

There are approximately 1000 CHS charts [Nichols and Monahan, 2000]. Below are descriptions of some of the boundaries, limits and areas (implying limits) that are currently shown as lines on CHS charts. All of the boundaries, limits and areas described do not uniformly appear on all charts although constant effort is made to bring the charts up-to-date with the latest policies and relevant developments. It is assumed, without examination of every CHS chart and without evidence to the contrary, that if a type of boundary, limit or area (implying limits) is mentioned in either Chart #1 or referred to in the CHS Online Information Library (COIL) then that feature might appear on at least one chart [Department of Fisheries and Oceans, 1996; Department of Fisheries and Oceans, 2000; Nichols and Monahan, 2000].

5.1.1.1 Harbours, ports and routes

As charts are basically navigation instruments, the limits of harbours, ports and navigation routes are always shown. Also shown are the limits of facilities related to harbour and ports including [Department of Fisheries and Oceans, 1996; Department of Fisheries and Oceans, 2000]:

- Limits of degaussing ranges;
- Limits of pipeline areas;
- Limits of seaplane landing areas;
- Limits of swept areas;
- Boundaries of routing measures;
- Projected works and works under construction;
- Marina, boat harbour (and other small craft facilities);
- Transshipment areas and facilities;
- Cargo shipment area;
- Pilot boarding areas and facilities;
- Area under reclamation;
- Area under construction;
- Drying areas (foreshore and inter-tidal);
- Dredged areas and channels.

5.1.1.2 Coastlines

Coastlines form the boundaries and limits of much federal, provincial and municipal title, jurisdictional and administrative geographic areas [Lane, 2000; Grant, 1999; Nichols and Monahan, 1999]. Coastlines represented by the ordinary high water mark (and in some cases low water mark) also form the boundaries spatial extents to which are attached many private rights [Nichols, 1983; La Forest, 1973]. CHS charts show (or at least make provision for the display of) [Department of Fisheries and Oceans, 1996; Department of Fisheries and Oceans, 2000]:

- Baselines;
- High water line (shoreline), usually HHWLT;
- Foreshore and low water line – LLWLT soon to be LAT;
- Coastal features, artificial and natural.

5.1.1.3 Precautionary areas

As navigation instruments, charts provide information for the safety marine vessels. There are references to “areas”, implying limits or boundaries, as well as explicit references to limits and zones. To enhance the safety of navigation some charts show [Department of Fisheries and Oceans, 1996; Department of Fisheries and Oceans, 2000]:

- Limits of inadequately surveyed areas;
- Limits of safety zones/development areas;
- Vessel dumping ground (implying limits or boundaries);
- Explosive dumping grounds (implying limits or boundaries);
- Chemical waste dumping ground (implying limits or boundaries);
- Garbage disposal areas (implying limits or boundaries);
- Incineration area (implying limits or boundaries);
- Dredging area (implying limits or boundaries);
- Foul ground, wrecks, obstructions (implying limits or boundaries);
- Projected works and works under construction (implying limits or boundaries);
- Doubtful dangers (implying limits or boundaries);
- Spoil grounds; dredging areas (implying limits or boundaries).

5.1.1.4 Restricted areas

Information related to restricted areas is shown on some charts. There are references to “areas”, implying limits or boundaries, as well as explicit references to limits. These restricted areas include [Department of Fisheries and Oceans, 1996; Department of Fisheries and Oceans, 2000]:

- Limits of military practice and exercise areas at sea (minefields, practice areas, exercise areas, submarine transit tracks, small arms ranges etc.);

- Coastguard facilities;
- Restricted area (inadequately surveyed areas).

5.1.1.5 International bilateral boundaries

Canadian charts show the agreed boundaries with the USA, France and Greenland (Denmark). The Canadian claims to boundaries that have not been resolved are sometimes shown. Canada has unresolved boundaries with the USA, and within the next ten years will have to conclude boundary agreements with Denmark and Russia in the Arctic [Nichols and Monahan, 2000].

5.1.1.6 International boundaries with the United Nations

UNCLOS automatically gives Coastal States a Territorial Sea with a maximum extent of 12 nautical miles, a Contiguous Zone (24 n.m. maximum extent) and an Exclusive Economic Zone (EEZ) up to 200 n.m from the country's baselines. It also permits the claiming of a juridical continental shelf outside the EEZ [United Nations, 1997; Sohn and Gustafson, 1984]. For details of the process, see Monahan et al [1999] and Monahan [2002]. In Canada these boundaries are defined under *Canada's Ocean Act [1996]*. To date, very few of these boundaries have been shown on charts, and then only on a few charts.

5.1.1.7 Inter-provincial and territorial boundaries

At present, charts show some boundaries between provinces and between Provinces and Territories. In cases where there may be some dispute, no line is shown on the chart. It is important to note that these are inter-provincial boundaries, which means that they are lines representing planes of separation between provinces or Territories and not between Canada and the Provinces or Territories. A great deal of jurisdiction is circumscribed by those boundaries, yet they do not always appear on any map or chart [Nichols and Monahan, 2000].

5.1.1.8 Fishing zones

Fishing zones are of great importance to the economy of communities in Canada. Fishing zones, including the fishing zone limit that corresponds to 200 nautical miles from the inner limits of the territorial sea, are shown on some charts.

5.1.1.9 National parks and provincial parks

National and provincial parks provide safe havens for flora and fauna, as well as provide controlled opportunities for humans to interact with nature. The limits of both these types of parks are charted.

5.1.1.10 Indian reserves and aboriginal rights

Aboriginal areas officially designated as "Indian Reserves" are charted. As aboriginal land claims work their way through the courts, these will have to be re-examined [Nichols and Monahan, 2000].

5.1.1.11 Ecological reserves and marine protected areas

Department of Fisheries and Oceans [1996 and 2000] provide for the display of ecological reserves on charts. These may appear on some charts. The *Oceans Act* [1996] created provisions for marine protected areas (and interim marine protected areas) that are being charted as they are established and as the relevant charts are brought up to date.

5.1.1.12 Customs Limit

Customs limits that determine the limits of administration and jurisdiction for the application of laws and regulations under the *Customs Act* [1985], *Customs and Excise Offshore Application Act* [1985] and the *Canada Customs and Revenue Agency Act* [1999] are shown on some charts.

5.1.1.13 Marine parks

Department of Fisheries and Oceans [1996 and 2000] provide for the display of marine parks on charts. The limits or boundaries of marine parks appear on some charts.

5.1.1.14 Wildlife sanctuaries, and protected areas

Department of Fisheries and Oceans [1996 and 2000] provide for the display on charts of various types of wildlife sanctuaries and protected areas. The limits or boundaries of marine parks may appear on some charts. Some of these areas include

- Limits of fish sanctuaries;
- Limits of prohibited fishing areas;
- Limits of bird sanctuaries;
- Other wildlife sanctuaries.

5.1.2 Marine boundaries not on CHS charts

Although charts are identified as primarily navigation instruments, there are factors that have expanded their use beyond that narrow utility. These include [Nichols and Monahan, 2000; United Nations 1997 and 1999; Sohn and Gustafson, 1984]:

- Their use as maps for the administration of marine resources by both federal and provincial governments, including delimitation of leases, licences and other rights;
- Their use as maps to support marine research and designation of special areas of interest (e.g., MPAs);
- Their use as tools for zoning ocean and coastal uses;
- Their use by international communities to support claims under the United Nations Law of the Sea (UNCLOS) Convention.

The additional uses of charts are not unexpected when one considers the importance of marine spaces to the social, economic and political needs of jurisdictions such as Canada. As users pursue the exploration, exploitation and management of marine spaces they require knowledge of, among other things, the spatial dimensions of the rights, responsibilities and restrictions that provide the framework for their interaction with the marine environment. Therefore fulfillment of marine user needs require information beyond the aid to navigation and the chart is one medium suitable for the communication of that type of spatial information [Nichols, Monahan and Sutherland, 2000; Eckert, 1979; Prescott, 1985; Payoyo, 1994].

Considering the multiplicity of uses to which a chart might serve, Nichols and Monahan [2000] suggest certain other boundaries that "might be usefully added over time." Further research has also revealed that a number of other marine areas, the boundaries of which do not appear on CHS charts, are managed and administered by federal and provincial authorities. All these areas and boundaries are described below. Not all of the approximately 2000 charts were examined so instances of boundaries or limits for the items outlined below could possibly currently appear on a chart.

5.1.2.1 International boundaries with the United Nations

As mentioned in section 5.1.1.6, some UNCLOS boundaries are not shown on charts. Federal authorities would be responsible for maintaining information on these boundaries, but provincial authorities may also store these spatial data for their own purposes.

5.1.2.2 Federal Oil and gas leases and licenses

Natural Resources Canada (NRCan) issues leases and licenses for gas and oil exploration and operations in the offshore [Nichols and Monahan, 2000; Nichols, Dobbin, Sutherland et al, 2001]. The operations are potential obstructions to navigation as well as represent boundaries enclosing spatial extents to which are attached rights and interests. Federal authorities would normally be responsible for maintaining information on these boundaries, although Provincial agencies responsible for revenue sharing may be primary users.

5.1.2.3 Rights of way for submarine pipelines and cables

CHS Chart #1 and the CHS Online Information Library (COIL) both provide for the representation of submarine pipelines and cables on charts. However there is currently no evidence of any representation of the boundaries for the rights-of-way (if they exist) for the cables and pipelines [Department of Fisheries and Oceans, 1996; Department of Fisheries and Oceans, 2000]. Federal authorities would be responsible for maintaining information on these boundaries.

5.1.2.4 Aquaculture and sea ranching

Some CHS charts show the location of aquaculture sites by labeling, and Chart #1 and COIL refer to evidence of this type of activity as "obstructions" [Department of Fisheries and Oceans, 1996; Department of Fisheries and Oceans, 2000]. However, the limits or boundaries of the sites themselves are not shown on charts [Nichols and Monahan, 2000]. Provincial authorities would be responsible for maintaining information on these boundaries. The scale of some paper charts is large enough to clearly show these boundaries, and some charts are not. However, in the digital world of Electronic Nautical Charts scale is less of a factor as this environment allows for scale changes (i.e., zooming).

5.1.2.5 Aboriginal claims

Land boundaries for coastal Indian Reserves are shown on some CHS charts. However, aboriginal nations have made and settled claims to rights[15] in the marine environment and these are not shown on charts [McNeil, 2001; Nichols and Monahan, 2000; Muir, 1999; Bartlett, 1988]. Federal authorities, as well as some provincial authorities, would be responsible for maintaining information on these boundaries.

5.1.2.6 Traditional private rights below the ordinary high water mark

Water lots, wharves etc. that represent traditional private rights below the ordinary high water mark (OHWM) are not shown on charts [Nichols and Monahan, 2000]. Provincial authorities would be responsible for maintaining information on these

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[15] R.v. Sparrow [1990] 1 S.C.R 1075 and r.v. Marshall [1999] 3 S.C.R. 0456 are recent examples of First Nations rights claimed in the marine environment Details on these cases may be found at http://www.lexum.umontreal.ca/csc-scc/en/pub/1990/vol1/html/1990scr1_1075.html and http://www.lexum.umontreal.ca/csc-scc/en/pub/1999/vol3/html/1999scr3_0456.html respectively.

boundaries. The argument in relation to scale discussed in Section 5.1.2.4 also applies here.

5.1.2.7 Purchased, Leased, and Other Lands for Wildlife Protection

The *Canada Wildlife Act* [1885] provides for lands to be purchased or leased for the protection of wildlife. Legal persons may also have “interests” in these lands for the same reason. These “lands” may theoretically be marine spaces and therefore their boundaries should appear on charts. The level of government responsible for these boundaries may be either federal or provincial. Some of the areas would be intertidal and even extend above high water

5.1.2.8 Safety zones around installations on the Continental Shelf

The *Oceans Act* [1996] requires that safety zones be established around commercial and other installations on the continental shelf. The boundaries for these zones should appear on charts. The federal government would be responsible for maintaining information on these boundaries. The argument in relation to scale discussed in Section 5.1.2.4 also applies here.

5.1.2.9 Industrial works or commercial operations in Arctic Waters

The *Arctic Waters Pollution Prevention Act* [1985] outlines guidelines for the establishment of industrial and commercial operations in Canadian Arctic waters. The aim of the legislation in this regard is the prevention of pollution in the Arctic waters. The boundaries of these operations should appear on charts. The federal government would be responsible for maintaining information on these boundaries.

5.1.2.10 Shipping safety control zones (Arctic Waters)

The *Arctic Waters Pollution Prevention Act* [1985] refers to the establishment of shipping safety control zones in Canadian Arctic waters. The boundaries or limits of these zones should appear on charts. The federal government would be responsible for maintaining information on these boundaries.

5.1.2.11 Water Resource Management Area

The *Yukon Waters Act* [1992], the *Northwest Territories Waters Act* [1992] and the *Canada Water Act* [1985] provide for the establishment of water resource management areas. The boundaries or limits of these areas should appear on charts. According to the Acts, both federal and provincial authorities would be responsible for maintaining information on these boundaries.

5.1.2.12 Federally designated "Special Areas" in provincial territories

The *Special Areas Act* [1985] allows the federal government to establish special areas within provincial territories in order to facilitate provincial economic development. The marine environment is economically very important to the provinces and it is feasible to believe that the *Special Areas Act* [1985] could be used to establish special areas in the marine environment. If that was the case, then the boundaries or limits for these spatial extents could be shown on charts. Both federal and provincial authorities would be responsible for maintaining information on these boundaries.

5.1.2.13 Federal Fishing License Areas

The *Fisheries Act* [1985] gives the federal government the authority to issue fishing licenses for defined areas to legal persons. The boundaries or limits of these licenses should be shown on charts. The federal government would be responsible for maintaining information on these boundaries.

5.1.2.14 Northwest Atlantic Fisheries Organization (NAFO) Regulatory Areas

In order to protect the Canadian fishing industry the *Coastal Fisheries Protection Act* [1985] established Northwest Atlantic Fisheries Organization (NAFO) Regulatory Areas. There are coordinates for these areas written in the legislation. If these areas do not appear on charts, they should be included. The federal government would be responsible for maintaining information on these boundaries.

5.1.2.15 Wildlife Habitat (spawning/breeding areas; other areas)

Department of Fisheries and Oceans [1996 and 2000] provide for the display on charts of various types of wildlife sanctuaries and protected areas. Also the limits or boundaries of marine parks may appear on some charts. However, it is not clear if wildlife habitat in the marine environment is included in the foregoing. For the same reasons for displaying wildlife sanctuaries etc. on charts, the limits or boundaries of wildlife habitat could be included. Both federal and provincial governments could maintain information on these boundaries.

5.1.2.16 Federal Real Property Grants, Leases, Licenses, Concessions

Real property grants, leases, licenses, and concessions may be granted by to legal persons under the *Federal Real Property and Federal Immovables Act* [1991]. If these grants, leases, licenses or concessions appear in the marine environment then they should appear on charts. The federal government would be responsible for maintaining information on these boundaries. The argument in relation to scale discussed in Section 5.1.2.4 also applies here.

5.1.2.17 Fishing and Recreational Harbours Leased to Legal Persons

The *Fishing and Recreational Harbours Act* [1985] provides for the lease of the fishing and recreational harbours to legal persons. Harbours are currently shown on charts, but if the spatial dimensions of the lease are different from a particular harbour's spatial extent then the boundaries for the lease should appear on charts. The federal government would be responsible for maintaining information on these boundaries.

5.1.2.18 Provincial Jurisdictional and Administrative Boundaries

Some provinces of Canada recognize various marine boundaries for both provincial jurisdictional and provincial administrative purposes. The bases for these boundaries are various provincial legislation and regulations [La Forest, 1973]. Many of these boundaries should appear on charts. Some of these boundaries include boundaries for:

- Counties and municipalities;
- Provincial fishing regulatory areas;
- Provincial ecological reserves and other protected areas;
- Provincial offshore oil and gas rights;
- Provincial coastal zone policies;
- Provincial marine policies;
- Territorial (some of these administratively are special in that they are boundaries defined by DIAND).

5.2 A Boundary Classification Scheme for Canadian Marine Boundaries

This section presents a boundary classification scheme based on all the foregoing discussions. This classification scheme is important to the governance of Canadian marine spaces:

- It provides a more complete list of Canadian marine boundaries and thereby improves boundary information that affects the governance of marine spaces;
- It provides classification(s) of each boundary, and this adds to the arsenal of information that supports the governance of Canadian marine spaces from a sovereign, jurisdictional, or administrative point of view;
- It identifies the level of government responsible for maintaining the boundaries, and information on the boundaries, and this contributes to the efficiency of the overall governance decision-making process by arming stakeholders with knowledge of which spatial extent(s) over which they may exercise authority;
- It provides information on which marine boundaries are currently not included on CHS charts and whether the boundaries should be included on CHS charts. Including the currently excluded boundaries on CHS charts provides notice of spatial extents to which policies and laws apply, thereby improving the enforcement aspect of the governance of marine spaces.

The scheme contributes to the efficiency of governance through improved knowledge to support the decision-making process. It contributes to the qualities of accountability and preservation of identity related to good governance by providing knowledge of spatial extents over which authority may be exercised, and responsibility held.

The scheme is presented as a table (Table 5.1) itemized according to boundary, classification of boundary, level of responsible government, and suitability for inclusion on charts. If a boundary has more than one possible classification all possible classifications will be listed. If a boundary has more than one possible responsible government authority all possible government authorities will be listed. If a boundary appears on all relevant charts it will be listed as "Yes" in the appropriate column. If a boundary is known to appear on some relevant charts it will be listed as "Some" in the appropriate column. If a boundary does not appear on any relevant chart it will be listed as "No" in the appropriate column. If it is unclear whether a boundary appears on any chart it will be listed as "undetermined".

Table 5.1 – Boundaries Classified to the Level of Responsible Government

Boundary	Boundary Classification	Level of Responsible Government	Currently on Chart	Suitable for Charts
International (bilateral)	Sovereign and Jurisdictional	Federal	Yes	Yes
Baselines (UNCLOS)	Jurisdictional but used to define sovereign	Federal	Some	Yes
Territorial Sea (UNCLOS)	Sovereign and Jurisdictional	Federal	Some	Yes
Contiguous Zone (UNCLOS)	Sovereign and Jurisdictional	Federal	Some	Yes
Exclusive Economic Zone (UNCLOS)	Sovereign and Jurisdictional	Federal	No	Yes

Boundary	Boundary Classification	Level of Responsible Government	Currently on Chart	Suitable for Charts
Continental Shelf (UNCLOS)	Sovereign and Jurisdictional	Federal	Some	Yes
Territories	Jurisdictional	Federal and Territorial	Yes	Yes
Province	Jurisdictional	Provincial	No	Yes
County	Administrative	Provincial	No	Yes
Municipal	Administrative	Provincial	No	Yes
Aboriginal claims	Aboriginal rights and administrative	Federal, provincial and Territory	No	Yes
Indian reserves	Aboriginal rights and administrative	Provincial and Federal	Yes	Yes
Traditional private rights below OHWM	Private rights	Provincial	No	Yes, with scale considerations
Coastlines (high water)	Jurisdictional, administrative, public and private rights	Federal, Provincial and Territorial	Yes	Yes
Coastlines (low water)	Jurisdictional, administrative, public and private rights	Federal, Provincial and Territorial	Yes	Yes
Drying areas (foreshore and inter-tidal)	Environmental	Provincial	Yes	Yes
Boundaries of routing measures	Administrative	Federal	Yes	Yes
Harbours and Ports	Jurisdictional and Administrative	Federal and Provincial	Yes	Yes
Degaussing ranges (harbours and ports)	Jurisdictional and Administrative	Federal and Provincial	Yes	Yes
Pipeline areas (harbours and ports)	Jurisdictional, Administrative and private rights	Federal and Provincial	Yes	Yes

Boundary	Boundary Classification	Level of Responsible Government	Currently on Chart	Suitable for Charts
Seaplane landing areas (harbours and ports)	Jurisdictional and Administrative	Federal and Provincial	Yes	Yes
Swept areas (harbours and ports)	Administrative	Federal and Provincial	Yes	Yes
Projected works and works under construction (harbours and ports)	Jurisdictional, Administrative and private rights	Federal and Provincial	Yes	Yes
Marina, boat harbour (and other small craft facilities) – (harbours and ports)	Jurisdictional, Administrative and private rights	Federal	Yes	Yes
Transshipment areas and facilities (harbours and ports)	Jurisdictional and Administrative	Federal	Yes	Yes
Cargo shipment area (harbours and ports)	Jurisdictional and Administrative	Federal	Yes	Yes
Pilot boarding areas and facilities (harbours and ports)	Administrative	Federal	Yes	Yes
Area under reclamation (harbours and ports)	Administrative	Federal	Yes	Yes
Dredged areas and channels (harbours and ports)	Administrative	Federal	Yes	Yes
Inadequately surveyed areas (harbours and ports)	Administrative	Federal	Yes	Yes
Safety zones/development areas	Administrative and private rights	Federal	Yes	Yes
Vessel dumping ground	Jurisdictional, Administrative and private rights	Federal	Yes	Yes

Boundary	Boundary Classification	Level of Responsible Government	Currently on Chart	Suitable for Charts
Explosive dumping grounds	Jurisdictional, Administrative and private rights	Federal	Yes	Yes
Chemical waste dumping ground	Jurisdictional, Administrative and private rights	Federal	Yes	Yes
Garbage disposal areas	Jurisdictional, Administrative and private rights	Federal and Municipal	Yes	Yes
Incineration area	Jurisdictional, Administrative and private rights	Federal	Yes	Yes
Dredging area	Administrative	Federal	Yes	Yes
Foul ground, wrecks, obstructions	Administrative	Federal	Yes	Yes
Doubtful dangers	Administrative	Federal	Yes	Yes
Spoil grounds	Administrative	Federal	Yes	Yes
Military practice and exercise areas at sea	Jurisdictional and Administrative	Federal	Yes	Yes
Coastguard facilities	Jurisdictional and Administrative	Federal	Yes	Yes
Restricted area (inadequately surveyed areas)	Jurisdictional and Administrative	Federal	Yes	Yes
Customs limit	Jurisdictional and administrative	Federal	Some	Yes
National Parks	Administrative	Federal	Yes	Yes
Provincial Parks	Administrative	Provincial	Yes	Yes
Federal fishing zones	Administrative	Federal	Yes	Yes
Provincial fishing regulatory areas	Administrative	Provincial	No	Yes
Provincial ecological reserves and protected areas	Administrative	Provincial	No	Yes

Boundary	Boundary Classification	Level of Responsible Government	Currently on Chart	Suitable for Charts
Wildlife habitat	Environmental, administrative, private rights, interest	Federal and Provincial	Undetermined	Yes
Marine protected areas	Jurisdictional and administrative	Federal	Some	Yes
Federal ecological reserves	Administrative	Federal	Some	Yes
Marine parks	Administrative, private rights and interest	Federal and Provincial	Some	Yes
Federal wildlife sanctuaries	Environmental and administrative	Federal	Some	Yes
Provincial wildlife sanctuaries	Environmental and administrative	Provincial	No	Yes
Aquaculture and sea ranching	Administrative and private rights	Provincial	No	Yes, with scale considerations
Purchased/leased lands for wildlife protection (*Canada Wildlife Act*)	Private rights	Federal	No	Yes
Safety zones (continental shelf installations)	Administrative	Federal	No	Yes
Industrial/commercial works (Arctic waters)	Private rights	Federal	Undetermined	Yes
Shipping safety control zones (Arctic waters)	Administrative	Federal	Some	Yes
Water resource management area	Administrative	Federal, Territory and Provincial	Undetermined	Yes
Federally designated special areas in provinces	Administrative	Federal and Provincial	No	Yes
Federal fishing licence area	Private rights	Federal	No	Yes

Boundary	Boundary Classification	Level of Responsible Government	Currently on Chart	Suitable for Charts
NAFO regulatory area	Administrative	Federal	Some	Yes
Leased fishing and recreational harbours	Private rights	Federal	Undetermined	Yes
Federal Real Property Grants, Leases, Licenses, Concessions	Private rights	Federal	No	Yes
Offshore mineral rights	Private rights	Federal	No	Yes
Federal oil and gas leases	Private rights	Federal	No	Yes
Rights-of-way for submarine pipelines and cables	Private rights	Federal and Provincial	No	Yes
Provincial offshore oil and gas rights	Jurisdictional and Administrative	Federal and Provincial	No	Yes
Provincial coastal zone policies	Jurisdictional and Administrative	Provincial	No	Yes
Provincial marine policy zone	Jurisdictional and Administrative	Provincial	No	Yes

72 boundaries are listed in Table 5.1. 36 of these boundaries are currently represented on CHS charts. 21 of the listed boundaries do not appear on any chart. 11 of the listed boundaries appear only on some charts. It was unable to be determined if 4 of the boundaries appear on any chart. Considering that CHS charts are now being used for more than navigation, all listed boundaries should appear on charts as this improved information can improve the governance decision-making process from all stakeholders' points of view. It is to be noted that many of the boundaries listed have multiple classifications and relate to multiple levels of governmental responsibilities. These points will be further discussed in Chapter 7.

CHS charts are mainly used for navigation and it is understandable that some of the boundaries that do not apparently pose a threat or obstruction to navigation are not represented on any chart. However, boundaries related to such activities as sea ranching refer to potential hazards to navigation and should be shown on CHS charts.

Even from a navigation-governance point of view it may be necessary to show all the boundaries listed in the table. Mariners need to be aware of when they may be infringing upon private rights, or when they are in a region of marine space which have attached to it restriction upon their public rights (e.g., provincial marine policy zone, federal and provincial ecological reserves and protected areas, water resource management area etc.).

CHS is a federal agency and many of the boundaries not currently shown on charts refer to provincial government governance activities (e.g. provincial ecological reserves and protected areas, provincial wildlife sanctuaries etc.). One could speculate (since this research could not verify this) that a lack of communication between federal and provincial government agencies regarding provincially administrated activities in marine spaces resulted in the omission of at least some of the boundaries from CHS charts. It may be too that no actual activity related to these boundaries exists.

It is clear from the foregoing that the inclusion of the omitted boundaries on CHS charts will improve the decision-making process of Canadian marine governance by providing improved boundary information to all stakeholders (i.e., administrators, users etc.). This is especially true since CHS charts are used for other purposes than navigation. The classification scheme is therefore a significant contribution to the governance of Canadian marine governance.

5.3 Summary and Conclusions

Although nautical charts are primarily navigation instruments and do not adequately model the 4-dimensional complexity of marine boundaries, they are still a useful medium for the dissemination of boundary information to support governance activities in marine spaces. This is evidenced by the fact that charts have been assigned utility outside of navigation, for example in use as support documents for making continental shelf claims. Many relevant sovereign, jurisdictional, administrative, public/private rights-based, and public/ private interest-based boundaries currently appear on one or another CHS charts, but there are many other explicit, implied and potential marine boundaries that could and should be included.

Therefore more boundaries should be included on CHS charts. With regard to paper charts, the boundaries shown would be dependent upon the scale of the chart. ENCs would be able to facilitate the inclusion of all desired boundaries.

A number of these boundaries occur within the tidal interface of the coastal zone. Some of the boundaries delimit the edge of land features, and some delimit the inner limit of marine spaces. The implication is that there is need for a seamless chart-topographic base map [Nichols, 2004]. At this time the author is unaware if such an entity exists.

A marine boundary classification scheme was presented in this chapter. The classification scheme contributes to the governance of Canadian marine spaces in that:

- It provides a more complete list of Canadian marine boundaries and thereby improves boundary information that affects the governance of marine spaces;

- It provides classification(s) of each boundary, and this adds to the arsenal of information that supports the governance of Canadian marine spaces from a sovereign, jurisdictional, or administrative point of view;
- It identifies the level of government responsible for maintaining the boundaries, and information on the boundaries, and this contributes to the efficiency of the overall governance decision-making process by arming stakeholders with knowledge of which spatial extent(s) over which they may exercise authority;
- It provides information on which marine boundaries are currently not included on CHS charts and whether the boundaries should be included on CHS charts. Including the currently excluded boundaries on CHS charts provides notice of spatial extents to which policies and laws apply, thereby improving the enforcement aspect of the governance of marine spaces.

Table 5.2 summarizes the major points raised in this chapter.

Table 5.2
Summary of Major Points in the Chapter 5

The fulfillment of marine user needs require information beyond the aid to navigation and the chart is one medium suitable for the communication of that type of spatial information.
To date only certain types of marine boundaries appear on charts, and not uniformly across the suite of charts. Other boundaries need to be displayed to improve support for the good governance of Canadian marine spaces.
CHS charts are used for more than navigation and are therefore a good medium for displaying marine boundaries that are not necessarily required for navigation. In this way the CHS chart can provide improved boundary information to support improved efficiency, accountability, and preservation of identity associated with the governance of marine spaces.
CHS charts could be improved by including more boundaries relevant to the governance of marine spaces.

CHAPTER 6

MARINE BOUNDARY INFORMATION AND THE GOVERNANCE OF MARINE SPACES: THREE NEW BRUNSWICK CASE STUDIES

> An important challenge for leadership in the information age is to lead the process of interpretation — to learn more effective ways of constructing new mental maps and sufficiently shared (though not identical) frameworks of interpretation within which that proliferating information can be translated into shared meanings … that are the essential foundations for legitimate collective action [Rosell, 1999].

6.0 Introduction

The aim of this chapter is to use three case studies to underscore the points brought out in the preceding chapters in terms of the need for collaborative, integrative or cooperative governance [Paquet, 1999a; Rosell, 1999; Savoie, 1999; Charette and Graham, 1999; Barksdale, 1998; Naisbitt, 1997], and the importance of boundary information to the governance of marine spaces [Nichols, Monahan and Sutherland, 2000; Nichols and Monahan, 1999; Grant, 1999]. The first case study is related to the province of New Brunswick's efforts to effect the administration of its marine spaces[16]. The second case study is related to the proposed Musquash Marine Protected Area (MPA) in the Musquash estuary off the coast of New Brunswick (NB), adjacent to the Bay of Fundy. The third case study examines the proposed New Brunswick Coastal Protection Policy.

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[16] This case study is based upon research conducted by the author is presented here with the permission of Service New Brunswick.

6.1 Case Study 1: New Brunswick's Marine Administrative Boundaries

In order for a jurisdiction to implement good governance of its marine spaces it must know the maximum spatial extent of the marine space over which it has jurisdiction, and can exercise its administrative powers. As a first step towards securing this knowledge, Service New Brunswick (SNB) formed a partnership with the Department of Geodesy and Geomatics Engineering of the University of New Brunswick, supported by the Geomatics for Informed Decisions (GEOIDE) Centres of Excellence, to delineate one possible maximum spatial extent of its marine administrative area. Using GIS technology, supported by legal research, the outcome of this process was two polygons representing a delineation of the potential maximum spatial extent of New Brunswick's submerged lands. This case study, based on work done by the author for SNB, summarizes the process of delineating the boundaries, as well as highlights the governance and boundary issues that are implicit in the process and outcome. The full details of the process are found in Appendix 1.

6.1.1 The basis for producing the polygons

In 1968, an agreement signed among the Maritime Provinces resulted in a survey that produced coordinates representing midlines between the provinces to facilitate the sharing of mineral resources in the marine environment. The coordinates for the proposed mineral sharing lines are referenced to the NAD27 datum [McLaughlin, 1968]. In 2001, SNB sought to determine the maximum spatial extent of its marine administrative area in preparation for a proposed marine policy. The special purpose mineral sharing lines from 1968 could not be applied to this objective without significant caveat. Therefore, a project was created to produce new coordinates appropriate to meet the objectives of the proposed marine policy. Traditionally, the boundaries between the Maritime Provinces are based on some equidistance principle. This principle was used to create the final polygons.

6.1.2 The Process of delineating the boundaries

In order to complete the process of creating the polygons mentioned above, it was necessary to secure data representing coastlines opposite to the shores of New Brunswick (to calculate the midpoints), as well as inter-provincial and international boundary coordinates to complete the polygons (Figure 6.1). The databases used in the model were chosen because of their immediate availability (including considerations of cost) and therefore were of varying scales and positional accuracies. The databases were also in various projections and referenced to different datums. The model workflow process for creating the polygons (that can be described as "a model for delineating New Brunswick's submerged lands from best available data") is described in Figure 6.2. The confidence placed in each database is outlined in the "hierarchy of confidence" set out in Table 6.1.

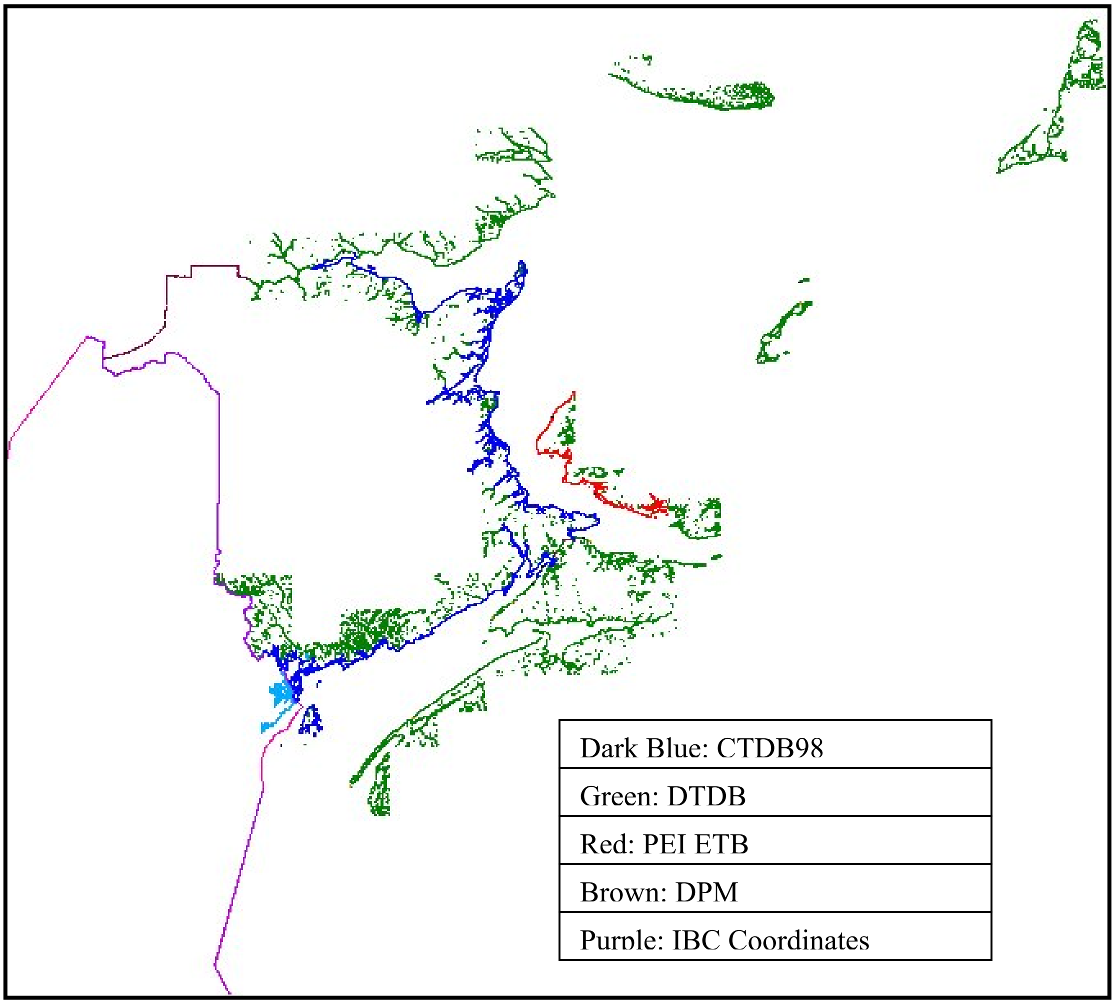

FIGURE 6.1 – LINE SEGMENTS FROM VARIOUS SOURCES USED IN THE PROCESS

Table 6.1 - Hierarchy of Confidence in Imported Data Sources

Database	Hierarchical Position	Rationale
CTDB98	1	This is SNB's Coastal Topographic Database, the database to which the final product must fit. The data has been subjected to known quality control. This data took precedence over all other data representing the same geographic extent.
International Boundary Commission (IBC) coordinates	1	These are published coordinates downloaded from NRCan (http://www.geocan.nrcan.gc.ca/ibc/ibccoord-nad83.htm). This data took precedence over all other data where international boundaries are represented except where gaps may exist.
Prince Edward Island's Enhanced Topographic Base (PEI ETB)	1-2	Apparently quality checked and reported to have a positional accuracy of ± 2.5m. This data took precedence all other data for the geographic area it represents (i.e., the south coast of PEI)
Proposed DNRE Mineral Lines and Shore Points	1-2	These data were supplied by the New Brunswick Department of Natural Resources and Energy (DNRE). They represent coordinates that were the result of a field survey exercise for proposed mineral sharing lines between the Maritime Provinces done in 1968.
Other International Boundary Coordinates from Department of Fisheries and Oceans (DFO)	2 - 3	These coordinates were obtained from DFO via email. This data took precedence over other data representing international boundaries where gaps exist.
Natural Resources Canada (NRCan) National Topographic Database (NTDB)	4	Positional accuracy range from 10 metres (urban areas) to 125 metres (isolated areas). This data was used in those geographic regions where no other data had been acquired by UNB and contained shoreline data for New Brunswick, Prince Edward Island, Nova Scotia and Quebec.
SNB Digital Property Map (DPM)	5	Without another available source, this database provided digital coordinates representing the inter-provincial boundaries between New Brunswick and the provinces of Nova Scotia and Quebec.

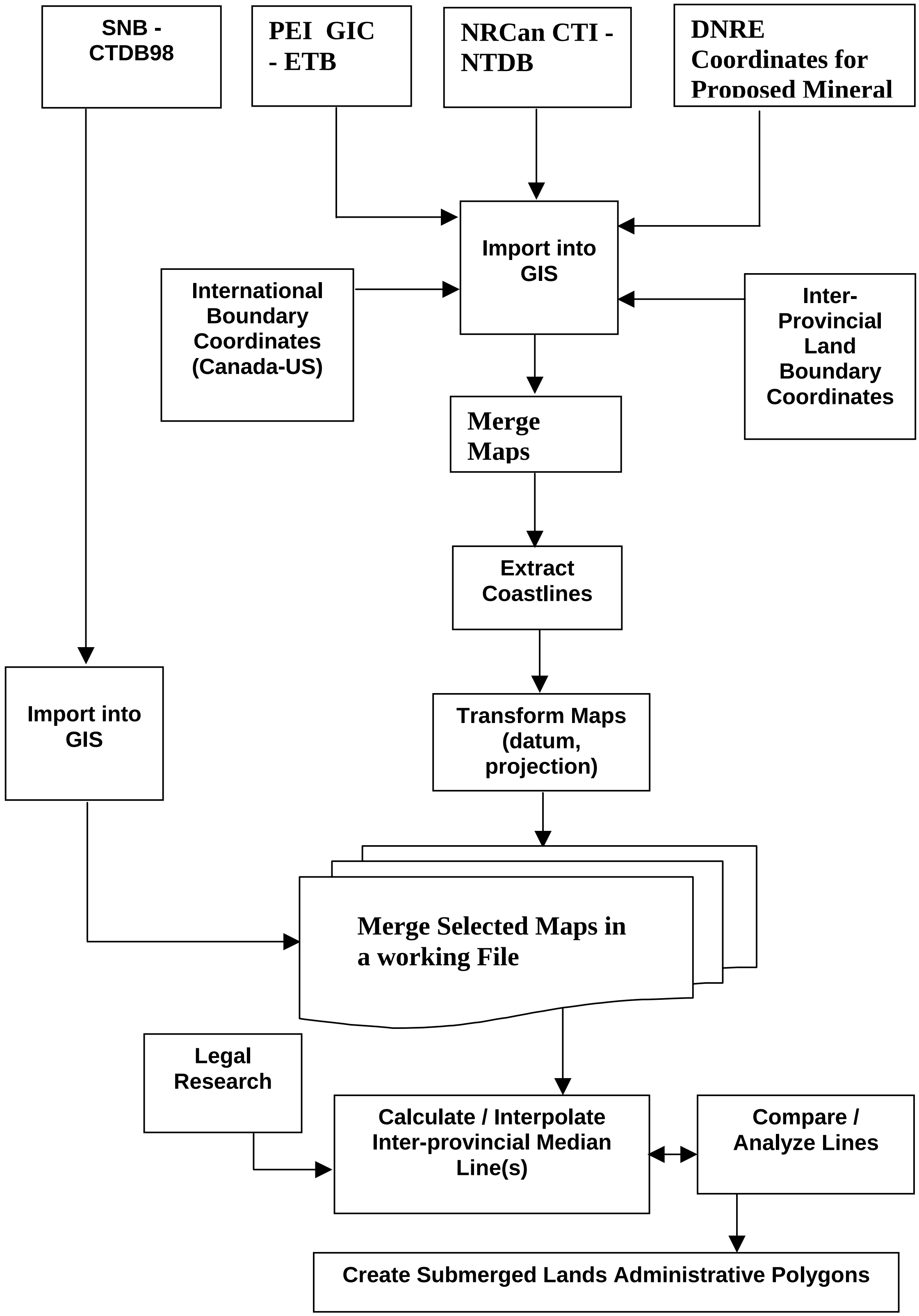

FIGURE 6.2 – THE GENERAL PROCESS OF CREATING NEW BRUNSWICK'S SUBMERGED LANDS POLYGONS

All spatial databases described in Table 6.1 were imported into a GIS. The relevant coastlines were then extracted and the extracted data transformed to the desired datum and projection. All the processed data were then merged into a working file according to the model described in Figure 6.1. Processing of the spatial files was accomplished with CARIS GIS (database importation, merging and transformation) and CARIS LOTS™ (calculation of median lines). The general steps taken to process the working file and produce the submerged lands polygons are as follows:

- Compare/analyze the imported DNRE mineral lines and the lines generated by using imported DNRE shore points;
- Analyze the inter-provincial boundaries from the SNB's Digital Property Map Database;
- Compare the imported coastline segments from the integrated sources;
- Generate median lines in the working file using integrated data;
- Generate the final median lines in the working file;
- Create the final submerged lands polygons.

In order to understand what impact the imported coastline segments were going to have on the final output of the delineation of the submerged lands, they were compared with one another It was fully understood at the outset that the types of comparisons possible were limited by the fact that there was no way of knowing if the line segments represented the same vertical datum (i.e., ordinary high water, ordinary low water etc.), or even if the same coastal features were mapped. Also, since there were data captured at more than one scale there were bound to be some generalizations in the smaller scale mapping exercise. The only "useful" comparisons and analysis were to determine which coastline was more seaward and possibly to determine some measure of distances between the resulting line segments.

Observation of the working file revealed that no one coastline was always more seaward than another. However, when comparing the CTDB98 and the NTDB it was found that the NTDB was more often more seaward. Metadata relating to the NTDB was grossly lacking at the time of acquisition of the files. However, personal communications with relevant federal government officials indicated that at least some of the NTDB coastlines were extracted from photographs using photogrammetry.

When comparing the NTDB and PEI's ETB it was found that the NTDB was more often seaward. As there is no obvious pattern to the manner or number of times in which the coastlines overlapped and intersected, no useful sample of distances between coastlines could be gained. Random measurements using CARIS GIS distance measurement tool revealed distance differences ranging from 0m to as much as approximately 530m. The great distance differences may be attributed to uncertainties in the vertical datum of some datasets, the topography of the area, and the generalized mapping of the datasets at 1:50000, although it proved difficult to ascertain certainty of these facts.

Median lines were created both by using coordinates imported from the DNRE files, and by using CARIS LOTS™ to process the integrated data. After all the various median lines were generated it was left to either choose one set of lines, or to create a set of lines being a composite of a number of lines. Figure 6.3 shows a sample of the various median lines generated.

There are distinct variations among the lines in terms of position and dimensions. This is due to a number of factors. These include the:

- number of baseline points chosen;
- positions of the chosen baseline points;
- shoreline data used to position the baseline points.

The median lines generated from the integrated data have more midpoints and therefore more closely reflect median lines reflective of the sinuosity of the coastlines used. The median lines that were generated from the integrated data (especially in the Bay of Saint Lawrence and the area of the mouth of the Tidnish River) were produced from baseline points that were not apparently used to produce the DNRE lines. For example, in the Bay of Saint Lawrence, baseline points on Anticosti Island and Isle de Madeleine were taken into consideration in constructing the median line from integrated data and this action is reflected in the significant difference with the DNRE line in that area.

For all the reasons outlined above, two criteria were developed to determine the choice of median points and line segments used to generate the final median lines. These criteria are:

- The median points generated from the integrated data would be of highest priority;
- Median points from the DNRE lines will be used only when they appear to represent median points between the median points as described at (a).

The immediately foregoing criteria were put into effect and a final set of combined median lines were created.

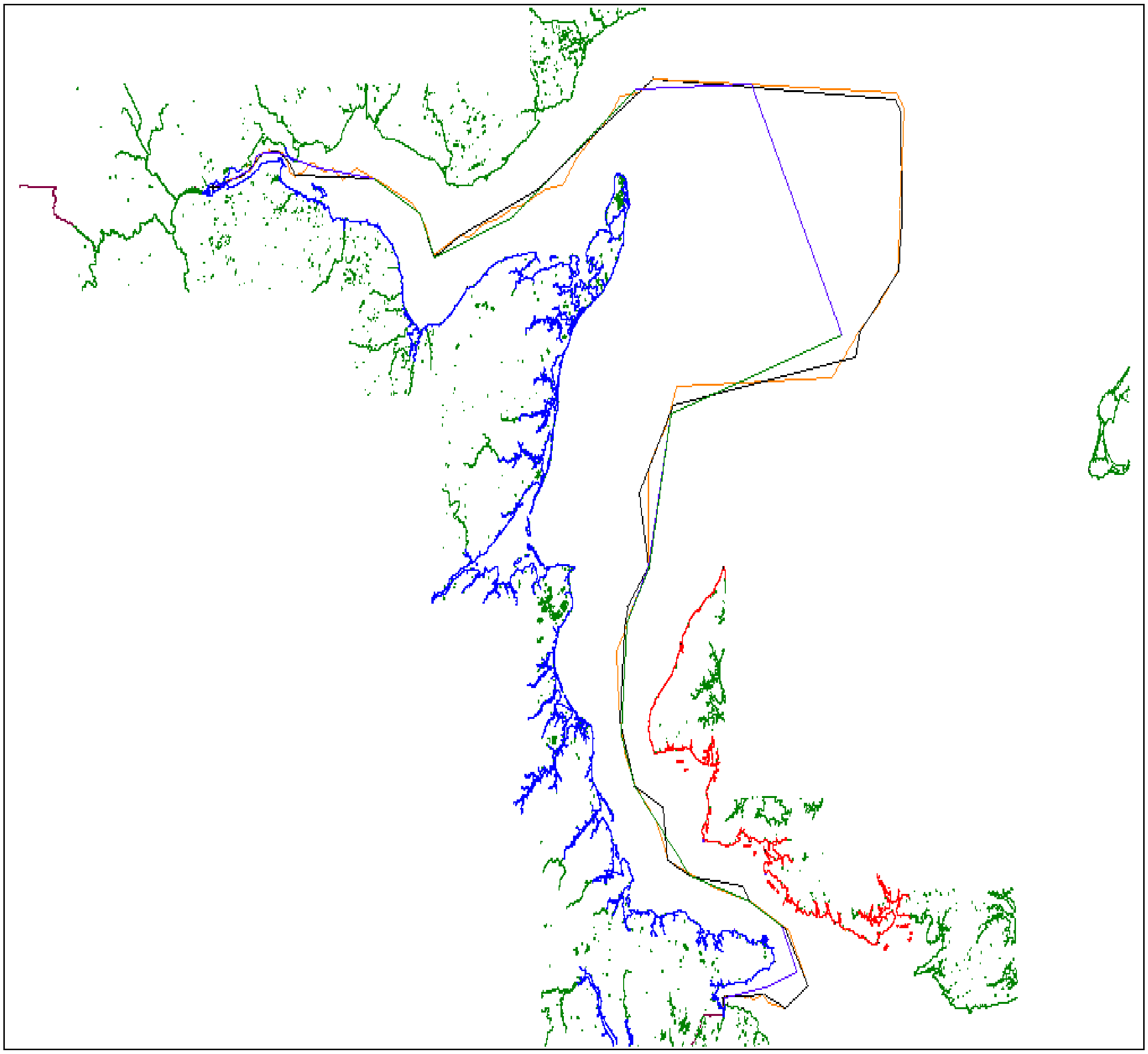

FIGURE 6.3 – A SAMPLE OF THE VARIOUS MEDIAN LINES

At this stage in the process, the final median lines were created. There remained the task of locating the relevant intersections of these lines with the appropriate line segments of the CTDB98 so as to enclose areas representative of New Brunswick's maximum limit of submerged lands. Steps, according to the criteria set out in above, and using CARIS GIS and LOTS™ where appropriate, were undertaken in order to produce the final polygons. The final product is graphically depicted in Figure 6.4.

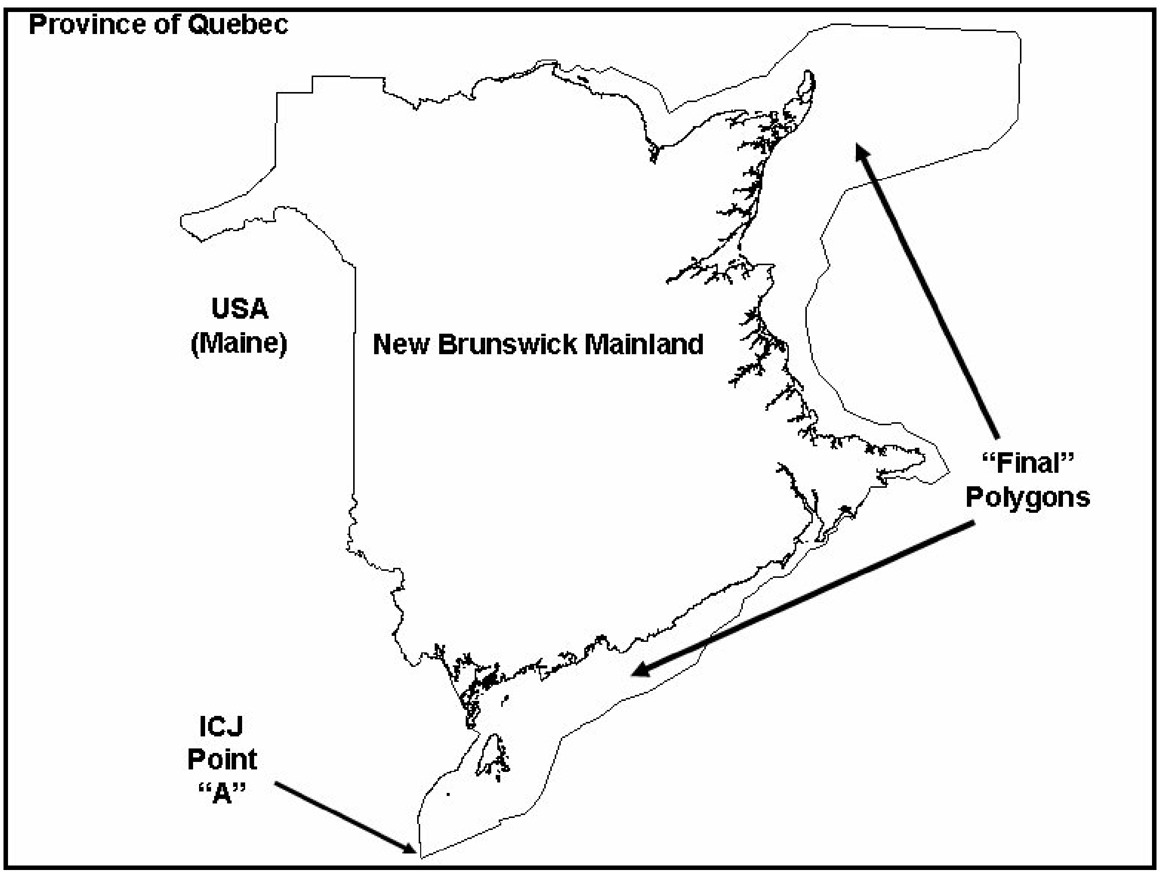

FIGURE 6.4 – THE FINAL POLYGONS

6.1.3 The findings

Technically, the model described in this chapter can satisfactorily allow for the production of polygons representative of New Brunswick's submerged lands from "best available data". However, the ideal situation would be to produce the polygons from data (whether integrated from various databases or from a database maintained by one entity) that all contain the same degree of positional accuracy, and preferably a high degree of positional accuracy. Also, if integrated databases are used it would be ideal if the same coastal features were represented. It would also be ideal if all physical features were represented for the geographic area represented by each database, and were referenced to a common datum.

It should be noted that any graphic representation of New Brunswick's submerged lands that were created in this research has no binding effect in law. Only binding legal agreements or decisions of a court of law can give that effect. The produced polygons serve only as the fulfillment of the user's (i.e., SNB's) need to have "a" digital representation of these boundaries. It is also pertinent to note that if different baseline points or digital data etc. were utilized, the dimensions of these boundaries would be different. Also, the polygons represent only one possible potential maximum dimension of New Brunswick's submerged lands.

There are a number of errors associated with the production of the final polygons. These include (among other things):

- Errors due to shoreline definition errors and vertical datum approximation errors;
- Errors introduced due to the original capture of the coordinates by owners of the data sources;

- Errors introduced due to the recording of the coordinates by the original surveyor;
- Errors introduced due to the digital re-recording of the coordinates for importation into the GIS that were obtained from hard copy;
- Errors related to importing the coordinates into the GIS;
- Errors related to transformation functions performed by the GIS;
- Errors related to the choice and number of baseline point locations;
- Errors related to accuracy of digitizing the baseline points.

With regard to the inter-provincial boundaries between New Brunswick and the contiguous provinces of Nova Scotia and Quebec, La Forest [1959 and 1973] offers the opinion that the New Brunswick-Quebec boundary in the Restigouche River runs along the center of the Restigouche River to the mouth of the Baie des Chaleurs (but encompassing the islands where the river narrows inland, in favor of New Brunswick). There are also a number of sources that describe the New Brunswick-Nova Scotia boundary. These include La Forest [1959 and 1973], March [1954] and correspondence held by DNRE [Noël, 1991]. March [1954] contains a metes and bounds description of the inter-provincial boundary as agreed to by both New Brunswick and Nova Scotia. The sources indicate that the boundary generally runs the middle (between banks) of the Tidnish and Missequash rivers, and the Bay of Fundy. There is also legislation relating to the description of the New Brunswick – Nova Scotia inter-provincial boundaries[17]. The ideal governance scenario is to maintain spatial information that adequately represents

[17] *An Act elating to the Boundary Line between the Provinces of New Brunswick and Nova Scotia*, [1859], and *An Act to explain an Act entitled An Act elating to the Boundary Line between the Provinces of New Brunswick and Nova Scotia*, [1862]

stakeholders' perception of reality, as well as demonstrate conformity with legal definitions of the boundaries.

SNB maintains a number of spatial databases including the CTDB98 (coastlines) and the DPM (inter-provincial boundaries) that were used in this case study. When the DPM inter-provincial boundaries were integrated with the CTDB98, the New Brunswick-Quebec inter-provincial boundary segments apparently reflected the understanding gained from La Forest [1959 and 1973]. This was not the case with the New Brunswick-Nova Scotia provincial boundary segments that, in a number of instances, intersected with the CTDB98 segments representing the banks of the Missequash River instead of altogether being between the segments representing the banks.

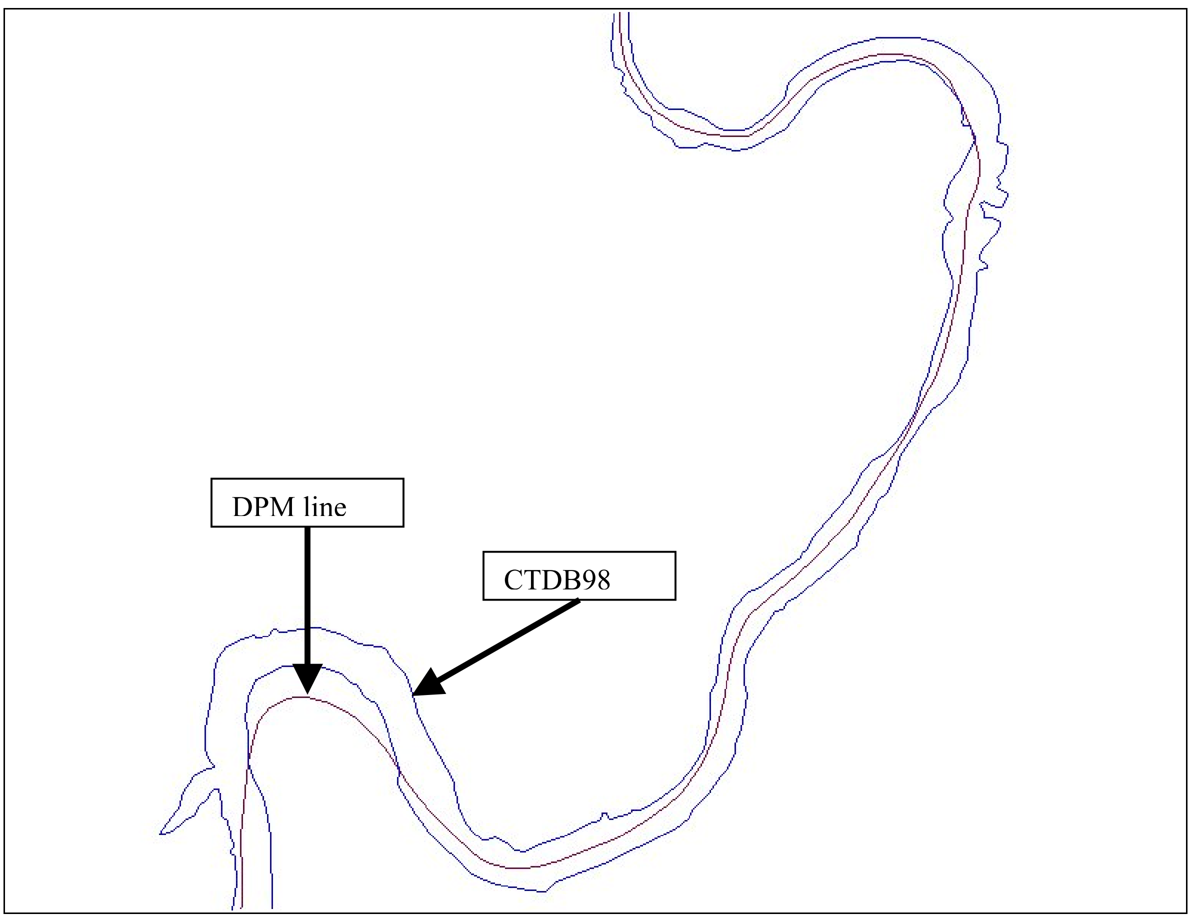

FIGURE 6.5 – THE DPM LINES INTERSECTING THE CTDB98 LINES FOR THE MISSEQUASH RIVER

All of the foregoing was taken into consideration when editing the digital data representing the inter-provincial boundaries as part of the process of creating the final submerged lands polygons. The outcome of this process, however, is that these digital representations of the inter-provincial boundaries are approximations. Furthermore, any digital representation of a boundary is only a model that can support further modeling, and management and administrative decision-making. Ground truthing always takes precedence [Lamden and de Rijcke, 1985, 1989 and 1996]. However, Chapter 4 (Section 4.2) referred to the fact that imprecise boundaries or boundary information are not always a hindrance to good governance.

Chapter 3 (Section 3.4.2) underscores the idea that stakeholders with common interests should cooperate, collaborate, or integrate. The federal government and the provinces of New Brunswick, Nova Scotia and Quebec all have an interest in the inter-provincial land boundaries between New Brunswick and Nova Scotia, and between New Brunswick and Quebec. Decisions have been handed down by tribunals and in law that indicate the spatial dimensions of these boundaries, and the Federal government of Canada along with the named provincial governments should all maintain the same digital representations of these boundaries. The same situation applies to international boundaries that form part of the spatial extent of provinces.

Explicit information sharing between these stakeholder entities would at least facilitate the desirable situation where stakeholders have access to the best quality data in which they all have an interest, but are not necessarily the primary collectors. The fact that there is not yet an *explicit* governance mechanism to facilitate the updating of all these stakeholders' databases when one party comes into possession of more accurate digital data is a governance problem and a source of duplication of effort and desynchronized databases. This type of governance problem will continue until all stakeholders cease to maintain data only according to its narrow mandate and realize that they share common objectives.

In terms of the governance of Canadian marine spaces, this case study emphasizes the need for coordinated and more accurate surveying of marine boundaries, especially coastline surveys. Coastal boundaries support private and public rights, and the exercise of Federal and Provincial jurisdiction and administrative powers. A more accurate delineation of marine jurisdictional and administrative boundaries will aid in the achievement of a jurisdiction's social, economic and political objectives, and also will aid in the amelioration of disputes should the occasion for the formal division of resources arise. Additionally, there is definitely the need for appropriate metadata related to coastline data. In many instances it was impossible to obtain information on how the coastline data was collected and processed, among other things.

6.2 Case Study 2: The Proposed Musquash Marine Protected Area

This case study is based upon a number of research studies currently being conducted by graduate students studying in the Department of Geodesy and Geomatics Engineering, University of New Brunswick. The research includes using ecological features as boundaries to support the governance of marine spaces[18], and the design of a marine cadastre for marine protected areas[19].

The Musquash Estuary (Figure 6.6), hereinafter simply referred to as "Musquash", is located 20 kilometres west of the city of Saint John, New Brunswick. It is a micro tidal estuary containing nesting areas for seagulls, cormorants, ducks and Canada geese as well as a large variety of marine and marsh flora. The estuary supports many species of finfish, lobster, starfish, and mussels among others. The estuary is still in a relative pristine condition and considering the value of the area to the health and productivity of marine life in the Bay of Fundy a proposal has been made to declare Musquash a Marine Protected Area (MPA) [Conservation Council of New Brunswick, 2000a; Department of Fisheries and Oceans, 2000; *Oceans Act*, 1996].

[18] Ted Byrne is a Master of Science in Engineering Candidate in the Department of Geodesy and Geomatics Engineering at the University of New Brunswick. He is currently researching the possibility of using ecological features as boundaries to support the governance of marine spaces.

[19] Sam Ng'ang'a is a Ph.D. Candidate in the Department of Geodesy and Geomatics Engineering at the University of New Brunswick. He is currently researching the design of a marine cadastre for marine protected areas.

FIGURE 6.6 – THE MUSQUASH ESTUARY (TED BYRNE PHOTO)

The effort to have Musquash become an MPA is a collaborative one, and a reasonably good example of collaborative governance with the active inclusion of many stakeholders including the Department of Fisheries and Oceans Canada, the Musquash Marine Protected Areas Planning Group, the Conservation Council of New Brunswick, fisherman associations, First Nation groups, community members among others [Conservation Council of New Brunswick, 2000b].

However, from a boundary point of view, the aim of declaring Musquash as an MPA in order to protect its resources might be compromised. The outer boundary of the Musquash MPA is in part described as "… all saltmarsh, estuary and mudflats below the high water mark from the head of the tide to a line between Gooseberry Island and

Musquash Head including a special scallop zone" [Singh et al, 2000; Ng'ang'a and Nichols, 2002]. This is demonstrated in Figure 6.7.

A multibeam survey conducted by the Ocean Mapping Group in the Department of Geodesy and Geomatics Engineering, University of New Brunswick revealed sand waves that might be evidence of tidal flushing actions in and out of the estuary (Figure 6.8). The outer edges of the sand waves were outside of the predefined outer boundary of Musquash. If the sand waves are indeed indicative of tidal flushing actions in and out of the estuary then the outer boundary as defined may not be adequate to protect the proposed MPA from possible pollutants deposited within the pathway of the tidal flushes.

FIGURE 6.7 – THE MUSQUASH ESTUARY SHOWING THE OUTER BOUNDARY
(From Conservation Council of New Brunswick [2000c])

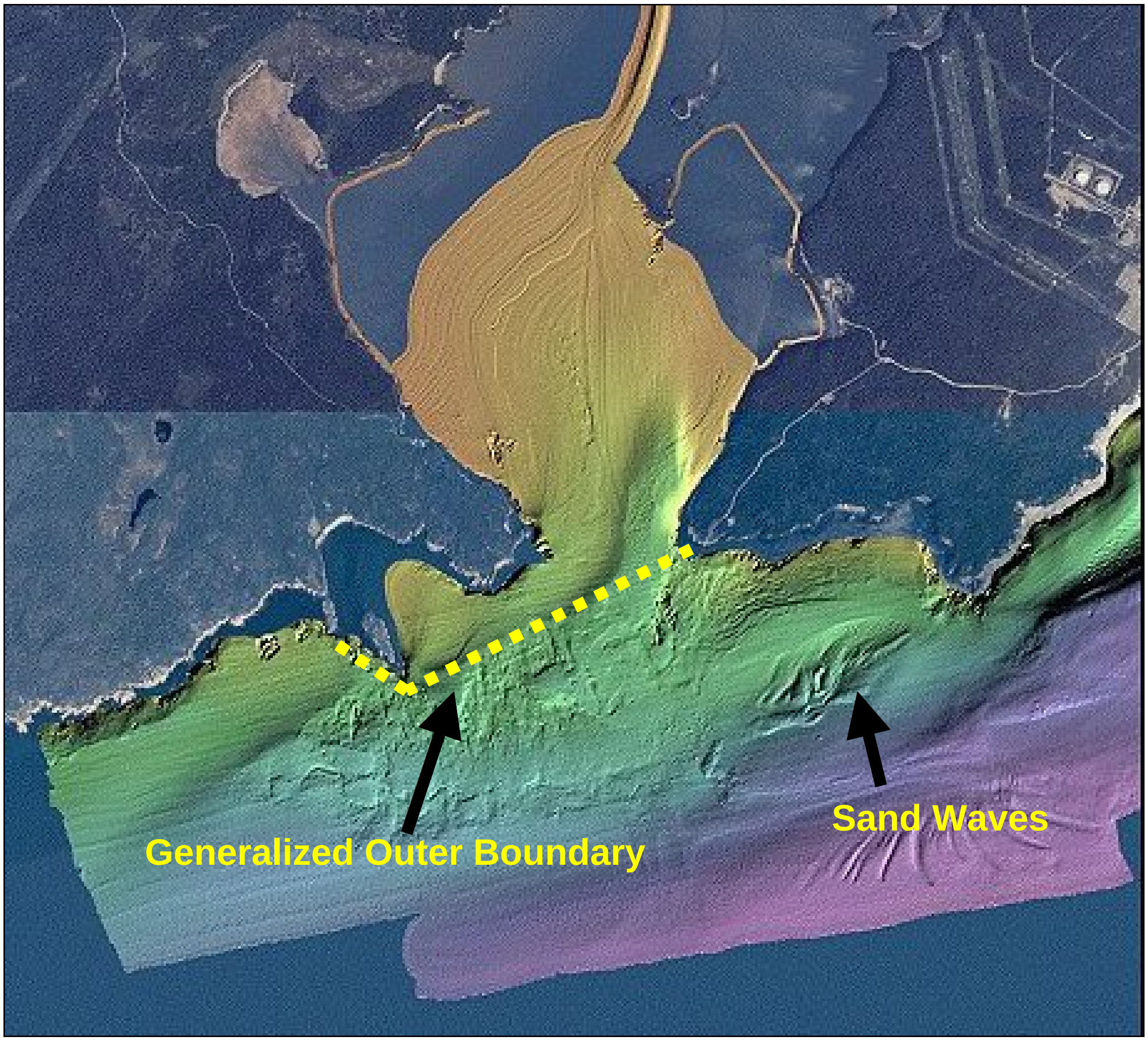

FIGURE 6.8 – THE MUSQUASH ESTUARY SHOWING THE OUTER BOUNDARY, AND SAND WAVES
(The Image is a composite of multibeam survey output [Ocean Mapping Group] and an orthophoto [Service New Brunswick])

The point being made here is that marine boundaries, like any other type of spatial boundary, are associated with specific functions and an inappropriately delineated boundary might not serve the function for which it was intended. Here also is an example of a federal department (i.e., DFO) attempting to define a boundary that neither represents federal jurisdiction nor property rights. However, if a marine boundary is adequately defined and delineated, it is an extremely valuable tool to support the good governance of marine spaces. Also, the use of ecological features to define and delineate marine boundaries is a viable option. Later surveys revealed tidal patterns that implied further flushing actions seaward of the mouth of the estuary. The Ocean Maping Group (OMG) suggested the creation of a buffer zone to mitigate the effects of the tidal actions on the estuary [OMG, 2003]. There were mixed reactions from stakeholders and the suggestion was not adopted.

6.3 Case Study 3: New Brunswick Coastal Protection Policy

In 2002 the New Brunswick Environment and Local Government formulated a Coastal Areas Protection Policy (NBCPP) [New Brunswick Environment and Local Government [2002]. The policy affects approximately 60 % of New Brunswick's population that resides within 50 km of New Brunswick's coast. The policy is applicable to approximately 5,501 km of coastline. The aim of the policy is to [New Brunswick Environment and Local Government [2002]: (1) mitigate threats from storm surges and flooding; (2) protect wetlands from deleterious factors; and (3) maintain sustainable fisheries and tourism. This chapter will deal only with some of the issues related to the policy.

The policy divides the coastal zone into 3 zones. They are:

- Zone A (Figure 6.9) – determined to be between Higher High Water Large Tide (HHWLT) and Lower Low Water Large Tide (LLWLT);
- Zone B – lands immediately adjacent to coastal features and determined to be 30 m landward from the inner edge of Zone A;
- Zone C - extending landward from the inner edge of Zone B.

The discussions herein will deal only with Zones A and B.

6.3.1 Boundary Problems with Zone A and B

The main boundary problem with Zones A and B is the use of HHWLT LLWLT as the definition of upper and lower limits. HHWLT is the average of the highest high waters, one from each of 19 years of observations. This boundary is very difficult to demarcate, and this difficulty has implications on the efficacy of the policy. For example, if an upland owner is unable to know the exact position of the HHWLT it is possible to commit an infraction against the policy. This situation also poses the risk of negating the efficacy of the policy if administrators are also unable to determine the points on ground where the policy regulations are to take effect. The use of HHWLT in this instance is an example of the inappropriate use of a boundary to effect good coastal governance.

The 30 m buffer associated with Zone B affects many socioeconomic activities. There are official limitations of residential and commercial activities within this zone. However, there are weaknesses with much of the limitations defined. For instance, hotels, motels, and multi-family homes are not allowed in Zones A or B, but many of these types of structures already exists in the zones and it is neither socially, politically, nor economically feasible to request removal of these structures. Additionally, since the policy is not yet fully in force, it is possible that many persons could rush to build structures that would normally contravene the rules of the policy.

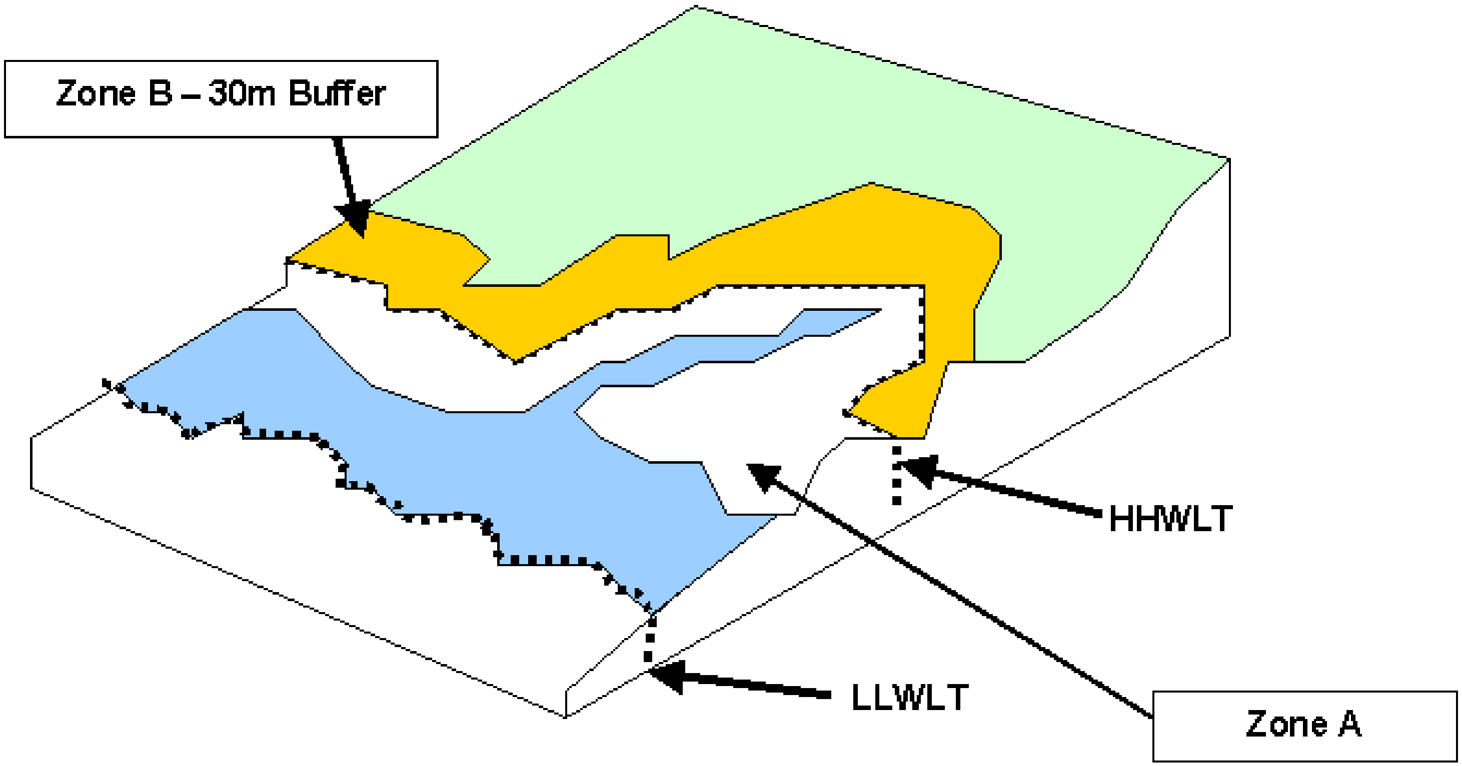

FIGURE 6.9 - NEW BRUNSWICK'S COASTAL PROTECTION POLICY ZONE A
(After New Brunswick Environment and Local Government, 2002)

Also, there are many exemptions provided for in the policy that in effect negates its effectiveness. For example commercial activities are not permitted within the coastal zone unless it is "coastal location essential". There is no guarantee that these "coastal location essential" commercial activities will not adversely affect the coastal zone. Another example relates to the fact that erosion control structures are permitted in Zone A, but it is unclear whether technical details on the construction of these structures are offered to residents within the policy areas to minimize the deleterious effects of ill-construction. Figure 6.10 shows one of the ill-effects of poorly constructed erosion control structures.

A number of points can be made from the foregoing that emphasizes points made throughout this thesis. These include (among other things):

- Boundaries are important factors in the good governance of coastal and marine spaces;
- An ill-conceived boundary can negatively affect the good governance of coastal and marine spaces;
- Governance instruments such as coastal policies must effectively balance social, economic, political, and environmental concerns.

FIGURE 6.10 – POORLY CONSTRUCTED EROSION CONTROL STRUCTURE

6.4 Lesson Learned

A review of the case studies discussed in this chapter will reveal some salient points in terms of general good governance concepts and principles, and also with regard to the quality of boundary definition and delimitation to support the governance of marine spaces. The points with regard to general good governance concepts and principles are as follows:

a. ***New forms of governance are beneficial:*** As described in the Musquash case study, collaborative, cooperative, and integrative governance is beneficial to achieve acceptable and suitable multi-stakeholder objectives. Stakeholders must however first recognize that they share common objectives in order for them to cooperate. The negative example of this need for cooperation, collaboration etc. was alluded to in the first case study in that both Nova Scotia and New Brunswick maintain spatial data relative to the same spatial extent, but both maintain separate databases that reflect duplication of effort that also results in desynchronized databases of varying quality. The result is a zone of uncertainty that will probably remain until a legal issue is raised.

b. ***Organizational structure can affect data quality and therefore affect governance:*** The fact that Service New Brunswick's spatial database, in terms of inter-provincial boundaries, did not model the legal definition of those boundaries is indicative of the possible non-communication of that legal knowledge (barring operator error) within the hierarchy of the organization. There is possibly not a shared mental map of the organization's view of the real world among all its employees or among different provincial government departments. This is a problem of the organizational structure, in terms of inter-organizational communications. As stated by Trebilcock [1999]:

> First it is clear that governance structures both in the private and the public sectors have become one of the most important public policy issues of our age. Organizational or institutional design enormously influences the performance of both sectors.

c. ***The quality of a governance instrument affects the quality of governance:*** The case of the New Brunswick Coastal Protection Policy highlights the fact that quality of governance instruments such as that policy affects the quality of governance intended. Loopholes, negating exemptions and vague terminologies can provide opportunity to make policies ineffective.

Many of the points made in this chapter underscore earlier points made in this thesis with regard to the quality of boundary delimitation to support the governance of marine spaces. These points include:

a. ***Delineated boundaries should closely model legal reality:*** Boundaries on the ground and boundary information in spatial databases should accurately reflect the legal definitions of those boundaries. Since delineated boundaries are models of reality, the model should as closely as possible reflect reality. Although this exercise is expensive it can be accomplished incrementally over time, as long as the objective is being actively pursued. Boundary information that in this manner is up-to-date, accurate, and complete enhances the efficiency of the governance decision-making process, ensures that adequate information is added to the pursuit of governance objectives, and supports meeting the governance criteria of efficiency, accountability, and preservation of identity.

b. ***Boundaries have specific purposes or functions:*** One function is related to the class of the boundary, i.e. whether it is a sovereign, jurisdictional or other class of boundary. Another function is as it supports social, economic, environmental, or political objectives. As was shown in the second case study of Musquash, a marine boundary that is adequately defined and delineated is an extremely valuable tool to support the good governance of marine spaces.

c. ***A boundary may have legal effect in terms of the use for which it was created:*** In the first case study, boundaries (i.e., the DNRE mineral lines) were created in 1964/68 with the purpose of dividing the mineral resources of submerged lands between the Atlantic Provinces of Canada. The research reported here that created a possible maximum spatial extent of New Brunswick's marine administrative area produced lines that differed in dimensions from the DNRE lines. This, however, is not the main issue. The issue is that the DNRE lines were created for the purpose of dividing mineral resources in submerged lands (i.e., they were special purpose lines) while the lines created in the latter exercise have the objective of enclosing a possible maximum extent of New Brunswick's administrative area. While this distinction may seem small, the legal effect of the purpose for which the lines were created is significant as can be seen in the delineation of the revenue-sharing line between Newfoundland and Nova Scotia as determined by the La Forest Tribunal [Arbitration Tribunal, Nova Scotia-Newfoundland Dispute, [2002].

d. ***Higher quality boundary information is beneficial to good governance:*** There is a need for Canada to invest in the acquisition of coastline spatial data that is of higher quality than is currently available and to have available documented metadata on how various coastlines are created. This was made evident in the disparity among the databases that were integrated to produce the "final" polygons referred to in the first case study. It was apparent that coastlines were inconsistently mapped, and additionally some databases were lacking in adequate metadata. Also data collection on some of the databases was done many years ago and, considering the ambulatory nature of coastlines the status of those databases, cannot be described as anything else than out of date. Depending on the use to which these databases are put good governance of Canada's marine spaces (especially if decisions are to be based on these models) can be negatively affected.

e. ***The choice of a boundary can affect the quality of governance:*** The choice of HHWLT as a boundary in the New Brunswick Coastal Protection Policy can have undermining effects on the objectives of that policy. If a boundary is difficult to locate, then it is reasonable to assume that it is also sometimes difficult to implement the rules associated with the spatial extent enclosed by that boundary.

Table 6.2 summarizes the major point made in this chapter.

Table 6.2
Summary of Major Points in the Chapter 6

Collaborative, cooperative and integrative governance are good alternative forms of governance (instead or hierarchical governance). Stakeholders with interests in the same marine spaces must recognize the benefit of collaboration, cooperation or integration of information resources.
Organizational, institutional structure and inter-governmental cooperation has great impact upon the quality of governance. An organizational structure should be designed so as to facilitate the communication of relevant information, including boundary information, to all levels of operation.
Delimited marine boundaries and spatial databases containing marine boundary data should reflect the legal definition of those boundaries.
All boundaries have specific classes of functions and their contribution to governance is highly dependent upon the quality of their delimitation.
The choice of a boundary type can affect the quality of governance over the area enclosed by that boundary.
Boundaries have specific purposes or functions. They may have legal effect in terms of the use for which they were created. High quality boundary information is beneficial to the good governance of marine spaces.
There is definitely the need for Canada to invest in the acquisition of coastline spatial data that is of higher quality (i.e.. more up-to-date, accurate etc.) than is currently available.
There is need for appropriate metadata associated with coastline data at all levels.
The quality of a governance instrument (e.g., a coastal policy) affects the quality of governance.

CHAPTER 7

DESIGN OF BOUNDARY INFORMATION FRAMEWORK MODELS FOR GOOD GOVERNANCE OF MARINE SPACES

7.1 Introduction

This chapter addresses the main objectives of this thesis (i.e. the boundary requirements necessary to support the good governance of marine spaces). It is accepted herein that socio-cultural, economic, political and environmental requirements are critical governance requirements for a jurisdiction. The focus of this Chapter is primarily Canada, but the boundary information framework designs presented in this chapter are expected to be flexible enough to be applicable to other international jurisdictions. The question of concern is “What characteristics of marine boundaries are required to give adequate support to the good governance of marine spaces?”

All the appropriate points brought out in the previous chapters, along with the results of a small sample survey conducted by the author, are utilized to address the question, and to design the boundary information frameworks. The approach to the design is from a functional perspective, i.e., from the perspective of why stakeholders in the governance of marine spaces do what they do, what tasks they perform, and consequently what is required of marine boundaries and marine boundary information for them to do those tasks to the benefit of good governance.

This chapter will first present boundary and boundary information requirements relevant to the governance objectives in marine spaces (i.e., the political, economic, socio-cultural and environmental objectives). Then, designs of the boundary information frameworks will be presented as a series of cross-referenced tables. Thereafter the strengths and weaknesses of the designs will be discussed.

7.2 Marine Boundary Requirements for Governance Objectives in Marine Spaces

Chapter 3 stipulated that government is the most pervasive player in governance. In Chapter 2 five political requirements relevant to the marine environment were identified. These requirements included:

- The security of its sovereign boundaries and the settlement of disputes over territorial marine spaces;
- The maintenance of socio-economic and political relations with other states including:
  - The control of cross-border trading in goods and services;
  - The application of custom duties and trading agreements;
  - The application of diplomatic immunity;
  - The application of immigration rules and regulations.
- The enforcement of its jurisdictional powers;
- The enforcement of laws and policies to facilitate economic and socio-cultural activities, and the management and protection of its marine natural resources;
- The exercise of its administrative powers and the delivery of appropriate services to its citizens in order to facilitate economic and socio-cultural activities, and the management and protection of its marine natural resources.

In Chapter 3 it was also determined that, although the social, economic and political sectors impact upon one another, all activities require political sanction, at least in Western societies. The polity is even an integral part of environmental protection through the implementation of laws and policies. Therefore, as in Chapter 3, the discussions in this chapter on boundary and boundary information requirements will be presented from the perspective of government as the most pervasive player in the governance of marine spaces.

7.2.1 Marine Boundary Requirements for the Protection of Sovereign Boundaries

Although Canada has ratified the United Nations convention on the Law of the Sea, this section will make reference to the *Oceans Act* [1996] as the basis for Canadian sovereignty in marine spaces. Under the *Oceans Act* [1996] Canada's territorial sea extends 12 nautical miles (nm) seaward from established baselines, and forms part of Canada. The laws of Canada apply within the territorial sea in the same manner as if this spatial extent was the Canadian exposed landmass. Additionally the *Oceans* Act [1996] establishes a Contiguous Zone (CZ) that extends 24 nm from established baselines of the Territorial Sea. Within the CZ Canada can take action to prevent or deal with infractions of Canadian fiscal, customs, sanitary and immigration laws. The *Oceans Act* [1996] also establishes an Exclusive Economic Zone (EEZ) extending 200 nm seaward from the Territorial Sea baselines, wherein the country has the right to exploit and conserve all natural resources, as well as exercise jurisdictional powers to protect the marine environment, regulate scientific research and control offshore structures. The limits of the EEZ coincide with a previously established Fishing Zone created to manage fisheries activities. A Continental Shelf, being understood to be subject to Canadian sovereign rights, has also been declared under The *Oceans Act* [1996]. Under the Act, Canada has the sovereign right to exploit non-living resources on the seabed and in the subsoil, as well as similar rights to sedentary species on the ocean floor with some revenue sharing provisions under UNCLOS [*Oceans Act*, 1996; Nichols, Dobbin, Sutherland et al, 2001].

These limits created under the *Oceans Act* [1996] affect sovereign, jurisdictional and administrative issues. Discussions in this chapter that refers to the CZ or EEZ refer to those objects defined under the *Oceans Act* [1996] unless otherwise specified.

Based on the foregoing there are a number of sovereign marine boundaries that Canada has to consider. The first one is the outer limits of the Territorial Sea that encompass a marine spatial extent over which Canada has the right to exercise the full power of its sovereignty. Included in this spatial extent are the surface of the water column, the water column itself, the seabed, and the subsoil. Among the other sovereign boundaries are the limits of the CZ, EEZ and continental shelf, but there are limits on the powers of Canada. Within the limits of the CZ all nations have the right of innocent passage, while within the limits of the EEZ and continental shelf all nations have the right of navigation and the right to construct pipelines and cables [*Oceans Act,* 1996].

Protecting and enforcing these sovereign marine boundaries require knowledge of their positions in the marine environment. Determining the positions of these limits also depend on knowledge of the positions representing the intersection of low water with the coast (as prescribed by the *Oceans Act* [1996]) or knowledge of the positions of baselines from which the seaward limits are measured [Monahan, Ng'ang'a et al, 1999]. In Canada baseline points for straight baselines have in the past been defined with reference to the North American Datum of 1927 (NAD27) that has been replaced by the North American Datum of 1983, Canadian Spatial Reference System (NAD83 (CSRS)). No changes have been made, however, to the Canadian baseline points in this regard [Nichols and Monahan, 1999; Craymer, Ferland and Snay, 1999].

International bilateral boundaries are sovereign boundaries. Canada shares ocean spaces with other countries by means of international bilateral boundaries. Countries involved are the U.S., Denmark and France and potentially in the Arctic, the Russian Federation. In the case of these boundaries there is the requirement to have agreement on the position of the boundaries by the parties involved. Positional accuracy with relation to international bilateral boundaries may be desirable for the governance of international waters but there are instances where countries have peaceably coexisted without international marine boundaries being accurately defined. This is the case, for example, between Canada and the U.S. in relation to the area around Machias Seal Island that is claimed by both countries. To date the boundary between the two countries has been left undefined without any real ill effect upon the relationship between the two States [Gulf of Maine times, 1997]. Therefore the protection of international bilateral boundaries and any zones of uncertainty is in fact dependent upon the relationships existing among nations.

The adequacy of baseline definitions might not apply to international bilateral boundaries in some instances. The adequacy of datum definitions for the locating of datum intersections with the coastlines of the States, and up-to-date surveys of coastlines involved are very important if the bilateral boundary is the result of calculations from opposite coastlines [Monahan, Ng'ang'a et al, 1999].

Additionally, in the deep offshore, the most practical method of delimiting a boundary is by way of coordinates. The coordinates should be referenced to the NAD83 (CSRS) datum in the case of Canada.

From the foregoing it can be seen that, for the political objective of protecting sovereign borders to be achieved, the boundaries themselves have certain requirements that have to be met to varying degrees (Table 7.1). These include:

- Certainty of legal definition;
- Conformity to legal definition;
- Agreement by parties to the boundary;
- Definition by coordinates where appropriate;
- Adequacy of baseline definitions;
- Adequacy of tidal datum definitions;
- Up-to-date coastline surveys;
- Accuracy of positioning.

Observation of Table 7.1 reveals that all identified boundaries ought to meet the criteria relevant to boundary requirements for the protection of sovereign borders, with the exception of the criteria "agreement by parties to the boundary". It is left up to nations to determine baselines according to acceptable criteria (i.e. straight baselines or baselines that follow the sinuosity of coastlines). Additionally, the other listed boundaries (with the exception of international bilateral boundaries and coastlines) are specific distances from established baselines and may be unilaterally defined. Specific to international bilateral boundaries the requirement of "adequacy of baseline definition" is only required if appropriate. As stated previously, with regard to international bilateral boundaries, accuracy of positioning is desirable but the absence of positional accuracy does not impede the governance of nations in some instances.

Table 7.1
Marine Boundary Requirements for Protection of Sovereign Borders

Boundary	Certainty of Legal Definition	Conformity to Legal Definition	Adequacy of Baseline Definition	Definition by Coordinates	Adequacy of Tidal Datum Definition	Accuracy of Positioning	Up-to-Date Coastline Survey	Agreement by parties to the Boundary
International (bilateral)	Yes	Yes	Where appropriate	Yes	Yes	Desirable	Yes	Yes
Baselines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Territorial Sea	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Contiguous Zone	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
EEZ	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Continental Shelf	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coastlines	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

7.2.2 Marine Boundary Requirements to Support International Political and Socio-Economic Relationships

The maintenance of socio-economic relations with other sovereign States is an important political task. These relationships are important both to the polity (for example, to support socio-economic activities abroad and to receive the goods and services it needs to carry out its duties) and to the citizens of a State as they pursue their socio-economic activities. The polity also has the responsibility to protect the socio-economic welfare of its citizens and does this by (among other things):

- The control of cross-border trading in goods and services;
- The application of custom duties and trading agreements;
- The application of immigration rules and regulations.

The activities listed above and those implied by the discussion in the previous paragraph create responsibilities impacting upon sovereignty, jurisdiction, and administration. Also because some of the activities relate to the transportation of people, goods, and services across the marine environment, navigation is affected. In Canada the relevant responsibilities fall to the federal government and its agencies.

The control of cross-border trading in goods and services, the application of custom duties and trading agreements, and the application of immigration rules and regulations require that the position of international boundaries and custom limits be known to some degree of accuracy. The application of jurisdictional rules and regulations, and administrative responsibilities also require that the relevant boundaries reflect certainty of legal definitions and conform to legal definitions to ensure that States are not contravening the rights of persons. In order to avoid hazards to navigation the relevant boundaries such as those relating to shipping lanes or routing measures have to be accurate, at least to at least a few metres. Although there are many boundaries and potential boundaries related to navigation this section will only explicitly refer to boundaries related to routing. The assumption is that all boundaries related to navigation should meet the above stated requirements. The arguments in the previous section relating to defining the boundaries by coordinates also apply.

Examples of relevant Canadian marine boundaries and their requirements are listed in Table 7.2. The table's usefulness (since all listed boundaries apparently must meet all listed requirements) is in the identification of the requirements needed to support international political and socioeconomic relationships.

Table 7.2
Marine Boundary Requirements to Support International Political and Socioeconomic Relationships

Boundary	**Certainty of Legal Definition**	**Conformity to Legal Definition**	**Accuracy of Positioning**	**Definition by Coordinates**
International (bilateral)	Yes	Yes	Yes	Yes
Customs limit	Yes	Yes	Yes	Yes
Boundaries of routing measures (Navigation)	Yes	Yes	Yes	Yes
Territorial Sea (Oceans Act)	Yes	Yes	Yes	Yes
Contiguous Zone (Oceans Act)	Yes	Yes	Yes	Yes
Territorial Sea (UNCLOS)	Yes	Yes	Yes	Yes
Contiguous Zone (UNCLOS)	Yes	Yes	Yes	Yes

7.2.3 Marine Boundary Requirements to Support the Enforcement of Jurisdictional Powers

In Canada, which is a federal state, jurisdiction has federal and provincial dimensions. Federal-provincial jurisdiction has been a historical issue, especially in the marine environment [La Forest, 1973; Lamden and de Rijcke, 1996; Nichols and Monahan, 1999; Cockburn, 2002]. Supporting this point, Jackson [1976] wrote: "The question of jurisdiction — competing, conflicting, concurrent or obscure — runs as a thread through Canadian history since 1867" and also "the question of jurisdiction is something of a Canadian obsession, probably much more than the United States, though possibly not more so than in Australia."

The question of which entity, federal or provincial, has jurisdiction over particular spatial extents is directly tied to marine boundaries. However, in Canada the issue of who has jurisdiction over certain marine spatial extents has to date remained a matter of jurisdictional uncertainty. Fortunately the long tradition of federal-provincial "accommodation and compromise" [Jackson, 1976] has been the catalyst for generally amicable solutions. This is an example of collaborative and cooperative governance and can be used to support the argument that precise boundaries are not always necessary to meet governance objectives [Nichols, Monahan and Sutherland, 2001].

The issues related to federal or provincial jurisdiction over Canadian marine spaces, and by implication the relevant marine boundaries, is affected by the common law, the Canadian Constitution, the definition of what are Canada Lands, and the history of Canadian Federation [*The Constitution Act*, 1876; *Canada Lands Surveys Act,* 1985;

Oceans Act, 1996; La Forest, 1959; Nichols, Dobbin, Sutherland et al, 2001]. The Constitution prescribes certain "Classes of Subjects" [*The Constitution Act*, 1876] over which the federal and provincial Crowns can make laws and have jurisdiction, but at the time of drafting (i.e., in 1867 as the *British North American Act*) the issue of submerged lands offshore was not perceived except for Public Harbours and inter-provincial transport [Raymond, 2002]. The *Canada Lands Surveys Act* [1985] defines "Canada Lands", which falls under federal jurisdiction, but the definition is vague in terms of where Canada Lands begin on the coast in terms of the land-sea intersection. Also, according to Nichols, Dobbin, Sutherland *et al* [2001], the Exclusive Economic Zone and the Contiguous Zone as defined by UNCLOS may not be a part of Canada Lands.

The common law tradition holds that provincial ownership applies to land between the OHWM and low water except if expressly transferred to the federal Crown (e.g. public harbours) [La Forest, 1973] but certain provinces, e.g., New Brunswick, claim jurisdiction over submerged lands below low water by virtue of historical rights before Confederation. Even after deliberating the merits of the Constitution and the common law, eminent legal thinkers such as La Forest [1973] concluded that the "ownership of the subsoil of the territorial sea off the Atlantic Provinces cannot … be regarded as settled." However, Canada has been able to overcome the immediate problems related to federal-provincial jurisdiction via, for example, royalty agreements, accords, and agreements to devolve responsibilities whereby provinces govern specific activities (e.g., aquaculture except in Prince Edward Island) through administrative powers divested to them from the federal Crown [Nichols and Monahan, 1999; Jackson 1976].

There are also the technical problems associated with the physical location of jurisdictional boundaries. The definition of a tidal datum defines the position of the land-water intersection. Therefore, one problem is the making of an adequate choice of a tidal datum to be used to locate the land-water intersection that will represent the physical location of the boundary along coastlines. Additionally, the dynamic nature of the coastal environment means that even if a precise tidal datum is specified the position of the boundary defined thereby will change over time [Flushman, 2002; Reed, 2000; Lamden and de Ricjke, 1996; Nichols, 1983]. Coastal boundaries will have to be resurveyed periodically in order to relocate the boundaries and to keep the boundary information up-to-date. Considering the length of Canada's coastline this is a very expensive task. In the deep offshore, the previous arguments relating to the definition of boundaries by coordinates still apply – although the co-ordinates may depend on the position of baselines.

The foregoing discussions underscore certain boundary requirements that will facilitate the enforcement of federal-provincial jurisdictional powers with regard to the good governance of marine spaces. These include:

- Certainty of legal definition;
- Conformity to legal definition;
- Accuracy of positioning;
- Definition by coordinates where appropriate;
- Adequacy of tidal datum definition;
- Up-to-date coastline survey.

Table 7.3
Marine Boundary Requirements to Support the Enforcement of Jurisdictional Powers

Boundary	**Certainty of Legal Definition**	**Conformity to Legal Definition**	**Accuracy of Positioning**	**Definition by Coordinates**	**Adequacy of Tidal Datum Definition**	**Up-to-Date Coastline Survey**
International (bilateral)	Yes	Yes	Desirable	Yes	Desirable	Desirable
Baselines (Oceans Act)	Yes	Yes	Desirable	Yes	Desirable	Desirable
Territorial Sea (Oceans Act)	Yes	Yes	Desirable	Yes	Desirable	Desirable
Contiguous Zone (Oceans Act)	Yes	Yes	Desirable	Yes	Desirable	Desirable
Exclusive Economic Zone (Oceans Act)	Yes	Yes	Desirable	Yes	Desirable	Desirable
Continental Shelf (Oceans Act)	Yes	Yes	Desirable	Yes	Desirable	Desirable
Territories	Yes	Yes	Desirable	Yes	Desirable	Desirable
Province	Yes	Yes	Desirable	Yes	Desirable	Desirable
Coastlines	Yes	Yes	Desirable	Yes	Desirable	Desirable

The relevant boundaries and their requirements are listed in Table 7.3. The items described as 'desirable' represent the fact that, although the particular boundary information might be an improvement, many of these boundaries exist in law and basically provide the functions for which they were designed.

There are other marine boundaries identified in Chapter 5 as "jurisdictional" boundaries that are not included in Table 7.3. It is to be understood that a delimited boundary may serve more than one purpose depending on the perspective of the party relating to it. A boundary might be a jurisdictional boundary to a jurisdictional authority and at the same time functions as administrative boundary to another entity. Still to another entity, the same boundary marks the limit of private rights. In Table 7.3 the boundaries are listed from the perspective of the maximum spatial extent of jurisdictional authority. The other boundaries will be dealt with from the perspective of administration or other rights. Also a level of government may have many lines of jurisdiction depending on the resource or activity in question.

7.2.4 Marine boundary requirements to support the enforcement of laws and policies

Government uses laws and the implementation of appropriate policies as one means of facilitating the socio-cultural and economic objectives of its citizens. Attempts at protecting the natural resources within a jurisdiction are also facilitated by these means. Laws and policies provide the necessary frameworks for the actions of citizens as they relate to one another and to the natural environment, land or marine. It is not within the scope of this work to examine all laws and policies relating to the marine environment. The focus will be on certain CZM and marine policies that will serve as references for determining marine boundary requirements to support the enforcement of policies in the governance of marine spaces.

Chapter 4 identified the fact that, in the Canadian marine environment, there are many varying and overlapping rights, and hence many varying and overlapping boundaries to manage. These rights and boundaries reflect the varying objectives competing for use of marine spaces, i.e., economic, social, cultural, environmental, and political objectives. Laws and policies are created to manage the behaviors of citizens, reasonably facilitate their objectives, and at the same time manage access to, and impact upon, the marine resources that are required to meet the various objectives [Paquet, 1999b; Harmon, 1995; Doern, 1988]. Therefore laws and policies tend to target maximum spatial extents within which many stakeholders compete for use of and access to marine resources.

The effectiveness of the laws and policies are in part dependent upon the marine boundaries enclosing the spatial extents that are targeted by the laws or policies. The arguments in relation to the marine boundaries in terms of certainty of legal definition and conformity to legal definitions still hold. To effect enforcement of marine laws and policies also requires accuracy of the boundary position and the dissemination of that knowledge to the enforcers, as well as to the other stakeholders affected by the laws and policies. Since many of the marine boundaries affected by laws and policies are coastal boundaries, the arguments proffered in Section 7.2.3 regarding tidal datums and the dynamic nature of coastlines are also relevant.

Chapter 6 outlined a case that demonstrated the fact that the objective of a policy to protect the marine resources of Musquash might be undermined by the placement of its outer boundary. Therefore the appropriateness of boundary location to achieve targeted objectives is also a boundary requirement to support the enforcement of laws and policies.

The foregoing discussions in this section outline certain boundary requirements that will facilitate the enforcement of laws and policies with regard to the good governance of marine spaces. These include:

- Certainty of legal definition;
- Conformity to legal definition;
- Definition by coordinates where appropriate;
- Accuracy of positioning;
- Appropriateness of boundary location;
- Adequacy of datum definition;
- Up-to-date coastline survey.

Examples of relevant Canadian boundaries and their requirements are listed in Table 7.4. In an ideal situation all boundaries listed would meet all requirements. However, many laws and policies affect wholly marine spaces, and the adequacy of datum definition and up-to-date coastline survey requirements do not significantly affect the enforcement of those laws and policies. In the case of laws and policies that impact coastlines the adequacy of datum definition requirement significantly improves the efficiency of enforcement. Up-to-date coastline surveys would also increase the efficiency of enforcement of laws and policies that impact coastlines but many of these laws and policies are in force without this requirement being met and therefore the requirement is listed as desirable for the improvement of governance.

Table 7.4
Marine Boundary Requirements to Support the Enforcement of Laws and Policies

Boundary	**Certainty of Legal Definition**	**Conformity to Legal Definition**	**Accuracy of Positioning**	**Definition by Coordinates**	**Adequacy of Datum Definition**	**Up-to-Date Coastline Survey**	**Appropriateness of Boundary Location**
International (bilateral)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Baselines (Oceans Act)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Territorial Sea (Oceans Act)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Contiguous Zone (Oceans Act)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Exclusive Economic Zone (Oceans Act)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Continental Shelf (Oceans Act)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Territories	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Province	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Coastlines	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
National Parks	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial Parks	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Federal fishing zones	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial fishing regulatory areas	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial ecological reserves and protected	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes

Boundary	**Certainty of Legal Definition**	**Conformity to Legal Definition**	**Accuracy of Positioning**	**Definition by Coordinates**	**Adequacy of Datum Definition**	**Up-to-Date Coastline Survey**	**Appropriateness of Boundary Location**
reserves and protected areas							
Wildlife habitat	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Marine protected areas	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Federal ecological reserves	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Marine parks	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Federal wildlife sanctuaries	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial wildlife sanctuaries	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Aquaculture and sea ranching	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Purchased/leased lands for wildlife protection (*Canada Wildlife Act*)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Water resource management area	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Federal fishing licence area	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
NAFO regulatory area	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial coastal zone policies	Yes	Yes	Yes	Yes	yes	Desirable	Yes

Boundary	Certainty of Legal Definition	Conformity to Legal Definition	Accuracy of Positioning	Definition by Coordinates	Adequacy of Datum Definition	Up-to-Date Coastline Survey	Appropriateness of Boundary Location
Provincial marine policy zone	Yes	Yes	Yes	Yes	yes	Desirable	Yes

7.2.5 Marine boundary requirements to support the exercise of administrative powers and the delivery of services

Administrative services are based upon implementing laws and policies that combine with regulations, organizational structures, information systems, and human resources to effect operational aspects of governance. Administrative services provide a more direct interface between government and citizens for the necessary exchange of information for all stakeholders to pursue their objectives. This is true in relation to both the land and marine environments.

The management of all types of information, including marine boundary information, necessary to support socio-cultural and economic activities, and to manage access to natural resources is very important at the administrative level of governance. The management of information facilitates the allocation of marine resources via the management of rights to marine spatial extents. Marine administrative boundaries enclose spatial extents within which particular rights are allocated, either to the complete spatial extent or to some portion thereof. In this regard, marine administrative boundaries are important components of the good governance of marine spaces [Nichols and Monahan, 1999, Nichols, Monahan and Sutherland, 2000].

From the perspective of Canadian government administration of marine resources there are two levels of governance: federal and provincial. Federal administrative marine authorities are intrinsically tied to federal jurisdictional authorities, while provincial administrative authorities are tied to either federal or provincial marine authorities, depending on the circumstances. In Canadian law, federal authorities claim jurisdiction and administrative authority over marine activities such as offshore oil and gas operations in submerged lands understood to be Canada Lands. The federal Crown also administers rights in trust for the 'public' and therefore has jurisdiction and administrative authority over activities dealing with navigation etc. [*Oceans Act*, 1996; United Nations, 1997 and 1999; Sohn and Gustafson, 1984].

In those marine areas where there are not uncertainties over federal and provincial jurisdiction or title, either federal or provincial administrative authority is in effect. In some other areas the Canadian Federal Crown has transferred administrative authority to the provinces in relation to specific activities such as aquaculture, harbours, or to benefit from oil and gas exploration and operations [Wildsmith, 1982; Nichols, Edwards et al, 1997; e.g. *Canada-New Brunswick Memorandum of Understanding on Aquaculture Development*, 1989].

Marine administrative boundaries (federal or provincial) are subsets of jurisdictional boundaries and therefore face the same requirements as put forward in Section 7.2.3. Also depending on what is being administered, for example oil and gas rights or the protection of an environmentally sensitive area, the appropriateness of boundary locations is also a requirement. Examples of relevant Canadian administrative marine boundaries and the associated requirements are listed in Table 7.5.

In an ideal situation all boundaries listed would meet all requirements. However, in wholly marine spaces, and the adequacy of datum definition and up-to-date coastline survey requirements do not significantly affect administration and service delivery. Where administration and service delivery impact coastlines the adequacy of datum definition and up-to-date coastline survey requirements would significantly improve efficiency but their absence would not be detrimental, hence they are listed as desirable.

Table 7.5
Marine Boundary Requirements to Support the Administrative Powers and the Delivery of Services

Boundary	**Certainty of Legal Definition**	**Conformity to Legal Definition**	**Accuracy of Positioning**	**Definition by Coordinates**	**Adequacy of Tidal Datum Definition**	**Up-to-Date Coastline Survey**	**Appropriateness of Boundary Location**
International (bilateral)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Baselines (Oceans Act)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Territorial Sea (Oceans Act)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contiguous Zone (Oceans Act)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exclusive Economic Zone (Oceans Act)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Continental Shelf (Oceans Act)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Territories	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Province	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Coastlines	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
National Parks	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial Parks	Yes	Yes	Yes	Yes	Yes, if impacting the coast	Desirable	Yes
Federal fishing zones	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial fishing regulatory areas	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes

Boundary	Certainty of Legal Definition	Conformity to Legal Definition	Accuracy of Positioning	Definition by Coordinates	Adequacy of Tidal Datum Definition	Up-to-Date Coastline Survey	Appropriateness of Boundary Location
Provincial ecological reserves and protected areas	Yes	Yes	Yes	Yes	Yes, if impacting the coast	Desirable	Yes
Wildlife habitat	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Marine protected areas	Yes	Yes	Yes	Yes	Yes, if impacting the coast	Desirable	Yes
Federal ecological reserves	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Marine parks	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Federal wildlife sanctuaries	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial wildlife sanctuaries	Yes	Yes	Yes	Yes	Yes, if impacting the coast	Desirable	Yes
Aquaculture and sea ranching	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Purchased/leased lands for wildlife protection (*Canada Wildlife Act*)	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Water resource management area	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Federal fishing licence area	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
NAFO regulatory area	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes

Boundary	**Certainty of Legal Definition**	**Conformity to Legal Definition**	**Accuracy of Positioning**	**Definition by Coordinates**	**Adequacy of Tidal Datum Definition**	**Up-to-Date Coastline Survey**	**Appropriateness of Boundary Location**
Provincial offshore oil and gas rights	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Provincial coastal zone policies	Yes	Yes	Yes	Yes	yes	Desirable	Yes
Provincial marine policy zone	Yes	Yes	Yes	Yes	Yes, if impacting the coast	Desirable	Yes
County	Yes	Yes	Yes	Yes	yes	Desirable	Yes
Municipal	Yes	Yes	Yes	Yes	yes	Desirable	Yes
Aboriginal claims	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
Indian reserves	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
All boundaries relating to Federal harbors, ports, and to do with navigation	Yes	Yes	Yes	Yes	yes	Desirable	Yes
Federally designated special areas in provinces	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes
NAFO regulatory area	Yes	Yes	Yes	Yes	Desirable	Desirable	Yes

7.2.6 Marine boundary requirements for private, customary, and aboriginal marine rights

From a boundary point of view, facilitating socio-cultural and economic objectives of Canadian citizens in marine spaces translates to the management of private, customary (or traditional), and aboriginal rights to marine spaces. These rights are subject to myriad federal and provincial legislation[20]. The spatial extents, and hence the boundaries, of all these rights are located within the bounds of both federal and provincial jurisdictional and administrative areas.

There are many private rights administered by the federal government. These include rights related to:

- Leases, safety zones, and development areas related to oil and gas exploration and production;
- Leases for offshore mineral rights;
- Leased areas for other industrial and commercial works;
- Disposal areas for chemical and other hazardous substances;
- Leased and purchased areas for private marine parks and the protection of wildlife;
- Federal fishing licence areas;
- Leased fishing and recreational harbors;
- Federal marine real property grants and concessions.

The survey of boundaries related to private rights administered by the federal Crown is the responsibility of the Surveyor General of Canada, and the survey tasks are

[20] The appropriate legislation governing these rights are listed among the references

executed by Canada Lands Surveyors [*Canada Lands Surveys Act*, 1985; *Canada Lands Surveyors Act,* 1998]. According to Section 27 of the *Canada Lands Surveys Act* [1985] "The Minister may direct that Canada Lands be surveyed, laid out and defined in any manner, by any method of surveying and with any description that the Minister considers desirable in the circumstances affecting those lands." In some cases this has been interpreted to be simply lines drawn on maps or charts and not surveyed on the ground (e.g. northern Yukon Territory administrative boundary). However, most rights boundaries are surveyed using set standards [Natural Resources Canada, 2005].

Since the NAD83 (CSRS) datum is now the Canadian federal standard, the coordinates of previously issued offshore rights that were referenced to other datums are now being transformed to NAD83 (CSRS). Coordinate shifts resulting from the transformations have prompted the Surveyor General to investigate appropriate strategies to determine how the definition of the spatial extents of the affected rights will be addressed [Nichols, S., J. Dobbin, M. Sutherland et al, 2001]. Discussions with representatives of the Surveyor General for Canada and statistical surveys completed by representatives of the oil and gas industry, and offshore fishermen suggest that accuracy of boundary positions is important to the federal government and their clients [Gagnon, 2002; Byrne, 2002; Noël, 2002]. The lack of fine precision in locating marine boundaries does not seem to be a hindrance to their marine governance activities.

Private offshore rights that are administered by the provinces are mainly related to aquaculture, other forms of sea ranching, and water lots for wharves and other activities [Nichols, Edwards et al, 1997]. Questionnaires completed by provincial administrators interested in private rights offshore indicated that while accuracy of boundary location is important to them, accuracy of 1 metre from the true position is sufficient for their needs [Finley, 2002; Light, 2002]. The lack of finer precision is therefore not a hindrance to their marine governance operations.

In New Brunswick recent survey standards for aquaculture sites have required demarcation by buoys tied to concrete blocks placed on the seabed in the Bay of Fundy. This is possible in instances where the farm site is located close to shore in reasonably shallow water. Along other parts of the coast sites are referenced by beacons on shore and relocated annually. The precision of using buoys as a visible reference of the corners of marine spatial extents has limitations due to the fact that, especially in the Bay of Fundy that has one of the highest tidal ranges in the world. First, buoys are subject to circular movements caused by tidal actions and therefore it is difficult, if not impossible, to precisely mark the corner of rights. Secondly, tidal movements have been known to cause the relocation of the concrete blocks many metres from the true position of the boundary. In the case of salmon cages, tidal actions have been reported to also move aquaculture equipment, including the cages, many metres outside of the spatial extents within which the aquaculture farms have been allocated the right to operate [Stewart, 1996].

There are traditional fishing rights that exist near the coasts of provinces. Provincial authorities may recognize traditional rights but there may not be any formal information on the boundaries (e.g., grants, leases, surveys). The general rule is that these rights have accrued under the common law by continued historical use of marine spaces. There is an issue of whether these rights continue to exist after the activity ceases (e.g., abandoned fishing weirs).

Aboriginal rights in the offshore have recently become a very important issue on all three of Canada's seacoasts. Aboriginal groups claim rights to portions of Canada's submerged lands and in some cases in the Pacific coast these outstanding claims have restricted other economic activities [McNeil, 2001; Muir, 1999; Nichols, Edwards, Dobbin et al, 1997] The problem is that the rights and the limits of these rights are not clearly defined, resulting in occasional disputes between citizens and aboriginal groups, and between federal authorities and aboriginal groups. The Marshall Case[21], which resulted from disagreements over aboriginal spatial rights, is just one of many instances of litigation resulting from this lack of clarity. From a governance perspective federal and provincial authorities monitoring and managing marine resources require knowledge of the spatial limits of aboriginal marine rights. However some First Nations are reluctant to settle these claims without knowing more of their traditional uses and potential rights. (e.g., Mi'kmaq First Nations Band).

The above discussion indicates that there are certain boundary requirements with regard private, customary and Aboriginal rights that support socio-cultural and economic activities as part of the good governance of marine spaces. These include:

- Certainty of legal definition;
- Conformity to legal definition;
- Definition by coordinates where appropriate;
- Demarcation by buoys where appropriate;
- Accuracy of positioning;
- Appropriateness of boundary location;

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[21] R.v. Marshall [1999] 3 S.C.R. 0456.
See http://www.lexum.umontreal.ca/csc-scc/en/pub/1999/vol3/html/1999scr3_0456.html

- Adequacy of datum definition.

Examples of relevant Canadian boundaries and their requirements are listed in Table 7.6. Again, in an ideal situation all boundaries would meet all requirements listed. However, in the case of aboriginal claims and offshore rights the governance objectives of peaceful pursuit of socioeconomic, political and environmental objectives are sometimes undermined by the determination of positional accuracy and in these cases boundaries are best left undetermined in order to minimize social conflict. In fact the problem is actually one of legal uncertainty and it is difficult without legal certainty to demarcate a recognized accurate boundary. The requirement to have the listed boundaries demarcated by buoys is only necessary where marine conditions make it appropriate.

Table 7.6
Marine Boundary Requirements for Private, Customary and Aboriginal Rights in the Marine Environment

Boundary	Certainty of Legal Definition	Conformity to Legal Definition	Accuracy of Positioning	Definition by Coordinates	Adequacy of Datum Definition	Demarcation by Buoys	Appropriateness of Boundary Location
Aboriginal claims and offshore rights	Yes	Yes	If social conflict is avoidable	Yes	Where appropriate	Where appropriate	Yes
Traditional private rights below OHWM	Yes	Yes	Yes	Yes	Desirable	Where appropriate	Yes
Coastlines (high water)	Yes	Yes	Yes	Yes	Yes	No	Yes
Coastlines (low water)	Yes	Yes	Yes	Yes	Yes	No	Yes
Pipeline areas (harbours and ports)	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Projected works and works under construction (harbours and ports)	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Marina, boat harbour (and other small craft facilities) – (harbours and ports)	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Vessel dumping ground	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Explosive dumping grounds	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Chemical waste dumping ground	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes

Boundary	Certainty of Legal Definition	Conformity to Legal Definition	Accuracy of Positioning	Definition by Coordinates	Adequacy of Datum Definition	Demarcation by Buoys	Appropriateness of Boundary Location
Garbage disposal areas	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Incineration area	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Wildlife habitat	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Marine parks	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Aquaculture and sea ranching	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Purchased/leased lands for wildlife protection (*Canada Wildlife Act*)	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Industrial/commercial works (Arctic waters)	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Federal fishing licence area	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Leased fishing and recreational harbours	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Federal Real Property Grants, Leases, Licenses, Concessions	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Offshore mineral rights	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes
Federal oil and gas leases	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes

Boundary	Certainty of Legal Definition	Conformity to Legal Definition	Accuracy of Positioning	Definition by Coordinates	Adequacy of Datum Definition	Demarcation by Buoys	Appropriateness of Boundary Location
Rights-of-way for submarine pipelines and cables	Yes	Yes	Yes	Yes	Yes	Where appropriate	Yes

7.2.7 Critique of the boundary information framework models

The designs presented in the previous sections are based on other boundary-related research, a small questionnaire (see report at Appendix III), as well as on research presented in previous chapters. The designs therefore may be lacking in stakeholder representation. It is possible that not all Canadian marine boundaries are represented. It is however the opinion of the author that a significant number of Canadian marine boundaries are represented to justify the usefulness of the designs. Although the sample was small research on boundaries and other marine boundary research validates the results shown. It is also possible that in some instances the information in the tables may be incorrect regarding whether listed boundaries should or should not conform to a particular requirement.

A benefit of the models' designs presented is that, in conjunction with the boundary classification scheme in Chapter 5, they identify requirements that can be associated with marine boundaries as they contribute to various governance functions. Additionally, the designs fully support the good governance criteria of efficiency, accountability, preservation of identity, and even capacity to change. The information in the tables adds to the efficiency of the governance decision-making process. Well-defined boundaries that meet all the requirements give more adequate notice to sovereign, jurisdictional, administrative, traditional, and private rights stakeholders and improve accountability. Community identity is also preserved in terms of confidence gained in their perceived relationships with the physical environment. With a less than ideal *status quo*, the designs could facilitate improvements in boundary information quality and hence facilitate changes in governance processes based upon improved decision-making.

From a cost perspective, certain requirements associated with the designs presented in this chapter will require expenditure related to surveying exercises. With regard to Canada's approximately 243,797 km long coastline the cost implications are huge. From a political perspective, the designs offer information support for the improvement of governance functions such as the protection of sovereign boundaries, the provision of political services, and political identity associated with territory.

The designs have social significance in that the improved boundary information supports a number of factors that affect social life. These factors include improved enforcement of jurisdictional powers, the enforcement of laws and policies, the exercise of administrative powers and delivery of services, and more secure private, customary, and aboriginal rights.

These factors also have economic implications. Jurisdictional powers, laws, policies, the exercise of administrative powers and service delivery, and more secure private, customary, and aboriginal rights all are part of an economic framework that provides a secure real property market environment.

Protection of the environment is an important issue. As can be seen from many of the boundaries listed in the design tables, protection of the marine environment has a direct relationship to marine boundaries. The designs therefore offer improved environmental protection through the provision of improved boundary information.

Finally, the designs can be applied in other jurisdictions. The survey included responses, from the United States, Britain, and Australia in addition to Canadian federal and provincial authorities. This also demonstrates the renewed international interest marine boundary information. Many international jurisdictions have requirements in their marine spaces similar to Canadian requirements even though their population demographics, laws and culture may differ from that of Canada.

7.4 Summary and Conclusions

This chapter addressed the question: "What are the required qualities and characteristics of marine boundary information to support good governance of marine spaces?" In order to answer this question the discussions were made from the perspective of politics since government is the facilitator of socio-cultural and economic activities, and a significant player in (as well as facilitator of) the management of marine resources through laws and policies. Therefore the discussions were made from the perspective of the following general governance activities:

- The security of sovereign borders;
- The maintenance of socio-economic and political relations with other states;
- The enforcement of jurisdictional powers;
- The enforcement of laws and policies;
- The exercise of administrative powers and the delivery of appropriate services;
- The facilitation of private, customary, and aboriginal rights to marine spaces.

The research question was addressed through the design of a series of boundary information requirements models depending on the class of governance activities being engaged in. A number of points were highlighted, including the fact that:

- There are a number of marine boundaries with varying degrees of sovereign rights attached to them;

- In Canada, at least at the level of federal government, the North American Datum of 1927 (NAD27) that has been replaced by the North American Datum of 1983, Canadian Spatial Reference System (NAD83 (CSRS) yet Canadian baseline points have not yet been converted to NAD83 (CSRS);
- The most practical method of delimiting a marine boundary in the deep sea is by way of coordinates;
- The use of buoys and concrete blocks to demarcate the corners of rights to marine spatial extents in shallower waters has been done but tidal actions affect the accuracy and precision of their positioning;
- The issues related to Federal or Provincial jurisdiction over Canadian marine spaces, and by implication the relevant marine boundaries, is affected by the common law, the Canadian Constitution, the definition of what are Canada Lands, and the history of Canadian Federation;
- Certain boundary requirements are desirable to improve good governance, although their absence does not affect governance of a lesser degree;
- Marine boundaries can have multiple functions and multiple classes of functions;
- The effectiveness of the laws and policies are in part dependent upon the marine boundaries enclosing the spatial extents that are targeted by the laws or policies;
- The management of all types of information, including marine boundary information, necessary to support socio-cultural and economic activities, and to manage access to natural resources is very important at the administrative level of governance;
- There are a number of boundary requirements necessary for the good governance of

Canadian marine spaces depending on the type of boundary, and function of the boundary. These include:

- Certainty of legal definition;
- Conformity to legal definition;
- Agreement by parties to the boundary;
- Definition by coordinates where appropriate;
- Demarcation by buoys where appropriate;
- Adequacy of baseline definitions;
- Adequacy of tidal (and other) datum definitions;
- Up-to-date coastline surveys;
- Accuracy of positioning;
- Appropriateness of boundary location.

The designs presented in this chapter offer one method of improving boundary information and hence positively affect the good governance of marine spaces. The following chapter (Chapter 8) offers four additional methods for improving boundary information. Table 7.7 summarizes the major points made in this chapter.

Table 7.7
Summary of Major Points in the Chapter 7

For the political objective of protecting sovereign borders to be achieved, sovereign boundaries have to meet the following requirements to varying degrees: • Certainty of legal definition; • Conformity to legal definition; • Agreement by parties to the boundary; • Definition by coordinates where appropriate; • Adequacy of baseline definitions; • Adequacy of tidal datum definitions; • Up-to-date coastline surveys; • Accuracy of positioning.
Marine boundaries supporting international political and socioeconomic relationships have to meet the following requirements: • Certainty of legal definition; • Conformity to legal definition; • Definition by coordinates; • Accuracy of positioning.
Marine boundaries supporting the enforcement of jurisdictional powers have to meet the following requirements to varying degrees: • Certainty of legal definition; • Conformity to legal definition; • Definition by coordinates; • Adequacy of tidal datum definitions where appropriate; • Up-to-date coastline surveys where appropriate; • Accuracy of positioning where appropriate.
Marine boundaries supporting the enforcement of laws and policies have to meet the following requirements to varying degrees: • Certainty of legal definition; • Conformity to legal definition; • Definition by coordinates where appropriate; • Accuracy of positioning; • Appropriateness of boundary location; • Adequacy of datum definition where appropriate; • Up-to-date coastline survey where appropriate.
Marine boundaries supporting the exercise of administrative powers and the delivery of services have to meet the following requirements to varying degrees: • Certainty of legal definition; • Conformity to legal definition; • Definition by coordinates; • Accuracy of positioning; • Appropriateness of boundary location; • Adequacy of datum definition where appropriate; • Up-to-date coastline survey where appropriate.
Boundaries associated with private, customary, and aboriginal rights have to meet the following requirements to varying degrees: • Certainty of legal definition; • Conformity to legal definition; • Definition by coordinates; • Demarcation by buoys where appropriate; • Accuracy of positioning where appropriate; • Appropriateness of boundary location; • Adequacy of datum definition where appropriate.

CHAPTER 8

FOUR ADDITIONAL METHODS OF IMPROVING BOUNDARY INFORMATION

8.0 Introduction

The boundary information framework models presented in Chapter 7 can aid the improvement of boundary information and good governance of marine spaces. This chapter offers four additional methods of accomplishing those objectives. First the design of a logical Canadian national marine boundary database framework will be presented. This design is based on research done on behalf of CHS. The logical national marine boundary database framework is first presented as a general object-relational model and then the same framework is examined from the perspective of the International Hydrographic Organization (IHO) S57 model for Electronic Nautical Charts (ENC) [International Hydrographic Organization, 2000]. The database framework presented is general and can be modified or extended depending on the intended use of the database.

Thereafter, the Canadian Marine Geospatial Data Infrastructure (MGDI) initiative, the concept of marine cadastre, and WebGIS technology will be discussed. The discussions will be from the perspective of improving boundary information to support good governance of marine spaces.

8.1 Design of a Logical National Marine Boundary Database Framework

It has been demonstrated in this thesis that improved boundary information contributes to the good governance of marine spaces. This section will present a logical national marine boundary database design that can also contribute to the good governance of marine spaces by promoting improved marine boundary information.

8.1.1 The Concept

The basis for this design is the common sense understanding that a boundary is perceived to minimally separate two areas (Figure 8.1). Logically, the line representing a boundary line can in fact be linked to 2 areas on the same plane.

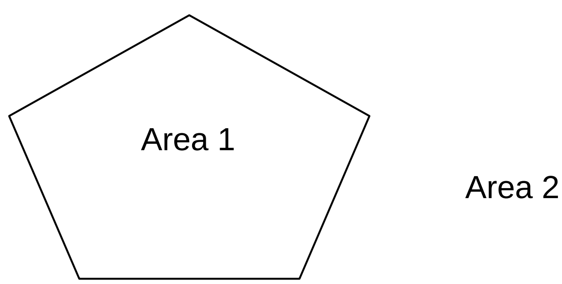

FIGURE 8.1 – AREAS SEPARATED BY BOUNDARIES

Queries made in relation to any boundary accesses area information and all the information related to the area (Figure 8.2). All the information related to the area can then retrieved. The basis for this design (from a database management point of view) is the fact that an area can have any number of enclosing boundary line segments. If the needed information is all related to the boundary element, then the same set of information will have to be stored for each boundary segment resulting in possible massive duplication. However, if the information is related to the area then it is stored once and can be related to all boundary line segments associated with the area in question.

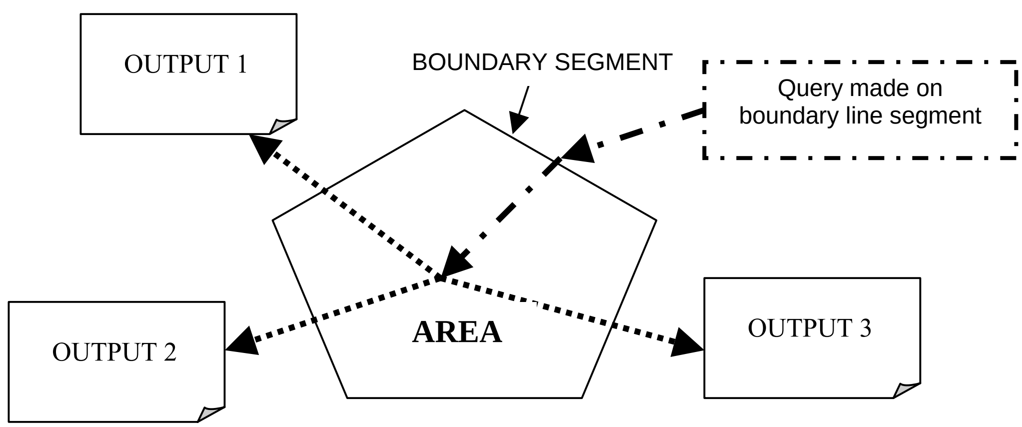

FIGURE 8.2 – RETRIEVING BOUNDARY INFORMATION BY ACCESSING THE ENCLOSED AREA INFORMATION

The model works whether the area in question encloses other areas, is enclosed by another area, is coincident with another area, or overlaps another area. The reason for this is that each area (along with the boundary segments associated with it) is treated logically as a separate entity. Figures 8.3 to 8.6 demonstrate variations on the foregoing described phenomena.

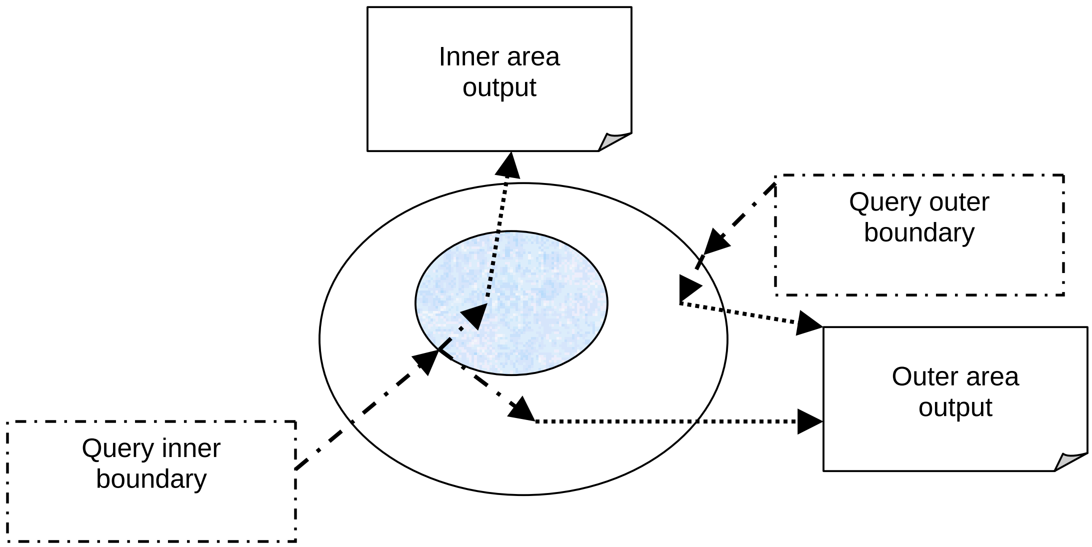

FIGURE 8.3 – AREA WITHIN AREA

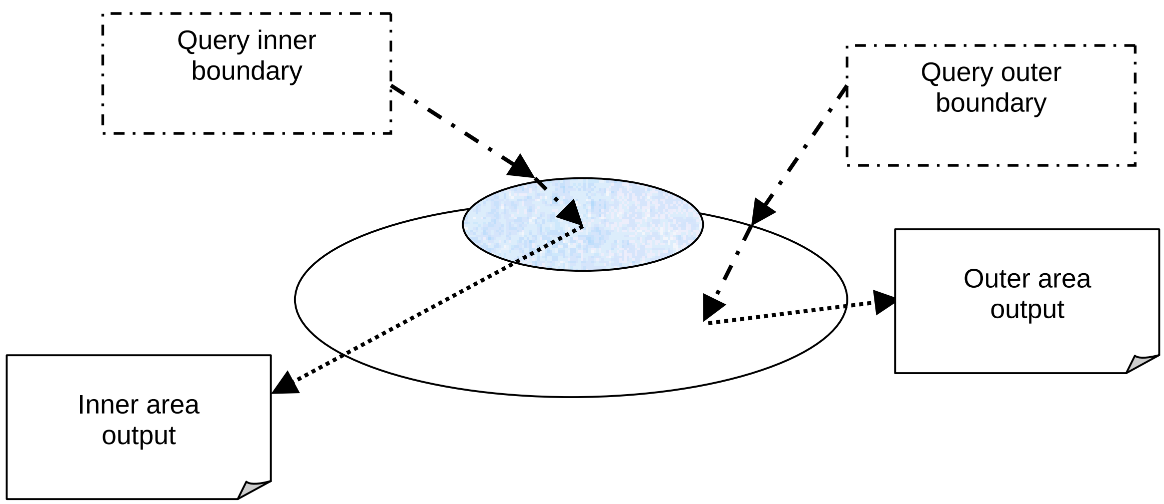

FIGURE 8.4 – AREA OVERLAPS AREA

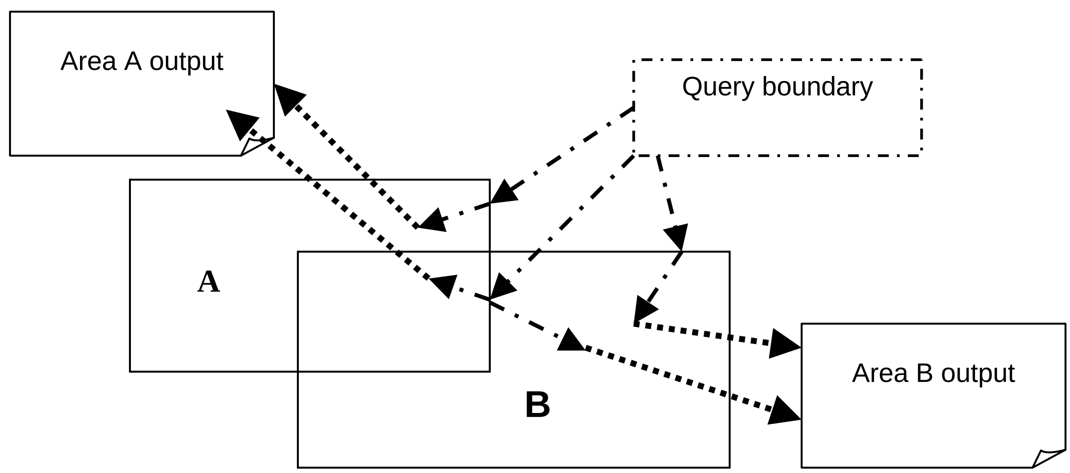

FIGURE 8.5 – AREA INTERSECTS AREA

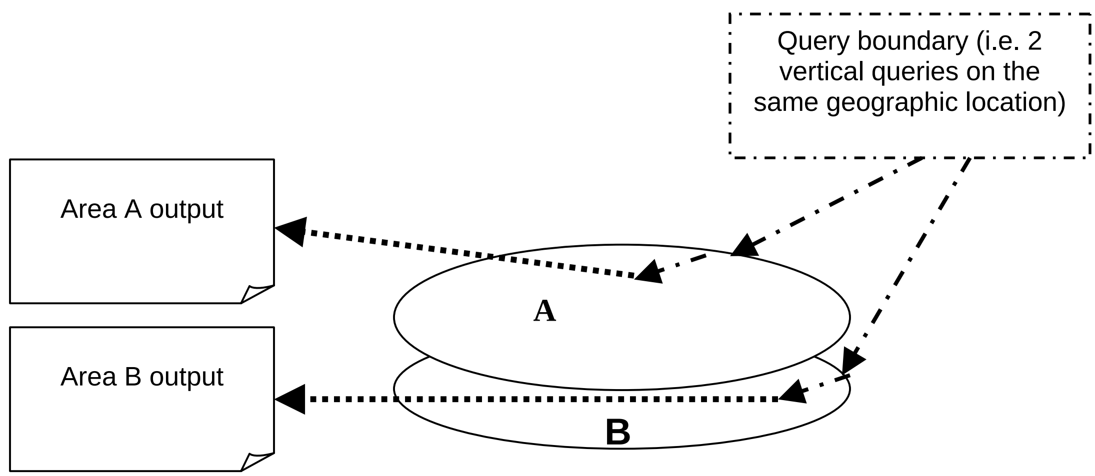

FIGURE 8.6 – AREA COINCIDES WITH AREA (LAYERS LOGICALLY SEPARATED)

8.1.2 The General Logical Database Framework

Based on the foregoing sections a logical national marine database framework will be presented in this section. The design is also based on certain assumptions:

- Because CHS charts are 2-dimensional media, boundaries are treated as lines. This is not withstanding the definition of a boundary offered in Chapter 2;
- Boundaries are the outer limits of spatial extents to which rights, responsibilities and restrictions are attached;
- Rights, responsibilities and restrictions are linked to legislation or laws that also determine the "class" of boundary;
- Each legislation or law is enacted at a certain level of government (e.g., federal, provincial etc.);
- A boundary can serve multiple functions;
- Each boundary can be associated with at least two areas;
- There can be many boundary segments for one area;
- Each area (and by association its boundaries) has one level of government responsible for it;
- A government entity can be responsible for more than one area (and by association its boundaries);
- Each area (and by association its boundaries) has certain rights, restrictions and responsibilities associated with it;
- Each area (and by association its boundaries) owes its existence to at least one legislation or law (described as "law");

- Each law has one law maker (e.g. Canada, UN, New Brunswick);
- A law maker can make many laws;
- There can be more than one type of legislation or regulation etc.;
- Each law is of a certain level (e.g. international, federal, provincial etc.);
- There can be more than one law that is international, federal etc.;
- Each area (and by association its boundaries) has one classification;
- A classification can be applied to more than one area.

Figure 8.7 shows the object relationships in general among all objects. Figure 8.8 shows the object relationship specifically for an area object.

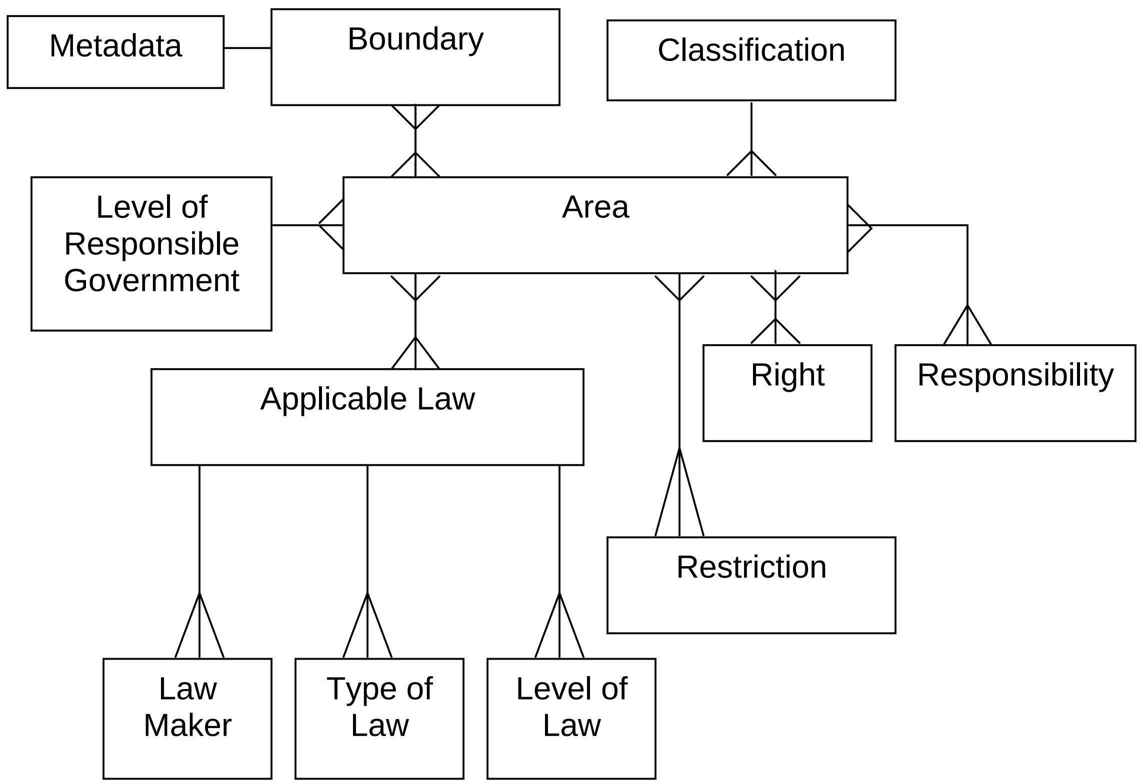

FIGURE 8.7 – OBJECT RELATIONSHIPS FOR ALL OBJECTS

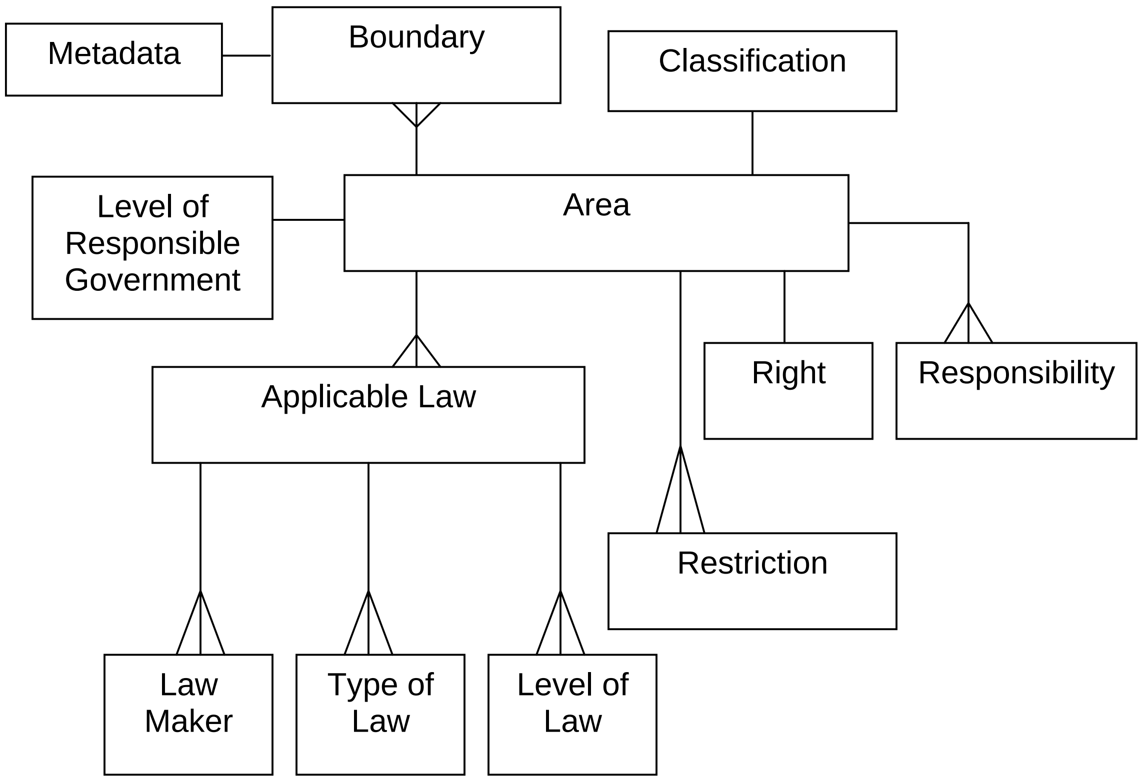

FIGURE 8.8 – OBJECT RELATIONSHIPS FOR EACH AREA OBJECT

8.1.3 The General Logical Database Framework (Possible S57 Version)

S57 is the International Hydrographic Organization (IHO) transfer standard for digital hydrographic data [International Hydrographic Organization, 2000]. In this section a possible S57 version of the database framework is proffered. The S57 specifications are entailed in very extensive documentation; therefore for detailed information, the S57 specifications should be consulted directly [International Hydrographic Organization, 2000]. The database framework outlined in the previous section includes objects that are not currently covered by S57. In cases like these, possible objects for the extension of S57 will be recommended.

Figures 8.9 and 8.10 graphically depict a generalized version of the S57 data model, and the S57 Feature Record respectively. This section will focus on the GeoObject class-object (Figure 8.9). Also of particular interest are the following S57 Feature Record fields (Figure 8.10):

- "Feature Record to Object Pointer" used as a link to other objects;
- "Feature Record to Spatial Record Pointer" used as the link to the object's geometry;
- "Object Geo Primitive" used to identify whether the object represents a line, area etc.

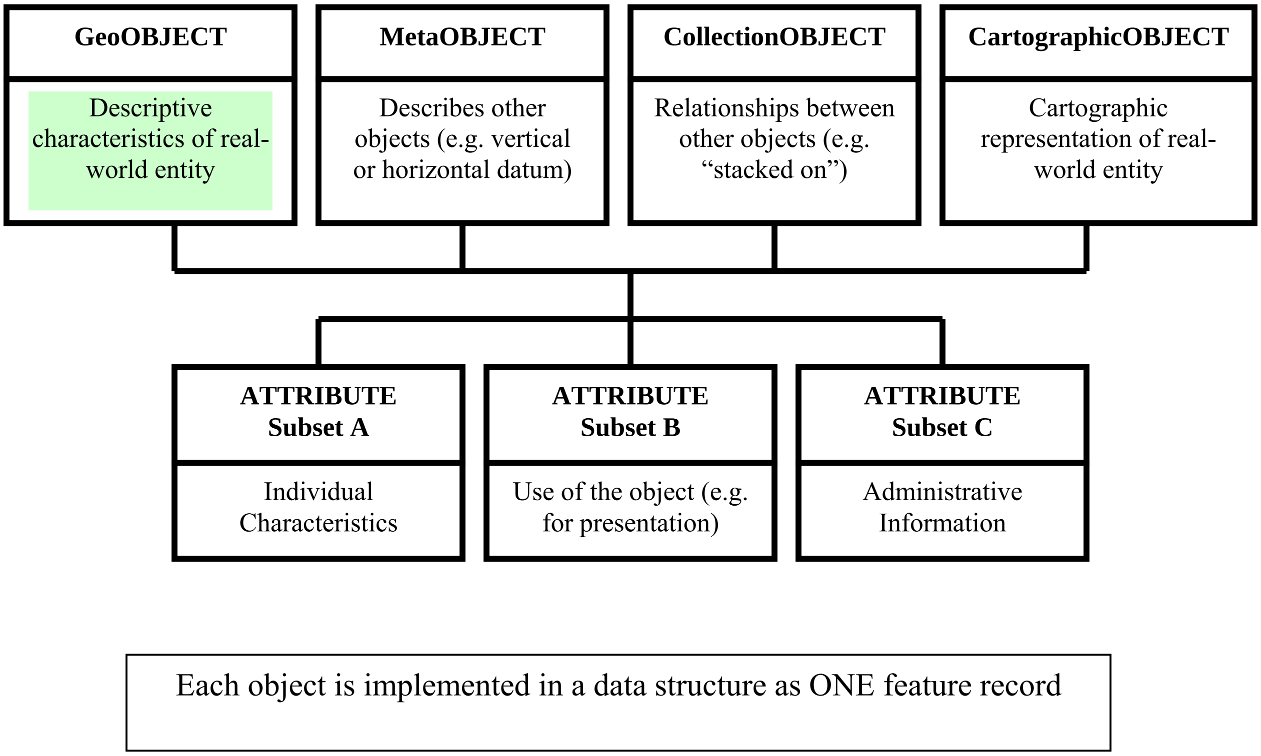

FIGURE 8.9. S57 DATA MODEL SHOWING THE 4 TYPES OF FEATURE OBJECTS AND THE ATTRIBUTES COMMON TO ALL OF THEM

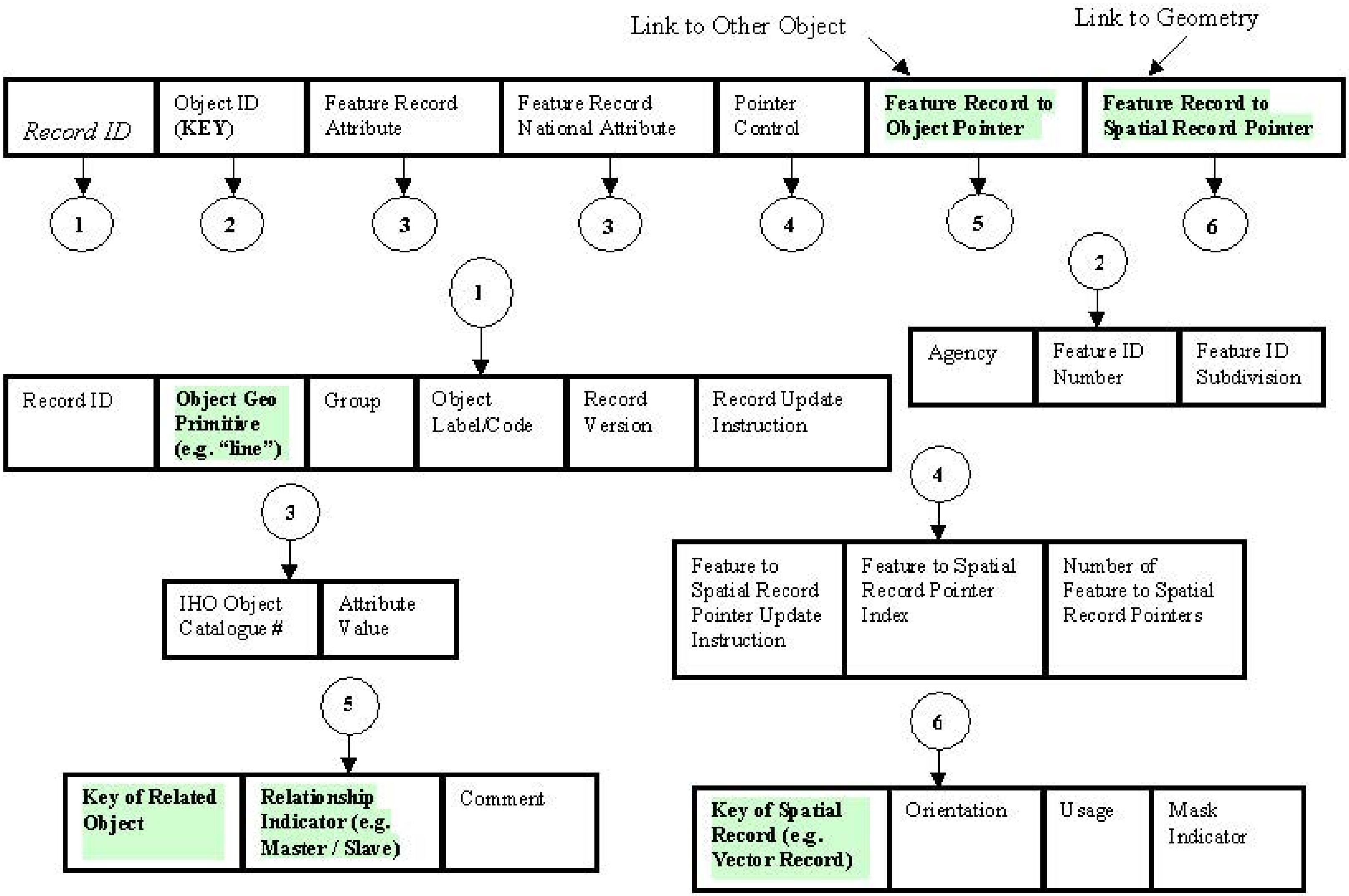

FIGURE 6.10 – FEATURE RECORD STRUCTURE SHOWING FIELDS AND SUB-FIELDS (NUMBERED LINK)

8.1.3.1 Feature Record to Object Pointer

The Feature Record to Object Pointer field (Figure 8.10) of the S57 Feature Record facilitates the linking of one object to another. Using the sub-field "Relationship Indicator" relationships may be specified as "master" or "slave". This is particularly useful to the logical marine boundary database framework that will described in this document, based on the concepts outlined in Section 8.1.1 and the manner in which S57 area and line objects are encoded [International Hydrographic Organization, 2000].

S57 area objects reference one or more faces, and each face in turn references their bounding edges [International Hydrographic Organization, 2000]. The logical marine boundary database design will depend on how the database will be used. If it is sufficient to treat the bounding edges of area objects as boundaries then there is no need for linking to separate boundary objects. This might be sufficient for administrative areas etc. but might not be sufficient where an international boundary is treated as a line and not linked explicitly to an area. If, however, it is required that there be explicit boundary lines for areas, in addition to boundary lines on their own, the Feature Record to Object Pointer field is useful to link an area to its boundaries. The area would be the "master" and the linked boundaries would be "slaves".

8.1.3.2 Feature Record to Spatial Record Pointer

The S57 Feature Record to Spatial Record Pointer field (Figure 8.10) links an object to its geometry (e.g. to its "Vector Record") [International Hydrographic Organization, 2000]. The Vector Record would determine how a line object's line segments are sequenced, or how an area object's face(s) are linked to its bounding edges. This underscores the compatibility of the concept outlined in Section 8.1.1 with S57.

8.1.3.3 Geo Object Primitive Field

The S57 Geo Object Primitive sub-field of the Record Identifier field (Figure 8.10) defines an object as a line, an area etc [International Hydrographic Organization, 2000]. The sub-field enhances the understanding of how S57 identifies and differentiates among line, area, point objects etc.

8.1.3.4 The Possible S57 Logical Marine Boundary Database Framework

Based on all the foregoing sections, Figure 8.11 presents the possible S57 version of Figure 8.8. Compulsory attributes as specified by S57 are not necessarily shown. "Face" and "Bounding Edge" are shown only for clarity of the concept. From the documentation S57 does not seem to support the concept of a boundary object unassociated with types of areas.

There is a traffic separation scheme boundary object that is related to a traffic separation zone object that seems to support specific boundary types linked to specific area types. The documentation also seems to support specific objects for specific boundary types not necessarily linked to area objects (e.g. international maritime boundary). There is also a cartographic line object, but this object is not permissible on Electronic Nautical Charts (ENC) [International Hydrographic Organization, 2000].

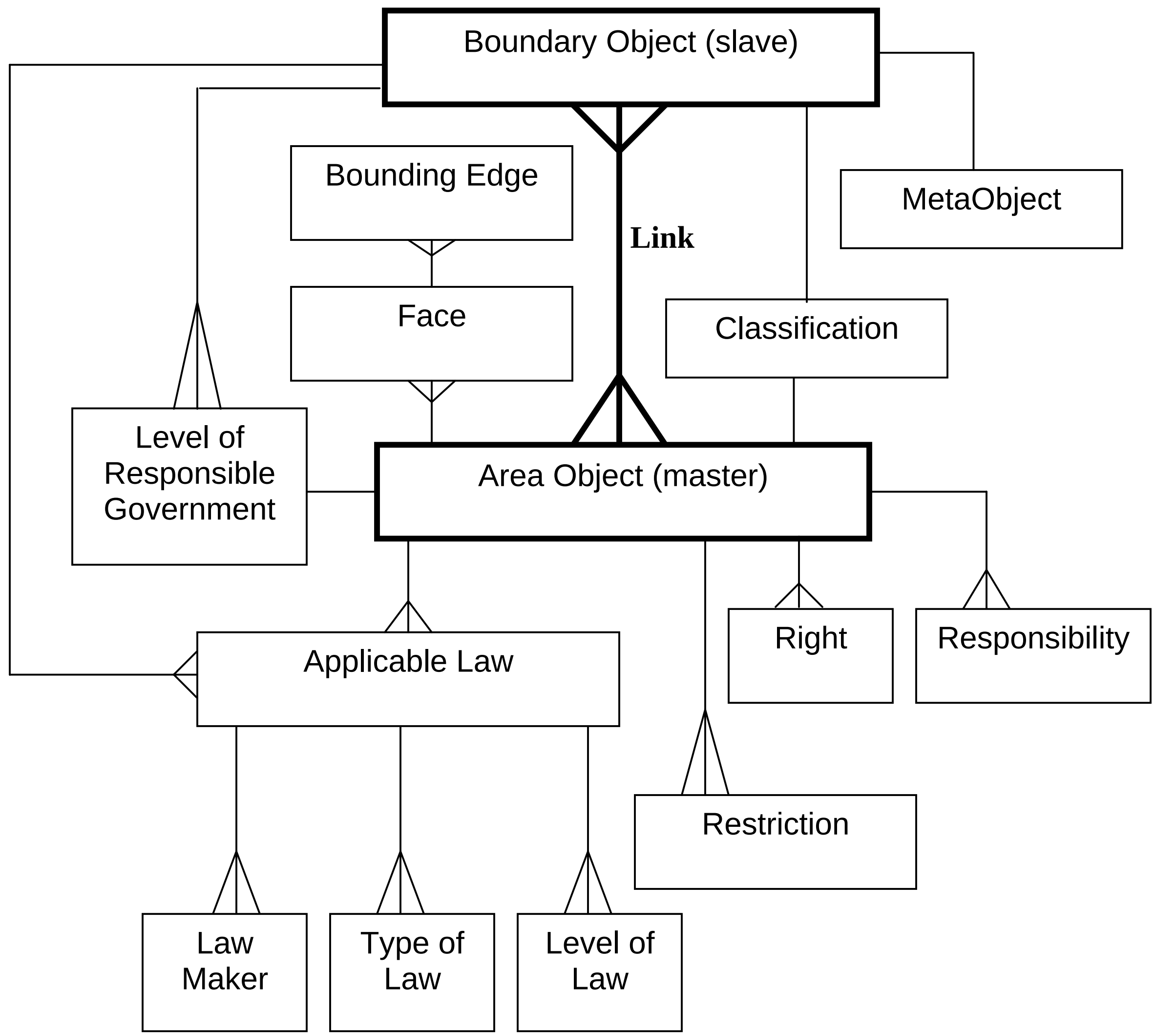

FIGURE 8.11 – S57 POSSIBLE LOGICAL MARINE BOUNDARY DATABASE FRAMEWORK

Table 8.1 lists available S57 GeoObjects and Attribute objects relevant to some of the classified boundaries in Chapter 5. For the other boundaries classified in Chapter 5, specific area and boundary classes would have to be created.

Table 8.1 – S57 GeoObjects of Possible Usefulness

S57 GeoOBJECT CLASS	ATTRIBUTE	OTHER S57 GeoOBJECT CLASSES RELEVANT TO THE ATTRIBUTE
Achorage Area (ACHARE)	CATACH (Category of anchorage area)	
Administration area (named) (ADMARE)	Information (INFORM) = all objects	
	Jurisdiction (JRSDTN)	
	Nationality (NATION)	
	Object name (OBJNAM) = all objects	
	Periodic date: start/end (PEREND) (PERSTA)	
	Source date (SORDAT) etc.	
	Textual description (TXTDSC) = all objects	
	Information in national language (NINFOM) etc.	
Cable Area (CBLARE)	Category of cable (CATBL)	Submarine Cable (CBLSUB)
	Category of coastline (CATCOA)	
	Category of coverage (CATCOV)	
Cargo transhipment area (CTSARE)		
Cartographic area ($AREAS) **– not for use in ENC**		
Cartographic line ($LINES) **– not for use in ENC**		
Caution Area (CTNARE)		
Coastline (COALNE)	Elevation (ELEVAT)	
Contiguous zone (CONZNE)		
Continental shelf area (COSARE)		
Custom zone (CUSZNE)		
Dock area (DOCARE)		
Dredged area (DRGARE)		
Dumping ground (DMPGRD)	Category of dumping ground (CATDPG)	
Exclusive economic zone (EXEZNE)		
Fishery zone (FSHZNE)		
Fishing facility (FSHFAC)	Category of fishing facility (CATFIF)	
Fishing ground (FSHGRD)		
Free port area (FRPARE)		
Harbour area (administrative) (HBRARE)		
Harbour facility (HRBFAC)	Category of harbour facility (CATHAF)	
Incineration area (ICNARE)		

S57 GeoOBJECT CLASS	ATTRIBUTE	OTHER S57 GeoOBJECT CLASSES RELEVANT TO THE ATTRIBUTE
Land area (LNDARE)		
Land region (LNDRGN)	Category of land region (CATLND)	
Marine farm/culture (MARCUL)	Category of marine farm (CATMFA)	
Military practice area (MIPARE)	Category of military practice area (CATMPA)	
Obstruction (OBSTRN)	Category of … (CATOBS)	
Offshore production area (OSPARE)	Category of production area (CATPRA)	Production/storage area (PRDARE)
Oil barrier (OILBAR)		
Pipeline area (PIPARE)	Category of pipeline (CATPIP)	
Production Information (M_PROD) **– not for use in ENC**	AGENCY (Agency responsible for production)	Compilation date (CPDATE)
	Producing country (PRCTRY)	
	Product (PRODCT)	
Precautionary Area (PRCARE)		
Restricted area (RESARE)	Category of … (CATREA)	
	Restriction (RESTRN) … others use too	
Sea area\named water area (SEAARE)	Category of sea area (CATSEA)	
Seabed area (SBDARE)		
Seaplane landing area (SPLARE)		
Shoreline construction (SLCONS)	Category of … (CATSLC)	
Small craft facility (SMCFAC)	Category of …(CATSFC)	
Swept area (SWPARE)		
Straight Territorial sea base line (STSLNE)		
Territorial sea area (TESARE)		
Traffic separation zone (TSEZNE)		
Traffic separation scheme - Boundary (TSSBND)	Caegory of traffic separation scheme (CATTSS)	Traffic separation line (TSSLNE)
Unsurveyed area (UNSARE) **– Group 2**		
Underwater/Awash Rock (UWTROC)		
	Survey date (SURDAT) etc.	
	Vertical datum (VERDAT)	
	Horizontal datum (HORDAT)	
	Quality of position (QUAPOS)	

Below are example descriptions of how an area object and linked boundary objects could be structured. For convenience the area object will be described as "Aboriginal Claim Area". The related boundary object will be described as "Aboriginal Claim Boundary". For explanations on the S57 attribute acronyms used, please refer to International Hydrographic Organization [2000] (some of them are listed in Table 8.1). Non-existent S57 GeoObject classes, and non-existent S57 attributes will be identified. S57 attributes of possible use that may need updating will be identified. The list of attributes is exhaustive. Only some of those attributes described in Figure 8.11 are detailed to give an example of what their structure could be.

GEO OBJECT CLASSES

Object Class:	**Aboriginal Claim Area***

ACRONYM: aboare*

SET ATTRIBUTE_A: **JRSDTN; NATION; NOBJNM; OBJNAM; LEVGOV*; RESTRN**; RIGHTS*; RESPON***
SET ATTRIBUTE_B: **INFORM; NINFOM; NTXTDS; PICREP; SCAMAX; SCAMIN; TXTDSC**
SET ATTRIBUTE_C: **RECDAT; RECIND; SORDAT; SORIND**

*** DOES NOT EXIST IN S57**
**** EXISTS IN S57 BUT WOULD HAVE TO HAVE NEW CODE-MEANING ADDED**

Object Class:	**Aboriginal Claim Boundary ***

ACRONYM: aboBND*

SET ATTRIBUTE_A:	**JRSDTN; NATION; NOBJNM; OBJNAM; LEVGOV*; CATBND***
SET ATTRIBUTE_B:	**INFORM; NINFOM; NTXTDS; PICREP; SCAMAX; SCAMIN; TXTDSC**
SET ATTRIBUTE_C:	**RECDAT; RECIND; SORDAT; SORIND**

*** DOES NOT EXIST IN S57**

FEATURE OBJECT ATTRIBUTES

Attribute:	**Level of Responsible Government**

ACRONYM: LEVGOV*

EXPECTED INPUT:

ID	**MEANING**
1	**FEDERAL**
2	**PROVINCIAL/STATE**

DEFINITION: **LEVEL OF GOVERNMENT RESPONSIBLE FOR MAINTAINING THE SPATIAL DATA**

*** DOES NOT EXIST IN S57**

Attribute:	**Category of Boundary**

ACRONYM: CATBND*

EXPECTED INPUT:

ID	**MEANING**
1	**SOVEREIGN**
2	**JURISDICTIONAL**
3	**ADMINISTRATIVE**
4	**PRIVATE**
5	**ABORIGINAL**
6	**COMMUNITY/CUSTOMARY**
7	**PUBLIC**

DEFINITION: **CLASSIFICATION OF BOUNDARY**

*** DOES NOT EXIST IN S57**

8.1.4 Strengths of the Logical Database Framework Design

It has been pointed out in previous chapters that marine boundaries in Canada are many, varied, and complex in that they overlap. The logical framework is able to adequately deal with this overlap, certainly from a 2-dimensional point of view.

Additionally, since it has been pointed out that an area object can have many 'faces' to which are attached edges, the S57 version of the design would be able to deal with the at least 3-dimensional nature of rights in marine spaces. The spatial dimensions of the faces could theoretically describe a volume, which more accurately reflects the reality of the relationship of marine rights to marine spatial extents.

The logical design would also facilitate the identification of a number of factors that affect good governance of marine spaces. These factors are questions as to:

- What type of boundary is this?
- What is the spatial extent associated with this boundary?
- What are the rights, responsibilities and restrictions associated with this boundary?
- Which legislation or law dictates the rights, responsibilities and restrictions associated with this boundary?
- What level of government created or administers this legislation or law?

Another strength of the design is its flexibility. For instance, the design can be expanded to include objects referencing occupiers or owners of the rights associated with a spatial extent and its boundaries. In this manner one would be able to answer the question as to who has what rights associated with a particular spatial extent and its boundaries.

Finally, adoption of the S57 version will facilitate easier sharing of marine boundary information among all users of ENCs. This is because S57 is an internationally accepted standard for ENCs.

8.1.5 Weaknesses of the Logical Database Framework Design

The main weakness of the design (and this excludes the S57 version of the design) is its limitation to accurately represent the 3-dimensional and greater nature of rights in marine spaces. The design adequately represents areas but as expressed in Chapters 3 and 4, marine boundaries are more likely to be liked to volumes of marine space. The design is more adequate for 2-dimensional charts.

8.2 Marine Geospatial Data Infrastructure

The management of marine spatial information (and by implication marine boundary information) is an asset to the efficient management of coastal and marine resources, and can in many instances help to avoid minimize conflict among the many stakeholders. Recognizing this, and the fact that no one stakeholder possesses all necessary information, many jurisdictions have begun initiatives to better manage coastal and marine spatial information and to apply information technology and concepts to the management of marine spatial information [Ng'ang'a et al, 2004; Nichols, Monahan and Sutherland, 2000; Ford and Zussman, 1997; Mansell et al, 1999].

For example, in order to coordinate the dissemination of marine spatial data that can support good governance of coastal and marine spaces, marine geospatial data infrastructure initiatives are underway in Canada and the U.S. as well as in other parts of the world. Initiatives like Canada's Marine Geospatial Data Infrastructure (MGDI) and the U.S. Federal Geographic Data Committee (FGDC) are considering the information and other infrastructure components necessary to provide geographically dispersed stakeholders with spatial data to support governance decision-making. Regional bodies such as the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) are also taking steps to implement marine geospatial infrastructures.

The components of any marine geospatial data infrastructure are expected to include key spatial data, computer network infrastructures, spatial data management software and other software, data- and other standards, metadata, stakeholders, and possibly a spatial data clearinghouse [GeoConnections, 2002; FGDC, 2002b; Australia New Zealand Land Information Council, 1995; Tosta, 1992 and 1994; National Research Council, 1993; Nichols and McLaughlin, 1992].

8.3 Marine Cadastre

The concept of a marine cadastre[22], another method for managing marine spatial information, has also begun to take root in Canada, the U.S., New Zealand, Australia and other parts of the world as is evidenced by contemporary workshops occurring worldwide, as well as by the papers and websites published, in relation to the topic. Some of the papers on the topic include Grant [1999], Hoogsteden, Robertson, and Benwell [1999], Ng'ang'a, Sutherland, and Nichols [2002], Ng'ang'a, Sutherland et al [2004], Sutherland [2004] among many others.

National groups such as the Australian National Marine Data Group (ANMDG) and the Marine Boundary Working Group of the FGDC have made the marine cadastre a priority [FGDC, 2002a; ANMDG, 2002; Ng’ang’a et al, 2004; Grant 1999; Hoogsteden, Robertson and Benwell, 1999]. Regional groups such as the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP)[23] and international organizations such as the International Federation of Surveyors (FIG)[24] have taken more than a passing interest in the topic.

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[22] A record of interests in the marine environment that contains spatial, legal and other relevant thematic information

[23] The PCGIAP has, in 2004, invited the author to expound on the concept to its membership.

[24] Based upon conference presentations and published papers by the author and other graduate students from the University of New Brunswick, Department of Geodesy and Geomatics Engineering, the FIG has incorporated the concept of marine cadastre into the objectives of its Commission 4. The FIG has also seen fit to appoint the author as Chair of the relevant Commission 4 working group to ensure that

Any marine cadastre design must take into consideration the minimally 3-dimensional nature of rights (and by implication the associated boundaries) in the marine environment. Ng'ang'a et al [2004] (see Appendix 2) put forward one data model (Figure 8.12) of what the marine cadastre might entail that may be an initial step in capturing the at least 3-dimensional characteristics of rights in the marine environment. The basic purpose of a marine cadastre is also to manage property rights in the marine environment. Table 8.2 shows the components of a marine cadastre from a property rights perspective. With the exception of "spatial data infrastructure", the components listed and described in the table are adequately represented in the model offered at Figure 8.11.

Table 8.2
Components of a Marine Cadastre from a Property Rights Perspective

COMPONENTS	CHARACTERISTICS
Objects of property	• Marine / coastal resources
Property rights	• Title • Jurisdiction powers • Administrative powers • Other rights and interests
Subjects of property	• Jurisdictional and administrative powers • Individuals • Groups
Spatial extent of property	• 3D / 4D marine spaces • Geographic extents • Limits / boundaries
Spatial Data Infrastructure	• Spatial information / data; • Metadata • Standards • Laws, legislation and regulations; • Land/property administration infrastructure (recording, registration dissemination, management, institutions, processes, organization etc.); • Information management infrastructure (institutions, computer networks, standards, etc.)

the topic is developed and gain exposure among its membership.

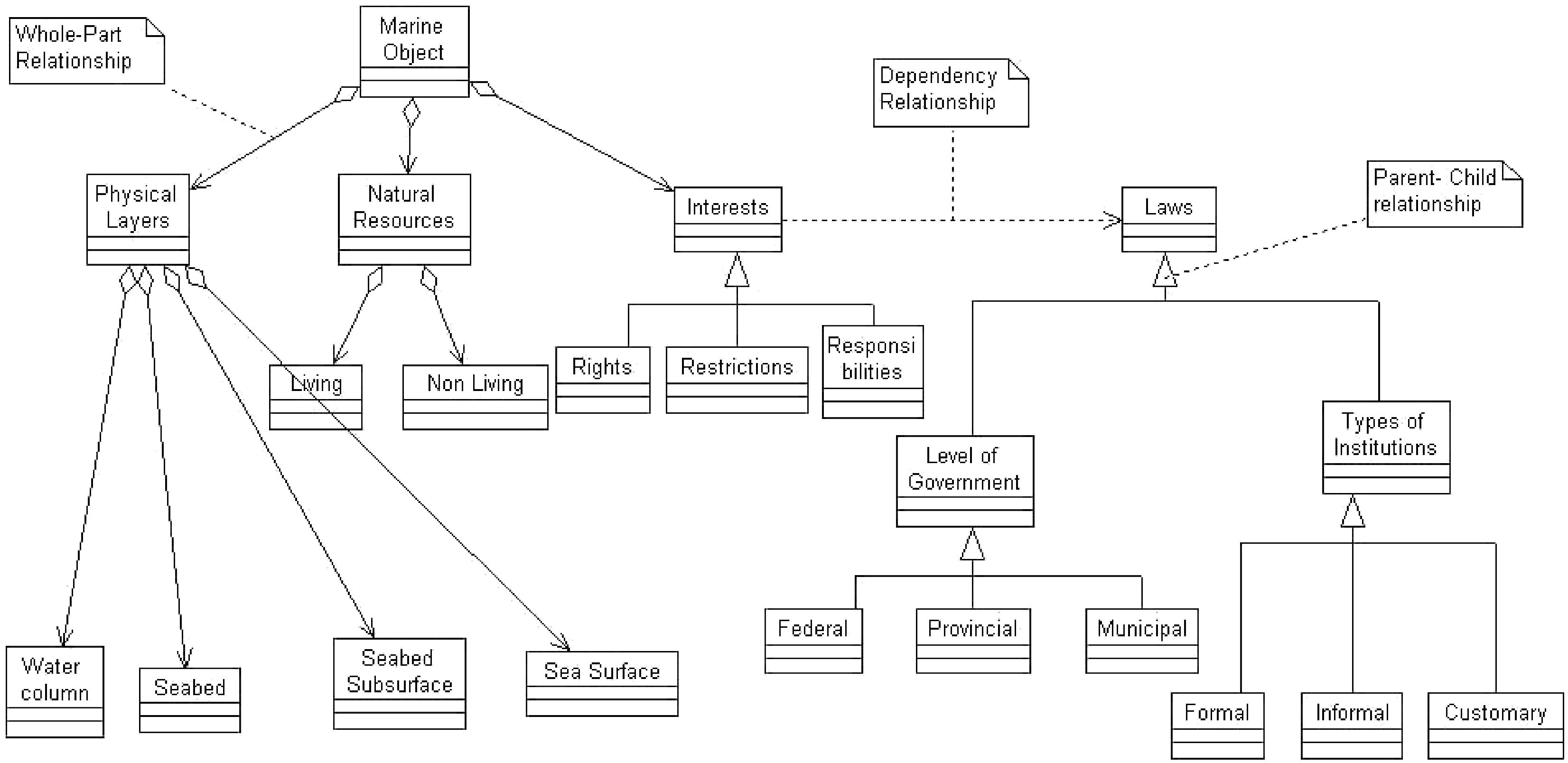

FIGURE 8.12 - MARINE PARCEL DATA MODEL
(from Ng'ang'a et al [2004])

8.4 WebGIS Technologies

It has been demonstrated that up-to-date, useful, complete, accurate and timely information is essential for better decision-making and therefore can enhance good governance. The point was also demonstrated in the previous chapters that to obtain all relevant information of this quality, it is possible that one may have to access the data stores of many diverse and scattered stakeholders. A created spatial data infrastructure is useful but one infrastructure that is already in place and utilized in conjunction with web-GIS technologies to share spatial information is the internet/worldwide web ("the Web") [Sutherland, Wilkins and Nichols, 2002; Sutherland and Nichols, 2001; Shu-Ching et al, 2000].

The emergence of web-GIS technologies, that can obviate the need for tedious and sometimes clumsy data conversion and sharing processes, is an opportunity for easier collaboration, integration and cooperation among organizations with a stake in good governance of coastal and marine spaces. This is done by using the Worldwide Web which provides an environment for data sharing and integration without organizations having to make any major changes to the structure and formats of the data they maintain. Sutherland and Nichols [2001] expound the benefits of web-GIS technologies to governance as follows:

> Certain web-GIS technologies, although not yet with the full range of analytical capabilities of most contemporary desktop GIS, now facilitate the transmission, integration, visualization and analysis via the internet of spatial information stored in geographically dispersed locations. These new technologies also support different data formats (e.g. ESRI shape files, CARIS, Oracle 8I, orthophotography etc.), projections, scales, datums etc., with conversions and visualization being done "on the fly." A user with permission to access the data sets need only have access to a web browser in order to view, query, and analyze the data sets. Although

still effectively in their infancy, these new technologies show remarkable promise for rapid development.

What does this all mean to the stakeholders in coastal and marine governance? Typically, these stakeholders operate in one or more of the private, community, and public spheres. Their mandates and interests, though overlapping, may vary considerably. They may have made investments in digital spatial data management in varying degrees according to socioeconomic resources at their disposal, preference for certain technologies, and according to their particular interests and goals. As mentioned earlier, these factors contribute to barriers in the efficient and sustainable governance and use of marine and coastal spaces, as crucial decision-making more often than not depends on access to data and information that may be stored other than in one particular stakeholder's database.

However, the ability afforded by the development of web-GIS technologies for stakeholders to share and integrate spatial information without significant investments in changing the way in which they store their data, also more easily facilitates collaborative, cooperative and integrative governance. Various levels of government, the private sector, and communities with rights and interests in a particular coastal or marine area may now collaborate, coordinate or cooperate on that area's governance by sharing with each other in real-time and over the internet, spatial data they maintain. This level of governance may be attained without any one party being forced to change the way in which it maintains its data sets in order to accommodate integration of that data set with another. This may represent significant savings in time and money.

8.5 Summary and Conclusions

A logical national marine boundary database framework was presented in this chapter. The design was first presented as a general object-relational model and then the same framework was examined from the perspective of the International Hydrographic Organization (IHO) S57 model. The database framework presented is general and can be modified or extended.

From the documentation S57 does not seem to support the concept of a boundary object unassociated to specific area types. For instance, there is a traffic separation scheme boundary object that is related to a traffic separation zone object. This seems to support specific boundary types linked to specific area types. The documentation also supports specific objects for specific boundary types not necessarily linked to area objects (e.g., international maritime boundary -- although this particular example was mentioned in the S57 documentation no details were found for an international boundary area). There is also a cartographic line object, but this object is not permissible on Electronic Nautical Charts (ENC) [International Hydrographic Organization, 2000]. The possible S57 model presented in this document is based on the understanding that specific area objects are linked to specific boundary objects.

The framework designed is strong in that it can handle most of the complexities associated with marine boundaries, and is flexible in that it can be expanded to meet specific needs. The framework is weak in that it represents 2-dimensional aspects of marine boundaries instead of at least three dimensions as exists in a real marine environment.

There are many initiatives and technologies such as webGIS, MGDI and marine cadastres that target the governance of coastal and marine spaces through the management of marine boundary information. They may have different functionalities and objectives but common to all is the management of marine spatial information. The spatial extents linked to the many rights existing in coastal and marine spaces are one very important aspect of spatial information. These initiatives and technologies need to consider that taking cognizance of the at least three dimensional nature of marine rights and their boundaries is a benefit to improving the quality of good governance of marine spaces. A summary of the major points made in this chapter is found in Table 8.3.

Table 8.3
Summary of Major Points in the Chapter 8

The creation of a national marine boundary database would contribute positively to the good governance of Canadian marine spaces. This database should adequately represent data relating to: • Boundary spatial information relating to the 3-dimensional nature of the marine environment; • Boundary classification; • The level of responsible government; • Applicable laws; • The creators, types, and levels of laws impacting upon the boundaries; • The rights, restrictions, and responsibilities associated with the boundaries; • Other appropriate metadata.
The IHO S57 standard for ENCs is a good initial object model for the creation of a national marine boundary database. Its encoded objects, including "face" objects, apparently gives the model the ability to model 3-dimensional spatial extents (or marine volumes). However, the S57 model is geared towards ENC navigation use and therefore boundary GeObject classes without direct navigation implications would have to be created and structured in order to make the model have a more general application to the good governance of marine spaces.
MGDI, marine cadastre, and WebGIS technology can enhance the good governance of marine spaces through better management of marine boundary information. However, the successful implementation of any of these systems implies the creation and maintenance of appropriate stakeholder relationships (i.e. collaboration, cooperation, and integration).

CHAPTER 9

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

9.0 Summary

Each society is structured in a particular way and has its own dynamics. Within a society a number of factors are at any time guiding the competition for needed resources to achieve various objectives, including:

- Demographic composition;
- Political and administrative systems;
- Elements of social and economic structures such as:
  - The distribution of power;
  - The distribution of property;
  - The relationships among groups (classes, tribes, castes, religious groups etc.);
  - The economic and occupational structures;
  - The extent of social mobility and role flexibility;
- Value systems and cultural/traditional beliefs.

It has been said that as societies develop, their objective is to meet the basic needs of everyone within that society. However needs may be less important than values. A society may be defined as traditional or modern, but even if a society has experienced modernization it still retains marks of its traditional culture that still affects attitudes, beliefs and values within that society. The values held within a society (by various groups) are determinants affecting the socio-economic and political dynamics operating therein, as well as influencing the various subjective visions of the "good life" being pursued at any point in time. These visions of the "good life," being part of individual or group life objectives, are used by these individuals or groups as standards of measurement of improvements to human well-being in light of contemporary social changes. This measurement is continually done as the society pursues its version of socio-economic and political development.

Governance is the management of stakeholder relationships with one another as they relate to their current and possible future social, economic, political and physical environments through the dictates of value systems. It is the process whereby a society, polity, economy, or organization (private, public or civic) steers itself as it pursues its socio-economic and political objectives. Governance harnesses decision-making with a view to managing change in order to promote the well-being of citizens. Decision-making requires information in order that objectives may be achieved and therefore governance requires information of all types (e.g. socio-cultural, economic, political, scientific, environmental, spatial etc.).

The need for information of all types is especially crucial to governance of marine spaces. Marine spaces provide natural, social and economic functions that contribute to increased quality of life. Additionally these spaces are sources of wealth for humankind by providing:

- Sources of food from animals, plants and fish;
- Means of transportation;
- Means of communication (e.g. cables);
- Areas for implanting fixed navigational installations (e.g. lighthouses and piers);
- Areas for the dumping of waste materials;

- Areas for scientific research on Earth's basic physical and biological processes.

The importance of marine spaces results in intensive and often competitive use. Accurate and up-to-date information (on many levels) regarding the resources that currently exist, the nature of the environment within which those resources exist, as well as on the users of those resources is therefore beneficial for effective management of marine resources. Information on (but not limited to) living and non-living resources, bathymetry, spatial extents (boundaries), shoreline changes, marine contaminants, seabed characteristics, water quality, and property rights all contribute to the sustainable development and good governance of marine resources.

There are many types of rights relating to marine spatial extents. These rights are owned by many stakeholders and can be surface rights, or rights to the water column, bed or subsoil. The at least 3-dimensional nature of especially the marine environment increases the complexity of the rights in that the rights themselves are at least three dimensional in nature. In other words the rights more often than not relate to volumes of marine space. At the same time these rights can overlap and that increases the complexity of the management of the rights. This complexity of rights means that the boundaries, associated with the spatial extents to which the rights are attached, are themselves complex.

The definition of a boundary as a line is certainly inadequate in the marine environment where even the public right of "surface" navigation technically involves some other portion of the water column. The perception of a boundary as a line has surely been influenced by the traditional nature of the modeling media. Maps, plans and charts even in the digital age are mostly 2-dimensional models, and even though there are

3-dimensional renderings of land and marine spaces boundaries have mostly been overlaid upon the rendered surfaces as lines.

Considering the at-least 3-dimensional nature of the bounded spatial extent, the author suggests that a boundary is more adequately described as a *plane* sectioning 3-dimensional (and probably more accurately 4-dimensional) space. The plane represents an agreement between owners of rights to contiguous spatial extents as sanctioned by legislation, law or by some other culturally relevant framework of rights, responsibilities and restrictions that shape the nature of a person's perception of his/her connection to 4-dimensional land or marine spaces.

It is generally accepted that it is the polity (at least in the Western world) that is legislated with the power to provide sovereign direction, as well as provide facilitation for social and economic activities in relation to all resources within sovereign borders. Politics is the art and science of government or the management and administration of state affairs. Government has a number of requirements with regard to state affairs, all of which have spatial dimensions in both land and marine spaces. These include the requirement to have, among other things:

- The security of its sovereign borders;
- The maintenance of socio-economic and political relations with other states;
- The enforcement of its jurisdictional powers;
- The exercise of its administrative powers and enforcement of policies;
- The facilitation of the positive development of its economy;
- The facilitation of the socio-cultural well-being of its citizens;
- The facilitation of the management of its natural resources.

The fact that these requirements have spatial dimensions in relation to marine spaces means that that maintenance of marine boundaries is an important contributor to their achievement. Marine boundaries have certain unique characteristics. These include the fact that they:

- Are likely to affect a significant portion of the world's population;
- Are more likely to be adjacent to or encompass valuable natural resources;
- Are subject to ambiguity in definition and positioning in reality;
- Are difficult to demarcate in relation to wholly marine boundaries;
- Are ambulatory in terms of tidal coastal boundaries.

In general, marine boundaries can be categorized as environmental or human-interactive. Environmental boundaries are biological, ecological etc. in nature and are not part of the focus of this thesis. Human-interactive boundaries are so described because human consciousness of them serves as frameworks for interaction with either the environment or other humans. Marine boundaries can also be classified according to the rights associated with the spatial extents enclosed by the boundaries. These rights include sovereign, jurisdictional, administrative, private, customary and aboriginal rights. In Canada these boundaries occur within the framework of legislation, common law, memoranda of understandings, accords, traditions and cultural heritage that each defines the nature of human interaction with each other and with the spatial extent delimited by the boundaries.

In Canada there are legal, technical and scientific problems associated with marine boundaries. Legal problems include the spatial dimensions of Federal-Provincial jurisdiction conflicts, unclear aboriginal rights, and rights associated with public and private utility of marine spaces. Technical problems are associated with datum definitions and transformation, survey problems linked to locating marine boundaries "on ground," and the quality of boundary information in scattered databases that inhibit the easy integration of boundary information to support good governance of marine spaces. The lack of scientific knowledge of tidal processes to support the definition of tidal datums and their consequent boundaries is also a problem that needs to be addressed.

There are approximately 1000 CHS charts. Although nautical charts are primarily navigation instruments and do not adequately model the 4-dimensional complexity of marine boundaries, they are still useful media for the dissemination of boundary information to support governance activities in marine spaces. This is evidenced by the fact that charts have been assigned utility outside of supporting safe navigation, for example in use as support documents for making continental shelf claims. Many relevant sovereign, jurisdictional, administrative, public/private rights-based, and public/ private interest-based boundaries currently appear on one or another CHS charts, but there are many other explicit, implied and potential marine boundaries that could and should be included.

It was brought out that certain boundary requirements are desirable to achieve good governance, but their absence may not significantly or negatively affect the *governance of a lesser degree* of marine spaces. It was also determined that marine boundaries can have multiple functions and their requirement to support the good governance of marine spaces can vary according to the function they perform.

9.1 General Conclusions of this Research

The research presented in this thesis lead the author to arrive at certain general conclusions. The conclusions are as follows:

- All human societies, are territorial and therefore boundaries, spatial and others, are important components of the way humans relate to one another and to the resources in the natural environment;
- Coastal and marine spaces are important to all life on Earth, and are of cultural, social, economic and political value to human societies;
- Humanity is faced with the dilemma of exploitation as well as conservation of coastal and marine spaces and therefore sustainable development is an essential concept in the governance of coastal and marine spaces;
- Governance is not new but the science of governance is fairly new. It is all-encompassing touching every area of human existence. There are many definitions of governance. Governance takes many forms and takes place on many levels;
- Science, technology and community knowledge are all very important to governance;
- Government, playing the role of facilitator of socio-cultural, economic, and environmental management activities, is the most pervasive player in governance;
- Although government is the most pervasive stakeholder in governance, the level of roles that it plays in any governance activities should be evaluated to assess whether other stakeholders are capable of more efficiently performing those roles;
- Where government is the ideal stakeholder to perform certain tasks, it should still engage in collaborative, cooperative, integrative etc. governance with all other stakeholders whose objectives are relevant;

- A holistic view of human society supports better understanding of governance requirements as this perspective affords a better understanding of cause and effects of systems and actions. This, for instance, has to be taken into consideration when designing policies to protect coastal and marine resources. The land and marine environments affect each other and this has to be taken into consideration when creating boundaries designed to offer protection to resources;
- To achieve the benefits of collaborative, cooperative, integrative etc. governance there is the need for modification to our mental maps that determine how we relate to one another and to the natural environment. If we don't share the same visions and understand one another's objectives then good governance can be undermined;
- The quality of a governance instrument (e.g., a coastal policy) affects the quality of governance;
- An organizational structure should be designed so as to facilitate the communication of relevant information, including boundary information, to all levels of functionality
- Information of all type is critical to the governance of land and marine spaces;
- The combination of organizational structures, human resources, and systems must facilitate the dissemination of legal knowledge to all levels of organizational functionality so that managed boundary information reflect the legal understanding of the boundary represented;
- Human-interactive boundaries in Canada are generally sovereign-rights (i.e. implying supreme rights of ownership), jurisdictional, administrative, rights-based (less than sovereign) and interest-based;

- If Canadian provincial authorities that have interests and rights in contiguous marine spaces would cooperate and collaborate in the collection and management of coastal and marine boundary information, there would be a reduction in duplicate efforts to manage the information, and consequently a reduction in associated costs;
- The quality of governance is affected by the combination of stakeholders, stakeholder value systems, available information, organizations and organizational structures, institutional design, policies, legislation and laws, governance forms (e.g. collaboration, integration, cooperation etc.), information and information infrastructures;
- Rights in the coastal and marine environments are linked to spatial extents and therefore the management spatial information (and by implication boundary information) is crucial to coastal and marine governance;
- Many types of possible, complex and overlapping rights are affected by coastal and marine governance and these rights must be taken into consideration in the formulation and execution of any governance mechanism so as to determine who has the right to make decisions about access to, and allocation of resources, and whose rights are affected by those decisions;
- All sanctioned human activities in land and marine environments have spatial dimensions and therefore also have boundary implications. Boundaries and boundary information (marine or land) are therefore important components of good governance;
- The effectiveness of the laws and policies are in part dependent upon the land and marine boundaries enclosing the spatial extents that are targeted by the laws or policies;

- The quality of information (i.e., the qualities of being more up-to-date, accurate, useful, timely and complete) available to support decision-making affects the quality of the decision-making. This is true of marine boundary information;
- Delimited marine boundaries, and spatial databases containing marine boundary data should reflect the legal definition of those boundaries;
- The choice of a boundary type can affect the quality of governance over the area enclosed by that boundary;
- The logical placement of a marine boundary is just as important as its mathematical positional accuracy in order to achieve its maximum functionality;
- Although technology and modern methods allow for precise positioning of boundaries, less precise positioning of boundaries (i.e. accuracy to metres instead of accuracy to millimeters) is often sufficient to facilitate governance activities in marine spaces;
- Positional accuracy, certainty of legal definition, and conformity to legal definition are requirements common to most marine boundaries;
- There is the need for a chart-topographic base map;
- MGDI, marine cadastre, and WebGIS technology can enhance the good governance of marine spaces through better management of marine boundary information. However, the successful implementation of any of these systems implies the creation and maintenance of appropriate stakeholder relationships (i.e. collaboration, cooperation, and integration);

- Marine cadastre has been recognized by nations and regions as an important tool in the governance of their marine spaces, and there is the need for Canada to put more investment into the idea of building a Canadian national marine cadastre;
- There is the need to have up-to-date coastline surveys at appropriate scales to support the good governance of Canadian marine spaces;
- There is need for appropriate metadata associated with coastline data at all levels.

9.2 Major Findings and Contributions of this Research

This section presents major findings and contributions of this research. Some of the findings are themselves major contributions.

9.2.1 A New Definition of Governance

Governance is defined in this dissertation as the management of stakeholder relationships as stakeholders relate to their current and possible future social, economic, political and physical environments through the dictates of value systems. This is a new definition of governance synthesized from numerous previous researches. Key to this definition (as described in Chapter 3) is the essential element of information. Information of all types, including boundary information, is required for governance to be efficient, accountable, flexible, and able to preserve community identity. Efficiency, accountability, preservation of community identity, and capacity for change are criteria for good governance.

9.2.2 A More Appropriate Definition of What is a Boundary

This dissertation has argued that a boundary is more than a line. It is a plane of separation between at least two spatial extents to which are attached certain characteristics or norms of human interaction with other humans and the natural environment. The definition of boundaries as planes is new and is an important contribution to the good governance of marine spaces since the perception of marine boundaries as lines is insufficient to model the volumetric complexities associated with rights to marine spatial extents. As visualization technology improves, this definition will become more relevant to the communication of higher quality boundary information in support of the good governance of marine spaces.

9.2.3 The Identification and Classification of Canadian Marine Boundaries

A marine boundary classification scheme was presented in Chapter 5. The classification scheme contributes to the governance of Canadian marine spaces in that:

- It provides a more complete list of Canadian marine boundaries and thereby improves boundary information that affects the governance of marine spaces;
- It provides classification(s) of each boundary, and this adds to the arsenal of information that supports the governance of Canadian marine spaces from a sovereign, jurisdictional, or administrative point of view;
- It identifies the level of government responsible for maintaining the boundaries, and information on the boundaries. This contributes to the efficiency of the overall governance decision-making process by arming stakeholders with

improved knowledge of the spatial extent(s) over which they may exercise authority;

- It provides information regarding marine boundaries that are not currently included on CHS charts and whether these boundaries should be included on CHS charts. Including the currently excluded boundaries on CHS charts provides to stakeholders more adequate notice of spatial extents to which policies and laws apply, thereby improving the enforcement aspect of the governance of marine spaces.

9.2.4 The Design of a Logical Marine Boundary Database Model

Recognizing that CHS charts have utility beyond being used for navigation, and recognizing CHS charts as valuable media for the display of marine boundaries to support the good governance of marine spaces a design of a logical Canadian national marine boundary database framework applicable to CHS charts is presented in this Chapter 6. The logical national marine boundary database framework design is first presented as a general object-relational model and then the same framework is examined from the perspective of the International Hydrographic Organization (IHO) S57 model for ENCs. The design as presented facilitates the answering of certain questions essential to the governance of marine spaces such as:

- What type of boundary is this?
- What is the spatial extent associated with this boundary?
- What are the rights, responsibilities and restrictions associated with this boundary?

- Which legislation or law dictates the rights, responsibilities and restrictions associated with this boundary?
- What level of government created or administers this legislation or law?

The design is general but flexible, and can be modified or extended depending on the intended use of the database. For instance the design can be expanded to include (among other things) objects referencing occupiers or owners of the rights associated with a spatial extent and its boundaries. In this manner one would be able to answer the question as to who has what rights associated with a particular spatial extent and its boundaries.

The S57 design will facilitate easier sharing of marine boundary information among all users of ENCs. This is because S57 is an internationally accepted standard for ENCs. The IHO S57 standard for ENCs is a good initial object model for the creation of a national marine boundary database. Its encoded objects, including "face" objects, apparently gives the model the ability to model 3-dimensional spatial extents (or marine volumes). However, the S57 model is geared towards ENC navigation use and therefore boundary GeObject classes without direct navigation implications would have to be created and structured in order to make the model have a more general application to the good governance of marine spaces.

Based upon all the deliberations in this dissertation, the creation of a national marine boundary database would contribute positively to the good governance of Canadian marine spaces. In this regard the designs presented in Chapter 6 are important contributions.

9.2.5 The Design of Boundary Information Framework Models

Marine boundaries have multiple functions, and multiple classes of functions and their requirements to support the governance of marine spaces can vary according to the functions they perform. Considering that marine boundaries are often essential components of the good governance of marine spaces, one important issue addressed in this dissertation relates to the identification of the marine boundary requirements that give adequate support to the good governance of marine spaces. It was brought out in Chapter 7 that there are a number of boundary requirements depending on the type of boundary, and function of the boundary. These include:

- Certainty of legal definition;
- Conformity to legal definition;
- Agreement by parties to the boundary;
- Definition by coordinates where appropriate;
- Demarcation by buoys where appropriate;
- Adequacy of baseline definitions;
- Adequacy of tidal (and other) datum definitions;
- Up-to-date coastline surveys;
- Accuracy of positioning;
- Appropriateness of boundary location.

In relation to governance objectives discussed in Chapter 2, these requirements are incorporated in designs of boundary information framework models presented in Chapter 7. From this perspective the designs are major contributions of this research. The requirements in relation to identified governance objectives are summarized below.

For the political objective of protecting sovereign borders to be achieved, sovereign boundaries ought to meet the following requirements to varying degrees:

- Certainty of legal definition;
- Conformity to legal definition;
- Agreement by parties to the boundary;
- Definition by coordinates where appropriate;
- Adequacy of baseline definitions;
- Adequacy of tidal datum definitions;
- Up-to-date coastline surveys;
- Accuracy of positioning.

Marine boundaries supporting international political and socioeconomic relationships ought to meet the following requirements:

- Certainty of legal definition;
- Conformity to legal definition;
- Definition by coordinates;
- Accuracy of positioning.

Marine boundaries supporting the enforcement of jurisdictional powers ought to meet the following requirements to varying degrees:

- Certainty of legal definition;
- Conformity to legal definition;
- Definition by coordinates;
- Adequacy of tidal datum definitions where appropriate;

- Up-to-date coastline surveys where appropriate;
- Accuracy of positioning where appropriate.

Marine boundaries supporting the enforcement of laws and policies ought to meet the following requirements to varying degrees:

- Certainty of legal definition;
- Conformity to legal definition;
- Definition by coordinates where appropriate;
- Accuracy of positioning;
- Appropriateness of boundary location;
- Adequacy of datum definition where appropriate;
- Up-to-date coastline survey where appropriate.

Marine boundaries supporting the exercise of administrative powers and the delivery of services ought to meet the following requirements to varying degrees:

- Certainty of legal definition;
- Conformity to legal definition;
- Definition by coordinates;
- Accuracy of positioning;
- Appropriateness of boundary location;
- Adequacy of datum definition where appropriate;
- Up-to-date coastline survey where appropriate.

Boundaries associated with private, customary, and aboriginal rights ought to meet the following requirements to varying degrees:

- Certainty of legal definition;
- Conformity to legal definition;
- Definition by coordinates;
- Demarcation by buoys where appropriate;
- Accuracy of positioning where appropriate;
- Appropriateness of boundary location;
- Adequacy of datum definition where appropriate.

9.2.6 The Identification of Marine Boundary Information Requirements

An important issue addressed in this dissertation relates to the identification of what qualities and characteristics of marine boundary information are required to adequately support the good governance of marine spaces. A number of points were brought out in the discussions undertaken in Chapter 4. These include the fact that:

- Desirable marine boundary information is up-to-date, accurate, logically consistent, complete, and useful;
- Information can be up-to-date but not accurate, logically consistent, complete or useful;
- Information can be accurate but not complete or useful;
- Information can be complete but not accurate, up-to-date or useful;
- Usefulness of information depends upon a number of factors including:

- Accuracy, currency, and completeness of the information;
- Stakeholder access to the information, facilitated by:
    - Shared mental maps of stakeholders' objectives in the marine environment;
    - The willingness to share information;
    - Appropriate organizational structures to facilitate the sharing of information;
    - Qualified human resources to manipulate the information;
    - Affordable data access mechanisms;
    - Appropriate geographic information and other technologies;
    - Efficient database management systems;
    - Efficient spatial data infrastructures.
- The existence and application of data standards and metadata;
- Reliable output formats and appropriate scales for the intended use of the information.

9.3 Recommendations

Based upon all the information presented in this thesis, a number of recommendations are made. These recommendations are as follows:

- Canadian organization managing boundary information should ensure that their organizational structures, human resources, and systems facilitate the dissemination of legal knowledge to all levels of their organizations so that managed boundary information reflect the legal understanding of the boundary represented;
- The Department of Fisheries and Oceans Canada (through the Canadian Hydrographic Services) should:

    - Recognize the multiuse (apart from navigational usage) of CHS charts by users of Canadian marine spaces;
    - Recognize the importance of various types of marine boundaries that are not currently represented on charts;
    - Engage research of its entire suite of charts to determine the different types of boundaries that are shown and should be shown on each chart;
    - Take steps to develop a database of marine boundaries with a view to having the boundaries represented on CHS charts for the benefit of chart users, including those users that are not primarily interested in navigation;
    - In building a database of marine boundaries, consider the expansion and use of the IHO S57 model for internal use to include area and boundary objects not currently facilitated by the standard;
- All Canadian provincial spatial databases should be considered for conversion to NAD83 (CSRS) in accordance with Canadian federal acceptance of the standard. Service New Brunswick has already made the change;
- Although Canada has implemented initiatives such as MGDI, theoretically to address the information needs for the governance of marine spaces, more attention needs to be paid to marine boundaries as a component of the initiative. The existence of the United States' Marine Boundary Working Group is testament to the seriousness accorded by that country to marine boundaries. Canada should recognize this and follow suit;
- Canada should make more significant investments into developing a national marine cadastre. Ever since the project group (from the GEOIDE project entitled "") has been

presenting its work abroad, other countries such as Australia and the Netherlands among others have made moves to invest and develop national marine cadastres. Regional bodies such as the PCGIAP have shown great interest in the concept. Although the concept of a marine cadastre has previously proffered by researchers in New Zealand (among others) the level of work produced by the project group has taken the idea to new heights. Canada should take steps to keep this advantage;

- Further research should be undertaken to extend the knowledge of what is required of marine boundaries and marine boundary information to support the good governance of marine spaces. Although this research is significant, much more needs to be done in terms of assessing the requirements of all stakeholders in marine governance.

9.4 Final Comments

The major contributions described in Section 9.2 as well as other deliberations throughout this dissertation meet the objectives outlined in Section 1.3. Boundary information framework models were designed and presented in Chapter 7. Additionally it was demonstrated:

- In Chapter 2 that boundaries are spatially 3-dimensional, and that a 2-dimensional perception of boundaries, especially in marine spaces, ought to evolve;
- In Chapters 4, 5, 6, and 7 that geomatics and spatial information, boundary information in particular, play important roles as contributory factors in the attainment of society's greater social, cultural, economic and political goals;
- In Chapters 3, 4 and 6 that we are all stakeholders in the governance of land and marine spaces, and that cooperation, integration and collaboration of stakeholders that

result in the sharing of information among all stakeholders is beneficial to good governance.

Although specifically mentioned in Chapter 3, it was demonstrated via implication in many parts of this research that, although it is usual for humans to decompose reality with the aim of understanding the whole by understanding the parts, it may be better to understand systems as a whole (i.e. systems thinking) especially in the marine context. Finally, through discussions presented throughout this dissertation, those involved in geomatics research should understand that geomatics technology is not an end in itself, and that geomatics contributes importantly to the quality human life. Acquisition of this awareness ought to be reflected in the nature and quality of engineering designs that are proffered by the geomatics profession.

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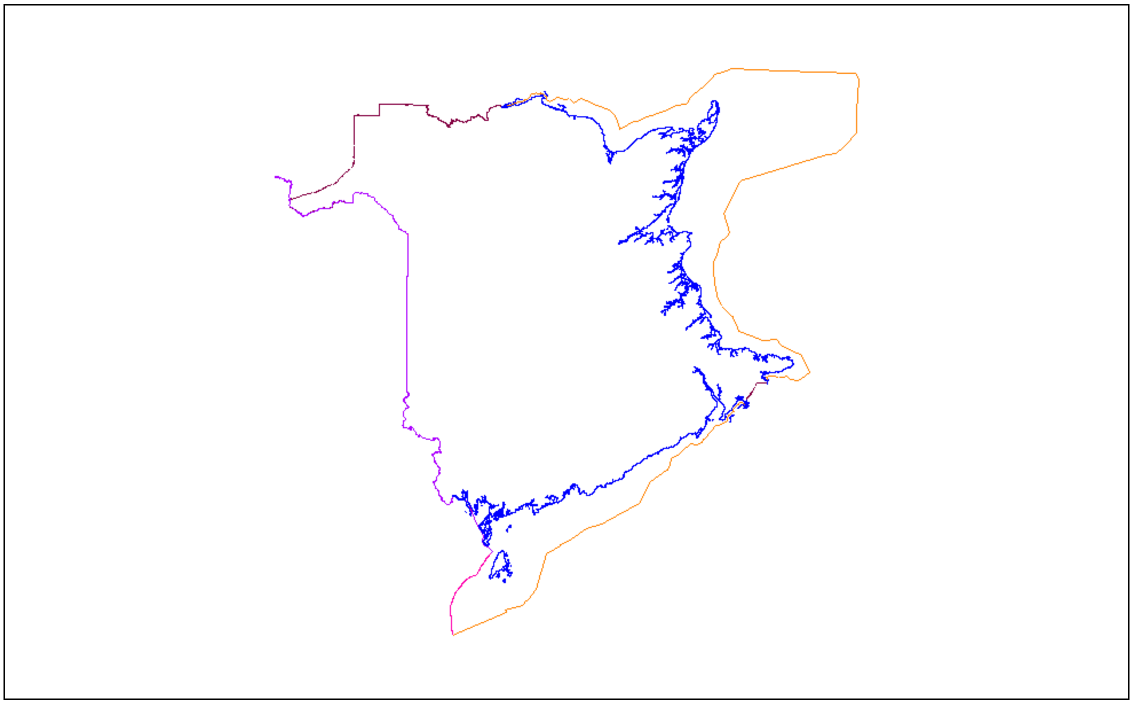
APPENDIX I

REPORT ON THE PROCESS OF CREATING POLYGONS REPRESENTING NEW BRUNSWICK'S SUBMERGED LANDS

REPORT ON THE PROCESS OF CREATING POLYGONS REPRESENTING NEW BRUNSWICK'S SUBMERGED LANDS



Completed under Contract 00-048
Version 2.0

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1.0 INTRODUCTION

This document outlines the process of creating two polygons representing the submerged lands of New Brunswick. The rationale for the choices made in this process is also described, as each sub-process is outlined. The NAD83 coordinates for the line segments encompassing the final Submerged Lands polygons, except the Coastal Data Base 98 line segments, are listed in the Appendix.

The basis for this document is a contract numbered 00-048 between Service New Brunswick and the University of New Brunswick (in particular the Department of Geodesy and Geomatics Engineering). The model workflow process for creating the polygons is graphically described in Figure 1. More details on the actual processing of the files are outlined in this document.

The databases used in the model were chosen because of their availability. The confidence placed in each database is outlined in the "hierarchy of confidence" set out in Table 1.

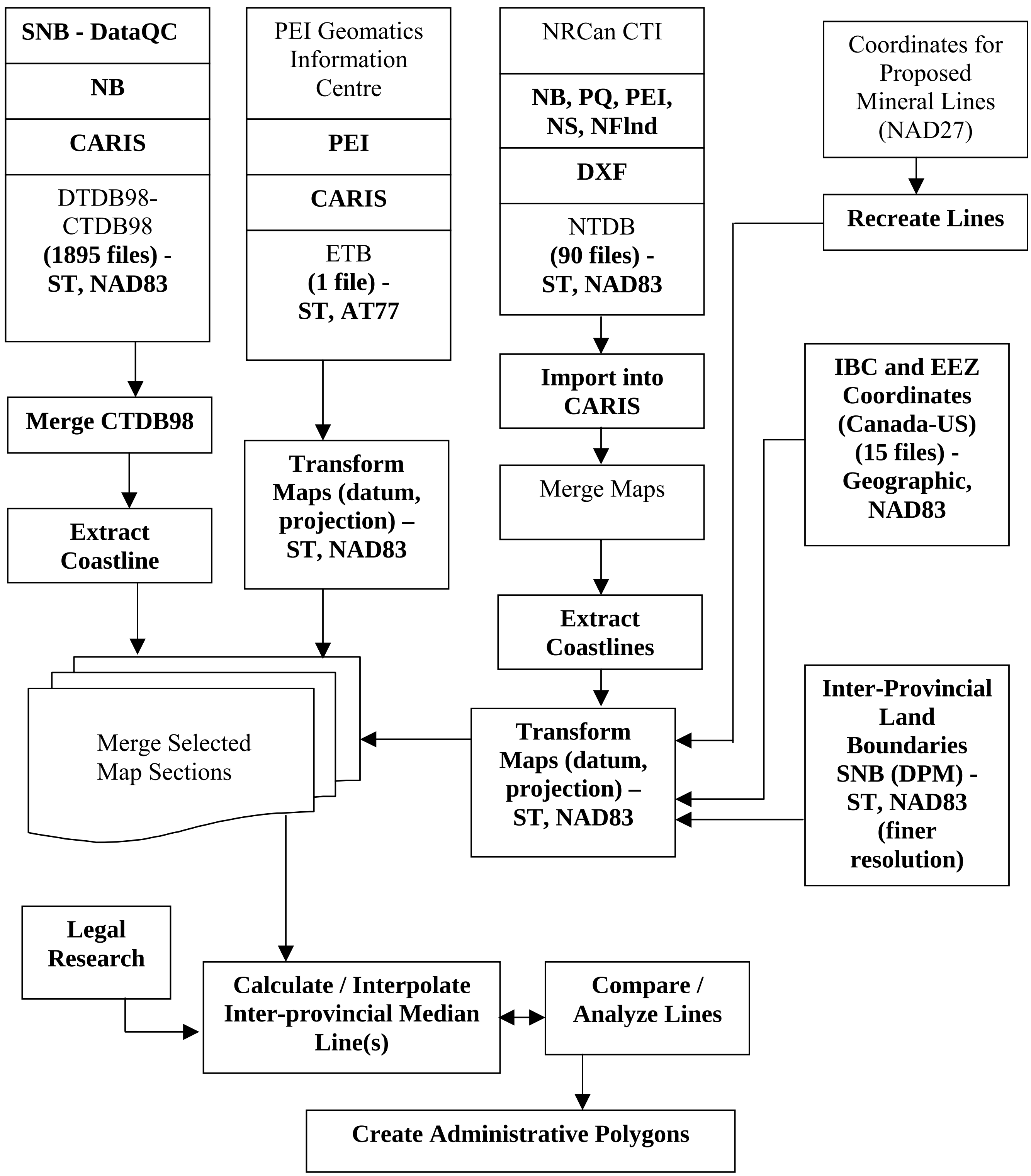

Figure 1 General Description of the Process Workflow

Table 1 - Hierarchy of Confidence in Imported Data Sources

Database	Hierarchical Position	Rationale
CTDB98	1	This is the database to which the final product must fit, and the data has been subjected to known quality control. This data will take precedence over all other data representing the same geographic extent.
IBC coordinates (NRCan)	1	These are published coordinates downloaded from NRCan (http://www.geocan.nrcan.gc.ca/ibc/ibccoord-nad83.htm). This data will take precedence over all other data where international boundaries are represented except where [a] gap(s) exist(s).
PEI ETB	1-2	Apparently quality checked and reported to have a positional accuracy of ± 2.5m. This data may take precedence over NTDB data for the geographic area it represents
Proposed DNRE Mineral Lines and Shore Points	1-2	These data supplied by the New Brunswick Department of Natural Resources and Energy (DNRE). They represent coordinates that were the result of a field survey exercise for proposed mineral sharing lines between the Maritime Provinces.
IBC and EEZ coordinates (DFO-CHS)	2 - 3	These coordinates were obtained from DFO via email. This data may take precedence over other data representing international boundaries where gaps exist.
NRCan's NTDB	4	Positional accuracy range from 10 metres (urban areas) to 125 metres (isolated areas). However this data will take precedence in those geographic regions where no other data has been acquired by UNB.
DPM Iter-provincial Bounaries	5	Consultation with knowledgeable entities has caused UNB to place some doubt on the positional accuracy of this data. However, without other data of higher positional accuracy this data will take precedence with regard to inter-provincial boundaries.

1.1 Definitions

There are certain words and phrases used in this chapter that, because of the context in which they are used, require definition. The definitions are listed below in Table 2.

Table 2 – Definitions
After SNB DTDB98 As-Built Specifications

Term	Definition
Attributes	Descriptions associated with graphic entities; can be CARIS Attributes or Non-Graphic Attributes.
CARIS Attributes	For these Technical Specifications, this refers to Feature Code, Source Id, Theme/User Number, and Index Key, as defined within the CARIS data structure.
CARIS ASCII	An ASCII file format within the CARIS suite of file formats, that supports topology, and can be used in multiple computer operating environments.
Client	As per definition in legal contract.
Contractor	As per definition in legal contract.
CTDB98	Service New Brunswick's Coastal Topographic Data Base.
DTDB	The New Brunswick Digital Topographic Data Base, comprised of the ETB and the DTM.
Dataset	The subset of topographic features that comprise that area in New Brunswick consisting of one 1:10 000 window, as referenced in the LWISM.
Dataset Boundary	A closed figure, defining the Dataset limits.
ETB	Enhanced Topographic Base which contains planimetric entities describing natural and man made features.
EEZ	Exclusive Economic Zone as defined by the United

Term	Definition
	Nations Convention on the Law of the Sea (UNCLOS) 1976
Feature Code	A CARIS Attribute usually used to describe the nature of a feature.
Index Key	A CARIS Attribute usually used to cross-reference a graphic component to an attribute file.
LWISM	The New Brunswick Land and Water Information Standards Manual.
Ordinary High Water Mark	The most discernable mark on the ground created by the medium high tide between the spring and the neap tides. On sand and cobble beaches, it is commonly identified by lines of seaweed and debris, changes in beach slope, changes in sedimentation, or changes in hue. On boulder beaches and rock platforms, the limit of intertidal flora and fauna or watermarks may be indicators. Where man-made features extend to or below the Ordinary High Water Mark, the coastline will follow either evidence on the structure, or in cases of no apparent evidence, an elevation transferred from the adjacent Ordinary High Water Mark. On Coastal Marshes, the location of the Ordinary High Water Mark is dependent on the composition of the marsh relative to the percentage of high and low marsh. For high marshes that are characterized by only infrequent flooding by the highest tides the ordinary high water mark would be located seaward of the marsh. As low marshes are usually flooded daily by the tides, the ordinary high water mark would define either the landward limit of the marsh or a separation between high and low marsh where the two forms of marsh occur together.
Polygon	A fully enclosed area feature bounded by one or more Segments.
Resolution	The smallest unit to which a point can be expressed in a digital file.
Segment	A sequence of connected points.
Source Id	A CARIS Attribute usually used to describe the data source, and other attributes.

Term	Definition
SLDB02	The Submerged Lands Data Base described in these Technical Specifications being planimetric data representing relevant hydrographic themes that are coastlines and wholly marine boundaries encompassing New Brunswick's marine administrative areas.
Submerged Lands Theme File	For these Technical Specifications, the file containing hydrographic data representing the submerged lands of New Brunswick.
Theme/User Number	A CARIS Attribute usually used to group features that are logically consistent.
Virtual Line	A line which does not describe a physical entity; it is used to add logic to the data.
Working File	For these Technical Specifications, the file in which all data processing occurs.

2.0 EXECUTING THE PROCESS MODEL

This section describes the execution of the process model. See Figure 1 for a graphic representation of the general work process. The processing of each imported database into the work file through to the process of visual and spatial analysis and manipulation to produce the submerged lands polygons are described.

2.1 Processing the CTDB98 Files

The CTDB98 files were processed as outlined in Figure 1. The resulting line segments appearing in the work file are shown in Figure 2. The CTDB98 was obtained in CARIS GIS format (specifically, a continuous database of 1895 files). The x and y resolution of this data is 1.0 metre. The CTDB98 continuous database was loaded in CARIS GIS and the following features (Table 3) with feature code = WACFOH* extracted to a working file of the same projection, resolution, scale and datum:

Table 3 – Extracted CTDB98 Features

FEATURE CODE	FEATURE	SOURCE
WACFOH20	Ordinary high water	Via photogrammetry – line overlaid on 1996 ortho-photo by GeoNet. Sample field survey conducted (surveyor, UNB, SNB, DataQC) to capture a portion of OHW. This line compared with ortho-photo line (good) and aided in the production of the final line.
WACFOHIS20	Ordinary high water – island	
WACFOHLL20	Ordinary high water – landward limit sharing	
WACFOHLLIS20	Ordinary high water – landward limit sharing -island	
WACFOHLL_V	Ordinary high water – landward limit sharing virtual line	
WACFOH_VN	Ordinary high water virtual neat line	

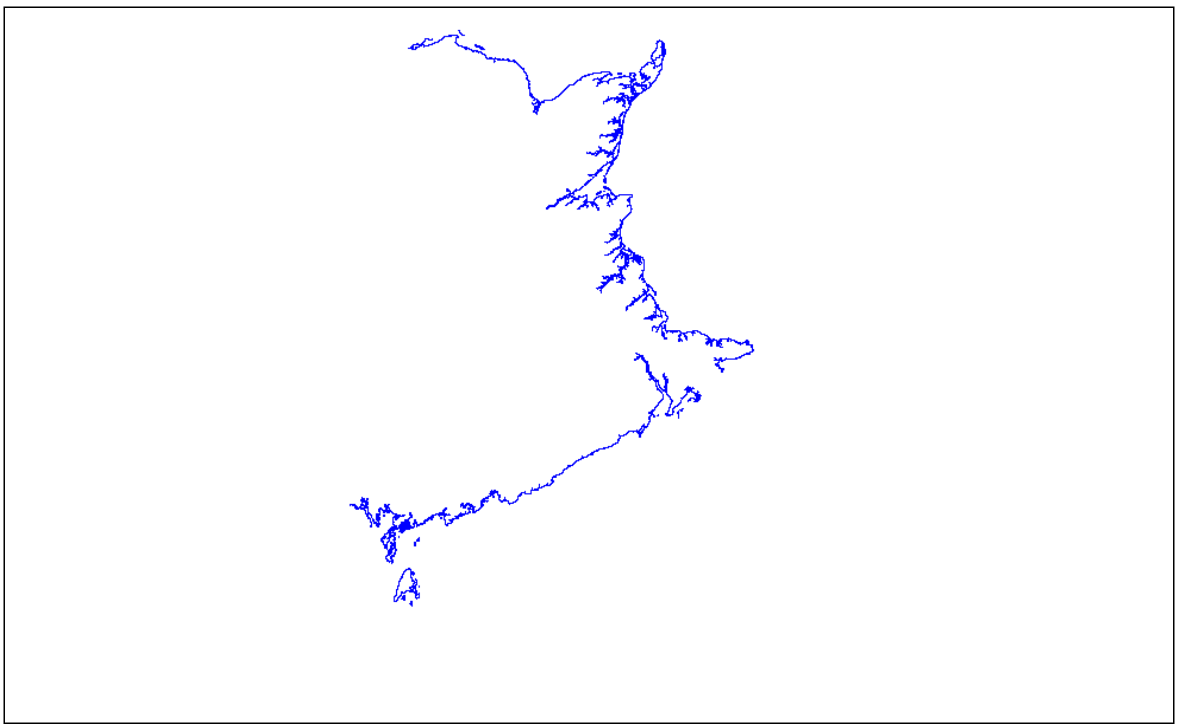

Figure 2 – Extracted CTDB98 Segments

2.2 Processing the NRCan NTDB Files

The NRCan NTDB files were processed as outlined in Figure 1. Data from 90 NRCan NTDB files were acquired in order to provide the relevant parts of these coastlines. These datasets are in geographic projection and referenced to the NAD83 datum and NRCan's hydrographic layer were provided in DXF format. The resulting line segments appearing in the work file are shown in Figure 3. The following features (Table 4) were extracted, merged, transformed to the New Brunswick stereographic projection, NAD83 and then incorporated into the working file:

Table 4 – NTDB Imported Features

FEATURE CODE	FEATURE	SOURCE
WATERBODY_14	Coastlines, rivers, lakes etc. (coastlines extracted)	Scanned and vectorized from paper maps existing at "the time". Paper maps would be created from aerial photos flown either spring or late autumn (minimum tree cover) [Sabourin, Pierre (2001), telephone conversation dated December 18, 2001]

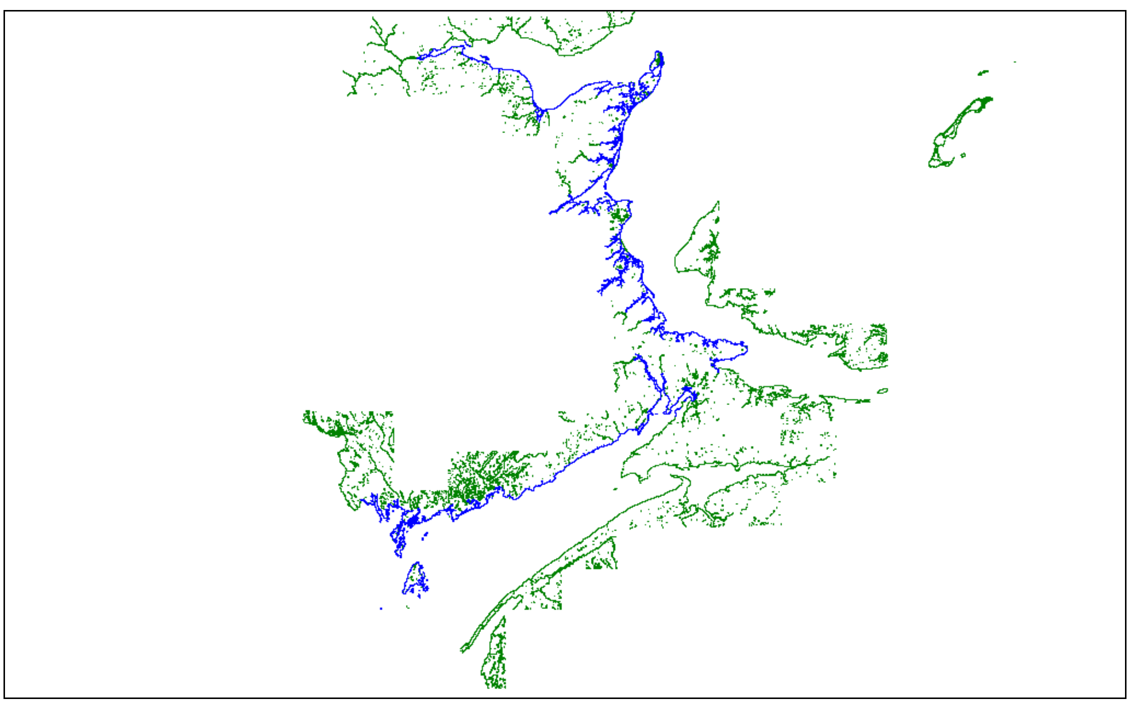

Figure 3 – Line Segments in Work File after NTDB Files imported

2.3 Processing PEI's Geomatics Information Centre (GIC) Files

The PEI GIC files were processed as outlined in Figure 1. The resulting line segments appearing in the work file are shown in Figure 4. Data from Prince Edward Island's Geomatics Information Centre (GIC) were acquired in order to provide the relevant parts of this coastline. This dataset is in stereographic projection and referenced to the AT77 datum and was provided in CARIS ASCII format. The x and y resolution of this data is 0.05 metre with a stated positional accuracy of ±2.5m. The following features (Table 5) were transformed to the New Brunswick stereographic projection, NAD83 and then incorporated into the working file.

Table 5 – PEI GIC Imported Features

FEATURE CODE	FEATURE	SOURCE
INLIWA	Coastline	LRIS aerial photo , ortho500 (photogrametric plotters) processed mid to late 1980s. Stated accuracy = ± 2.5m
INLAWA	Coastline text	

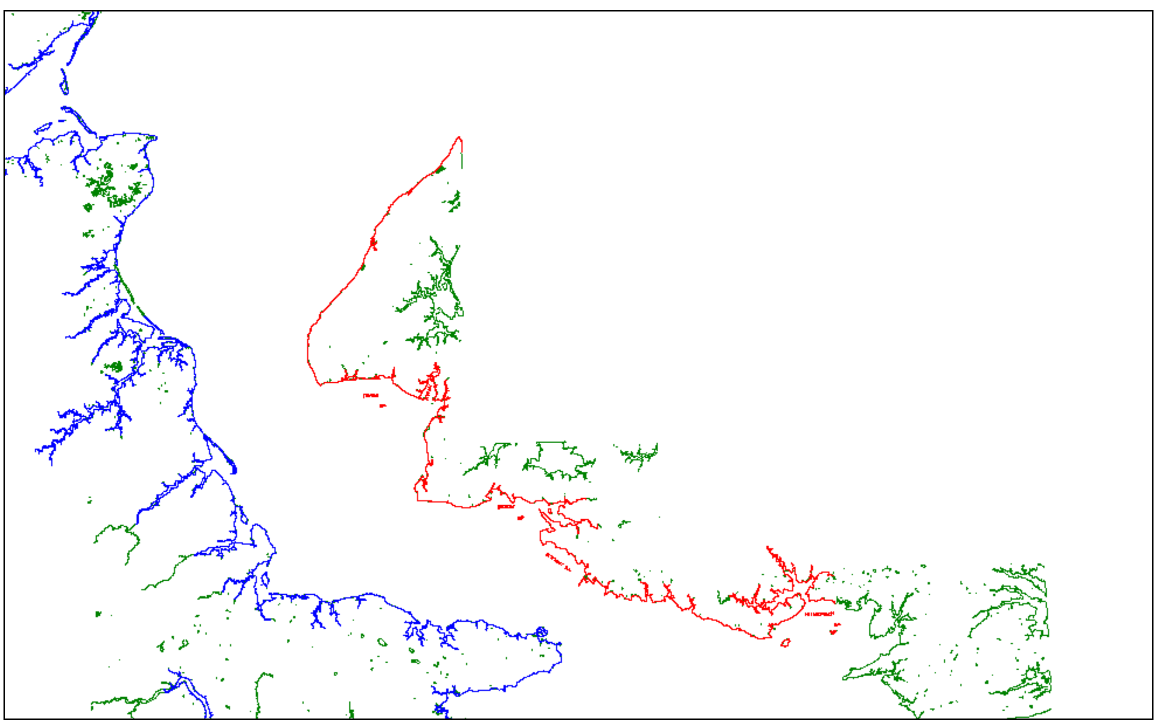

Figure 4 – A Portion of the Work File after PEI GIC Segments Imported

2.4 Processing SNB's Digital Property Map Data Base Files

The SNB DPM files were processed as outlined in Figure 1. This dataset is in New Brunswick's double stereographic projection and referenced to the NAD83 datum. The x and y resolution of this data is 0.05 metres. The files were provided in CARIS ASCII format. The following features (Table 6) were extracted, merged, transformed and then incorporated into the working file. The resulting line segments appearing in the work file are shown in Figure 5.

Table 6 - SNB DPM Imported Database

FEATURE CODE	FEATURE	SOURCE
DLBNPR2	Inter-Provincial / International Boundary	Digitized from Orthophoto?
DLBNT2	Inter-Provincial / International Boundary Text	

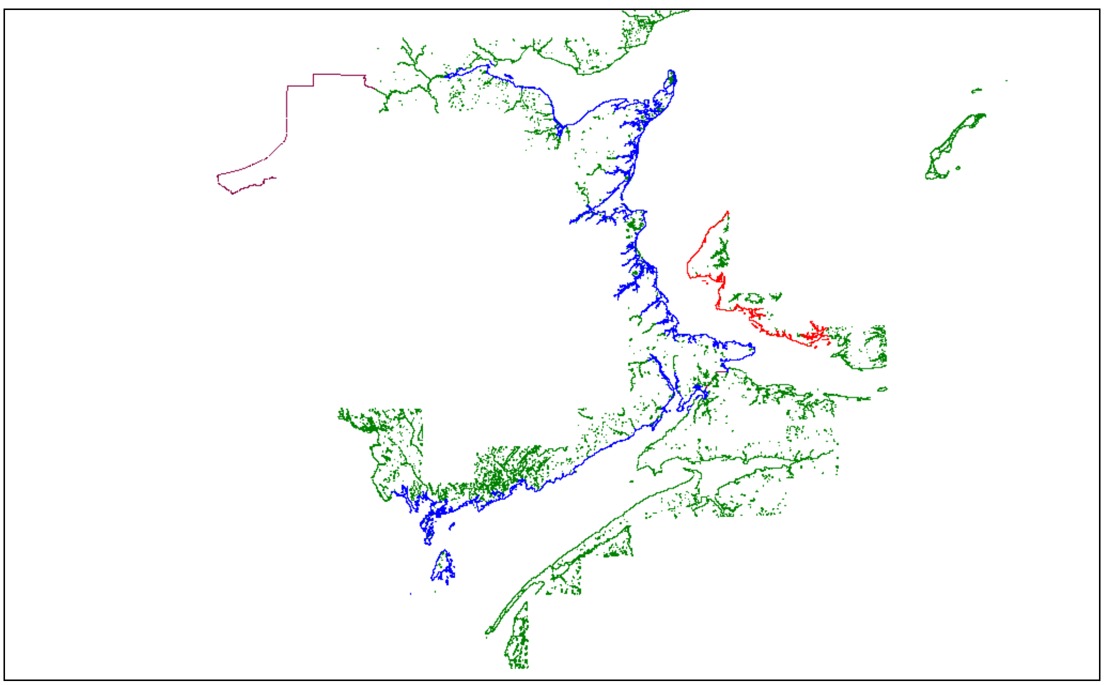

Figure 5 – Line Segments in Work File after SNB DPM Files imported

2.5 Importing NRCan-IBC and DFO-CHS Land and Marine Boundary Coordinates

The NRCan-IBC and DFO-CHS coordinates were processed as outlined in Figure 1. The resulting line segments appearing in the work file are shown in Figure 6. These coordinates were acquired via files downloaded from an NRCan website [NRCan, 2002]. These data are in geographic projection and referenced to the NAD83 datum. These coordinates were imported into CARIS GIS in order to produce point-to-point lines. The imported lines were then merged in to a single file and appropriately transformed to the New Brunswick stereographic projection. The transformed file was then merged into the working file.

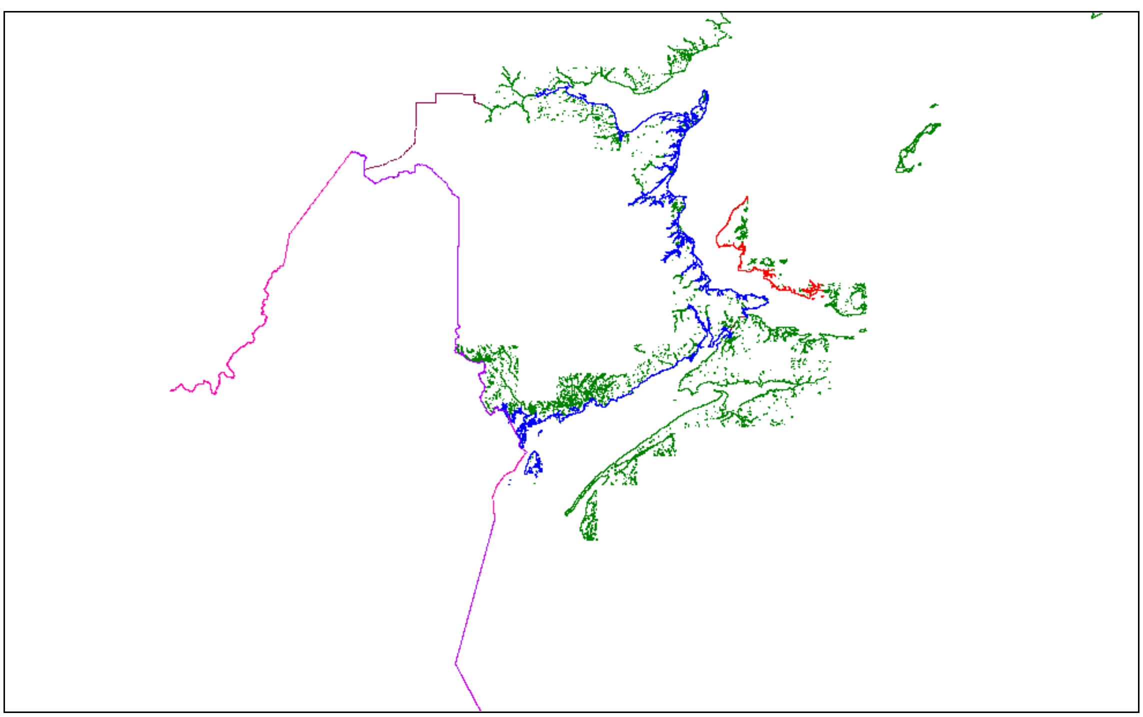

Figure 6 – Line Segments in Work File after International Boundaries imported

2.6 Importing DNRE Proposed Mineral Lines Coordinates

The DNRE coordinates were processed as outlined in Figure 1. The resulting line segments appearing in the work file are shown in Figure 7. These coordinates are referenced to the NAD27 datum and were provided in hard copy [McLaughlin, 1968]. The coordinates were first imported into CARIS GIS as point-to-point lines referenced to the NAD27 datum. They were then transformed to NAD83 and incorporated into the working file.

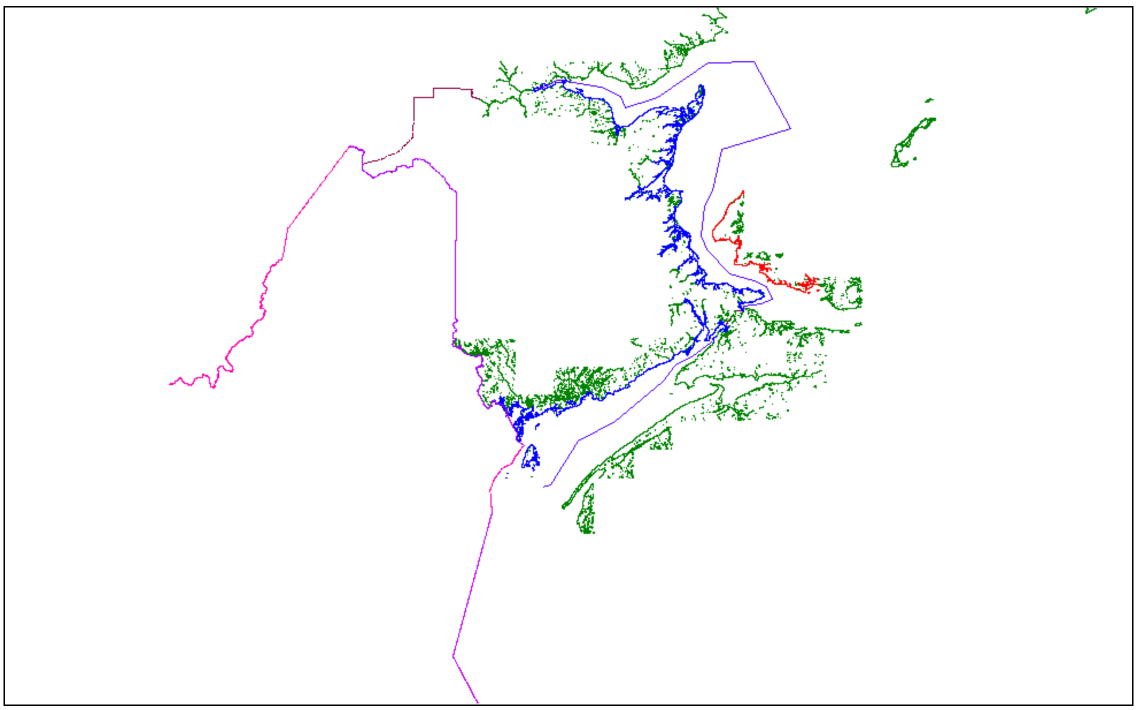

Figure 7 – Line Segments in Work File after DNRE Boundaries imported

2.7 Fitting the Submerged Lands Data with New Brunswick's Terrestrial Data

It is expected that the submerged lands polygons will fit with the CTDB98. Coastlines already part of the CTDB98 will also form part of the Submerged Lands polygons, so these line segments will not be a problem. In order for the interpolated, calculated and imported lines that will form the other parts of the marine administrative boundaries to fit with the CTDB98 the following polygon descriptions (Tables 7, 8 and 9) are provided:

TABLE 7- BAY OF FUNDY SUBMERGED POLYGON

Line Segments	Description
NB Coastline	▪ **Begins** at the intersection of the International Boundary Commission point-to-point boundary line and the ordinary high water landward limit sharing virtual line at a point identified by the NAD83 coordinate 45-11-06.01N, 67-17-28.56W. ▪ **Ends** at the first intersection of the CTDB98 line with the DPM NB-NS inter-provincial boundary at the NAD83 coordinate 45-51-47.62N, 64-15-49.93W. ▪ **Source:** SNB-DataQC (CTDB98) and International boundary Commission coordinates. ▪ **Themes:** Hydrography and Administrative Boundary
International submerged boundary (part established and part interpolated)	▪ **Begins** at last submerged Canada-US point (international boundary "point A" – NAD83 coordinate 44-11-12N, 67-16-44W), then interpolated generally north, enclosing Machias Seal Island as Canadian territory. ▪ **Ends** at the last established International Boundary line that intersects with the ordinary high water landward limit sharing virtual line at a point identified by the NAD83 coordinate 45-11-06.01N, 67-17-28.56W. ▪ **Source 1:** International boundary published coordinates ▪ **Source 2:** Interpolated/Calculated from merged CTDB98, NRCan NTDB and International Boundary Commission coordinates. ▪ Based on research, cases, precedence ▪ **Themes:** Hydrography, Administrative Boundary, Provincial Boundary and International Boundary
Partly interpolated inter-provincial submerged boundary between NB and NS	▪ **Begins** at the intersection of the CTDB98 line with the DPM NB-NS inter-provincial boundary, at a point identified by the NAD83 coordinate 45-51-47.62N, 64-15-49.93W. ▪ **Ends** at last submerged Canada-US point (international boundary "point A" – NAD83 coordinate 44-11-12N, 67- 16-44W) ▪ **Source:** Interpolated/Calculated from merged CTDB98, NRCan NTDB and International Boundary Commission coordinates. ▪ Based on research, cases, precedence, and calculations ▪ **Themes:** Hydrography, Administrative Boundary and Provincial Boundary

Table 8 - Baie des Chaleurs Submerged Polygon

Line Segment	Description
NB Coastline	▪ **Begins** at the intersection of the NB-PQ point-to-point inter-provincial boundary line with the ordinary high water landward limit sharing virtual line at a point identified by the NAD83 coordinate 47-59-29.57N, 66-47-54.84W. ▪ **Ends** along the NB coast adjacent to Northumberland Strait at the intersection of the NB-NS inter-provincial boundary with the ordinary high water landward limit sharing line at a point identified by the NAD83 coordinate 45-58-37.28N, 64-02-48.50W. ▪ **Source:** SNB-DataQC (CTDB98 and DPM) ▪ **Themes:** Hydrography and Administrative Boundary
Partly interpolated inter-provincial submerged boundary between: ▪ NB and PQ ▪ NB and PEI ▪ NB and NS	▪ **Begins** at the intersection of the NB-PQ point-to-point inter-provincial boundary line with the ordinary high water landward limit sharing virtual line at a point identified by the NAD83 coordinate 47-59-29.57N, 66-47-54.84W. ▪ **Ends** along the NB coast adjacent to Northumberland Strait at the intersection of the NB-NS inter-provincial boundary with the ordinary high water landward limit sharing line at a point identified by the NAD83 coordinate 45-58-37.28N, 64-02-48.50W. ▪ **Source:** Interpolated/Calculated from merged CTDB98, DPM, PEI ETB and NRCan NTDB. ▪ Based on research, cases, precedence, and calculations. ▪ **Themes:** Hydrography, Administrative Boundary and Provincial Boundary

TABLE 9 - COUNTY/MUNICIPAL SUBMERGED POLYGONS

Line Segment	Description
NB Coastline	▪ **Begins** and **ends** along [to be determined] county-coastline intersection points (Bay of Fundy and Northumberland Strait) ▪ **Source:** SNB-DataQC (CTDB98) ▪ **Themes:** Hydrography and Administrative Boundary
Inter-county/ Municipal submerged boundaries	▪ **Source:** Interpolated/Calculated from merged CTDB98 and possibly NRCan NTDB. ▪ Based on research, cases, precedence ▪ **Themes:** Hydrography, Administrative Boundary and County Boundary

2.8 Processing the Working File

The manner in which the working file was processed to produce the submerged lands polygons are detailed in the following sub-sections and visualized in Figure 7. The general steps include:

- Compare/analyze the imported DNRE mineral lines and the lines generated by using imported DNRE shore points using NTDB at 1: 10 000 and at 1:50 000
- Compare the international boundary segments in the working file.
- Analyze the inter-provincial boundaries imported from SNB's DPM.
- Compare the imported coastline segments from the integrated sources
- Generate median lines in the working file using integrated data
- Generate median lines in the working file using only NTDB
- Generate the final median lines in the working file
- Create the final submerged lands polygons

2.8.1 Criteria for Choosing Baseline Points

Choosing baseline points can be done randomly or according to some defined criteria. This section deals with the criteria for choosing baseline points that will be used to eventually calculate midline points that will be the source for the various median lines. Without evidence of prior precedence in used in similar exercises, it was decided that apart from other rules outlined below to apply rules similar to those recommended in the United Nations Convention on the Law of the Sea (UNCLOS) if warranted. Below are the criteria to be used in choosing baseline points:

1. Prominent features will be chosen unless there is lack such features where baseline points are required.

2. Where there are no prominent features, other features will be chosen to best simulate an appropriate midline (e.g. to maintain a midline consistent with the sinuosity of a river).

3. UNCLOS rules applying to Historic bays and closing bay lines (i.e. maximum closing lines of 24 nautical miles) [United Nations, 1997; Sohn and Gustafson, 1984] may be applied in relevant instances.

4. Previous agreements among provinces, or legal decisions will override all other criteria in locations where those agreements or decisions conflict with the criteria set out herein.

5. Median lines to be generated are assumed to be the result of giving opposite shores 50-50 weighting unless specified otherwise.

2.8.2 Comparing Lines Generated from Both Imported DNRE Mineral Lines coordinates and Shore Coordinates

In this section a comparison is made between the coordinates used to recreate the DNRE mineral lines in the working file (1:10 000), and the median line coordinates generated from the use of imported DNRE shore coordinates described in below in this section. Both sets of coordinates were subjected to identical processing in terms of how they were imported into the GIS, transformed and merged into the working file. This exercise was done to test the accuracy of the coordinates for the DNRE mineral lines, which will be taken into consideration when delineating the submerged lands polygons.

The shore coordinates were the ones originally used in 1968 to determine mineral lines between the Atlantic Provinces [McLaughlin, 1968]. The shore points, in NAD27 coordinates, were first imported into CARIS GIS using the “Import 3D Point Data” tool and given the feature code “DAFTSY”. This symbol feature code is not in itself very descriptive but was chosen because of its symbol size for use in CARIS LOTS™ that allows symbols to remain at a constant visible size regardless of display scale, thereby aiding ease of selection. The coordinates were then transformed to NAD83. The transformed coordinates were then merged into the working file. The steps utilized in creating the median lines from the shore points are described below:

a. Open the working file in CARIS LOTS™ and display only features with feature code = DAFTSY.

b. Using chosen baseline points and the median line function of CARIS LOTS™ generate median lines between the coasts of NB, and the opposite coastlines of PEI, PQ and NS.

The DNRE shore points were not able to be duplicated in totality for any other exercise described in Section 2.8.6, as it seems that the surveyor(s) had access to a landmass (Dead Man’s Island in the Bay of Saint Lawrence, West of Isle de Madeline) which does not appear in any of the other databases used in this model experiment.

The resulting median lines coordinates generated from the shore points were then compared with the imported DNRE median line coordinates. The results are outlined in Tables 10, 11 and 12. A graphical sample of the difference in point locations is depicted in Figure 8.

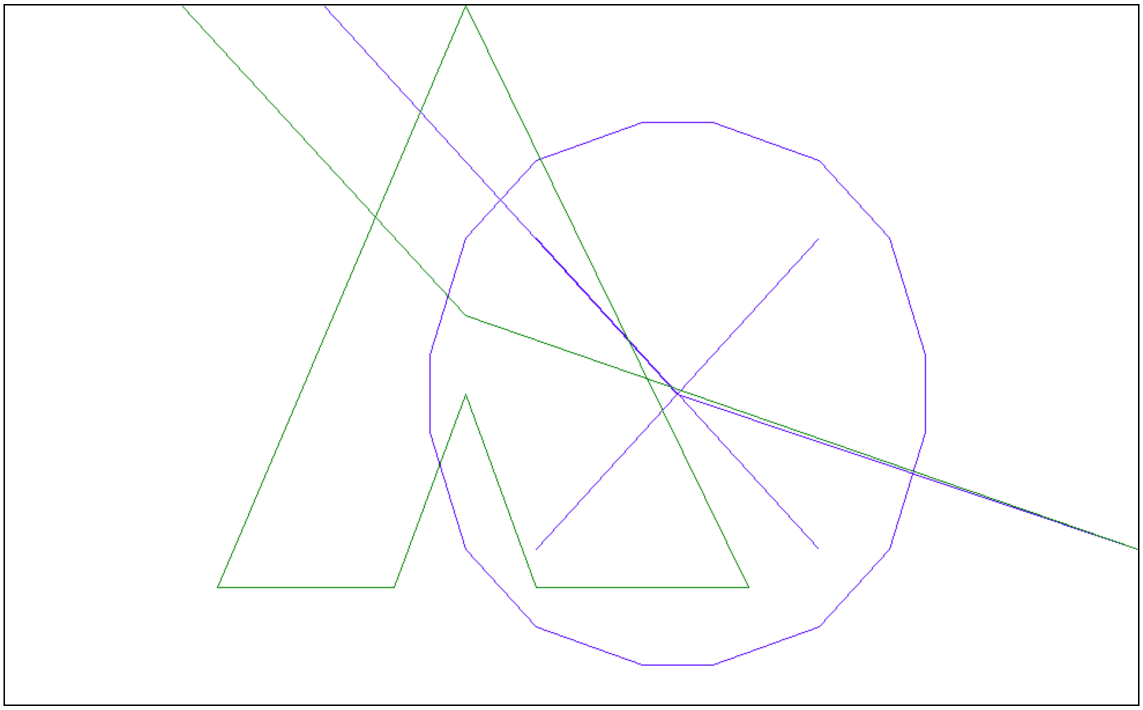

Figure 8 – Graphical Depiction of Point Location Differences
(The blue line and symbol relates to the DNRE imported line.
The green line and symbol relates to the line generated from DNRE shore points)

Table 10
COORDINATES FOR DNRE POINTS IN THE RESTIGOUCHE
WORKING FILE: 1:10000 (NAD83)

	DNRE LINE POINTS		**CENTRE POINTS CALCULATED BY CARIS LOTS FROM SHORE POINTS**		**APPRX. DIFF. (m)**
1	48-01-19.76N	65-51-29.18W	48-01-20.05N	65-51-28.79W	12
2	47-56-00.80N	65-36-23.16W	47-56-01.22N	65-36-23.49W	15
3	47-49-42.68N	65-32-10.19W	47-49-43.03N	65-32-09.70W	15
4	47-55-15.68N	65-06-42.07W	47-55-15.81N	65-06-42.12W	4
5	48-13-13.72N	64-25-18.97W	48-13-13.52N	64-25-18.59W	10
				AVERAGE =	11.20

Table 11
COORDINATES FOR DNRE POINTS IN NORTHUMBERLAND STRAIT
WORKING FILE: 1:10000 (NAD83)

	DNRE LINE POINTS		**CENTRE POINTS CALCULATED BY CARIS LOTS FROM SHORE POINTS**		**APPRX. DIFF. (m)**
1	47-36-20.65N	63-19-52.91W	47-36-20.90N	63-19-52.56W	10
2	47-26-03.66N	64-15-57.01W	47-26-03.46N	64-15-56.64W	10
3	47-04-00.76N	64-23-50.11W	47-04-00.46N	64-23-49.56W	15
4	46-56-07.68N	64-31-07.04W	46-56-08.08N	64-31-07.26W	13
5	46-39-56.64N	64-33-37.05W	46-39-56.49N	64-33-37.24W	7
6	46-32-16.74N	64-29-43.14W	46-32-16.78N	64-29-43.56W	9
7	46-19-09.75N	64-12-17.07W	46-19-09.82N	64-12-17.34W	6
8	46-14-54.72N	63-53-37.05W	46-14-54.55N	63-53-36.69W	9
9	46-11-19.67N	63-43-46.99W	46-11-19.25N	63-43-46.83W	14
				AVERAGE =	10.33

Table 12
COORDINATES FOR DNRE POINTS IN THE BAY OF FUNDY
WORKING FILE: 1:10000 (NAD83)

	DNRE LINE POINTS		**CENTRE POINTS CALCULATED BY CARIS LOTS FROM SHORE POINTS**		**APPRX. DIFF. (m)**
1	45-35-13.76N	64-42-52.20	45-35-13.76N	64-42-52.66W	10
2	45-30-25.74N	64-56-22.27	45-30-25.35N	64-56-22.00W	13
3	45-22-08.78N	65-05-28.22	45-22-18.24N	65-05-28.63W	292
4	45-00-13.70N	65-43-33.32	45-00-13.29N	65-43-33.65W	14
5	44-50-15.76N	66-11-36.45	44-50-15.93N	66-11-36.44W	4
6	44-26-08.78N	66-32-29.41	44-26-09.10N	66-32-29.13W	11
7	44-25-02.81N	66-38-44.54	44-25-02.71N	66-38-44.49W	3
				AVERAGE =	49.43

The experiment was repeated using a temporary working file at 1:50 000 because the coordinates were first plotted on a map of this scale. The results are described in Tables 13, 14 and 15. There were only insignificant differences in the results that could be attributed to the method of determining the distances between the measured points: the "calculate geodetic distance" tool of CARIS LOTS™ was used and this requires a pointing method which can introduce some human error. Other sources of errors would include:

a. Errors introduced due to the recording of the coordinates by the original surveyor.

b. Errors introduced due to the digital re-recording of the coordinates for importation into the GIS (they were obtained from hard copy).

c. Errors related to importing the coordinates into the GIS.

d. Errors related to transformation functions performed by the GIS.

Table 13
COORDINATES FOR DNRE POINTS IN THE RESTIGOUCHE
WORKING FILE: 1:50000 (NAD83)

POINT #	**APPROXIMATE DIFFERENCE (m)**
1	12
2	15
3	15
4	4
5	10
AVG =	11.20

Table 14
COORDINATES FOR DNRE POINTS IN NORTHUMBERLAND STRAIT
WORKING FILE: 1:50000 (NAD83)

POINT #	**APPROXIMATE DIFFERENCE (m)**
1	11
2	10
3	15
4	13
5	6
6	9
7	6
8	9
9	14

AVG =	10.33

Table 15
COORDINATES FOR DNRE POINTS IN THE BAY OF FUNDY
WORKING FILE: 1:50000 (NAD83)

POINT #	**APPROXIMATE DIFFERENCE (m)**
1	10
2	13
3	17
4	292
5	15
6	12
7	3
AVG =	51.71

It is to be noted that when the line using the DNRE median points was created it was found to intersect with lines representing a section of the shoreline of the Restigouche River. This occurs with both the NTDB and the CTDB98 and detracts from the confidence placed in the DNRE line. The phenomenon is depicted in Figure 9.

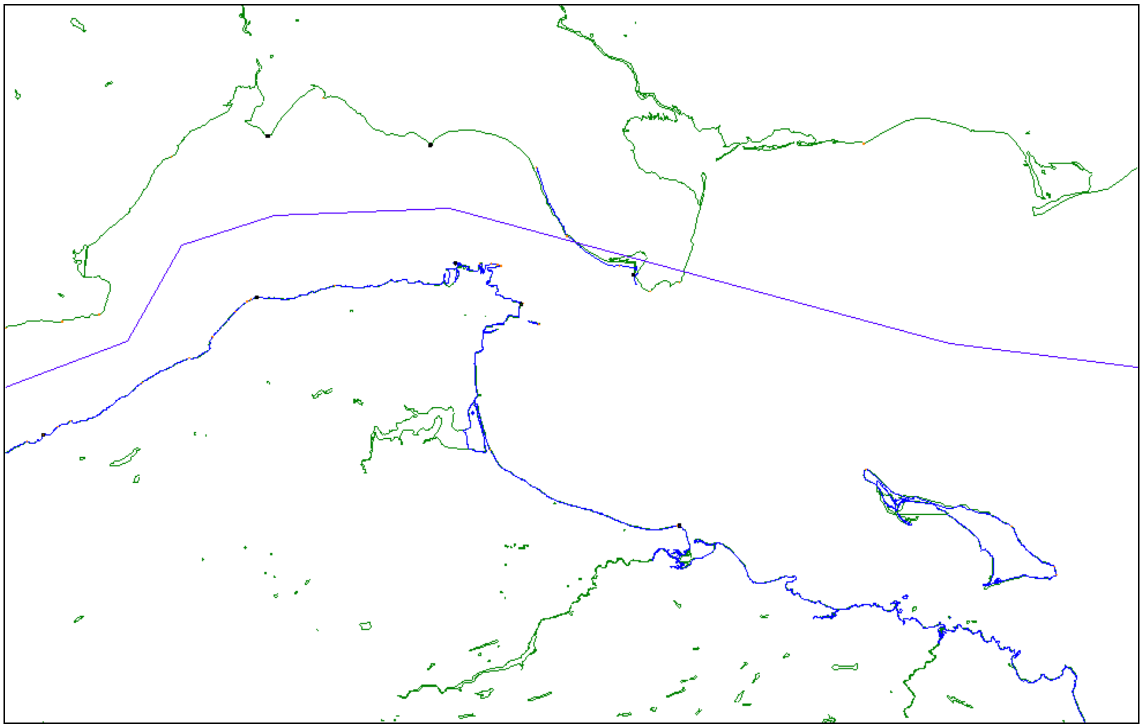

Figure 9 – DNRE Median Line Intersecting with the NTDB and CTDB98

2.8.3 Comparing International Boundary Segments in the Working File

This section focuses on a comparison and analysis of the two (2) **sets** of international boundary segments imported into the working file. One set of boundaries was downloaded from an NRCan site [NRCan, 2002]. The other set of coordinates was obtained from DFO-CHS. Both sets of coordinates were provided in geographic coordinates referenced to the NAD83 datum and were both identically processed (Section 2.5).

There are some differences between the two sets coordinates, in terms of the precision of the coordinates and to the density of points in each line. The NRCan-IBC lines, compared to the DFO-CHS lines, are less dense in terms of the number of points in each line, and the LAT-LONG values are of less precision being in the form "##-##-##N, ##-##-##W" whereas the DFO-CHS lines are in the form "##-##-##.###N, ##-##-###.###W".

Also both sets of lines have gaps and none completely delineate the total land and marine international boundaries between the U.S. and Canada-New Brunswick. Both lines together, however, cover the all of the relevant boundaries with the exception of two gaps. One gap appears at locations purported to be representative of Canada's perception of its EEZ South-West of Machias Seal Island (Figure 10). The line segments referred to in the last sentence were obtained from DFO-CHS. No data at present was obtained to verify where or how DFO-CHS obtained these coordinates.

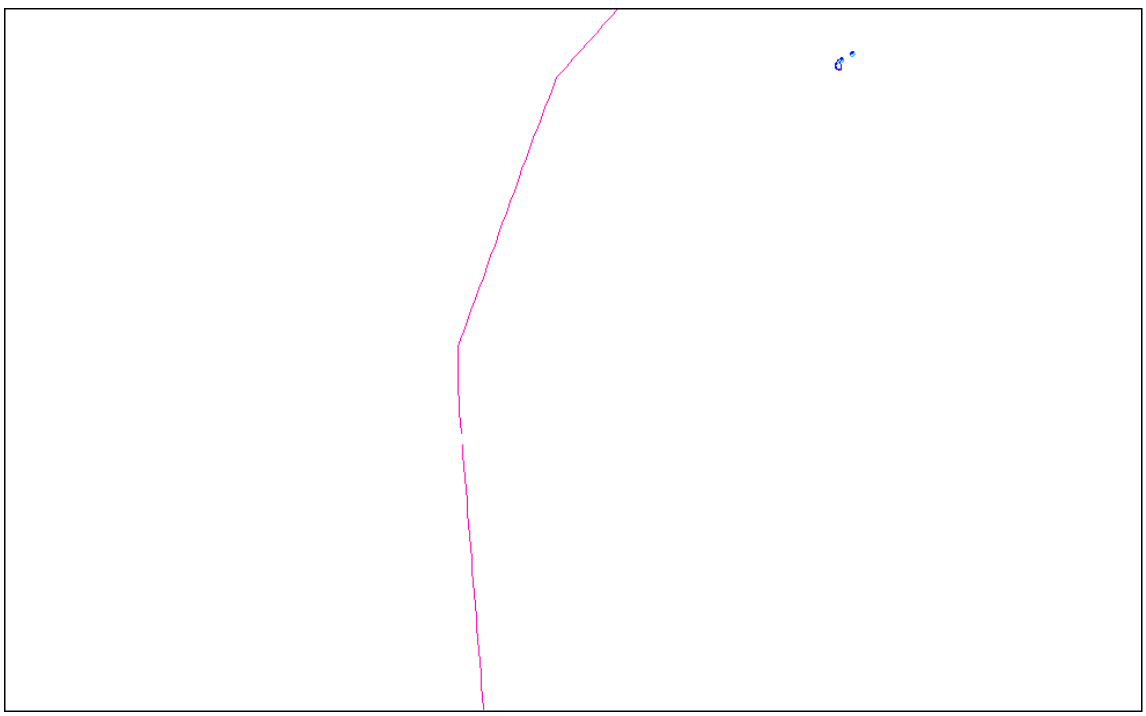

Figure 10 – A Gap in the DFO-CHS Line

The other gap is more exists because of the characteristics of one DFO-CHS line that appears to be representative of the Hague line [International Court of Justice, 2002; NRCan, 2002]. This line is one of two sets of line segments obtained from DFO-CHS that seemingly represent the Hague Line: one does not coincide with the NRCan-IBC version of the Hague Line although it connects with the EEZ line previously discussed. The other line exactly coincides with the NRCan-IBC line but has more point density. Figure 11 depicts this phenomenon.

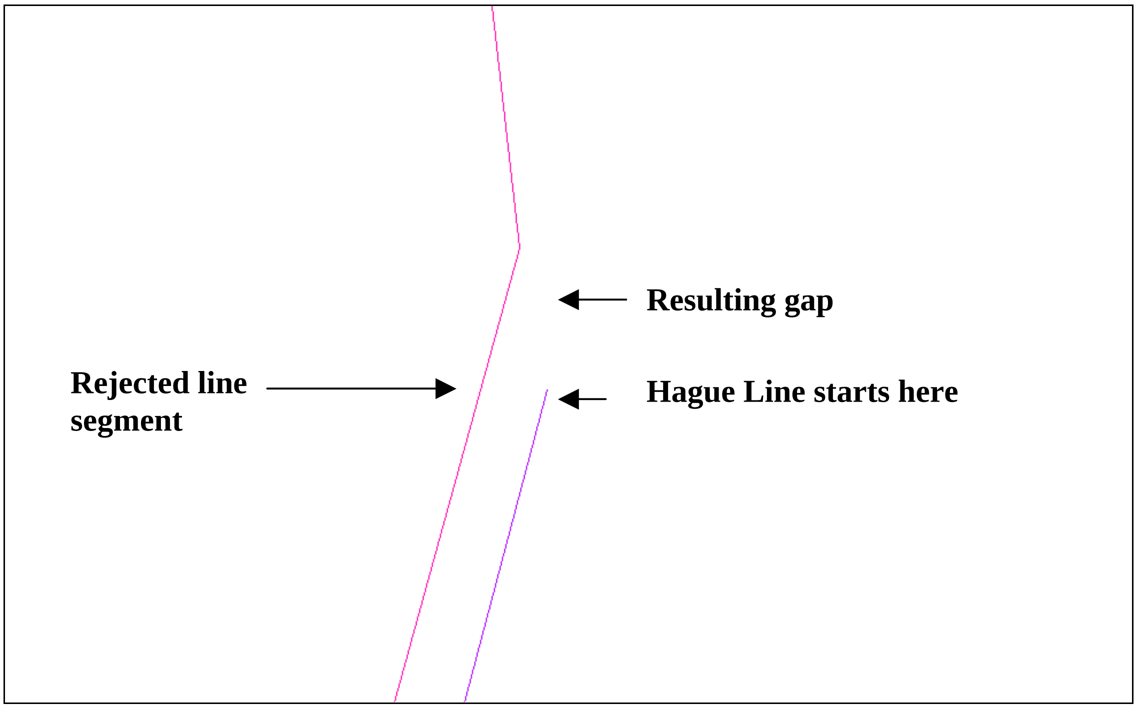

Figure 11 – Graphical Depiction of the International Boundaries (zoomed in) (The pink line is the DFO-CHS line. The purple line is the NRCan-IBC line)

The gap exists because the "apparent" Hague Line component of the line not coinciding with the NRCan-IBC was rejected in favor of the NRCan-IBC line that is given more weight because checks have been made and they were found to more closely match the coordinates officially agreed upon by the International Court of Justice [International Court of Justice, 2002]. The lines from DFO-CHS were used to fill gaps in the NRCan-IBC lines, as an interim solution in delineating the submerged lands of New Brunswick. Possible sources of errors in the coordinates of the international boundary lines would include:

a. Errors introduced due to the recording of the coordinates by owners of the data sources.

b. Errors related to importing the coordinates into the GIS.

c. Errors related to transformation functions performed by the GIS.

2.8.4 Analyzing the Inter-Provincial Boundary Line Segments Imported from SNB's DPM

The inter-provincial boundary line segments imported from SNB's DPM were investigated to see how well they fit with the CTDB98 since both databases are maintained by the same agency. The inter-provincial line segments were needed in order to close the submerged lands polygons at intersections with the CTDB98. It was decided to accept the DPM data if the representation of the inter-provincial borders ran at least within the line segments representing both shores of the Restigouche River (in the case of the New Brunswick-Quebec border), and ran at least within the line segments representing the shores of the Missequash and Tidnish Rivers (in the case of the New Brunswick-Nova Scotia border).

Figure 12 – Depiction of the NB-NS Border (Brown) and the CTDB98 (Blue)

Observation of the New Brunswick-Quebec boundary proved to be at least visually satisfactory though it was not proven to be a valid legal representation. The New Brunswick-Nova Scotia boundary, however, does not always fall within the line segments of the Missequash River. Figure 12 depicts some portion of this phenomenon.

La Forest [1959 and 1973] determines that the New Brunswick-Quebec boundary in the Restigouche River runs along the centre of the Restigouche River to the mouth of the Baie des Chaleurs (but encompassing the islands where river narrows inland in favor of New Brunswick). This will be taken into consideration when creating the final submerged lands polygons. With regard to the New Brunswick-Nova Scotia provincial border there are also a number of sources that outline its delimitation. These include La Forest [1959 and 1973], March [1954] and correspondence held by DNRE [Noël, 1991]. March [1954] contains a metes and bounds description of the inter-provincial boundary as agreed to by both New Brunswick and Nova Scotia. There are also coordinates representing four turning points from a survey of the inter-provincial border done in 1974 by David Crooker [DNRE, 2002]. The sources indicate that the boundary runs the middle (between banks) of the Tidnish and Missequash rivers, and the Bay of Fundy. This will also be taken into consideration when creating the final submerged lands polygons.

Three other errors were discovered when visually analyzing the imported DPM inter-provincial boundaries. There were two gaps discovered in the New Brunswick-Quebec line segments (Figures 13 and 14). The first gap was closed by extending one line and then joining that line with the other. The second gap was closed by extending one line to intersect the other line and then deleting the overshoots. There was an overlap/intersection discovered when investigating the New Brunswick-Nova Scotia line segments (Figure 15). The error was addressed by cutting the lines where they intersected, and then deleting the overshoots.

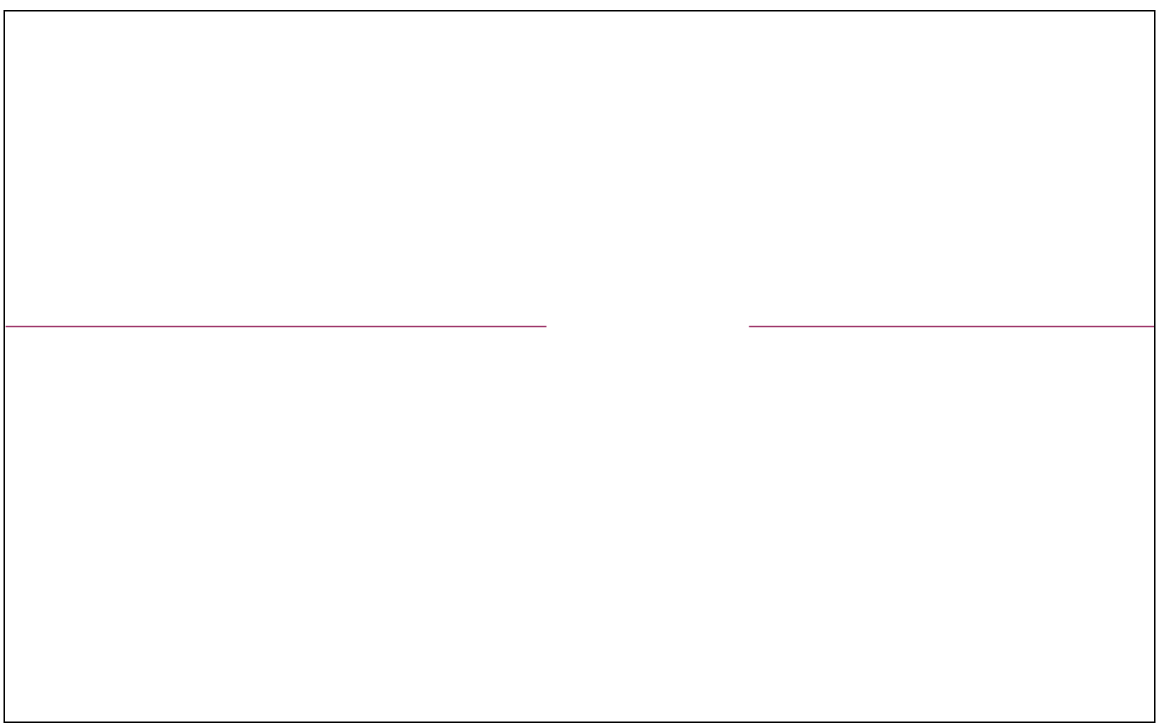

Figure 13 – First Gap in the New Brunswick-Quebec Line Segments

Figure 14 – Second Gap in the New Brunswick-Quebec Line Segments

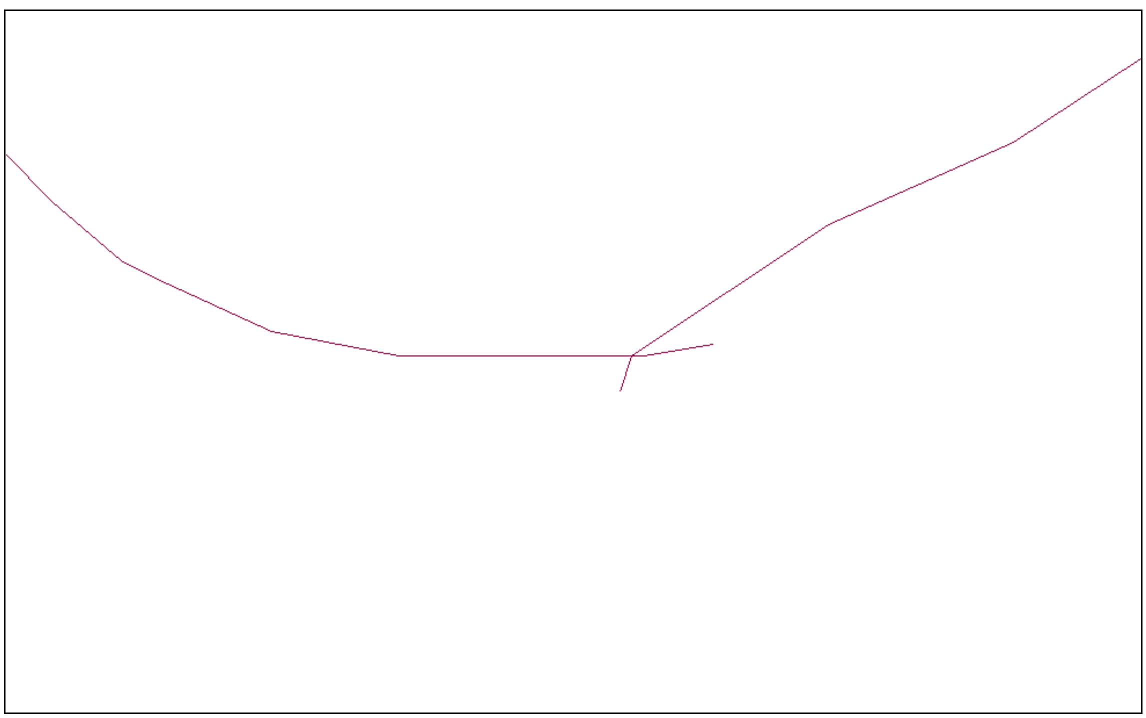

Figure 15 – Intersection in New Brunswick-Nova Scotia Line Segments

There are a number of possible errors associated with the inter-provincial boundaries imported from the DPM. Possible sources of errors in the coordinates of the inter-provincial boundary lines imported from the DPM would include:

a. Errors introduced due to the original capture of the coordinates by owners of the data sources.

b. Errors related to importing the coordinates into the GIS.

c. Errors related to transformation functions performed by the GIS.

2.8.5 Comparing the coastline Segments from the Integrated Sources

In order to understand what impact the imported coastline segments was going to have on the final output of the delineation of the submerged lands, they were compared. It was fully understood at the outset that the types of comparisons possible were limited by the fact that there was no way of knowing if the line segments represented the same vertical datum (i.e. ordinary high water, ordinary low water etc.), or even if the same coastal feature were mapped. Also, since there were data captured at more than one scale there was bound to be some generalizations in the smaller scale mapping exercise. The only “useful” comparisons and analysis was to determine which coastline was more seaward and possibly to determine some measure of distances between the line segments.

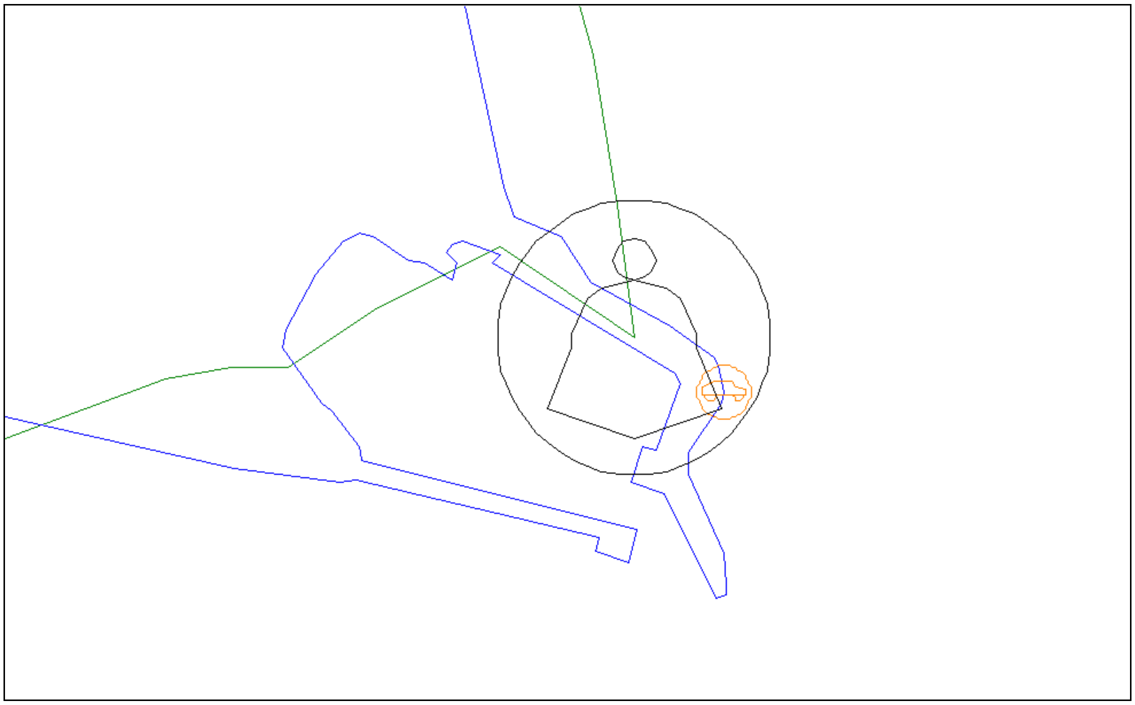

Figure 16 – Depiction of the CTDB98 (blue) and the NTDB Coastlines (green)

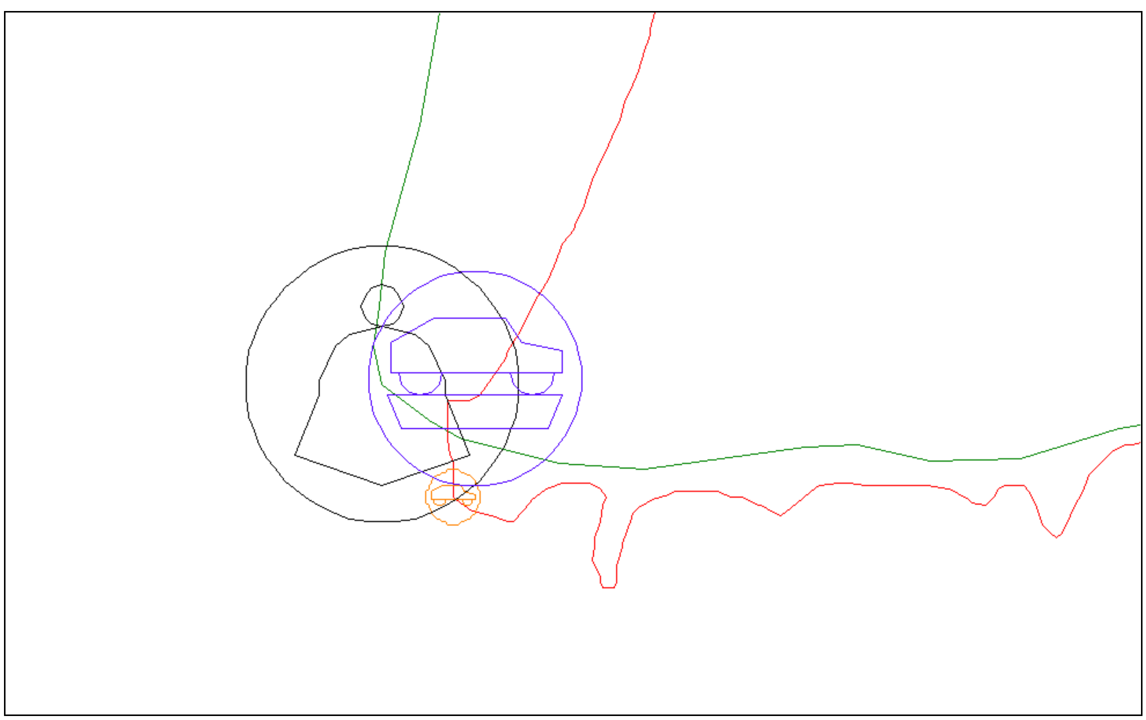

Figure 17 – Depiction of PEI'sETB (red) and NTDB Coastlines (green)

Observation of the working file revealed that no one coastline was always more seaward than another. However when comparing the CTDB98 and the NTDB it was found that the NTDB was more often more seaward. When comparing the NTDB and PEI's ETB it was found that the NTDB was more often seaward. As there is no obvious pattern to the manner or number of times in which the coastlines overlapped and intersected, no useful sample of distances between coastlines could be gained. Ramdom measurements using CARIS GIS distance measurement tool revealed distance differences as small as 0m (obviously) and as much as approximately 530m. A depiction of the difference between the CTDB98 and the NTDB is at Figure 16. A depiction of the difference between PEI's ETB and the NTDB is at Figure 17. Possible sources of errors related to the imported coastlines lines would include:

a. Errors introduced due to the original capture of the coordinates by owners of the data sources.
b. Errors related to importing the coordinates into the GIS.
c. Errors related to transformation functions performed by the GIS.

2.8.6 Generating Median Lines in the working File Using Integrated Data

In this section the process of using the working file to generate median lines from the integration of data from various sources is described. The model described in Figure 1 directly applies to this process. The result from this process will be compared with other solutions in order to produce the desired delineation of New Brunswick's submerged lands. The number of baseline points chosen in this exercise is greater than those used for creating the DNRE median lines, and was performed in this manner so as to produce lines that would better (subjectively speaking) represent medians as dictated by the sinuosity of the coastlines used to choose baseline points. Both the steps and the results are described below:

a. Open the working file in CARIS LOTS™. Rejecting all other data where the CTDB98 represents the coastlines of New Brunswick, display only CTDB98 segments (i.e. features with feature code = WACFOH* representing ordinary high water coastline).

b. Display also features with feature code = DLBNIN (international boundaries) and feature code = DLBNPR2 (inter-provincial boundaries from the DPM). The international and inter-provincial boundaries were needed to determine where baseline points were, and were not, needed.

c. Digitize baseline points for NB (i.e. via heads-up digitizing) according to criteria set in Section 2.8.1.

d. Using, according to the hierarchy of confidence previously described, isolate features with feature code = WATERBODY_14 (coastline from the NTDB) and digitize baseline points (i.e. via heads-up digitizing) for the coastlines of PQ and NS facing NB according to criteria set in Section 2.8.1.

e. Using, according to the hierarchy of confidence previously described, isolate features with feature code = INLIWA (coastline from PEI GIC) and digitize baseline points (i.e. via heads-up digitizing) for the coastlines of PEI facing New Brunswick according to criteria set in Section 2.8.1.

f. Using chosen baseline points and the median line function of CARIS LOTS™ generate median lines between the coasts of NB, and the opposite coastlines of PEI, PQ and NS. A sample of these median lines is shown in Figure 18.

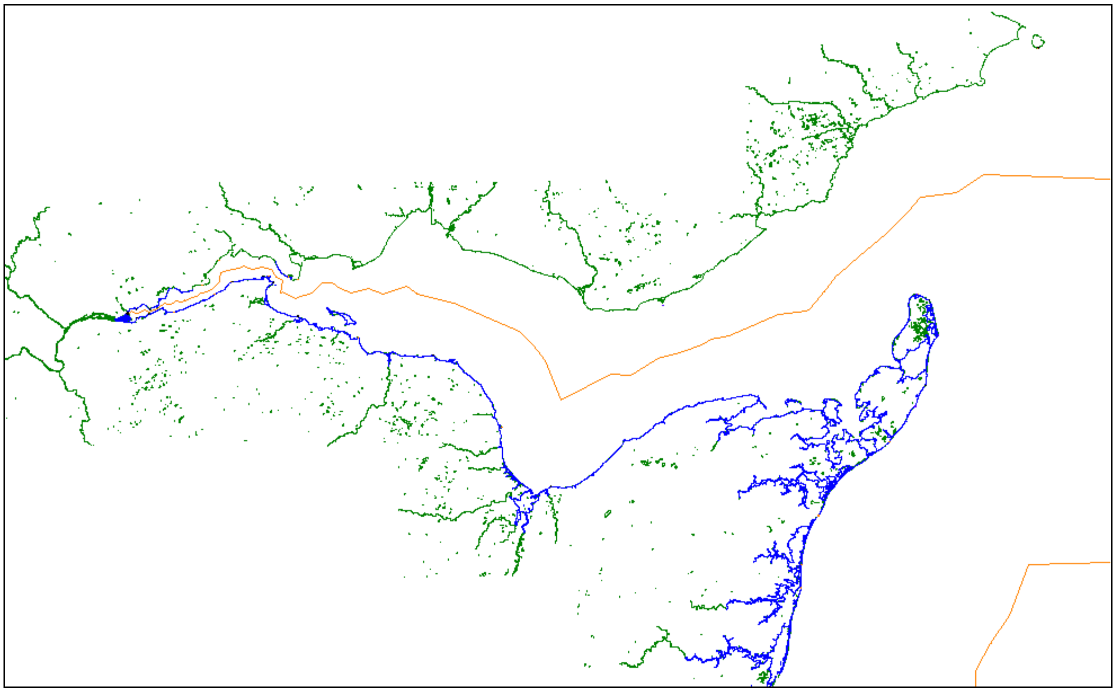

Figure 18 – Median Line (orange line) Created From the Integrated Databases

Possible sources of errors in generating the median lines would include:

i. Errors introduced due to the original capture of the coordinates by owners of the data sources.

ii. Errors related to importing the coordinates into the GIS.

iii. Errors related to transformation functions performed by the GIS.

iv. Errors related to the choice of baseline point locations.

v. Errors related to accuracy of digitizing the baseline points.

2.8.7 Generating Median Lines in the Working File Using Only NTDB Data

In this section the process of using the working file to generate median lines from the use of only NTDB data is described. This exercise was undertaken because the NTDB was the only database used that has representations of all desired coastlines. The number of baseline points chosen is greater than those used to produce the DNRE median lines. The baseline points used in this exercise also differ in some instances from those used in the exercise described in the immediately preceding section. As previously mentioned in Section 2.8.6, the same coastal features are not necessarily captured in all the databases used in this experiment, and this in many circumstances inhibits choosing the “same” baseline points. The result from this process will be compared with other solutions in order to produce the desired delineation of New Brunswick’s submerged lands. Both the steps and the results are described below:

a. Open the working file in CARIS LOTS™ and display only features with feature code = WATERBODY_14 (coastline from the NTDB), feature code = DLBNIN (international boundaries) and feature code = DLBNPR2 (inter-provincial boundaries from the DPM). The international and inter-provincial boundaries were needed to determine where baseline points were, and were not, needed.

b. Digitize baseline points (i.e. via heads-up digitizing) for the coastlines of PQ and NS facing NB according to criteria set in Section 2.8.1.

c. Using chosen baseline points and the median line function of CARIS LOTS™ generate median lines between the coasts of NB, and the opposite coastlines of PEI, PQ and NS. A sample of this median line is shown in Figure 19.

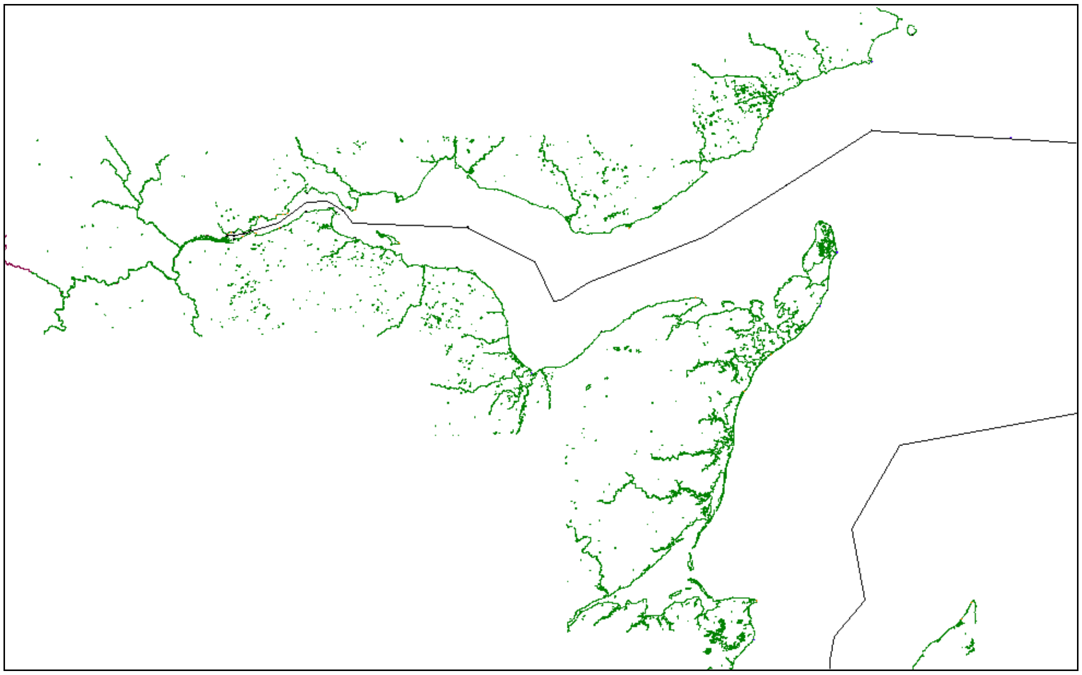

Figure 19 – Median Line (black line) Created From the NTDB Only

Possible sources of errors in generating the median lines would include:

i. Errors introduced due to the original capture of the coordinates by owners of the data sources.

ii. Errors related to importing the coordinates into the GIS.

iii. Errors related to transformation functions performed by the GIS.

iv. Errors related to the choice of baseline point locations.

v. Errors related to accuracy of digitizing the baseline points.

2.8.8 Generating Composite Median Lines in the Working File

After all the various median lines were generated it was left to either choose one set of lines, or to create a set of lines being a composite of a number of lines. Figure 20 shows the various median lines generated.

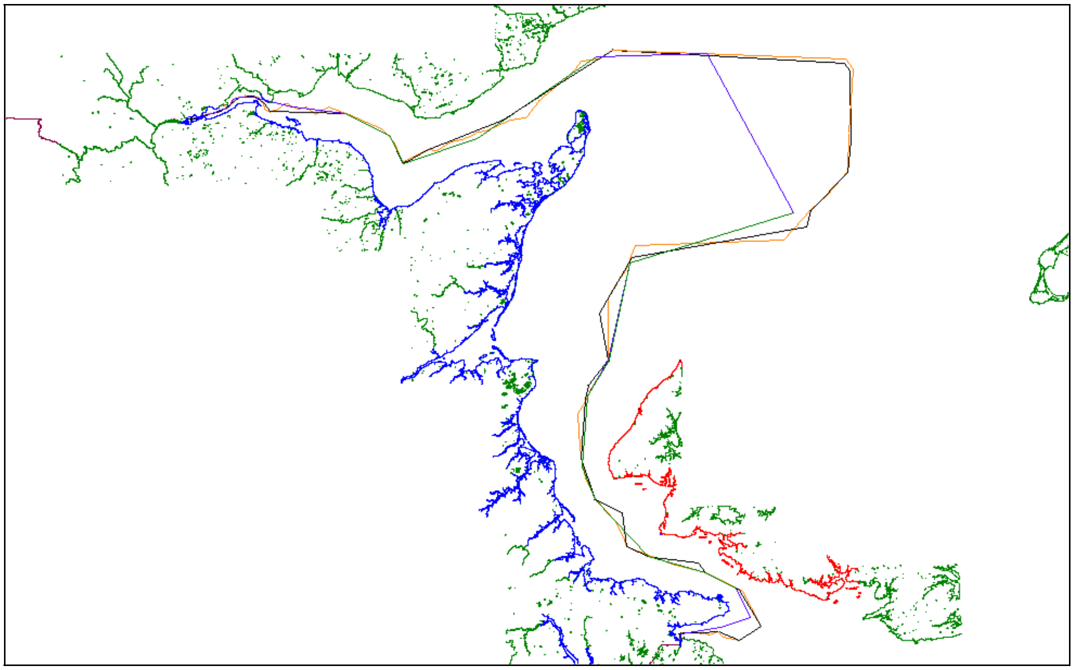

Figure 20 – A Sample of the Various Median Lines

There are distinct variations among the lines in terms of position and dimensions. This is due to a number of factors. These include (among other things) the number of baseline points chosen, the positions of the chosen baseline points and the shoreline data used to position the baseline points.

The differences among the various coastline data was pointed out earlier, and these differences directly affect where a midpoint will occur even if the same features were chosen from each database. The number of baseline points chosen directly impacts upon the number of midpoints generated, which in turn affects the sinuosity of the lines.

The median lines (Figure 20, orange median line) generated from the integrated data has more midline points and therefore more closely reflects median lines reflective of the sinuosity of the coastlines used. These lines also, especially in the Bay of Saint Lawrence and the area of the mouth of the Tidnish River, are affected by baseline points not apparently used in the DNRE lines.For example, in the Bay of Saint Lawrence baseline points on Anticosti Island and Isle de Madeliene were taken into consideration in constructing the median line from integrated data and this action is reflected in its difference with the DNRE line (Figure 20, blue median line) in that area. The median lines generated from only the NTDB data also reflect these phenomena.

For all the reasons outlined in the immediately preceding paragraph (and sections) a set of criteria were developed to determine the choice of median points and line segments used to generate the final median lines. These criteria are:

a. The median points generated from the integrated data would be of highest priority.

b. Median points from the DNRE lines will be used only when they appear to represent median points between the median points as described at (a).

c. Median points generated from the use of only the NTDB data will be used only when they appear to represent median points between the median points as described at (a).

The immediately foregoing criteria were put into effect and a final set of combined median lines were created. Samples of these final lines are shown in Figure 21 and 22.

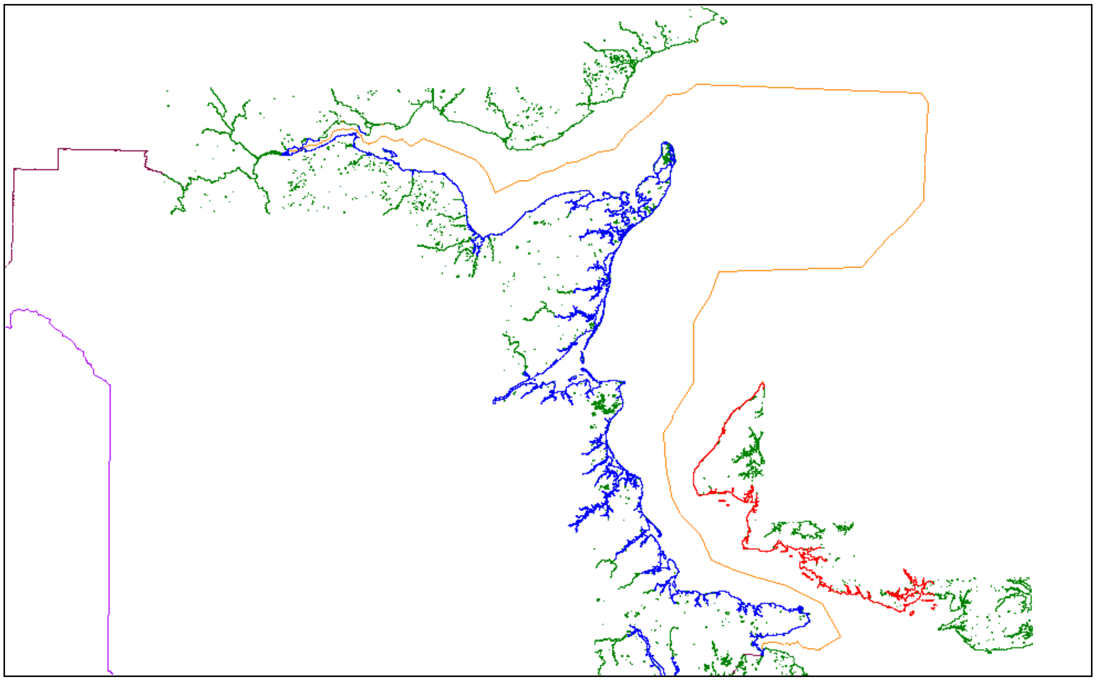

Figure 21 – Combination Median Line in the Bay of Saint Lawrence and Northumberland Strait

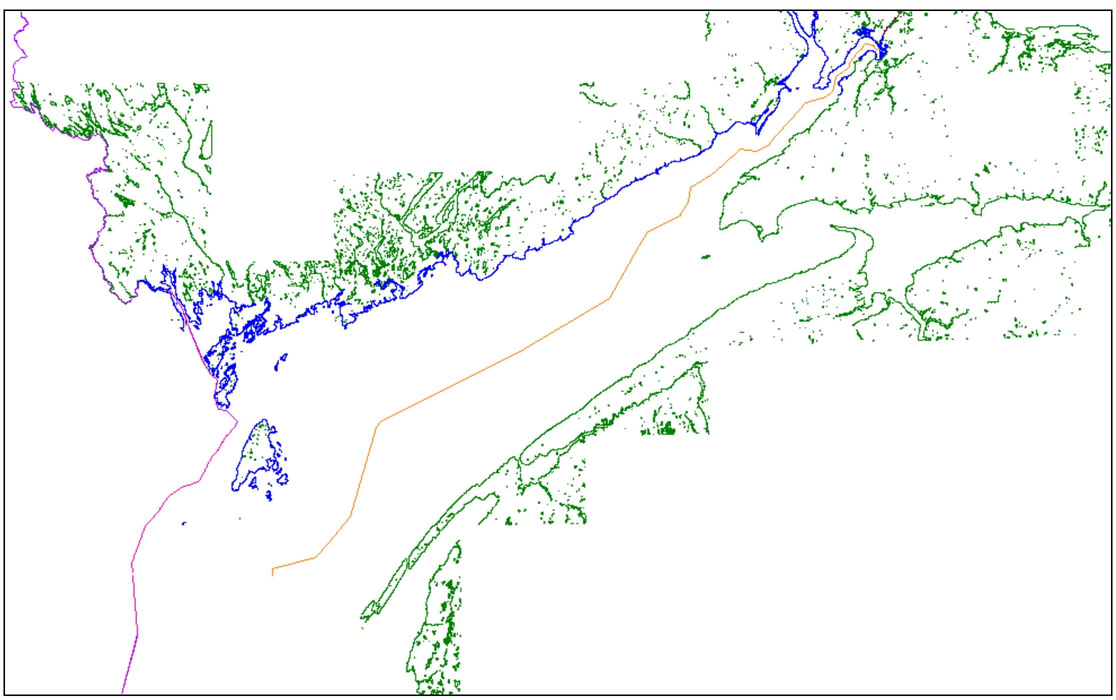

Figure 22 – Combination Median Line in the Bay of Fundy

Section 2.8.4 referred to the problems of the DPM New Brunswick-Nova Scotia inter-provincial boundary line segments intersecting with the CTDB98 line segments and not following a course altogether between the Missequash River. These problems were addressed by first creating with CARIS LOTS™ median lines where they did not occur. Then these created median lines were appropriately joined with the DPM boundary segments, and then finally those DPM line segments that did not fit the criterion of a midline were deleted (see Figures 23 and x.24). Possible sources of errors in generating the final median lines would include:

i. Errors introduced due to the original capture of the coordinates by owners of the data sources.
ii. Errors related to importing the coordinates into the GIS.
iii. Errors related to transformation functions performed by the GIS.
iv. Errors related to the choice and number of baseline point locations.
v. Errors related to accuracy of digitizing the baseline points.

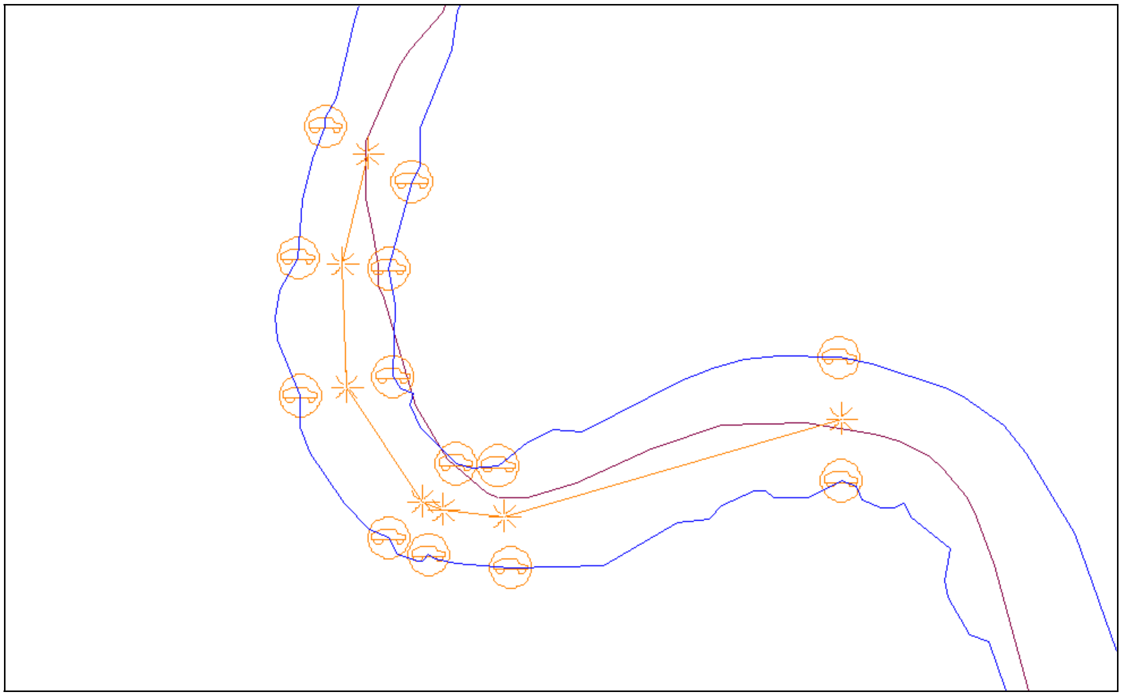

Figure 23 – Sample of Created Median Line before DPM Segment Deleted

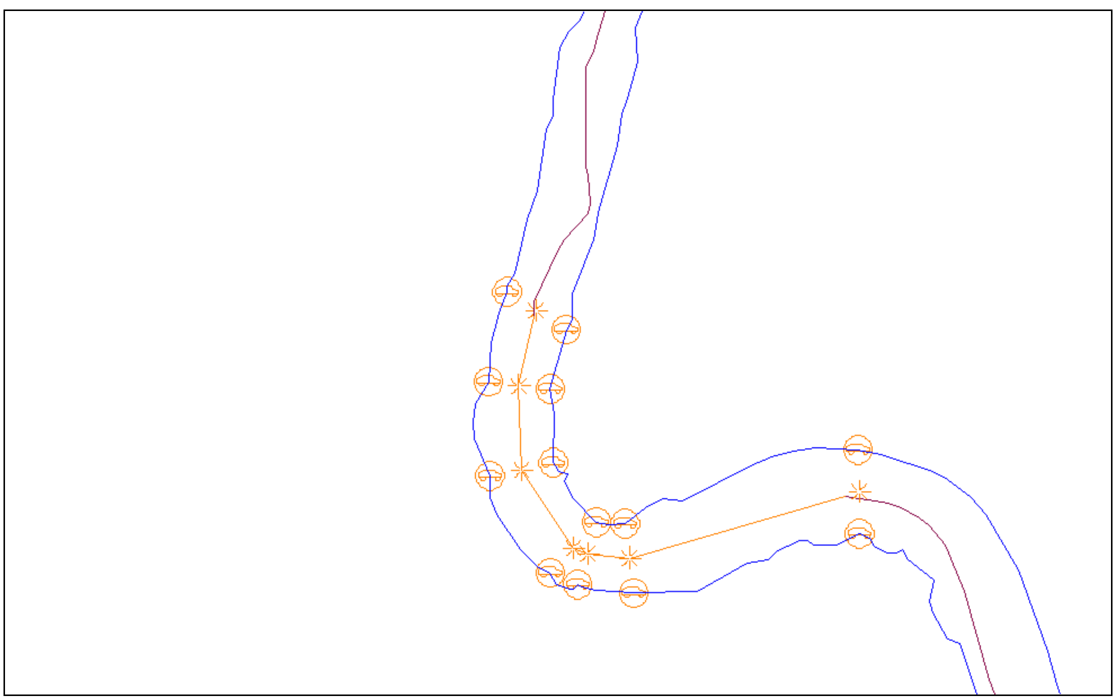

Figure 24 – Sample of Created Median Line after DPM Segment Deleted

2.8.9 Creating the Final Submerged Lands Polygons

At this stage in the experiment the final median lines have been created. There remains the exercise of location the relevant intersections of these lines with the appropriate line segments of the CTDB98 so as to enclose areas representative of New Brunswick's submerged lands. It is prudent to note that any graphic representation of New Brunswick's submerged lands created via this experiment has no binding effect in law as only binding legal agreements or decisions of a court of law can give that effect. The produced polygons serve only as the fulfillment of the user's (i.e. SNB's) need to have "a" digital representation of these boundaries. It is also pertinent to note that if different baseline points or digital data etc. were utilized, the dimensions of these boundaries would be different. Also, each polygon is only one ***potential maximum*** polygon.

A number of steps (using CARIS GIS and LOTS™ where appropriate) were undertaken in order to produce the final polygons. These include:

a. Closing the gap in the DFO-CHS line outlined in Section 2.8.3.

b. Joining the line at (a) to the first point (International Court of Justice "Point A") of the NRCan-IBC international boundary in the Gulf of Maine. This represents the furthest point south of New Brunswick's submerged lands.

c. Joining the last median line point in the Bay of Fundy with the "Point A" described at (b).

d. Deleting those sections of the DFO-CHS and NRCan-IBC line segments that were not necessary to complete the international boundary segments, and joining the remaining segments to the remaining NRCan-IBC international boundary segments.

e. Splitting the CTDB98 line segments representing the Restigouche, St. Croix, Missequash and Tidnish Rivers where they are intersected by either DPM inter-provincial boundary or international boundary line segments. This will allow the appropriate line segments to be exported to a separate Submerged Lands Theme file.

f. Joining the final median lines to the relevant inter-provincial and international boundaries to complete the polygons (see Figure 25).

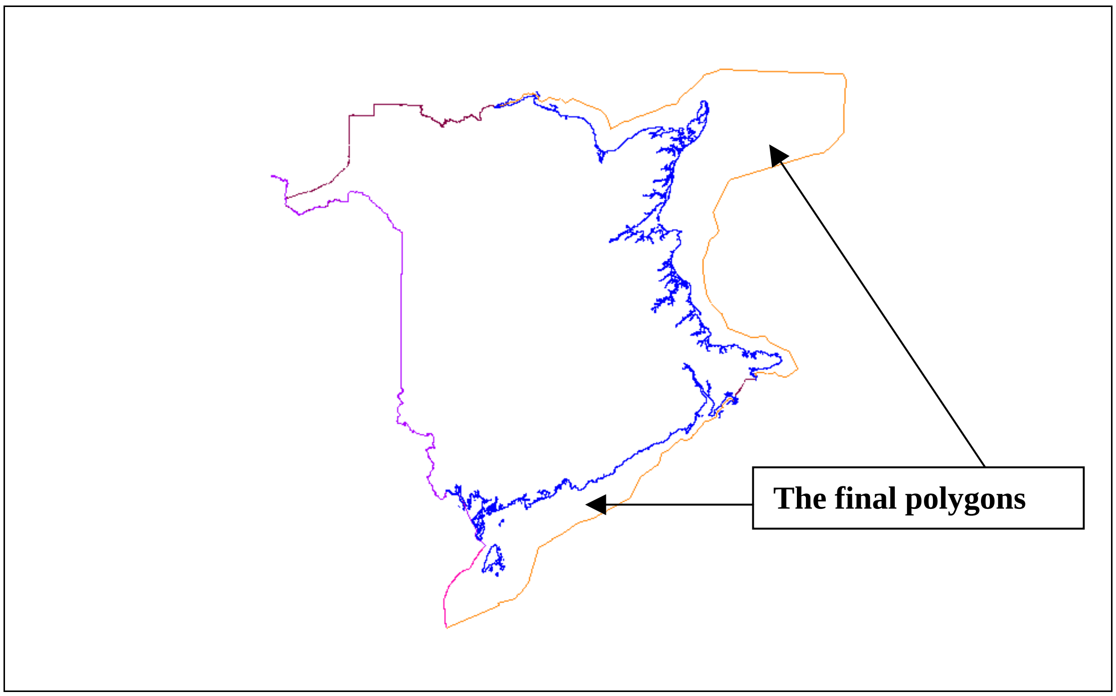

Figure 25 – The Final Polygons

3.0 CREATING THE SUBMERGED LANDS THEME FILE

This section describes the Submerged Lands Theme File that represents the final processing of the polygons. The steps are outlined below:

1. All the line segments representing the final polygons were extracted to a Submerged Lands Theme File.

2. Source Ids in the Submerged Lands Theme File were modified according to SNB specifications for all data. The Source Ids assignments are described in Table 16 (nb "*" indicates that there are a number of codes with that portion of the Source ID varying).

Table 16 – Assigned Source ID

FEATURES	SOURCE ID
CTDB98 line segments/points	G2CTZUNBSB02
Polygon line segments/points created at UNB	UBVD*UNB**02
IBC line segments/points	IBCTAUNBSB02
DFO-CHS line segments/points	CHCT*UNBSB02
Property map line segments/points	GICT*UNBSB02

3. A digital check was performed on the Submerged Lands Theme File to verify valid attributes-graphics combinations and any errors discovered were corrected (i.e. to ensure correct Feature Code-Source Id combinations).

4.0 SPECIFICS OF THE SUBMERGED LANDS POLYGONS

This section describes some specifics of the Submerged Lands polygons in terms of area, and the rules applied to islands. Islands in the Bay of Fundy, Northumberland Strait and other relevant geographic regions are a part of the province of New Brunswick, and consequently are part the provincial spatial database of New Brunswick. It is required to determine whether the polygons representing these islands form part of dryland of submerged land polygon. Arbitrarily, based upon the fact that lands above the

OHW are "dry land" it is decided that these polygons will be associated with the dry land polygon representing the mainland of New Brunswick.

The areas of the submerged lands polygons (i.e. not account for the islands) are outlined in Table 17. The line segment points of the submerged lands polygons (excepting the CTDB98 segments) are described in the appendix.

Table 17 – Area of the Submerged Lands Polygons

POLYGON	**AREA (Ha)**	**AREA (Km^2)**
Submerged (Gulf of Saint Lawrence – Northumberland Strait)	1702799.430	17022.02
Submerged (Bay of Fundy)	0819238.518	08189.51
TOTAL =	**2522037.948**	**25211.53**

5.0 CREATING AN INDEX OF 1:0000 WINDOWS

The general process of creating an index of 1:10000 windows is described in this section. The steps taken are generally as follows:

1. **A blank CARIS LLDG file was created (ATS77, geographic)**
2. **CARIS Tools' "Map Data Addition – Add Grid Lines" was used to create grid lines in the file at (1). The main parameters used were:**
   a. **Interval = 0-3-0N, 0-6-0W**
   b. **Fixed Point = 46-00-00N, 66-30-00W**
3. **CARIS Tools' "Topology Creation" was used to convert the lines to arcs, locate arc intersections, and cut the lines at the intersections so that points would be created at each intersection**
4. **The LLDG file was then transformed to NAD83 and the theme numbers, feature codes and source IDs of the lines appropriately modified**
5. **The final polygons were then merged into the file at (4)**
6. **The index at**

http://www.planet.snb.ca:80/PLANET/docs/topo/dtdb98/support.html was downloaded and the labels/names extracted. The extracted labels/names were then merged into the file at (5)

7. **The un-needed grid lines were deleted from the file at (5)**
8. **Labels/names were then added to the other relevant grid sections**
9. **All data except the appropriate index grid lines were then removed from the file.**

Table 18 outlines the number of 1:10000 windows. Figure 26 shows the enhanced index.

Table 18 – Number of Window per Line Segments

DTDB ONLY (ALL WINDOWS)	CTDB98 ONLY (LINES ONLY)	SUBMERGED ONLY (ALL WINDOWS)	CTDB98 AND SUBMERGED (LINES ONLY)	DTDB, CTDB98 AND SUBMERGED (LINES ONLY)	TOTAL (ALL INDEX WINDOWS)
1594	278	583	26	2	2483

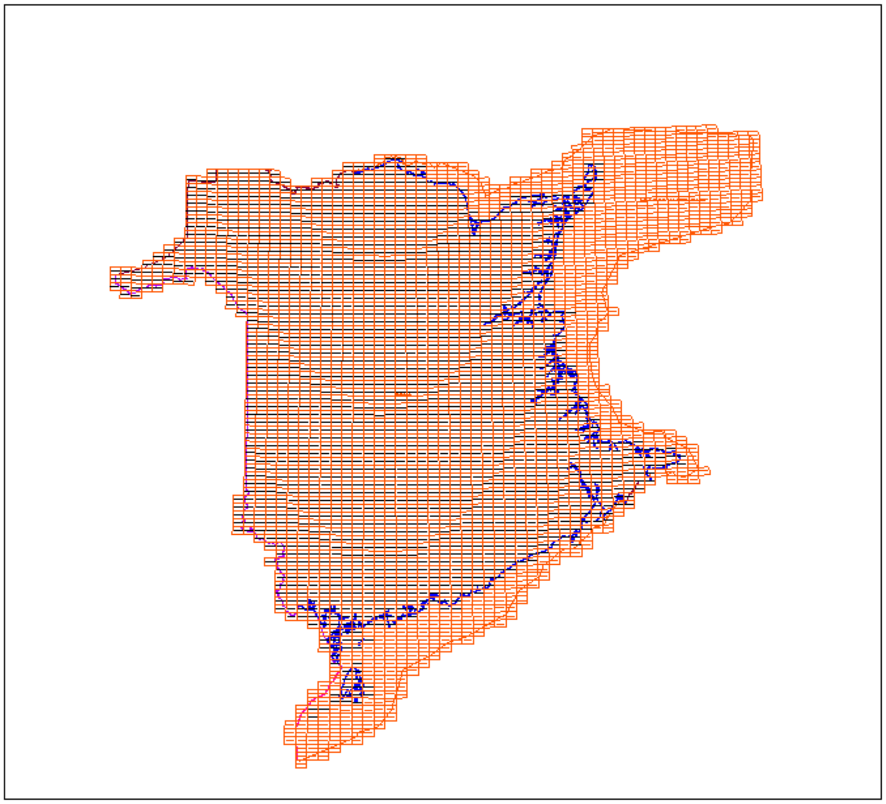

Figure 26 – The Enhanced Index (showing the final polygons before their removal)

6.0 REFERENCE

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7.0 APPENDIX – SUBMERGED LANDS LINE SEGMENTS

(EXCEPT CTDB98)

7.1 Restigouche River Inter-Provincial Line (DPM Segment)

!Datum Information:
Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
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47-59-29.49N	66-47-47.31W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
47-59-29.77N	66-47-37.09W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
47-59-29.92N	66-47-31.98W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
47-59-30.06N	66-47-25.76W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
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47-59-32.78N	66-46-58.33W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
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47-59-53.46N	66-46-24.19W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
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47-59-58.32N	66-46-08.49W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
47-59-59.19N	66-46-07.00W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
48-00-00.10N	66-46-05.13W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
48-00-00.14N	66-46-05.08W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
48-00-01.99N	66-46-01.13W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
48-00-03.46N	66-45-58.25W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
48-00-04.56N	66-45-56.76W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

7.2 Restigouche River-Northumberland Strait Inter-Provincial Line (Interpolated)

!Datum Information:
Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
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48-00-07.92N	66-45-45.58W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-00-18.36N	66-45-09.12W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-00-07.93N	66-44-39.69W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-00-07.58N	66-44-22.46W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-00-17.18N	66-42-13.56W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-00-24.75N	66-41-41.36W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-00-55.80N	66-40-15.25W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-01-47.25N	66-35-25.16W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-02-00.63N	66-34-18.91W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-02-07.34N	66-34-01.54W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-02-19.66N	66-33-40.03W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-02-29.74N	66-33-05.57W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-02-53.01N	66-31-39.46W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-03-22.55N	66-30-50.22W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-04-04.99N	66-30-10.96W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-05-10.78N	66-27-36.31W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
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48-02-57.54N	66-09-44.68W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-02-27.77N	66-07-49.69W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-02-56.05N	66-04-55.67W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-01-12.65N	66-01-48.49W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-02-55.72N	65-57-25.83W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
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48-01-07.60N	65-50-23.22W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-57-51.84N	65-39-15.00W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-56-22.30N	65-37-01.49W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-56-01.22N	65-36-23.49W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-54-32.58N	65-34-56.68W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-50-00.19N	65-32-16.50W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-49-43.03N	65-32-09.70W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-52-51.82N	65-23-50.98W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-52-42.70N	65-20-28.55W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-54-33.96N	65-15-44.28W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-55-08.73N	65-12-04.88W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-56-02.22N	65-08-21.68W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-56-41.04N	65-06-48.10W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-57-01.40N	65-03-35.84W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-59-23.85N	64-55-06.73W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-59-43.97N	64-50-22.39W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-59-59.38N	64-49-43.88W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-01-53.36N	64-47-13.11W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-02-07.38N	64-47-02.03W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-03-33.25N	64-45-15.90W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-03-53.14N	64-44-37.65W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-05-48.99N	64-41-02.59W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-08-20.95N	64-36-27.23W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-10-41.50N	64-32-37.55W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-12-23.67N	64-30-30.97W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-13-13.72N	64-25-18.97W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-14-47.58N	64-19-39.96W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-13-13.70N	63-47-29.99W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-10-39.63N	62-59-52.45W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
48-08-23.59N	62-57-30.21W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-53-56.93N	62-59-40.79W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-45-04.25N	63-00-45.95W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-39-57.18N	63-08-07.40W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-36-45.48N	63-13-58.25W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-36-20.65N	63-19-52.91W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-26-03.46N	64-15-56.64W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-24-27.85N	64-17-15.94W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-12-16.66N	64-27-15.34W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-04-00.46N	64-23-49.56W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
47-02-34.48N	64-25-13.90W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
47-00-13.19N	64-29-32.78W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-56-41.78N	64-30-58.98W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-56-07.68N	64-31-07.04W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-54-53.18N	64-31-53.60W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-52-04.83N	64-34-37.77W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-47-38.92N	64-34-33.07W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-42-01.61N	64-33-54.15W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-40-17.88N	64-33-21.19W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-37-10.72N	64-32-41.57W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-32-30.85N	64-29-41.91W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-27-37.43N	64-23-04.91W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-22-51.75N	64-20-02.31W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-21-35.98N	64-19-25.17W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-19-02.63N	64-11-30.70W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-17-10.48N	64-04-34.19W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-17-15.61N	63-55-53.36W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-14-55.38N	63-53-38.89W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-14-54.72N	63-53-37.05W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-14-54.55N	63-53-36.69W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-11-23.38N	63-44-11.49W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-11-19.67N	63-43-46.99W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-10-25.65N	63-41-44.72W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-02-22.31N	63-35-55.41W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-20.56N	63-43-17.53W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-00-02.81N	63-48-41.32W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-01-31.81N	63-50-26.99W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-00-48.51N	63-53-14.39W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-01-16.34N	63-54-26.37W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-01-03.83N	63-55-11.92W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-01-33.55N	63-58-14.12W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-01-30.76N	63-59-03.96W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-01-31.38N	64-02-12.02W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-01-15.18N	64-03-04.51W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-00-40.61N	64-02-54.09W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-00-27.49N	64-02-48.21W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
46-00-18.91N	64-02-46.69W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-59.81N	64-02-49.07W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-45.78N	64-02-29.47W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-40.89N	64-02-28.25W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-34.44N	64-02-27.88W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-32.85N	64-02-29.30W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-27.46N	64-02-42.14W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-59-16.14N	64-02-38.50W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-12.38N	64-02-41.69W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-09.46N	64-02-53.35W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-07.43N	64-02-53.95W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-05.34N	64-02-53.39W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-01.38N	64-02-43.67W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-59-00.85N	64-02-35.98W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-59.70N	64-02-35.28W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-59.23N	64-02-34.38W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-58.10N	64-02-34.29W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-53.10N	64-02-38.27W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-52.91N	64-02-51.99W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-51.47N	64-03-00.37W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-50.80N	64-03-01.01W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-49.96N	64-03-01.32W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-48.64N	64-03-01.43W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-47.82N	64-03-01.23W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-46.90N	64-03-00.58W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-46.41N	64-03-00.23W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-58-46.38N	64-03-00.18W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

7.3 Tidnish River Inter-Provincial Line (DPM Segment)

!Datum Information:
Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-58-46.38N	64-03-00.18W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-58-46.31N	64-03-00.14W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-58-42.47N	64-02-56.36W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-58-41.97N	64-02-55.73W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-58-37.81N	64-02-48.90W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-58-37.26N	64-02-47.67W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-58-37.28N	64-02-48.50W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

7.4 Missequash River Inter-Provincial Line (DPM Segment 1)

!Datum Information:

Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-51-47.62N	64-15-49.93W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-47.05N	64-15-50.65W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-46.38N	64-15-51.37W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-45.84N	64-15-52.00W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-45.59N	64-15-52.38W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-45.03N	64-15-53.47W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-44.38N	64-15-54.98W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-44.08N	64-15-56.06W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-43.93N	64-15-56.81W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-43.58N	64-15-58.95W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-43.37N	64-15-59.75W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-43.25N	64-16-00.08W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-43.06N	64-16-00.32W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-42.65N	64-16-00.84W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-42.36N	64-16-01.13W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-42.07N	64-16-01.24W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-41.49N	64-16-01.31W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-39.77N	64-16-01.24W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-37.05N	64-16-01.35W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-36.47N	64-16-01.28W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-35.88N	64-16-01.12W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-35.56N	64-16-01.04W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-35.10N	64-16-00.69W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-34.50N	64-16-00.20W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-34.14N	64-15-59.80W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.87N	64-15-59.30W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.56N	64-15-58.61W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.39N	64-15-57.88W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.24N	64-15-57.05W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.19N	64-15-56.08W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.15N	64-15-55.57W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.17N	64-15-55.24W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.23N	64-15-54.92W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.42N	64-15-54.45W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-33.76N	64-15-53.83W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-51-34.68N	64-15-52.54W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-34.99N	64-15-52.02W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-35.05N	64-15-51.83W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

7.5 Missequash River Inter-Provincial Line (DPM Segment 2)

!Datum Information:

Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-51-32.08N	64-15-43.88W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-32.01N	64-15-43.89W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-31.69N	64-15-43.90W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-31.40N	64-15-43.96W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-31.14N	64-15-44.06W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-30.56N	64-15-44.41W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-30.05N	64-15-44.61W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-28.76N	64-15-44.80W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-27.37N	64-15-45.14W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-25.60N	64-15-45.86W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-24.74N	64-15-46.36W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-24.39N	64-15-46.65W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-23.94N	64-15-46.99W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-22.89N	64-15-47.82W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-22.25N	64-15-48.41W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-21.14N	64-15-49.56W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-20.06N	64-15-50.63W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-19.77N	64-15-50.96W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-18.61N	64-15-52.59W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-17.82N	64-15-53.96W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-17.14N	64-15-55.24W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-16.85N	64-15-55.72W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-16.63N	64-15-55.96W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-16.22N	64-15-56.30W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-15.70N	64-15-56.55W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-15.09N	64-15-56.81W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-14.13N	64-15-57.08W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-12.87N	64-15-57.59W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-51-12.17N	64-15-58.04W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-11.82N	64-15-58.28W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-11.53N	64-15-58.57W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-10.87N	64-15-59.34W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-10.40N	64-16-00.06W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-09.96N	64-16-01.00W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-09.41N	64-16-02.46W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-09.04N	64-16-03.77W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-08.66N	64-16-05.46W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-08.48N	64-16-06.49W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-08.43N	64-16-07.28W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-08.45N	64-16-07.97W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-08.59N	64-16-08.80W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-08.76N	64-16-09.26W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-09.06N	64-16-09.75W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

7.6 Missequash River Inter-Provincial Line (DPM Segment 3)

!Datum Information:

Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-51-10.64N	64-16-20.86W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-09.74N	64-16-20.99W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-08.41N	64-16-21.00W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-07.50N	64-16-21.04W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-06.02N	64-16-21.37W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-05.31N	64-16-21.50W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-04.53N	64-16-21.62W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-04.41N	64-16-21.72W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-04.03N	64-16-22.24W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-03.58N	64-16-22.54W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-02.82N	64-16-23.22W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-01.56N	64-16-23.87W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-01.21N	64-16-24.02W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-00.83N	64-16-24.27W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-51-00.12N	64-16-24.30W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-58.59N	64-16-24.36W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-58.43N	64-16-24.32W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-50-57.78N	64-16-24.25W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-57.56N	64-16-24.36W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-56.99N	64-16-25.12W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-56.73N	64-16-25.36W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-55.62N	64-16-26.15W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-55.29N	64-16-26.16W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

7.7 Missequash River Inter-Provincial Line (DPM Segment 4)

!Datum Information:

Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-50-05.59N	64-16-37.61W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-05.75N	64-16-37.33W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-06.03N	64-16-36.94W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-08.57N	64-16-34.02W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-10.03N	64-16-32.43W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-10.40N	64-16-31.76W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-10.62N	64-16-31.11W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-10.77N	64-16-30.78W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-11.03N	64-16-30.53W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-11.15N	64-16-30.48W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-11.45N	64-16-30.56W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-11.77N	64-16-30.55W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-12.00N	64-16-30.73W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-12.75N	64-16-30.97W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-13.14N	64-16-30.96W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-13.72N	64-16-30.84W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-14.14N	64-16-30.59W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-14.62N	64-16-30.58W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-15.30N	64-16-30.64W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-16.83N	64-16-30.67W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-17.41N	64-16-30.56W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-18.64N	64-16-30.46W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-19.25N	64-16-30.34W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-19.99N	64-16-30.04W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-20.28N	64-16-29.98W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-20.73N	64-16-29.77W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-50-21.21N	64-16-29.48W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-22.20N	64-16-28.60W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-22.80N	64-16-28.12W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-22.96N	64-16-27.92W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-23.18N	64-16-27.40W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-23.46N	64-16-27.02W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-23.81N	64-16-26.82W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-24.17N	64-16-26.67W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-24.71N	64-16-26.28W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-25.51N	64-16-25.83W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-26.31N	64-16-25.24W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-26.47N	64-16-25.14W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-26.76N	64-16-25.13W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-27.21N	64-16-25.06W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-27.47N	64-16-25.10W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-28.00N	64-16-25.26W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-28.26N	64-16-25.49W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-28.46N	64-16-25.76W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-28.99N	64-16-26.34W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-29.38N	64-16-26.69W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-29.68N	64-16-26.82W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-30.07N	64-16-27.17W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-30.44N	64-16-27.58W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-31.11N	64-16-28.62W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-31.50N	64-16-29.02W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.16N	64-16-29.50W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.68N	64-16-29.57W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-33.52N	64-16-29.54W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-34.07N	64-16-29.29W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-34.42N	64-16-28.99W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-34.96N	64-16-28.28W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.46N	64-16-27.42W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.74N	64-16-26.85W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.92N	64-16-26.24W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-36.01N	64-16-25.68W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-36.03N	64-16-25.13W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.98N	64-16-24.34W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.87N	64-16-23.79W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.73N	64-16-23.29W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.56N	64-16-22.97W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.30N	64-16-22.61W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-34.44N	64-16-21.71W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-50-33.78N	64-16-21.19W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.99N	64-16-20.71W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.83N	64-16-20.53W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.66N	64-16-20.30W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.52N	64-16-19.84W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.27N	64-16-18.65W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.19N	64-16-17.96W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.15N	64-16-17.45W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.20N	64-16-16.75W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.35N	64-16-16.10W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.47N	64-16-15.68W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-32.75N	64-16-15.06W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-33.00N	64-16-14.40W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-33.22N	64-16-14.02W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-33.88N	64-16-13.07W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-34.58N	64-16-12.30W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-35.28N	64-16-11.67W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-37.58N	64-16-09.91W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-38.09N	64-16-09.65W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-38.51N	64-16-09.50W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-38.93N	64-16-09.48W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-40.51N	64-16-09.37W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-42.04N	64-16-09.45W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-42.95N	64-16-09.69W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-43.41N	64-16-09.90W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-46.19N	64-16-11.51W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-46.88N	64-16-11.85W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-48.87N	64-16-12.56W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-49.62N	64-16-12.95W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-49.92N	64-16-13.12W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-50.38N	64-16-13.66W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-50.55N	64-16-13.93W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-50.79N	64-16-14.52W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-50.89N	64-16-14.94W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-50.93N	64-16-15.12W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map
45-50-51.08N	64-16-16.32W	DLBNPR2	Z	GICTZUNBSB02	Digital Property Map

7.8 Missequash River Inter-Provincial Line (Interpolated Segment 1)

!Datum Information:

Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000

Rotation (x,y,z): 0.000   0.000   0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-51-35.05N	64-15-51.83W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-35.24N	64-15-51.59W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-35.73N	64-15-50.13W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-35.96N	64-15-48.55W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-35.96N	64-15-47.02W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-35.75N	64-15-46.01W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-34.28N	64-15-43.89W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-33.92N	64-15-43.76W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-32.72N	64-15-43.49W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-32.08N	64-15-43.88W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

7.9 Missequash River Inter-Provincial Line (Interpolated Segment 2)

!Datum Information:
Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000   0.000   0.000
Rotation (x,y,z): 0.000   0.000   0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-51-10.64N	64-16-20.86W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-11.59N	64-16-21.20W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-12.21N	64-16-21.40W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-14.77N	64-16-21.30W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-15.69N	64-16-20.75W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-15.81N	64-16-20.01W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-16.17N	64-16-16.93W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-15.51N	64-16-14.83W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-15.21N	64-16-14.19W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-11.57N	64-16-11.83W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-51-09.06N	64-16-09.75W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

7.10 Missequash River Inter-Provincial Line (Interpolated Segment 3)

!Datum Information:
Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000   0.000   0.000
Rotation (x,y,z): 0.000   0.000   0.000

Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-50-55.29N	64-16-26.16W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-53.75N	64-16-26.73W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-51.87N	64-16-26.72W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-50.09N	64-16-25.12W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-49.95N	64-16-24.66W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-49.83N	64-16-23.32W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-51.08N	64-16-16.32W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

7.11 Bay of Fundy Inter-Provincial Line (Interpolated Segment)

!Datum Information:
Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-50-05.59N	64-16-37.61W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-04.30N	64-16-39.56W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-02.76N	64-16-41.94W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-00.58N	64-16-44.86W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-49-37.76N	64-17-17.10W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-49-44.45N	64-17-26.47W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-00.57N	64-17-54.10W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-09.27N	64-18-01.82W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-21.75N	64-18-15.37W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-32.08N	64-18-49.03W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-38.58N	64-19-17.10W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-36.88N	64-20-01.76W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-35.71N	64-20-08.25W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-50-19.75N	64-20-46.65W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-49-50.50N	64-21-07.48W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-49-33.19N	64-21-36.18W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-49-04.10N	64-22-24.38W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-47-33.78N	64-24-14.31W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-46-49.56N	64-24-10.84W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-45-56.65N	64-25-54.85W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-45-18.07N	64-27-31.72W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-44-14.40N	64-27-54.59W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-42-46.35N	64-28-20.10W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-41-48.71N	64-30-09.74W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-41-11.09N	64-34-06.73W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-40-57.50N	64-35-10.93W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-38-01.93N	64-38-52.01W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-35-13.76N	64-42-52.20W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-35-13.76N	64-42-52.66W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-35-05.06N	64-43-03.55W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-33-50.59N	64-44-22.53W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-32-53.60N	64-47-19.99W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-33-15.36N	64-51-13.39W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-30-53.84N	64-55-17.57W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-30-25.35N	64-56-22.00W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-29-08.74N	64-58-04.26W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-29-01.80N	64-58-25.86W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-26-53.02N	65-03-30.77W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-24-29.10N	65-03-59.85W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-22-18.24N	65-05-28.63W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-22-08.78N	65-05-28.22W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-22-07.00N	65-06-12.89W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-17-08.65N	65-16-24.10W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-08-13.77N	65-23-33.48W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-00-13.70N	65-43-33.32W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
45-00-13.29N	65-43-33.65W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-59-50.74N	65-44-20.43W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-57-19.29N	65-55-43.46W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-52-42.69N	66-04-28.97W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-50-15.93N	66-11-36.44W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-50-15.76N	66-11-36.45W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-50-12.63N	66-11-41.24W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-46-37.78N	66-19-51.49W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-31-10.37N	66-26-35.96W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-26-57.57N	66-31-25.19W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-26-09.10N	66-32-29.13W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-26-08.78N	66-32-29.41W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-24-29.73N	66-34-30.79W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-22-29.27N	66-44-46.82W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-22-08.40N	66-44-49.93W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-21-17.99N	66-44-40.28W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing
44-11-11.98N	67-16-44.05W	DLBNPR	Z	UBVDZUNBSB02	UNB Heads Up Digitizing

7.12 Gulf of Maine International Line (DFO-CHS Segment)

!Datum Information:

Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
44-46-35.61N	66-54-09.22W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-46-22.77N	66-54-22.36W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-46-09.93N	66-54-35.63W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-45-57.09N	66-54-48.82W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-45-44.28N	66-55-02.00W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-45-32.75N	66-55-17.51W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-45-21.26N	66-55-33.02W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-45-17.26N	66-55-38.03W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-45-11.35N	66-55-48.99W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-45-05.32N	66-56-00.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-44-53.58N	66-56-11.31W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-44-42.00N	66-56-22.68W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-44-30.27N	66-56-33.95W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-44-23.35N	66-56-38.98W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-44-15.32N	66-56-45.47W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-44-07.30N	66-56-52.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-44-03.27N	66-56-55.05W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-43-50.76N	66-57-03.54W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-43-38.26N	66-57-11.98W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-43-30.33N	66-57-18.46W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-43-22.30N	66-57-24.94W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-43-10.24N	66-57-35.57W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-42-58.31N	66-57-46.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-42-48.82N	66-57-53.52W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-42-39.33N	66-58-00.98W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-42-28.30N	66-58-12.48W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-42-17.34N	66-58-23.97W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-42-07.30N	66-58-38.51W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-41-57.26N	66-58-53.00W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-41-50.35N	66-59-03.48W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-41-43.31N	66-59-14.00W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-41-30.27N	66-59-25.24W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-41-17.30N	66-59-36.44W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-41-04.26N	66-59-47.58W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-40-51.32N	66-59-58.87W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-40-38.25N	67-00-10.01W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-40-33.34N	67-00-15.01W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
44-40-23.76N	67-00-19.51W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-40-14.25N	67-00-23.96W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-39-59.32N	67-00-31.00W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-39-44.36N	67-00-38.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-39-36.32N	67-00-45.05W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-39-23.83N	67-00-56.55W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-39-11.31N	67-01-08.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-38-57.91N	67-01-18.65W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-38-44.65N	67-01-29.37W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-38-31.25N	67-01-39.95W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-38-21.31N	67-01-46.53W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-38-11.27N	67-01-53.01W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-58.79N	67-02-02.52W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-46.27N	67-02-11.97W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-36.80N	67-02-16.01W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-27.32N	67-02-20.00W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-21.94N	67-02-40.31W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-16.60N	67-03-00.63W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-11.34N	67-03-21.08W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-06.00N	67-03-41.39W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-37-00.65N	67-04-01.70W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-55.26N	67-04-22.00W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-50.04N	67-04-42.31W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-44.69N	67-05-02.75W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-39.30N	67-05-23.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-33.95N	67-05-43.36W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-28.59N	67-06-03.67W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-23.24N	67-06-23.97W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-16.33N	67-06-38.36W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-09.28N	67-06-52.66W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-36-02.27N	67-07-06.95W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-35-54.24N	67-07-24.23W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-35-46.08N	67-07-41.55W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-35-37.95N	67-07-58.73W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-35-29.79N	67-08-16.05W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-35-21.66N	67-08-33.23W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-35-13.49N	67-08-50.49W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-35-05.46N	67-09-07.81W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-34-57.32N	67-09-24.98W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-34-45.17N	67-09-37.85W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-34-33.11N	67-09-50.54W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-34-20.95N	67-10-03.40W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
44-34-08.89N	67-10-16.13W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-33-56.73N	67-10-28.95W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-33-44.67N	67-10-41.67W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-33-32.51N	67-10-54.48W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-33-20.45N	67-11-07.21W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-33-08.29N	67-11-20.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-32-57.35N	67-11-28.99W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-32-45.87N	67-11-37.00W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-32-34.25N	67-11-45.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-32-22.40N	67-11-59.46W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-32-10.46N	67-12-13.94W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-31-58.64N	67-12-28.37W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-31-46.70N	67-12-42.85W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-31-34.75N	67-12-57.24W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-31-22.93N	67-13-11.76W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-31-10.98N	67-13-26.14W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-30-59.04N	67-13-40.66W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-30-47.22N	67-13-55.09W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-30-35.62N	67-14-09.47W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-30-24.00N	67-14-23.85W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-30-12.40N	67-14-38.27W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-30-00.81N	67-14-52.65W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-29-49.18N	67-15-07.03W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-29-47.19N	67-15-09.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-29-33.35N	67-15-16.19W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-29-19.50N	67-15-23.34W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-29-05.65N	67-15-30.48W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-28-51.84N	67-15-37.63W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-28-37.86N	67-15-44.78W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-28-24.05N	67-15-51.92W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-28-10.20N	67-15-59.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-27-55.25N	67-16-06.42W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-27-40.30N	67-16-13.77W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-27-25.35N	67-16-21.17W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-27-10.50N	67-16-28.52W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-26-55.55N	67-16-35.87W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-26-40.60N	67-16-43.27W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-26-25.65N	67-16-50.61W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-26-10.66N	67-16-57.96W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-25-55.71N	67-17-05.35W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-25-40.76N	67-17-12.70W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-25-25.81N	67-17-19.95W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
44-25-10.86N	67-17-27.34W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-24-56.00N	67-17-34.68W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-24-41.05N	67-17-42.07W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-24-26.10N	67-17-49.41W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-24-11.15N	67-17-56.79W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-23-56.20N	67-18-04.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-23-46.15N	67-18-09.05W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-23-36.24N	67-18-14.10W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-23-21.15N	67-18-13.85W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-23-06.22N	67-18-13.64W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-22-51.25N	67-18-13.30W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-22-36.19N	67-18-13.09W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-22-21.02N	67-18-11.20W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-22-05.94N	67-18-09.41W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-21-50.76N	67-18-07.49W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-21-35.58N	67-18-05.74W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-21-34.58N	67-18-05.50W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-21-20.53N	67-18-03.82W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-21-05.35N	67-18-01.93W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-20-50.18N	67-18-00.14W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-20-34.32N	67-17-58.12W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-20-18.46N	67-17-56.14W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-20-02.61N	67-17-54.11W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-19-46.65N	67-17-52.09W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-19-30.83N	67-17-50.11W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-19-14.97N	67-17-48.09W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-18-59.11N	67-17-46.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-18-43.16N	67-17-44.08W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-18-27.30N	67-17-42.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-18-11.48N	67-17-40.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-17-55.62N	67-17-38.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-17-39.67N	67-17-36.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-17-23.81N	67-17-34.02W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-17-07.96N	67-17-32.00W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-16-52.13N	67-17-30.02W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-16-36.14N	67-17-28.09W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-16-20.32N	67-17-26.12W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-16-04.46N	67-17-24.10W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-15-48.61N	67-17-22.08W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-15-32.65N	67-17-20.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-15-16.80N	67-17-18.08W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-15-00.97N	67-17-16.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
44-14-45.02N	67-17-14.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-14-29.16N	67-17-12.03W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-14-13.30N	67-17-10.05W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-13-57.48N	67-17-08.04W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-13-41.49N	67-17-06.11W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-13-25.67N	67-17-04.14W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-13-09.81N	67-17-02.12W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-12-53.96N	67-17-00.10W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-12-38.00N	67-16-58.09W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-12-22.14N	67-16-56.07W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-12-06.32N	67-16-54.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-11-52.80N	67-16-51.62W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-11-39.31N	67-16-49.06W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-11-25.79N	67-16-46.58W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-11-12.30N	67-16-44.15W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS
44-11-11.98N	67-16-44.05W	DLBNIN	Z	CHCTZUNBSB02	DFO-CHS

7.13 Passamaquoddy Bay International Line (IBC Segment)

!Datum Information:

Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-04-28.18N	67-05-40.45W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-01-41.69N	67-03-59.63W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-57-14.07N	67-01-17.98W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-56-41.12N	67-00-35.99W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-55-42.09N	66-59-48.68W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-54-37.39N	66-58-07.37W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-53-41.23N	66-58-19.99W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-52-38.76N	66-58-47.99W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-52-02.12N	66-58-55.70W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
44-51-37.69N	66-58-50.53W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-51-03.54N	66-58-29.25W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-50-29.86N	66-58-29.47W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-49-43.87N	66-57-55.08W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-49-31.81N	66-55-57.33W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-47-39.09N	66-53-07.48W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
44-46-35.61N	66-54-09.22W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.

7.14 Passamaquoddy Bay International Line (DFO-CHS Segment)

!Datum Information:
Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-06-45.34N	67-06-45.20W	DLBNIN	A	CHCTAUNBSB02	DFO-CHS
45-04-28.18N	67-05-40.45W	DLBNIN	A	CHCTAUNBSB02	DFO-CHS

7.15 St. Croix River International Line (IBC Segment)

!Datum Information:
Datum Name: NA83
Major Axis: 6378137.000
Minor Axis: 6356752.314
Shifts (x,y,z): 0.000 0.000 0.000
Rotation (x,y,z): 0.000 0.000 0.000
Scale factor: 1.000000

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-11-06.01N	67-17-28.56W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-06.14N	67-17-28.57W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-07.38N	67-17-27.57W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
45-11-09.06N	67-17-27.55W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-10.06N	67-17-24.63W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-15.32N	67-17-27.55W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-19.66N	67-17-22.98W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-20.76N	67-17-13.29W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-23.77N	67-17-08.93W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-28.68N	67-17-06.34W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-30.37N	67-17-01.10W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-30.47N	67-17-00.55W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-30.70N	67-17-00.09W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-28.02N	67-16-44.48W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-28.81N	67-16-28.73W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-28.26N	67-16-19.24W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-25.80N	67-16-09.22W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-11-16.64N	67-15-44.09W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-58.35N	67-15-19.11W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-52.33N	67-14-58.55W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-51.18N	67-14-50.75W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-41.71N	67-14-38.12W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-20.84N	67-14-34.14W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-15.48N	67-14-27.75W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-10.91N	67-14-07.77W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-06.66N	67-13-58.51W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-09-53.39N	67-13-47.26W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-09-48.26N	67-13-38.22W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-09-48.13N	67-13-23.38W	DLBNIN	A	IBCTAUNBSB02	NRCan-International

LAT.	LONG.	FEATURE CODE	X,Y CODE	SOURCE ID	SOURCE
					Boundary Comm.
45-09-59.75N	67-13-04.76W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-03.09N	67-12-49.09W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-09.58N	67-12-31.04W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-17.05N	67-12-18.31W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-10-16.94N	67-12-10.07W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-09-58.31N	67-11-33.66W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-09-56.05N	67-11-26.77W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-09-52.83N	67-10-04.26W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-09-43.24N	67-09-31.59W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-08-45.19N	67-08-41.57W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-07-56.21N	67-07-43.54W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.
45-06-45.34N	67-06-45.20W	DLBNIN	A	IBCTAUNBSB02	NRCan-International Boundary Comm.

APPENDIX II

TOWARD A 3D MARINE CADASTRE IN SUPPORT OF GOOD OCEAN GOVERNANCE: A REVIEW OF THE TECHNICAL FRAMEWORK REQUIREMENTS

Toward a 3D Marine[25] Cadastre in Support of Good Ocean Governance: A Review of the Technical Framework Requirements

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Paper published in *Computer, Environment and Urban Systems, 28 (2004), pp. 443-470*

Abstract

Jurisdictions that are contemplating the development of 3D Cadastres cannot afford to ignore the marine environment. Apart from its extreme importance as a resource, the marine environment and its use is volumetric by nature and involves the exercising of rights to the surface, water column, seabed, and subsoil.

This paper highlights the value of the marine cadastre[26] in providing support for effective and efficient decision making associated with good ocean governance. Its primary focus is the technical framework of a marine cadastre as part of the marine property rights information infrastructure. The paper begins by outlining the importance of coastal and marine areas; links this to the three-dimensional mosaic of private and public interests found in marine space; then shows how this complexity affects ocean governance. The paper then outlines how information on property rights is crucial to ocean governance; how the technical framework for the marine property rights information infrastructure can be built (by reviewing the various components of a marine cadastre); and concludes by outlining other issues that need to be considered in developing a marine cadastre.

Introduction

Coastal and marine areas are ever increasing in value to the welfare of countries, communities and regions. These areas provide natural, social and economic functions that contribute to increased quality of life. The oceans are instrumental in determining climate that beneficially affect all life on Earth [Payoyo, 1994]. Other natural functions include habitat for endangered species, species breeding and resting areas, water treatment, groundwater recharge, and flood attenuation. Other social and economic functions include tourism, commercial and recreational fishing, oil and gas development, and construction [Eckert, 1979; Prescott, 1985; Gomes, 1998]. Additionally these spaces are sources of wealth for humankind by providing [Eckert, 1979; Payoyo, 1994]:

i) Sources of food from animals, plants and fish;
ii) Means of transportation;
iii) Means of communication (e.g. cables);
iv) Areas for implanting fixed navigational installations (e.g. lighthouses and piers);
v) Areas for the dumping of waste materials;
vi) Areas for scientific research on Earth's basic physical and biological processes.

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[25] In this paper the term "marine" refers to submerged lands found in relatively large bodies of water i.e. lakes, sea, and ocean.

[26] In this paper a marine cadastre is an information system that allows rights in marine space to be defined, recorded, visualised and managed.

Coastal and marine environments are also very susceptible to the negative effects of factors ranging from geology and climate, to human terrestrial, coastal and marine activities. It is almost impossible to control geology and climate, and very difficult to avoid human impact on coastal and marine environments as these environments play such an integral role in the quality of human life. However, the current pattern of the use of coastal and marine spaces is not sustainable and there is an urgent need to make sustainability a fundamental norm in the use of these areas [Miles, 1998]. Good marine governance is therefore vital in the sustainable use of these environments.

Ocean Governance

Governance is about decision-making and steering, and the distribution of knowledge and power within an organized entity (e.g. a jurisdiction, government department etc.) as that entity pursues its goals and objectives [Centre on Governance, 2000; Paquet, 1994; Paquet, 1997; Rosell, 1999]. Accurate, up-to-date, complete and useful information regarding the resources that currently exist, the nature of the environment within which those resources exist, as well as users' relationships to those resources is therefore always a requirement for effective governance of marine areas. Information on (but not limited to) living and non-living resources, marine contaminants, water quality, shoreline changes, seabed characteristics, bathymetry, spatial extents, and property rights, responsibilities and restrictions all contribute to the sustainable development and good governance of marine environments [Nichols, Monahan and Sutherland, 2000].

The issue surrounding the organisations or "entities" that are in charge of ocean governance is as yet unresolved. This derives from the fact that there are several stakeholders involved in ocean governance resulting in co-management strategies being the most effective governance solutions. Internationally, the United Nations Convention on the Law of the Sea (UNCLOS) has focused nations' interests on offshore resources by providing a legal mechanism whereby a nation can extend its claim as far seaward as the continental shelf [United Nations, 1983]. Since it explicitly deals with the rights, restrictions and responsibilities to the physical layers offshore, UNCLOS has created a complex three-dimensional mosaic of private and public interests. When a nation's coastal zone management programs, jurisdiction and administration issues are added on to this mosaic, a clear understanding of the nature and extent of associated three-dimensional (3D) spatial limits is crucial for decision making purposes.

The Marine Cadastre

In this paper, McLaughlin's [1975] definition of a cadastre is used i.e. " a parcel-based record of interests in land encompassing both the nature and extent of these interests". Extending this description further, a marine cadastre can be defined as an information system that facilitates the visualisation of the effect of a jurisdiction's private and public laws on the marine environment (e.g. spatial extents and their associated rights, responsibilities, restrictions, and administration). Other relevant information such as that regarding the physical and biological natures of the environment may be connected to the cadastre using spatial referencing to give the cadastre a multipurpose function.

The multipurpose cadastre concept has been traditionally designed on a three dimensional spatial unit representing unique, homogeneous, contiguous interests [see McLaughlin, 1975; National Research Council, 1980; Moyer and Fisher, 1973]. In some senses the cadastre also represented a fourth dimension, time (e.g., time-shared interests). In the oceans where resources and activities, and therefore rights and restrictions, can co-exist in time and space and can move over time and space, the definition of a parcel is even more complex. Furthermore, a cadastre in the conventional sense may not be the best unit of representation for all interests. Other approaches are currently being examined to perhaps better achieve the objectives of ocean governance within a context of multiple interests, scales, and users. Until another framework is proven more useful, the cadastral concept may help the initial exploration of ideas.

3D Issues Surrounding the Marine Cadastre

For many years, the Common Law has regarded property rights as a “bundle of sticks” each representing a separate right in the property. [Kaiser Aetna v. U.S., 444 U.S. 164, 176 (1979); Black, 1990]. Traditionally, a single person (or legal entity) has held many of the elements of the bundle at any given time. Today complicated zoning regulations, easements, leases, and other use rights complicate the traditional system. Some authors [e.g. Hoogsteden and Robertson, 1998,1999] have advocated the “unbundling” of these property rights in order to clarify today’s complicated ownership scheme. In fact, Bevin {1999] promotes the division of rights into “legal land objects” by arguing, “…If a law defines phenomena, rights, or restrictions which are related to a fixed area or point of the surface of the earth, it defines a land object”.

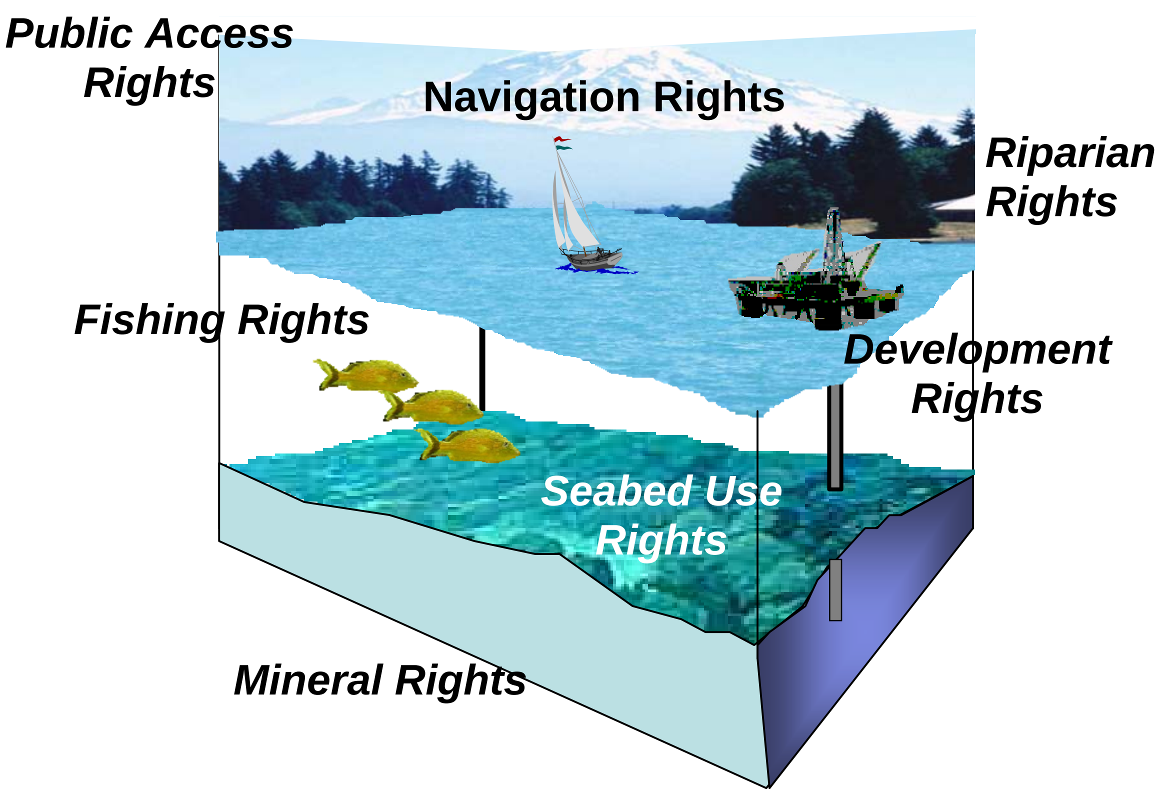

Figure 0: 3D Perspective of Marine Rights [after Sutherland, 2001]

Figure 1 portrays how a 3D definition of any given right renders a more accurate picture of the property rights in marine space. It visually supports the argument that defining a land object based on the surface area of land it occupies does not present an accurate view of every right that may exist in that land. Clearly, the right to explore for minerals may have an impact on the surface of the land, but it will also affect a 3D cross-section of the parcel below the land's surface. Policy-makers would no doubt benefit from an understanding of the upper and lower bounds of the exploration rights, and how these may affect the environment or other property entitlements within the same parcel.

Nowhere is the need to unbundle rights in 3D form more pressing than in the world's oceans. This is true for several reasons. First, in a marine environment, individual ownership of a "parcel" is not the norm. Government ownership, public rights, and international law may usurp whatever private rights exist in the water column, and may eliminate an individual's "right to exclude others from the property," which is traditionally considered one of the most treasured strands in a private property owner's bundle of rights. [Kaiser Aetna v. U.S., 444 U.S. 164, 176 (1979); Loretto v. Teleprompter Manhattan CATV Corp. et al, 458 U.S. 419 (1982)]. The distinct portrayal of these rights is therefore essential for informed policy-making.

Secondly, few marine activities can be said to take place on the "surface" of the water. Nearly everything marine actually takes place in a volume of water. Most marine rights, such as aquaculture, mining, fishing, and mooring rights and even navigation have an inherently 3D nature, which makes a 2D definition of these rights legally inadequate. Where and how do these rights overlap? It is entirely possible that any two marine rights intersect not at the surface of the water, but at some point far below, in the water column or even within the seabed. In order to control and regulate marine activity, a more accurate portrayal of rights in the water column is required. This can only be achieved using a 3D representation of these rights. But how do you build the framework for visualising these rights? The authors contend that the steps to building this framework are comparable to building a marine cadastre. This (by necessity) involves reviewing the basic components of a marine cadastre. This review is carried out in the next section.

Building the Marine Cadastre – The Technical Framework

Several authors [e.g. Hoogsteden and Robertson, 1998,1999] have argued that the construction of a marine cadastre should incorporate a "seamless onshore-offshore"[27] cadastre objective. This objective is based on the premise that the marine cadastre should not promote discontinuity at the land/water interface. From this argument then, the authors contend that the components of the marine cadastre should be similar (or closely linked) to those outlined in land based cadastre. These components are generally accepted as [e.g. McLaughlin, 1975; National Research Council, 1980, 1983]:

- i) A reference framework consisting of a geodetic network;
- ii) A series of large scale base maps including the procedures and standards for the production of base maps;
- iii) A series of registers that record interests in land parcels;

[27] Hoogsteden and Robertson [1998,1999] argue that the importance of spatial and textual continuity traversing the land-water interface is to obtain coherence of: the register of interests, the unique parcel identifiers, the cadastral survey system, and the cadastral map, based on a common national (sometimes international) coordinate system.

iv) A cadastral overlay that allows unique identification of delineated cadastral parcels.

In the following sections the authors discuss each of these components in the context of the special requirements of a marine cadastre.

The Geodetic Reference Framework

The geodetic reference framework permits the spatial referencing of all data to identifiable positions on the earth's surface. Traditionally, this consisted of monumented points whose locations were accurately determined with respect to a mathematical framework. In the case of the marine cadastre, this might not be possible as placing monument points in marine space presents quite a challenge.

Demarcation of boundaries notwithstanding, it is generally accepted that there are three design issues that need to be resolved in defining the geodetic reference framework component of a cadastre [McLaughlin, 1975; National Research Council, 1980, 1983]. These include the mathematical projection and datum[28] to be used; the control spacing requirements; and the accuracy requirements. Each of these design issues are discussed in the following sections.

Type of Mathematical Map Projection and Datum to be used

To ensure that parcels are uniquely positioned and identified, datums and map projections used in marine spaces have to be identified and harmonised. Both horizontal and vertical datums need to be defined for this purpose. Although issues surrounding horizontal datum definition are comparable to those encountered in land based cadastre, the vertical datum (or chart datum[29]) has its own peculiarities.

The definition of chart datum has always been the source of much confusion. Different definitions of chart datum exist e.g. mean lower low water, mean low water, low water, lowest astronomical tide mean low water spring [Monahan and Nichols, 1999; Fowler and Treml, 2001]. Accentuating the problem is the fact that most mapped shorelines are not tide level-controlled, but an approximation from aerial photography or other surveys many years ago [Nichols et al, 1997, 2000, 2001]. Internationally, the International Hydrographic Organisation (IHO) and the International Maritime Organisation (IMO) advocates that states should consider adopting the lowest astronomical tides[30] as the chart datum [Elema and Jong, 1999, Groten, 1999]. This is an effort to define a standard for vertical datums and reduce the discrepancies brought about when merging data sets that variously refer to "lowest low water astronomic tide", "mean water level", or no datum at all. However, budget, equipment, time and human resource constraints prohibit the practical implementation of this standard. A further discussion of the complexity surrounding chart datum is outside the scope of this paper. The reader is instead directed to Fowler and Treml [2001] for a more in depth discussion of this issue.

Even within a country there are several state and local geodetic systems that are in effect. This is complicated by the different jurisdictions that marine spaces are divided into. Take this Canadian jurisdiction example; on one hand, a legal boundary survey of an Aquaculture lease in the province of New Brunswick in Canada is carried out by a New Brunswick Land Surveyor and lease coordinates provided based on double stereographic

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[28] Datums define the size and shape of the earth and the origin and orientation of the coordinate systems used to map the earth. They vary as one crosses between jurisdictions.

[29] In general, the chart datum is usually based on some kind of a low water level.

[30] This datum is obtained by obtaining tidal observation over a period of 18.4 - 18.6 years.

projection and NAD83 datum. On the other hand, oil and gas leases which fall under Federal jurisdiction are surveyed by Canada Lands Surveyors and coordinates provided based on Universal Transverse Mercator (UTM) projection and NAD 27 datum [Nichols et al., 1997]. From this example it can be seen that in order to determine the location of an oil and gas lease with respect to an aquaculture lease, one would have to transform one set of coordinates to another.

The transformation of coordinates from one datum to another is generally a process that introduces error into the coordinates that are finally derived. Using the previous example, if one was to transform the oil lease geodetic coordinates to those of the aquaculture lease, then the Molodensky datum transformation method would be used. It is a well-documented fact [e.g. Elema and Jong, 1999, Vanicek and Krakiwsky, 1982] that Molodensky datum transformation formulas produce results of sufficient accuracy only when local rather than mean datum shifts are available. The situation does not significantly improve when converting from cartesian coordinates (as opposed to geodetic coordinates) using the Helmert transformation. This 7-parameter transformation assumes that the geodetic system has consistent scale and orientation throughout the network, which is not necessarily the case. For simplicity of computations, the rotations and scale factor are usually considered to be zero, which reduces the Helmert transformation to a "less-precise" 3-parameter transformation [Elema and Jong, 1999]. Transformed coordinates should therefore be understood in the light of these potential errors.

In any case, marine positioning has dramatically changed with the advent of satellite based positioning systems such as the Global Positioning System (GPS). GPS positions are usually reported in the World Geodetic System 1984 (WGS 84) datum. With the IHO strongly supporting any initiative to reference hydrographic charts to WGS 84 [Elema and Jong, 1999], one can infer that a *de facto* marine cadastre datum is well on its way to being endorsed. As indicated previously, IHO and IMO advocate that states adopt the lowest astronomical tides as the chart datum. Heights obtained using GPS are related to the WGS 84 datum and therefore only have a geometrical[31] rather than a physical meaning. Since one is interested in heights relative to the (physical) mean sea level then the difference between the ellipsoid and the chart datum must be computed at every GPS point. For a more in-depth discussion on this, the reader is referred to Groten [1999].

Density (Control Spacing) Requirements;

GPS absolute positioning accuracy has been improved by using the Differential GPS (DGPS) service. This service significantly improves positioning accuracy by utilising a reference GPS receiver, placed on an accurately surveyed point that transmits corrections to other receivers in its vicinity. The reliability of a marine DGPS system is based on the shore-based network of DGPS stations that generate and transmit the DGPS corrections. If density requirements are to be considered in the context of DGPS, then one can refer to the five different DGPS infrastructures that are available. Wells [1997] offers the following categories:

i) Public DGPS systems – These are all installed by government agencies and provide free access to DGPS by all users. Examples include the 75 marine beacon DGPS transmitters established by United States and Canadian Coast Guards and the 50 similar marine DGPS transmitters being established in Europe. It is also

[31] Based on the mathematical GRS 80 Ellipsoid

important to note that systems designed to support aviation are also being established and will add to the public DGPS infrastructure.

ii) Long-range Commercial DGPS systems-At least 2 global DGPS networks are in place (maintained by Racal and Fugro) with many smaller networks available in areas of intense offshore industrial activity. These form the wide area DGPS (WDGPS) networks.

iii) Short-range commercial DGPS systems – At least 2 short-range DGPS networks (maintained by Digital Corrections International and Accqpoint) are available in many countries. These Local Area DGPS (LADGPS) systems communicate corrections via paging systems using FM subcarriers leased from commercial FM broadcast stations.

iv) Scientific active control DGPS-This option is based upon global scientific GPS tracking networks of over 50 stations called the International GPS service for Geodynamics (IGS). Their primary purpose is to monitor continental drift and other earth deformations and motions. However a commercial DGPS product has evolved out of this and it is now possible to distribute results to DGPS users in real time.

v) User operated DGPS base stations – Most GPS receiver manufacturers supply DGPS systems that allow users to set up their own base stations. This allows control over the quality and performance of the positioning and may be the only option for certain areas where other options are not available.

Accuracy Requirements.

Issues surrounding the accuracy requirements of the geodetic reference framework for marine applications are being partially resolved through standards. There are a number of international, national, enterprise standards[32] that prescribe acceptable and competent practices and procedure for marine positioning. A comprehensive review of all such standards is outside the scope of this paper. In this section, the authors focus on the IHO special publication no 44 (IHO S44) standards.

IHO S44 specifies the minimum standards for hydrographic surveys[33] based on an area's importance for the safety of surface navigation. This is to ensure that the hydrographic data collected is sufficiently accurate and that the spatial uncertainty of data is adequately quantified to be safely used by mariners (commercial, military or recreational) as primary users of the information [International Hydrographic Organisation, 1998]. It takes into account the impact of widely available DGPS on hydrographic surveys. IHO S44 also provides different accuracy requirements for areas to be surveyed. These recommendations indicate that the basic accuracy requirements of the geodetic framework (for the marine cadastre) have been outlined. Table 1 shows a summary of the four orders of survey that are defined.

Table 1: Summary of Minimum Standards for Hydrographic Surveys (after Monahan and Wells, 2000; International Hydrographic Organisation, 1998)

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[32] e.g US Army Corps of Engineers standards, General Instructions for Hydrographic Surveyors etc.

[33] The terms hydrographic surveying, hydrography and ocean mapping are constantly interchanged in this paper. They refer to the science of measuring and depicting parameters necessary to describe the precise nature and configuration of the seabed, its geographical relationship to the landmass, and the characteristics and dynamics of the sea.

Order	Special	1	2	3
Examples of Typical Areas	Harbours, berthing areas, and associated critical channels with minimum underkeel clearances	Harbours, harbour approach channels, recommended tracks and some coastal areas with depths upto 100 m	Areas not described in Special Order and Order 1, or areas up to 200 m water depth	Offshore areas not described in Special Order and Orders 1 and 2
Horizontal Accuracy (95% confidence level)	2m	5m + 5% of depth	20m + 5% of depth	150m + 5% of depth
Depth Accuracy for reduced depths(95% confidence level)	a=0.25m b=0.0075	a=0.5m b =0.013	a=1.0m b=0.023	Same as Order 2
100% Bottom search	Compulsory	Required in selected areas	May be required in selected areas	Not applicable
System detection capability	Cubic features>1m	Cubic features > 2m in depths up to 40m; 10% of depth beyond 40m	Same as Order 1	Not applicable
Maximum line spacing	Not applicable, as 100% search compulsory	3 x average depth or 25m, whichever is greater	3-4 x average depth or 200 m, whichever is greater	4 x average depth

In addition to providing the accuracy requirements for hydrographic surveys, IHO S44 also provides specifications for horizontal control together with navigation aids and other important features used during hydrographic surveys. Primary and secondary shore control should be located by ground survey methods to a relative accuracy of 1: 100000 and 1:10000 respectively. When geodetic satellite positioning methods are used, the error should not exceed 10 cm and 50cm at 95% confidence level respectively. Table 2 shows the recommended horizontal positional accuracy (at 95% confidence level) for navigation aids and other features.

Table 2: Summary of Minimum Standards for Positioning of Navigation Aids and Important Features (After International Hydrographic Organisation, 1998)

	Special Order surveys	Order 1 surveys	Order 2 and 3 surveys
Fixed aids to navigation and features significant to navigation	2m	2m	5m
Natural Coastline	10m	20m	20m
Mean position of floating aid to navigation	10m	10m	20m
Topographical features	10m	20m	20m

Finally, a new requirement pertaining to the measurement of tidal heights has been adopted [International Hydrographic Organisation, 1998]. The total measurement error should not exceed +/- 5 centimeters at the 95% confidence level for Special Order surveys and +/-10 centimeters for other surveys. These measurement errors (including those introduced from the sounding datum determination process and the transfer of that datum from the tide gage to the survey area) must then be combined with the other depth measurement errors to determine the depth accuracy of soundings.

A Series of Large[34] Scale Base Maps

The base map should provide a primary medium by which the locations of parcels can be related to the following; the geodetic reference framework, natural and artificial features, and political boundaries [National Research Council, 1983]. In following the lead of several authors [McLaughlin, 1975; National Research Council, 1980, 1983] this paper reviews three primary issues that have been identified as needing to be considered when designing the base map component of a cadastre. They include: the various data sources available, the data content of the base map, and the accuracy of the data collected. These are discussed in the following section.

Data Sources

Unless in the future there is a consolidation and standardisation of global marine mapping programs most jurisdictions will continue to find themselves with incomplete, out of date, or a less than ideal mapping base. Most jurisdictions find themselves able to depend on two sources of data for the marine cadastre; existing charts and new charts. A particular agency (or department) usually has the mandate for hydrographic surveying and is usually responsible for most existing (and new) charts.

When it comes to other kinds of data (other than that collected by hydrographic surveying), most nations find that the responsibility for marine data is scattered over different jurisdictions, agencies and departments. For example, in reviewing the Ocean Planning Information System (OPIS) in the USA, Fowler and Treml [2001] highlighted how a federal agency (National Oceanic and Atmospheric Administration Coastal Services Center) had worked in conjunction with the states of North Carolina, South Carolina, Georgia and Florida to accomplish their goals. Hirst et al., [1999] provide a summary of 6 main agencies involved in Australia's marine boundary determination together with the role played by each of them. In Canada, the Federal Department of Fisheries and Oceans DFO) is in charge of many of the marine datasets although other federal, provincial, and private organizations hold various datasets. In fact, the situation has led to organizations such as the Atlantic Coastal Zone Information Steering Committee (ACZISC) springing up to provide a guide to the myriad of coastal information found in Atlantic Canada[35].

Even when one agency is in charge of nautical charts the accuracy and update frequency of the dataset is usually a matter of concern. To elaborate this, consider the example of the Canadian Hydrographic Service (CHS)[36]. CHS has approximately 1000

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[34] A large scale is usually required to visually appreciate the dimensions and location of a cadastral parcel. The scale of a cadastral map system is principally a function of the size of the predominant land parcel.

[35] This organization is made up of 7 federal departments/agencies, the four Atlantic Canada Provinces, the private sector, academia, First Nations, and the International Oceans Institute of Canada.. The web address of ACZISC is http://www.dal.ca/aczisc/.

[36] one of DFO's agencies

charts in its inventory. On average, 26 new charts were produced between 1972 and 1993 with 87 new editions being issued as well as 96 reprints [Nichols and Monahan, 2000b]. This impressive tally can be misleading since new chart editions do not represent sequential replacements. Areas in some charts tend to change substantially every couple of years while others remain unchanged and consequently, an examination of the charts available at any one time will show inconsistency. Furthermore, an examination of the history files shows a constant striving to bring the charts into line with the latest policies but equipment, time and financial constraints have continued to present notable obstacles to achieving this goal. The contents of each chart should therefore be evaluated in order to ascertain how they could be used as a possible base map data source.

The situation encountered by CHS is not unique to Canada. Other countries have similar or more serious issues that they are dealing with. In any event, some relief has come in the form of existing global marine mapping programs that have provided optional data sources. The joint IHO / Intergovernmental Oceanographic Commision (IOC) mapping information available as the General Bathymetric Chart of the Oceans (GEBCO) is one such option. GEBCO contains 16 Mercator sheets covering the world from 72N to 72S, on a scale of 1:10 million at the equator. It also contains two polar stereographic sheets covering the polar regions (to 64N and 64S) on a scale of 1:6 million [British Oceanographic Data Centre, 2001]. In addition, this information is updated in digital form through the GEBCO Digital Atlas with new versions being published on CD-ROM at three yearly intervals by the British Oceanographic Data Centre[37]. To date 555 copies have been sold (or distributed as complimentary copies) in 55 countries.

Clearly, GEBCO scale is not practical for the purpose of a marine cadastre. Some nations have some reprieve; for example, arctic nations are participating in a joint mapping program to share data and expertise in the Arctic Ocean.[38] The US Navy has declassified under-ice nuclear submarine data collected prior to 1982, and are operating a modern submarine under the ice each year for scientific purposes in project SCICEX [Coakley et al., 1999]. However, for nations that have little else, GEBCO provides a data source "starting point" for the base map component of the marine cadastre.

Data Content

Design of the base-mapping data content must allow a variety of users to relate parcels to specific types of base information. Traditionally, this variety in data content has been achieved using 2D overlays [National Research Council, 1980, 1983]. As pointed out in section 3.1, this overlay-oriented view is inadequate for representing the "mosaic" of rights in marine space. New attempts at cadastre reform are specifically dealing with the overlay issue[39] and are outside the scope of this paper. In this section this paper focuses on the definition of the base map content.

Section 4.1 has outlined why the geodetic reference framework makes up one level of the data content in a marine cadastre. Understandably, natural and artificial features are expected to form the next level of data content but this is not quite as straightforward as it

[37] BODC maintains the GEBCO Digital Atlas on behalf of the International Hydrographic Organisation (IHO) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO. It represents the first seamless, high quality, digital bathymetric contour chart of the world's oceans.
[38] IASC/IOC/IHO Project for Arctic Bathymetry at http://www.ngdc.noaa.gov/mgg/aboutmgg/oceanmapping.html
[39] See Cadastre 2014: Report of FIG Commission 7, Working Group 1 at http://www.swisstopo.ch/fig-wg71/doc.htm

seems. Whereas these features traditionally formed the next level of base map data, their "cadastral" purpose in the base map is not quite as clear. For example, one can use natural features such as streams or shorelines to locate ownership boundaries of parcels quite easily. It is however another matter to attempt to locate boundaries of parcels using man-made features such as cables and pipelines. The point of contention is not the importance of cable and pipelines in a cadastre; after all they are important in safety of navigation, protection of the environment, and the prevention of conflicting uses and rights. It instead hinges on whether this data content should be made part of the base map. Clearly though, data showing some (or all) natural and artificial features has to be part of the base map.

To obtain international guidelines on this issue consider the example of the recommended base map content when preparing a claim under UNCLOS. Several authors [e.g. Monahan and Mayer, 1999; van de Poll et al., 1999] indicate that the scientific and technical guidelines of the Commission on the Limits of the Continental Shelf (CLCS)[40] provide guidelines to *de-facto* base map content. The general expectation is that navigation data, raw water depth (bathymetric data), field values of magnetic fields, calculated water depths, free-air gravity and magnetic anomaly, should make up the data content of such a claim. In an exercise demonstrating the preparation of such a claim off Eastern Canada, Monahan and Mayer [1999] indicated that they used ETOPO-5 data[41], predicted Topography data, single beam data[42] and contours for their purpose. They rationalised that bathymetry data, shoreline data and jurisdictional (and administration) boundaries should make up the base map of such a claim. This is not far removed from base map content that would be found in a land-based cadastre. Both contain the following elements; a geodetic reference framework, natural (comparable to bathymetry and shoreline data) and artificial features, and various political boundaries. The authors conclude from this that a first attempt at defining the base map content of the marine cadastre is already in progress.

Data Accuracy

In reviewing the accuracy requirements of the geodetic reference framework in section 4.1.3, this paper has referred extensively to IHO S44 standards. Table 1 provides a summary of minimum standards for hydrographic surveys and includes accuracy guidelines for horizontal and vertical positions of the base map data content. In order to appreciate the specifics of the recommended accuracy standards of the base map content this section reviews each data content in turn; namely, natural and cultural features mapped by the bathymetry / shoreline data, the geodetic framework, and the jurisdictional / administrative boundaries.

i) Specifications regarding the bathymetry data are encapsulated in Table 1. IHO S44 specifies varying horizontal accuracy for the soundings that make up the bathymetry, in meters at the 95% confidence level, for the four survey orders. The positioning standard also includes a depth-dependent factor that takes into account the added uncertainty of the positions of soundings from multibeam sonar systems

[40] Paragraph 8 of Article 76 of UNCLOS establishes an obligation on coastal states to submit information to the CLCS on the limits of the continental shelf beyond 200nm.

[41] Downloaded from the National Geophysical Data Center website at http://www.ngdc.noaa.gov/mgg/global/seltopo.html

[42] supplied by the Geological Survey of Canada

as depth increases. Edition 4 (as opposed to Edition 3) of IHO S44 provides for errors associated with the measurement of tides, determination of a sounding datum and the transfer of the sounding datum from an appropriate tide gage to the survey area. In order to calculate the error limits for depth accuracy, the values for "a[43]" and "b[44]" listed in Table 1, together with the value of depth (d), should be introduced into the following equation:

$$\pm \sqrt{[a^2+(b*d)^2]}$$

ii) Specifications regarding shoreline data are encapsulated in the prescribed standards for the measurement of tidal heights outlined in the latter part of section 4.1.3.

iii) Specifications regarding the geodetic framework have been outlined in section 4.1.3.

iv) Specifications regarding jurisdictional and administrative boundaries can be extracted from Tables 1 and 2. In general these boundaries are tied to the language of the law and are usually referenced from a (natural or straight) baseline. The baseline depends on the shoreline data and therefore one can generally say that standards for the measurement of tidal heights outlined in the latter part of section 4.1.3 affect the accuracy of these boundaries. Additionally, the accuracy deteriorates due to errors caused by several other parameters including measurement software, scale and resolution of data, and transformation parameters. For a further discussion of the errors that affect the political boundaries the reader is directed to Fowler and Treml [2001].

A Series of Registers that Record Interests

The register of interests in a marine cadastre is designed to portray interests in parcels once they are identified. To determine what the register of interests should contain involves taking the information requirements of more than one set of users into account in the design of the marine cadastre. Taking the multipurpose nature of the cadastre into consideration, it follows then that although it may be designed to serve one particular purpose the cadastre should facilitate connection to (and visualisation of) other user information. To do this, an inventory of tenures[45] that exist in the marine environment is important. At the same time, formal or informal laws that are the basis of these tenures need to be identified and their effect qualified and visualised.

New technologies now allow us to not only see the water column (e.g., schools of fish) but also the seabed surface and the geological structure beneath the surface. Technologies for sidescan sonar, single beam echo-sounders, multibeam sonar and seismic surveys provide the tools for systematically exploring and describing ocean frontiers more clearly. In conjunction with sophisticated visualization software, the imagery allows users to view the living and non-living resources in the coastal and offshore areas. It is possible to associate interests with living and non-living resources found in marine space. Therefore, it is not difficult to see that these same technologies can be used to view the complexity of the associated rights, responsibilities and restrictions in the coastal and offshore areas. In order to visualise this, the authors suggest using the property rights data model outlined in the following section.

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[43] a = constant depth error, i.e., the sum of all constant errors.
[44] b = factor of depth-dependent error.
[45] Specifically the rights, restrictions and responsibilities and their 3D spatial extent.

The Marine Property Rights Data Model

Assume that there exists a marine parcel (or an alternative marine object) that is the focus of data collection, storage, and retrieval on marine interests. Since queries will be based on the ability to identify what rights exist within the marine object, then it is imperative that all (or most) rights and interests that exist in the marine environment are captured. One approach might be to group the interests according to the physical layers that make up the marine space. If this is the case, then there needs to be an explicit regime that defines what interests exist on the water surface, water column, seabed, and subsurface.

Defining interests based on the physical layers of marine space is reasonable. Nearly everything marine actually takes place in a volum*e* of water. Most marine rights have an inherent 3D nature. But what types of interests are found in marine space? What other interests may usurp the private rights that exist in marine space? How do they eliminate an individual's "right to exclude others from the property"? Where do two marine rights intersect in the physical layers of marine space? The answer to these questions lies in defining the effective law in a particular marine space and the spatial limit of jurisdiction and administration.

A visual model would enhance the appreciation of the aforementioned ideas. This model would represent the main elements found in marine space, the attributes associated with them, and the relationships between these elements. Traditionally, relational database models, tying several tables together through table keys, have been used to catalogue the interests that exist in a cadastre. Newer data models such as the Object Oriented (OO) modelling concept are now being used. OO modelling depends on classes, objects and relationships as the fundamental concepts. In OO terminology then, the marine property rights data model will define a marine parcel (or object) as follows:

i) The marine parcel (object) is made up of 4 physical layers i.e. water surface, water column, seabed and sub surface[46]. This represents a whole-part relationship between the marine object and its components. For example, Canada's province of Nova Scotia enacted a *Pipeline Act* in which the province claims jurisdiction over the seabed. This is a law that specifically claims jurisdiction over a physical layer of the marine object;

ii) The marine parcel (object) contains living and non-living resources. This is represented as a whole-part relationship between the marine object and the resources that fall within its spatial extent. Living resources include benthic[47] and pelagic[48] species found in the marine space, while non-living resources include naturally occurring resources such as petroleum together with artificial resources such as cables and pipelines. For example, Canada's *British North American Act* of 1867 gives the federal government jurisdiction over 'public harbours', considered non-living resources in this data model;

[46] Defined as that area underneath the seabed.

[47] The biogeographic region that includes the bottom of a lake, sea, or ocean, and the littoral and supralittoral zones of the shore.

[48] The biogeographic realm or zone that comprises the open seas and oceans, including water of all depths

iii) The marine parcel (object) contains certain interests associated with it. This is represented as a whole-part relationship between the marine object and the interests. Each physical layer that makes up the marine object can have a legally recognised right, restriction or responsibility associated with it. For example, existing rights to fish certain species in the water column in a recently designated marine reserve might remain unaffected (although certain quotas might apply), while fishing activities that damage the seabed e.g. scallop dragging, might be altogether forbidden.

iv) It follows then that interests can be broadly classified as rights, restrictions or responsibilities that individuals have with respect to a marine object. The marine object might have one or all of these interest types associated with it. In the data model, the relationship between the marine object and the interest types is represented as a parent-child relationship;

v) Interests can also be categorised according to the type of laws that recognise their existence. For example, in Canadian jurisdiction the categories could include: laws based on the types of legal institutions i.e. formal (e.g. fishing rights in the Fisheries Act), informal (e.g. right to swim), and customary (e.g. Aboriginal fishing rights); and laws enacted according to the political structure i.e. federal (Canada's *Oceans Act*), provincial (Nova Scotia's *Pipeline Act*), or even municipal. Clearly there is a dependency relationship between the interests and the laws. There is also a parent-child relationship between the law, types of institutions, and level of government.

Figure 2 shows the data model of the marine parcel object. The authors suggest that this model provides a standard way to capture the laws that facilitate the allocation, delimitation, registration, valuation and adjudication of marine property rights; the interests that are allocated; the resources that the interests refer to; and their 3D spatial extent. This data model can be used to create a record (or register) of interests for the marine cadastre. The implementation of this model however is outside the scope of this paper.

Creation and Maintenance of Cadastral "Overlays"

A basic component of the marine cadastre is the ability to delimit the status of marine property ownership. Traditionally, this has been accomplished using a cadastral overlay where the individual building block for the overlay is a cadastral parcel[49]. Traditionally, the cadastral surveying system has played an important role in creating and maintaining cadastral overlays. This section briefly outlines the role of a cadastral survey system in a marine cadastre and reports on existing offshore "cadastre" in Canada.

The cadastral survey system has traditionally been used to specifically govern the creation and mutation of boundaries [National Research Council, 1980]. In marine space, many countries now define marine boundaries and maintain a form of offshore "cadastre" based on several activities (e.g. the petroleum drilling, mining, construction of public utilities, aquaculture etc). The spatial extent of marine property rights in these "cadastres" is usually based on a license or lease (with explicitly stated rights, restrictions and responsibilities) defining the resources being exploited.

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[49] Traditionally defined as "an unambiguously defined unit of land within which unique property interests are recognised" [National Research Council, 1980, 1983; McLaughlin, 1975; Larsson, 1991].

Oil and gas exploration leases in Canada provide an example of one such cadastre. The *Canada Oil and Gas Land Regulations* (COGLA) provide for the division of offshore Canada Lands (up to the Exclusive Economic zone), based on North American Datum of 1927 (NAD 27), into grid areas (15' or 10' latitude in width and 10' longitude in breadth). Each grid area is then divided into sections (60, 80 or 100 sections based on the latitude) and then further subdivided into units (16 units per section). In addition to this general framework, survey plans must be submitted to the Surveyor General[50] indicating: position, direction and length of the boundaries of grid areas; position of existing wells; nature and position of monuments; and road allowances or rights of way.

Like traditional cadastral survey systems, the procedure for defining the oil and gas licenses and leases is defined in surveying and boundary statutes (in this case COGLA). The National Research Council [1980] indicated that these statutes should govern most boundary surveys and specify the following information:

i) The geometric reference framework to which all information must be referred;
ii) The type and weighting of information that must be provided in evidence of the creation and mutation of a boundary;
iii) The standards of survey practice that must be met in providing this information;
iv) The authority vested in public survey administrator (e.g. the Director of Surveys) to examine and register the proposed boundary mutation;
v) The right of judicial appeal from administrative decisions.

Elements of a cadastral surveying system outlined by the National Research Council [1980] are met in the preceding oil and gas lease example. Clearly, this boundary delineation scheme is only specific to oil and gas in Canada. Information about the location of (and rights to lay) cables and pipelines is generally not available. In fact, the licenses and leases are not specific in describing how allocated rights affect existing rights such as navigation and fishing. At the same time, it is obvious that areas where licenses and leases have not been allocated will remain devoid of any information. Creation of a marine cadastre using this framework will only lead to gaps in information.

One example of a project with a prototype marine cadastral information system is the OPIS project for the southeastern US[51]. Fowler and Treml [2001] report that this project has focused on international, federal and state policy framework in the region and created spatial "footprints" of the geographic area where individual policies applied. The ability to integrate, visualize and analyze different data sets using GIS software played a great role in the success of this project. In the internet mapping application that was developed, the user is able to navigate various maps of southeastern US coastal ocean and retrieve the effective policy in a selected 2D location. The approach in this project represents the modern face of a marine cadastral "overlay".

The Oceans Governance project[52] at University of New Brunswick, Canada, uses a slightly different approach. It focuses on improving Canada's understanding of ocean governance requirements by addressing marine boundary issues in Atlantic Canada through several case studies [Nichols et al., 2000a]. One of the case studies deals with

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[50] This is only applicable on lands under Canadian federal jurisdiction.
[51] This project is available on the internet at http://www.csc.noaa.gov/opis
[52] Funded by Geomatics for Informed Decisions (GEOIDE), the project description is available at http://www.unb.ca/GGE/Research/OceanGov

governance of a marine reserve; specifically, the proposed Musquash marine protected area in the Bay of Fundy, New Brunswick, Canada. Like the OPIS project, spatial data relative to this area has been, and is being collected by the federal and provincial governments, academia, communities, non-government organizations etc. The data sets are collected and stored in a variety of data formats and dispersed geographic locations, and among a variety of organizations with different mandates. This case study is different from OPIS because it aims to build a framework that provides a continuous, up-to-date inventory of the following: the nature of the legal interests (ownership, use, control, jurisdiction) that exist; and the **3D** spatial extent of the interests. The project is still in progress and further reports will be forthcoming as results are obtained.

OTHER ISSUES IN DEVELOPING A MARINE CADASTRE

In this section this paper highlights other issues that need to be addressed in the development of a marine cadastre. The authors acknowledge that issues surrounding the marine cadastre are constantly evolving and that an exhaustive review of these issues is not possible here. This paper however outlines what the authors perceive to be other issues that need to be addressed in the development of a marine cadastre.

i) Governance Issues

- **Boundaries as a governance solution or a governance problem?** Surveyors generally approach the governance issue from the perspective that "good boundaries make good neighbours" and that clarity of boundaries will improve governance. Legal specialists on the other hand argue that the law only eliminates ambiguities when an issue occurs, i.e., boundary delimitation should be dispute-driven. Social scientists add to the complexity by arguing that boundaries of ocean spaces do not need to be drawn and instead the focus should be on co-management of resources.
- **Multi-organizational and multi-disciplinary approaches required:** There are many stakeholders and a main function of governance is to improve the communication and collaboration among them. New models need to be designed for ensuring that planning and decision-making processes are inclusive. This is a radical shift from the department-mandate-driven and single-discipline-oriented approaches that are traditional in government and in research.

ii) Legal Issues

- **Better understanding the distinctions in law between jurisdiction, administration, and ownership:** In non-legal discussions, the distinctions tend to be blurred. However, in the oceans the distinction is critical to understanding the complexity of government authorities with respect to control, ownership, and use of marine spaces and specific resources. There is a need to ensure exactly what kinds of rights and restrictions are being reflected in the cadastre.

iii) Technical Issues

- **Need for Standards:** A discussion on some of the technical issues surrounding the building of a marine cadastre has been presented. It is important to note that a broad range of standards is required to improve the accessibility and use of marine data. These standards included those for determining the geodetic reference framework, the base map, and the cadastral surveying system.
- **Recognizing the Limitations of Technology**: A marine cadastre is not a technology solution. In fact the technology, although enabling us to visualize

some of the issues more clearly, may inhibit our understanding as well. There are issues such as: a) loss of information through generalization; b) assumptions that a set of data must be accurate or complete because it is in digital format; c) a tendency to be overwhelmed by the colourful images rather than paying attention to the actual problem. There is a need to use the technologies more wisely to better communicate information (and its limitations) to a broader range of people.

Summary

Traditional definitions of the cadastre have always defined a parcel as a continuous *volume* of land in which unique, homogeneous interests are recognised. The parcel in a marine cadastre is no exception. As a 3D division of the earth, it includes superadjacent and subadjacent rights in addition to surface rights. In the oceans where resources and activities, and therefore rights and restrictions, can co-exist in time and space and can move over time and space, the definition of a parcel is even more complex. The authors note that the parcel may not even be the best unit of representation for all interests. However, until another framework is proven more useful the cadastral concept is used here to facilitate the initial exploration of ideas. This paper therefore does not suggest that the framework for a marine cadastre should be modelled around the land-based cadastre. It only borrows ideas from the land-based cadastre primarily because the marine cadastre should promote coherence at the land/water interface.

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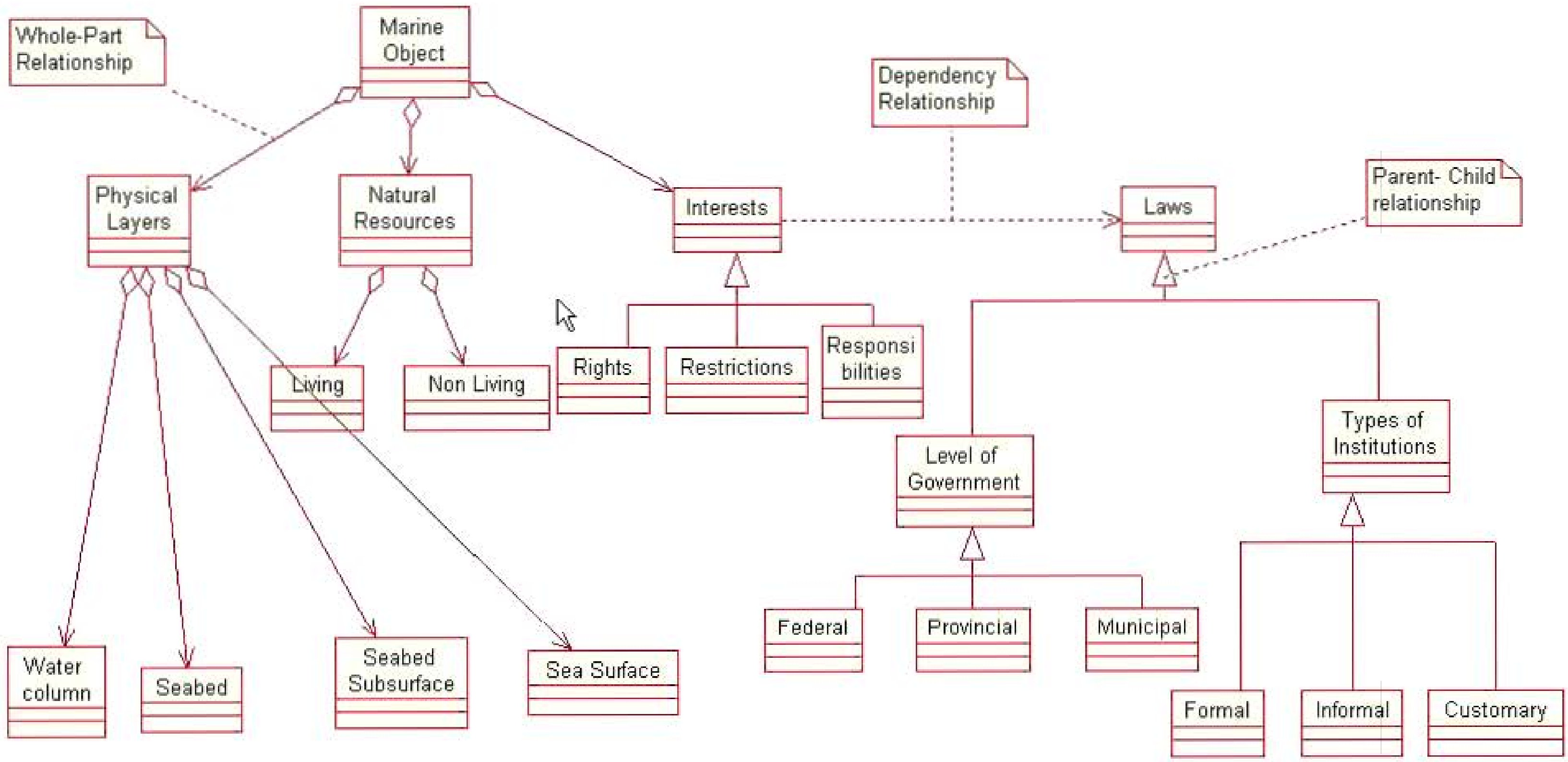

Figure 2:The Marine Parcel Data Model

APPENDIX III

REPORT ON A SURVEY OF USERS OF MARINE SPACES

REPORT ON A SURVEY OF USERS OF MARINE SPACES

Michael Sutherland
May 2005

This report summarizes a survey of users of marine spaces within the context of how important certain boundary characteristic and boundary information are to their activities in marine spaces. The survey targets a small sample of international government marine service providers (i.e. federal and provincial/state agencies). The results may therefore not be significant but gives an indication of what boundary characteristics and information are important to these service providers. It is possible that some questions were "loaded" or incorrectly structured.

The participant countries include Canada, The United States of America (US), Australia and The United Kingdom of Great Britain (UK). Thirteen federal service providers participated and include:

- Canada (9)
- UK (1)
- US (3)

Six provincial/state service providers participated and include:

- Australia (2)
- Canada (2)
- US (2)

All respondents were senior officers in their respective agencies. The types of participant agencies include those that provide services in the following areas:

- Coastal zone management
- Fisheries surveys
- Maritime transportation surveys
- Hydrography
- Petroleum surveys
- Marine protected areas
- Environmental protection
- Jurisdictional/regulation enforcement
- Coast guard services
- Coastal and marine information management
- Marine activity administration
- Cartographic and mapping services
- Wildlife protection and management

The survey asks general as well as specific questions. This report will however focus only on certain questions:

- How important are the boundaries to your activities?
- If you use a map/chart, how important to you is boundary accuracy on a map/chart?
- If you use a map/chart, how accurate (in relation to the true position) on a map/chart do boundaries important to you need to be to meet your requirements?
- If you use a map/chart, how much would an inaccurate boundary on a map affect your needs?

In addition answers in relation to boundary information quality (accuracy, completeness, timeliness etc.) will be addressed.

Question: How important are the boundaries to your activities?

A list of marine boundaries was offered with the option to respond with numbers between 1 and 5, with 1 being least important and 5 being most important. The option was also offered for respondents to specify boundaries not listed.

7 respondents used "X"s instead of numbers, making their response minimally comprehensible. It was however apparent that marine boundaries are necessary for these agencies to provide their services. Those that responded with numbers demonstrated that marine boundaries ranged in importance from "not" to "most" important.

The following 2 questions will be dealt with together:

- **Question: If you use a map/chart, how important to you is boundary accuracy on a map/chart?**

- **Question: If you use a map/chart, how accurate (in relation to the true position) on a map/chart do boundaries important to you need to be to meet your requirements?**

Importance of Boundaries	1	2	3	4	5
Number responding "Accuracy less than 1 metre"					3
Number responding "Accurate to at least 1 metre"			2	1	5
Number responding "Accuracy greater than 1 metre still meets my needs"				2	6

From the above table it can be seen that boundary accuracy is important to all respondents (with 1 being not important, and 5 being most important). All three respondents who require sub-metre precision were survey agencies. 42% require accuracy to at last 1 metre, and 42% can function with accuracy greater than 1 metre, although a worst-case scenario was not ascertained.

Question: If you use a map/chart, how much would an inaccurate boundary on a map/chart affect your needs?

Ill effects of inaccurate boundaries	1	2	3	4	5
Number responding		1	1	5	11

1 respondent did not answer the question. Almost all of the respondents would be most affected by inaccurate boundaries.

Regarding the quality of boundary information (i.e., accuracy, completeness, timeliness, usefulness, being up-to-date)

Measure of boundary quality needs ->	1	2	3	4	5
Accurate		1	3	4	10
Complete				3	15
Up-to-date				3	15
Timely			4	4	10
Useful				3	16

The table above demonstrates that the boundary information qualities of completeness, being up-to-date and being useful are the most important to the respondents. The qualities of accuracy and timeliness are only slightly less important, however.

Implications

The implications of the survey are that:

- Marine boundaries are essential to the activities of the respondents, who are all involved with many aspects of marine activities and therefore affect the governance of marine spaces;
- The accuracy of boundary placement is very important to the marine activities and therefore to the governance of marine spaces. However, it is not necessary in many cases to have precision to sub-metres;
- Boundary information qualities of accuracy, completeness, timeliness, being up-to-date, and being useful are all required to support the governance of marine spaces. However, useful information that is up-to-date and complete is essential.

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