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Ministry of Sustainable Resource Manag

A Cadastral Information Model for BC

Version 1.4 (DRAFT)

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1.3 Draft	Changes to Figure 1 as requested by Base Mapping and Geomatic Services	Brendan Feary	December 20, 2004
1.4 Draft	Changes to the Target View diagram in Appendix D	Brendan Feary	January 12, 2005

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EXECUTIVE SUMMARY

This document defines a high-level framework model for the management of cadastral (i.e. land records) information managed by the BC Ministry of Sustainable Resource Management (MSRM) and its partner agencies. The model is intended to serve as a skeleton to support better information integration, rationalization and sharing across major land records management projects, systems and initiatives as they are planned and implemented in the coming years.

To meet its Service Plan goals for 2005, MRSM is engaged in a number of electronic service delivery initiatives for the provision of land-related information and services concerning ownership rights and interests in land and resources (i.e. cadastral or land records information). These related initiatives include:

- Integrated Land & Resource Registry Project (ILRR) – scheduled for delivery in the north-east of the province by April 2005;
- Digital Survey Plan Project (DSP) – First release involving PDF submission scheduled for delivery by April 2005;
- Electronic Filing System (EFS) – became operational on April 1, 2004;
- Integrated Cadastral Fabric (ICF) – delivery of the ICF to meet Province's commitment to ICIS by Dec 2005;
- Common Cadastral Fabric (CCF) – initiated in 2003 and received direction in April 2004. Delivery schedules have not been determined; and
- Land and Resource Data Warehouse Project (LRDW) – ongoing delivery of LRDW data and services, with delivery of e-commerce component by mid-2005.

During a series of meetings hosted by the Information Management Branch (IMB) in the early summer of 2004, discussion took place between representatives of each of the projects in an effort to better understand the inter-relationships, dependencies and timelines. Concern existed within IMB and the individual project teams and sponsoring branches that successful completion of any of the projects could be jeopardized if the goals and timelines are not well understood and a coordinated approach to addressing the dependencies was not taken.

The work resulting in the creation of this document is an attempt to coordinate the design across the abovementioned critical, dependent projects. The high-level model emerging from this work is a unified high-level representation of cadastral information, based on defined principles, rules, guidelines and assumptions. The model provides a framework that is intended to support the detailed design of each project. It is envisaged that implementation of the principles inherent in the model to each specific project will result in improved consistency, compatibility and sharing of information across projects with minimal data redundancy.

The scope of the model includes the following subject areas:

- **Survey information** – includes survey control required for geo-referencing legal surveys and for base mapping, and survey observations showing the surveyed dimensions from survey plans as the basis for maintaining parcels;
- **Parcel information** – includes the spatial and non-spatial properties of parcels and associated relationships to survey information and to interests and encumbrances;
- **Interest and encumbrance information** – includes the spatial and non-spatial properties of interests and encumbrances along with relationships to underlying parcels;
- **Administrative and assessment information** – includes the spatial properties of administrative areas and boundaries, and of parcels used for property tax assessment purposes.

The content in this document resulted from considerable discussion among key Ministry staff regarded as domain experts in the management of land records information in BC. The two main sections of the document are quite different. In Section 2, a conceptual framework data model is presented that provides a long term view of the way in which land records information could be better organized, structured and integrated to support interoperability of existing and future systems in government, and ultimately to improve the land administration services delivered by BC government agencies and its partners. The model is not something that can be implemented in a short period of time, rather, it is a high-level blue-print that may influence the design and development of future systems in years to come, based on fundamental principles and concepts that are also being embraced by other international jurisdictions. The model itself can be extended, improved and documented to a greater level of detail as new related systems are designed and implemented.

Section 3 provides several high-level views of the movement of cadastral data through the various information systems, from submission of source documents through to the provision of widespread access by many users for different purposes. These views attempt to show a migration path from the present environment, to a target environment that is aligned with the ideas set out in the framework model. These high-level data flows include the role played by current systems as well the implementation of new systems resulting from projects such as the ILRR and the DSP.

A central element of the model is a single, integrated, unambiguous and accurate representation of cadastral parcels as the base against which the spatial geometry of much other cadastral and non-cadastral information will be referenced. The ILRR is particularly dependent on such a fabric to provide the level of certainty in the definition of legal land and resource interests required to support land and resource decision-making.

The following recommendations are made to begin the process of aligning current, planned and future systems with the concepts and principles defined in this report:

1. The model should be accepted and promoted by key cadastral domain experts (including analysts, managers and directors) within IMB, Registries and Titles Department (RTD) and Base Mapping Geomatic Services (BMGS).
2. The model should be incorporated into the ministry's overall information architecture. This may require work to ensure alignment of the model relative to key Ministry or international standards.
3. The model should be completed and extended in certain key areas including attribution, associations, multi-dimensionality, handling of historical data and metadata.
4. The concepts and principles described in the model should be reflected in the design and implementation of any new information systems, particularly the ILRR and the DSP projects.
5. Options for rationalizing and consolidating Tantalis spatial data (RTD) and ICF (BMGS) should be explored in detail. This investigation must consider the impact on existing applications and databases, technology platform, staff and cost.
6. A strategy and plan should be developed to advance the CCF initiative with the funding and resources it requires, but in ways that will ensure consistency and alignment with the information presented in this report. In order to meet the legal requirements of the ILRR by 2007, the strategy for the CCF will need to address the following:
    a. Completion of the initial parcel fabric build process;
    b. Rationalization and consolidation across the various sources to reduce or eliminate redundancy and inconsistency of data;
    c. Updating of the fabric in a timely manner to include new parcels to improve the currency of the fabric; and
    d. Upgrading the fabric over time to improve the positional accuracy.
7. Subject to the outcome of recommendations 5 & 6, the scope and role of the CCF should be re-confirmed, along with custodial roles and responsibilities. This may require revisiting the June 2003 agreement between two Ministry ADMs concerning roles and responsibilities in the compilation of the ICF (MSRM7 (2003)), as well as the potential impact resulting from the recent creation of the Land Title and Survey Authority.

1. INTRODUCTION

1.1 Document Purpose

The purpose of this document is to define a high-level framework model for the management of cadastral (i.e. land records) information managed by the BC Ministry of Sustainable Resource Management (MSRM) and its partner agencies. The model is intended to serve as a skeleton to support better information integration, rationalization and sharing across major cadastral projects, systems and initiatives as they are planned and implemented in the coming years. Fujitsu Consulting undertook this work under contract to MSRM.

The audience for this document includes:

- Information Management Branch (IMB);
- Base Mapping and Geomatic Services Branch (BMGS);
- Registries and Titles Department (RTD);
- Other provincial agencies with regulatory responsibility for administration of specific legal rights and interests in land and resources;
- Corporation of BC Land Surveyors; and
- Consulting companies and contractors retained by the Ministry to work on cadastral projects, initiatives and information systems.

1.2 Background

To meet its Service Plan goals for 2005, MRSM is engaged in a number of electronic service delivery initiatives for the provision of land-related information and services concerning ownership rights and interests in land and resources (i.e. cadastral information). These related initiatives include:

- Integrated Land & Resource Registry Project (ILRR) – scheduled for delivery in the north-east of the province by April 2005;
- Digital Survey Plan Project (DSP) – First release involving PDF submission scheduled for delivery by April 2005;
- Electronic Filing System (EFS) – became operational on April 1, 2004;
- Integrated Cadastral Fabric (ICF) – delivery of the ICF to meet Province's commitment to ICIS by Dec 2005;
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These projects and initiatives are all inter-related. Being a spatially enabled register, the ILRR will be dependent on the ICF, and eventually the CCF, to provide the underlying base cadastral mapping to support its operation. Similarly, CCF will be dependent on the DSP as the source of new parcels created through legal surveys performed by land surveyors. The LRDW will be the primary means for accessing and distributing ICF and CCF data to clients both internal and external to government, requiring parcel data to be uploaded (published) into the LRDW on a periodic basis. The EFS was recently introduced by the Land Title Branch to support electronic conveyancing. This project has a close relationship to the DSP in that the first release of digital survey plan submission will be implemented as an extension to the EFS.

During a series of meetings hosted by IMB in the early summer of 2004, discussion took place between representatives of each of the projects in an effort to better understand the inter-relationships, dependencies and timelines. Concern existed within IMB and the individual project teams and sponsoring branches that successful completion of any of the projects could be jeopardized if the goals and timelines are not well understood and a coordinated approach to addressing the dependencies was not taken.

One of the key issues to emerge during the IMB-led discussions concerned the management of data and the degree of overlap in the scope of data handled by each of these projects (as implied above). It was felt that each project had been progressing in its data design in a largely isolated fashion, and making assumptions concerning expectations for the handling and provision of certain data where a dependency was identified. Moreover, there appeared to be confusion among the various project teams concerning the definition, scope and responsibilities with respect to key cadastral information required by a project, and the flow of information between projects. The likelihood of risk of failure of any or all projects to meet desired objectives was therefore increased due to fundamentally incompatible designs or incorrect assumptions. At a minimum, such an approach could result in major system and data maintenance headaches in future years, something which could be avoided through a more coordinated data design across the related projects.

The work resulting in the creation of this document is an attempt to coordinate the data design across the abovementioned critical, dependent projects. The high-level model emerging from this work is a unified high-level representation of cadastral information, based on defined principles, rules, guidelines and assumptions. The model provides a framework that is intended to support the detailed design of each project. It is envisaged that implementation of the principles inherent in the model to each specific project will result in improved consistency, compatibility and sharing of information across projects with minimal data redundancy.

In summary, the business drivers justifying the definition of a high-level cadastral framework model are the need to:

- Build and maintain a current and reliable parcel base or fabric as a foundation for implementation of the ILRR and for all land-related government, industry and public requirements and interests;

- Establish an effective and efficient program for the maintenance of the spatial component of parcel-based information;
- Address inefficiencies and data conflicts associated with the management of multiple sources of existing parcel-based information;
- Support timely access to parcel-based information of known quality and certainty;
- Clarify organizational roles and responsibilities concerning the management of parcel-based information among the various branches, projects and initiatives that have legislative, regulatory or business-oriented interests with respect to subsets of parcel-based information; and
- Align the delivery of the various projects and initiatives based on a set of consistent information models commonly understood across all projects.

1.3 Purpose

The overall purpose in the development of the high-level cadastral framework model is to ensure consistency and compatibility of cadastral data and processes across the specific projects and to minimize data and process redundancy. The components of the framework model include:

- Identification of the major types of cadastral-related information including the major entity classes and their associations across all projects (i.e. an overall conceptual framework model that can be used as the basis for extension in the design of individual projects);
- Identification of the information boundaries between the dependent projects, including high-level responsibilities for management of the major cadastral data types;
- Establishment of principles, rules and guidelines to be applied in the detailed data design of individual projects to ensure consistency and compatibility of data in the resulting systems;
- Definition of a high-level data flow diagram showing the major data stores and business units, along with the processes and flows that transform and move data between the data stores and business units.

1.4 Scope

From a data perspective, the scope of the model includes the following subject areas:

- **Survey information** – includes survey control required for geo-referencing legal surveys and for base mapping, and survey observations showing the surveyed dimensions from survey plans as the basis for maintaining parcels;
- **Parcel information** – includes the spatial and non-spatial properties of parcels and associated relationships to survey information and to interests and encumbrances;
- **Interest and encumbrance information** – includes the spatial and non-spatial properties of interests and encumbrances along with relationships to underlying parcels;

- **Administrative and assessment information** – includes the spatial properties of administrative areas and boundaries, and of parcels used for property tax assessment purposes.

1.5 Participants

Development of the model involved significant consultation with Ministry data experts and contractors representing the key projects or initiatives dealing with the collection, management and provision of cadastral information. All the consultation occurred as a series of working sessions held with the Ministry staff from last August to early October 2004. The following table identifies all the individuals who participated in any of the working sessions.

Table 1 - Working Session Participants

Participant	Branch
Darrel Richardson	BMGS – Cadastral Base Map Unit
Melanie Cole-Kellow	BMGS – Cadastral Base Map Unit (Contractor)
Paul Van Nieuwkuyk	BMGS – Cadastral Base Map Unit (Contractor)
Doug Say	IMB – Application Development Services
Peter Friesen	IMB – Data Management Services
Ray Bonner	IMB – Data Management Services
Al Becker	IMB – Strategic Planning and Corporate Projects
Chris Grant	IMB – Strategic Planning and Corporate Projects
Dave Skea	IMB – Strategic Planning and Corporate Projects
Denise Owen	IMB – Strategic Planning and Corporate Projects (Contractor)
Olga Kopriva	IRB – Data Quality and Conversion
Jon Meeres	IRB – Registry Data Section
Scott MacPhail	IRB – Registry Data Section
Rosa Munzer	IRB – ILRR Senior Project Manager
Jeff Beddoes	SGB – Deputy Surveyor General
Jim Sutherland	SGB – Survey Section

1.6 Acronyms

The following acronyms are used extensively throughout this document.

Table 2 - Table of Acronyms

Acronym	Description
ALTOS	Automated Land Title Office System
BMGS	Base Mapping and Geomatic Services Branch

Acronym	Description
CCF	Common Cadastral Fabric
DSP	Digital Survey Plan Project
EFS	Electronic Filing System
ESF	Electronic Submission Framework
FTA	Forest Tenure Administration
ICF	Integrated Cadastral Fabric
ICIS	Integrated Cadastral Information Society
IGA	Interest Granting Agency
ILRR	Integrated Land and Resource Registry Project
IMB	Information Management Branch
LRDW	Land and Resource Data Warehouse
LTO	Land Title Office
MSRM	Ministry of Sustainable Resource Management
RTD	Registries and Titles Department
SGB	Surveyor General Branch
UML	Universal Modeling Language

Note concerning use of the words 'Cadastral' and 'Cadastre'

The word 'cadastral' is used extensively this document. There are many interpretations of the word, but for the purpose of this document 'cadastral' means '…showing the extent of legal rights in land (such as ownership rights or usage rights).' In this context rights also apply to the ownership and use of natural resources related to land such as water, timber and mineral rights. The phrase 'showing the extent…' clearly implies some kind of spatial representation of the extent of rights. With the exception of the explicit definition of the cadastral parcel class in the model, the word 'cadastral' is synonymous with the term 'land records'.

The International Federation of Land Surveyors (FIG) defines the word 'cadastre' as '…a parcel-based and up-to-date land information system containing a record of interests in land (i.e. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, and ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (conveyance), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection."

2. CADASTRAL FRAMEWORK DATA MODEL

This section of the document presents the high-level cadastral framework data model.

2.1 Vision of Spatially Integrated Cadastral Information

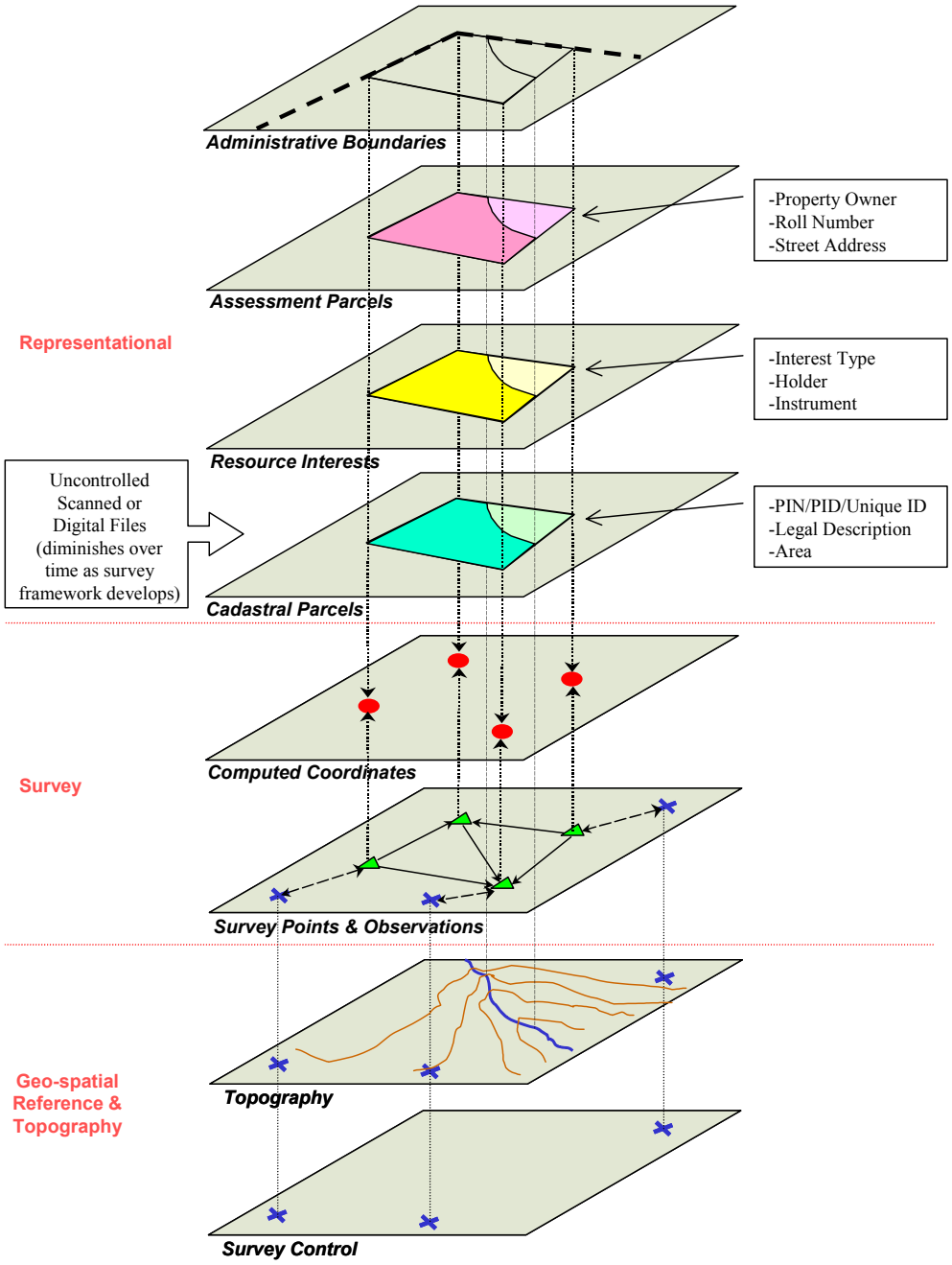

Figure 1 - Spatially Integrated Cadastral Layers

A key driver in the development of the framework model is the need to achieve spatial, or vertical, integration across the many layers of information that must be represented. The lack of spatially integrate-able data results in high levels of uncertainty in the interpretation and usability of information when two or more representations of the same parcel boundary exist, but each representation originates from a different source with different standards. Moreover, the many inherent dependencies and associations existing between different layers of information are rarely modeled in such a way that if the boundary of a parcel is moved, the boundary of an associated object of a different type moves also.

For many reasons, spatial integration of cadastral data has been difficult to achieve in BC despite it being a kind of 'holy grail' of spatial information management. The model defined here is purposely intended to recognize the inherent dependencies in the information so that spatial integration can be achieved.

Figure 1 above provides a graphical representation of the relationships and dependencies among various layers of cadastral data necessary to achieve spatial integration. A key concept being conveyed in the diagram is that a common geo-spatial reference framework supports the positioning of all geometry that represents the location and extent of cadastral objects.

The diagram does not suggest or imply any particular implementation, nor does it imply that cadastral data originates exclusively from survey plans. For example, the diagram attempts to show an irregular boundary based on the topographical representation of a stream. It is also acknowledged that reaching this level of integration, underpinned by an accurate survey framework, is a long-term endeavour that may take many years to accomplish. Until that time, cadastral parcels will continue to be assembled from a variety of sources (e.g. surveyed, unsurveyed and even uncontrolled), however, compilation from uncontrolled sources will be phased out as the controlled, survey accurate framework is developed via the submission of more accurate data from local governments and others, as well as through digital survey plans.

2.2 International Cadastral Data Modeling Efforts

There is considerable international activity in the definition of cadastral models that is highly beneficial for BC. Among the most notable efforts there appears to be a degree of convergence of underlying principles indicating that standardization of cadastral models across jurisdictions may become a reality in the future. The international efforts that have been useful in shaping the definition of the cadastral model defined here include:

- **International Federation of Land Surveyors (FIG)** – This organization has been active over a number of years in providing a forum for discussion and facilitation of cadastral reform ideas and issues, including publication of the Cadastre 2014 document in which a number of forward-looking principles are proposed. In addition, FIG is currently supporting the development of a core cadastral domain model, some of the principles of which are embodied in the model being proposed in this document.

- **Australia and New Zealand** – In Australia and New Zealand a National Cadastral Data Model has been developed based on a review of cadastral models supplied by the all the jurisdictions in Australia and New Zealand. This model not only integrates cadastral information, but it is also harmonized with topographic data, place names and street addresses. Australia and New Zealand are also active in FIG that would explain the convergence in these two efforts.
- **ArcGIS Parcel Data Model** – ESRI , in conjunction with Fairview Industries, has developed and implemented a parcel data model which runs on the ArcGIS platform. The model was developed as part of the National Integrated Land System (NILS) in the United States and is consistent with the Cadastral Data Content Standard defined by the US Federal Geographic Data Committee (FGDC). NILS is a suite of ArcGIS tools for managing US public land and is sponsored by the Bureau of Land Management and the US Forest Service. ESRI is also a participant in FIG and is using the parcel data model to implement principles defined in Cadastre 2014.

Consideration of these efforts with respect to development of a BC model described in this document is important for two reasons.

1. It provides a validation check to ensure that our thinking with respect to the development of a BC cadastral model is consistent with growing body of international knowledge, and;
2. It provides an opportunity to leverage the work performed by these international efforts through the adoptions of certain principles and patterns in the cadastral model for BC. This lessens our overall effort to develop the BC model and provides greater potential for sharing cadastral information with other Canadian or international jurisdictions in the future.

2.3 Modeling Notation

The cadastral framework model is described as a static class diagram using the Unified Modeling Language (UML). A class diagram describes the types of objects and the various kinds of structural relationships that exist among them, such as associations and sub-classes. Class diagrams also typically show the attributes and operations of a class although for this model, operations have not been defined.

Figure 2 below is a fragment of a class diagram to aid in interpreting the model. A rectangular box represents each class; relationships between classes are represented as lines. There are two types of relationships: lines with an open arrowhead at one end indicate super-class/sub-class (or ‘kind-of’) relationship, while a line with no arrowhead indicates an associative relationship.

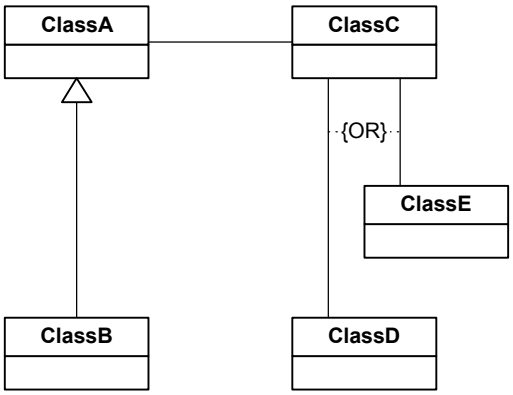

Figure 2 - Class Diagram Example

In the example above it can be interpreted that ClassB is a sub-class of ClassA (i.e. B is 'a kind of' A). This also means that A is the super-class of B. Specifically it means that B will inherit the properties (i.e. attributes, operations and associations) of A, but it may have additional properties specific to itself and any of its sub-classes that are not properties of A.

In addition, ClassC can be interpreted being associated with ClassA. This is a different type relationship to the 'kind-of' relationship described above and represents an associative relationship between two objects of different classes. Associative relationships can define either aggregation, or composition, but this distinction is not particularly important for the cadastral model at this level. Typically associative relationships also identify cardinality (i.e. the number of instances of one class related to one instance of the associated class, and vice versa) and optionality (i.e. if it is mandatory for the association to exist between instances of the two classes at all). Note that cardinality (a.k.a. multiplicity) and optionality have not been identified in the framework model at this stage to aid in readability of the model.

A variation in the associative relationship exists between classes C, D and E. In this situation, using the 'OR' notation, an instance of C is associated with an instance of D OR an instance of E, but not both. The notation is described in detail in Fowler (1997).

2.4 Class Diagrams

The cadastral framework model is a high-level conceptual representation of the key cadastral information objects required to support effective program delivery across the various agencies, branches, business units and systems (either existing or planned) involved in land records administration. It is intended to support an understanding of the scope of business data and inherent relationships, independent of any specific implementation technologies or techniques. As such, it intentionally does not imply or suggest how the classes might be implemented, such as which classes are abstract and which are concrete, or how the classes map to specific geo-spatial layers or tables in

particular database systems. Given the distributed custodial responsibilities across the various classes of information, the model will likely be implemented as a distributed set of geo-spatial information systems where responsibility of individual systems will rest with different business areas and organizational groups.

In keeping with the principle of representing business data objects unconstrained by implementation specifics, the model does not separate spatial (i.e. geometric) properties of objects from non-spatial properties. Objects are modeled as business objects that may have both spatial and non-spatial properties. Some objects consist entirely of spatial properties (e.g. surveyed boundary) while others may have a mix of spatial and non-spatial properties (e.g. resource interest). Still others are entirely non-spatial (e.g., interest holder). Separation of spatial and non-spatial properties into distinct classes will be required at a more detailed level of analysis when implementation constraints are imposed on the model.

To aid in readability, the cadastral framework data model is presented as a set of class diagrams where each diagram represents a particular subset of the entire model. These subsets, or packages, represent a specific subject area, along with relationships to other packages, and roughly equate to the way in which the model might be implemented in terms of database systems or data stores, though care should be taken not to interpret the package boundaries too literally. In the class diagrams, packages are shown as file folders containing one or more classes. A class is contained in only one package folder.

For complete context, the entire model is shown in Appendix A as a single class diagram. This diagram shows all classes and relationships for all packages on a single diagram where package boundaries can be inferred by the colouring (or shading) of the classes.

The model is described as four interrelated packages as follows:

- **Cadastral Fabric** – the aspect that includes representation of the underlying cadastral parcels, either surveyed or unsurveyed, and the boundaries defining the extent of parcels
- **Rights and Interests** – the aspect that includes representation of all legal rights and interests in land and resources including interest holder, interest type, legal instruments defining specific rights, responsibilities and restrictions, and relationships to cadastral parcels or boundaries defining extent of rights or interests.
- **Survey Fabric** – the aspect that includes representation of all the survey measurement and control information used as the basis for defining the location of boundaries and the extent of cadastral parcels or resource interests.
- **Administrative and Assessment** – the aspect that includes representation of administrative areas and boundaries and relationship to resource interests of cadastral boundaries.

2.4.1 Cadastral Fabric Package

Figure 3 below shows the components of the Cadastral Fabric package and the relationship of those components to other packages. The cadastral parcel, boundary and point classes are the key classes of this package. Most of the classes have extensive geometric properties meaning that they would be implemented using spatially enabled technology. This package equates reasonably closely with the ICF product and the representation of survey parcels in the spatial portion of Tantalis.

An important principle that must be emphasised regarding geometric properties is that they hold no legal status whatsoever in the definition of location and extent of instances of cadastral parcel, boundary and point classes. That is, they are regarded as being 'representational' only. This supports the legal principle that monumentation on the ground is the strongest form of evidence in defining the location and extent of boundaries. Over time, however, as a result of densification and higher accuracy surveys, the geometric representation of boundaries can be improved to give a truer representation of what actually exists on the ground, resulting in a strengthening and improving in the accuracy of the cadastral fabric. A survey-accurate cadastral fabric is one in which all gross or systematic errors have been eliminated, and the residual errors are attributable only to the natural, random errors inherent in the survey measurement methods.

Cadastral parcels may be either surveyed or unsurveyed. In addition to having geometric properties, cadastral parcels will be uniquely identified – with a PIN, PID or some other identifier in cases where unsurveyed parcels neither PIN nor PID. They will also have a legal description and an area. Cadastral parcels are the essential units, or building blocks, that are used as the basis for representing many types of resource interests. This explains the associative relationship with resource interests.

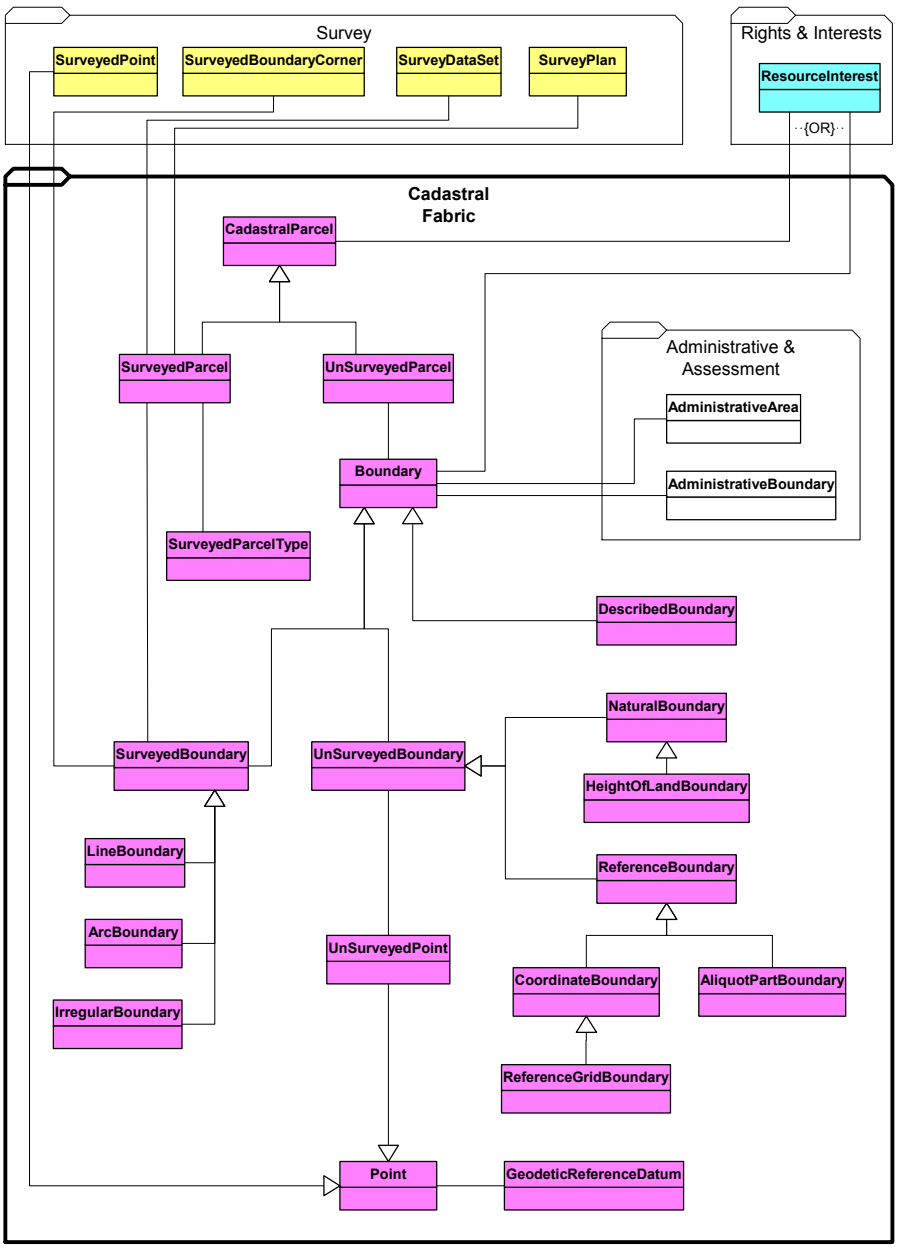

Figure 3 - Cadastral Fabric Package

The collection of all cadastral parcels represents the foundation parcel fabric of the province. Specific topologic rules will need to be applied to provide seamless, non-overlapping coverage of parcels over the land base, although topological rules will vary depending on the type of cadastral parcel since some parcels may be allowed to overlap (e.g. surveyed right of way parcels). An initial definition of the parcel types and topological rules is provided in the detailed class descriptions in Appendix B. Cadastral parcels may also be thought of as legal parcels although it is important to note that their representation is intentionally separate and distinct from any representation of ownership or other rights, interests and restrictions that is the domain of resource interests.

Surveyed parcels will form the majority of cadastral parcels. Surveyed parcels are those parcels that have been created through the act of legal survey and are fully defined (both legally and geometrically) on a survey plan prepared by a BC Land Surveyor or a Canada Lands Surveyor in some cases. Survey parcels are made up exclusively of an ordered sequence of surveyed boundaries where a surveyed boundary represents the relationship between two surveyed boundary corners. The sequence of surveyed boundaries must form a geometrically closed polygon for the cadastral parcel to be topologically valid. Surveyed boundaries may be straight lines, segments of circular arcs, or irregular lines if explicitly surveyed on the survey plan.

Unsurveyed parcels are parcels created by means other than by legal survey. This may occur when a portion of a larger parcel (such as a primary parcel) is surveyed out and a remainder is created based on the shape of the original parcel less the area of the new parcel that has been separated out. The remainder, or balance, parcel is unsurveyed since only the area of the portioned off parcel has been surveyed. However, in many situations it is necessary to create the remainder parcel and provide a legal description and area. Unsurveyed parcels may also be created from an enclosing set of surveyed parcels. These parcels are unsurveyed 'holes' in the fabric and are usually identified by some sort of topology checking and polygonization process. These parcels are important if it is required to provide continuous parcel coverage over area without any holes in the fabric.

Unsurveyed parcels may be composed of both surveyed and unsurveyed boundaries, as distinct from surveyed parcels, which are composed only of surveyed boundaries. Like surveyed parcels, unsurveyed parcels are made up of an ordered sequence of boundaries (surveyed or unsurveyed) forming geometrically closed polygons.

Unsurveyed boundaries may be of various types and come from various sources. Natural boundaries may be irregular lines represented on topographic maps, such as shore lines or river beds, or they may be heights of land such as the representation of a ridge line or watershed boundary.

Various types of reference boundaries are also types of unsurveyed boundaries. These could be coordinate boundaries, where the boundary is defined by coordinate locations (such as UTM coordinates on Official Plans describing park boundaries) or they could be defined by reference grid coordinates such as the PNG grid in north-east of the province. The aliquot part boundary is also a type of reference boundary.

An additional type of boundary is the described boundary. This is included to handle representations of boundaries that are described by metes-and-bounds. A described boundary may reference other surveyed or unsurveyed boundaries in its definition. For example, a metes-and-bounds description may include the text:

> *'...proceed west along the north boundary of District Lot NN (a surveyed boundary), thence in a straight line to the location having UTM coordinate values <UTM Northing, UTM Easting> (a coordinate boundary), thence on a bearing of YYY degrees to the high water mark of the coastline, thence north along the line*

defining the high water of the coastline (a natural boundary)...etc'.

The model has been intentionally designed to flexibly handle many different kinds of real-world situations involving surveyed, unsurveyed and described boundaries that are combined in different sequences to form cadastral parcels, which in turn provide the most basic spatial definition of the parcel structure of the province.

The Administrative and Assessment package is not intended to be a sub-package of the Cadastral Fabric package as the diagram implies. It is external to the Cadastral Fabric package as in the same way as the Survey package and the Rights and Interests package.

A more detailed description of the Cadastral Fabric classes is contained in Appendix B.

2.4.2 Rights and Interests Package

Figure 4 below shows the components of the Rights and Interests package and the relationship of those components to other packages. The classes contained in this package are clearly within the scope of the ILLR.

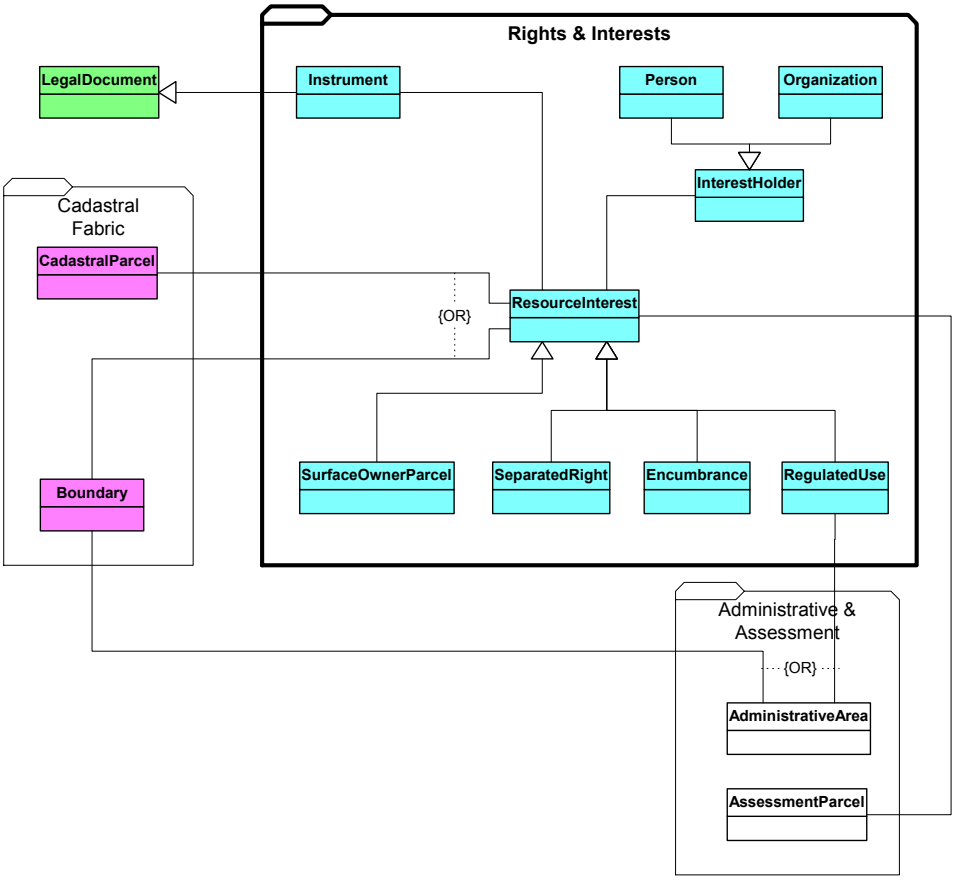

Figure 4 - Rights and Interests Package

The resource interest is the key class in this package, having four sub-classes. The name 'resource' is a generalization that is understood to include land as well as natural resources other than the land itself. A resource interest may have a relationship to a cadastral parcel, or, a relationship to a sequence of boundaries, but not both. This is shown in the diagram as an 'OR' constraint indicating that only one of the two potential associations can exist for a single resource interest object. This is intended to handle situations where certain types of resource interests will be coincident with a cadastral parcel (a surveyed parcel in almost all cases) but other types of resource interests will be represented by a sequence of boundaries of any type, assembled to form a closed polygon.

The separation of cadastral parcels and resource interests is a key principle of the model and implementation of this principle already exists in the Tantalis system (MELP1 (2000)). Legal parcels (i.e. survey parcels) can exist regardless of whether a registered interest actually exists, or ever existed, over the area defined by the survey parcel. Furthermore, there are many instances when the spatial extent of a survey parcel does not exactly coincide with the extent of rights conveyed to the interest holder (i.e. there is no one-to-one relationship between a resource interest and its corresponding survey parcel). This is discussed further under surface owner rights below.

All resource interests have an associated interest holder and an associated instrument. The interest holder can be either a person or an organization. Lemmen (2003) defines interest holder as a 'legal person', where such an entity can be an individual or an organization, however, the meaning is the same. Although not shown in the model, situations where a resource interest has multiple interest holders, where each holds a share of the rights, will need to be accommodated. This may occur in a strata complex where the individual strata owners hold a share of common property, or in situations where ownership of land is shared between a private individual (or organization) and the Crown.

The instrument is the reference to the legal document defining the specific nature of the rights, responsibilities and restrictions (RRRs) between the interest holders and the party with the authority to grant the rights (i.e. the Crown). Thus a certificate of title or a lease document would be examples of instruments associated with a particular resource interest.

Meyer, N. (2004) discusses the concepts of rights and interests as a 'bundle' applying to an area of land, colloquially known in BC as a 'piece of dirt'. The bundle comprises certain interests that may be held by the owner, interests that may be reserved to the Crown, and still other interests that may be held by other parties. Many of the rights can be sold, leased or granted individually. The bundling and unbundling of rights is also discussed extensively in Lyons et al. (2002) and this has added significant complexity to the administration of rights. While the definition of each right or interest can vary widely, they can be grouped into four overall types. Based on the categorization described in Von Meyer, N. (2004), these four types are presented as sub-classes of resource interests. The four sub-classes are:

- Surface Owner Parcel;
- Separated Right;
- Encumbrance; and
- Regulated Use.

Surface Owner Parcel

A surface owner parcel is a resource interest that defines ownership of the land surface. This is perhaps the most fundamental and widespread of all types of resource interests. Because nothing can be accomplished in developing land and resources without consideration of who holds surface ownership rights, querying surface ownership parcels will answer the first question in statusing an area of land: Is the land Crown or private?

All land within provincial borders is owned by the Crown, or it is owned privately as a result of a legal alienation process of granting it to a private owner and raising title in the LTO signifying ownership in fee simple. The land can be subsequently subdivided or sold in which ownership of all or part of the land is transferred to a different owner.

Sometimes the Crown grants land to itself and raises title for which it is the registered owner. For example, this may be done to aid in the expeditious transfer of all, or subdivided portions, of the land to other private owners as part of a major Crown land development project. In other cases, the Crown can acquire privately owned land (e.g. for road construction purposes), or privately owned land can revert to the Crown (due to delinquent payment of property taxes). In either case the ownership is transferred from private back to Crown. Thus, Crown owned land is comprised of all unalienated land (which may or may not be surveyed), plus land registered in the LTO for which it (or one of its many provincial or federal agencies) is the designated owner. All other land is considered privately owned.

When unaliented (i.e. Crown) land is granted the Crown retains ownership of certain portions. The retained rights may include lakebeds, riverbeds and all sub-surface rights. Historically the laws governing rights retained by the Crown have varied over time, especially with respect to sub-surface rights. Anomalies also exist in the province where the Crown actually included riverbeds and lakebeds as part of the rights that were granted with the surface. In addition, land may also be set aside for access purposes effectively restricting the landowner's use of that portion of the land. For this reason, there may not be one-to-one correspondence between the extent of the parcel that was actually surveyed and the extent of ownership granted, because the Crown retains certain rights. This is a key reason for separating the representation of extent of survey (i.e. the cadastral parcel) from the representation of the extent of ownership rights granted (i.e. the resource interest). In essence, the extent of rights granted is derived from the extent of survey less the extent of rights retained by the Crown.

Separated Right

As introduced in the preceding description, certain rights can be managed and allocated separately from surface ownership rights. These are called separated rights. Such rights are important in addressing the second question in statusing an area of land: Are there other rights existing on, under or over the land surface that are separate from surface ownership?

In BC, sub-surface rights, timber rights and water rights can be sold, leased or licensed independent from each other and separate from surface ownership. Such rights fall in the resource interest sub-class of separated rights.

There are many types of separated rights that extend from the use and enjoyment of the land surface to include rights of access, extraction and processing of natural resources. Given the abundance of natural resources in BC there are many types of leasing and licensing agreements that can be entered into for industrial, commercial, agricultural or recreational purposes concerning use of the land surface, or of timber, water or mineral resources. Many of these activities occur on Crown land and, while the Crown holds surface ownership, individual rights associated with specific resources may be held by a variety of different parties.

Timber harvesting licenses, water licenses, Crown land leases and mineral claims and leases are all examples of separated rights. Crown-granted mineral claims are worthy of special mention in this discussion. During a particular period in the province's history, certain types of sub-surface mineral resources were 'granted' and thus owned by a legal party in much the same way as the land surface is granted. While these resources are legally 'owned', they still fall into the class of separated right because ownership is still a form of right (the highest form, but a form nonetheless), and ownership of the resource is separate or distinct from ownership of the surface.

Despite the independence of separated rights from surface ownership, certain types of separated rights might result in restrictions for the surface owner. For example, the Crown may be restricted in selling Crown land if a leaseholder holds a lease over an area. While this type situation might seem like an encumbrance for the surface owner (i.e. the Crown), the specific rights, responsibilities and restrictions of both parties (i.e. interest holder and surface owner) would be spelled out in the legal instrument (i.e. lease document) signed and executed by both parties. Conversely, rights to access sub–surface minerals does not automatically give the sub-surface interest holder access to the surface to perform exploration and extraction activities, without the surface owner's legal consent.

Refer to Appendices B and C for more details concerning specifics types of separated rights.

Encumbrance

For the purposes of the framework model, an encumbrance is defined as the right of use over property held by another party. Like separated rights, these rights are important in addressing the second question in statusing an area of land: Are there other rights or interests existing on, under or over the land surface distinct from who owns the surface?

There are different types of encumbrances, but rights enabling access (i.e. right-of-way) are extremely common, as are a variety of easements for utility and conservation purposes. A distinguishing characteristic of encumbrances, compared to separated rights, is impact of the encumbrance on the surface owner. The enabling of certain rights to another party (or parties) results in a restriction of the surface owner's use of that portion of land covered by the encumbrance. Thus, the surface owner's use and enjoyment of that particular portion of land is 'encumbered', which may affect the value of the land. A second characteristic of encumbrances is that of transferability. Because encumbrances are registered on title, they are transferred with the title whenever ownership of the surface parcel is transferred. Restrictive covenants would also be regarded as encumbrances because they restrict the activities of the surface owner and are transferred when surface ownership changes.

While mapping the spatial extent of every type and occurrence of encumbrance may not be feasible, certain types of encumbrances should be captured spatially. For this reason, the model must be able to accommodate all forms of encumbrances, whether or not they will be spatially represented.

Refer to Appendices B and C for more details concerning encumbrances.

Regulated Use

A regulated use is defined as the ability of a public agency at the federal, provincial or local government level, or other recognized governing body (e.g. First Nations), to restrict the activities that can occur within a defined area of land, regardless of whether the public agency is the surface owner or not. Such restrictions may or may not be shown explicitly on title and the surface owner or interest holder may or may not be fully aware of all the restrictions the could apply.

As discussed in Lyons et al. (2002), the unbundling of rights together with the devolution in management of specific types of rights to an increasing number of public agencies has created a bewildering level of complexity of rights and restrictions that may exist over a parcel, but not appear on title. As a consequence, development approvals usually require evaluation and approval by each agency responsible for a particular class of rights or restrictions and can add a significant burden to the entire development approval process.

Land use planning zones are a form of regulated use where local government is the public agency responsible for ensuring that development projects are consistent with the planning zones and bylaws. In this case, local government is not the surface owner, but has the power to establish restrictions in the use the land within a prescribed area.

Parks are another form of regulated use where the responsible authority is an agency of the government. Thus, for provincial parks, the provincial government has the power to restrict (or allow) certain types of activities within the boundaries of a proclaimed park. Conceptually the same applies to national parks (federal government) and municipal parks (local government) as well. Interestingly, with parks, in contrast to land use planning zones, the public agency is likely to be the surface owner as well.

The same concepts also apply to various types of reserves. Reserved land is set aside by a public agency for a specific purpose that limits the activities that can take place on the land. Indian reserves, ecological reserves and other protected areas clearly fall into this category.

A further type of regulated use may apply to areas like contaminated sites and archaeological sites. While it might not seem immediately apparent that these should be regulated uses, they certainly fit the definition in that a public agency (i.e. Environmental Management Branch or Archaeology and Registry Services Branch) can restrict the activities that can occur within these designated areas.

Refer to Appendices B and C for more details concerning regulated uses.

2.4.3 Survey Fabric Package

Figure 5 below shows the components of the Survey Fabric package and the relationship of those components to other packages. The classes contained in this package generally fall within the scope of what is planned for implementation in Release 2 of the DSP project and creation of the Survey Fabric.

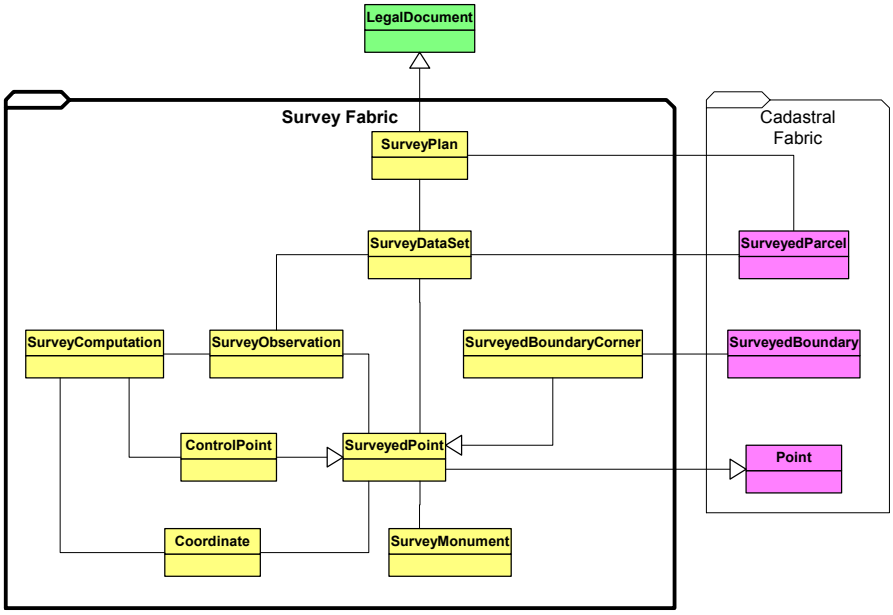

Figure 5 - Survey Fabric Package

A survey plan is a legal document produced by a BC Land Surveyor (or Canada Lands Surveyor as the case may be). The survey plan shows the dimensions of the boundaries of any surveyed parcels along with a legal description for each parcel; hence the association with the surveyed parcel class. There are many types of legal survey plans depending on the purpose and type of land transaction it is intended to support. For the purposes of this model, however, the survey plan class represents the legal document that is deposited in the Land Title Office or the Office of the Surveyor General and recorded in the land registry system (i.e. ALTOS or Tantalis).

A survey dataset is a representation of the information shown on a survey plan, but in an intelligent, structured, computer readable form. This information is used to compute coordinates of all survey points included in the survey using computational techniques, such as least squares, that enable quality information for each point to be recorded. The information contained in the survey dataset contains derived survey observations and points representing the boundaries of surveyed parcels plus any ties to control points required to accurately locate the survey relative to other surveys. The survey dataset also contains a topological definition for any survey parcels to be created plus a definition of any textual properties such as the legal description, legal area or parcel identification. This information, along with the adjusted coordinate values is used to integrate new survey parcels into the overall fabric or cadastral parcels.

The model intentionally separates individual survey observations appearing on a survey plan from the surveyed boundaries used to define a surveyed parcel in the cadastral fabric. The survey fabric is designed to support redundancy in survey observations, since the same parcel boundary may be measured (i.e. observed) many times by different surveyors on different survey plans at different times. Each observation is a legitimate observation regardless of when or how it is was measured and the survey computation is used to compute adjusted coordinate values for the surveyed boundary corners based on all known observations to the surveyed corners. Because positional quality information is used in the computational process for all known observations, adjusted coordinate values for the surveyed boundary corners will gradually be refined as a result of more recent, more accurate and more abundant measurements (i.e. increased measurement redundancy).

The associative integrating components between the survey fabric and the cadastral fabric package are the surveyed boundary corners (sub-class of survey point) and the topological and textual properties of any new survey parcels to be created. The adjusted coordinate values of the surveyed boundary corners and the topological definition of the surveyed parcel are used to create a survey-accurate definition of the parcel in the cadastral fabric.

An important consequence of this way of relating cadastral parcels with surveyed information is the non-static nature of the location of parcel corners. A coordinate value is not a static defining characteristic of a surveyed boundary corner. Instead, the surveyed boundary corner is defined in terms of its identity (e.g. monument identification), not its location, and the coordinate value is but one of its properties (or attributes) that may

change or take on multiple values. In this way a surveyed boundary corner may have many coordinate values based on the many surveys in which it is included. This is entirely consistent with current survey practices, but is a source of frustration and confusion for GIS specialists where coordinate values are used as the primary definition of a point representing a parcel corner, and a single coordinate value is required to maintain topological consistency (i.e. no slivers or overlaps) at that point. Since the model is explicitly designed to support improvements in positional accuracy over time, some instability in the base will result until a sufficient amount of new survey information results in convergence of coordinate values to a specified level of uncertainty (i.e. tolerance). Until convergence is achieved, which may take years in some areas, this instability may create associativity difficulties for objects of other classes that reference surveyed boundaries points as part of their spatial definition.

2.4.4 Administrative and Assessment Package

The components of the Administrative and Assessment package, along with the relationships to other packages can be inferred from Figure 3 and Figure 4. A separate class diagram for the package has not been provided.

Administrative boundaries and administrative areas are shown as separate classes. Administrative boundaries represent delineations or demarcations between regions where it is not possible to represent the entire region as an administrative area, for example, provincial or international borders. Through the association with the boundary class, administrative boundaries may be represented as connected sequences of surveyed boundaries, unsurveyed boundaries on described boundaries thus ensuring coincidence the boundaries of cadastral parcels.

Administrative areas represent enclosed regions for purposes of supporting the management and administration of government programs or agencies. Examples of administrative areas include: land districts, land title districts, land management regions, school districts, health regions, electoral areas, forest regions and districts, municipal areas and regional districts. Administrative areas form a topologically continuous non-overlapping coverage of an area. Like administrative boundaries, administrative areas are associated with a connected sequence of boundaries (from the boundary class), except that for administrative areas the boundary sequence must form a geometrically closed polygon. To ensure a topologically continuous, non-overlapping coverage, boundary segments between neighbouring administrative areas of the same type should be shared.

Because certain types of regulated uses may also be represented as administrative areas, an association exists between the administrative area class and the regulated use class. In BC, examples of this include parks and reserves. In existing systems these are currently represented as administrative areas, however, based on the model being developed here, they would be more correctly classified as regulated areas. The association has been created in the model to reflect the dual nature of these objects.

For completeness of the model a class representing assessment parcels is also shown. Assessment parcels represent a unit for the purpose of property assessment and taxation. BC Assessment uses these parcels to determine the assessed value of properties in BC. Municipalities in turn base annual property tax amounts on the assessed value. Assessment parcels are associated with certain types of resource interests.

The assessment parcel class has an association with the resource interest class. While most assessable parcels will be associated with surface owner parcels, parcels defining separated rights, such as Crown land leases, are also regarded as assessable parcels. It is the leaseholder's responsibility to pay the annual property tax in the same way as a freehold owner of a surface parcel.

The actual relationship between assessment parcels and resource interests can be quite complicated. In many cases that relationship will be one-to-one, however, frequently many resource interests may be associated with a single assessment parcel, as in the case of extensive agricultural holdings where many, perhaps disjoint or non-continuous, resource interests are included in a single assessment parcel (i.e. property). Conversely, a single surface owner parcel may contain many individual assessment parcels, as in the case of a commercial shopping mall.

Complete definition of the assessment parcel class and its associations is not fully developed in the model. The definition provided should be considered a starting point for extension.

2.5 Limitations of the Model

A number of limitations with respect to the cadastral framework model described in this document must be identified. At this stage of completion, the model is a conceptual skeleton of key cadastral information types based on certain key concepts and principles. The model will likely evolve over a period of time, and while it is not a model for implementation in its current form, it is intended to serve as a roadmap to guide the design and implementation of systems resulting from key cadastral projects and initiatives. It is hoped that adherence to the model's basic concepts and principles will result in more integrated, interoperable systems with less duplication or redundancy of data. This document will be an important tool in the communication of the key concepts and principles included in the model and will serve as a vehicle for ongoing communication and further discussion with the major stakeholders having interests in management of cadastral information.

In terms of content the model has the following limitations:

1. Exhaustive classification of all sub-classes and enumeration of all types has not been performed. This applies particularly to survey parcels, the sub-classes of resource interests, administrative boundaries, natural boundaries and reference boundaries. Further work is required to unambiguously define the characteristics of the separated

rights and encumbrances such the classification of the many types of interests and encumbrances will yield consistent results.

2. Full attribution of classes has not been performed. Sufficient attributes have been defined in Appendix B to give an indication of the attribute properties of classes.
3. Typically UML static class diagrams also define operations occurring on classes, but these have not been defined.
4. The model does not differentiate between abstract and concrete classes in sub-class/super-class relationships. This is intentional at this level of abstraction. To support implementation, more detailed analysis is required to determine the most effective methods for implementing these structures.
5. Retaining the historical state of key classes (such as cadastral parcels or resource interests) has not been defined, though this would be an important component of any implementation based on the principles and concepts contained in this model.
6. Separation of classes into specific geometric classes (i.e. classes containing geometric properties only) has not been performed. It was intentional to model the cadastral business objects as objects having both spatial and non-spatial properties. Definition of geometry-only classes is a lower-level implementation issue.
7. Occurrences of all sub-classes of resource interests may not be geometrically represented as polygons. Certain types of resource interests, for example water licenses (a type of separated right), will likely be geometrically represented as point locations, not polygons. Other types may be represented as lines. Many of the classes in the model have geometric properties including the geometric representation.
8. Meta data properties, such as quality information, have not been defined.
9. At this stage of development the model does not consider multi-dimensionality (e.g. 3D and temporality), however, there is nothing in the model precluding their future development. A more rigorous definition of the model would need to explore the three dimensional properties of objects such as sub-surface mineral tenures, air space parcels, strata parcels, volumetric easements, etc.
10. In addition to multi-dimensionality and temporality, other areas of the model requiring refinement include described boundaries, natural boundaries and aliquot part boundaries.
11. Associations with assessment parcels have not been fully developed.

In terms of standards the model has the following limitations:

- The model attempts to follow the notation standards for class diagrams described in Fowler, M., Scott, K. (1997), however as noted above, full definition of attributes and operations has not been performed.
- As the model develops further, it would be desirable to align it with Ministry and ISO 19100 standards in the areas of: geometry descriptions, date-time descriptions, metadata, XML encoding and perhaps other areas.

The model is not harmonized with other information types outside of the cadastral domain, though useful extension would include harmonization with topographic

information, place names and street addresses and the road network. Common characteristics across data sets to enable harmonization should include: persistent identifiers, create and retire dates, feature level metadata and geometric primitives.

3. HIGH LEVEL CADASTRAL DATA FLOW

This section of the document presents a high-level view of the flow of cadastral information from original source through various operational systems to the point where the information is made accessible to a wide range of users. The purpose of these views is to understand the interactions between the various systems (either existing, in development or planned) and the agencies responsible for managing the systems, projects or initiatives. Three views of data flow are presented corresponding to different points in time out into future. This progression, from the current situation to some desirable future target state, provides a high-level migration path along with some useful insights into issues that will need to be addressed before the any target view can be fully realized.

The three data flow views are:

- **Current View - 2004** – represents the current view of cadastral data flow in late 2004 based on the operational state of information systems and applications at that time.
- **Interim View - 2005** – represents the view of cadastral data flow projected to be in place by mid 2005, after implementation of the ILRR in the northeast of the province and Release 1 of the DSP project.
- **Target View - 2007** – represents the view of cadastral data flow projected to be in place by 2007, after implementation of the ILRR in all areas of the province and Release 2 of the DSP project.

Diagrams depicting the data flows views described here are provided in Appendix D.

3.1 Current View – 2004

The current view represents the view of cadastral data flow in late 2004 based on the operational state of information systems and applications at that time. This view serves as the baseline, or starting point, for change to be implemented over a number of years. Because neither ILRR nor DSP are operational at this time, they are not included in the data flow. The same applies to the CCF, since it is still in a conceptual stage without a funding source or resources.

The data flow diagram in Appendix D for this view shows the original source of cadastral information updates, in the form of tenure applications, and the flow of these sources into the key operational systems managed by the various Interest Granting Agencies (IGAs). It is assumed that source information is in hard-copy form (although the FTA process is probably an exception to this) and entered into the appropriate IGA system by IGA staff. The systems are used to record and track the application information leading to the creation of a particular type of tenure or interest. Many of the IGA systems (e.g. Tantalis and FTA) are spatially enabled and manage their own spatial information. These systems may reference or replicate certain key spatial data layers from other sources and use them as the reference base for representing tenure specific interests. This is a key driver in the

need for a common and complete cadastral base against which the spatial geometry of all cadastral data and some non-cadastral data can be referenced. A good example of a common base that has been widely adopted is the role TRIM has played as the single source of topographic data for the province.

While some of the systems have evolved their own method of providing widespread end-user access to tenure specific information, others publish snapshots of their data into the LRDW on a periodic basis. Standard access tools (such as the IMF) have been developed and deployed that enable secure Web-based access to the data, thus alleviating any security and performance issues associated with allowing widespread query-only access to IGA systems.

The ICF is represented in the current data flow diagram as a product, not as a data source or system. It is a spatial product, derived from multiple sources of information including Tantalis, ALTOS, TRIM, BC Assessment, and many local government systems. From these sources an integrated view of private and Crown land parcels is compiled into a topologically consistent and well-attributed layer (i.e. a fabric of cadastral parcels). The intention is that this product will form the parcel base for referencing cadastral and other business data created and used by all the ICIS partners, as well as by the ILRR. The ICF is partially complete, and was originally intended for completion by December 2005 to meet the province's obligations as a partner of ICIS.

Given the importance of a single, integrated, unambiguous and accurate cadastral fabric there are numerous issues with the current view that must be addressed if migration to the target view described in this document is to be realized. The root causes of these issues are diverse and are the result of decisions made over many years that have had significant impact on the quality of the cadastral fabric that exists today. The issues are outlined as follows:

1. **Data Completeness** – While the Crown cadastral fabric held in Tantalis is largely complete, major gaps exist in the private land portion of the ICF, as reported in MSRM6 (2004).
2. **Data Currency** – A maintenance program to update Crown cadastral fabric held in Tantalis has been in place for many years, however, for the private land fabric, a method of updating and maintaining has yet to be established, with the result the data is not synchronized relative to its source and may be a year or more out of date.
3. **Data Accuracy** – Depending on the data capture methods used by local government, acquired private parcel data is of superior positional accuracy as a result of a higher density of surveys and more recent and accurate surveys. In contrast the positional accuracy of the Crown parcel data in Tantalis is generally less than the ICF, reflecting the quality of the source documents used in the initial compilation and the compilation techniques used. Variability of accuracy, particularly in areas where Crown and private parcels co-exist, is a key contributor to problems of inconsistency (described next).
4. **Data Consistency** – In addition to consistency problems because of accuracy variability, consistency problems also exist because data has been acquired and

assembled from different sources at different times using different standards and techniques. Remedying these problems has proven to be one of the most difficult challenges to address.

3.2 Interim View – 2005

The interim view, shown in Appendix D, represents the view of cadastral data flow projected to be in place by mid 2005, after implementation of the ILRR in the northeast of the province and Release 1 of the DSP project. Again the CCF is not represented in the data flow due to lack of funding and resources for the initiative.

Release 1 of DSP will result in the submission of PDF images of survey plans, instead of hard-copies, to the Land Title Branch and Surveyor General Branch via the recently implemented Electronic Filing System. This release, however, will have no impact on the overall flow of data to support the building and on-going maintenance of the cadastral fabric. Its purpose is to support the legal plan submission and deposit process, not the updating of the cadastral fabric.

The significant data flow change for the interim view is the implementation of the ILRR in the northeast region of the province. Given the timelines for the delivery of the system by the end of the current fiscal year (2004/2005), plans are firmly established for the provisioning of the required data from multiple sources, including the LRDW for private parcel data, Tantalis for up-to-date Crown land data and individual IGA systems for tenure specific interest data. The ILRR will become the primary repository of rights and interests, designations and administrative areas to support land and resource dispositions in the northeast.

To support the initial ILRR implementation, private parcel data will be sourced through the LRDW and not directly from the ICF. The ILRR project is not planning to use the full ICF product as the parcel base for the initial implementation, only the private parcel portion. This is due to the previously described currency issues for the Crown land data portion of the ICF, compared to Tantalis, and because access to the up to date Crown land data will be an important requirement to support land and resource development activities in the north-east. The cause of the currency issue stems from the snapshot of Tantalis data that was included in the ICF when compilation for the northeast took place some time ago. After the snapshot was taken, Tantalis data continued to be updated as new applications were processed, but as outlined above, these updates have not been incorporated in the ICF because an update and maintenance process is yet to be established.

3.3 Target View – 2007

The target view, shown in Appendix D, represents the view of cadastral data flow projected to be in place by 2007, after implementation of the ILRR in all areas of the

province and release 2 of the DSP project. This view also represents a migration to the concepts and principles described in this model.

The year 2007 is a significant date because that is when the ILRR is expected to be operational in all areas of the province, and, together with ALTOS, will become the official register of all rights and interests in land and resources in BC. To provide the level of certainty expected for an official register, issues of accuracy, completeness, currency and consistency of the data contained not only in the register, but also the operational systems that provide data to the register, will need to be addressed.

In addition to extension in the implementation of the ILRR from the northeast to all areas of the province, two other projects will have a major impact on flow of cadastral data. In Release 2 of the DSP project, submission of structured survey data in an XML file will be implemented and compiled into a fabric of survey observations. The survey fabric will become the source for adjusted boundary corners from which surveyed parcels will be constructed. The ongoing compilation and adjustment of new observations (representing the boundaries of new survey parcels) into the survey fabric provides a rigorous method for upgrading the positional accuracy of the cadastral fabric, in addition to providing an efficient method for updating the fabric with the inclusion of new parcels.

The second project (or initiative) with the potential to have a major impact is the Common Cadastral Fabric (CCF). As outlined above however, this project is still in a very early conceptual stage and is having difficultly getting ‘off the ground’ due to lack of funding and resources, although some decisions have been made regarding custodial responsibilities.

The CCF has the potential to become a shared repository of spatial data containing cadastral information and administrative boundaries, and used by all public agencies (provincial and municipal) as the reference base for agency-specific tenure or non-tenure information. Data in the CCF would also be updated and improved to provide the level of currency to support the requirements of the ILRR. Conflicts in linework originating from different sources would also be resolved along with alignment of other features that share common geometry (MSRM4 (2004). The CCF appears to address some of the deficiencies of existing cadastral mapping datasets and has the potential to provide a complete, accurate, current and consistent reference base for the spatial representation of all cadastral information.

Appendix D provides a possible target data flow scenario for cadastral data. In this view the CCF is shown along with relationships to the survey fabric, Tantalis, ILRR, LRDW and other IGA operational systems. The CCF is intentionally shown in the diagram as conceptual entity, not a physical one, and further investigation is required to determine the best implementation approach to ensure interoperability with the other systems.

It is possible that the CCF could exist as a standalone datastore with interfaces to the other systems to facilitate flow of data between systems, however, this would involve managing redundant copies of information and developing techniques to ensure that the

data is kept synchronized and current. If past experience is any gauge, this has proven to be difficult to accomplish and is therefore probably a model to be avoided.

A preferred approach is to consider options for rationalizing and consolidating spatial data stores to avoid the problems of data duplication, synchronization and currency. This is denoted in the diagram in Appendix D by the dashed red shape enclosing the CCF, the spatial portion of Tantalis and the Survey Fabric. Two possible approaches to rationalizing Tantalis spatial and the ICF might be possible. One involves decoupling spatial data from Tantalis, combining it into a single integrated spatial data store having private parcels as well (i.e. CCF), and providing linkages back to the decoupled Tantalis attribute data to achieve interoperability. The second approach would be to consolidate and rationalize by extending the capabilities of Tantalis to become a single integrated sharable source of spatial cadastral data with the necessary spatial to attribute linkages across systems and support interoperability.

While both these approaches would result in a single, consolidated source of spatial information that would address issues of data duplication, synchronization and currency, detailed analysis is required to identify the benefits, issues, impacts and costs before selecting the best option.

The scope of the CCF in the target view would include all the classes within the cadastral fabric package of the framework model. This would result in a datastore containing occurrences of boundaries (cadastral boundaries) and all sub-classes, and cadastral parcels and all sub-classes. The cadastral parcels would be geometrically and topologically consistent, dependent on parcel type, with strong references to surveyed boundary corners contained in the survey fabric. The CCF would also be the operational source for maintenance of administrative areas and boundaries. These would be published into the ILRR for general access.

The ILRR would be the datastore containing all occurrences of resource interests, including surface owner parcels, and should provide a focal point for responding to and handling land statusing queries. This will require interfaces to each of the operational IGA systems to enable the official recording of all types of rights in the register. The spatial representation of resource interests in the ILRR would be referenced against the cadastral parcels and boundaries in the cadastral fabric (i.e. CCF). If the operational IGA systems use the CCF as the reference base for locating specific types of rights and interests, then proper alignment of boundaries with respect to the cadastral fabric should result, otherwise conflicts would need to be addressed at the time of recording in the ILRR. The ILRR would also enable access to administrative areas and boundaries by used by ILRR users.

4. CONCLUSIONS AND RECOMMENDATIONS

The content of this document resulted from a considerable amount of discussion among key Ministry staff regarded as domain experts in the management of cadastral information in BC. The two main sections of the document are quite different. In Section 2, a conceptual framework data model is presented that provides a long term view of the way in which cadastral information could be better organized, structured and integrated to support interoperability of existing and future systems in government, and ultimately to improve the land administration services delivered by BC government agencies and its partners. The model is not something that can be implemented in a short period of time, rather, it is a high-level blue-print that may influence the design and development of future systems in years to come, based on fundamental principles and concepts that are also being embraced by other international jurisdictions. The model itself could be extended, improved and documented to a greater level of detail as new related systems are designed and implemented.

Section 3 of the document provides several high-level views of the movement of cadastral data through the various information systems, from submission of source documents through to the provision of widespread access by many users for different purposes. These views attempt to show a migration path from the present environment, to a target environment that is aligned with the ideas set out in the framework model. These high-level data flows include the role played by current systems as well the implementation of new systems resulting from projects such as the ILRR and the DSP.

A central element of the model is a single, integrated, unambiguous and accurate representation of cadastral parcels as the base against which the spatial geometry of much other cadastral and non-cadastral information will be referenced. The ILRR is particularly dependent on such a fabric to provide the level of certainty in the definition of legal land and resource interests required to support land and resource decision-making.

The following table provides a summary of the potential impact of migration toward the principles and high-level information flows presented in this document on the data quality issues of completeness, currency, accuracy and consistency of the cadastral fabric.

Table 3 – Potential Impact of Migration on Quality of Cadastral Fabric

Data Quality Perspective	Current View - 2004	Interim View - 2005	Target View - 2007
Completeness	• Complete Crown parcel fabric • Continuation of private parcel compilation	• Complete Crown parcel fabric • Continuation of private parcel compilation	• Complete, integrated Crown and private parcel fabric
Currency	• Updating of Crown parcels (small latency) • No updating of private parcels	• Updating of Crown parcels (small latency) • Updating of private parcels (small latency)	• Current Crown and private parcels (minimal latency) from continuous updating process

Data Quality Perspective	Current View - 2004	Interim View - 2005	Target View - 2007
Accuracy	• Variable Crown parcel accuracy • Variable private parcel accuracy of higher accuracy	• Strategy and development of computational techniques for improving positional accuracy of Crown and private parcel fabric	• Ongoing application of computational techniques improve positional accuracy of integrated fabric
Consistency	• Separation of Tantalis and ICF • Inconsistency between representation of Crown and private boundaries	• Strategy for rationalization of Tantalis and ICF to single source • Process and techniques to reconcile Crown and private parcel boundary inconsistencies	• Rationalized Tantalis and ICF datastores • Single consistent, seamless source of Crown and private parcels

In conclusion, the following recommendations are made to begin the process of aligning current, planned and future systems with the concepts and principles defined in this report:

1. The model should be accepted and promoted by key cadastral domain experts (including analysts, managers and directors) within IMB, RTD and BMGS.
2. The model should be incorporated into the ministry's overall information architecture. This may require work to ensure alignment of the model relative to key Ministry or international standards.
3. The model should be completed and extended in certain key areas including attribution, associations, multi-dimensionality, handling of historical data and metadata.
4. The concepts and principles described in the model should be reflected in the design and implementation of any new information systems, particularly the ILRR and the DSP projects.
5. Options for rationalizing and consolidating Tantalis spatial data (RTD) and ICF (BMGS) should be explored in detail. This investigation must consider the impact on existing applications and databases, technology platform, staff and cost.
6. A strategy and plan should be developed to advance the CCF initiative with the funding and resources it requires, but in ways that will ensure consistency and alignment with the information presented in this report. In order to meet the legal requirements of the ILRR by 2007, the strategy for the CCF will need to address the following:
    a. Completion of the initial parcel fabric build process;
    b. Rationalization and consolidation across the various sources to reduce or eliminate redundancy and inconsistency of data;
    c. Updating of the fabric in a timely manner to include new parcels to improve the currency of the fabric; and
    d. Upgrading the fabric over time to improve the positional accuracy.

7. Subject to the outcome of recommendations 5 & 6, the scope and role of the CCF should be re-confirmed, along with custodial roles and responsibilities. This may require revisiting the June 2003 agreement between two Ministry ADMs concerning roles and responsibilities in the compilation of the ICF (MSRM7 (2003)), as well as the potential impact resulting from the recent creation of the Land Title and Survey Authority.

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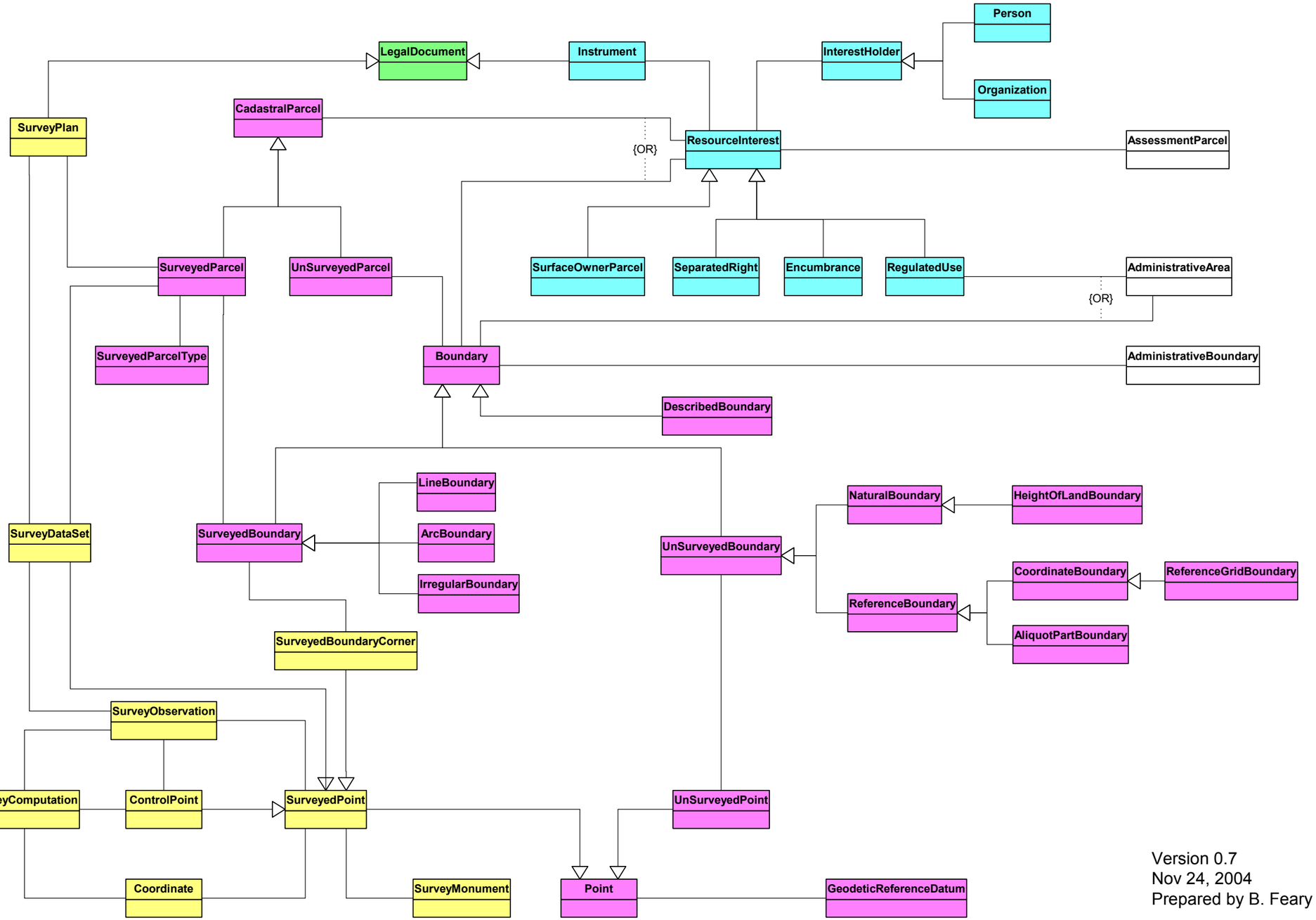
APPENDIX A: ENTIRE CADASTRAL DATA MODEL

This diagram on the following page shows the entire cadastral framework model as a UML Class Diagram.

MSRM CADASTRAL FRAMEWORK MODEL



Version 0.7
Nov 24, 2004
Prepared by B. Feary

APPENDIX B: DETAILED CLASS DESCRIPTIONS

The appendix contains supporting detail to the narrative style description of the class diagrams in Section 2 of the report. The tables are incomplete for certain classes, but sufficient details are provided to convey an initial understanding of the model.

Parcel Fabric

Parcel Fabric Class	Definition\ Description	Rules	Types or Sub-classes	Key Attributes	Key Associations
CadastralParcel	An identifiable and legally described area of land whose boundaries define the extent of ownership or rights in land. It is also the smallest bounded areal unit of land capable of being subdivided or traded, with boundaries defined mostly, but not exclusively, by legal survey.	• Geometric type is polygon • Non-continuous over geographic extent of province (i.e. holes are tolerated)	• SurveyedParcel • UnSurveyedParcel	• PID, PIN or both • Legal Description • Area	• Associated with one or more resource interests since the cadastral parcel is the basis for legally describing and defining the extent of certain types of resource interests.
SurveyedParcel	A cadastral parcel whose boundaries have been defined exclusively by legal survey and shown on a registered survey plan.	• May overlap, but specific rules and restrictions apply according to type • Primary parcel may not overlap with other primary parcels. • Non-primary parcels may overlap with primary parcels but not with other non-primary parcels.	• PrimaryParcel - The first legal definition of a surveyed parcel, which remains persistent after subdivision or portioning out. • NonPrimaryParcel - A surveyed parcel created as a result of subdivision or portioning out and capable of further subdivision. • Other (e.g. SurveyedRight-of-Way) – Enumeration of all types or classes is incomplete	• Inherited from parent super-class	• Associated with an ordered sequence of surveyed boundaries to form a geometrically closed polygon • Associated with one survey plan • Associated with one survey dataset • Relationship to parent surveyed parcel • Relationship to root primary parcel

Parcel Fabric Class	Definition\ Description	Rules	Types or Sub-classes	Key Attributes	Key Associations
UnSurveyedParcel	A cadastral parcel consisting of boundaries that may have been defined by means other than by legal survey. The boundaries defining the extent of the parcel may be a combination of surveyed boundaries, described boundaries, or unsurveyed boundaries). Such boundaries may originate from various data sources.	• May overlap with primary parcels, but not with non-primary parcels.	• None	• Inherited from parent super-class	• Associated with an ordered sequence of boundaries (surveyed, described on unsurveyed) to form a geometrically closed polygon
Boundary	A cadastral boundary, either surveyed, unsurveyed, or described which defines the extent of cadastral parcels, resource interests or administrative areas.	• Boundaries form a topologically consistent node/line network with nodes at the terminal points of the boundary • Boundaries connect at nodes	• SurveyedBoundary • UnsurveyedBoundary	• ID • Length • Direction	• Associated with one or more unsurveyed parcels • Associated with one or more resource interests • Associated with one or more administrative boundaries • Associated with one or more administrative areas
UnsurveyedBoundary	A cadastral boundary, defined by means other than legal survey.	•	•	• NaturalBoundary • HeightOfLandBoundary • ReferenceGridBoundary • CoordinateBoundary • MetesAndBoundsDescription	
NaturalBoundary	An unsurveyed boundary defined by natural feature such as a lake shoreline	•	•	•	
HeightOfLandBoundary	An unsurveyed boundary defined by a height of land such as a watershed boundary, ridgeline or gully.	•	•	•	
ReferenceGridBoundary	An unsurveyed boundary defined by a reference grid line such as the PNG grid or mapsheet grid.	•	•	•	
CoordinateBoundary	An unsurveyed boundary defined by coordinate values such as UTM.	•	•	•	

Rights and Interests

Rights & Interests Class	Definition	Topology Rules	Possible Types	Key Attributes		
ResourceInterest	An occurrence of specific legal rights or interests in land (or resources) held by an Interest Holder over a defined area	• Non-continuous • Overlapping • Relationship to CadastralParcel OR • Relationship to CadastralBoundaries	• OwnerParcel • SeparatedRight • Encumbrance • RegulatedUse	• ID • Legal Description • Area •		
InterestHolder	A legal person or organization who holds specific rights or interests in land (or resources) over a specific area	• N/A	• Person • Organization	• ID • Name • Address		
Instrument	A type of legal document (registered or unregistered) defining the rights, responsibilities and restrictions for a specific occurrence of an interest in land or resources.	• N/A	• ?	• Document number		

Interest Parcel Sub-classes

Interest Parcel Sub-class	Definition	Topology Rules	Possible Types	Nature or Impact of Surface Ownership Rights	Nature or Impact of Rights and Interests Held by Parties other than Surface Owner	Rights Transferable

Interest Parcel Sub-class	Definition	Topology Rules	Possible Types	Nature or Impact of Surface Ownership Rights	Nature or Impact of Rights and Interests Held by Parties other than Surface Owner	Rights Transferable
SurfaceOwnerParcel	Smallest unit on land surface capable of being sold without further subdivision	• Non-continuous • Non-overlapping	• Crown Grant • Fee Simple • Reversion • Acquisition	Indefeasible title enabling full 'use and enjoyment' of surface	No ownership rights	Yes
SeparatedRight	Ownership or usage rights to land and resources, separate from surface ownership rights	• Non-continuous • Overlap with owner parcels • Overlap with other separated rights (specific rules apply) • Overlap with encumbrances	• Lease (e.g. Mineral lease) • Licence • Permit • Application • Development Agreement	Indefeasible title enabling full 'use and enjoyment' of surface Some restrictions may apply concerning sale or transfer of surface ownership of land which is leased.	Specific ownership and usage rights to surface and non-surface, but excluding and not impacting surface ownership. Examples: • Mineral Claim • Water License • Tree Farm License • Crown Land Lease	Yes
Encumbrance	Right of use or interests over property owned by another party	• Non-continuous • Overlap with owner parcels • Overlap with other separated rights (specific rules apply) • Overlap with encumbrances	• Easement • Right-of-way • Restrictive covenant • Lien/charge (non-spatial)	Indefeasible title, but with limitation of usage rights and possible diminution of value. Examples: • No building over easement or ROW	Specific usage rights and interests Examples: • Drainage/sewage easement • ROW for access • Mortgage	Yes
RegulatedUse	Limitations set by a public agency on the use of land and resources	• Non-continuous • Overlaps with all other classes	• Reserve • Transfer of Admin • Crown Admin Area • Land Use Zone • Archaeologically or environmentally sensitive areas	Indefeasible title, but with limitation of usage rights and possible diminution of value Examples: • Building height or type restriction • Commercial or industrial activity restriction • Development in proximity of archaeological site or contaminated site	Limitation of usage rights and possible diminution of value. Examples: • ?	No

APPENDIX C: CLASSIFICATION OF CCF LAYERS

The following table provides a classification of the CCF content layers based on the cadastral framework model. This classification is provisional and will required further discussion and confirmation as the CCF initiative progresses. The two right-most columns indicate the major class and sub-class (if appropriate) of the framework model that each CCF layer should fall into.

Content of Common Cadastral Fabric (CCF)

The Common Cadastral Fabric is the compiled representation of Crown land tenures, Administrative Boundaries and all legal survey plans. This fabric is representational only and cannot be relied upon to determine legal boundaries or tenure locations. Custodians are accountable for the legal records while the Steward is accountable for their compilation into the CCF. The Director, Base Mapping and Geomatic Services is the Custodian for the CCF. The Surveyor General is the Custodian of all Crown Land Registry plans, documents and records and the Director of Land Titles is the Custodian of all land registry plans, records and documents

DATA

***Land Act* Tenures**	**Custodian**	**Legal Steward**	**Compilation Steward**	**Meta Data**	**Framework Model Class**	**Framework Model Subclass**
Crown Admin	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Surface Owner Parcel
Crown Licences	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Separated Right
Crown Reserve/Notations	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Regulated Area
Crown Leases	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Separated Right
Right-of-Way - Crown Land in Tantalis	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Encumbrance
Reserves	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Regulated Area
Development Agreement	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Separated Right
Inclusion	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	?
Permit	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Separated Right
Transfer of Administration/Control	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Regulated Area
Revenue Sharing Agreement	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	?
History - Applications and approved tenures	Surveyor General	Surveyor General	LWBC * / SG	Surveyor General	Interest Parcel	Separated Right
Applications	LWBC	LWBC	LWBC	LWBC	Interest Parcel	?
LWBC Inventory Parcels	LWBC	LWBC	LWBC	LWBC	Interest Parcel	Surface Owner Parcel

Survey(s)	**Custodian**	**Legal Steward**	**Compilation Steward**	**Meta Data**		
Assessment Parcel Boundaries	BCAssessment	BCAssessment	BCAssessment	BCAssessment	Assessment Parcel	N/A
Private Parcels - Land Title Office	Director Land Titles	Surveyor General	Director BMGS	Director BMGS	Cadastral Parcel	Surveyed Parcel
Surveyed Parcels - Crown	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Cadastral Parcel	Surveyed Parcel
Legal Parcels - Crown	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Cadastral Parcel	Surveyed Parcel
Surveyed Roads & Highways	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Cadastral Parcel	Surveyed Parcel
SRW (Statutory Right-Away)	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Cadastral Parcel	Surveyed Parcel
Well Site Plans	Surveyor General	Surveyor General	Surveyor General	Surveyor General	Cadastral Parcel	Surveyed Parcel
History	Surveyor General	Surveyor General	Director BMGS	Director BMGS	not yet supported by model	N/A
Right-of-way - Land Titles Parcels	Director Land Titles	Surveyor General	Director BMGS	Director BMGS	Cadastral Parcel	Surveyed Parcel

Crown Ownership Transfer	**Custodian**	**Legal Steward**	**Compilation Steward**	**Meta Data**		
Crown Grant	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Interest Parcel	Surface Owner Parcel
Certificate of Purchase	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Interest Parcel	Surface Owner Parcel
(Dominion Patents)	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Interest Parcel	Surface Owner Parcel
Statute Transfer	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Interest Parcel	Surface Owner Parcel
Reversion	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Interest Parcel	Surface Owner Parcel
Acquisition	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Interest Parcel	Surface Owner Parcel

Administrative Boundaries	**Custodian**	**Legal Steward**	**Compilation Steward**	**Meta Data**		
Indian Reserves *(subset of Federal Lands)*	Federal Gov't	Surveyor General	Director BMGS	Director BMGS	Interest Parcel	Regulated Area
Agricultural Land Reserve Boundary	Agricul Land Com	Agricul Land Com	Director BMGS	Director BMGS	Interest PArcel	Regulated Area
Assessment Areas	BCAssessment	BCAssessment	Director BMGS	Director BMGS	Administrative Area	N/A
Municpal Boundaries	CAWS, Local Gov't Dept	Surveyor General	Director BMGS	Director BMGS	Administrative Boundary	N/A
School District Boundaries	Education	Surveyor General	Director BMGS	Director BMGS	Administrative Boundary	N/A
Regional District Electoral Areas	CAWS	CAWS	Director BMGS	Director BMGS	Administrative Area	N/A
Regional Districts	CAWS	Surveyor General	Director BMGS	Director BMGS	Administrative Area	N/A
Provincial Electoral	Elections BC	Surveyor General	Director BMGS	Director BMGS	Administrative Area	N/A
Land Title Districts	LTO	Surveyor General	Director BMGS	Director BMGS	Administrative Area	N/A
National Harbours	Federal Gov't	Federal Gov't	Director BMGS	Director BMGS	Interest Parcel	Regulated Area
Land Management Regions	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Administrative Area	N/A
Land Districts	Surveyor General	Surveyor General	Director BMGS	Director BMGS	Administrative Area	N/A
International Boundaries	Other	Surveyor General	Surveyor General	Surveyor General	Administrative Boundary	N/A
Provincial Boundaries	Surveyor General	Surveyor General	Surveyor General	Surveyor General	Administrative Boundary	N/A
Off Shore Boundaries	Other	Surveyor General	Surveyor General	Surveyor General	Administrative Boundary	N/A
Federal Harbours	Federal Gov't	Federal Gov't	Director BMGS	Director BMGS	Interest Parcel	Regulated Area
National Parks	Federal Gov't	Surveyor General	Surveyor General	Surveyor General	Interest Parcel	Regulated Area
Provincial Parks, OIC Reserves, Protected Areas	WLAP	Surveyor General	Surveyor General	Surveyor General	Interest Parcel	Regulated Area
Land Claim Settlement Areas	First Nation	Surveyor General	Surveyor General	Surveyor General	Interest Parcel	Regulated Area
Ecological Reserve	WLAP	WLAP	Surveyor General	Surveyor General	Interest Parcel	Regulated Area
Forest Region	MOF	MOF	Surveyor General	Surveyor General	Administrative Area	N/A
Forest District	MOF	MOF	Surveyor General	Surveyor General	Administrative Area	N/A

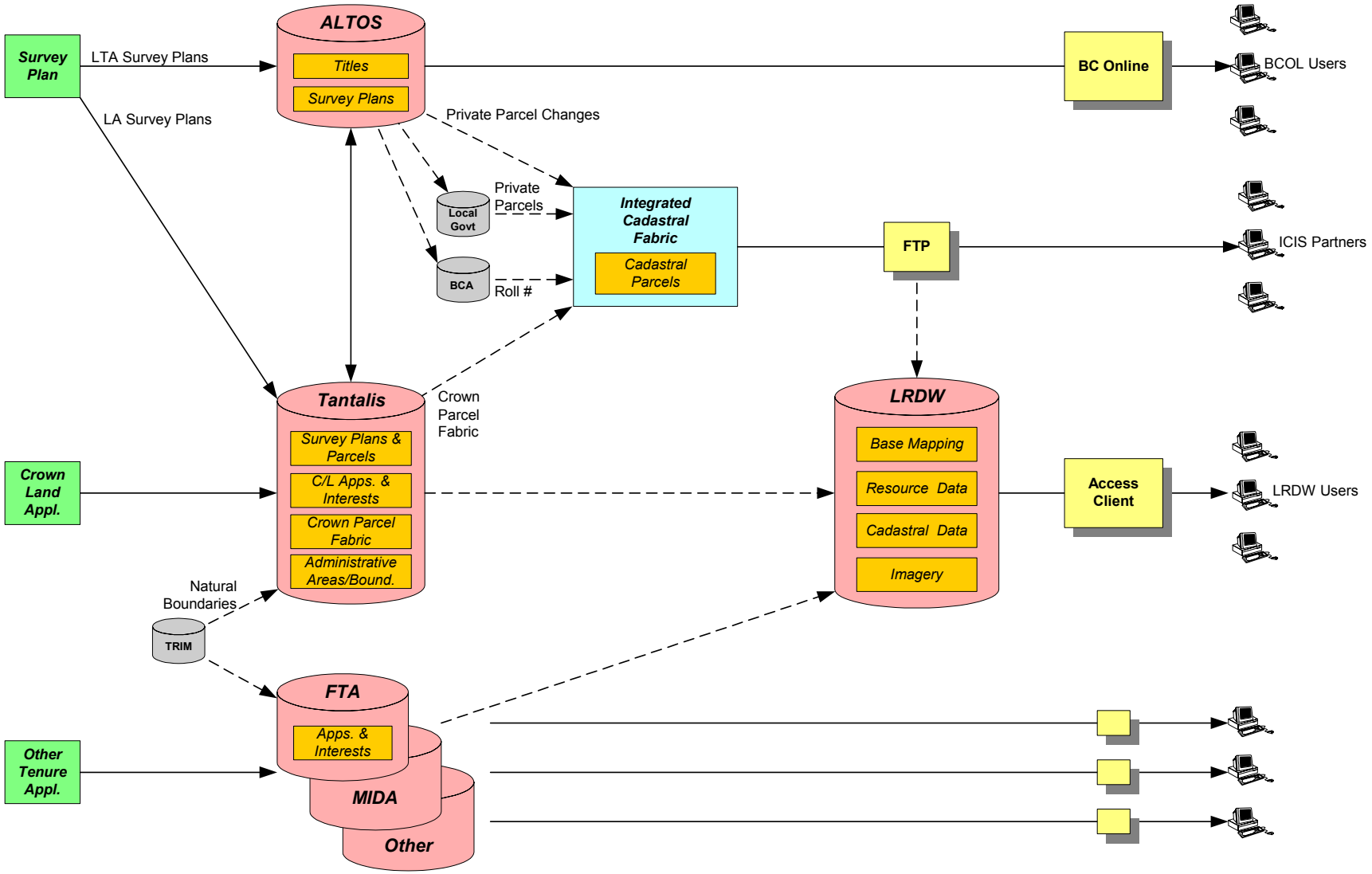
Survey Control Monuments	**Custodian**	**Legal Steward**	**Compilation Steward**	**Meta Data**		
Survey Monuments Renewal Info	Director BMGS	n/a	Director BMGS	Director BMGS	SurveyMonument	N/A
GPS Control	Director BMGS	n/a	Director BMGS	Director BMGS	SurveyedPoint	ControlPoint
Survey Monuments	Director BMGS	n/a	Director BMGS	Director BMGS	SurveyMonument	N/A
ISAs	Surveyor General	n/a	Surveyor General	Surveyor General	Administrative Area	N/A
(digitial symbols, designation numbers)		n/a				

* = LWBC is the primary compilation steward with support from SG's Branch
RED *- Still need clarification*
BLUE *- Changes as per January 16th meeting*
Legal Steward: Where legal authority applies name Director or N/A where not applicable

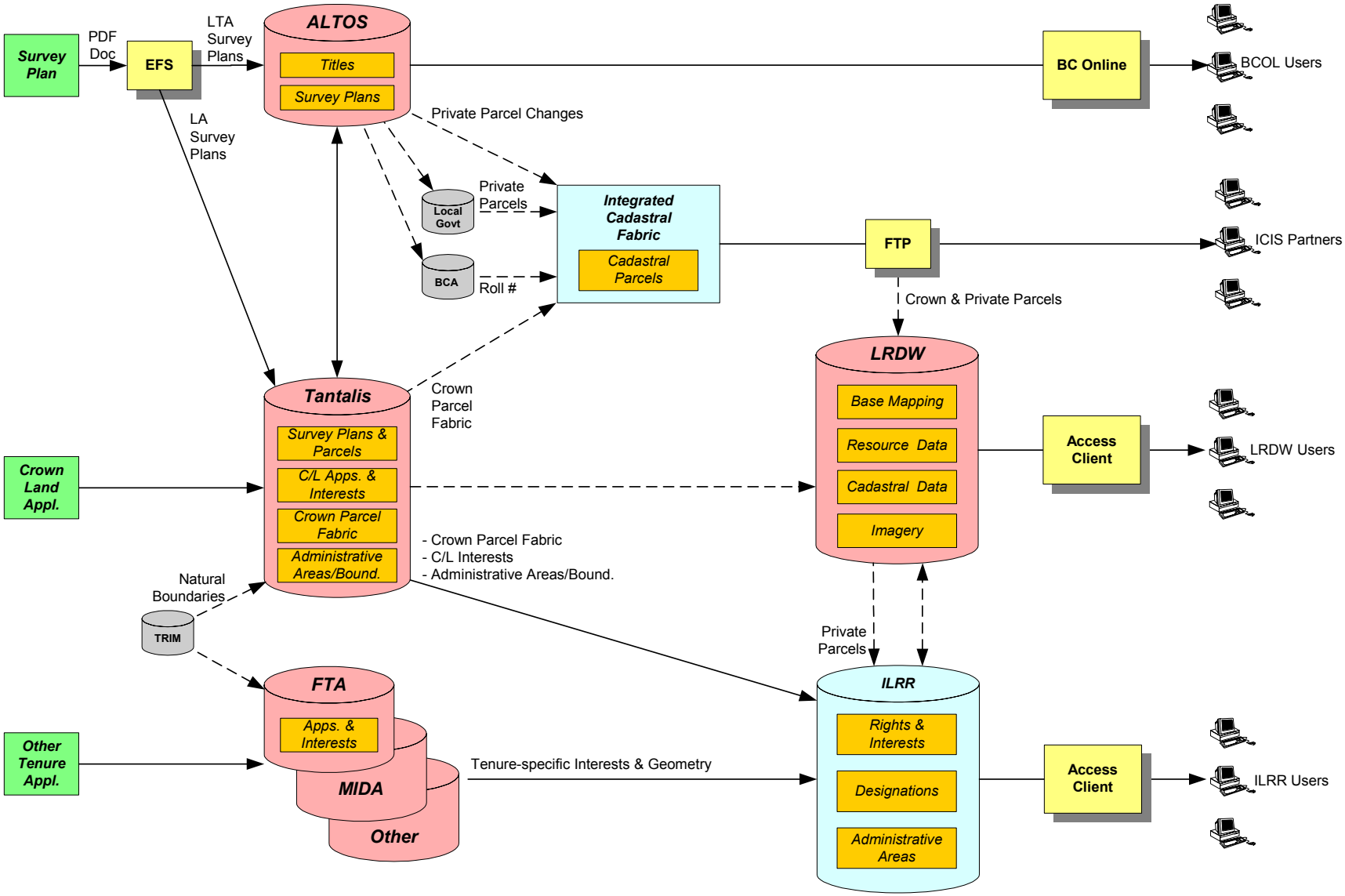
APPENDIX D: HIGH-LEVEL DATA FLOW DIAGRAMS

This appendix contains the data flow diagrams that accompany the description of cadastral data flow contained in Section 3 of the document. Three diagrams corresponding to the 3 point-in-time views are provided.

HIGH-LEVEL CADASTRAL DATA FLOW - Current View - 2004



HIGH-LEVEL CADASTRAL DATA FLOW - Interim View - 2005



HIGH-LEVEL CADASTRAL DATA FLOW - Target View - 2007