



**ENTERPRISE ARCHITECTURE (EA) —**

**A BLUEPRINT FOR CHANGE**

**APPENDIX H**

**GEOSPATIAL INFORMATION SYSTEMS (GIS)**

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# 1.0 CONCEPT

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The Hawaii State GIS Program, located within the Office of Planning (OP) of the Department of Business, Economic Development and Tourism (DBEDT) is statutorily responsible for leading a coordinated, multi-agency effort to create a digital library of geographic data to improve government efficiency by facilitating data accessibility and eliminating the development of redundant databases (Section 225M-2(b) (4), Hawaii Revised Statutes). The GIS Program is tasked with providing leadership and coordination of GIS data and activities among state agency GIS users. Initially, the State GIS Program was quite successful – cooperation and coordination, especially with ICSD, were instrumental in building the State’s GIS infrastructure and database. Several State GIS strategic planning projects have been undertaken in recent years, notably in 2005 and 2008, resulting in recommendations similar to those contained in this document.

However, dwindling resources, particularly in the areas of staffing and funding have impacted the ability to act on those draft plans, both in terms of the ability to provide adequate infrastructure and in terms of OP’s efforts to coordinate and develop a true Enterprise GIS. In addition, the rapid growth of the number of users over the past several years has taxed OP’s ability to communicate with other agencies about their geospatial needs and initiatives. The result has been that multiple versions of data layers are stored at various agencies, some “stove-piping” of both data layers and GIS activities has taken place, and opportunities for collaboration have been missed.

Clearly, a new approach must be taken to better coordinate the GIS activities of state agencies in a more collaborative and managed environment.

## 1.1 THE VISION FOR GIS IN HAWAII

The vision for GIS at the State of Hawaii is to enable easy access to the highest quality authoritative geospatial information at all levels of the State, to extend spatial visualization and analysis capabilities to non-GIS specialists, to enable mobile technology for field personnel, and to foster enhanced collaboration and better decision making (Figure 1). This will be achieved by implementing a comprehensive Geospatial Platform that supports the discovery, consumption, and publishing of relevant geospatial information and tools. The State’s geospatial goals, objectives, applications and products will, to the extent possible, support all geospatial software platforms used by State agencies and conform, whenever possible, to open GIS standards. A move towards a service-oriented architecture (SOA), or more specifically a web-oriented architecture (WOA), will enable information to be published once and used many times. Services and solutions will be built in an enterprise fashion, that is to say, built incrementally with business purposes in mind. As information and tools become available from new services and solutions developed across the State, a common gateway or portal will be used so that information consumers can easily discover provider content. Implementation of this vision will result in an information sharing and collaboration environment that transforms planning, communication, and decision-making capabilities across the State. In addition to technology implementation, achieving the vision will require the collaborative development of, or changes to GIS governance, policies and standards. This must include a renewed commitment by the State GIS Program to be responsive to user needs.

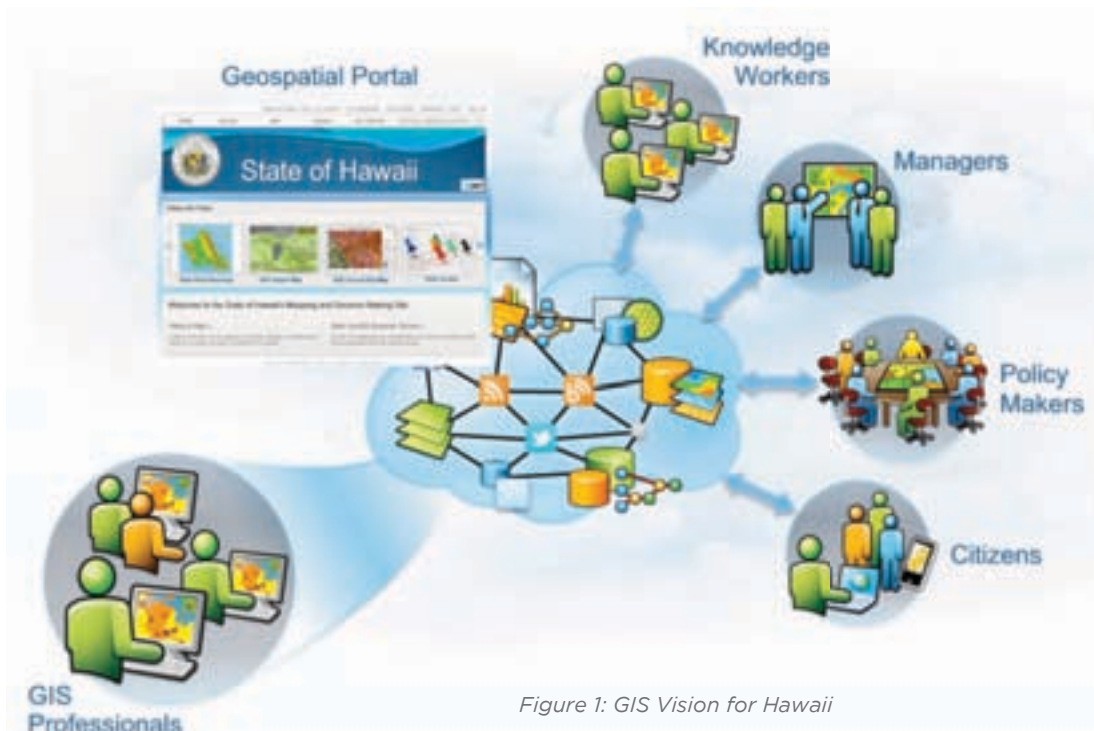


Figure 1: GIS Vision for Hawaii

## 1.2 THE MISSION

The mission of the Hawaii State GIS Program is to improve the quality and lower the cost of services and information provided by the Hawaii State government through the state's collective investment and effective application of geospatial data and systems and collaboration with other government and non-governmental organizations on geospatial issues and projects of mutual concern.

## 1.3 HAWAII GIS PROGRAM STRUCTURE

As the agency responsible for statewide planning and coordination, the Office of Planning (OP), through its GIS Program Management Office (PMO), will continue to plan, lead, and coordinate the GIS activities and resources within and among state agencies. The GIS PMO will provide support to agencies managing projects requiring geospatial resources, including assisting with planning and needs assessment, developing specifications, acquiring data, system implementation, training, and user support. Additionally, the PMO will continue to assist with data development, mapping and analysis needs as resources permit. The GIS PMO coordinates with external partners – county GIS coordinators, liaisons with federal agencies – as well as with agency GIS User Groups. The relationship of the GIS PMO to OIMT and the governing bodies is depicted in Figure 2.

State agencies currently have broad access to a centralized geospatial database that is organized and updated by the

GIS PMO and is hosted at ICSD. This database will be hosted and managed by the Office of Information Management and Technology (OIMT), will allow for update by authoritative data providers, and will serve as a common building block upon which to design and deploy GIS applications.

The GIS PMO will also work closely with a GIS Advisory Council -- a multi-sector committee (possibly the CIO's GIS Working Group and/or the Hawaii Geographic Information Coordinating Council (HIGICC)) that will recommend standards, policies, strategies, legislation, and may help set priorities. It will also be an advocate for the GIS PMO at the executive level, help facilitate interagency cooperation, and may act as a project management oversight committee (PMOC) as well. The GIS Advisory Council will report to the CIO Council.

The existing positions within the GIS PMO will remain:

### GIS Program Manager

This position serves as the head of the GIS Program. Duties and responsibilities include administering and coordinating the planning, development, implementation and maintenance of a multi-agency Statewide GIS which includes establishing broad work plans, developing programmatic priorities and budgets, conducting program analysis, making programmatic policy recommendations, providing consultative and advisory services to departments and developing cooperative agreements with other governmental agencies.

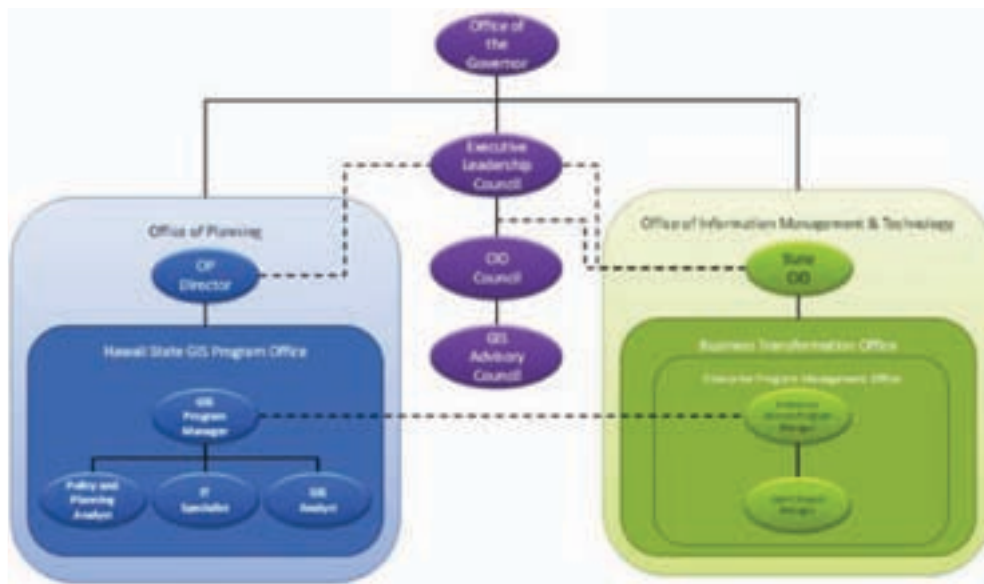


Figure 2: GIS Program Structure

<sup>1</sup> Hawaii Revised Statutes (HRS) chapter 225-M-2(b)(4).

<sup>2</sup> Many states use this model of a mandated GIS council working with or in place of a GIS PMO (see Attachment C, "State GIS Councils" and Attachment D, "Idaho EO - Idaho Geospatial Council"). Hawaii is one of only a few states that does not have a state-sponsored GIS Council. Instead HIGICC, comprising members in the federal, state, county, education, and private sectors, has acted as Hawaii's council, but without an official or direct role in the statewide GIS PMO. However, HIGICC's bylaws compare favorably with the IGC's (Attachments E and F, respectively), and HIGICC role as an official Advisory Council should be evaluated.

## **IT Specialist**

The primary purpose of this position is to administer the Statewide GIS database, serve as a liaison among user agencies to facilitate communication and coordination, manage OP's hardware and software resources, assist the GIS program manager with various GIS initiatives and activities, manage the State's GIS Internet mapping website, produce thematic maps requiring spatial analysis and cartographic design, and perform other related duties as required.

## **Policy and Planning Analyst**

Researches, analyzes, designs and produces the most difficult and complex thematic maps and applications and participates in the design and maintenance of the GIS database; and performs other related duties as required.

In addition, a GIS Analyst will be added to the staff to add capacity to the GIS PMO to enable expansion of the current GIS environment (application development, additional map services, virtualization, infrastructure migration, training, etc.), and to take a more active role in and better support statewide geospatial efforts.

Future positions that will be required as the program matures include the following:

## **GIS Database Administrator**

The GIS Database Administrator (DBA) is responsible for the design, analysis, development, procurement, implementation, modification and support of the database management systems that support the State's Enterprise GIS applications and data. The DBA is responsible for the security, performance, integrity of the database, to include planning, development and troubleshooting. The DBA provides support for architecting, implementing, operating and maintaining enterprise databases as part of geographic information system solutions. Additional roles include analyzing, planning and executing database patches and upgrades, defining,

documenting and refining database requirements, database monitoring and performance tuning, documenting and implementing hosting environment policies and security requirements, and testing and troubleshooting databases to ensure continued GIS application operation and the compliance of all database components with data center requirements.

## **GIS Server Administrator**

The GIS Server Administrator will provide ongoing systems administration including installation, maintenance and troubleshooting on daily basis. Provide support to address the availability and reliability issues on systems (Windows/Unix/Mainframe) across multiple locations. Operational responsibilities include remediation of daily incident tickets, system compliance responsibilities, system run enhancement testing and staging, policy/procedure enhancements and adherence, customer contact coordination, and strategy recommendations.

## **GIS Application Developer**

The GIS Applications Developer will be responsible for the design and development of custom desktop, web and mobile GIS applications for State agencies, particularly applications that impact or benefit multiple agencies and/or the public. The Developer will support and enhance existing web solutions, work to maintain coding standards and quality assurance procedures and stay current on technologies, tools, and trends within the GIS and IT industries. Wherever possible, application development should utilize open GIS standards and industry best practices. This facilitates application scalability; application maintenance and reuse; and information sharing or exchange.



# 2.0 PROJECTS

# 2.0 PROJECTS

As described in previous sections, the “to be” GIS deployed in the State of Hawaii will provide easy access to geospatial data, visualization and services to State agencies and the public. This will eventually include development, testing, staging and production environments, replication and synchronization of certain databases to/from neighbor island data centers, and policies and procedures for data update and maintenance. Data and services will be published and discoverable both internally to State government agencies and, where appropriate, externally to partners and the public.

Pilot projects undertaken in FY 2013 are intended to begin implementation of the larger system described above, on a smaller scale. Although these projects represent only the first steps towards true enterprise GIS, their implementation will result in dramatic improvements in data accessibility, performance and customer service for State GIS users and

the public alike. Activities include conversion of GIS data into a relational database for better performance, creation of map and data services for easier access, and creation of federally compliant metadata for easier discoverability of data. Each planned acquisition or activity will contribute to the envisioned system, both in the short term and in the long term.

## 2.1 STATE GIS STRATEGIC PLAN

Creation of the State GIS Section of the OIMT IT and Business Transformation Plan has generated a great deal of interest among State agency users and GIS partners in other sectors. Issues related to user needs, collaboration and data sharing policies, relationships and mechanisms between local, federal and non-profit partners are many and complex, and are beyond the scope of this document. A full State GIS strategic plan to address these and other issues will be developed with consultant/facilitator assistance and updated biannually.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4
Acquire Consulting Services								
Develop State GIS Strategic Plan								



## 2.2

### DATA INVENTORY / GEOSPATIAL ASSET DISCOVERY

In order to go forward with such initiatives as creating Enterprise License Agreements for software or creating a GIS Analyst Series, and to ensure that the GIS Program supports the data, software, and applications actually in use by State agencies, a Data Inventory and Geospatial Asset Discovery project will be conducted. This process will help to identify redundant or conflicting data sets and other geospatial assets that exist in State agencies in order to reconcile data inconsistencies, identify authoritative data, and make the best use of existing and future state resources, by, for example, taking advantage of economies of scale realized when all potential buyers of some item work together. Initially, the information will be collected via a survey designed by the GIS Working Group. In the following fiscal year, after some initial clean up of data has taken place, a data discovery tool / crawler will be purchased for a more thorough and systematic inventory.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4
Conduct Survey								
Data Curation								
Procure Crawler								
Deploy Crawler								

## 2.3 CONVERSION TO RELATIONAL GEODATABASE / CLOUD STORAGE AND DISTRIBUTION

Conversion of the data layers in the State GIS database from shapefiles to a relational geodatabase is essential for improved data management and performance. In addition to taking advantage of the latest storage technologies, the use of a geodatabase will allow us to define and enforce data integrity rules for features, such as not allowing gaps between polygons, creating and using attribute domains, etc. Importantly, it will leverage the underlying RDBMS to provide better data security, a key need expressed by users. In the long term, this data format will also allow the use of geodatabase replication to distribute and synchronize data, for example, between State data centers.

There is recognition that there is a need to support multiple data formats, in addition to the proprietary geodatabase. The GIS will follow the model used by the City and County of Honolulu – data is stored in an enterprise geodatabase, but is distributed in other formats in use by agencies and partners, including open source formats.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4
Plan Conversion								
Acquire Geodatabase Solution								
Convert Geodata to Geodatabase								
Deploy Geodatabase								

## 2.4 CREATION / CONVERSION OF METADATA

While all datasets in the State GIS database have metadata, most of that metadata is not compliant with federal standards. In addition, much of the geospatial data held by State agency users have no metadata. The benefits of creating and maintaining metadata that complies with established standards are many, including:

- Preserve lineage of data investments
- Facilitate data distribution and discovery via geospatial clearinghouses
- Assess the utility of geospatial resources for a particular project
- Install data accountability
- Establish data liability
- Provide a common language for data contributors and consumers

Metadata creation and maintenance is often seen as cumbersome by data producers who are short on resources. Thus, the State GIS will take the lead by documenting State GIS data, while developing metadata templates and procedures that will make it easier for other data contributors to follow suit. The Office of Planning has developed a federally compliant metadata template that is currently being tested. The template will be submitted to the GIS working group for review and comment in late summer, followed by submission to the State Attorney General's office for review and comment. It is anticipated that this project can be accomplished using in-house and volunteer resources, however should it be determined that funding is necessary to assist with development of a State standard metadata template or for the actual conversion of the metadata, the GIS Program will work with the HIGICC to apply for a Cooperative Agreements Program (CAP) grant from the Federal Geographic Data Committee (FGDC). Creation and maintenance of compliant metadata will be an ongoing task.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4
Analyze Metadata Requirements								
Develop New Metadata Standards								
Implement New Metadata Standards								
Convert Existing Metadata to New Standards								

## 2.5 DEVELOPMENT OF “GEOPLATFORM,” INCLUDING DEVELOPMENT OF DATA AND MAP SERVICES

Discovery and access to GIS data by State government agencies are keys to efficient use of State resources, better sharing of geospatial data and elimination of data silos. The geoplatform will include an integrated website, management of data, services, web maps, groups and administrative tools. It will include a portal that will serve as a single point of access to spatial information, regardless of location, format or structure of the source and will have the ability to search and access diverse geospatial resources, and applications (see Figure 3).



Figure 3: Notional View

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4
Plan Geoplatform	█	█						
Acquire Geoplatform		█						
Design and Build Geoplatform			█	█				
Deploy Geoplatform				█				
Maintenance				█	█	█	█	█

## 2.6 EXTENSION/COMPLETION OF GEOSPATIAL PLATFORM IMPLEMENTATION

The build-out and completion of the State GIS infrastructure, particularly because GIS technology changes and evolves so quickly, will be an incremental process requiring iterative system design phases. Although the specifics are difficult to determine at this time, it is certain that there will be database design improvement and multiple environments (e.g. Development, Testing, Staging and Production – e.g., see Figure B, Conceptual GIS System Architecture). There may be a need to replicate and synchronize versions among State data centers for best performance (see Figure C, Conceptual GIS Data Architecture). Publication to the database by authorized publishers should be a simple process, such as that used by geodata.gov, i.e. an automatic process of data harvesting rather than a manual process.

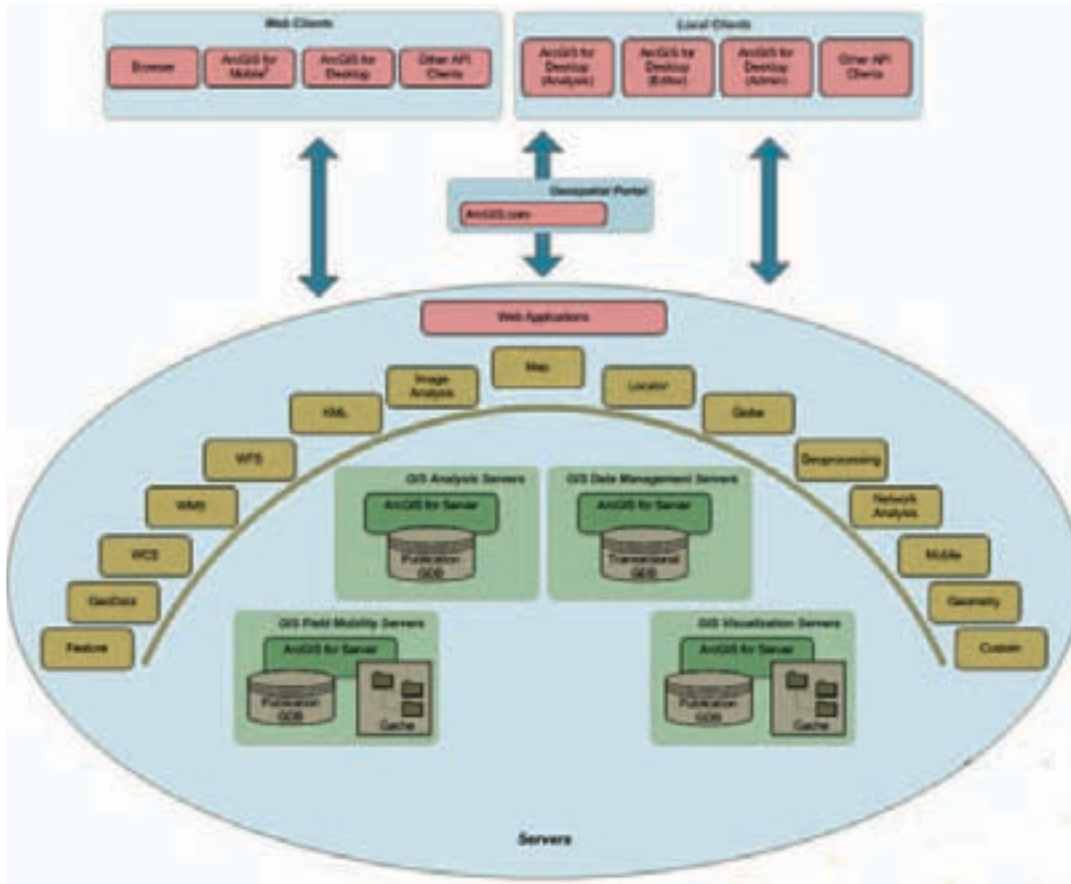


Figure 4: Conceptual GIS System Architecture

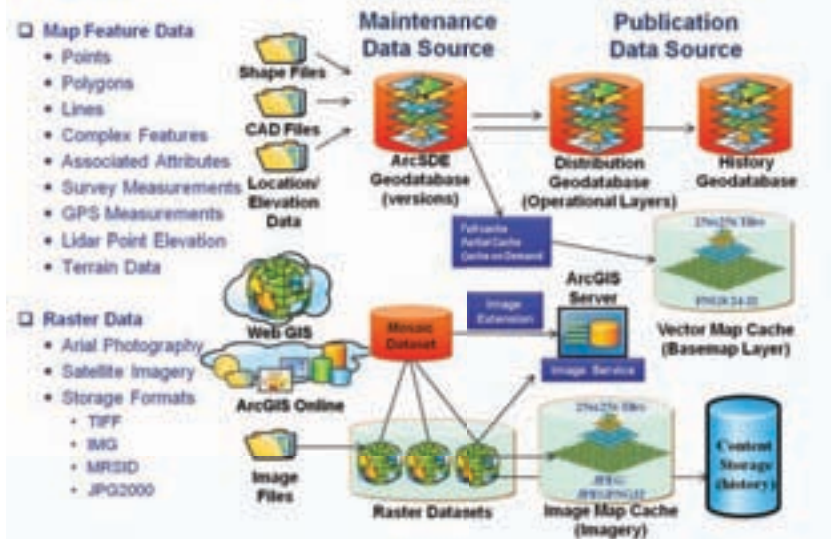


Figure 5: Conceptual GIS Data Architecture

## Extending the Design to Partners:

Discovery and access to GIS data by citizens, industry and local and federal government agencies are key to both efficient use of State agency resources and to open government initiatives. Thus, in addition to the critical need to improve data sharing, storage, and usage within the Hawaii state government, there is separate but related need for GIS data to be discoverable and downloadable by the general public, government and private companies in Hawaii.

To meet this need, the State, in partnership with the Hawaii Geographic Information Coordinating Council (HIGICC), will build and maintain one centralized site for finding geospatial data in Hawaii, a strategy used in most US states. This solution also follows the federal government's lead in geodata storage, discovery and distribution. In this scenario, data producers/providers such as the Pacific Disaster Center (PDC), the Pacific Islands Ocean Observing System (PacIOOS), the University of Hawaii and others will continue to store and serve their own data and services, but the portal will provide links to those resources (Figure D). This portal will continue to enable and encourage open access to data and metadata while enforcing authoritative data standards and policies. The State will work with its many GIS partners in the region to plan and implement the external portal, including the pursuit of grant opportunities. In addition to system design, issues to be addressed will include funding, governance agreements, inventory of existing portals and metadata requirements and gaps.

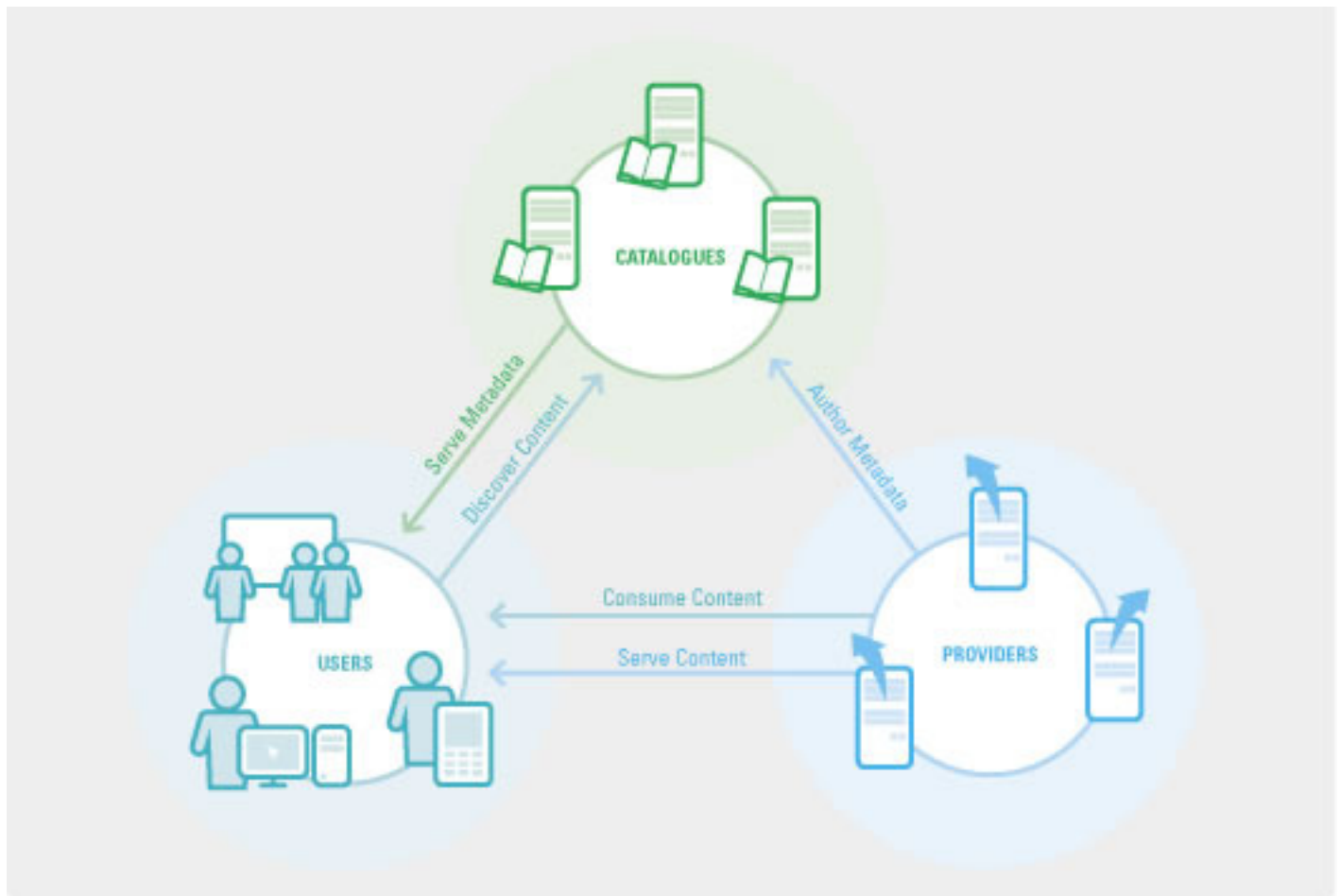


Figure 6: Extend the Design to Partners

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+
Evaluate Pilot								
Geoplatform								
Design System								
Acquire Hardware/ Software Services								
Deploy System								
Maintain System								

## 2.7 DEVELOPMENT OF STATE GIS WEB MAP, IMAGE AND FEATURE SERVICES

The State GIS Program will provide a variety of base data to State agency and public users alike via both web map and web feature services. It is anticipated that most, if not all GIS data residing on the current GIS file server will be made available using web services, feature services, and “clip and ship” tools. The program will also serve all of the State’s LiDAR and imagery data via the web. In-house staff will develop the standard map and feature services used to make State GIS data available.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4
Prioritize and group layers for map services								
Prioritize layers for feature services								
Prioritize imagery data for image services								
Prepare data/layers if necessary (e.g. format tables, tile imagery)								
Develop and test map services								
Develop and test feature services								
Develop and test image services								
Deploy services								
Maintain services								



## 2.8 FORMALIZE GOVERNANCE AND POLICIES

The development of policies, procedures, and standards will facilitate the smooth operation of the enterprise GIS and will facilitate the development, sharing and use of geospatial data. Authoritative developers/sources will need to be identified for particular data sets. The governance structure in the previous sections will need to be formalized in some way, whether it is via Charter, legislation or some other means. The policies, procedures and standards to be developed by the working group include, but are not limited to:

- 1. Metadata** – Metadata is critical to the understanding, correct usage and discoverability of geospatial information. The State GIS Working Group will work together to decide upon a standard metadata format to be used by all participants in the State GIS (most likely it will be either the federal Content Standard for Geospatial Digital Metadata (CSGDM) or some variant of the International Standards Organization (ISO) 19115:2003 Standard for Geographic Information – Metadata (e.g. the North American Profile of ISO 19115:2003). While both of these standards are endorsed by the Federal Geographic Data Committee (FGDC), there are advantages and disadvantages to each standard. The group should also develop templates, in consultation with the State Attorney General's office, for use by agencies to make it as simple as possible to create and maintain standardized metadata. There are numerous metadata editing tools and procedures in place at partner installations such as the Pacific Disaster Center that can be reviewed for use by the Hawaii State Enterprise GIS.
- 2. Data standards** – National accuracy standards exist for geospatial data, as do standards for the recommended formats and attributes of some types of geospatial information. These existing standards should be adopted whenever possible, however “good enough” data, or data that satisfies 80% of geospatial data users must be included in the State GIS database. The working group will have to define the consistent meaning of “good enough,” as well as identifying authoritative data sources and data custodians.
- 3. Standard spatial reference systems** – One or more standard spatial reference systems will need to be identified, including horizontal and vertical datums, coordinate systems and projection information.
- 4. Data sharing and exchange policies** – In order to be successful and reduce or even eliminate data stovepipes and redundant data sets, data sharing and exchange policies will need to be developed for State GIS participants and partners. The State Attorney General's office will be consulted when developing the policies and agreements. The Working Group will make use of existing resources and examples when developing the policies and agreements (e.g., the National States Geographic Information Council (NSGIS) has several examples of successful agreements available on their website).
- 5. Standard policies and procedures for data inclusion in the State database** - The current procedure used to add or update data in the State GIS database is to send the data to an analyst in OP, who then performs minimal QA/QC, creates or updates metadata, and uploads it both to the GIS fileserver and the State GIS website if applicable. Going forward, policies and procedures will be developed to 1) determine the authoritative data provider/custodian for each layer, (2) determine minimum requirements that must be met in order for a data layer to be included in the official State GIS database (e.g., compliant metadata, correct projection, topologically correct, attribute verification conducted), and (3) determine standard mechanisms to be used to add update/register data in the database.
- 6. Service Request Procedures/Error Reporting** - Procedures and mechanisms to document, track and process mapping, analysis and other requests to the PMO will be developed. The Office of Planning has developed a GIS Service Request Form that might be used as a model. In addition, hardware, software, network and data problem/error reporting and tracking procedures will be developed and implemented (in collaboration with other OIMT working groups as appropriate).
- 7. Data acquisition priorities** – A mechanism must be developed to identify data acquisition priorities for datasets that might require legislative funding or data acquisition partnerships.
- 8. Custom Application Development policies** – Both OIMT and the GIS Program should be consulted before departmental custom GIS application development to ensure compatibility with standard platforms and to prevent duplication of effort. It is recommended that application development should utilize open GIS standards and industry best practices. This facilitates application scalability; application maintenance and reuse; and information sharing or exchange.
- 9. Endorsement of an Address Standard** - Various agencies at all levels typically use their own, usually non-standard, way of storing street addresses. This creates problems when trying to geocode data for mapping and analysis. FGDC has created an addressing standard. The State GIS working group will evaluate this standard and others, including recent e-911work by the counties, and determine what actions or recommendations could be taken to help to standardize database address storage in State agencies, and across the State. This exceptionally challenging initiative will require collaboration with state, county and federal entities.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4
Metadata								
Data standards								
Standard spatial reference systems								
Data sharing and exchange policies								
Standard procedures for data registration, etc.								
Service Request procedures								
Data acquisition priorities								
Application Development policies/procedures								
Address standard								After FY14

## 2.9 ENTERPRISE LICENSE AGREEMENT(S) FOR GIS

The vast majority of GIS data and applications in Hawaii State government, as well as in county government, academia and the private sector have been built using Esri products. Esri is the world's GIS software leader and has been the State's de facto standard for geospatial data creation and analysis for more than 20 years. Execution of an Enterprise License Agreement (ELA) with Esri will deliver numerous benefits: lower unit cost of Esri software, fixed, predictable overall costs during the life of the agreement, more transparency in GIS costs, flexibility to deploy Esri software products when and where needed, streamlined procurement, availability of GIS to agencies that otherwise could not afford GIS and continuous support of the geospatial data and mapping requirements of administration initiatives. Note that an Esri ELA will NOT preclude agencies from using other GIS software solutions. (adapted from <http://www.imap.maryland.gov/portal/elaannouncement.asp>)

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4	FY14 Q1	FY14 Q2	FY14 Q3	FY14 Q4
Gather Agency Requirements								
Negotiate & Execute Contract								
Monitor and Renegotiate Contract as Necessary								

## 2.10 DEVELOP GIS ANALYST SERIES

In order to address the serious issues with recruitment, development and retention of GIS professionals within the State of Hawaii, the State GIS Program will work with the Department of Human Resource Development and other appropriate state agencies to create a GIS Analyst Series within the civil service system. This is an important step for the institutionalization and promotion of GIS throughout state offices. By recognizing the unique skill set and competencies of GIS professionals, a GIS Analyst Series will enable the State to attract and recruit individuals with those specific skills and training. The Working Group will seek advice and assistance with this project from NASCIO, NSGIC, RCUH, DHRD and the four counties.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+
Research Other Jurisdictions								
Develop PDs								
Submit and Obtain Approval								

## 2.11 TRAINING

The deployment of a redesigned State GIS will require training of new and existing users on the use of the new system. A training team composed of a combination of in-house staff and contract staff should be sent to each agency, including neighbor island offices to train and obtain feedback on the system. An initial training initiative should take place during the pilot project rollout in FY 13, and again when the full system is deployed.

Rapid advances in technology and geospatial information analysis and delivery will require employees to keep abreast of industry developments and emerging standards, and to upgrade their skills in order to remain current with their job requirements. One of the most consistently expressed needs of GIS users and practitioners in State government through the years has been a need for training. A training plan will be developed that will likely include a combination of self-directed online training, webinars and classroom training.

It is anticipated that some of the training will be included in the ELA mentioned above, and that some training will be developed in partnership with the HIGICC.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+
Develop & Conduct Training for Pilot Project								
Develop & Conduct Training for Full System								
Coordinate Training with Partners								
Conduct and Manage Training Program								

## 2.12 TECHNICAL SUPPORT FOR INFRASTRUCTURE, SOFTWARE, DATA

In order for the State GIS to be successful, there must be high system availability and knowledgeable, responsive technical support for the related hardware, software and data. Service Level Agreements should be developed and implemented with requirements and expectations clearly documented and the resources required to meet those requirements and expectations made available (e.g., staffing, incident logs, FAQ's, etc.). The working group will determine which platforms/software/technologies will require technical support, and what type of technical support is required. Procedures, including escalation procedures will be documented, implemented and tracked. It is noted that given the existing uses of GIS technology in the State, technical support need only be provided during business hours at this time.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+
Requirements Analysis								
Determine Responsible Parties								
Identify Required Resources								
Develop SLAs								
Implementation								

## 2.13 VOLUNTEERED GEOGRAPHIC INFORMATION (VGI) AND CROWD-SOURCING

There has been a great deal of interest in using social media to solicit public input to government functions. For example, the City and County of Honolulu has a mobile app with which a citizen can snap a picture of an object requiring City attention (e.g., a broken street light), geo-enable the picture using their smart phone, and send that geographically referenced photo to the City call center to have a repair work order generated. There are any number of similar applications that the State might implement, such as reporting highway potholes or vandalism. Before undertaking such a project, the State would have to determine what the guaranteed response time would be, how work order routing took place, etc.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+
Identify Pilot Project(s)								
Identify corresponding back-office requirements								
Coordinate with affected agencies								
Implement Pilot(s)								
Extend methods/ procedures to other State functions								

## 2.14 MOBILE APPLICATIONS

Many workers in the field record information on paper and return to the office to enter the data into a computer. Mobile apps will save time and improve accuracy in data collection. Live links or scheduled synchronization mechanisms will be developed to automatically transfer the data collected to a master database. Mobile applications will also be used to deliver information and services to the public, such as the locations of and routes to public buildings or the ability to report environmental violations.

Mobile GIS applications should be developed to assist with various state government activities, including those with a geospatial component, such as asset management, environmental sampling or field mapping. According to the IT research and advisory firm, Gartner,

“Mobile and wireless technologies must be a core component of every organization’s IT strategy. As these technologies mature, they will bring new consumer and business applications to more places and devices.”

(<http://www.gartner.com/technology/core/products/research/topics/mobileWireless.jsp>)

Mobile technology in Hawaii state government will require an enterprise approach with local (i.e., agency or program) implementation. The OIMT role will be to establish policies and standards, while the departments are best suited to determine actual application requirements. OIMT will develop standards and best practices, create a price or vendor list for approved field units, and create and maintain a “mobile app store” to be used by State agencies. Application functionality though, will be determined by the individual agencies. For example, field workers in one functional area may need real-time data access, with field data entered on a small device such as a smart phone. Workers in another area may collect large amounts of data on ruggedized devices with large screens and pen or touch capability, to be synched with a master database upon return from the field. The primary role of the GIS Program in mobile application development will be to host and serve base geospatial data, and keep an inventory of geospatially-enabled mobile applications for possible use by other state agencies. Costs shown below are intended to represent investments in mobile technology required as an enterprise, not only for those applications having a geospatial component.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+
Develop Standards and Best Practices								
Create/Update Price/ Vendor list for approved field units								
Create and maintain mobile app store								



## 2.15 GIS TOOLS AND SERVICES

Commonly used GIS applications and functions, such as geocoding, file format conversion (e.g. shape to kml), coordinate/projection conversion, buffering, etc., will be developed and offered as consumable services for all State employees and/or the public.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+
Identify and Prioritize Tools								
Acquire or Develop and Implement Tools								

## 2.16 DATA ACQUISITIONS

As a general rule, data is the most costly component of a GIS, and includes data creation, acquisition, update and maintenance. Some data layers can be automatically created from location information stored in a table (e.g., latitude / longitude, GPS data), while other data can be digitized from scanned or hard-copy maps. Various remote sensing technologies are also used to capture information on the ground for use in a GIS (e.g., satellite and aerial imagery, radar imagery, etc.). Remotely sensed data, often collected at a resolution of 1 meter or less, typically costs in the hundreds of thousands of dollars each time it is collected.

The State GIS Program has a long history of coordination and funding participation in joint data development and acquisition projects in Hawaii on behalf of State agencies, including partnerships with USGS (digitization of Hawaii topographic maps), NRCS (acquisition of satellite imagery data), NOAA (development of impervious surface and landcover data), and various State agencies (development and maintenance of neighbor island parcel data). In addition, the program has helped

to fund data “uplift” projects in order to bring licensed data into the public domain. This has often been on an ad hoc basis, and has typically involved a combination of state and federal CZM funds. Cost sharing agreements can save time and money in data collection – for example, the counties and the State might all contribute to a remote sensing collection effort that involves bringing a plane to Hawaii, resulting in less cost than each county arranging and paying for a plane to collect data only for their area of interest.

There will be a variety of such opportunities in the coming years, such as an uplift and increased study area of imagery data being acquired by the NGA, update of landcover data, joint LiDAR data acquisitions, licensing of highly accurate and continually updated street data, and licensing of continually updated zip code data to name just a few.

In order to keep the information in the State GIS useful and current, investments must be made in data creation, acquisition and update, doing so with cost sharing agreements or data acquisition consortia whenever practicable.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+

## 2.17 COASTAL AND MARINE SPATIAL PLANNING APPLICATION

Coastal and marine spatial data is frequently required by state decision-makers. However, most decisions regarding uses and activities in marine areas are made on a case by case basis with information provided primarily by applicants to a permitting agency (e.g., conditional use permits, ocean leases, and special management area permits). Unlike with land based development and uses, our coastal and marine areas have not yet had the benefit of comprehensive spatial planning. Coastal and Marine Spatial Planning (CMSP) extends Hawaii’s long held tradition of land use planning and resource management into our coastal and marine areas to better determine how uses in these areas balance economic, cultural, and environmental issues, to ensure that our limited resources are available now and for future generations.

The Hawaii Marine Map (HMM) project will develop a web-based decision support tool that can be used by resource

managers, scientists, stakeholders, and the public to conduct spatial planning in Hawaii’s territorial sea (and surrounding waters). The HMM project will collect information on the spatial extent of human uses of the state’s marine resources that provide economic and socio-cultural benefits. In the near term, the resulting data sets will form the basis for informing siting decisions for energy projects in ways that minimize potential impacts to the marine ecosystem and human uses. Longer term, these data will be useful for other marine spatial planning processes and to establish a baseline for subsequent monitoring and evaluation research of management measures. At present, the data sets for relevant ecological, economic, social and cultural considerations are not available from a single source. This makes it difficult for decision-makers and community groups to access, visualize and conduct potential impact and use conflict analyses in a meaningful and expedited way. The HMM project will develop an online system that compiles the relevant data sets and creates tools allowing users to visualize and analyze that data for various sites and uses.

Estimated Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Equipment / Hardware	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Software	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
<b>Total</b>	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Anticipated Project Timeline								
Task	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20+
Develop Requirements								
Develop RFP								
Hire Consultant								
Develop/Acquire necessary data								
Application Development								
Testing								
Deploy Application								
Maintain Application								
Enhance Application								



# **3.0 10-YEAR TIMELINE AND COSTS**

### 3.0 10-YEAR TIMELINE AND COSTS

Staff Costs	FY13	FY14-15	FY16-17	FY18-19	FY20+
Personnel	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Projects	FY13	FY14-15	FY16-17	FY18-19	FY20+
State GIS Strategic Plan	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Data Inventory / Geospatial Asset Discovery	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Conversion to Relational Geodatabase / Cloud Storage and Distribution	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Creation / Conversion of Metadata	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Development of "Geoplatform," including Development of Data and Map Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Extension/Completion of Geospatial Platform Implementation	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Development of State GIS Web Map, Image and Feature Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Formalize Governance and Policies	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Enterprise License Agreement(s) for GIS	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Develop GIS Analyst Series	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Training	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Technical Support for Infrastructure, Software, Data	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Volunteered Geographic Information (VGI) and Crowd-sourcing	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Mobile Applications	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
GIS Tools and Services	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Data Acquisitions	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review
Coastal and Marine Spatial Planning Application	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review

Overall Total	FY13	FY14-15	FY16-17	FY18-19	FY20+
Overall Total	Pending Review	Pending Review	Pending Review	Pending Review	Pending Review