STATE OF CALIFORNIA resources AGENCY

California Public Lands Geodatabase: A Collaborative Statewide Data Maintenance Process

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Abstract:

The California Legacy Project provides tools and information to help protect and restore California's natural resources and working landscapes. GIS is central to this initiative, facilitating the development and dissemination of information used to guide resource conservation decisions- for state agencies, local governments, and community-based groups. One of Legacy's important GIS datasets is the Public, Conservation and Trust Lands (PCTL). Traditionally maintained in ArcInfo coverage format, the Legacy Project supported the development and implementation of an ArcGIS geodatabase model for the PCTL dataset. The multi-user editing environment, topography tools, and more efficient data management capabilities have decreased the update process from months to weeks. This paper explores the institutional and technical components of this collaborative effort, which has brought State and Federal agencies, local governments and non-profit groups together create a single, comprehensive, and current dataset of public lands in California.

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SECTION ONE – INTRODUCTION

The State of California Public, Conservation and Trust Lands (PCTL) GIS data layer has been developed to identify lands that are held in the public interest for conservation of natural resources purposes. Lands owned in fee title by federal, state, and local governments as well as conservation lands owned by Non Governmental Organizations (NGO's) are currently included. The PCTL data layer is critical to departments and programs within the California Resources Agency, including the California Legacy Project, and to the State and Federal government GIS user community. The data are used to identify public ownership and identify protected lands, as well as to serve a host of other more general uses such creating maps, deriving other data sets, and conducting analysis on a statewide basis.

BACKGROUND

The PCTL data layer was preceded by two GIS data development and maintenance efforts:

1. A GIS data set representing publicly owned lands initially developed by the California Department of Forestry and Fire Protection that was later maintained and enhanced by the Teale Data Center GIS Lab (now closed).

2. A GIS data set intended to be a major revision to the Teale public lands data set that was initiated by the U.S. Bureau of Reclamation to support analysis and mapping for the CalFed program, and focused primarily on State and Federal ownership.

The data compiled by the U.S. Bureau of Reclamation (USBR) was current to 1997, and was developed in ArcInfo regions coverage format. Data was contributed by some twelve land management agencies. Data contributed by each land management agency was stored within its own subclass within a single ArcInfo coverage. While this format simplified the inclusion of data from many disparate agencies, no effort was made to resolve differences in data representation (e.g. gaps and overlaps) or conflicts over multiple owners depicted for the same areas. In March of 2002 the USBR data was provided to

VESTRA Resources, Inc. who, on behalf of the Legacy Project, integrated the regions data into a single ArcInfo polygon coverage. This process resulted in a seamless dataset with attribute information reflecting ownership, management, review dates, and land classification information.

Furthermore, VESTRA Resources, Inc. also updated the coverage to reflect new data as received from a number of the original source agencies, as well as to include ownership data for smaller agencies and groups not originally included in the USBR dataset. This included integrating new data as provided from several agencies, namely, the California Dept of Parks and Recreation, the Bureau of Land Management, and the California Dept of Fish and Game. In addition to the major land owner data contributions, minor land ownerships were included from the original Teale public lands data set and from a public lands and management data set developed by UC Santa Barbara Gap Analysis project. The GAP Analysis data set distinguished between local, state, and federal jurisdictions and private lands held by NGOs, and also delineated areas managed for the long-term maintenance of natural ecological processes and biodiversity.

SECTION TWO – DATA CONSIDERATIONS

The issue at hand is creating a logical process, through which the Public, Conservation and Trust Lands (PCTL) ownership boundary information can be updated, maintained, and improved over time. The method that has been employed to date involves a tedious and non-standardized process of analyzing and adjusting single boundary lines, on a case-by-case basis. This method is inefficient and time consuming, and does not lend itself to timely updates. In order to create a dataset that can add value to California's conservation initiatives and contributor agencies, it is imperative that a logical, systematic methodology be developed that will establish an ownership dataset that will be useful and trusted in the future.

KEY FACTORS FOR EFFICIENT DATA INTEGRATION

There are several key factors that must be considered for the development of an update methodology. These factors are listed below:

- Agencies use different reference layers when developing their GIS (i.e. different versions of the Public Land Survey)
- There is no standard for ownership boundary maintenance between agencies and/or groups
- The process through which individual agencies develop and maintain their land ownership GIS datasets is not well-documented, nor is the GIS data update process tied to the business process associated with real estate or land records transactions.
- Ownership update cycles are not standard – either between agencies or from one update to the next
- Ownership conflicts occur due to:
  - Lag in boundary updates after land swapping between agencies – one agency will add the newly acquired areas while the other will not remove it from their records
  - Difference in reference layers (i.e. PLS) results in overlaps or gaps where in fact the same boundary is being referenced

- Periodically, the BLM updates the Public Land Survey (PLS) to reflect corrections and adjustments. These changes have not been reflected in the public lands GIS data sets
- The current PCTL layer also does not match the PLS grid, as the original editing process did not snap features to township, range or section lines unless the area was being edited due to overlaps or gaps. Recall that the primary source dataset for the current PCTL layer was the USBR regions coverage, the subclasses of which were unadjusted ownership datasets as received from source agencies.

Many of the potential problems listed above occur as a result of a communication disconnect between state, federal and local government entities, as it relates to the development and maintenance of land ownership data. While some entities have well-developed data development and maintenance procedures, others are just beginning to bridge internal divides, and move towards integrated ownership GIS data maintenance processes. The inconsistencies between land management entities and their GIS data maintenance practices are the source for the majority of the data issues mentioned above.

THE NEED FOR ORGANIZATIONAL COORDINATION AND DATA STANDARDS

It is not possible for this methodology to independently account for the more fundamental problems associated with the integration of datasets from multiple sources – the largest of which are differing reference sources and update cycles. This methodology aims, rather, to build a logical update structure that will serve as a foundation for the development and updating of a statewide ownership layer, and will provide for gradual improvement through time.

The only way to address these problems is for contributing entities to coordinate their data development efforts. Data contributors are currently moving towards the standardization of certain aspects of statewide data development. As these standards are implemented over time, some of the problems currently associated with the integration process will be reduced. It will become far easier to resolve conflicts, integrate shared boundaries, as well as to maintain updates on a regular cycle.

Specifically, data contributors are addressing the following issues:

Standard State Boundary:

There is currently no standard or 'official' state boundary commonly used or available for the development of datasets. While there is an official county boundaries dataset (which delineates the Oregon, Nevada, Arizona and Mexico land borders), there is no agreement on a single version of the California coastline. There have been several efforts at developing a definitive version, and state stakeholders are working to choose one as a statewide standard.

Public Land Survey:

There is no single version of the Public Land Survey that is endorsed and used by contributing agencies as a reference for the development of ownership data. While some entities do not use the PLS at all in the development of their ownership data, it would still be valuable to determine a standard whose use could be encouraged over time. Having a single version of the PLS, or a single provider of a current PLS would serve to mitigate boundary discrepancies between owning entities.

Coordinate System:

Another source of inaccuracy in the integration process is related to differing coordinate systems. While it is not possible for many contributing agencies to adjust what coordinate system they use, identifying a single system as the California standard would potentially serve to guide data development by other contributors.

Water Features:

There is no current protocol for whether or not to include water features as part of ownership datasets. Although this is not a problem for many uses of the GIS dataset, it can become an issue when used for habitat modeling or for land use acreage calculations.

While it is obviously not easy to change what in many cases are institutionalized processes and techniques, the above issues could be addressed by the coordination of a regular working group comprised of the major land-owning entities in the state. The Legacy Project has initiated such a coordinating body for data contributors to the Public, Conservation and Trust Lands dataset. It would also be of great benefit to expand and formalize this group by engaging the statewide and regional GIS councils.

As the above issues are resolved, geographic data created in California will, over time, become more consistent and reliable. While some issues may always exist, establishing standards will help in defining how geographic data is developed and maintained. Ultimately this will result in more consistent contributor data, reduced update cycle time and cost, and a more accurate dataset.

IMPORTANT GIS DATA MANAGEMENT CAPABILITIES

There are several GIS data management capabilities that can be useful in resolving some of the issues associated with the PCTL update process. The major capabilities are examined individually below.

THE GEODATABASE

One of the most recent developments in GIS is the concept of the 'geodatabase'. A geodatabase can be described as a relational database management system that accommodates both spatial (geographic) and tabular information. It provides a logical structure within which to group GIS datasets, and a means to develop sustainable database history. The geodatabase is also compatible with enterprise database management systems, such as Oracle and SQL/Server. This enables centralized storage of geographic and associated data, streamlines data management, facilitates dataset dissemination, and provides mechanisms for maintaining data integrity.

Multi-Editor Sessions

A limitation in previous data development efforts was the inability for more than one user to edit and update ownership datasets at any one time. While for smaller agencies or individual features this is not a large issue, when considering the update process for a large-scale landowner in California, such as the BLM or the US Forest Service, having only one editor is a considerable limitation. Implementing the PCTL data integration and maintenance process within an enterprise geodatabase environment makes it possible to have multiple users working on a single dataset at one time. These capabilities significantly expedite the update process.

Edits performed by one editor do not get updated to the 'master' database until the editor specifies. Even then, edits are posted to the database, and can be verified prior to acceptance. This check capability reduces the odds of a faulty edit being included in the PCTL dataset, as work can be double-checked.

Versioning

A capability that is relatively new to the geodatabase is the concept of versions – that is, creating database history according to previous 'states' of the data. The same technology that allows for multiple editors to work on a single dataset at a time also allows for a snapshot of the dataset to be preserved prior to a new edit session. The database can then be queried to display the dataset at any of the versioned instances. This capability is very useful for change analysis over time, and for modeling applications.

Topology

The most important concept for structuring and editing land ownership data is topology. Topology is simply defined as the spatial relationship between features in a dataset. Topology enables advanced spatial analysis and plays a fundamental role in ensuring the quality of a GIS database. Topology enables GIS users to answer questions such as adjacency, connectivity, proximity and coincidence of features. While traditional topological relationships within a single dataset, such as adjacency, have been supported for a number of years, it is now possible to define topological relationships between the features of multiple layers. This is an important development, as it can greatly facilitate the data update and integration process.

For the PCTL update process, the concept of coincidence and adjacency are important, especially as they relate to the editing of features with shared boundaries. With a large statewide dataset such as ownership for California, the ability to use topological relationships between features as a means to easily identify change areas is a very important capability for successful implementation of an efficient update process.

Defining topological relationships between datasets is effective not only for identifying changed features but also for editing those features to make them up to date. Using topological rules to identify areas that need to be updated is more efficient than the traditional overlay process for a number of reasons:

- Each topology rule violation (edit area) is identified along with a description of the rule that is being broken, simplifying the course of action to be taken (add, subtract or merge the feature)
- The topological rule(s) as defined for/between dataset(s) can be validated for either the entire dataset or for individual features, which helps to ensure the integrity of the dataset during the editing process
- The topological errors/update areas can be listed and displayed directly on the editing screen, making the editing process clearer and more directed (errors for a given area can all be updated at the same time)
- Once topological rules that meet the requirements of the PCTL update process have been created, they do not have to be re-defined. This contributes to the continuity of the editing process, by ensuring that the same process is used from update to update.

SECTION THREE – GEODATABASE DESIGN

As mentioned in the previous section, the geodatabase offers a comprehensive way with which to structure and maintain spatial and tabular data. Central to the PCTL update process is the development of a logical database design- one that facilitates data editing as well as maintenance. This section explores several key components of the geodatabase, and then describes the PCTL geodatabase design in detail.

THE FEATURE DATASET

An important geodatabase concept is the *feature dataset* (FD). This can be considered as a kind of 'envelope' within the geodatabase, used to organize data layers (feature classes) that share similar characteristics. The FD is defined by the following rules:

- A feature dataset's coordinate system is shared by all feature classes contained within it
- A feature dataset's coordinate precision propagates to all feature classes contained within it
- Topology rules can only be defined for feature classes contained within a feature dataset

Using feature datasets in the PCTL database design ensures that data is maintained correctly both as it was received, as well as it is prepared for integration. By defining a separate FD for each contributor source, the original coordinate system and extent set for the source data could be maintained. Defining other FDs to hold projected and standardized contributor data ensures a more consistent integration process. The geodatabase FD also allows for relationships to be defined between datasets, with the use of topology rules. As mentioned in the previous section, these rules can be defined to meet the needs of the PCTL ownership layer, and serve to ensure the integrity of the dataset over time.

Coordinate Extent and Precision

As mentioned, the values set for a feature dataset's coordinate extent and precision persist to all feature classes held within it. The '*extent*' refers to the minimum and maximum x and y coordinates, according to the chosen coordinate system, for all features. The '*precision*' refers to how many significant digits are stored for each coordinate. In the geodatabase environment, these two parameters are interdependent - setting a large extent reduces the amount of precision with which features can be stored; conversely, a smaller extent allows for greater precision. It is important to ensure, therefore, that a feature dataset's extent is large enough for all features while accommodating for source data accuracy. For the PCTL process, the extent had to be large enough to accommodate the entire state of California, while maintaining coordinates precisely enough to preclude loss of data accuracy.

PCTL Geodatabase Design

In order to effectively implement an update procedure, it is imperative that the geodatabase structure housing the current PCTL ownership dataset, agency source data, and PCTL dataset history be managed efficiently.

The current PCTL geodatabase design consists of three separate databases, set up to hold:

- *Agency Source GDB* - Unaltered contributor source data
- *Agency Standardized GDB* - Contributor source data projected and mapped to the PCTL attribute structure. This is where preliminary editing occurs
- *PCTL GDB* - Current and past PCTL datasets. This is where final data integration takes place

Figure 3-1 depicts a generalized design for the three geodatabases, and indicates how data progresses through the database structure from receipt to integration. It also depicts the topological relationships between feature classes within the feature datasets.

The '*Agency Source*' geodatabase (GDB) houses all contributor data as received. Within the GDB, each contributor has a *feature dataset* (FD) that contains each set of updates as a *feature class* (FC). The FD has a precision and an extent, as well as an attribute structure that is unique to the contributor. Since editing does not take place in this GDB, a separate FD for editing was not created.

The *'Agency Standardized'* GBD maintains the design structure of *'Agency Source'* in that each contributor has a separate FD. However, when the data is loaded into these FDs, it is re-projected and the original attribute structure is mapped to fit the PCTL design. Also, a separate, '*Working'* FD was created and the 'standardized' FCs were copied in for editing. It was in this FD that topology was assigned for overlaps between different contributors as well as overlaps between features belonging to the same contributor.

The third GDB, '*PCTL*' is where the final editing and integration takes place. There are four feature datasets - one for each stage in the final PCTL integration process. As in the 'Standardized' GDB, one feature dataset acts as an editing workspace: the integrated contributor data layer created in the 'Standardized' GDB is merged with unchanged features from other contributors (those that did not provide updates), and topology is defined. Integration between the updated features and the state boundary also takes place in this final geodatabase. This geodatabase also serves as a repository for previously-completed PCTL layers. As depicted in figure 3-1, the PCTL_Final FD holds completed PCTL layers, while the PCTL_Current FD holds feature classes comprised of the current representation of features for each contributing agency. For contributors that don't provide data for a given update cycle, it is these feature classes that are integrated with the updated information to create a new PCTL.

Both the '*Agency Source*' and the '*Agency Standardized*' geodatabases (GDBs) maintain a structure where each contributor is assigned to a separate *feature dataset* (FD). This facilitates the maintenance of agency data in both native and normalized format, and provides a logical way to maintain a historical record of data by contributor.

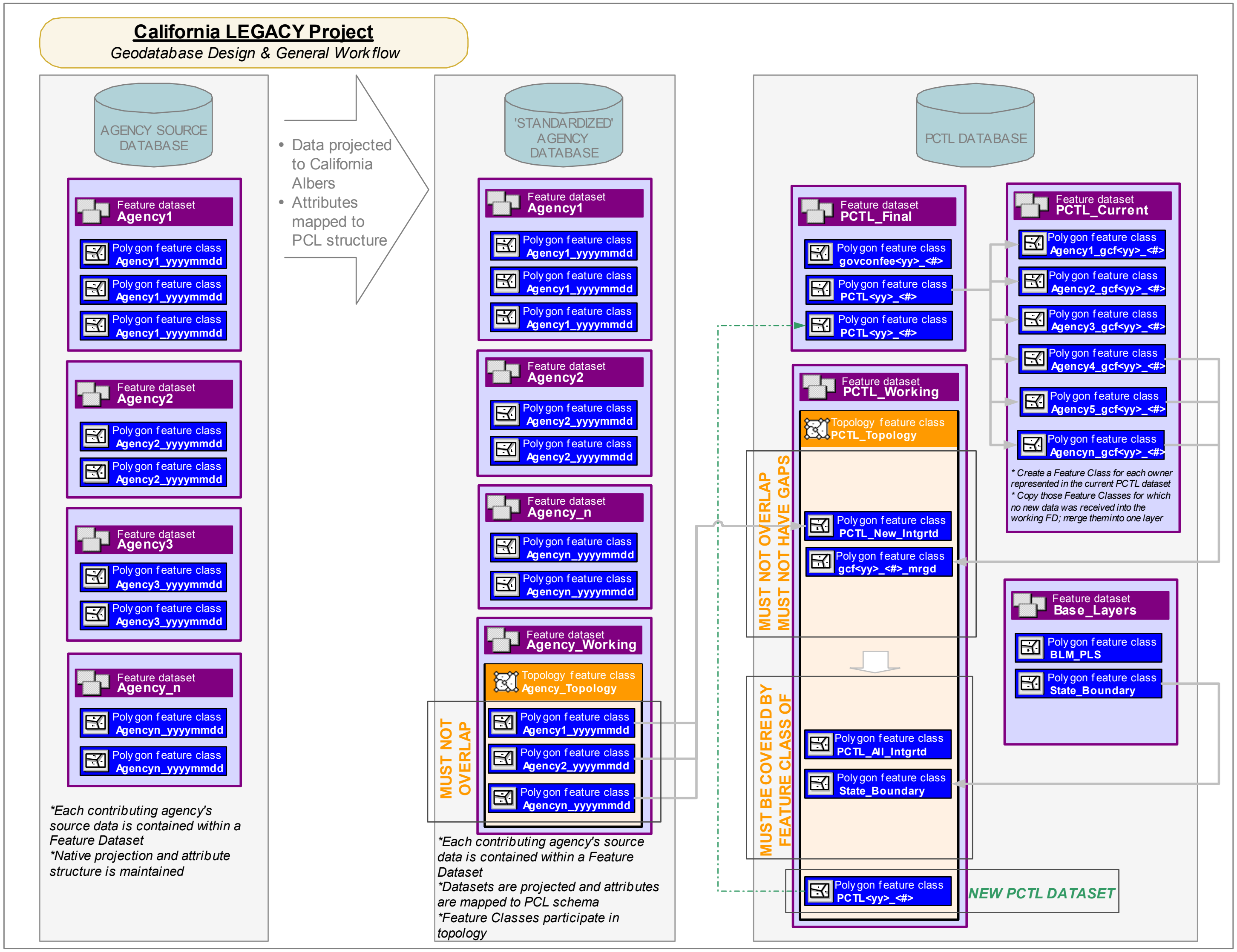

Figure 3-1: PCTL General Geodatabase Design & Workflow

SECTION FOUR – PCTL UPDATE METHODOLOGY

The PCTL update process relies on a systematic method to accomplish GIS data integration. It uses the GIS data development and management capabilities identified in the previous section. This section describes how to implement the update methodology within the ESRI ArcGIS 8.3 software environment.

While the editing and integration of contributor data was performed within the enterprise geodatabase environment, the database was initially created as a personal geodatabase. Once the feature datasets were defined – with associated feature classes and topology rules – they could be easily copied into the enterprise geodatabase environment.

GENERAL PROCEDURES

STEP ONE: LOADING DATA INTO THE GEODATABASE

The first step is to load the data, as received in various formats from contributors, into the geodatabase environment. Initially, unaltered data was loaded into the '*Agency Source*' GDB, as described in Section 3. Loading data into a geodatabase can be accomplished a number of ways, but the easiest is to use the Simple Data Loader, available in ArcCatalog.

STEP TWO: DATA PROJECTION

The next step was to standardize the contributor data prior to editing. This entailed projecting the data to a common coordinate space. The coordinate system chosen by the Resources Agency as most suitable for statewide data representation is the '*Teale Albers*' or '*California Albers*' projection. The parameters for this projection are listed below:

Units:	*Meters*
1st Standard Parallel:	*34 00 00*
2nd Standard Parallel:	*40 30 00*
False Easting:	*0*
False Northing:	*-4,000,000*
Datum:	*D_North_American_1927*
Spheroid:	*Clarke_1866*
Linear Unit:	*Meter*

Table 4-1: Teale/California Albers Projection Parameters

Although ArcGIS software can "project on-the-fly" to correctly display datasets with different projections into a common coordinate system, advanced topology editing requires that all data is stored in the same coordinate space.

STEP THREE: STANDARDIZE DATA ATTRIBUTES & COORDINATE PRECISION

After the projection of the source data to California Albers, the next stage was to standardize its coordinate precision and attribute structure to adhere to the established PCTL standards. These standards were developed collaboratively by the PCTL contributing agency working group, and accommodates the general needs of the data users (see Appendix B: Table 1 – Attribute List for PCTL). The Simple Data Loader also allows for custom mapping of attributes into the PCTL structure. Details for performing this task are listed below:

1. Within the '*Agency_Standardized*' geodatabase, create new FCs within the agency FDs. Define the attribute structure according to the PCTL standards (see Appendix B). If a FC already exists with that structure, the fields can be imported to the new FC.

2. Using the Simple Data Loader, load the agency data (as projected in the previous step) into each of the new feature classes. At this stage, map the attributes from the original agency structure into the PCTL format, using the process described in Step Two of this section

Loading the projected source data into the '*Agency Standardized'* GDB also serves to standardize the coordinate precision of the data. As described in Section Three, the extent and precision of a feature class are constrained by the values set for its feature dataset. For the '*Agency Standardized'* GDB, the precision values entered for the agency FDs was 1000. Table 4-2 displays the precision and coordinate range values:

Min X and Y:	*-1,000,000*
Max X and Y:	*1,147,483.645*
Precision:	*1,000*

Table 4-2: PCTL Extent and Precision

The range of X and Y values accommodate statewide data, and the precision value of 1,000 ensures that coordinates are maintained to three decimal places. Since California Albers units are meters, this means that coordinates are maintained to 0.001 of a meter. This precision is far beyond the actual precision of the source data, and ensures that data loss during migration is negligible.

Step Four: Isolate Contributor Data Conflicts

The next stage was to ensure that no major conflicts existed between features in new data, as received from each contributor. This was accomplished by using ArcGIS topology rules to identify conflicting features within and between datasets. As mentioned in Section Three, topology can only exist within a feature dataset, and only feature classes within that FD can participate.

Step Five: Editing Contributor Data Conflicts

By using the editing hierarchy and the ArcMap topology editing tools, rule violations (areas of overlap) were viewed and resolved. As mentioned, validation of a topology identifies rule violations or errors. By loading a topology and its participating feature classes into an ArcMap session, these rule violations can be viewed. The 'Error Inspector' allows for a user to zoom to a particular edit, query the rule that is being violated, and resolve the overlap by subtracting, merging, or marking as an exception (see Appendix A-Contributor Datasets and Hierarchy). Exceptions were marked when the editor felt unable to make the decision of how to resolve an overlap based on the hierarchical rules.

Versioned Editing in the Geodatabase

As mentioned in Section Two, enabling a multiple editor environment expedites the data integration process. By using ArcSDE to connect ArcGIS to an enterprise data management system (in this case, SQLServer), having multiple editing sessions at one time is possible. ArcSDE allows editors to possess their own 'version' of the data. An editor performs edits to their version, and, at specified intervals, reconciles the version back to the default (or parent) dataset.

For the PCTL editing process, the geodatabase was initially created on a local machine, and considered to be the 'master'. A geodatabase was then created via ArcSDE in SQLServer, and for each stage in the update process only the relevant feature datasets (with associated feature classes and topologies) were copied to the enterprise environment. Once a feature dataset was copied to SQLServer, it could then be registered as versioned- enabling each authorized user to create their own version of the database for editing.

Final Integration of Contributor Data

After the new data from the contributors was edited for overlaps and integrated, all the data needed to compile a complete and seamless ownership layer was loaded into the PCTL geodatabase. The data contained in the third and final geodatabase included: the integrated update layer, data from contributors that did not have updates, the California coastline and the California state boundary. In the future, this database will also hold all previously completed versions of the PCTL GIS layer.

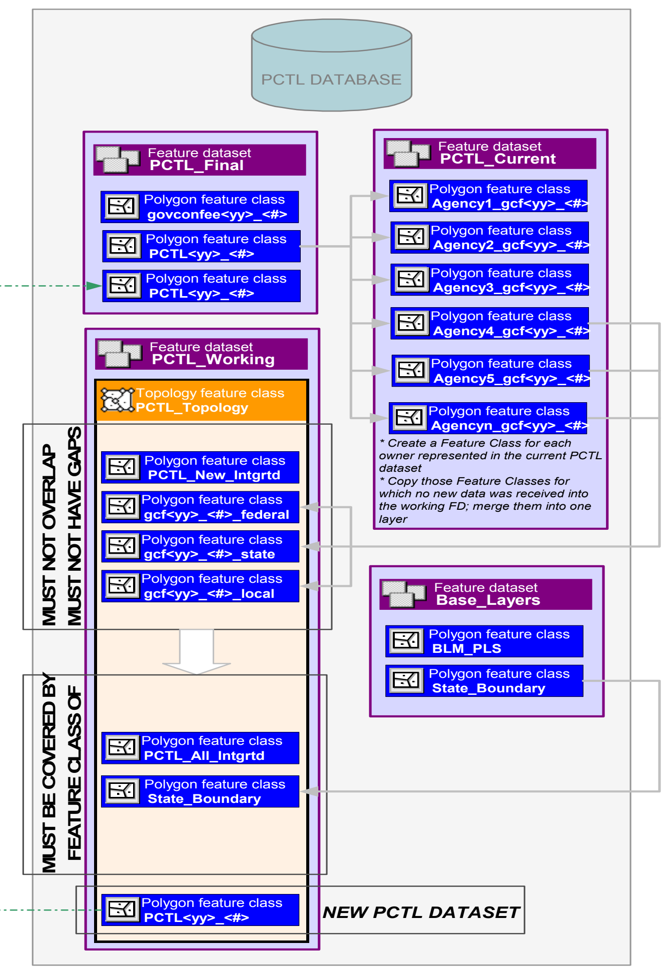

Figure 4-1: Design set-up for the PCTL GDB

INCORPORATING THE FINAL FEATURE CLASSES

Figure 4-1, above, illustrates how the PCTL geodatabase was created.

The data for those groups who did not provide updates were extracted from the earlier ownership layer, govconfee03_3. These features were copied into new feature classes, distinguished as Local, State, Federal, and Other. They were then copied into the working feature dataset, along with the new, corrected contributor data layers (FCs). The topology polygon rules were redefined to include the extracted data. The rules defined were: 'MUST NOT OVERLAP' (features in a single FC) and 'A MUST NOT OVERLAP WITH B' (between features in the layers). Gaps were also corrected as editors came upon them, using the reshape process. As described previously in this section, errors were resolved in ArcMap with the topology editing tools.

Editing Gaps

Topology rules concerning gaps were not initially defined until there was an integrated layer. Obvious gaps between features were corrected as editors came across them while working on overlaps. After the update and govconfee03_3 layers were integrated, MUST NOT HAVE GAPS was assigned as a topology rule to catch any remaining sliver gaps.

Gaps were corrected by intentionally creating overlaps, and then validating these overlaps with the topology tools. By reshaping a feature to overlap the adjacent feature and validating according to the 'MUST NOT OVERLAP' topology rule, each gap could be efficiently removed. By causing an overlap, the editor was certain that the entire gap was corrected and that the boundaries of the two features were coincident.

INTEGRATING THE COAST LINE

Once all of the edits were made, the PCTL features had to be merged with the state boundary, CA_BOUNDARY. The newly integrated PCTL ownership FC and CA_BOUNDARY FC were loaded into a new feature dataset. A new topology was created and the rule PCTL 'MUST BE COVERED BY' CA_BOUNDARY was given. In ArcMap, editors verified features along the entire state boundary, ensuring that features in the PCTL layer met but did not extend past CA_BOUNDARY.

In cases where slivers existed between PCTL features and CA_BOUNDARY, the process for editing gaps was employed. In areas where the PCTL extended past CA_BOUNDARY, the subtract method was used.

After the state boundary and the PCTL ownership features had been reconciled with one another, the two layers were merged together to form a single, seamless layer. One last topology rule, MUST NOT OVERLAP was run to ensure that all the errors were caught.

MANAGING FUTURE UPDATES

As contributors send updates, it is important to determine changes between those updates and the ownership boundaries held in the current PCTL layer. Future updates will be handled in a manner similar to the previous set of updates. The initial process will remain the same; however, features that have changed will not be integrated with existing features until the final step. For specifics on loading and editing data, please refer back to General Procedures at the beginning of this section.

IDENTIFY CHANGED FEATURES

As the updates are received they will be loaded into the *Agency Source GDB* as new FCs within the contributor's FD. The FCs will then be re-projected and their attributes mapped to mirror the PCTL structure, as they are loaded into the *Agency Standardized GBD* as new FCs. It is in this GDB that the updates will be compared with the existing Agency layer. The topology rule 'MUST BE COVERED BY FEATURE CLASS OF' will be assigned.

Violations to this rule would occur where there has been a change – either a land acquisition or a land sale. Areas in the new version that are not contained in the old would be new acquisitions, whereas areas contained in the old version but not in the new would reflect those lands that have been sold. Some of the changed features identified may result from adjustments made during the editing process to generate the current seamless PCTL (slivers and gaps). These rule violations should not be resolved to match the update features. Only those changes representing land acquisitions, sales and updated feature boundaries should be considered.

Merge Updated and Unchanged Existing Agency Data

Once all of the existing PCTL agency layers have been updated according to update process, the next step would be to merge all *updated* as well as *existing unaltered* agency datasets together into a single dataset. This dataset is the initial version of the new, updated PCTL layer, prior to having its topological integrity validated.

Identify New PCTL Overlaps or Gaps

Any features that have changed will be extracted from the update layer and loaded into the *PCTL GDB*. This new FC will be compared with the current PCTL layer. Once the first round of updates is completed for any given agency or group, there will be a consistent layer against which to compare any future changes.

The new PCTL layer is created as a result of merging both *updated* and *existing unaltered* agency datasets. As such, it is necessary to verify that all new or updated ownership features do not overlap with unchanged PCTL features, and that sliver gaps have not been created. This can again be handled by defining topological rules to define the relationship between features in a single dataset: the rule would be that features 'MUST NOT OVERLAP' and 'MUST NOT HAVE GAPS'.

While ownership features from different agencies should not overlap, conflicts can occur where there is a lag between a real estate transaction and the update of boundary information. In some cases, one agency's data contains boundary information for another agency's lands. In these cases it is important to ensure that the most accurate boundary is included in the update process, and any others are removed.

Creating the Final PCTL Layer

After the overlaps and gaps have been edited, the final stage is to integrate the California boundary FC. As described in *Integrating the Coastline,* the boundary is loaded in and one last topological rule, 'MUST BE COVERED BY' is defined. Once the ownership layer is checked for conflicts with the state boundary, the FCs can be merged together to create the new PCTL layer.

The new PCTL layer would then be removed from the working FD, named appropriately, and then placed into the FD to hold all current and past versions of the PCTL layer.

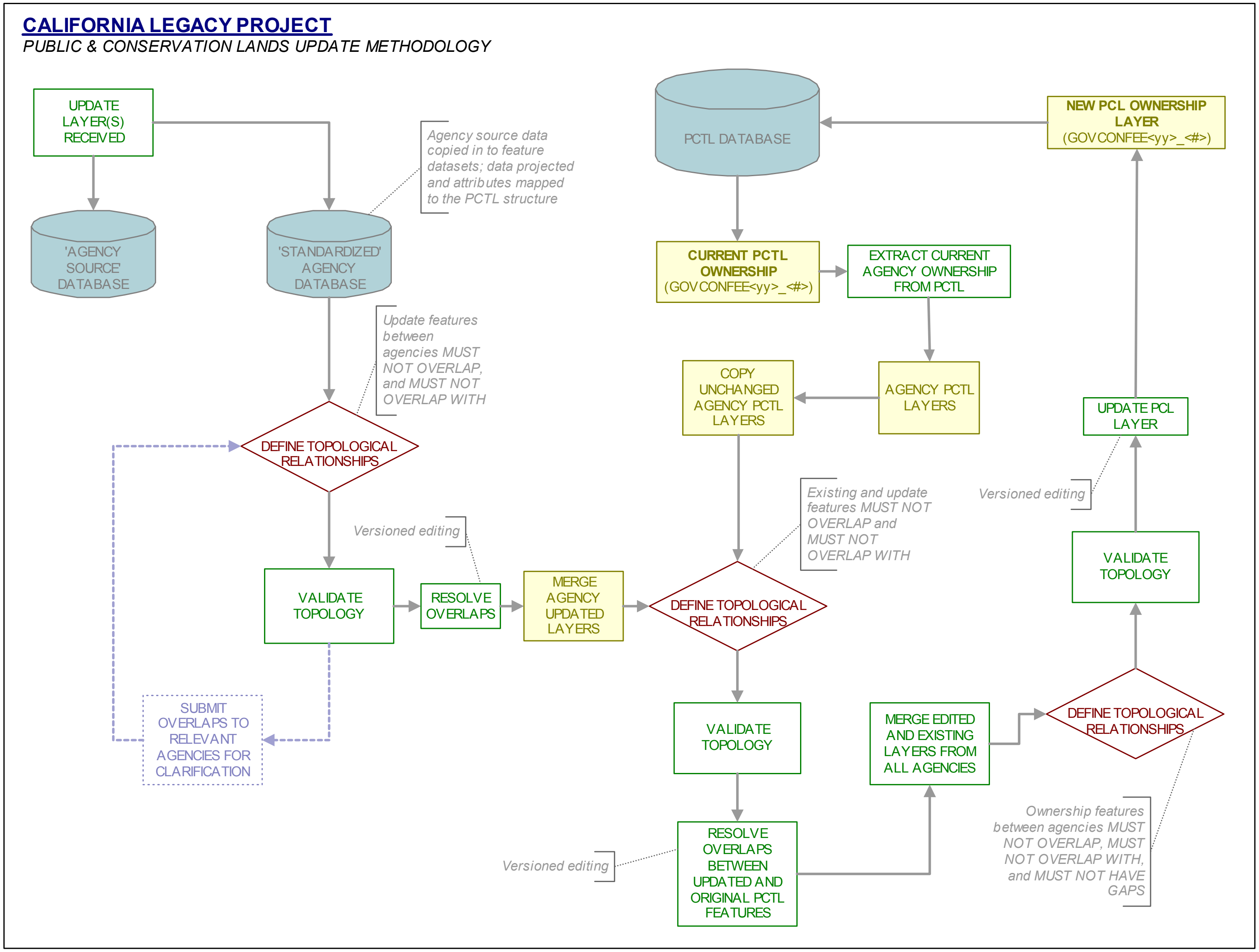

Figure 4-2: PCTL Update Methodology Workflow Chart

SECTION FIVE- FUTURE CONSIDERATIONS

DATA CONTRIBUTORS WORKGROUP

In order to maintain the inertia gained during the initial rounds of the update process, it is valuable to maintain the data contributor's workgroup as a means to develop and improve lines of communication between the Resources Agency departments, state and federal agencies, and non-government groups that contribute data or use the PCTL. This group should convene on a regularly scheduled basis, and act as a forum for data issues. The group would also be responsible for the development of standardized attribute structure and the implementation of both metadata standards and update cycles. This group would also serve to increase the legitimacy to the PCTL layer itself.

BLM PUBLIC LANDS SURVEY

An initial concern raised in discussion was how to include updates and changes made to the Bureau of Land Management's Public Land Survey (PLS) layer in the PCTL dataset, as well as how to address issues of differing PLS versions between source datasets. These issues were not addressed by the USBR when they compiled the regions coverage of California's ownership, nor in the initial integration of data as performed by VESTRA Resources, Inc. These factors make it extremely difficult to try to directly address these problems with this methodology.

As mentioned at the beginning of this paper, the integration process initially used to create the seamless PCTL layer from the USBR regions coverage did not snap all features to the PLS grid. While the PLS was used as a reference layer, features were only snapped to township, range or section lines where editing occurred. In this way, the majority of features were left as they came in the region subclass; that is, unchanged and of unknown association to PLS. While the current PCTL layer fits well with the BLM PLS, it does not fit *exactly*.

Until there is a single PLS reference layer that all landowning agencies and groups designate as the standard for the development of digital data in the state of California, it is not an efficient use of resources for the PCTL update process to include snapping all features to a single PLS. If contributing agencies begin to move towards a standardized approach to the development of digital data, it can be expected that, over time, the overall accuracy of the PCTL layer will improve.

METADATA

Fundamental to the integrity of the Public, Conservation and Trust Lands dataset is the continued development of detailed metadata, defining any updates performed, source data as well as contact information.

APPENDIX A – CONTRIBUTOR DATASETS & HIERARCHY

The following table gives the dataset (original name) as well as the alias that was used in setting up the topology rules. It also includes the rank given to each dataset. This rank was based upon who sent the original data and which agencies sent updates.

CONTRIBUTOR	*DATASET ALIAS*	*DATASET NAME*	*RANK*
BLM	blm_fee_w	ownpcablm_n_w	1
USFS	USFS_fee_w	r5admin_n_w	2
USFWS	USFWS_fee_w	usfws_bnd_n_w	3
CDFG	CDFG_fee_w	dfg_lands_n_w	3
CDPR	CDPR_fee_w	stprks062603_fee_n_w	3
TNC	TNC_fee_w	tnccf062603_fee_n_w	4
NPS	NPS_fee_w	ownpca_nps_n_w	4
USBR	USBR_fee_w	ownpca_usbr_n_w	4
SLC	SLC_fee_w	ownpca_slc_n_w	4
GCF	DOD_gcf	gcf03_3_DOD*	5
GCF	Other_Federal_Lands	gdf03_3_Federal*	5
GCF	Other_Local_Lands	gcf03_3_Local*	5
GCF	NGO_Other	gcf03_3_NGO_Other*	5
GCF	Other_State_Lands	gcf03_3_State*	5

**<gcf03_3> indicates that the data was extracted from the original, coverage format of the ownership layer, named govconfee03_3*

It should be noted that for the BLM data (ownpca layer from which other agency data was extracted), tribal lands (owner = BIA) were NOT included at this time. There is some discussion about integrating the tribal lands with the rest of the PCTL layer but keeping it separate within the geodatabase, and available upon request only).

Appendix B – Attribute Lists

Attribute Lists for Public, Conservation and Trust Lands

The following attribute lists are the final PCTL fields.

Table 1: FEE Lands

OBJECTID	(System-generated Autonumber field)
PROPID	(Key to features (properties) in the PCTL feature class)
PROPNAME	(Commonly used name for property)
ADMINAREA	(Name of administrative area that the property is part of, if applicable)
PRIMOWNER	(Agency or group that possesses PRIMARY ownership rights to a property)
OWNABBRV	(Accepted abbreviated acronym for owning entity)
PRIMMNGR	(Primary managing group or agency for property)
UPDTDATE	(Date that the feature was last updated/edited within the ownership dataset)
DATASRC	(Numeric code indicating source of data)
MAINGROUP	(Categorization indicating general grouping for the owning entity)
TEALECODE	(Original Teale coding scheme, re-definable to depict owning agency and level of government)
SRC_JOINID	(ID number or code to link back to the source dataset)
RCRDDATE	(Date that property transaction was recorded with the county assessor. This is a DATE field)
GISDATE	(Date that property was mapped into the source contributor's GIS database. This is a DATE field)

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