

# **FEASIBILITY STUDY ON INTEGRATION OF OPEN SOURCE GIS WITH ALACHUA COUNTY'S PERMITTING MODULE**

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<b>1.0</b>	<b>Executive Summary.....</b>	<b>4</b>
<b>2.0</b>	<b>Background and Introductory Information.....</b>	<b>5</b>
<b>3.0</b>	<b>Current Geospatial Infrastructure.....</b>	<b>7</b>
<b>3.1</b>	<b><i>Spatial Database.....</i></b>	<b>8</b>
3.1.1	Technology and Status.....	8
3.1.2	Needs of Alachua County DGM.....	8
3.1.3	Analysis of the Spatial Database.....	9
3.1.4	Recommendation.....	10
<b>3.2</b>	<b><i>Web-based GIS Systems.....</i></b>	<b>11</b>
3.2.1	Technology and Status.....	11
3.2.2	Current Use Cases of Alachua County DGM.....	11
3.2.3	Analysis of the Web-based GIS.....	11
3.2.4	Recommendations.....	13
<b>3.3</b>	<b><i>Web-based Custom Geospatial Modules: GeoGM Mapper, GeoPT, and the Building Permit Tracker.....</i></b>	<b>14</b>
3.3.1	Technology and Status.....	14
3.3.2	Needs of Alachua County DGM.....	15
3.3.3	Analysis of the Web-based Geospatial Modules.....	16
3.3.4	Recommendation.....	17
<b>3.4</b>	<b><i>General Infrastructure.....</i></b>	<b>17</b>
<b>3.5</b>	<b><i>Comprehensive Recommendations.....</i></b>	<b>18</b>
<b>4.0</b>	<b>Alachua County DGM Current Permitting Module.....</b>	<b>20</b>
<b>4.1</b>	<b><i>Technology of the Permitting Module: What is CD-Plus? What are the Permitting and Other CD-Plus Modules?.....</i></b>	<b>20</b>
<b>4.2</b>	<b><i>CD-Plus User Stories and Workflows.....</i></b>	<b>23</b>
4.2.1	Overview of Failure to Support Workflows.....	23
4.2.2	CD-Plus Infrastructure and Alachua County DGM Workflow Diagrams.....	23
<b>4.3</b>	<b><i>Analysis.....</i></b>	<b>28</b>
4.3.1	Noted Usability Flaws in CD-Plus.....	29
4.3.2	Impact of Usability/Design Flaws on Alachua County DGM and its CD-Plus Users.....	30
4.3.3	Suggested Improvements to the Software and the Related Workflows.....	34
4.3.4	Components to be Potentially Integrated.....	35
4.3.5	Limitations on Improvement.....	37
<b>5.0</b>	<b>Geospatial Integration.....</b>	<b>41</b>
5.0.1	What is Geospatial Integration?.....	41
<b>5.1</b>	<b><i>Current Technology Capability for Geospatial Integration.....</i></b>	<b>42</b>
5.1.1	Future of the Technology.....	43
<b>5.2</b>	<b><i>Considerations for a New and Improved Permitting Module.....</i></b>	<b>43</b>

5.2.1	A Brief Introduction to Open Source Software.....	43
5.2.2	Advantages of Open Source Software.....	44
5.2.3	Choosing between Open Source and Proprietary Software.....	45
	Table 5.2. Proprietary Community Development Management Software Alternatives.....	45
5.2.4	How Does Good Software Development Happen?.....	51
<b>6.0</b>	<b>Possible Approaches in Moving Forward.....</b>	<b>54</b>
6.1	<i>Proposed Scopes of Work</i> .....	54
6.2	<i>Funding Sources</i> .....	56
	Table 6.2 Analysis of CD-Plus-Related Costs to Date.....	57
6.3	<i>Risks</i> .....	59
6.4	<i>Summary Total Cost of Ownership</i> .....	60
<b>7.0</b>	<b>Conclusion.....</b>	<b>61</b>
	Table 7.0 Comparison of Rights Granted by Licensing Agreements.....	64
	<b>Appendices.....</b>	<b>66</b>
	Appendix 1: <i>Proposed Scopes of Work identified in TOPP's feasibility study on integration of open source GIS with Alachua County DGM's Permitting module, The Open Planning Project</i> .....	66
	Appendix 2: <i>Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application, Alachua County DGM GIS Division</i> .....	66
	Appendix 3: <i>Building Division Permit System Bid Tabulation: September 2007, Jefferson County, Missouri</i> .....	66

## 1.0 Executive Summary

The complex operations of the Alachua County Department of Growth Management (Alachua County DGM) require the support of a robust information technology and GIS (Geographic Information Systems) infrastructure. Since its activities are centered around the proper governance of the physical space of Alachua County, nearly all the workflows of the Department of Growth Management have an inherent spatial component. Spatial integration in a technology infrastructure brings difficult technical challenges; however it is critical to the success of Alachua County DGM. The GIS Division of Alachua County DGM has recognized this, and is pursuing strategies to help achieve better spatial integration within all of its systems.

Recently, the GIS Division has become interested in better spatially enabling the Permitting module used to create, issue, and track building permits throughout Alachua County and, more broadly, with moving to a more open source software ecology. The GIS Division asked The Open Planning Project (TOPP), a technology organization with both a geospatial and an open source background, to help evaluate the current needs and technologies of Alachua County DGM, and give its recommendations for moving forward. After completing a comprehensive investigation, this report is a summation of TOPP's assessment of the current operations and infrastructure, and its analysis and recommendations for the future.

### **GIS infrastructure**

TOPP's evaluation concludes that it is quite possible to replace much of Alachua County DGM's existing GIS server infrastructure with open source equivalents. Indeed, nearly all functionality currently used by the GIS Division is available and well supported in equivalent open source GIS packages.

Since most leading open source GIS software is compatible with proprietary GIS solutions, TOPP recommends an iterative series of moves towards an open source ecology: Begin by replacing the outdated web-based GIS with a full-featured open source solution that capitalizes on the latest web-mapping advances; next, switch the database server's operating system to the more powerful 64-bit Linux; and finally transition the ArcSDE/Oracle spatial database to a viable and trusted open source alternative.

### **CD-Plus Permitting module and its potential for geospatial integration**

To properly evaluate the CD-Plus Permitting module and its potential for geospatial integration, TOPP studied the current Alachua County DGM workflows and processes around permitting. In the process, TOPP identified many potential areas for usability and functional improvement. Most every part of the permitting process has a geospatial aspect, which is currently accomplished in a very ad hoc manner. There are many disparate pieces to the overall system, and the users of the current software tend to work around its deficiencies, instead of having software that enables their workflows.

The CD-Plus software and its Permitting module are poorly-built applications whose design fails to meet or adhere to standard software design best practices that help ensure a program's

stability and flexibility. As a direct consequence, the software is blighted with routine system problems and functional errors that the CD-Plus users have endured over the seven years of its deployment. Compounding this are the circumstances surrounding the vendor lock-in with Perconti Data Systems, Inc. (Perconti Data Systems), which has habitually failed to provide the adequate service, repairs, and documentation needed to keep the software truly supporting Alachua County DGM operations.

To secure the long-term stability of the Department, TOPP recommends that Alachua County DGM pursue an open source alternative to the CD-Plus Permitting module. This will avoid vendor lock-in and bring feature-rich, well-designed, expandable software built with and through input from staff and other stakeholders. The new software will reflect departmental workflow requirements by providing for the Permitting and other processes' geospatial needs. More generally, it will remove a failing system over which the Department had little or no control and instead bring about a solution that does exactly what its users want and need, and which can be improved in-house or through a partnership with the Department's choice of vendors.

Even with the upfront investment needed, it is a fiscally responsible decision for Alachua County DGM to initiate the development of an open source Permitting module to replace the CD-Plus Permitting and Inspections module, and one in the tradition of previous information technology infrastructure investments, which are all designed to meet the increasing and expanding demands for its services.

## 2.0 Background and Introductory Information

The Alachua County Department of Growth Management (Alachua County DGM) is responsible for long term Planning and Development Services within the unincorporated area of Alachua County, Florida. The Department has six Divisions: Building, Comprehensive Planning, Development Services, Housing Programs, Zoning, and, most relevant to this report, GIS.

Through these six Divisions the Department prepares, updates, and implements the Alachua County Comprehensive Plan; facilitates Economic Development; administers the County's Housing Programs; and ensures adherence to Building Codes and Development Regulations.<sup>1</sup> The GIS Division is a crosscutting team that supports technology infrastructure across Divisions while accomplishing its own set of goals.

The GIS Division operates in four areas:

- Geospatial decision support in various areas of urban and rural planning applications
- Asset and record management for land administration systems
- WebGIS application development and maintenance for Internet and Intranet
- Conception, design, and implementation of general E-Services

The GIS Division's main goal is to democratize Geographic Information Technology (GIT) as an open spatial enterprise, using geo-infrastructure as a framework for overall systems integration.

The main activities of the GIS Division:

- GIS and IT strategic planning and advanced technology research
- Pursuit and implementation of innovative research grants
- Technology management and systems design
- Project management and application development
- Data management and development, analysis, and map production<sup>2</sup>

The GIS Division has been striving to establish itself as a state of the art unit, while accomplishing its daily duties. To this end, the Division has conceived of, developed, and implemented ambitious and useful geospatial-services in support of County Department activities and of bringing information to the general public. Division initiatives have included several major GeoWeb applications built upon free/open source software (FOSS). The Division also carefully designs the constellation of Alachua County DGM sites to accommodate future growth of e-services, which has borne fruit over time as the number of offerings has scaled to 43+ e-services and fulfilled its objective as an "indispensable framework for the implementation of e-gov services."<sup>3</sup>

The Open Planning Project (TOPP) is a technology-driven non-profit organization based in New York City. TOPP's mission is to build technology that enhances government transparency and provides opportunities for citizens to actively transform their communities. To fulfill its mission, TOPP builds open decision systems and models in support of citizen participation in urban planning and initiated the GeoServer project in 2001 to provide a more open, interoperable infrastructure of geographic information. GeoServer connects from legacy databases to open standards to enable organizations to easily share their geospatial information for visualization and analysis, and its upcoming release is geared towards advancing collaborative mapping capabilities. Today, GeoServer is used in over 80 countries and in such large-scale deployments as MassGIS and Portland TriMet.<sup>4</sup> Under TOPP's careful stewardship, a vibrant open source community has grown over time and contributed more features, performance enhancements, and bug fixes than one company could ever achieve alone. TOPP continues to play a major role in guiding the project, with three of its employees serving on the Project Steering Committee in the PSC Chair and Co-Lead Developer roles.

In August 2007, TOPP visited the Alachua County Department of Growth Management in Gainesville to initiate a feasibility study on integration of open source GIS with the Permitting module used by the County. Through on-site discussions, interviews, observation of users, and oral narratives, TOPP learned about the current geospatial infrastructure, the current Permitting module, and staff responsibilities and department operations. Additionally, the GIS Division provided written and historical information and documentation of its systems, including reports,

maintenance agreements, contracts, descriptions and history of its systems, etc., all of which greatly helped to flesh out the full picture of current geospatial integration potential.

After the informative on-site visit, careful review of the documentation provided by the GIS Division, test-driving current software, investigating alternatives and their feasibility, and significant research, analysis, and discussion by a four-person team in the weeks following, TOPP will present in this report its findings and recommendations regarding:

- Alachua County DGM's current geospatial infrastructure
- The Permitting module of the CD-Plus software used by the County
- The feasibility of a geospatial upgrade to the Permitting module
  - ∇ Feasibility related to existing systems and their extensibility
  - ∇ Feasibility related to the magnitude of effort required to achieve any geospatial upgrade
- TOPP's assessment of the resources needed for full integration of the Permitting module with open source GIS

TOPP would like to thank the staff of Alachua County DGM for the kind hospitality they showed us during our visit and their generosity with their time, energy, and willingness to provide detailed insight into the day-to-day operations and systems of the County. It was truly a pleasure working with such a forward-thinking and dedicated Department.

### **3.0 Current Geospatial Infrastructure**

#### **Overview**

Since April 2007, Alachua County DGM, GIS Division has engaged in a major infrastructure consolidation of its GIS and land administration activities. It now hosts into a single server Oracle and ArcSDE, as well as the Oracle-backed CD-Plus database. Currently, the Division is the process of migrating all GIS Databases and Imagery to this more centralized database.

This evaluation of Alachua County DGM's current geospatial infrastructure looks at its three main components:

- The spatial database built on Oracle and ArcSDE
- The web-based GIS systems built on ArcIMS and MapAtlas
- The web-based geospatial modules developed in-house in PHP by Alachua County GIS including GeoGM Mapper, GeoPT, and the Building Permit Tracker

TOPP's evaluation concludes that it is quite possible to replace much of Alachua County DGM's existing GIS server infrastructure with open source equivalents. Indeed, nearly all functionality currently used by the GIS Division is available and well supported in equivalent open source GIS packages.

Since most leading open source GIS software is compatible with proprietary GIS solutions, TOPP recommends an iterative series of moves towards an open source ecology: Begin by replacing the outdated ArcIMS with a combination of GeoServer and OpenLayers; next, switch the database server's operating system from Windows Server 2003 to 64-bit Linux; and finally transition from ArcSDE/Oracle to PostGIS/PostgreSQL. This process can happen over any time frame the GIS Division chooses, ranging from several months to several years.

### **3.1 Spatial Database**

#### *3.1.1 Technology and Status*

In April, 2007 Mannion Geosystems, LLC performed several evaluations and ensuing tasks for Alachua County GIS to increase the capacity of the Division to meet the increasing and expanding demands for its services.

Primary actions taken to improve and integrate the information technology infrastructure:

- Installation of Oracle Database 10g (Oracle 10g), a relational database management system (RDBMS) and ESRI's Spatial Data Engine (ArcSDE), a database access engine to the spatial data, its associated attributes, and metadata stored within the RDBMS.
- Migration to Oracle 10g.
- Creation of a new spatial database ('geodatabase' in ESRI terms) built on ArcSDE technology backed by the Oracle 10g RDBMS.

At the time of TOPP's visit, the migration to the centralized geospatial database was waiting for a restructure of the core data models before migrating from shapefiles to the ArcSDE/Oracle infrastructure.

#### *3.1.2 Needs of Alachua County DGM*

There are currently 5-6 GIS layers that Alachua County DGM regularly edits. These layers are primarily focused around asset and records management for land administration systems including current land use and future land usage/development plans. Alachua County DGM draws upon an additional 40-50 layers from other sources for use in its mapping applications.

These data layers include:

- Census data
- Address points from the 911 Office
- Tax parcels from the Property Appraisers Office
- Schools and School Zones layers which they house for the district



- Surface waters including historic flood data from FEMA
- Conservation and Environmental Hazard layers
- Transportation layers including road data
- Community Landmarks

Additionally, there is also high quality oblique imagery from Pictometry (at 1 foot and at 1 meter). The oblique imagery is not being stored in the spatial database at present.

These data layers from sources external to Alachua County DGM are all stored as files. Most get updated in a fairly ad hoc manner from the various sources.

There was an attempt to use a more Service-Oriented Architecture (SOA) to orchestrate data updates, with the 911 Office exposing their ArcSDE instance to service requests for data from the DGM. When the GIS Division found that the SOA-like application was not up reliably, they reverted to just getting monthly updates to the data.

It should be noted that the open source geospatial world is working on 'geosynchronization'<sup>5</sup> to handle efficient updates in situations where the source is not always up reliably.

### *3.1.3 Analysis of the Spatial Database*

While the process of updating GIS information from diverse sources could be improved to automate its workflow and enable better quality/currency of data, the new core spatial database architecture is very solid and should be reliable for many years.

A downside to the current spatial database is that it is built fully on proprietary technology. As such, Alachua County DGM is required to pay ongoing license and maintenance fees of ~\$2,700 per year (\$1,700 to Oracle for Oracle 10g and \$1,000 to ESRI for ArcSDE) while it uses these technologies.

There is no functionality or feature that Alachua County DGM currently uses in its spatial database that cannot be met by equivalent open source software. An open source solution for spatial databases, such as PostGIS/PostgreSQL, would more than meet the technical and functional needs described above in 3.1.2 and allow for future expansion of offered services.

PostgreSQL is a powerful, open source relational database system with a proven architecture from 15 years of active development that has earned it a strong reputation for reliability, data integrity, and correctness. PostGIS adds support for geographic objects to a PostgreSQL database. In effect, PostGIS "spatially enables" the PostgreSQL server, allowing it to be used as a backend spatial database for GIS, much like ESRI's ArcSDE or Oracle's Spatial extension.<sup>6</sup>

A useful feature included in PostgreSQL is a framework that allows developers to define and create their own custom data types along with supporting functions and operators that define their behavior. As a result, a host of advanced data types have been created ranging from geometric and spatial primitives to network addresses, which can be optionally added to the system.

Extensibility in this manner is highly desirable. In a *Directions Magazine* article on 'The Spatial RDBMS in the Enterprise' from fall of 2002, Jason Weinberger, then Product Manager for MapInfo Developer Tools at the MapInfo Corporation, explains: "When selecting the spatial database that will best suit an enterprises needs, the operators are perhaps the biggest differentiator between products. The greater the number of operators available, the more ways one can manipulate the data." With the ability to create custom data types with supporting functions and operators, PostgreSQL puts control into the users' hands to allow them to accomplish their objectives. The article concludes that "in order to implement spatial capabilities on an enterprise wide scale, a spatially enabled RDBMS is a critical success factor. Look for products that will not only meet the needs of today, but also the needs of tomorrow. Products that leverage the database's core capabilities while adhering to open standards enable the enterprise to grow and meet present and future spatial needs."<sup>7</sup> With the high level of access and control provided by its open source nature, combined with intelligent, built-in frameworks that enable users to easily customize it to suite their needs, a PostGIS/PostgreSQL solution could be a forward-thinking choice for the GIS Division.

### 3.1.4 Recommendation

Since the transition to the new database system has not been completed, it could potentially be an opportune time to switch to an open source solution like PostGIS/PostgreSQL. However, this would only make sense if the CD-Plus database, which also depends on an Oracle component, was also migrated at the same, in order to fully remove any dependency on proprietary Oracle products.

Open source software would not have any fixed and required license fees associated with ongoing usage. To facilitate its operation, it is advisable to obtain some type of support contract for an open source spatial database system from an organization or consultant who is well versed in the nuances of the particular software employed. However, any support contract could be customized to the actual needs of Alachua County DGM and obtained through an open and competitive bidding process, as there is no vendor lock-in mandating who can provide support and no fixed fee requirements.

If it is not the case that the CD-Plus database will be migrated at the same time, then a transition to an open source spatial database solution can wait until a later date. The ArcSDE/Oracle spatial database infrastructure that the GIS Division has acquired is a structurally sound option that will be able to meet the growing needs of Alachua County DGM.

It should be noted for the future that there have been recent reports<sup>8</sup> about tentative plans for ESRI to provide ArcSDE support for PostgreSQL in ArcGIS 9.3, slated for release in Q1 or Q2 of

2008. The GIS Division can monitor future developments around this possibility and evaluate this option if and when this comes to fruition.

## **3.2 Web-based GIS Systems**

### *3.2.1 Technology and Status*

The current web-based GIS infrastructure employed by the GIS Division is based on a fairly outdated ArcIMS server that connects directly to the County's shapefiles. Unfortunately, this current ArcIMS-based system only presents information in a 'silo', as one must exclusively use the interfaces set up by the GIS Division, such as GeoGM and GeoPT, to interact with the data.

Additionally, the ArcIMS-based GIS renders maps in outmoded, 2-dimensional, portal-bound visualizations that can be confusing to understand and to navigate by non-experts.

In 2003, the GIS Division also utilized existing generic GIS software and a free extension to create in-house its MapAtlas, an internet application that serves as a County-wide searchable pdf atlas and offers ready-made pdf maps for viewing or download for each one-mile area defined by Section-Township-Range (STR) or by land grant. It serves the need for well-styled reference maps but does not allow for customization, representation of multiple layers, or control of the map's scale.

### *3.2.2 Current Use Cases of Alachua County DGM*

The current ArcIMS-based system is heavily employed through the GeoGM and GeoPT applications. Despite its limitations, it functions as the primary interface to geospatial data for many Alachua County DGM staff members and for the public.

With MapAtlas, for each STR, one can view and download ready-made standardized maps that contain parcels overlaid with Zoning, Future Land Use, Wetlands/Floodplains, Strategic Ecosystems, and 2 ft Topographic Contours layers or with Aerial Photographs. The Atlas is updated each month to reflect the latest parcels for the entire County, and the latest Future Land Use and Zoning for the unincorporated areas of Alachua County. It is used internally by the other five Divisions of Alachua County DGM, as well as by the Public Works, Environmental Protection Department, and Fire and Rescue Departments, all permit applicants, and citizens at large, with about 100 transactions per day and 300-400 unique users per month.

### *3.2.3 Analysis of the Web-based GIS*

The outmoded web-based GIS restricts the interactive potential and inhibits the performance quality of the geospatial services provided by the GIS Division for both internal and external users. These users can only access Alachua County data through the interfaces provided by the GIS Division in custom, targeted-use applications like GeoGM and GeoPT that have lackluster visual presentation and load times. By moving to a modern GIS option, the GIS Division could unlock tremendous potential for internal and external users to harness the 53+ layers of public

data available on the Alachua County DGM site for exciting visualizations, creative data combinations and analysis, and increased accessibility.

### **Future use cases and improvements enabled by a modern web-based GIS deployed by Alachua County DGM**

The first area that can be greatly improved is the general interface provided by ArcIMS. Web-based GIS has gone through a massive advancement, precipitated by the wonderful interactive interface of Google Maps. The standard for presenting mapping data on the web now involves the ability to drag the map about and zoom in and out at will. Replacing the current interface with something that facilitated information discovery and exploration—with a user zooming in, manipulating layers, and dragging the map until the eastern County border appeared on the horizon and he or she bumps up against Putnam County—would create a joyful and seamless user experience.

To enable this 'slippy'-ness of a map, a server will create 'tiles' that lead to faster performance from appropriate web applications, using whatever data is supplied. Overall, this should increase the efficiency of Alachua County DGM staff by decreasing the amount of time spent accessing maps as part of their daily workflow. Faster, more attractive, and easy to use maps will also arouse interest and excitement in the general public and bring higher visibility to the work done by the DGM and services offered by the GIS Division.

Another advantage to moving to a more modern web mapping solution is that it can allow users to overlay the County's data onto the new high quality mapping sources like Google Maps, Virtual Earth and virtual globes like Google Earth and NASA World Wind. Google Maps licensing terms are crafted to increase public access to spatial data. As long as the site using the provided data is available to all, the terms specify that even the County's own GIS maps can be overlaid on top of all the great Google data for free. The clarity of maps created using County GIS data on top of Google Maps-driven visualization would help replace the fixed pdfs of the Map Atlas with something created dynamically by the user.

Finally, the raw data behind the map can also be made available to the public in many formats (including standards-based formats). This opens up the possibility for others to use Alachua County data to make interesting visualizations that the County may not require directly or have the time and resources to produce. By liberating this geospatial information from the silo imparted by the current ArcIMS-based system, users are no longer constrained to use only those interfaces set up by the GIS Division.

In other Counties across the country, citizens have been making 'mash-ups' which combine public data in new ways and visualize it on map.<sup>9</sup> Making the County's raw data more available will encourage a democratization of mapping and analysis by others. This initiative, like many GIS Division efforts, would embody the prescriptions of the GIS Code of Ethics, particularly section *1.2 Contribute to the Community to the Extent Possible, Feasible, and Advisable*, which recommends making data and findings widely available and strive for broad citizen involvement in problem definition, data identification, analysis and decision-making.<sup>10</sup>

The GIS Division's geospatial services web portal recently began to include a Data Warehouse, which indicates that the Division is already thinking along these lines. A non-ArcIMS-based solution could help make the data more easily available in a broad range of standards-based formats.

### 3.2.4 Recommendations

There are many new proprietary and open source packages that could serve as a more modern web-based GIS for Alachua County DGM, with such features as standards-based data output and the ability to create tiles by default. Unfortunately, creating tiles just became a premium feature in ArcGIS Server, and this upgrade would require extensive licensing fees for the GIS Division.

GeoServer, using OpenLayers (its default front end), is one of many open source packages that can through tiling enable an interface whose quality rivals that of Google Maps, but made with one's own data. This interface will be more attractive and easy to use for the general public and for Alachua County DGM staff. Open source solutions like GeoServer also have excellent connectivity to Google Earth, so the public at large will be able to use it to visualize all the County's data. This will take no additional configuration past the initial setting up of the mapping portal.

Accordingly, TOPP recommends GeoServer used with OpenLayers as a robust open source alternative to replace the ArcIMS component in order to inexpensively meet and expand the web-bas GIS services offered by Alachua County DGM.

OpenLayers (<http://openlayers.org>) is a pure JavaScript library for displaying map data in most modern web browsers, with no server-side dependencies. OpenLayers implements a JavaScript API for building rich web-based geographic applications. As a web mapping front end, it is very close to Google Maps in functionality, but also enjoys the flexibility to connect to a number of backends through the open Web Map Server (WMS) standard. The WMS standard has implementations by a number of open source packages as well as ArcGIS Server and other proprietary GIS. OpenLayers can also connect directly to Google Maps, Virtual Earth, Yahoo! Maps, etc. With this capability, one can easily take advantage of the free imagery provided by these services and use it as a backdrop to one's own layers at no cost as long as the web site is public. This is one of the ways OpenLayers can help Alachua County DGM take advantage of a blend of public and private multiple data providers.

GeoServer is a mature open source project that has been in active development for over five years and has an international community of contributors. It is an implementation of the Web Map Service (WMS) specification and ships with OpenLayers as its default viewer. It provides one of the leading web mapping implementations, as well as additional abilities to serve data onto Google Earth and Google Maps, and to do online editing of feature data, and it will soon handle versioning and automatic validation of edits. GeoServer can communicate directly with ArcSDE, so there is no need to replace the existing backend and do a heavy migration. Instead, to get started with GeoServer, one simply needs to configure it and style the maps. The GIS Division will obtain significant immediate benefits by moving to GeoServer, and the value it

provides is constantly increasing. It is a full-featured server product which is quickly gaining many features not available at all in proprietary products, or only available as premium features at very high cost, through contributions from its large open source development community.

For Alachua County DGM, a focus on open standards is fundamental, as it protects against lock-in within any particular system. By utilizing open standards like WMS, a front end can be developed with OpenLayers and then switched to use an alternative backend. This is not the case with ArcIMS—the web tier and the map generation are inextricably linked, and so it is not possible to replace just one of these components. Similarly, with WMS, one can switch to any new front-end application without being forced to reconfigure all the back-end data layers. This provides more flexibility than ArcIMS, and again avoids any kind of lock-in to a particular product, which can be an issue even with open source software if it is a single, monolithic system. An example of an open source product that does not protect well against lock-in is MapGuide Open Source, a monolithic system that seems to be closely modeled on the ArcIMS architecture, with WMS included as an afterthought instead of being central to its internal communication.

In conclusion, a GeoServer with OpenLayers replacement for ArcIMS will fulfill the current use cases of Alachua County DGM and enable new ones like using Google Earth and Google maps as base layers for visualization of County data, opening data up to the public in a broad range of standard formats, and providing beautiful visualizations and user experience.

### **3.3 Web-based Custom Geospatial Modules: GeoGM Mapper, GeoPT, and the Building Permit Tracker**

#### *3.3.1 Technology and Status*

The GIS Division has developed web-based geospatial modules in PHP to help facilitate precise asset and record management for land administration systems and to enable geospatial decision support in various areas of urban and rural planning applications at Alachua County DGM.

These hard-won applications draw upon and unite geospatial layer data with tabular data generated by Alachua DGM and other County Departments during land use administration processes, including building permit application, re-zoning and zoning variances, and code enforcement and inspection activities.

The CD-Plus software, discussed at length below, is used by Alachua County DGM to track and control aspects of its building permitting and inspection and code enforcement processes. The design of CD-Plus *does not allow the software to include or even link to any geospatial technologies*, including ESRI GIS, Internet maps, or the newly acquired Pictometry aerial imagery.

Since geospatial inclusion into the CD-Plus software is impossible, the GIS Division has cleverly built in-house custom geospatial modules that access and utilize information stored in the

Oracle-backed dedicated CD-Plus database. These include the Geographic Permit Tracker (GeoPT), the GeoGM Mapper (GeoGM), and the Building Permit Tracker.

### 3.3.2 Needs of Alachua County DGM

Since the design of CD-Plus does not allow for the incorporation of or linking to geospatial technologies in software, this creates many additional steps in the workflow of users who need to visualize the locations of data stored in the CD-Plus database. For example, some Alachua County DGM staff are forced to turn to laminated paper maps or to open the MapAtlas application to view a pdf of a STR map simply to identify an inspection zone when issuing a permit.

The web-based geospatial modules that the GIS Division has developed as workarounds for this deficiency represent dedicated efforts to combat striking technical limitations with ingenuity and tenacity. These modules manage to extract enough particular information needed from the CD-Plus database to allow the Alachua County DGM staff to accomplish the organizational objectives around long-term Planning and Development Services. The three sets of modules that are discussed below all require access to the CD-Plus database and are therefore subject to the resultant technological constraints.

#### **GeoGM Mapper (GeoGM)**

GeoGM is an interactive web-based GIS that allows users to create a map online featuring any of the 53+ GIS layers provided by the County. The datasets are intended to inform both land planning professionals and those seeking general information about Alachua County. GeoGM is capable of using both the interface to the CD-Plus database and the interface to the Access database fed by the GIS Division's internal DMS interface at a parcel and STR level. As a result, at the parcel and STR level, it is able to display the full history of up to 28 years of actions on zoning, zoning variances, and building permits with all related agendas, staff reports and other collateral.

*Note: while originally limited to an ArcIMS Image Service, GeoGM recently appears to be undergoing some development that will allow users to connect live to these 53+ layers from their computers, via ArcGIS, ArcExplorer, ArcPAD or their web site. TOPP applauds these efforts.*

#### **Geographic Permit Tracker (GeoPT)**

GeoPT provides access to a dynamically-generated map with building permit, full land application and action history by parcel. GeoPT presents historic land use application data from each of the last 25 years all the way through real-time comments from today's geo-inspection reports from the inspectors and plan examiners.

### **Building Permit Tracker**

The overview section of 'About the Building Permits Tracker' explains:

The Permit Tracker consists of a suite of web based geospatial applications which support the operations of the building permits and the building inspections. In real time, they integrate the field activities of the inspectors, the office activities of staff, and the Automatic Telephone Request System into a single geospatial web framework.

The Building Permit Tracker also provides an important source of information to public, non-County parties. For example, builders, contractors, homeowners, and homebuyers can now monitor the entire process of construction, from start to finish, in real time from their homes or offices. They can view the results of plan examinations, schedule inspections, view inspection results, and identify staff assigned to their construction site. This not only de-mystifies the building permit regulatory process, but also improves the efficiency of the entire real estate development industry within Alachua County.

Finally, the Building Permit Tracker increases the transparency and accountability of Alachua County DGM by enabling anyone to create maps and download reports in Excel or plain text format for building activities, inspections, field entry results, and telephone messages for a specific area of the County for each of the last 25 years and for recent activity.

#### *3.3.3 Analysis of the Web-based Geospatial Modules*

The CD-Plus software is poorly documented and the license and maintenance agreement with Perconti Data Systems, the proprietary creator of CD-Plus, does not make mention of the CD-Plus database, its design, its upgrades, Oracle upgrades, or the relationship between CD-Plus and Oracle. Nor was the GIS Division ever given any charts or diagrams of the software's database tables, of how the tables interrelate, of its data dictionaries, etc.

All this leads to GIS Division staff spending time and resources on the demoralizing task of experimentally reverse engineering the CD-Plus software:

- GIS staff must try almost randomly to intuit ways to pull information out of the CD-Plus database, whose design is composed of several tables and is entirely dependant on and dictated by the design of the CD-Plus front end.
- The lack of database documentation and the poor design of the database schema turns commonplace maintenance chores like server migration into nightmarish conditions of grasping in the dark for the GIS Division staff and consulting partners.
- While working in close collaboration with building inspectors, code officers, front counter personnel, the Building Official, the Zoning Codes Supervisor, the Department Programs Analyst, local builders contractors and the Builders Association to build the suite of web-based geospatial applications that comprise the Building Permit Tracker, the



GIS Division drew upon the input and support of these stakeholders to reverse engineer the functionalities and requirements of CD-Plus, in creating use cases and workflow diagrams on its user requirements, on its business flows, on its intelligence of functionality and on how they relate to Florida Statutes to compensate for an utter lack of documentation of the CD-Plus software. Active user involvement continued from conception until the final implementation.<sup>11</sup>

The GIS Division staff has gone above and beyond to create multi-faceted suites of web-based modules, with as much geospatial integration as possible given current technological constraints, to serve the needs of both Alachua DGM staff and the community of construction professionals, home owners, and the general public. The CD-Plus software and its database design limit the geospatial integration possibilities such that one can only pull out data previously inputted to the application and associate it with Alachua County spatial data in external applications. Information retrieval and association in external applications is all that is possible because the collected data is not geo-coded or displayed visually on maps by the CD-Plus application, nor does CD-Plus allow the inclusion of or linking to geospatial technologies.

#### 3.3.4 Recommendation

The GIS Division has already taken full advantage of the current potential when providing geospatial visualization and analysis of the building permit and building inspection data tracked in CD-Plus. Unless steps are taken to reverse the corrupting impact the CD-Plus application has had on the data collected and the means of accessing it, further geospatial integration is not viable.

### 3.4 General Infrastructure

A final infrastructure piece worth noting regards section 5.1.5 of the report by Manion Geosystems, which points out that the server running Oracle Database 10g and ArcSDE is a 64-bit system, but the operating system currently installed does not take advantage of the 64-bit architecture.

There were indeed consequences to the 32-bit limitation of the installed Windows Server 2003.

- Manion Geosystems had to install a 32-bit version of Oracle instead of the more powerful 64-bit version.
- The pain involved in configuring 32-bit Windows to take advantage of more than 2 of the 4 gigabytes of memory installed on the machine was documented in section 1.4.1 of Manion's same report.

These factors led Manion Geosystems to recommend a reinstall of a 64-bit operating system on the next upgrade to this server. Their report does point out, though, that ArcSDE is not currently certified to run on 64-bit Windows systems.

To take full advantage of the hardware capabilities available, it may be advisable to switch to open source operating system. ArcSDE is certified to run on 64-bit Linux systems, as is Oracle 10g. There is a potential for cost savings by switching operating systems, because this would avoid licensing costs associated with upgrading to the 64-bit version of Windows Server 2003. GeoServer and PostGIS are also able to take advantage of a 64-bit operating system, so such a move will also be compatible with the open source geospatial solutions under consideration.

### 3.5 Comprehensive Recommendations

#### Overview

Since nearly all functionality currently used by the GIS Division is available and well supported in equivalent open source GIS packages, Alachua County DGM's existing GIS server infrastructure can be replaced with open source equivalents.

TOPP recommends a iterative approach with three main steps: begin by replacing the outdated ArcIMS with a combination of GeoServer and OpenLayers; next, switch the database server's operating system from Windows Server 2003 to 64-bit Linux; and finally transition from ArcSDE/Oracle to PostGIS/PostgreSQL.

Since the recommended open source GIS software is compatible with proprietary GIS solutions, the phases can take place over any time frame the GIS Division prefers, from several months to several years.

#### Recommendations

The evaluation found no functional areas where existing geospatial solutions used by Alachua County DGM cannot be replaced by open source equivalents. ArcSDE has some advanced features that open source alternatives do not currently match, including the versioning of features and joins across data formats, but the GIS Division is not currently making use of any of these features.

As a result, a feasible long-term goal for the GIS Division can be complete replacement of the proprietary ESRI and Oracle stack with open source software. The current maintenance fees (roughly \$3000 a year) can be reallocated to consulting services for customized open source solutions, open source training, or customized improvements to the open source packages with great benefit to Alachua County DGM. Note that at the present time TOPP only recommends replacing the server side stack (ArcIMS, ArcSDE (now part of ArcGIS Server as of ArcGIS 9.2), Oracle), as the desktop GIS story in the open source world is not as strong.

While it is good to keep in mind this long-term goal of a full open source server side software stack and to have determined that it indeed seems feasible, TOPP's recommendation for the GIS Division is to take a more piecemeal approach in moving from proprietary applications to open source alternatives. This can be understood as replacing the individual planks on a sailing ship to eventually achieve a fully rebuilt vessel. The open source geospatial software stack easily communicates with existing proprietary software, and replacing one piece at a time reduces risk while demonstrating a clear success and cost savings at each step. Additionally, as the GIS

Division only recently underwent a full migration of data to ArcSDE/Oracle, there is no need to rush into another round of migration at this time. It would be better for the GIS Division to spend some time implementing new workflows that leverage the advantages gained in moving to ArcSDE/Oracle.

When initiating the first step in a series of planned infrastructure improvements, TOPP recommends beginning with something that gets Alachua County staff and citizens excited; striking, visible changes at the beginning would help pave the way for a long series of improvements. The smartest approach in this case would be to gain user goodwill and buy-in through dramatic usability improvements in the most visible part of the GIS infrastructure. The open source replacements for this layer in the stack are very mature, reliable and feature-rich, and their visibility to users will help to validate this first move in their eyes.

In contrast, the biggest measure of success when replacing a back-end component is for no one to even notice, to transition so smoothly that it sparks absolutely no complaints. This is quite difficult to achieve, and when there are the inevitable hiccups, users feel only the pain unmitigated by any new benefits. If one instead improves part of the front end, users will observe the noticeably better functionality and value it as a 'big upgrade'. In this case, a few bumps along the way as part of the 'big upgrade' will be acceptable and forgivable, since people understand that there can be growing pains when switching to a new and improved service.

### **Phase One**

For Alachua County DGM, the most visible part of the GIS infrastructure is conveniently ripe for an upgrade. This is the outmoded ArcIMS component, which TOPP recommends replacing with a combination of GeoServer and OpenLayers. The GIS Division can harness this pair to create compelling web-based geospatial applications that have powerful user interaction capabilities on both the visual representation of the map (zooming, scrolling, etc.) and the data that drives it (live editing of data through the web with transactional changes to the backend database).

The GeoServer with OpenLayers solution provides easy tile creation, performance enhancements and connectivity to Google Earth and Google Maps. Its superior front end will make more attractive, usable mapping interfaces that will complement and highlight the work of the Department. And with GeoServer's easy 'standards by default' approach, Alachua County data configured just once will then be available for output in a host of standards-based formats.

The GeoGM and GeoPT modules, currently ArcIMS applications, could be migrated to the new GeoServer and OpenLayers solution and would also benefit from all of the new functionality it brings.

### **Phase Two**

After ArcIMS has been replaced, the next step recommended is to transition the database server to 64-bit Linux. A Linux server will still be able to run ArcSDE and Oracle 10g, but the switch will reduce the total cost of ownership of that box by removing the Windows dependency and take advantage of the 64-bit system in a way that the current Windows Server 2003 operating

system does not. We recommend Ubuntu Server Edition for its ease of use, though SUSE or RedHat could work as well, and ArcSDE is 'certified' to work on each of these distributions.

### **Phase Three**

The final piece to replace will be ArcSDE and Oracle. These are two very expensive proprietary software solutions that have a clear open source competitor in PostGIS and PostgreSQL. Many high profile companies and organizations, including GlobeXplorer (serving terabytes of imagery to over one million requests a day), the EU Joint Research Center, and InfoTerra have successfully implemented solutions with PostGIS/ PostgreSQL. It is easier to maintain than Oracle, as a capable technology staff member can figure out the basics through investigation and reading documentation, instead of attending a multi-day training simply to learn how start, let alone tune, it successfully.

A more thorough study should be done to investigate and confirm that each and every piece of functionality used by the Alachua County DGM can indeed be replaced with PostGIS prior to a migration. TOPP's initial assessment does point in this direction, as advanced features in ArcSDE like versioning are not utilized now. It should also be noted that versioning features will soon be available in GeoServer, so it will be possible for the GIS Division to implement versioning using an open source solution regardless of PostGIS support for it.

A phased approach will gain user satisfaction and buy-in, allow time for capitalizing on previous investments, and lead Alachua County DGM toward an eventual fully open source infrastructure.

## **4.0 Alachua County DGM Current Permitting Module**

### **4.1 Technology of the Permitting Module: What is CD-Plus? What are the Permitting and Other CD-Plus Modules?**

According to the CD-Plus Headquarters website:

CD-Plus is a complete community development management product that is customized for you [sic] jurisdiction. Whether you are a small town or a booming metropolis, CD-Plus can handle the administration of a large network and provide fast access to your data without the overhead of a full-time administrator. Our table driven structure and quality hands-on training provides easy administration by users so that they can do there [sic] work without being bogged down by system administration.

The site goes on to describe the integrated features as:

- Telephone request interface
- Complete document/image management system
- Third party GIS, finance, and document imaging interfaces
- Customizable help file with your policies and procedures
- Internet interface
- Print to paper/fax/email right within CD-Plus
- MobileHWY interface
- Crystal Reports

*(note: the GIS Division has found that not all of these features exist or are viable)*

Technically, the CD-Plus software is designed as a desktop application, requiring a one-time installation on each computer that its users will employ. It appears to be written in C++, but there is no documentation available to confirm this. C++ code written by developers must then be compiled into low-level machine code that will run the end users' software. The final software cannot be updated or reverse engineered by the end users; unless it is distributed with the compiled application, the source code is only accessible to the original developers. In essence, the developers have the only set of keys to the software. In this case, Perconti Data Systems holds the keys to the CD-Plus software, and they have never given a copy to Alachua County DGM.<sup>12</sup>

The CD-Plus front-end sits on top of the CD-Plus database that is backed by an Oracle client. Both are installed and configured as part of the CD-Plus front end's installation process.

CD-Plus is also 'limited users' licensed software, meaning that the number of users with access to its database and its operations is restricted to the number of licenses that Alachua County DGM has purchased.

### **Permitting and Inspections**

This module of the CD-Plus software is intended to track and control permits from application, to plan review, to issuance, to inspection, to Certificate of Occupancy or completion.

Perconti claims that features include:

- Automated value calculation
- Standard inspections
- Full contractor licensing submodule for contractor verification and renewal
- An optional touch-tone inspection processing system *(purchased by Alachua County DGM)*
- Standard reviews
- Fee computations

As we will see, the software does not provide the promised result of “assist[ing] the technicians in accurate and complete permit processing.”<sup>13</sup>

### **Other Modules**

The original CD-Plus rollout, based on a contract with Perconti Data Systems enacted in May 1999, included the Permitting and Inspections module and the Code Enforcement module, which controls and tracks complaints, cases, citations and violations. The County also elected to incorporate the Automatic Inspection Request System (AIRS), a telephone automation system for requesting inspections, which is linked with the different CD-Plus modules via the Telephone Request Interface.

In 2002, the County paid for a second round of CD-Plus software that included the Development Review module, which “automates the process [f]or reviewing development applications,” and the Growth Management module, which “tracks infrastructure usage and approves adequate facilities requirements for each project.” According to the CD-Plus Headquarters website, the two modules are intended to be used in conjunction to track and control specific land use allocations at the property level and the resources allocated or vested versus those actually used.

These would likely be valuable services for Alachua County DGM. However, as discussed in a Summer 2007 memo regarding CD-Plus phase-out written by Juna Goda Papajorgji<sup>14</sup>, it seems that the County has never used the Development Review module and, what is more troubling, that the Growth Management module does not appear to even be installed. The purpose of this memo is to describe the work completed by the GIS Division to accommodate five groups of CD-Plus users with web-based, geospatially-enabled, in-house built modules and details ongoing efforts by the GIS Division to expand the in-house modules to support the activities of the Code Enforcement officers, leaving only the ‘Permitting’ portion of the Permitting and Inspections module and a tiny subset of the Code Enforcement module with CD-Plus-dependent users.

These new modules were necessary to fully accomplish the functionalities that CD-Plus fails to handle adequately. In addition, they offer many new features and functionalities and have unlicensed, unlimited access. Such features include live and integrated connection to GIS for live access to scheduled inspections, live tracking of inspection results, and permit activities and history for each of the last 25 years, all fully integrated with the Telephone Request Interface and all fully documented for user support. These new features will greatly assist with the day-to-day work of Alachua DGM staff, more fully than CD-Plus.

The GIS Division plans to leverage gains from its ongoing SDE implementations to enhance these new modules with additional functionalities, and over time to re-architect and re-engineer their design to be more efficient and robust.

## 4.2 CD-Plus User Stories and Workflows

### Overview

To properly evaluate the Permitting module and its potential geospatial integration, The Open Planning Project team studied the current workflows and processes around permitting. In the process TOPP identified many potential areas for improvement. Most every part of the permitting process has a geospatial aspect that is presently accomplished in a very ad hoc manner. There are many disparate pieces to the system, and the users of the current software tend to work around its deficiencies, instead of having software that enables their processes.

#### 4.2.1 Overview of Failure to Support Workflows

The CD-Plus software is counterintuitive to the business workflows of issuing permits, scheduling inspections, and reporting violations. Alachua County DGM staff adapt by creating their own workaround workflow—for example, issuing a permit before collecting payment in order to minimize trips to the printer. The software should be harnessed to create more structured protocols with a clear order of operations, guided by a checklist or outline inside the application, to support consistent workflows.

Further, TOPP's evaluation found that most steps in the permit tracking process have some sort of geospatial component: searching by proper address to call up a record associated with it; assigning the permit application to the proper zone; distributing daily assignments among the inspectors. The current system, however, is at the limit of its geospatial integration potential. This means that Alachua County DGM clerks must laboriously switch between separate applications, custom-built based on reverse engineering the CD-Plus database to complete their responsibilities. The team has done a commendable job cobbling together solutions, but further geospatial integration is not possible without fundamental changes to the CD-Plus software.

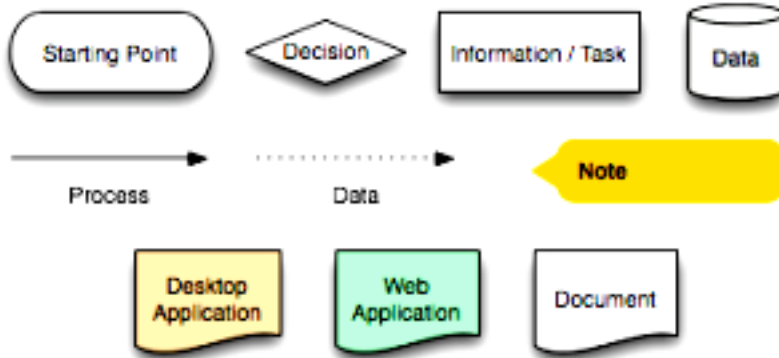
Although resulting user frustration with CD-Plus has been evident for some time, and further evidenced by the fact that two purchased modules were never adopted at all, no significant attempt was ever made over the years to improve and adjust these modules to fit the needs of their users. Instead, the counterintuitive, laborious process continues to lead to significant operational disruption.

For example, there is an internal breakdown in the permit tracking process as the permit is passed around for review by the necessary Divisions and by other Departments. The software does not track who is currently reviewing a building permit in the office or in another location like the Fire Marshall's office. Permits that leave the office are particularly prone to being forgotten, leading Alachua County DGM to drop the ball on its customers.

#### 4.2.2 CD-Plus Infrastructure and Alachua County DGM Workflow Diagrams

## Key

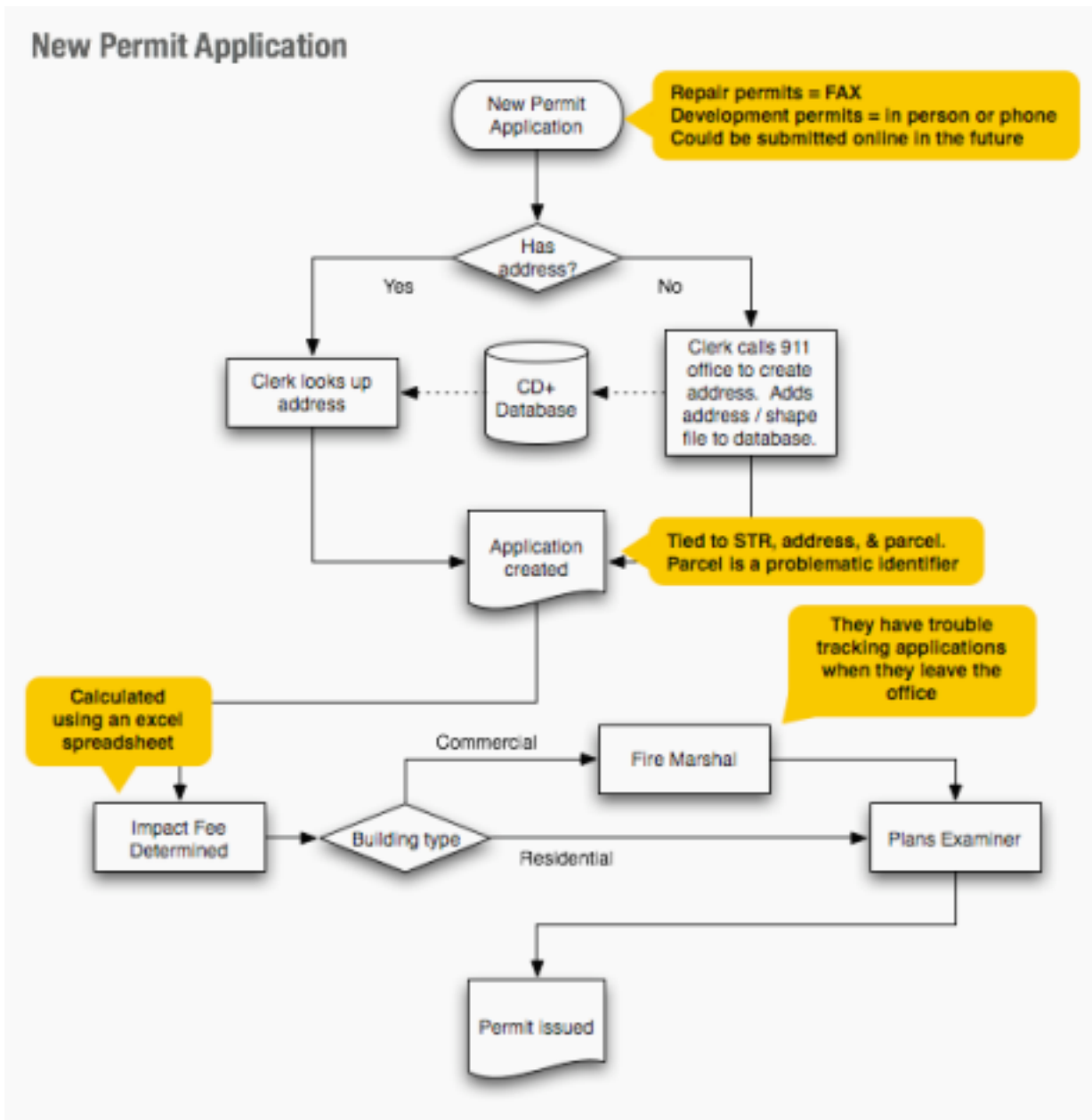
Symbols used throughout this document



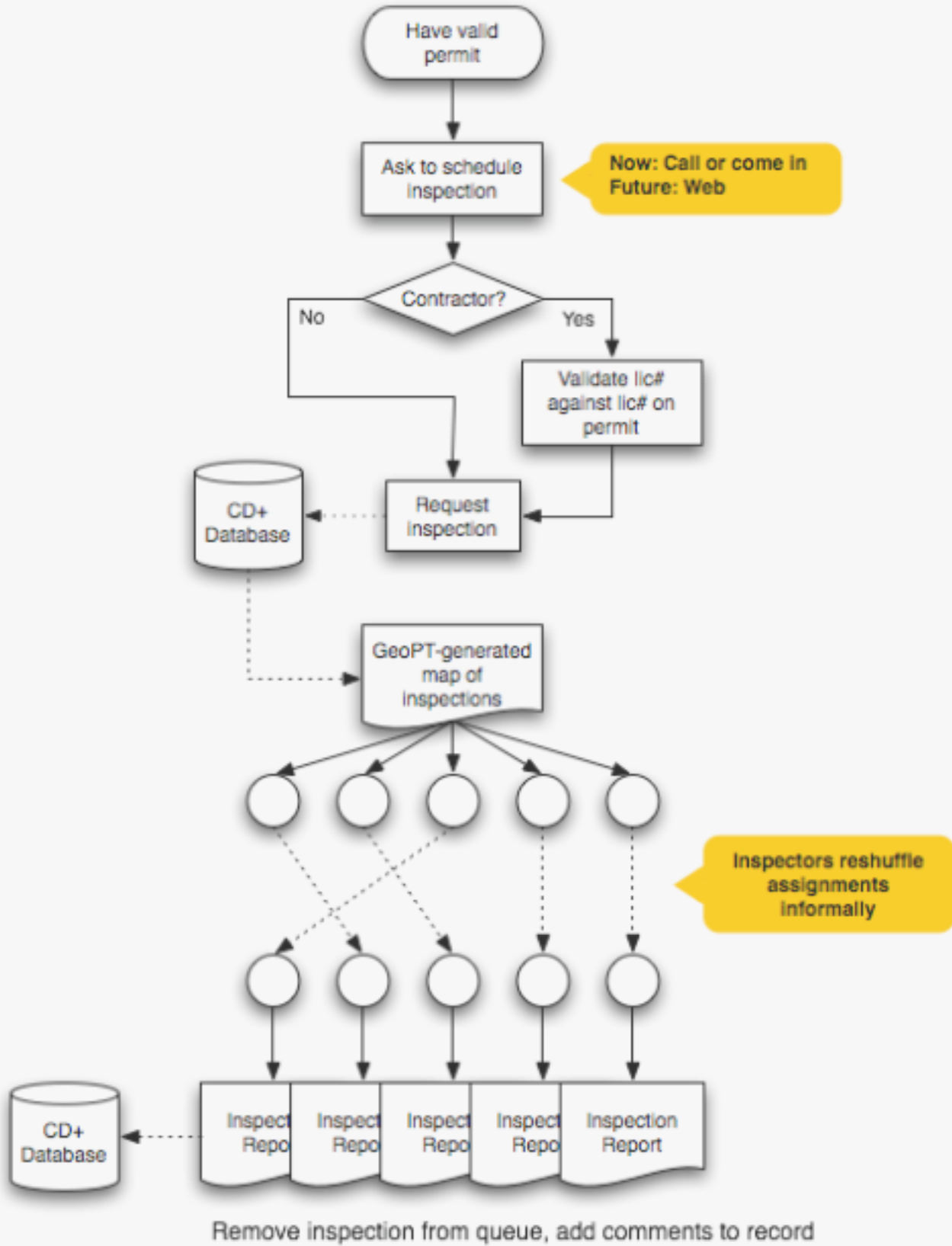
In the process of its evaluation, TOPP created diagrams to visualize three core workflows of Alachua County DGM and to capture both the actions/tasks completed by its staff and the technologies used to do so.

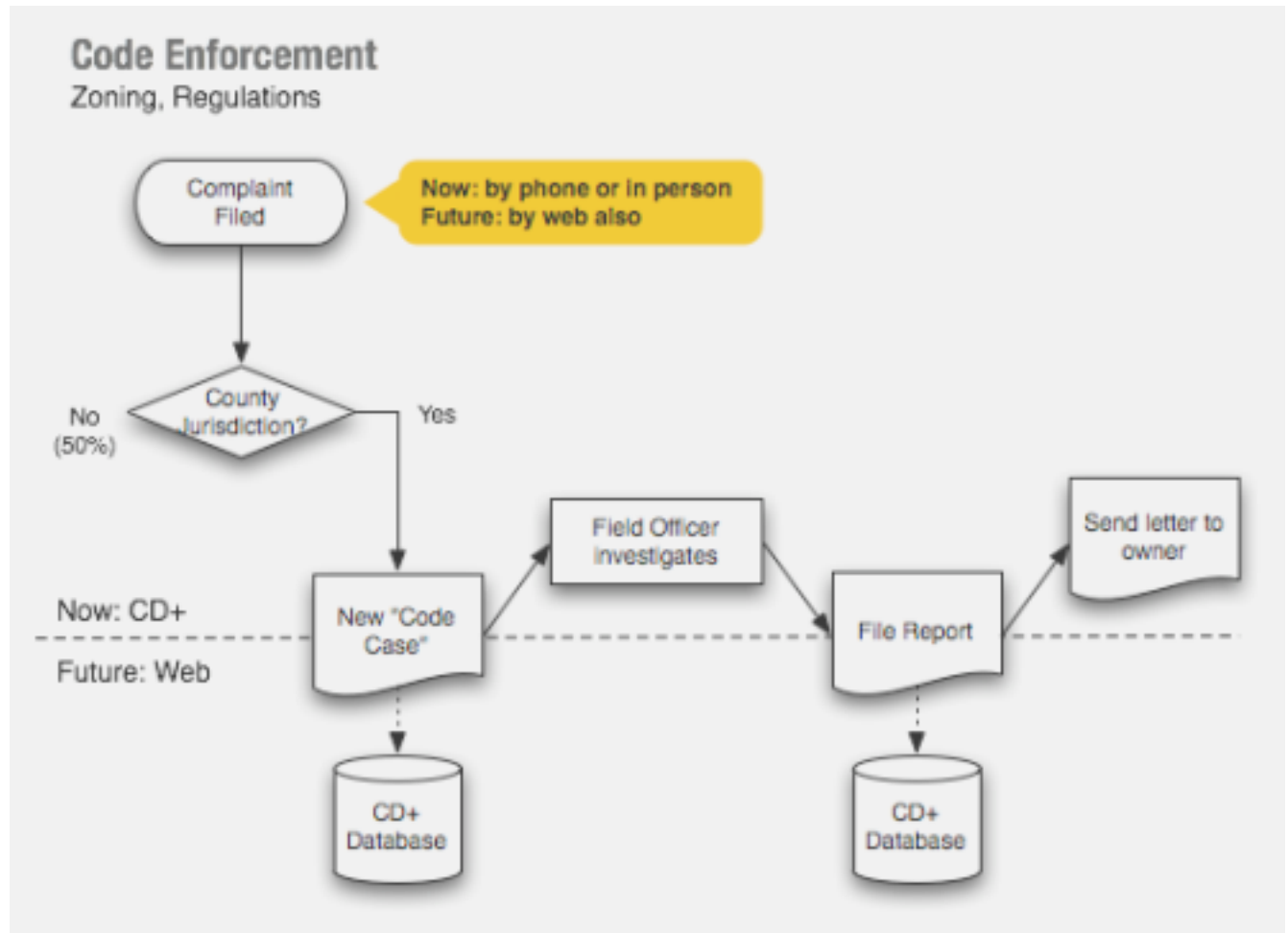
They are a useful overview of the functionality provided and the role played by the current software system in the business workflows, which, in many ways, it also shapes.





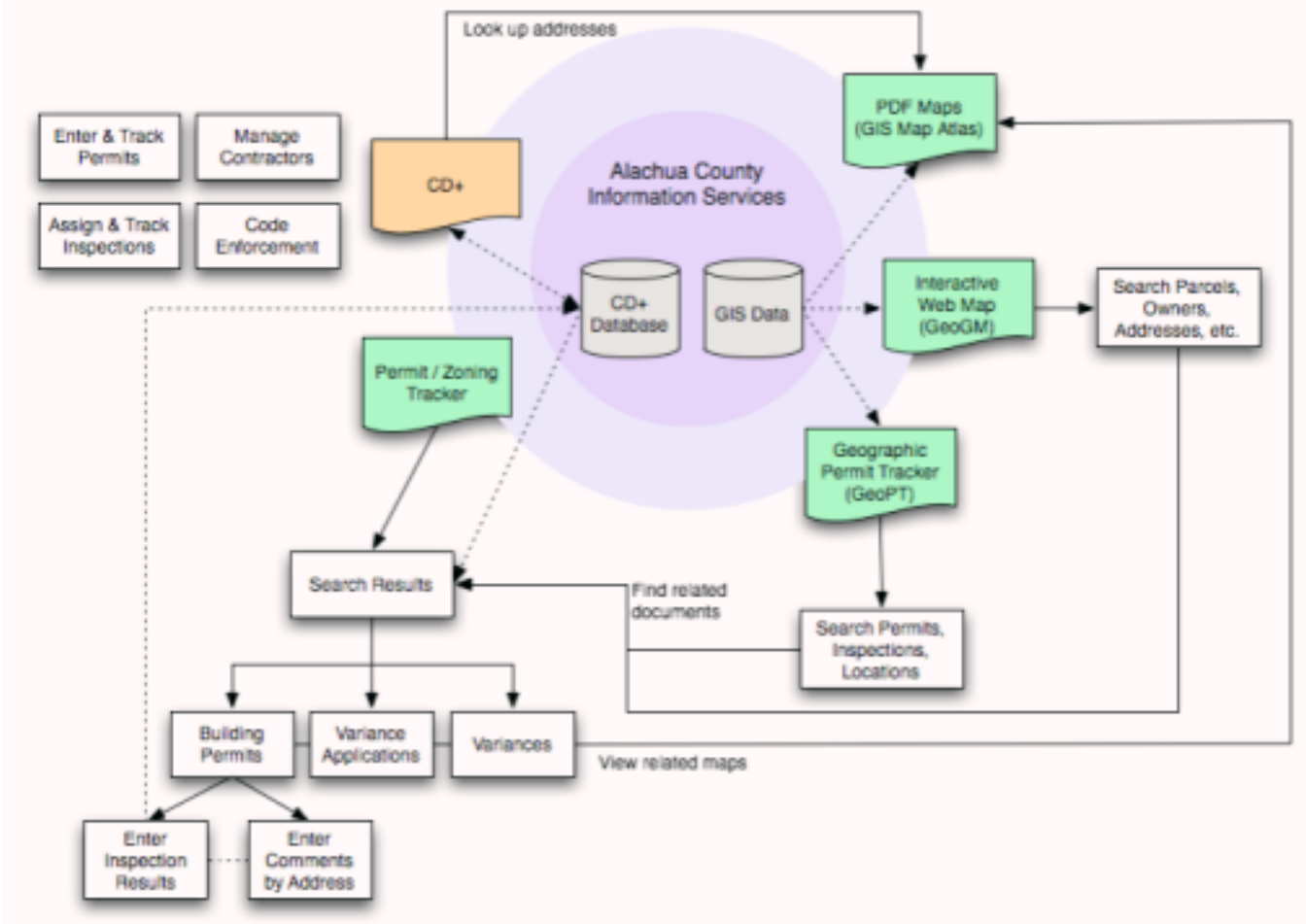
## Inspection Process





### Information Services Related to CD+

Current Configuration



### 4.3 Analysis

The above diagrams show the amount of interdependence between various tasks and the software components that assist in those tasks. There were also many tasks that are not covered in this diagram that take place in other software components (like the pre-application process), or are not tracked in software at all (like the current “owner” of a permit’s next step).

The diagrams make very clear how necessary geospatial information is to the work processes. They also show the many applications that are required to accomplish each task.

During TOPP’s visit, our information gathering uncovered some of the general usability problems its users contend with each day. The lack of geospatial integration and the usability flaws are significant problems with the current software, as is the frequency and severity of system failures.

#### 4.3.1 Noted Usability Flaws in CD-Plus

To briefly list some of the more conspicuous usability flaws found in CD-Plus as an overview for the reader, TOPP would note the following:

- In general, common tasks require an excessive number of clicks for completion.
- Many potentially automated tasks are done by eye (for example, validating the credit card expiration date), introducing more duties and the risk of human error.
- There are very poor searching capabilities. For example, clerks cannot search street name because inconsistent data entry has made this ineffective. There is no attempt on the part of the software to help correct this.
- Comparing data between screens is time consuming.
- It is quite easy to lose one's place and forget which window one is in.
- The interface is extremely modal. Modes are generally frowned upon in interface design because they inevitably lead to input errors, known as 'mode errors,' when the user forgets what state the interface is in, performs an action that is appropriate to a different mode, and gets an unexpected and undesired response. Interface expert Jef Raskin, one of the creators of the Macintosh computer, calls modes "a significant source of errors, confusion, unnecessary restrictions, and complexity in interfaces."<sup>15</sup>
- Common workflows are not captured by the software, but instead must live in the head of users. This leads to non-standardization of protocols and the potential to miss steps in the process.
- No history of changes made to a particular record is available, and there is no versioning ability to revert to a record to a previous state.
- Some Alachua County DGM staff members have two logins because CD-Plus does not allow users to have multiple roles or be a part of more than one group. These staff members must log out and then log back in to access different parts of the system.
- The system lacks a framework for proper access control. The CD-Plus user creation process creates an Oracle user at the same time tied to this login. This Oracle user account is automatically granted permissions at the same role/level as the CD-Plus user account. This comes with rights to make changes on database tables, and therefore any CD-Plus user has the ability to completely delete important data, since CD-Plus provides no refined framework for database access control separate from front end user creation.
- Users are unable to act upon a batch of records at the same time (e.g. re-ordering scheduled inspections requires opening each one and typing in a new order number).

A second major problem with the current setup is that it is in no way integrated. When using CD-Plus, the clerks will often need to find some information on a map to enter. A common example of this is checking the inspection zone that a permit will fall under. When issuing a building permit, CD-Plus requires the inspection zone to be manually entered. To determine the zone, a clerk must look at a laminated paper map (often itself too small to be useful) or bring up the MapAtlas application, select the proper STR, open and then check the zone on the pdf map. The clerk can then finally enter the code into CD-Plus and then move on to the next step. A first pass at integration would be to include the map used to check the zone directly into the Permitting module itself. Since this screen always involves a map, it makes sense to display a map there. But a truly integrated system would go further. The clerk's purpose in looking at the map is just to identify a zone. This can be completely automated, with the application going straight to the database to get the zone from the address in a process called 'geo-coding.' An optional map could then pop up for the clerk to confirm that it is in fact the proper zone.

#### *4.3.2 Impact of Usability/Design Flaws on Alachua County DGM and its CD-Plus Users*

CD-Plus is used all day long by a number of people, and they have gotten extremely fast at using it. However, in our brief opportunity for observation, we noticed a number of ways that users work *around* the software, instead of with it.

The CD-Plus interface is very inefficient, unintuitive and poorly designed. It forces a number of context shifts and navigation of pages, and it is a common occurrence to discover strange or unintuitive functionality. The majority of actions that one wishes to complete could be re-arranged into a more natural workflow, beginning with a rethinking of the workflow around searching, viewing and updating the data. Many of the end users have come up with workaround solutions to make the software behave in a way that makes sense in the work processes, but it is clear that a new solution is needed. Unfortunately, the software is at its limits of expansion. The minimal geospatial integration modules that capitalize on what *is* possible run alongside the software, requiring convoluted workflows and exacerbating usability woes.

This impracticality can only lead to dissatisfaction, and indeed, users are frustrated. The GIS Division has been increasingly vexed with the software due to the lack of documentation, frequent malfunctions, and improper administration practices. Their formal users' survey and informal conversations with users within and outside the Department indicate that everyone shares the GIS Division's sentiments.

This frustration is also born in a lack of trust in the system. CD-Plus suffers a chronic syndrome of system problems and its functionality is regularly questionable. Users complain that working with CD-Plus is a matter of constant aggravation, that system errors are a constant routine in its operation. Many users have also indicated that they have found serious errors in the functionality of CD-Plus which jeopardize the validity of their actions and require constant vigilance to baby-sit the very software that is supposed to facilitate their work. They give examples like allowing a permit to be issued when a contractor's license has expired or when a contractor's insurance has expired, identical naming protocols for code violation cases and building permits, and others.<sup>16</sup>

This report prepared by the GIS Division has a passage that is a perfect summation of the current situation:

Using CD-Plus appears to be a task with which users are required to comply, rather than a utility that facilitates their work and increases the efficiency of their operations, which is in the end, the test for all technology implementations.<sup>17</sup>

CD-Plus has failed this test and has never been accepted by its users. Propagation of the CD-Plus has also floundered. This is evident in the users' resistance to the two unused CD-Plus modules, Development Review and Growth Management. Additionally, the GIS Division's CD-Plus user survey discovered that a good percentage of individuals that had been licensed to use CD-Plus were not actually using it at all, with others only capitalizing on a portion of what they were licensed and permissioned to do.

The user survey uncovered further breakdowns where the lines of operations were blurred by the effects of CD-Plus. There are cases where one user was entering data on behalf of others, or one Department for another.

Three examples are:

- How the comments from the Health Department and the Public Works were handled.
- The way the Development Review Committee action comments are or are not entered.
- That the Departmental Analyst was spending a significant percentage of her time to either enter or edit data into CD-Plus.

While this deterioration in operational integrity has broader implications beyond CD-Plus, protocols slip more easily when unnecessary challenges are required to be taken on in staff members' execution of these protocols.

Additionally, this points out a contradiction in the role of the Departmental Analyst dedicated to CD-Plus. While CD-Plus has had the luxury of this fulltime administrator dedicated entirely to it, she did not seem to have had enough authority to exercise her full governance responsibilities or to fight for improvements and better service from Perconti Data Systems. Instead, she was mostly left to handle its mundane operations, most of which should in fact have been handled by the CD-Plus users themselves.

There are cascading effects of the usability and functional flaws of CD-Plus. It is useful to look at two examples in detail.

#### **Example One: Cascading effects of poor data standardization in CD-Plus**

The majority of the CD-Plus user interfaces are editable forms. The forms include textboxes, drop down select boxes, checkboxes, date selectors and note fields.

Bad Design: Most text fields force all text to be stored in uppercase characters.

- Effect: Prevents the user from entering types of information that require upper and lowercase characters.
- Bad Design: No ability to customize the lists of values in dropdown select boxes.  
Effect: Some dropdown select boxes have values that do not make sense in the context of the Department's use of the field.
- Bad Design: Some select boxes do not enforce the selection of one of the list values.  
Effect: The entry of erroneous and non-standard data.

The GIS Division has proactively avoided these issues in other systems such as the Departmental Document Management system for Zoning and Variances. This system employs a common practice of data standardization: requiring selection from an established list of well-known values for Street Type, such as St, Ave, Blvd, Cir, etc. The clarity of the resulting data in that system can be contrasted with the almost 50 different incorrect or non-standard values for Street Type that have been entered into CD-Plus over time.<sup>18</sup>

The consequence of this haphazard data entry process is very poor and incomplete results when searching, making records harder to access and Alachua County DGM's data less valuable than it can or ought to be. Perpetuating data entry in this manner means that the longer it continues, the worse the effects and the difficulty in correcting them will be.

### **Example 2: Cascading effects of the inferior CD-Plus upgrade installation process**

End users do not have a choice about whether or not they want to upgrade the CD-Plus software on their computers. Rather, it is a forced update issued by the Alachua County DGM staff member who copies the new files to the network share.

- Bad Design: There is a server called oracle\_codes where the Oracle database runs. This server has a few file shares including one called CD-Plus. In this file share, there is a 'current version' directory, which contains executables. When Perconti Data Systems makes an update for CD-Plus, they send new executables to the County. An Alachua County DGM staff member puts these new executables in the 'current version' directory on the network file share. When the CD-Plus application starts up, it knows to check the network folder for executables. While this happens, 'Verifying Files' is displayed on the screen.
- Effect: A forced update for the whole group of CD-Plus users that is automatically activated for each user by opening the program.

This also means hurdles of network and domain issues to overcome when trying to install CD-Plus outside of a closed network, as has been the case with the Property Appraisers, the Health Department, and other Alachua County Departments over the years. In these cases, since the machine CD-Plus is running on is outside of the closed network where the 'current version' directory lives, network and domain issues arise when the CD-Plus application seeks access to the directory.



- Bad Design:** No proper version numbering of releases (e.g. Version '3.0c') and no notification by the program that the software has been upgraded.
- Effect:** Users have no idea if this 'current version' directory has been updated and if they will now be running a new version of the software. They receive no notification from the software that an upgrade has taken place, nor can they derive this information themselves from any kind of intelligent version numbering of the software release they are now using.
- Bad Practice:** There is no documentation about or introduction to the changes that have been made in each upgrade, and no change log that a user could access that indicates what was included in each update.
- Effect:** The user has no idea why and how the software is different after the update, has no idea how to effectively use the new version of the software and must figure this out through trial and error, and in fact must suffer confusion about why things are behaving differently until they realize that the software must have been updated.
- Bad Design:** There is no mechanism to allow end users to revert back to a previous version of the software. Further, there is no archive of previous versions of the CD-Plus software, no backups of the older versions of executables from the 'current version' directory.
- Effect:** If there is an update that is highly flawed, there is no way to rollback to the previous version, because the previous version no longer exists.

The only possible way to accomplish this would be to work with ITS, who performs daily backups of all machines, to dig up the backup files for the oracle\_codes server available from prior to the when the staff member put the new executables into the 'current version' directory. On the other hand, the Perconti Data Systems Maintenance and Support Agreement does state that the client "may make copies of the Vendor Programs in machine readable form for nonproductive backup purposes only", and putting a backup version into production could be considered a violation of the terms of the agreement.

Even if the update is not terribly flawed, if it brings significant changes to the software, a user could prefer to keep using the previous version until the impact of these changes was measured. However, there is no mechanism to allow users this choice.

CD-Plus's inferior upgrade process introduces real risks for the ongoing operations of Alachua County DGM. The hurdles that must be overcome to correct a bad update are significant, and even in the case of a smooth upgrade, the potential for user confusion and frustration is quite high. This method does not meet industry standards and norms for upgrading software, and is yet another way that the poor design implemented by Perconti Data Systems can incur cascading negative effects across the entire Department.

Alachua County is not alone in its disenchantment with the CD-Plus software and Perconti Data Systems. The GIS Division has interviewed other Counties who use CD-Plus and found that they share their frustrations with it and its vendor. This demonstrates that it is not a failure of this particular deployment, but rather a failure of the software itself.

#### 4.3.3 *Suggested Improvements to the Software and the Related Workflows*

TOPP was able to identify a many areas where improvements to the software and the related workflows would go a long way towards achieving higher organizational efficiency.

A selection of those TOPP felt would have, if implemented, the greatest rate of return in terms of increasing a streamlining in function and satisfaction in users include:

- Better systems to track permit applications as they are passed around for review inside Alachua County DGM and among other Departments.
- Notifications to staff members via email or a site dashboard/inbox generated when the staff member has new tasks to complete.
- A more persistent identifier for permits than parcel number. The parcel number can change over time if the parcel is subdivided, causing a breakdown if a permit is linked to a parcel. This is made even more necessary because parcel numbers get reused in different places in some cases.
- The creation of a more structured order of operations and protocols, guided by a checklist or outline present inside the software. Right now, clerks create their own workaround workflows that may go against good operating procedures. For example, they may issue a permit before collecting payment in order to minimize trips to the printer.
- Overall, reduce the number of clicks for common tasks across the application.
- Perform more automatic validation of data and more automatic completion of forms based on known relationships and data. For example, currently, a user must always check a separate window to see if a contractor's insurance has expired. The software should be able to detect that automatically.
- Reduce the number of modal pop-ups and better reflect the visual relationships between data objects.
- Make the geospatial portion a first class component with optional integrated maps from most screens, and automatic validation and completion of fields based on geospatial lookups.

Although it was rolled out during the height of the dot-com boom, much of the functionality of the CD-Plus software also seems to predate the web.

There are several tasks that could be completed through the web, including:

- Initiating new permit applications
- Collecting payments
- Reporting new code enforcement cases
- Reports from the field from inspectors and Code Enforcement officers  
*(note: this has been made possible through the deployment of some of the new web-based modules created by the GIS Division, however it appears to be completely external to the CD-Plus application)*

Many notifications/status updates that are issued by Alachua County DGM, such as expired permits and when new permits are ready, could also be accessed through the web and sent via e-mail.

While new web-based functionality can be built alongside the existing CD-Plus infrastructure, at some point it is better to design a system geared towards the web and geospatial integration instead of building a number of one-off solutions. With this comes the potential to compress much of the workflow in to fewer clicks and screens, and to be able to reuse the same software for external and internal functions, as well as remote and local applications.

#### 4.3.4 Components to be Potentially Integrated

Though outside the scope of the immediate work, the evaluation highlighted a number of processes that could potentially be incorporated with a new Permitting system, and conceived and built as modules pluggable into a core system. If accomplished in an open source manner, it is likely that other Counties could use these modules to fulfill similar use cases and potentially fund new development in the future that would build upon a solid core.

#### **Payments**

A major role that CD-Plus plays is calculating and tracking fees associated with permits. Primarily, CD-Plus calculates the fees associated with a given permit based on a variety of conditions (square footage, # of driveways, etc.), and tracks whether or not fees have been collected. Some of these calculations are currently computed using an Excel spreadsheet and then entered into CD-Plus. The fees are periodically reviewed and updated by the Alachua County Commissioner, and following this, a technical staff member internally updates the software.

All payments are processed offline, taken by check or via credit card in Alachua County DGM's office. While CD-Plus does not actually process any transactions, it does collect and store credit card information for some customers. Payment processing could be incorporated into a Permitting module, which would guarantee that the 'amount paid' field both corresponds to an accurate total of assessed fees and is linked to an actual payment, instead of being prone to bad entry. This would also be another check against permit issuance without or prior to payment.

There are several existing open source packages for payment processing<sup>19</sup> that could perhaps be built upon instead of needing create the entire component from scratch. Web components like Google Checkout and PayPal, designed to be exceedingly easy to enable, could let Alachua County accept payments through the web.

### **Development Review**

Before a building permit application can commence, the development in question must pass the Development Review Committee (DRC), which is constituted by members from the Departments of Growth Management, Environmental Protection and Public Works. Alachua County already purchased a module of CD-Plus to handle Development Review, but it is not used at all. A custom built solution could directly address the reasons that CD-Plus was not taken up; an assessment of those reasons was outside of the scope of this evaluation.

A Development Review module, integrated with the Permitting module and geospatial components, could be the first step to more thoroughly capturing Alachua County's full Development Application Review lifecycle and all of the information this process generates in one centralized place.

### **Preapplication**

After a development goes through the DRC, but before each lot on the parcel goes through permit application, it must go through preapplication. During this phase, officials from environmental agencies review the lot for compliance to applicable rules. This process is currently supported by Microsoft Sharepoint. After successful preapplication, agency reviewers make notes in the Address File for that address in CD-Plus. When the permit application is processed, County staffers will check the address file for preapplication notes.

This is a nice web-based solution, but lacks a geospatial component. It also contains no linkages to the actual permit application process, even though permit application processing will always require access to the preapplication notes. A better integration would automatically make those notes available to the permit application, and not stored separately in the address file. A Preapplication module integrated with the Permitting module, and perhaps a Development Review module, would be another important step towards pulling together more of the Development Application Review lifecycle and related information into one place.

### **Permit Life Cycle and Notifications**

Once a permit is issued, it has a six-month lifecycle. Each time an inspection is completed, the permit is extended for another six months. Roughly once per month, Alachua County DGM staff run an 'Expired Permit' report to see which permits have expired. A letter is then sent to the holder of each expired permit. A renewal fee of \$140 is required to reopen an expired permit.

There is currently no early warning system for expiring permits. Since the cost of extending a permit is only \$70, it is likely such a system would be popular. Automatic e-mail notifications to holders of soon-to-expire permits would be a zero-cost way to greatly improve customer service in this area. Weekly summary e-mails to Alachua County staff with soon-to-expire permits and licenses could also be issued to flag this for enforcement and compliance.

## **Reporting**

Report creation is a crucial, yet currently cumbersome, crosscutting task for the County. The reporting functionality is actually not an integrated part of CD-Plus; instead it is performed by a propriety generic report-generating application called Crystal Reports. A Crystal Reports viewer is embedded in CD-Plus, which will open in a new window and allow the CD-Plus user to select between the different report templates and set the input values needed for the specific template.

The report templates are designed using Crystal Reports, and added to or updated by hand by an Alachua County DGM staff member or by Perconti Data Systems after several steps of bureaucracy. Basic training or previous experience with Crystal Reports is necessary before creating or editing the templates. The report designer also needs a licensed copy of Crystal Reports installed on his/her computer in order to be able to create or edit the templates.

Previously, the Departmental Analyst dedicated to CD-Plus would handle template creation and editing, and Perconti Data Systems has occasionally provided new report templates or assisted with updating reports by moving around fields, etc. The effect of this setup is that the ability to obtain information from CD-Plus is severely limited—users can only generate a report with needed information if a template for that report already exists, users only have a limited and specific number of fields for inputs to use to narrow in on the desired results, users cannot edit or customize the report independently and must wait for either the Departmental Analyst or Perconti Data Systems to create a new template for them, there is no ability for users to create a report based on a custom query of their own, and so on. The result is a slow, inefficient process, which reduces the potential usefulness of the reported data. And although it is a separate application, since the Crystal Reports viewer is accessed through CD-Plus, access to running reports is limited to the licensed CD-Plus users.

A better solution would be dynamic, web-based reporting available to any Alachua County staff member and to the public. This could be tailored to the Permitting module and could also benefit from geospatial integration, such as an option to display report output on maps.

## **Versioning**

CD-Plus fails to track the changes made to a record over time and provide a history of those changes with the ability to roll back to a previous version. If erroneous changes to a record are made, the correct information must be historically reconstructed, a process with severe risks to the integrity of the data. An improved Permitting module should include a versioning component that tracks the author, time, and content of each change made to any record, a way to view the record's history that lists each of these changes, and a means to revert to a previous version of a record to correct mistakes.

### *4.3.5 Limitations on Improvement*

CD-Plus is a vendor-locked product, highly endangering the sustainability of Alachua County DGM's operations by making it entirely and exclusively dependent on Perconti Data Systems.

This is an obsolescent model where the vendor is in exclusive, absolute control. If Perconti Data Systems goes out of business or decides not to support this product, Alachua County will have just 30 days' notice to budget, seek out another product and another vendor, go through an RFP process, wait for product completion and customization, and go through the process of its acceptance, implementation, etc.<sup>20</sup>

Accompanying the vendor lock-in, and certainly enabled by it, is an inefficient and substandard operational model, that is, the relationships and the mechanisms that assure the long-term sustainability and operation of CD-Plus and the Department's operations that it supports. Alachua County DGM is put in a highly disadvantaged position towards the vendor, which has affected the efficient and agile running of its operations.

Proof of this poor operational model and its effects can be seen in Perconti Data Systems's unresponsiveness to support requests. There are no protocols to manage and track support requests, no logs of service requested, no documentation of an issue's resolution or its failure to be resolved, and no accounting records of time spent working on requested issues. There is not even a yearly report on the current year's use of support hours accompanying Perconti Data Systems's invoice for the next year.

The GIS Division has observed a pattern of unresponsiveness and insufficient answers in response to support requests. For example, Perconti Data Systems has given problematic or incorrect answers to requests for basic information the GIS Division needed to accomplish its major migration, to requests for compliance-related changes required in the CD-Plus permit application templates, and to inquiries regarding the existence of a help file for users. The existence of this help file, although advertised on the CD-Plus Headquarters website to this day, was neither confirmed nor denied by the vendor over a fairly extensive correspondence and certainly not delivered to the GIS Division.<sup>21</sup>

Complicating matters further is the lackluster Maintenance and Support Agreement that Alachua County DGM has with Perconti Data Systems. This Agreement includes insufficient specifications and definitions of the deliverables to be provided by the vendor. It does not make reference to the CD-Plus back-end database, and only appears to cover the front end, i.e. only half, of the application. There are no contractual protections of Alachua County's rights by means of caps on price/rate increases or restrictions on the changes to the terms of the Agreement, which can be made at any time by the vendor. Nor is there clarity about what Alachua County will actually be charged for, as fuzzy terms like *additional services*, *Program Enhancements*, *Program Corrections*, and *support priorities* populate the Agreement without definition.

Alachua County DGM pays heavily for this inadequate maintenance and support:

- ~\$15,000 per year to Perconti Data Systems Inc. for 12 hours of support per month. This support is limited to *system problems only*, for the *CD-Plus front end only*. In fact, the Agreement is quite clear that anything other than a response to "verifiable and reproducible program errors" will be at an additional cost, even if the 12 hours per month of contractually-stipulated support have not been used:

- Support Vendor shall consider and evaluate the development of Program Enhancements for the specific use of Customer and shall respond to Customer's requests for additional services pertaining to the Licensed Program (including, without limitation, data conversion and report-formatting assistance), provided that such assistance, if agreed to be provided, shall be subject to supplemental charges mutually agreed to by Support Vendor and Customer.<sup>22</sup>
- ∇ Amusingly, while the scope of services in the Agreement does specify that the "Support Vendor shall maintain a telephone hot line and email address that allows Customer to report system problems and seek assistance in use of the Licensed Program,"<sup>23</sup> it does not at any point later in the scope indicate or require that assistance in the use of the Licensed Program actually be given.
- ∇ It should also be noted that the support plan at the level of 12 hours per month for \$15,000 per year purchased by Alachua County DGM is the Bronze plan, Perconti's lowest offering in terms of both cost and stipulated hours. Plans begin here and rise all the way to the Diamond Plan, with 160 hours per month of support, i.e. a Perconti Data Systems staff member dedicated to supporting the Diamond client fulltime in their use of CD-Plus, at a cost of \$144,000 per year. There is something troubling about the fact that Perconti Data Systems will offers this Diamond level Maintenance and Support Agreement for a piece of software that boasts that it "can handle the administration of a large network and provide fast access to your data without the overhead of a full-time administrator."<sup>24</sup>
- Additionally, another ~\$1,500 per year is paid to Perconti Data Systems for the *maintenance of hardware and software* of Vetrol Data Systems's Automated Inspection Request System (AIRS) and ~\$1,500 per year to the Oracle Corporation for *unlimited software upgrades, license, and support*.

The terms of the support agreement with Oracle are much more in line with industry standards. Standard maintenance agreements put no cap on support, guarantee free upgrades and enhancements to their products, provide support to reports of system problems that occur in either the front end or backend of the application, and protect the rights of the client as well as the vendor. Interestingly, although providing such exponentially greater support to the client, these standard agreements usually are, by orders of magnitude, less expensive than that with Perconti Data Systems, which has put Alachua County DGM in a very inauspicious position.

As a propriety product, CD-Plus cannot be improved, changed, or adjusted without additional cost paid to the vendor nor through a competitive process, as it is vendor-locked. At the conclusion of the contract with Perconti Data Systems, Alachua County DGM retains no right to continue to use the product in which they have made such significant investments.

As mentioned above, only the original developers have access to the source code of CD-Plus. This limits the GIS Division to producing external improvements that work alongside CD-Plus in

an attempt to better support the workflows of Alachua County DGM, instead of correcting the problems in the CD-Plus software itself.

The situation is made worse by the virtual lack of documentation, with no configuration files, instructions, installation guides, proper help files and guides for the user, use case scenarios upon which the software's functions are based, diagrams or charts of its tables, and of how they inter-relate, or data dictionaries provided by Perconti Data Systems either at the time of software delivery or in response to ongoing requests.

IT companies commonly establish online knowledge warehouses for their products. Frequently, a company will maintain two types of knowledge warehouses:

- A knowledge warehouse populated by the software's users, usually via:
  - ∇ E-mail messages posted to listservs.
    - These listservs are often tailored not just to the product or a particular module, but also to the role of the person subscribing to the listserv, i.e. a superproduct-users list or a superproduct-developers list or a superproduct-admins list.
  - ∇ Topic-specific bulletin boards/forums where users can post problems and exchange advice and solutions.
  - ∇ User-created documentation, such as wiki-enabled help pages or user-produced tutorials that show off a particular feature and how to best take advantage of it.
- A knowledge warehouse populated by the IT company, usually via:
  - ∇ System utilities available 24 hours per day to system administrators for accessing and downloading when they are really needed.
    - This includes all product documentation, configurations files, installation guides, and other useful files, all classified by version, by type, and by framework system to make it easy for the system's administrator to quickly locate exactly what he or she needs.
  - ∇ Video, audio, and Flash-based tutorials and screencasts usually created by the company for both support and marketing purposes.
  - ∇ Some medium for authoritatively responding to user questions.
  - ∇ Lately, many knowledge warehouses are including a developer or company Blog that gives insight into things like where the software is going, challenges the development team is facing, reasoning behind certain design choices made by the UI team, new milestones the company has reached, open positions at the company and why it is great to work there, etc.

Throughout the 25 years that Perconti Data Systems has been building software, they have never chosen to offer either type of knowledge warehouse for CD-Plus or any other product. There is not a single gesture towards providing any support that does not involve contact with a Perconti



Data Systems staff member, not even that most basic form of support—the list of Frequently Asked Questions (FAQ).

In summation, Alachua County DGM's experience with the CD-Plus application demonstrates the consequences of a poorly performing piece of software, of being beholden to a disappointing vendor, and more broadly of being beholden to a single vendor at all. TOPP's evaluation is that this product is causing more harm—more work, frustration, and risk—than good, with no signs of improvement on the horizon. It is on the basis of this understanding that we begin our discussion about geospatial integration and its feasibility.

Full recommendations will follow these sections.

## 5.0 Geospatial Integration

### 5.0.1 *What is Geospatial Integration?*

To begin this section, which contains the evaluation of the feasibility of a CD-Plus upgrade for geospatial integration, it is useful to clarify what geospatial integration means in this context:

A geospatially-integrated system possesses shared, integrated, geo-referenced information that presents a unified picture of and through common data access, web services, and applications. The visualization that is the hallmark of GIS and the relational expertise of data analysis combine to meld GIS and public data into a unified picture, enabling GIS Division mission goals of geospatial decision support for planning activities and proper recordkeeping processes for geospatial data.

Geospatial integration is needed because, as discussed above, each part of the permit process has some sort of geospatial component, from searching by proper address to call up a record associated with it, to assigning the permit application to the proper zone, to distributing daily assignments among the inspectors. The current system, however, is at the limits of its potential for geospatial integration, with separate applications that clerks must switch between that are each custom-built based on reverse engineering the CD-Plus database.

As with better web integration, with better geospatial support there is a potential to compress much of the workflow in to fewer clicks and screens, and to reuse the same software for external and internal functions and in remote and local applications.

In making the geospatial portion a first class component, intelligent and handy advancements could include:

- Optional integrated maps from most screens in the application. One can imagine nearly every screen in the software having a 'map this' button, which displays a map of the current record being accessed, no matter what type, from permit application to inspection report.

- Search results could also be displayed on a map to help the searcher hone in on a specific search result since location is often part of the contextual information understood at various steps in the user's workflow.
- Automatic validation and filling of fields based on geospatial lookups, leading to better data standardization and accuracy.
- A more persistent geo-referenced identifier for permits: as mentioned above, the parcel number fails to be an adequate identifier for permits because it has the potential, if not likelihood, to change over time or be used in more than one place. A geo-referenced identifier would eliminate this possibility and the confusion it causes.
- As mentioned earlier, reporting is currently flawed, as the reporting functionality is actually not an integrated part of CD-Plus. Instead, reports are produced using Crystal Reports, and each report must be hand-made by a County staffer. A better solution would be dynamic, web-based reporting available to the public. This could be tailored to the permit applications, and could also benefit from geospatial integration – making an option to display report output on maps.

## 5.1 Current Technology Capability for Geospatial Integration

The design of CD-Plus does not allow the software to include or even link to any geospatial technologies, including ESRI GIS, Internet maps, or the newly acquired Pictometry aerial imagery. As discussed in section 3.3, the current system achieves a degree of geospatial integration with the CD-Plus Permitting and Inspections module through the GeoPT and Building Permit Tracker suite of modules.

These applications were built in-house by GIS Division staff, who reverse engineered the CD-Plus/Oracle database to extract the needed information and to perform the appropriate logins. GeoPT is built using PHP, and the geospatial component is achieved by a nightly process that extracts the information on the inspections for the next day and then combines them with a shapefile from the 911 Office. While the solution works quite well and shows a great amount of ingenuity, it also points to the deficiencies of the current infrastructure.

The crux of this issue is the existing data, and the fact that the Oracle database that it is stored in is a bit of a mess. The CD-Plus application is a front end to an Oracle-backed database that collects data in a pre-determined, pre-structured way. The data collected from CD-Plus is stored in a dedicated database called the CD-Plus database. The design of this database, which is composed of several tables, is entirely dependent and fully dictated by the design of the CD-Plus front end.

More importantly, the data created by the application is structured a way determined exclusively by the needs of the CD-Plus front end. The structure of the data, therefore, would not fit naturally into the design of a new piece of software. Re-utilization of this data without extra investment is not possible.

This is exacerbated by the virtual lack of documentation and a virtual lack of response and responsibility on the part of Perconti Data Systems in providing it. There is no official documentation on the database structure, it is not clear which tables are used, and many standard database design features are lacking, such as foreign keys. This lack of documentation poses an unnecessarily heavy burden upon the GIS Division staff, who must experimentally divine how to use the data to meet GIS Division needs.

The transition to storing Alachua County geospatial information in ArcSDE backed by the same Oracle 10g database as CD-Plus will help this situation a bit by putting the tables in this common location. But it will still require reverse engineering of the CD-Plus database structure combined with custom ArcSDE joins to expose that information on to maps.

### *5.1.1 Future of the Technology*

Minimal geospatial integration has only been achieved by creating solutions that reverse engineer the CD-Plus database and run along side the software, requiring convoluted workflows. The GIS Division has done a great job cobbling together a solution, but it lacks the potential for a more robust integration without fundamental changes to the CD-Plus software.

A large investment in to the CD-Plus software to enable further integration may not even be an option, since Perconti Data Systems, as the sole proprietary of the software may simply choose not to implement it. Even if Perconti Data Systems is interested, geospatial software is far from their area of expertise, so it would likely come at a high cost for sub-contracting the work out to a firm with geospatial software development experience or gaining the expertise in-house at Perconti Data Systems.

Given the lack of basic software development, documentation and maintenance standards cited in the 'Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application'<sup>125</sup> this seems like an ill-advised proposition, especially considering the incredible amount of domain-specific expertise needed to properly build geospatial software. TOPP cannot make such a recommendation in good faith to Alachua County DGM.

In summary, the GIS Division has made strides in putting CD-Plus data on mapping components; however there would be a lot more potential—both technically and with regards to user happiness and efficiency—if Alachua County DGM's Permitting module was either open source or built with geospatial integrations in mind, and ideally both.

## **5.2 Considerations for a New and Improved Permitting Module**

### *5.2.1 A Brief Introduction to Open Source Software*

As mentioned above, CD-Plus is a program owned by Perconti Data system and Alachua County DGM has a non-exclusive, non-transferable right to use this licensed program under, and only under, the terms of the proprietary license that Perconti Data Systems has issued to the Department. In this model, the vendor is in exclusive, absolute control. Perconti Data Systems does not even have a collection of licensed service providers, certified support specialists, or

trusted vendors who can work with CD-Plus clients to improve or customize their CD-Plus installation, which has become standard for most trusted software-producing institutions.

Only the original developers have access to the CD-Plus source code. If the software and its permit module were a piece of open source software, anyone would have access to the source code and could therefore clearly identify its key components and how they work. This includes the database, the structure of the information that enters the database, and the interface between it and the program's front end, which has been so problematic for the GIS Division. It would be like giving the GIS Division the entry into a giant library that held all the knowledge needed to understand how the world of the software works, the parts that comprise it, the how-to and ability to fix things that are not working correctly, and the right to change anything to better suit the needs of Alachua County DGM.

### *5.2.2 Advantages of Open Source Software*

Software provides value by assisting its users in better accomplishing their objectives. Sometimes these objectives include not just the satisfaction of requirements, but also meeting them in a more robust or more efficient way to gain a competitive advantage over rivals.

In general, it is advisable to go with an open source option when software does not provide a key competitive edge to its customer. In the case of building permitting software for governments, it is clear that Alachua County is not in competition with Marion County to have the best building permitting system. And, as a government agency, Alachua County DGM is not capable of losing the business of building permit issuance to either an upstart outside competitor or, say, the Supervisor of Elections Office. This can be better understood when contrasted with an example: Goldman Sachs would not want to open source their stock prediction engine, since then their competition could also use it when choosing stocks and receive all of the same value that the software provides about making smart investments.

When there are several entities with similar needs to meet, and who are not in competition and suffer no competitive disadvantage if others use the same software tool to accomplish their parallel objectives, an open source application can also be a smart fiscal choice. Instead of having a vendor re-sell the very same software to each party to the vendor's profit, a group of interested parties can split development and expansion costs and also gain greater control over the software's development and direction.

A compelling case for an open source solution is demonstrated by GovPartner's proprietary CommunityDevelopmentPartner (CDP), community development process management software for planning and zoning, permitting, tracking, building safety and code enforcement. In 1996, the City of Sunnyvale, CA reviewed existing permitting software packages and "decided that the available systems were not flexible enough to meet the requirements".<sup>26</sup> In partnership with Microsoft, Sunnyvale IT staff built their own cutting edge, internet-ready permitting system with integrated building safety, planning/zoning, and code enforcement modules. In 2000, the city granted an exclusive license on all its in-house e-gov systems to GovPartner. Announcing this, then City Manager Robert LaSala stated: "Our City developed some of the highest-quality software the municipal market has seen. As a result, we found that many other cities want to

obtain the software, which was not possible until we found an appropriate way to make the software available. The public/private partnership that we have created with Berryman & Henigar (parent company to GovPartner) will now enable other municipalities to benefit from the use of our software."<sup>27</sup>

GovPartner now re-sells Sunnyvale's e-gov systems to cities across the country itself and through its Regional Business Partners. If Sunnyvale had instead released the software under an open source license, Alachua County and any other local government could freely install, test drive, evaluate, and adopt it for their use, instead of each paying GovPartner for the right to use taxpayer-funded software; furthermore, they could adapt it for their particular needs and could contribute improvements and receive the benefits of other communities' contributions at no cost. Because CDP is instead proprietary software, a casual trial installation for evaluation of the product's suitability is impossible, and any customizations or additions to the software can only be made by GovPartner, at the company's sole discretion, and without any competitive bidding process to arrive at a fair price for the work.

### 5.2.3 Choosing between Open Source and Proprietary Software

Another thing to consider when deciding between open source versus proprietary solutions is what options currently exist that could meet the organization's need. If one or more good, cheap proprietary solutions already exist and it would be prohibitively expensive to develop an open source solution, then the proprietary solution may make sense. For this to be true, the existing proprietary solution would need to be feature complete for current and future business cases. If not, vendor lock-in could make the new features for current or anticipated needs prohibitively expensive.

Currently, there are no available open source solutions that could replace CD-Plus and its Permitting module. As indicated in table 5.2 below, several proprietary community development management solutions are available for purchase. However, there is not a single one that can clearly meet all the current and anticipated needs of Alachua County out of the box, and therefore any of these proprietary options would likely require customization to the County's specific permit processing workflows.

**Table 5.2. Proprietary Community Development Management Software Alternatives**

Description	Concerns
TRAKiT by CRW Systems is a suite of community development applications and interfaces.  For more information, see: <a href="http://www.crw.com/">http://www.crw.com/</a> , <a href="http://www.crw.com/products-services/">http://www.crw.com/products-services/</a> , <a href="http://www.crw.com/products-services/family/permitrak.php">http://www.crw.com/products-services/family/permitrak.php</a>	Sole-vendor model similar to Perconti; 'Products and Services' page on website as of November 2007 gives the "update" that "TRAKiT is currently being redeveloped under a .NET framework. Look for our newest version in the beginning of 2007."

Description	Concerns
<p>Logos.NET by New World Systems is web-based community development software.</p> <p>For more information, see: <a href="http://www.newworldsystems.com/index.asp">http://www.newworldsystems.com/index.asp</a>  <a href="http://www.newworldsystems.com/product_logos_cd.htm">http://www.newworldsystems.com/product_logos_cd.htm</a></p>	<p>Sole-vendor model; very outmoded website; no descriptions of its modules; single screenshot example of product interface displays poor usability and design.</p>
<p>Our Town Permit Management System by Our Town Software is part of a suite of municipal software applications.</p> <p>For more information, see: <a href="http://www.ourtownsoftware.com/">http://www.ourtownsoftware.com/</a></p>	<p>The latest software update available to download under the support section for the Permit Management System is dated July 15, 2005; documentation is only eight pages long.</p>
<p>Municipal Permits Application of the Municipal Government suite by Vadim Software</p> <p>For more information, see: <a href="http://www.vadimsoftware.com/default.asp">http://www.vadimsoftware.com/default.asp</a>  <a href="http://www.vadimsoftware.com/main.asp?p=10">http://www.vadimsoftware.com/main.asp?p=10</a></p>	<p>There are only 5 lines to describe Vadim's Municipal Permits Application on its website. The site does indicate that the software was “designed to issue, report, inspect and maintain an issued permit database for properties within a municipality,” but it is not clear what other features are included.</p>
<p>Hansen Information Technology's enterprise product suite and its Construction &amp; Use Permits module</p>	<p>Hansen characterizes its enterprise solutions by: “Pioneering a citizen-centric data model that provides a 360-degree view of a citizen's transactions across the entire government enterprise, Hansen’s integrated data model of business applications, government best practices, and leading performance indicators, offer state and local governments a single solution, from a single vendor, for all its IT needs.” It is clear that Hansen’s model is to sell an entire integrated package of applications for all of a government’s activities, ranging from Asset Management to Business Intelligence, and to be the sole software provider to that local government. Aside from a section highlighting <i>DynamicPORTAL</i>, the public web portal to the permitting application, and basic permitting workflow support, there is no presentation of the module’s features, technology, or user interfaces. The ‘Permitting, Licensing and Code Enforcement’ video is pitched at small governments who do not yet have community development management software; it emphasizes the generic benefits of having such software as opposed to merits specific to Hansen’s modules.</p>

Description	Concerns
<p>For more information, see: <a href="http://www.hansen.com/default.asp">http://www.hansen.com/default.asp</a>, <a href="http://www.hansen.com/solutions/enterprise/default.asp">http://www.hansen.com/solutions/enterprise/default.asp</a>, <a href="http://www.hansen.com/solutions/building-permits/default.asp">http://www.hansen.com/solutions/building-permits/default.asp</a>, <a href="http://www.hansen.com/video/video.asp">http://www.hansen.com/video/video.asp</a></p> <p>EnerGov and its Permit Management module by EnerGov Solutions, LLC is a "complete enterprise land management solution."</p> <p>For more information, see: <a href="http://www.energov.com/default.htm">http://www.energov.com/default.htm</a>, <a href="http://www.energov.com/permitman.htm">http://www.energov.com/permitman.htm</a></p>	<p>One of the better offerings in the bunch, this suite is built in .NET and does include many features needed by Alachua County DGM; however, the flash demo and website highlight how the software is "specifically designed for your needs" and that "an integral part of your solution is professional services - the support, training, and consulting that increase the value of your solution and is a fundamental tool for your operations growth and success"; it is clear that EnerGov Solutions has not intended for EnerGov to be an out-of-the box solution, but rather has built the need to purchase professional services into its business and software development models.</p>
<p>eCommunityPlus by SunGard Pentamation is a windows-based public services and community development information management system for municipalities, counties, and authorities. Its Permitting component is part of the Community Development Application, a desktop application with a web-access view.</p> <p>For more information, see: <a href="http://www.pentamation.com/">http://www.pentamation.com/</a>, <a href="http://www.pentamation.com/gov/p-communityServices.htm">http://www.pentamation.com/gov/p-communityServices.htm</a>, <a href="http://www.pentamation.com/gov/co-history.htm">http://www.pentamation.com/gov/co-history.htm</a></p>	<p>The Community Development application, "a complete project development and land management system which manages the entire zoning, planning, permitting, inspection and violation processes," is not described in much detail; website lists a Permits application, but no information specific to it: no product description, screenshots, features, technical requirements, or current customers roster, etc. Consequently, it is very difficult to ascertain its pros and cons.</p>

Description	Concerns
<p>Springbrook Customer Information Systems (CIS) by Springbrook Software and its Building Permits module</p> <p>For more information, see: <a href="http://www.sprbrk.com/index.html">http://www.sprbrk.com/index.html</a>, <a href="http://www.sprbrk.com/products/cis_building_permits.html">http://www.sprbrk.com/products/cis_building_permits.html</a></p>	<p>Springbrook CIS emphasizes its 'lot and customer' information sharing between modules, however there are no other community development management-focused modules; the website also stresses that the Building Permits module is "tightly integrated with Springbrook's General Ledger, Accounts Receivable, Central Cash POS, and Project Management modules," which is not relevant to Alachua County DGM. There is no mention of any interfaces to external applications, GIS, or the web, nor is there a geospatial component. CIS seems most fitting for small local governments seeking software for their entire organization and not concerned about integration with existing systems or GIS.</p>
<p>LAPS by Creative Information Systems Company (CISCO) is a generic Licensing and Permitting Software for use any permitting agency, not just building permit-issuing agencies.</p> <p>For more information, see: <a href="http://www.cisco-ps.com">http://www.cisco-ps.com</a>, <a href="http://www.cisco-ps.com/licensing_permits">http://www.cisco-ps.com/licensing_permits</a></p>	<p>Built not by CISCO the international technology company but instead by a small company based in New Port Richey, Florida with the same name, LAPS is part of their "public safety software" product offerings. Since LAPS includes the ability to create and track everything from Bicycle Licenses to Taxicab Permits to Burn Permits, its ability to be customized to the specific needs of Building Permits is limited.</p>
<p>asyst:Building Permits by USTI "is one of a comprehensive system of individual asyst™ applications that can be mixed and matched to meet the most exacting needs of your local government organization."</p> <p>For more information, see: <a href="http://www.asyst32.com/index.asp">http://www.asyst32.com/index.asp</a>, <a href="http://www.asyst32.com/deptdtl.asp?Dept=240">http://www.asyst32.com/deptdtl.asp?Dept=240</a></p>	<p>Product information about asyst:Building Permits does not reference any geospatial or web integration. It also requires customers to run Windows servers. There is no documentation or support section linked from the USTI website.</p>



Description	Concerns
<p>Land Management by Freedom Systems and its Permit and Code Compliance module</p> <p>For more information, see: <a href="http://www.freedomsys.com/index.php">http://www.freedomsys.com/index.php</a>,  <a href="http://www.freedomsys.com/software_pm_1.php">http://www.freedomsys.com/software_pm_1.php</a></p>	<p>There is no information about the technology that drives this product, but the company information page mentions that they work primarily with boroughs, townships, and authorities throughout the Mid Atlantic Region. Alachua County DGM and its needs seem to be outside of this scope and this locale.</p>
<p>HdL Permits Software by the HdL Companies is a stand-alone application; the company also offers a separate Code Enforcement application.</p> <p>For more information, see: <a href="http://www.hdlcompanies.com/index.cfm">http://www.hdlcompanies.com/index.cfm</a>,  <a href="http://www.hdlcompanies.com/index.cfm?fuseaction=nav&amp;navid=31">http://www.hdlcompanies.com/index.cfm?fuseaction=nav&amp;navid=31</a></p>	<p>The software features page for HdL Permits software does not list geospatial or web integration, nor is it integrated in any way with the Code Enforcement application; the technical specifications page indicates that it only works with Windows servers and that reports are powered by Crystal Reports.</p>

Description	Concerns
<p>CityView software and its Permitting and Inspections application (or <i>prebuilt</i>, as they call it) by Municipal Software.</p>	<p>The CityView software application family is unique in that there are built-in customization capabilities to the 'prebuilts' and an application builder toolkit. Its website strongly emphasizes how this lowers ongoing support costs by allowing users to modify the applications themselves. After some preliminary internet research, TOPP discovered that ongoing licensing and support costs for CityView are actually quite high.</p> <p>For Jefferson County, MO, the basic software maintenance fees are quoted at ~\$30,000 per year. The 'public portal' that allows access to CityView data via the internet requires a separate annual maintenance cost of \$18,354, which is based on a 2000 Census population of 183,542 (Alachua County 2000 Census population was 217,955<sup>28</sup>). And while integrated GIS capabilities are advertised, there is no mention of the \$9,000 (with an \$1,800 annual maintenance fee) that Municipal Software charges to use one's separately purchased ArcEngine with CityView. For \$5,000 with a \$1,000 annual maintenance, the read-only GIS Basic package will work with a separately purchased ArcReader.</p> <p>As you can see in Appendix 3, while already totaling over \$50,000, these are only some of the annual maintenance, support, and licensing costs associated with the CityView suite. Required ongoing fees at this level, due to the proprietary vendor annually, quickly absorb any cost savings gleaned from making small modifications to the software in-house.</p> <p>For more information, see: <a href="http://www.municipalsoftware.com/index.php">http://www.municipalsoftware.com/index.php</a>,  <a href="http://www.municipalsoftware.com/our_solutions/cityview/index.php">http://www.municipalsoftware.com/our_solutions/cityview/index.php</a></p>

This is one reason why CD-Plus is so expensive, since some customization will always be required to make a standard off-the-shelf product, created by a software company to meet generic needs, well-suited to the specific workflows that are unique to each purchasing entity. Further, a vendor has no incentive to create a product that is easily customizable by the customer. As the sole distributor and modifier of the product, the vendor reaps revenue from each customization and also re-asserts its lock-in by not allowing for customer-driven or outside consultant-performed customizations.

A core open source community development management software product that began with its permitting component, with a customization capability built in from the very start, could serve many Counties and could be collaboratively funded. For the generic GIS needs of this product there is existing open source software that is as good as proprietary options, which can be leveraged to provide true geospatial integration inside the product. Together, this would make for the beginnings of a compelling and expandable community development management software suite.

Additionally, TOPP views this as the most cost-effective option over the long term. It frees Alachua County DGM from the vendor lock-in that means costs for every single customization, expansion, or upgrade. Cost savings can be achieved through an independent, vendor-neutral bidding process for improvements to the products and for smaller changes, the GIS Division gains the ability to make performance tweaks, bug fixes, and workflow changes on their own. Pursuing an open source option also introduces the possibility of partnering with other Counties as potential co-funders. In this model, nearly all of the development costs for the core product can be split between the 'agreed parties', and the more Counties that come on board, the lower the investment required from each.

Collaboration among Counties is an opportunity for best practice sharing and other efficiencies, including the implementation of Florida State statute-specific requirements. If a few Counties ill-treated by CD-Plus came together to fund its replacement, it could include cost sharing of geospatial integration. This could otherwise be prohibitively expensive for these Counties and would be technically risky based on non-expertise of this company that has already produced failing systems.

#### *5.2.4 How Does Good Software Development Happen?*

Since it is the case that there are no existing open source solutions, if Alachua County DGM decides to pursue the development of an open source alternative to CD-Plus and its Permitting module, it is important to establish a development process that will facilitate the success of the software produced.

An iterative development process is equally important to the success of the project. There are significant gains in adopting an iterative process that will make certain that the software is both technically sound and fits the needs of its users. Some of these aspects are no mandatory migration date, the ability to adopt a more 'agile' development workflow, and a greater control over the timeframes of the project.

#### **Soliciting user input**

To ensure user satisfaction and adoption of the software, it is critically important to bring stakeholders into the project as 'local experts' at its earliest stages and to seek stakeholder participation in every stage of development. The GIS Division is familiar with this best practice, having sought extensive participation from a diverse group of stakeholders during the development of the GeoPT and Building Permit Tracking suite of modules. The GIS Division has also set a high bar with regards to the incorporation of user feedback into development, as evidenced by the gratitude it expresses for "the loyal support and feedback from our numerous

users over the years, [which] has helped us refine and improve constantly on these sites" and its extensive, publicly-accessible documentation of historic user feedback and site usage.<sup>29</sup>

As local experts, users of a piece of software are the best source of information about how a piece of software currently works and how it could be better. By examining the workarounds that these users have ingeniously invented to make the current software behave in a way that makes sense with work processes,<sup>30</sup> a smart software development team can glean great insight into how a new product should function.

A parallel investigation would also look at why the CD-Plus Growth Management and Development Review modules were never adopted by their intended users. According to the internal 'Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application,' which states that "from our interviews with these users, it appears that they have explored CD-Plus before they have made a decision not to make it part of their operations and not to use these two modules," the lack of adoption was a conscious choice on the part of those for whom the software was originally purchased based on their personal evaluations of the modules. The report also indicates that the modules "would have been embraced by their users, had they been able to efficiently support their operations and to solve their problems."<sup>31</sup> There is a goldmine of information and human resources here that can be drawn upon to make sure that ongoing design decisions are made correctly.

### **Migration**

The current process for CD-Plus upgrades is flawed. Upgrades are forced updates issued by the Growth Management staff member who copies the new files to a specific network share and overwrites the previous version of the files, and the end users do not have a choice whether or not they want to upgrade the software on their computer. There is no documentation about what changes have been made in each upgrade to soften the blow for end users. Worst of all, there is no archive of previous versions of the CD-Plus software, and, therefore, no mechanism to allow end users to revert back to a previous version of the software if the upgrade brings difficulties.<sup>32</sup> It is obvious that any smart development process should seek to avoid putting users through this if at all possible.

From a programming perspective, it is always difficult to work with legacy data and systems. To create a completely new Permitting module from scratch would be much easier if it did not have to incorporate any old data. This is impossible though, because any new Permitting module must include the historical record of building permits, so at a very minimum migration scripts will have to be written to bring the old data to the new system. While this is likely the easiest route from a technical development perspective, it is less than ideal from the users' perspective because it would require a hard date when users would have to stop using the old system and start using the new. Without a hard date for the switch, users would be updating two databases, which would lead to chaos since changes would not move across both systems.

The difficult part about a hard stop switchover is that some users may still prefer to use the old software, since they are already very familiar with it and may need time to learn something new. With a hard stop, there would be no option to let users transition over at their own pace.

An alternative would be to write the new system so it can function against the existing database. This ensures a much smoother transition, and indeed users could start using the new software before it was fully complete, which would provide ongoing feedback and bug reporting. The technical aspects of this option will be discussed below, but the important point here is that this iterative approach would be much kinder on users. It would even provide a way to directly address any concerns that arise during their preliminary use and adjust the software before completion, instead of having users wait for fixes to an existing final product.

### **Agile development model**

This constant seeking and incorporation of user feedback is a primary characteristic of the 'Agile' model of software development. The *agile* model can be characterized by its emphasis on short time frames between software releases, many rounds of significant customer feedback, and face-to-face communication—all of which leads to an agility in providing the client exactly what they want and not wasting time or resources on anything that won't really be used. It can be contrasted with the 'Waterfall' model, the more traditional way of building software, a sequential process that moves from requirements analysis to design to implementation to testing to integration and, finally, to maintenance where bugs and user concerns can begin to be addressed.

TOPP has chosen to mention these software development methodologies here because for this project, we strongly recommend leveraging *agile* techniques. CD-Plus saw a serious adoption failure by Alachua County DGM staff with a number of its features and modules. Extensive user investigations, meetings, and ongoing feedback from a diverse pool of stakeholders, which would happen naturally as part of an *agile* development process, are critical to ensuring the new product's success and uptake. Though employing this methodology can increase development costs because of the greater amount of face-to-face time and also require a dedicated investment of stakeholder time for interviews, user testing, and software evaluation, Alachua County DGM would quickly recoup its investment through benefits in the software delivered, ease of transition, and in the ways it seamlessly supports the workflows of the staff.

### **Timeframe**

Finally, with an iterative approach, Alachua County DGM can decide how aggressively to pursue open source replacements. If a slower schedule is preferred, then the migration can take place in successive steps over time, for even as long as several years, and slowly replace the most painful parts of the system. If done right, the first year's efforts should show significant improvements. After this initial round of investment, Alachua County DGM can evaluate its next set of pressing needs and define a scope of work for the next iteration. There is no need to commit wholesale to a vendor or an extensive scope of work upfront.

## 6.0 Possible Approaches in Moving Forward

### Summary

The route forward for GIS infrastructure improvements and evolution towards a fully open source ecosystem, as detailed above, is fairly straightforward. The remaining question is about timetables, and how quickly Alachua DGM wants to establish open source alternatives. This can be done all at the same time, or, if a more phased schedule is preferred than the GIS Division can focus on beginning with the most outmoded components, the web-mapping pieces, and moving out from there. By focusing its first efforts here, the GIS Division can capitalize on open source software that will bring great strides of progress to its most forward-facing components and provide clear usability and performance improvements to both internal users and the general public.

With the Permitting module, and CD-Plus more broadly, if Alachua County DGM chooses to replace its current software in order to achieve better geospatial integration and general usability improvements, there are clearly a number of trade-offs to be made. Building a new software tool is always a large undertaking, and success is certainly not guaranteed. Alachua County DGM can minimize the risks associated with new software development by creating a new package as open source software. As detailed later, this can improve the chance of success, especially if any other Counties are also interested in contributing to the project.

The best way to proceed would be for Alachua County DGM to contract with a company that specializes in building open source software to conduct extensive interviews of users and to build prototypes to be sampled by these stakeholders. This would give Alachua County DGM a sense for what is possible, and provide a more accurate understanding of the full scope of work of this undertaking—one based on detailed requirements and a more accurate estimation of the difficulty in working with the legacy systems.

Since a complete replacement for CD-Plus could be expensive, the important result of a prototyping and requirements gathering investment would be a staged development proposal comprised of manageable pieces that may be funded iteratively, but with each phase providing a new round of deliverables immediately usable by Alachua County DGM. For example, the first phase of development could include a straightforward Permitting module with preliminary geospatial integration, but which does not feature automatic validation of data, pervasive mapping, or code enforcement workflows. This could empower the County to obtain as much value as possible from each software development investment, and would allow the development to move forward with each budget allocation in the most fiscally efficient manner possible, as each funding round would be based on more and more accurate estimates of time and difficulty as the project takes shape.

### 6.1 Proposed Scopes of Work



*Note: The descriptions below are summaries. For full descriptions of each proposed scope of work, including features and requirements, limitations of scope, and rough estimations of work hours and costs, please see Appendix 1.*

### **Scope 1: Permitting module prototype with basic geospatial integration**

Features and requirements for this initial basic prototype are chosen to best illustrate the substantial usability and efficiency gains obtained from a Permitting module designed to reflect Alachua County DGM workflows, including their geospatial components. It will be comprised of functional user interfaces, whose interaction design supports the Permitting workflow, that are ready for user testing. There will be 2-3 test mapping integrations, each with onscreen displays of mapping data needed for the task at hand and a built-in mechanism that identifies the person currently responsible for the Permit's next step.

As a demonstration implementation of the Permitting module's front end for creating, updating, and tracking permits, this prototype will not be connected to the database; test data will not be preserved nor will historic data be available. Automatic validation of data will also be outside of the scope of this prototyping phase.

### **Scope 2: Web-based GIS infrastructure improvements and geospatial module migration**

GIS infrastructure improvements in the second phase of work center around replacing ArcIMS with GeoServer and OpenLayers. It will include configuring GeoServer to work with Alachua County data, initiating a sample that replicates and improves existing Alachua County DM maps' styling, preparing instructions on how to do this styling work in the future for the GIS Division staff, creating tiles for Alachua County data, and migrating the GeoGM and GeoPT modules. All improvements will be deployed live on the GIS Portal when ready and once data is configured, an exploration of Google Maps and Google Earth connectivity can commence.

Phases two and three, described in section 3.5 above, i.e. migration to 64-bit Linux and replacement of ArcSDE/Oracle with open source alternatives, will not occur at this time. GeoServer will not be configured to integrate the existing desktop GIS, nor will Alachua County DGM data stored in the CD-Plus database be geo-coded in this phase. Additional mapping styles and/or the migration of additional applications or modules will require a separate agreement, as will ongoing support after a successful deployment.

### **Scope 3: Permitting module completion**

As determined by TOPP's initial evaluation, scope three anticipates the creation of a full-featured Permitting module based on stakeholder needs that truly supports Departmental workflows and protocols. This can be broken down into smaller phases of work that proceed iteratively. TOPP has recommended beginning with a prototype that showcases the Permitting module's intuitive front end, which can be demonstrated during meetings with potential co-funding Counties. When completed, this module will support the creation, editing and tracking of new and historic permits with data standardization facilitated through customizable interfaces and automatic validation of data through geo-coding and through known relationships among data. Geospatial integration will feature pervasive maps, the ability to map any record, and the ability to view search results on a map. Support for other Development Application Review lifecycle workflows

will be external to the permitting module development, as will an integrated payment system, advanced reporting functionality, and the migration to a more persistent identifier for permits, as this process should be driven by a Departmental initiative, not by software development.

#### **Scope 4: CD-Plus Permitting module migration**

The fourth scope details steps to be taken to ensure a successful migration to the new Permitting module. The Permitting module's software development process will conclude with rigorous functional testing upon migrated datasets of actual Alachua County DGM data. When it is pronounced ready, a campaign to prepare will begin with hands-on training of staff members transitioning to the new system, final tweaks to the workflows based on feedback uncovered during this training, face-to-face knowledge transfer with the GIS Division staff, and, if possible, a parallel deployment with CD-Plus. The module will first go live to internal users and then move to a full, publicly accessible deployment. It is not possible to provide perpetual assistance with, or support of, CD-Plus and its modules after a standard migration period, even if Departmental use continues. After one year, a support agreement will be needed for services regarding the new Permitting module.

#### **Scope 5: Future Endeavors**

Once an open source Permitting module has replaced CD-Plus' Permitting and Inspections module, Alachua County can assess its needs and may choose to pursue some or all of the following: modules to support Code Enforcement and other Development Application Review lifecycle workflows; payment processing integrated with the Permitting module; email notifications with status updates; robust versioning of records enabling users to view, compare and revert to a previous version of a record; expanded participation in the open source community that builds around the software, including developing a robust API for the core Permitting software to assist others in creating plug-in modules that extend the software to meet their specific needs, streamlining migration processes for other Counties, or reconsidering ArcSDE/Oracle and open source alternatives.

## **6.2 Funding Sources**

Alachua County DGM has several possible avenues to pursue when seeking funds to develop a replacement to the Permitting module of CD-Plus. These include reallocation of funds, partnering with other Counties, sustainability investments, and joint initiatives.

The CD-Plus software has required significant ongoing funds in addition to a substantial two-phase purchase. Table 6.2 details both the upfront and maintenance costs that Alachua County DGM has invested in the failing software over the seven years of its deployment. With the GIS Division developing modules to accommodate many of the average 35 users who were previously dependant on CD-Plus, only 11-13 users will remain, with their use limited to the Permitting portion of the Permitting and Inspections module and a tiny subset of the Code Enforcement module.<sup>33</sup> This brings the ongoing support costs, which total \$63,700 - \$78,700, to an average of \$6,000 per user per year. With user dissatisfaction with CD-Plus well-documented, this seems like an unsatisfying expenditure for Alachua County DGM, and perhaps these costs could be re-allocated to invest in a new Permitting module that would provide greater user satisfaction and return on investment.



**Table 6.2 Analysis of CD-Plus-Related Costs to Date<sup>34</sup>**

Upfront Costs		
Phase I (1999)	Permitting and Inspection, Code Enforcement software modules, and Automated Inspections Results System (AIRS)	\$94,500 <i>(~\$117,000 in 2007 dollars)</i>
Phase II (2002)	Development Review and Growth Management software modules ( <i>unused</i> )	\$54,500 <i>(~\$62,500 in 2007 dollars)</i>
Database	Oracle Database 8i now using Oracle Database 10g	\$11,000 <i>may not include all costs</i> <i>(~\$13,600 in 2007 dollars)</i>
Dedicated Hardware	Hardware requisitioned for use with CD-Plus	<i>Specs and costs not well documented</i>
<b>Total recorded upfront costs:</b>		<b>\$160,000+</b> <b><i>(~\$193,100+ in 2007 dollars)</i></b>
Maintenance Costs		
Perconti Data Systems	Yearly Maintenance and Support Agreements ( <i>front end only</i> )	\$12,000 - \$17,000 per year 7 year total: ~\$106,000
Oracle Corporation	Yearly Maintenance and Support Agreements	\$ 1,700 per year 7 year total: ~\$12,000
Dedicated Personnel	Departmental Program Analyst	\$50,000 - \$60,000 per year 7 year total: ~\$400,000
<b>Total ongoing costs per year:</b>		<b>\$63,700 - \$78,700</b>
<b>Total Cost of Ownership for CD-Plus to date is approximately \$700,000</b>		
<ul style="list-style-type: none"> <li>• Product usage restricted to ~60 licensed users</li> <li>• With new modules, only 11 – 13 dependent users remain</li> <li>• Average number of actual users per day has been ~35</li> <li>• Average yearly CD-Plus specific cost is now ~\$6,000 per user</li> </ul>		

The second funding source that Alachua County DGM could consider pursuing is to partner with other discontented CD-Plus customers. Several neighboring Counties, including Marion County, use the software and have had similarly dissatisfying experiences with both the software itself and with Perconti Data Systems.<sup>35</sup> Additionally, Alachua County DGM staff members have attended the yearly Perconti Data Systems Users' Conference where they met other fellow CD-Plus users.

By drawing upon this network of frustrated CD-Plus user contacts, Alachua County DGM, with leadership from the GIS Division, can begin to reach out to other Counties to propose a collaboratively-funded alternative. Just as there are limited proprietary options available for Alachua County, there are no perfect alternatives in existence for any County. If each County purchases its own proprietary option, then they each pay for the software itself and for customization needed for their own departmental workflows and to be in compliance with Florida State statutes. A collaboratively-funded open source alternative could be used by any number of Counties. Moreover, if one or more Counties chose to invest resources in developing an in-house capacity for expanding the Permitting module or core community development management software, then everyone would benefit.

Since it can be difficult to coordinate amongst and within each County Administration, it may take time and effort to convince other Counties to join the development effort and to assist them with cutting through their own red tape. In light of this, one approach for Alachua County DGM to consider would be to constrain the initial phase of software development to a manageable scope, and allow other Counties to contribute later to improve and expand it. As mentioned above, an initial basic implementation could only focus on building permits with limited geospatial integration. The software development company could work with Alachua County DGM to scope out future phases of development, for features like expanded geospatial integration and code enforcement workflows, and provide cost estimates for each. These proposals, accompanied by a presentation and compelling demo of how far along and intelligent the basic Permitting implementation is, could be shopped around to potential partner Counties, who would each only have to contribute the next phase of funding to realize the benefits from past and future investments by others.

Once the Permitting module development is coming to a close, produced either with staged investments by Alachua County DGM or through collaborative funding partnerships with other Counties, next steps can be considered. This could involve writing new modules that each replace a CD-Plus module, like Code Enforcement or the unused Growth Management and Development Review modules. But it could also involve new components tailored to Alachua County DGM's processes with features that might otherwise have been spread out by a vendor over three or four different modules for purchase separately. By investing in open source software development, Alachua County DGM receives a voice in guiding the software's path, rather than being forced to accept whatever a vendor decides to provide.

### 6.3 Risks

Software development can be a hazardous process if not set about in the right way with the right people using the right approach to anticipate and meet challenges.

- Risk can be mitigated by choosing an open source development process.
  - ∇ If the company contracted to build the software goes out of business or otherwise does not work out, Alachua County DGM would have access to all the source code written, which could be passed on to the subsequent development team.
- Risk can be mitigated by choosing an iterative development process.
  - ∇ Don't buy the farm. Prototyping, detailed requirements setting for phased development, and documentation can insure the County gets exactly what it needs in the software.
- Risk can possibly be mitigated by sharing it with others.
  - ∇ Sharing costs across multiple Counties would decrease the investment required of each party and thereby spread risk.

One of the trickiest questions in this evaluation was about what to recommend for the migration from the existing CD-Plus system to a new application. As mentioned above, the crux of this issue is the existing data, and the fact that the Oracle database that it is stored in, with 241 tables, is a bit of a mess. Complicating this poor design is the fact that no official documentation on the database structure exists, there is no access to its data dictionary, it is not clear which tables are used and how they interrelate, and many standard database design features like foreign keys have not been employed.

Legacy data and systems complicate the development of new software and make a programmer's job much harder. If a new Permitting module didn't need to access historic data, it would be much simpler to build. The needs of Alachua County DGM do not allow for this, however, as access to the historical record of building permits is crucial to its operations.

This leaves several options for the development team:

- Option 1: Write, test, and, when the new Permitting module is ready, deploy migration scripts to bring the old data to the new system. As mentioned above, this is likely the easiest route from a development perspective. It is not ideal from a user's perspective though because it enforces a hard date for all users to transition to the new system, regardless of whether they are ready to do so.
- Option 2: Write the new system so that it can function against the existing database. From a user's perspective this is preferable because it means a smoother transition and lets them begin to use the new software even before it is fully complete. From a technical perspective, the downside to this approach is that it would be much more difficult to write code against the existing, undocumented database. It also ties the new program to the older system, with all of its quirks and limitations. This decreases its chances of the

new Permitting module truly taking off as an open source project by limiting its target audience, since it would depend on users migrating from CD-Plus, or else replicating a CD-Plus database just to use the software.

- Option 3: After leaving Alachua County, we hit on what could be an ideal solution. There is a programming technique called 'Object-Relational Mapping' (O/RM) for converting data between incompatible type systems in databases so that it can be used by object-oriented programming languages like Java, Python, and PHP. This technique, which is simplified by tools called 'object-relational mappers', should make it possible for software developers to write the best code they can and then spend time defining a mapping from their code to the legacy database.

By not constraining development to fit a CD-Plus mold, new code could be much more expandable in the future and could be able to run with other database options. And for new deployments without legacy data, the object-relational mapper would automatically define an ideal table structure. There are good object relational mappers for almost every OO language, and TOPP employee Ian Bicking originally wrote and maintains a leading Python O/RM tool called SQLAlchemy. Any O/RM tool under consideration would have to be evaluated extensively to make sure it works well against Oracle 10g and can handle all the nuances of the current CD-Plus Oracle database. But this is an exciting possibility with the potential to allow the new Permitting module to run alongside the old CD-Plus software during testing and even after full deployment.

#### **6.4 Summary Total Cost of Ownership**

While the initial investment to develop an open source Permitting module will be substantial, and may require more upfront cost than a proprietary solution if solely funded by Alachua County DGM, there is a significant return to this and any ongoing investment in the form of a Permitting module that:

- Does exactly what its users want and need.
- Reflects streamlined business flows, user stories, and intelligent functionality.
- Will, through these streamlined workflows that perform as users wish, increase Departmental efficiency.
- Will help counteract lost opportunities and long term damage caused by CD-Plus:
  - ∇ The irreversible impact on the structure of the data collected, imposed by the design and functionality of the front end.
  - ∇ The negative effects of the operational quality of product, user convenience and satisfaction, scale of utilization, etc., which collectively impact efficiency of operations and management of resources.

- ∇ The incurred indirect operational cost related to the architecture of the system, which imposes severe cost upon resources. For example, client-based vs. server-based deployment, choice of contemporary vs. old technology, etc.

Further, an open source Permitting module would support Departmental fiscal sustainability because of the increased control over future costs. It will not require a full time support person either as an administrator of the software or as a data-entering workaround. It will not require contract and maintenance agreements with any particular vendor, and all development and ongoing maintenance can be secured through a competitive bidding process. And it can be improved, changed, and built upon without constraint in the future.

## 7.0 Conclusion

The GIS Division's main goal is to democratize GIT as an open spatial enterprise, using geo-infrastructure as a framework for overall system integration. Enterprise applications that openly share spatial information help organizations work more efficiently, allowing data to move among staff members, tasks, and departments without special 'middleware.' In the past, proprietary GIS technologies limited interoperability, but Alachua County DGM can benefit from their new systems that share spatial information freely.

The GIS Division has made strides with putting CD-Plus data on mapping components, however there would be a lot more potential—both technically and with regards to user happiness and efficiency—if Alachua County DGM's Permitting module was either open source or built with geospatial integrations in mind, and ideally both.

### **Possibilities enabled by a Permitting module built with geospatial integration in mind**

A Permitting module is not simply a permitting-issuing workflow that creates and tracks process data, which can be then referenced by location on a map in an external application. This narrow view reflects the scope of the current CD-Plus Permitting module.

A more comprehensive, geospatially-integrated, Permitting module brings:

- Geo-coding of data upon entry so many workflow steps can gain automated data validation and field entry, minimizing the risks and inconsistencies introduced by hand-entered data.
- Maps that appear in the same window/screen of the application, or at a minimum do not require Alachua County DGM staff to open a separate GIS or map-viewing application or to find a paper map.
- An ability to view report outputs, custom queries, and search results easily on a map. For example: Where does this contractor have other active building permits? In what areas are we seeing the most recent applications? Is there a glut of expired permits in a particular section of the County where development may have slowed?

While new web-based and program-specific functionality could be built alongside the existing CD-Plus infrastructure, at some point it is better to invest in a system designed for and geared

toward web and geospatial integration instead of being bound to one-off solutions, with limited or no growth potential, that can only bandage over the software's shortcomings to accommodate short-term needs.

### **Possibilities enabled by a new Permitting module is built as open source software**

New open source community development management software, beginning with a Permitting module, can be both geospatially and web enabled as discussed above, but also can simplify workflows through user conversations and better usability/interaction design. This would allow the technology to truly be "a utility that facilitates the users' work and increases the efficiency of their operations, which is in the end, the test for all technology implementations."<sup>36</sup>

Potential benefits include:

- Improvements to usability that would be both timesaving and morale-saving for both current CD-Plus users and the GIS Division that supports them.
- A full-time administrator for the software is not required if users have what they need and want to get their jobs done, especially one who "mostly handles its mundane operations, most of which should in fact have been handled directly by users," as has been the case.<sup>37</sup>
- Changes to any part of the software, from the front end's user-facing screens to the back-end database, would be possible at any time.
  - ∇ This includes any process tweaks or requirement changes necessitated by adjustments to the Florida Statutes or brought about by updates to the Alachua County Comprehensive Plan.
- Better integration with other applications/web services: by keeping its component parts modular and with an accessible and definable API, the new application can be used by (and with tools from) other County Departments, other Counties, in partnerships with UFL, UC-Davis and other institutions, for special projects similar to LEMAC and the GIS Decision Model for Detecting Substandard Housing, and for non-DGM specific applications.
- A software ecosystem that is sustainable based on internal resources, support purchased only on demand, no support vendor lock-in, and by continually being and becoming the product the County actually needs.

### **Possibilities of operational gains enabled by a new Permitting module**

If Alachua County DGM did decide to invest in a new open source Permitting module, it could require by contract and expect the following:

- Excellent documentation:
  - ∇ User documentation that describes how to install, use or repair the software.
  - ∇ Developer documentation that describes, explains and instructs regarding the software's attributes, including its parts, assembly, installation, maintenance and

use. Good documentation also facilitates the improving, extending and updating of software.

- ∇ Documentation could be presented in a format that enables developers and users to improve and customize it, such as a wiki.
- Specific requirements that address issues that have hurt the GIS division in the past:
  - ∇ User-interfaces that enable standardization of data, such as Street Type values.
  - ∇ A mechanism that allows end users to revert back to a previous version of the software after a disappointing upgrade.
  - ∇ Customizable values in editable forms and other user interface design practices that will reflect the needs of the task at hand.
- Capacity building of the GIS Division through knowledge sharing and partnering with software developers:
  - ∇ GIS Division staff members could work closely with the software developers and obtain a strong understanding of all aspects of the Permitting module, including the User Interfaces, the database, software administration, etc. as well as how to improve and expand the software in-house.
  - ∇ Developers would have ideal access to real use cases and actual data for testing.
- Authority over the work product:
  - ∇ Ownership in open source software can be complicated because, unless assigned away, each contributor holds the copyright to his/her specific contribution. While Alachua County DGM could retain copyright ownership as part of its contract with software development company it hires, this would come with a perpetual administrative burden of managing a copyright assignment process from all future code contributors to the open source project, who may or may not be hired by or affiliated with Alachua County DGM.
  - ∇ However, open source licenses grant the right to copy, adapt or distribute the source code freely. By choosing the most appropriate open source license for the new software, Alachua County DGM will thereby retain authority over the software and have the freedom to utilize and adapt the software in whatever way it wishes. See table 7.0 for a comparison.
- Built-in facilitation of good software management practices:
  - ∇ The software can be designed to facilitate good management of itself with easy administration and maintenance tools, built-in bug reporting, correspondence forms and issue tracking, user-editable documentation, etc. to ease what had been burdensome to the Departmental Program Analyst.

**Table 7.0 Comparison of Rights Granted by Licensing Agreements**

Perconti Data Systems, Inc. Maintenance and Support Agreement	Open Source Software Distribution/Licensing Policies
Customer may install one set of the Vendor Programs, in the most current form provided by Support Vendor, in Customer's own facility	Anyone can install the software as often as they wish, in any version old or new, anywhere they would like: home, office, school, different Departments, etc.
Customer may use such Vendor Programs in connection with the Licensed Programs, and in a manner consistent with the requirements of the Agreement, for the purposes of serving Customer's internal business needs;	Anyone can use the software in conjunction with any other program, in a manner consistent with the terms of the specific OS license applied to it, for any purpose. <i>(OS licenses cannot discriminate against field of endeavor)</i>
Customer may make copies of the Vendor Programs in machine readable form for nonproductive backup purposes only.	<b>Copies:</b> Anyone is granted the right to freely copy and redistribute the software. An OS license must not restrict any party from selling or giving away the software and shall not require a royalty/fee for such sale.
Customer may not use, copy or modify the Vendor Programs, or any copy, adaptation, transcription, or merged portion thereof, except as expressly authorized by Support Vendor.	<b>Form of the copy:</b> The program must include its source code giving anyone the ability to view and change the code that drives the software.
Customer's rights shall remain in effect for so long as Customer is authorized to use the Licensed Programs under the License Agreement.	<b>Modification:</b> Anyone has the right to make changes to the software. An OS license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.
Upon termination of such License Agreement, Customer shall return or destroy the Vendor Programs, and returning the Vendor Programs in the manner required by the License Agreement shall be sufficient for such purpose.	<b>Authorization:</b> All rights attached to the program (to use, copy, and modify it) must apply to all to whom the program is redistributed, without the need for execution of an additional license by those parties.
	<b>Termination:</b> There is no automatic termination or expiration of OS licenses and the rights they grant.
The Vendor programs are and shall remain the sole property of Support Vendor, regardless of whether Customer, its employees, or contractors may have contributed to the conception of such work, joined in the effort of its development, or paid Support Vendor for the use of the work product.	An author, even if contributing to a bigger project, owns the copyright of his/her code and can assign an OS license to it. This is true unless the contract under which the code was written specifies otherwise or if the author has willfully assigned the copyright away. Alachua County DGM could hold or share copyright of the software, if desired.
Customer shall not assert any right, title or interest in such works, except for the non-exclusive right of use granted to Customer at the time of its delivery or on-site development.	To keep ownership centralized and make licensing enforcement easier, some OS projects ask that contributors explicitly assign the copyright of their contributions to a body that administers the project.



## Final Thoughts

Even with the upfront investment required, it is a fiscally responsible decision for Alachua County DGM to initiate the development of an open source Permitting module to replace the CD-Plus Permitting and Inspections module. This type of investment is in the tradition of previous information technology infrastructure updates, which focused on GIS capacity building, geospatial decision support for planning activities, asset and record management for land administration systems, and web development and maintenance.<sup>38</sup>

It is also in line with the prudent practicality and forward thinking that characterize Alachua County DGM. Since its inception, the GIS Division has been striving to establish itself as a state of the art unit, while accomplishing its daily duties. Initiating an open source replacement for the Permitting module reflects this by creating an opportunity for open source leadership and the ability to draw upon cutting edge technology, all while ensuring the sustainability of operations.

The visualization and geo-coding of collected data, when made trivially easy for the staff of Alachua County DGM, greatly increases the effectiveness of Geospatial Decision Support Systems, the accuracy and efficiency of Land Administration Asset and Records Management, the potential to deliver a compelling set of E-Services to the public, and the security, standardization, and integrity of data that drive the internal and external-facing Web Applications. In this way, a geospatially integrated and open source Permitting module will positively impact nearly every activity critical to the mission of Alachua County DGM and its GIS Division.

## **Appendices**

**Appendix 1: *Proposed Scopes of Work identified in TOPP's feasibility study on integration of open source GIS with Alachua County DGM's Permitting module, The Open Planning Project***

**Appendix 2: *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application, Alachua County DGM GIS Division***

**Appendix 3: *Building Division Permit System Bid Tabulation: September 2007, Jefferson County, Missouri***

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<sup>1</sup> Alachua County DGM, "Department of Growth Management," Alachua County Department of Growth Management, <http://growth-management.alachuacounty.us/index.php>.

<sup>2</sup> Alachua County DGM GIS Division, "GIS and Mapping Division," Alachua County Department of Growth Management, [http://growth-management.alachuacounty.us/gis/gis\\_division.php](http://growth-management.alachuacounty.us/gis/gis_division.php).

<sup>3</sup> Alachua County DGM, "About the Growth Management's site," Alachua County Department of Growth Management, <http://growth-management.alachua.fl.us/about.php>; Alachua County DGM GIS Division, "History of the GIS Division: Fall 2000-2001," Alachua County Department of Growth Management, [http://growth-management.alachuacounty.us/gis\\_history.php?year=2001](http://growth-management.alachuacounty.us/gis_history.php?year=2001).

<sup>4</sup> For more information, see <http://geoserver.org/> and [http://www.moximedia.com:8080/imf-ows/imf.jsp?site=gs\\_users](http://www.moximedia.com:8080/imf-ows/imf.jsp?site=gs_users), <http://trimet.org/index.shtml> and <http://maps3.trimet.org/public/map/map>, and <http://www.mass.gov/mgis> and <http://lyceum.massgis.state.ma.us>.

<sup>5</sup> For more information, see: <http://techblog.terrapages.com/2007/05/federated-geo-synchronization-standards.html>.

<sup>6</sup> For more information, see: <http://postgis.refrations.net/> and <http://www.postgresql.org/>. PostgreSQL license info: Any modifications, enhancements, or changes made to PostgreSQL by an individual/organization are theirs to do with as they please under its open source BSD License. Its website concludes, "PostgreSQL is not only a powerful database system capable of running the enterprise, it is a development platform upon which to develop in-house, web, or commercial software products that require a capable RDBMS."

PostGIS license info: PostGIS has been developed as a project in open source spatial database technology and is licensed under the GNU General Public License.

<sup>7</sup> Jason Weinberger, "The Spatial RDBMS in the Enterprise," *Directions Magazine* October 13, 2002, [http://www.directionsmag.com/article.php?article\\_id=259](http://www.directionsmag.com/article.php?article_id=259).

<sup>8</sup> See for example: <http://apb.directionsmag.com/archives/3393-Tentative-Plans-for-ArcSDE-Support-for-PostgreSQL.html>

<sup>9</sup> See for example: <http://schoolperformancemaps.com/fl/>, <http://jerseymap.org/>, [http://www.onnyturf.com/gmap/index.php?gmap\\_id=2](http://www.onnyturf.com/gmap/index.php?gmap_id=2), and <http://maps.huge.info/places.htm>.

<sup>10</sup> The GIS Certification Institute (GISCI), "A GIS Code of Ethics," The GIS Certification Institute, [http://www.gisci.org/code\\_of\\_ethics.aspx](http://www.gisci.org/code_of_ethics.aspx).

<sup>11</sup> Alachua County DGM GIS Division, "About the Building Permits Tracker," Alachua County Department of Growth Management, <http://growth-management.alachuacounty.us/gis/applications/about.php>.

<sup>12</sup> Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application* (Gainesville, FL: Alachua County Department of Growth Management, August 2007), section 4.1.

<sup>13</sup> Perconti Data Systems, Inc., "CD-Plus Modules," Perconti Data Systems, Inc., <http://cdplushq.com/modules.htm>.

<sup>14</sup> Juna Goda Papajorgji to Rick Drummond (AICP, Director), Memorandum re: phasing out of CD-Plus and our 2008 Maintenance Agreement with Perconti Data Systems, Inc. (Summer 2007,) 2.

<sup>15</sup> Wikipedia contributors, "Mode (computer interface)," Wikipedia, The Free Encyclopedia, [http://en.wikipedia.org/wiki/Mode\\_\(computer\\_interface\)](http://en.wikipedia.org/wiki/Mode_(computer_interface)).

<sup>16</sup> Detailed in Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, 7 & 52 in Appendix 4, 4 - 5 in Appendix 1.

<sup>17</sup> Alachua County DGM GIS Division, Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application, section 4.4 paragraph 1.

<sup>18</sup> See chart in Alachua County DGM GIS Division, Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application, section 4.2.

<sup>19</sup> Two examples of these open source modules are ECHO's Internet Payment Gateway (see [http://www.echo-inc.com/payment\\_gateway.html](http://www.echo-inc.com/payment_gateway.html)) and jbilling (see <http://www.jbilling.com/>)

<sup>20</sup> The GIS Division believes this process could easily take one to two years, during which Alachua County DGM operations would be interrupted. See Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 3.2 paragraph 1.

<sup>21</sup> See the feature list at <http://cdplushq.com/modules.htm>, which includes a 'Customizable Help file with your policies and procedures'. Expanded discussion of Perconti Data Systems's failure to provide adequate responses to support requests can be found in Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 5.1 and 2-3 in Appendix 10.

<sup>22</sup> Perconti Data Systems, Inc., *Maintenance and Support Agreement FY 2008* (St. Petersburg, FL: Perconti Data Systems, Inc., July 2007), 2.

<sup>23</sup> Perconti Data Systems, Inc., *Maintenance and Support Agreement FY 2008* (St. Petersburg, FL: Perconti Data Systems, Inc., July 2007), 1.

<sup>24</sup> Perconti Data Systems, Inc., "CD-Plus Modules," Perconti Data Systems, Inc., <http://cdplushq.com/modules.htm>.

<sup>25</sup> Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application* (Gainesville, FL: Alachua County Department of Growth Management, August 2007).

<sup>26</sup> HRG Technology Group, *Case Studies: City of Sunnyvale* (Cedar Rapids, IL: HRG Technology Group, September 2002), <http://www.hrgtechgroup.com/casestudies.html>. For more information, see: <http://www.hrgtechgroup.com/egovsol.html>,

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[http://www.govpartner.com/index.asp?Type=B\\_BASIC&SEC={92B49290-78D1-41C2-B0C2-14DA98D26135}](http://www.govpartner.com/index.asp?Type=B_BASIC&SEC={92B49290-78D1-41C2-B0C2-14DA98D26135}), [http://leavcom.com/gp\\_080801.htm](http://leavcom.com/gp_080801.htm)

<sup>27</sup> GovPartner, *Silicon Valley City and San Diego Firm Announce e-Government Public/Private Partnership* (San Diego, CA: Berryman and Henigar, Inc., September 27, 2000), [http://www.govpartner.com/index.asp?Type=B\\_PR&SEC={21D7DDB4-CFAE-46A4-98FB-34698FFED6C3}&DE={D0DE58BC-72EF-48E7-BE6F-4D6039AD273D}](http://www.govpartner.com/index.asp?Type=B_PR&SEC={21D7DDB4-CFAE-46A4-98FB-34698FFED6C3}&DE={D0DE58BC-72EF-48E7-BE6F-4D6039AD273D}).

<sup>28</sup> Emergency Services Consulting, Inc., *Alachua County Fire and Emergency Services Plan 2004*, (Wilsonville, OR: Emergency Services Consulting, October 2004), 169.

<sup>29</sup> Alachua County DGM, "About the Growth Management's site," Alachua County Department of Growth Management, <http://growth-management.alachua.fl.us/about.php>.

<sup>30</sup> See materials referenced in: Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 4.2 paragraph 1.

<sup>31</sup> Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 4.4 paragraph 4.

<sup>32</sup> Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 4.1 paragraph 2.

<sup>33</sup> Juna Goda Papajorgji to Rick Drummond (AICP, Director), *Memorandum re: phasing out of CD-Plus and our 2008 Maintenance Agreement with Perconti Data Systems, Inc.* (Summer 2007.) 1.

<sup>34</sup> See Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 2.1.

<sup>35</sup> Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 5.2.4.

<sup>36</sup> Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 4.4 paragraph 1.

<sup>37</sup> Alachua County DGM GIS Division, *Report on the evaluation of Perconti Data Systems, Inc. CD-PLUS software application*, section 5.2.4 paragraph 4.

<sup>38</sup> Jones Edmonds and Associates, Inc., *Alachua County Department of Growth Management Data Management Evaluation Report* (Gainesville, FL: Jones Edmonds and Associates, Inc., May 2006), 5.