

Vermont's Geographic Information System

Moving GIS into the Enterprise

White Paper

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1. Introduction

1.1. Abstract: Geographic Information Systems (GIS) have had a prominent role in Vermont for over a decade. The Vermont General Assembly initiated the creation of Vermont's Geographic Information System (VGIS) in the early 1990s when it established the Vermont Center for Geographic Information (VCGI). VCGI and Vermont's GIS community have been recognized as leaders in technological cooperation among states using geographic information technologies (GIT). In recent years we have seen GIS become an indispensable part of state, regional, and local government in Vermont.

Advancements in GIS technology now make it possible to establish what was originally envisioned when the General Assembly created the VGIS; an *enterprise* GIS that enables GIS data sharing and provides geo-spatial services to state government. Over the past two years VCGI has invested in these new technologies, thereby creating the foundation for a statewide enterprise GIS. This white paper articulates a vision for the future of Vermont's Geographic Information System.

2. VGIS – Where we are today

2.1. VGIS – Brief History: The General Assembly first authorized statewide geographic information activities in 1988 through the state's Growth Management Act, and has provided GIS direction in actions taken since then. It subsequently created VCGI in 1992. Act 204 of 1994 reauthorized and established VCGI as a public, not-for-profit corporation and a "body corporate and politic, and a public instrumentality of the state," establishing public purposes. VCGI is charged by statute (10 VSA 122) with developing and implementing a *comprehensive strategy* for the development and use of a Vermont Geographic Information System (VGIS). To meet this charge, VCGI has establish VGIS policies which promote coordination and collaboration among state agencies, as well as standards "to ensure that all data gathered by state agencies that is relevant to the VGIS shall be in a form that is compatible with, useful to, and shared".¹ VCGI's mission is to provide central data warehousing, dissemination, products and services for state agencies, Regional Planning Commissions (RPCs) and local government.

2.2. Current VGIS Architecture: The VGIS has come a long way in the past decade. Ten years ago there were only a few dozen GIS users in Vermont, using floppy disks and 8mm tapes to share data. Now there are hundreds of users. The advent of the Internet age in the late 1990s transformed the way users access geo-spatial information. In 1997

¹ 10 VSA 121 - 1994

VCGI released its first website, enabling users to search, review, and download VGIS data layers. This was the first step in a series of steps which propelled the VGIS into what it is today.

Over the past two years VCGI has invested in new technologies, providing the foundation for a statewide enterprise GIS system. The VGIS consists of several components, including a centralized GIS data server (MS SQL Server² & ArcSDE³), cataloging database (index of VGIS data layers), metadata, web map services (WMS), and an online portal (<http://www.vcgi.org/dataaware>). The VGIS Data Warehouse has also been designed to support distributed servers (“linked servers”). The Agency of Natural Resources has already established a *linked server*.

The majority of users access data from the online portal (<http://www.vcgi.org/dataaware>). The online portal (VGIS Data Warehouse) provides one-stop-access for VGIS datasets. Search tools allow the users to find what they need. Users can view metadata and download pre-bundled data. A *Custom Download* tool also allows users to view and interact with the data (zoom in/out), then “clip & zip” the data to their particular area of interest.

VCGI has also created VGIS web map services (WMS). VGIS web map services consist of dynamic and customizable maps that are published over the Internet. A particular web map service may contain a single GIS dataset (e.g. imagery, roads or land use) or a collection of several GIS datasets depending upon the user’s priorities. Map services allow users of GIS software to access GIS data directly over the web, just like any other local dataset on their hard drive. This makes the sharing of GIS data easier and much more flexible. It is also possible to develop web-based applications which utilize these services. VCGI already hosts a number of web map services and applications, including those which support Vermont Emergency Management activities.

2.3. VGIS Management: The VGIS is administered by VCGI, but is supported by organizations throughout the state who create, maintain, and provide GIS data. Certain data layers are maintained by VCGI (e.g.: town boundaries, hydrography, etc.), others are maintained by state agencies such as VTrans, ANR, and E911. Participating agencies continually provide new/updated data to VCGI for inclusion into the central VGIS Data Warehouse.

² “MS SQL Server” is Microsoft’s RDBMS software package. <http://www.microsoft.com>

³ “ArcSDE”, or Spatial Database Engine, is a product produced by Environmental Systems Research Institute (ESRI). This product is an API (Application Programming Interface) which enables spatial data to be stored in a RDBMS system. <http://www.esri.com>

3. VGIS – Moving Toward an Enterprise Architecture

3.1. Goals:

- Establish the VGIS Data Warehouse (data server) as the primary geo-spatial data server for all state agency GIS applications. Enable support for distributed servers.
- Expand VGIS web map services to support state geospatial data access for all agencies as well as the public.
- Scale-up VCGI's existing server architecture to support the full number of available users.
- Develop a communication/marketing plan to promote participation in the Enterprise VGIS System. Identify potential partners (particularly state agencies) who would benefit by being part of the Enterprise VGIS System (eg: VTrans, ANR, ACCD, VDH, AG, etc.).
- Negotiate an “enterprise licensing agreement” with ESRI covering agencies who are part of the VGIS Enterprise System.
- Provide sufficient bandwidth to support state agency users making direct connections to the data server.
- Continue to establish data sharing/exchange, maintenance, and security protocols that assure the integrity of the VGIS Data Warehouse as the growth of the system warrants.
- Develop secure (password controlled) and non-secure (public) access to support privacy needs for different user bases.
- Provide single point access for state GIS data to meet the needs of Federal GIS initiatives such as National Map (USGS) and Homeland Security.

3.2. VGIS Data Warehouse: The VGIS Data Warehouse was built to meet the requirements articulated in “*VGIS Data Warehouse – Backend Design*” document (October, 2002). The document was drafted with input from VTrans and ANR, and defines an implementation that is extensible and scalable. VCGI has been successful in its’ implementation of this new architecture, and envisions an expansion of this architecture to support an enterprise-level environment.

The VGIS Data Warehouse offers a foundation for the establishment of a primary geo-spatial data service for state agencies. There are currently several agencies maintaining their own redundant data repositories on agency and departmental file servers (data they’ve downloaded from the online VGIS portal at <http://www.vcgi.org/dataaware>). Until recently, limitations in GIS technology made this the only viable option. However, VCGI’s recent re-engineering of the VGIS system in accordance with

additional industry capabilities makes this unnecessary. Allowing agencies to connect to the central VGIS data server would help to reduce the production of redundant, inconsistent, and conflicting data layers by multiple state agencies. It would also help to assure all state agencies are working with the same VGIS data.

- 3.3. VGIS Web Map Services:** VGIS web map services (WMS) consist of dynamically created maps that are published over the Internet. These services build on over ten years of development of Vermont's Spatial Data Infrastructure (VSDI), thus leveraging an already significant investment. By providing access to GIS through a widely available medium (the Internet) in a standardized, platform-neutral programming environment (HTTP/XML), WMS is by far the most practical way for agencies to incorporate GIS into their applications. Since this approach doesn't require agencies to invest in additional software and data management, it is also the most cost-effective. These services will become a key component of an enterprise VGIS implementation.

VGIS web map services are described using a standard, formal XML notation, which provides all of the details necessary to interact with the service. VCGI is now offering access to every VGIS data layer using this approach. All kinds of sites, from simple web pages to more complex database-driven interactive applications can include geographic data from VGIS servers. There is no need to download data, or store redundant data on departmental or agency servers. The VGIS Web Services Application Programming Interface or API is based on open standards (Web Map Service Implementation Specification) developed by the Open GIS Consortium (OGC) <http://www.opengis.org/>, providing a vendor neutral service for state agencies. VCGI has been looking into implementation of the OGC Web Feature Service Implementation Specification (WFS). As noted, VGIS web map services allow a client to overlay map images for display from multiple Internet servers. In a similar fashion, the OGC Web Feature Service (WFS) allows a client to retrieve geospatial data encoded in OGC Geography Markup Language (GML) from multiple Web Feature Services. WFS also enables users to create, delete, or update GIS data over the Internet. VCGI is committed to the implementation of Open GIS standards.

- 3.4. VGIS Metadata Services:** The lack of data documentation, or metadata, often limits the value of data. Users are unable to determine whether a particular dataset meets their application requirements when metadata is missing. Metadata is a critical component of any enterprise IT environment.

VCGI recognized the importance of metadata over a decade ago when it drafted the VGIS Metadata Standard. This was well before any national or international standards existed. In the late 1990s the Federal government (Federal Geographic Data Committee – FGDC) establish a national geo-spatial metadata standard. VCGI has adopted and

migrated to this new standard, and will be migrating to the International Standards Organization's (ISO) geo-spatial metadata standard once it becomes available.

Every VGIS dataset has a complete FGDC compliant metadata record (<http://www.vcgi.org/metadata>). These records are available in HTML and XML format, and are also bundled with the geo-spatial dataset. The VGIS Data Warehouse is an NSDI Clearinghouse Node, making it part of our nation's National Spatial Data Infrastructure. The VGIS metadata services also provide access to metadata records via the ANSI/NISO⁴ Z39.50 search and retrieval specification. Z39.50 is a computer-to-computer communications protocol designed to support searching and retrieval of information in a distributed network environment.

3.5. Challenges: The State of Vermont is well positioned to fully integrate GIS into its' enterprise IT environment. The state's investment in VCGI and the VGIS has provided the state with a mature foundation for this next phase. However, challenges remain including:

- Reaffirmation of VGIS policies and standards among state agencies.
- Revision of VGIS policies and standards to reflect new enterprise architecture.
- Enhancement of VGIS infrastructure to support a large number of agency users.
- Migration of departmental and agency users to a central GIS service paradigm.
- Organizational cooperation and collaboration.

4. Recommendations and Conclusion

4.1. Recommendations: The migration to an enterprise VGIS should occur over a multi-year timeframe, allowing sufficient time to establish infrastructure and organizational elements necessary for success.

4.1.1. Year 1

- **Policy:** Integration of VGIS policies and standards into the Vermont Department of Information and Innovation protocols. The Vermont Department of Information and Innovation (DII) would support the role of VCGI and the VGIS in relation to state government operations. State agencies would be directed to follow VGIS standards, as was intended when the Legislature established VCGI and the VGIS.
- **Marketing Plan:** Develop a communications and marketing plan, which informs agencies and departments, and promotes participation in the

⁴ ANSI = American National Standards Institute. NISO = National Information Standards Organization
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establishment of the VGIS Enterprise System.

- **GIS Infrastructure:** Draft an *Enterprise VGIS* strategy document, which establishes a blueprint for moving the VGIS infrastructure into the enterprise environment.
- **Coordination:** Evaluate the establishment of a GIS Steering Committee that meets quarterly to address statewide GIS technology related issues within the state. The steering committee could be the VCGI Board and/or VCGI Technical Advisory Committee, or a new committee.

4.1.2. **Year 2** (To be determined after discussions with the Department of Information and Innovation representatives and other partners)

- **Policy:**
- **IT Infrastructure:**
- **Coordination:**

4.2. Conclusion: Over the last 10+ years VCGI has been developing, supporting and safeguarding the State of Vermont's investment in geo-spatial technologies. As Vermont moves to increase the coordination of the technological advancement of state government, it is entirely appropriate that VCGI be a part of that effort. VCGI's role as data expert, coordinator and educator in the GIS arena is recognized and respected by the community. To further support our statutory responsibilities we would like to propose a strong technological and administrative partnership between the new Department of Information and Innovation and VCGI that enhances the efforts of each organization.