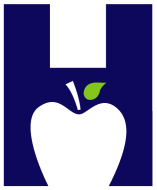

Oklahoma State
Department of Health

Oklahoma State Department of Health Geographic Information Systems (GIS) Needs Assessment and Requirements Analysis

Report of Findings and Recommendations

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1. Executive Summary

Geographic Information Systems, GIS, is the marriage of geography, information technology and management information systems….

The OSDH GIS Needs Assessment and Requirements Analysis (NARA) was commissioned to document and evaluate the current state of GIS use in OSDH, as well as previously unidentified needs for the technology. Extensive interviews were conducted with managers and data users from across all Service areas over the course of eight months. This report is the product of the synthesis of the interviews and other observations and experiences of the OSDH GIS Coordinator and GIS Advisory Committee (GAC) members (Appendix 5).

The current state of GIS implementation at OSDH is in its infancy. However, there is great interest in and potential for expanding the use of this technology, as well as a desire to better leverage resources currently held by the agency. Table 1 describes the primary findings of the NARA and related recommendations put forth by the GAC. These findings are described in more detail in Chapter 5.

Table 1: Findings and Recommendations of the GIS Needs Assessment

Finding	Recommendation
Coordination/Capacity	
Historically, the model of GIS coordination at OSDH has been decentralized.	OSDH can better focus mapping activities by continuing with and expanding upon the centralization efforts that were initiated in 2006 with the hiring of the GIS Coordinator and strengthened by the creation of the GIS Advisory Committee. Carefully guided centralization efforts will provide for efficient and effective application of GIS technology.
Understanding and utilization of GIS technology within OSDH programs is extremely varied.	Support for GIS training at differing levels for interested staff will allow for more effective use of maps and spatial analysis.

Finding	Recommendation
Coordination/Capacity	
OSDH is an extremely varied agency with a wide range of services and priorities. Nevertheless, almost all programs have some kind of geographic component to their data/work and share a common desire to incorporate the use of GIS in their work.	Continuing efforts to move toward a more centralized GIS system will prepare OSDH to meet the mapping needs of all programs. Collaboration of GIS work across programs would maximize efforts and resources.
OSDH senior leadership has expressed support of GIS use by supporting the establishment of a Coordinator position and funding software centralization.	The GIS system could best maximize this support by focusing early GIS work on projects that will provide the greatest return on investment to encourage continued support of the technology.
OSDH staff have been motivated to organize GIS interest groups, including the GIS Users Group and the GIS Advisory Committee.	The GIS system will be most successful if it is designed with input from the GIS interest groups and its use promoted through these groups.
Data Creation and Maintenance	
Many of the mapped data at OSDH are not in GIS formats (ex. PowerPoint maps), thus they are not easily updated or shared. Because of this, much staff time is used to re-create maps from scratch.	Staff time and effort can be saved by making available base GIS data and frequently used maps to agency map authors via a central database that can be accessed over the Intranet. These data are most useful and reliable if they are quality-assured and updated by GIS staff on a regular schedule.
There is an initiative in the Health Care Information Division to create a data warehouse that will ultimately be expanded agency-wide.	Incorporating the GIS database into the larger agency data warehouse will allow for the GIS database to be integrated with other agency data systems, and data users will be able to easily locate GIS data.
Programs have a need to access GIS data pertaining to neighboring states for consideration of border issues in health care utilization evaluation, emergency response, and disease investigations.	Efforts to include health resources data from bordering states in the OSDH GIS database will be recognized by many staff.

Finding	Recommendation
Data Creation and Maintenance	
There is a need to normalize datasets and to create agency-wide identifiers for people and facilities to enable higher quality analysis and program evaluation. The Health Informatics Council and its subcommittees are addressing people identifiers.	Normalizing and applying data cleaning standards to databases will facilitate easier GIS mapping. Also, the GIS Advisory Committee would be an ideal group to collaborate with other agency workgroups that will develop common facility identifiers (i.e. for hospitals, long term care facilities).
Geocoding of client data and facility locations is not complete, highly accurate or standardized. Addresses are not often cleaned and rarely validated prior to geocoding.	Data quality can be improved by implementing standardized geocoding procedures that include address cleaning and validation. The GIS Advisory Committee and Master Person Index Committee have initiated this effort.
Base geographic data used to geocode is out-of-date.	Evaluation and purchase of high-quality roads and zip code datasets would support accurate geocoding efforts.
Most programs collect mailing addresses for clients, facilities, or other entities, but it is not clear if these represent physical residence location or not.	Programs can improve their ability to map their data by emphasizing the value of geocodable addresses and implementing guidelines to obtain that information when collecting data.
There is the perception that a centralized GIS database would contain program datasets.	Users will have more confidence in a centralized GIS database that does not contain program or client data, adheres to HIPAA and other state and federal data confidentiality guidelines, and is designed to limit access to sensitive geographic datasets.
There is concern in several programs about data security and access issues.	Users will be more confident in and likely to participate with the GIS database if they are reassured by communication about a high level of data security in the geodatabase, which will include varying levels of user access.

Finding	Recommendation
Computational Infrastructure	
Most staff have access to desktop, and sometimes laptop, computers with sufficient capabilities to use GIS software.	This level of computing access can be maintained if GIS software computing needs are considered in future hardware purchases (desktops and laptops) and efforts are made to provide GIS computing resources to all staff by adding free GIS software to the standard computer image. Computing resources may be more difficult to provide to county health department staff.
There are data and web servers already being used to support GIS activities, such as the mapping component of the PHIDDO system. IT staff maintains these servers.	Continued IT support for the GIS servers, as well as server access for the GIS Coordinator to manage the GIS system, will contribute to its strength and reliability. GIS Strategic Plan recommendations regarding a timeline for future server upgrades will support an expanded GIS program and should align with IT plans for server upgrades.
OSDH owns Global Positioning System (GPS) units but they are under-utilized.	Existing GPS resources could be used more efficiently if they are shared among programs and made available to OSDH field staff. The use of GPS by field staff could reduce travel costs and improve staff efficiency.
There has been a previous investment in purchasing GIS software licenses. The license maintenance has been centralized to better utilize the resources.	Several OSDH programs have been proactive in supplying GIS software to their staff. The agency can continue to build on this previous investment by supporting maintenance for software licenses and responding to needs for more licenses as use of the technology grows. Equipping most staff with free GIS software, such as ArcReader, could reduce demand for purchased licenses.

Finding	Recommendation
Client Services and Outreach	
Programs would like to have a web-based approach to sharing mapped data and information with the public and partners.	GIS staff can address this need by developing an interactive web map (or series of maps) to be accessed by the public to locate public health information and resources. Web mapping can also be incorporated into current systems, such as OK2SHARE and PHOCIS.
Supplying map-based referrals can enhance client services in county health departments.	By providing access to an online mapping system integrated as a module in PHOCIS, OSDH can equip county health department staff to customize client referrals for services by their distance from a point of reference (i.e. client's home, work, transportation network).
OSDH programs have a need to target resources (staff time and funds) by using a geographic approach.	With program budgets in decline in several areas, programs could benefit by utilizing GIS, when possible, to target staff time and funds to specific geographic areas of the state.
Metadata and Standards	
There is little creation of metadata for GIS data in OSDH.	Data quality and appropriate data use can be improved by OSDH adopting an internationally recognized metadata standard to be applied to all OSDH-created GIS datasets. Training and education about metadata will encourage staff to use and create thorough and standardized metadata.
There is no standard roads dataset used for geocoding at OSDH.	Consistency and reliability of geocoding results could be improved through the evaluation and adoption of a standard roads dataset to be used for all geocoding at OSDH. This will help to ensure that geocoding is consistent across programs and that GIS data will align correctly on maps.

Finding	Recommendation
Metadata and Standards	
There is no standard map projection and coordinate system identified for OSDH. Inappropriate or inconsistent use of map projections could result in misleading or, at least, inconsistent maps and analysis.	The reliability of agency mapping and spatial analysis can be improved by the adoption of agency standards to guide the use of map projections and coordinate systems. It can also be improved through training on the appropriate use of projection standards for mapping and analysis.
There are no standards applied to the creation of maps for use in presentations and published documents (printed and electronic). There is no use of disclaimers on maps that could protect OSDH from inappropriate use of agency maps.	Development and adoption of a series of standard map templates and map design recommendations, including standard map disclaimers, can ensure that there is consistency to the look of maps across the agency.
GIS Staffing	
Some program staff conduct GIS work in addition to their regular job duties. Fulltime GIS staff are best equipped to provide support and expert advice to programs regarding their mapping activities.	Learning basic GIS skills will allow OSDH staff to create maps and perform spatial analysis as needed to support their primary work activities. However, consideration should be given to hiring additional fulltime GIS specialists to support program-specific GIS activities.
There is only one staff person (the GIS Coordinator) who is devoted fulltime to supporting the centralized GIS system that enables program staff to efficiently use GIS technology.	In order to support an agency-wide GIS system that includes shared software, a GIS database requiring frequent updates, and a variety of mapping systems to maintain, it would benefit the agency to support hiring additional FTEs in GIS staff positions.

Finding	Recommendation
GIS Training and Resources	
There are introductory GIS trainings available to all central office staff at least two times per year.	OSDH can continue to save on training costs by offering these trainings and eventually expanding the offerings to county health department staff. By offering internally developed trainings, the content can be customized to suit agency needs and money can be saved by not sending agency staff to external trainings, which incur travel and registration costs.
There is a need for multiple levels of training geared to managers and support staff that introduces them to the capabilities for using GIS technology for program management and evaluation.	Providing support for the development of additional trainings will help expand the technology and educate managers and support staff about the possibilities for incorporating GIS into program evaluation and management of people and resources.
There are several specialized software extensions that OSDH has purchased but are rarely used because staff are not trained to use them.	The agency will make better use of these currently held software resources by supporting the development and offering of trainings that will teach staff the use and applications of the GIS software extensions.
In many programs in the agency, primarily in the GIS Coordinator office, there are printed GIS reference materials, such as books, magazines, and manuals that could be shared with GIS users across the agency. There is not currently a system to organize that sharing.	A GIS library that resides in a central location in the OSDH central office will provide a place where staff can peruse GIS reference materials and potentially borrow those materials. Establishment of borrowing guidelines and a system to track the materials can facilitate this process.
GIS Priority Applications	
There is a need to identify underserved areas.	OSDH can benefit from using GIS to identify geographic areas of the state that are underserved by its programs, staff or other health resources. This mapping can help direct and support decision-making regarding areas of the state in which to focus efforts.

Finding	Recommendation
GIS Priority Applications	
OSDH frequently has interactions with the Oklahoma legislature that could be enhanced with maps.	By providing access to maps of current legislative districts in the GIS database, and encouraging staff to customize these maps for legislative communications, OSDH will support agency efforts to communicate program data and/or priorities in a relevant and visual format.
Routing and network analysis is a common need throughout the agency. There is a need for more efficient in-state travel planning that could be supported by the GIS system and specialized routing tools. There is also a common need for identifying service areas based on travel time rather than straight-line distance.	The use of GIS technology for network analysis could support planning for staffing and evaluation of service area size. OSDH can maximize this potential by encouraging training in and use of the network analysis tools.
There is interest in using advanced spatial analysis methods (i.e. cluster analysis, kernel density analysis, network analysis) to enhance research and program evaluation.	The use of advanced spatial analysis methods can be supported by emphasis on training and collaboration and by hiring additional Geostatistical analysts to support advanced GIS implementation.

2. Project Background

2.1 Rationale

The use of Geographic Information Systems (GIS) in public health research and planning has significantly increased in the past decade. Many state health departments have integrated computer-mapping technologies into their everyday workflows. The Oklahoma State Department of Health (OSDH) has come into this area somewhat late as compared to several other state health departments and Oklahoma agencies; however, this places the agency in a good position to learn from other organizations about mistakes made and lessons learned in GIS implementation projects.

There have been non-electronic methods of mapping and spatial analysis going on in OSDH for years. The use of road maps, pushpins, and PowerPoint maps has characterized most mapping efforts prior to 1996 and continues to this date for several programs (Figures 1 - 5). Computerized mapping with GIS was first used in OSDH in 1996 by the Chronic Disease Service for mapping cancer registry data, followed by the Injury Prevention Service in 1998 and the WIC Service in 2001. Awareness of GIS and use of the technology expanded significantly in early 2005 when a Chronic Disease epidemiologist started the OSDH GIS Users Group to provide a forum for agency GIS users to ask questions, share data and information, and request support for projects. Out of this group came the desire to conduct a GIS needs assessment and hire a GIS Coordinator with the ultimate goal of setting up a centralized GIS system for OSDH. The Coordinator was hired in September of 2006 and assumed the responsibility of the needs assessment as her primary deliverable in her first year. The needs assessment was completed in August of 2007, and this report is the outcome of that project.

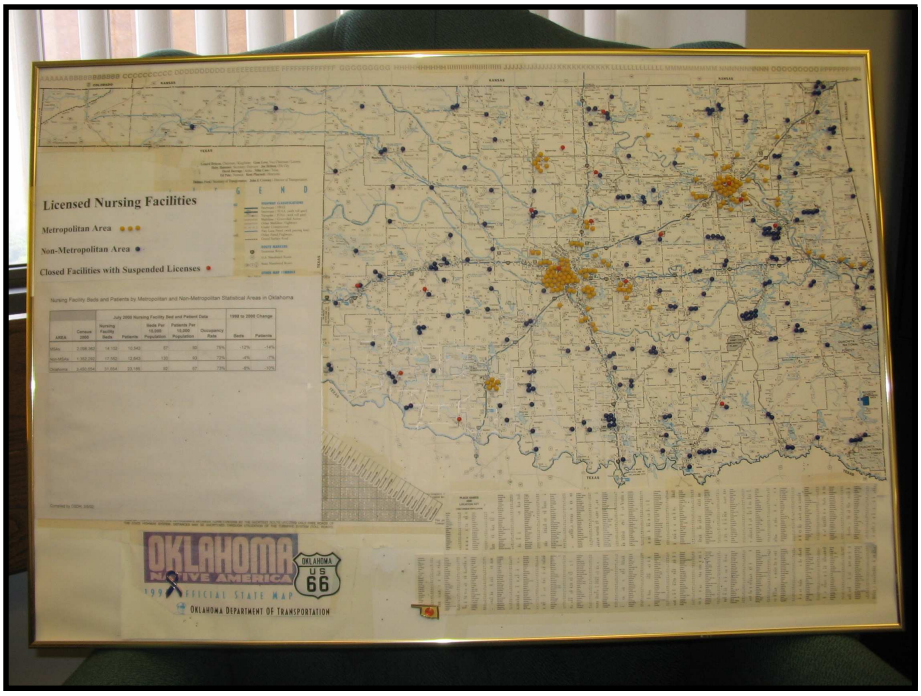

Figure 1: Pushpins on a road map depicting licensed nursing facilities sometime in the 1990's, used in Protective Health Services

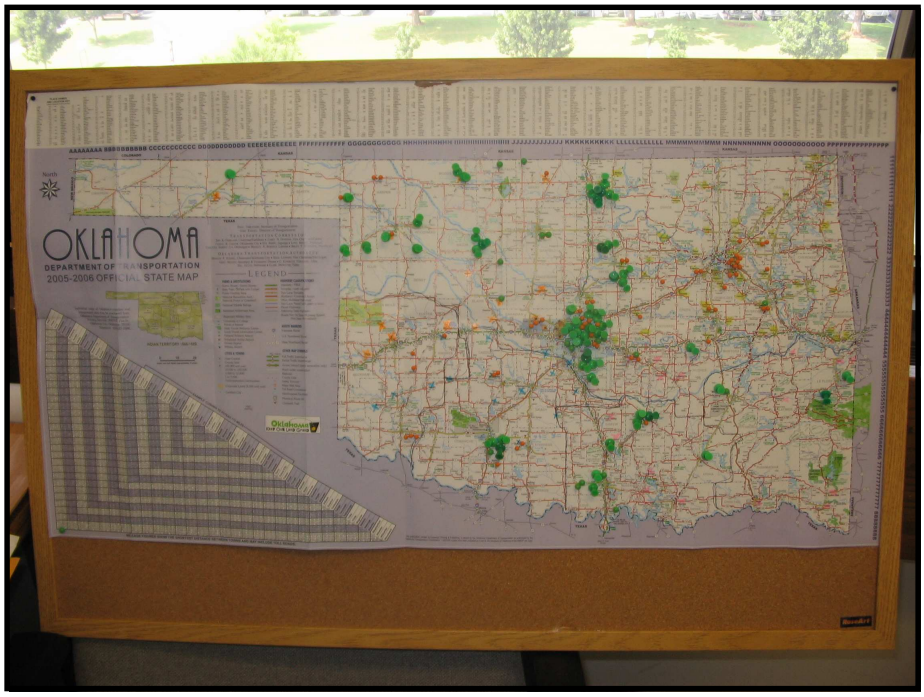

Figure 2: A road map with pushpins depicting arthritis resources, updated and used recently in Community Development Service

Figure 3: A laminated road map used in an Acute Disease Service conference room

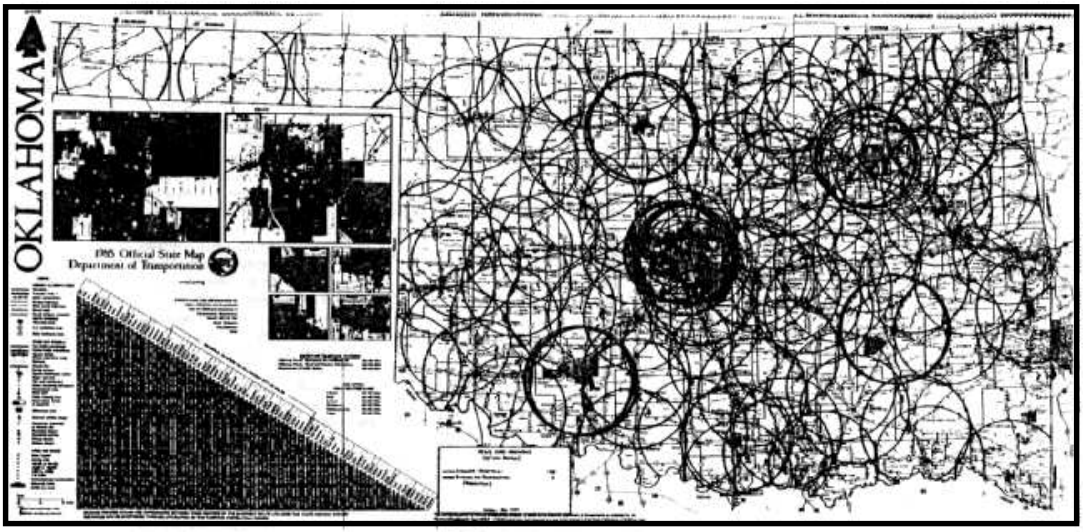

Figure 4: A state road map depicting 25-mile buffers around licensed acute care hospitals around 1986, from the "1985 State Health Plan, 1986 Supplement"

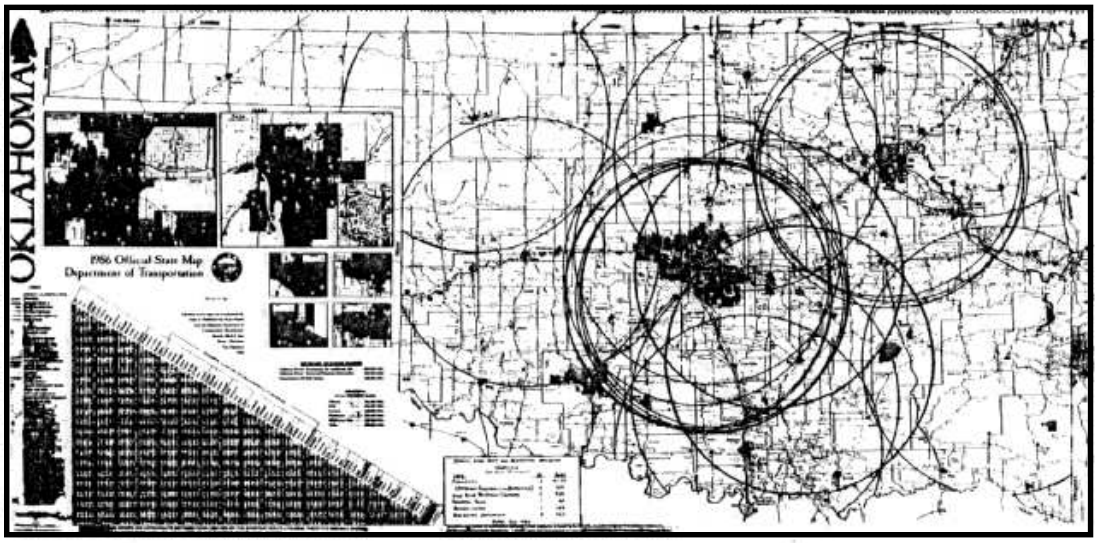

Figure 5: A state road map depicting 60-mile buffers around special/restricted/long-term hospitals around 1986, from the "1985 State Health Plan, 1986 Supplement"

2.2 Scope

The scope of this project included a multi-phase plan to identify agency GIS needs and address those needs through the coordination of GIS activities, including the eventual design of a centralized, agency-wide GIS system. The phases of the project included (1) conducting in-depth interviews with staff in all program areas, a few county health departments, other state agencies and state health departments; (2) conducting an inventory of current software, hardware and geospatial data resources in the agency; (3) producing a needs assessment report to communicate findings; (4) assembling a GIS advisory committee to assist with the design of the centralized GIS database; and, (5) recommending an appropriate GIS system for OSDH. This report details the completion of and findings from numbers 1 through 4. Number 5 will be addressed in a later project phase.

3. The Organizational Context

3.1 GIS at the Oklahoma State Department of Health

To date, GIS use at OSDH has been fragmented and uncoordinated with only a few program areas and individuals engaging in computer mapping and spatial analysis activities. Time and money have been invested in GIS technology – including software, data, hardware and staff training - but these have been acquired in a fragmented manner across the agency. There has been much duplication of effort in acquiring and storing data and creating maps. The GIS software and data have not been made widely available to staff outside of a few program areas and numerous acquired GIS resources have been under-utilized due to the current, decentralized state of GIS at OSDH.

However, it is beneficial to the agency that there has been initial investment in GIS technology, and there is emerging interest in using GIS among OSDH staff. There are many programs that have not previously purchased GIS software but see the potential for using the technology in their work and would like to begin doing so.

The remaining sections of this chapter will outline the ways in which OSDH staff has been using manual and computer mapping in their work and how they would like to use GIS in the future. Information for these sections came from the needs assessment interviews as well as a review of information on the OSDH website.

3.2 GIS Use and Needs Within OSDH

The programs and services offered by OSDH are classified within the agency by subject and/or population-served. Under the Commissioner of Health are eleven direct report offices and five Deputy Commissioner (DC) Areas. Under each DC area, there are a number of Services with various programs or divisions within each Service. The interviews for the GIS needs assessment were conducted in groups by DC area with significant effort made to speak with Service area chiefs, staff with GIS experience, and at least one person from every program or division. Staff members in the direct report offices were also interviewed. Appendix 1 contains tables that list the staff members – by DC area - who were interviewed for the needs assessment.

The following sub-sections include descriptions of each service area in OSDH, including brief descriptions of their work, descriptions of previous and current GIS use, if any, and a summary of potential GIS applications. To supplement this chapter, there are a number of tables in Appendix 2 that list in detail all of the potential GIS applications for each Service in OSDH. The potential applications are broken down into primary applications and secondary applications. Primary applications are those that appear to be most urgent, have the most immediate

impact on improving services, or are more easily accomplished in the short-term. Secondary applications are the GIS activities that would be useful to the program but are not as immediately pressing and possibly more difficult to accomplish (i.e. requiring more resources, GIS expertise, specialized software, etc.) or that are dependent upon the initial completion of a primary application.

3.2.1 Family Health Services

The Family Health Services (FHS) Deputy Commissioner area contains six service areas that protect and promote the health of women, children and families in Oklahoma. These areas are: Family Support & Prevention Service (FS&PS); Child Guidance Service; Dental Service; Maternal & Child Health (MCH) Service; Screening, Special Services & SoonerStart (S, SS & SS); and Women, Infants and Children (WIC) Service. There has been some significant use of GIS in these areas, particularly in S, SS & SS, WIC Service and MCH Service. There are also potential GIS applications that can enhance program management and evaluation for each of the Service areas.

The Deputy Commissioner of FHS, Dr. Edd Rhoades, sees GIS as a tool for accountability and performance management. He thinks it should be used to evaluate program performance over time and assess whether interventions and program activities are effective. He also sees GIS as being very useful for targeting specific geographic areas for services by analyzing health status indicators spatially. In addition, he sees GIS as useful for managing FHS program s. He recently asked SoonerStart staff to prepare maps to communicate staff vacancies by region. He envisions that these maps could be useful for demonstrating challenges that they face in filling vacant positions. He believes that there is much more than can be done with these maps, for example by overlaying office locations with filled staff positions and vacant staff positions on the same map. Dr. Rhoades is supportive of GIS as a centralized resource in OSDH and would like to see its use expanded within his area and in work that crosses Deputy areas.

Family Support & Prevention Service

The Family Support & Prevention Service (FSPS) includes two main programs, Children First (C1) and the Oklahoma Child Abuse Prevention Program (OCAP). These two programs together serve to prevent child abuse in Oklahoma families through support, early intervention and education.

Children First

The C1 program is a home visitation program that is offered through county health departments (CHD) to first time mothers. The program employs approximately 160 fulltime nurses who conduct home visits, provide referrals and education to families and assess risks for domestic violence and child abuse. Client data is stored in the Public Health Oklahoma Client Information System (PHOCIS). There has not been

any use of GIS in C1 to this point, mostly due to the fact that the program does not have any GIS software and a few staff members have only recently been trained to use GIS.

There are quite a few potential applications for computer mapping and spatial analysis within C1 and several of these could be considered high priority. Program staff present an annual report to the Oklahoma legislature (their funding source) each year to report program activities and request further funding. Staff believe that these narratives could be greatly improved by including maps that demonstrate areas of high need for services and high risk for child abuse. This mapping could have an immediate positive impact on funding and legislative support for the C1 program.

Mapping would also be helpful for the C1 program by providing a way to determine access to prenatal care and identify populations that likely do not have easy access to this care. Nurses armed with service maps could more easily refer clients to prenatal care services and also help identify where more funding could be directed to provide these services.

GIS can be used to support caseload management by combining data about the number of referrals made in an area, population demographics, and the number of C1 nurses working in that area. This will allow program managers to place nurses in areas according to demonstrated need and to justify increases or decreases in staff numbers.

Being a home visitation program, C1 could benefit greatly from network analysis conducted in a GIS. Nurses perform many home visits each week, and GIS could help with home visit planning by identifying efficient routes for the nurses to travel. This is particularly needed in rural areas where travel time is complicated by poor road conditions, terrain and long distances between client homes. This network analysis would be especially helpful for managers and nurses who are new to an area and not initially familiar with the geography. Additionally, efficient routing for home visits could decrease travel costs and increase nurse productivity.

Oklahoma Child Abuse Prevention Program

OCAP is a program that focuses on community-based prevention of child abuse through home visits, training and education activities. Staff members conduct home visits and establish community centers that offer education and resources to families. Within OCAP, the Child Abuse Training and Coordination Council (CATC) provides education and training to professionals who interact regularly with families.

There are 23 child-advocacy centers located in a variety of facilities, including county health departments, two tribal facilities and various private agencies. There are different program districts for the OCAP and CATC programs. At this point there is no GIS software available to program staff but at least one staff member has

received introductory training and has initiated efforts to geocode child-advocacy center locations.

Initially, this program can benefit from mapping the location of all child-advocacy centers and multi-disciplinary teams (MDTs) across the state as well as the OCAP districts and CATC districts. Once all of the services are mapped, this can be used to identify counties that are not served by program activities. This can also be used to determine which CATC districts lack one or both components (centers and MDTs). Maps can then be used to persuade district attorneys to lobby for more centers in an area of need.

Aside from mapping services, it will be helpful, for program planning purposes, to identify areas of the state that have more families at-risk for child abuse or neglect. This will help to target the placement of new centers and to allocate funding. In addition, this will help with decision-making with regard to awarding new contracts to agencies that would like to provide OCAP services.

Finally, since OCAP, CATC, and C1 all exist to prevent child abuse in Oklahoma, it will be helpful to use GIS to overlay these datasets to determine if all three programs have services in all counties and identify which counties are lacking one or more services. These data can be overlaid with data about child abuse rates to evaluate program effectiveness and plan for future work.

There is a desire among OCAP and CATC staff to determine the ease with which their clients can access provided services using GIS to assess the distance that program participants must travel to access services. By using network analysis in a GIS, OCAP and CATC can quantify client travel-time to determine if travel is a barrier to services in rural areas. If this is the case, then the analysis can help demonstrate a need for more funding for services in rural areas.

OCAP provides funds to client families for respite care as a key support service for preventing child abuse. There is a perception among staff that the respite program might be under-utilized although there are no data to support or deny this. The staff believe it may be beneficial to map where respite dollars are going in the state to determine if there are areas in which clients are not taking advantage of this support service.

Related to respite care, it will be helpful for OCAP staff to have state licensed child care facilities mapped to inform clients of resources in their area where they can use their respite funds. An Internet-accessible site that shows child care facilities on an interactive map will be very useful for families trying to find qualified child care in their area. Having these data mapped will also help program staff determine if a lack of childcare resources is related to a low use of respite dollars in an area.

Child Guidance Service

The Child Guidance Service provides education and services to families and childcare providers to assist them in nurturing their children. Their services include consultation for childcare providers (through in-person consultations and telephone consultation via the Child Care Warmline), training for parents and professionals, assessment of children for developmental delays or behavioral issues, and services to enhance social skills.

There have been some mapping activities in this Service area, although they have been limited to making maps in PowerPoint. These have included mapping Child Guidance clinics and counties served as well as mapping births to unwed mothers by county. Staff mentioned how time consuming it is to create and update the PowerPoint maps and that a more automated process using GIS would be much more efficient. One evaluation staff member was recently trained to use the ArcGIS software, and there is much interest in utilizing the technology to support Child Guidance activities once they have GIS software access. In the meantime, one staff person has been borrowing time on another program's GIS software license to continue a mapping project. This project involves mapping the locations of all day care providers in Oklahoma along with the numbers of mental health consultants per county to determine where there is a need for more consultant staff.

There are other potential GIS projects within this Service that involve mapping the location of services as well as rate mapping and population mapping. GIS will be useful for assessing staffing patterns for childcare provider consultants and for evaluating the need for and placement of new clinics. Mapping demographics and rates will also help the Service to target resources to certain populations and geographic areas. Mapping the origin of calls to the Warmline could better target advertising for that service. Finally, Child Guidance field staff can use network analysis in the GIS to plan routing for home visits and day care consultations.

Dental Health Service

The Dental Health Service works to promote oral health and prevent oral disease in Oklahoma. Service activities include monitoring dental health resources and surveying children to evaluate oral health. Staff work closely with other programs including the Tobacco Use Prevention Program, Maternal and Child Health Service and Chronic Disease Service.

Staff members in the Dental Health Service have previously created maps with Microsoft PowerPoint. They have mapped the Dental Health Service program areas by county with colors and used symbols to indicate which counties have staffed or un-staffed public health dental clinics. They have also mapped the six dental regions and the towns in which they sampled children for the 3rd grader dental

survey. They have not had any access to GIS software or trained staff to do GIS mapping or analysis in the past.

The potential uses of GIS for the Dental Health Service include: mapping dental facilities/services, mapping fluoridated water systems, and mapping disease rates and survey results to establish a comprehensive picture of dental health for the state. Possibly one of the most beneficial uses of GIS for this service is to provide maps of facilities and water systems to the public on the OSDH website. This could serve to minimize the number of calls that the Dental Service staff receive from the public. Many people call to inquire about where to find a dentist who accepts Medicaid, where to find a free dental clinic, or to check on whether their water supply is fluoridated. By making this information available on the Internet, the public will have easy access to the information that prompts many calls. Currently, there is a Dental Clinical Care Directory on the OSDH website, listed by county and city, but mapping this information will make it more user-friendly for the public.

The project to map fluoridated water systems will require a close partnership with the Oklahoma Department of Environmental Quality (DEQ) since they maintain the community water systems database. The Dental Health Service staff suggested that it would be helpful to establish a link to the DEQ database to access the fluoridation data and make regular updates to the map. It should be noted that the CDC has a website called "My Water's Fluoride" in which someone can find out the status of fluoride in their water. However, the website can be difficult to use because you need to know what county your water system originates in and what the names of the water systems are. A detailed map of community water systems would make this information more easily accessible.

Maternal & Child Health Service

The role of the Maternal and Child Health (MCH) Service is to provide leadership in the state to improve the health and well-being of Oklahoma's maternal and child health population. The Service is comprised of two divisions and one section: the Child & Adolescent Health Division, Women's Health Division, and MCH Assessment section. The MCH interview for this GIS needs assessment only included staff from the MCH Assessment section. This section provides evaluation and assessment support to the other MCH Divisions. Some of their ongoing evaluation projects include: running the Oklahoma Pregnancy Risk Assessment Monitoring System (PRAMS) and its follow-back survey, the Oklahoma Toddler Survey (TOTS); conducting first and fifth grade health surveys; and conducting the Oklahoma Youth Risk Behavior Survey (YRBS).

The MCH Assessment section has had a GIS ArcView software license for several years although it has been rarely used in the last year or two. This is largely due to the fact that the one trained staff person has not had much time to spend on GIS mapping. Previous GIS use in this area has included mapping data at the county-level including mapping teen pregnancy rates, infant mortality data, data from the

maternal mortality review and fetal and infant mortality review, and data for the teen pregnancy fact pack. Recently, other MCH staff people have shown an interest in being trained on using the GIS software, however, and would like to make more use of their license.

Potential expanded uses of the GIS software in MCH assessment include mapping services and populations to evaluate access to health care for certain groups of people. By mapping the locations of MCH clinics, pharmacies, physicians and schools, MCH staff can determine access to care and relate that to survey results and population data to help focus their efforts in improving maternal and child health in Oklahoma.

Recent initiatives have been made to use GIS to assist the OSDH Infant Mortality Task Force in identifying factors related to infant mortality. MCH staff will be working on mapping the locations of infant deaths in combination with other variables such as physician locations and the socioeconomic status of the population to establish a picture of the geography of infant mortality in the state and particularly in the metropolitan areas. Extended analysis will use GIS cluster analysis methods to determine if infant births are clustered.

Screening, Special Services, & SoonerStart

As a whole, the programs in Screening, Special Services & SoonerStart (S, SS & SS) serve children and youth with special needs and their families. They provide surveillance, screening and referrals/case management to special populations to address health issues that affect young children. The programs within S, SS & SS include the: Newborn Screening Program (Genetics and Hearing), Oklahoma Birth Defects Registry, Oklahoma Public Health Environmental Tracking System (OKPHETS), SoonerStart and Lead Poisoning Prevention Program.

This area has had a significant amount of GIS use to date within the Birth Defects Registry and in the OKPHETS program. They have sophisticated GIS software and hardware resources as well as staff that have training and experience using those resources. They can serve as a good resource and example for other OSDH programs wanting to implement GIS in their work.

A potential GIS project that spans several S, SS & SS programs is one to look at overlaps (both geographically and by individual client) of children identified by and accessing services from multiple programs such as SoonerStart, Lead Poisoning Prevention, Birth Defects Registry and Newborn Screening. Part of this project can be completed with non-spatial table linking but GIS will be a good tool to identify geographic overlaps and enhance program planning activities.

Newborn Screening

The Newborn Screening Program (NSP) consists of the Genetics Program (GP) and the Newborn Hearing Screening Program (NHSP).

Genetics Program

The Genetics Program coordinates screening for newborns to test for metabolic disorders and provides education and referral for services to individuals with these disorders as well as to adults concerned about genetic disorders. Newborn screening is offered in hospitals and physicians' offices, and there are two genetic centers in the state, in Oklahoma City and Tulsa, that provide clinical, laboratory and counseling services. The Genetics Program recently developed a State Genetics Plan in collaboration with the Oklahoma Genetics Advisory Council.

There has not been previous mapping or GIS use in the GP; however, there are several ways in which GIS could be useful for program management and evaluation. The primary GIS applications for this area would be mapping the locations of individuals with genetic disorders and populations most at risk for these disorders to better target screening outreach and specialty treatment services. The secondary applications include testing for clusters of individuals diagnosed with certain genetic disorders (especially Sickle Cell Disease) and identifying areas where newborns may not get screened for genetic disorders. This last application would require a link to the vital records births dataset but would allow program staff to identify individuals who have not been screened.

There are several obstacles to GIS use in the GP. The program does not have the staff that can devote time to learning how to use GIS software and complete these applications. Additionally, their datasets are small and require extreme confidentiality so most mapping efforts would only be for internal use and would have to be closely guarded. Finally, the program can greatly benefit from linking their data with other program databases (vital records, immunization, etc); however, this requires an infrastructure and staff to support this.

Newborn Hearing Screening Program

The Newborn Hearing Screening Program (NHSP) coordinates hearing screening for newborns and toddlers in Oklahoma. They provide screening equipment to county health departments and referral services to families of children with suspected or diagnosed hearing loss. The number of children with hearing loss in Oklahoma is smaller than the national average but there is suspicion that this could be due to missed screenings rather than actual lower rates.

There has not been previous GIS use or other mapping in the NHSP, but there are several ways in which GIS can enhance program activities. Potential mapping projects include those that involve mapping facilities and providers and some that include mapping individuals. NHSP staff refer families to speech and hearing specialists or hearing screening locations, and maps can be very useful to provide families with visual depictions of these services in addition to the lists that are usually provided. Also, GIS can be helpful in identifying if there is a geographic trend corresponding to which families follow up with hearing specialists after a hearing loss is detected, and, if so, overlaying these data with the specialists' locations to identify if travel distance to specialists contributes to the problem.

Birth Defects Registry

The Oklahoma Birth Defects Registry (OBDR) provides surveillance of birth defects in the state. Surveillance includes tracking children diagnosed with birth defects from birth to age six and providing information to parents regarding services for their children. Much of the research done with the surveillance dataset has been related to the Oklahoma Public Health Environmental Tracking System (OKPHETS) grant.

Oklahoma Public Health Environmental Tracking System

The Oklahoma Public Health Environmental Tracking System was established in 2003 with a grant from the Centers for Disease Control (CDC) to examine relationships between health outcomes and the environment. Specifically, the system used health data from OSDH surveillance systems and environmental hazards data from the Oklahoma Department of Environmental Quality (DEQ) to identify any relationships between exposure to hazards and health problems. Much of the research focused on birth defects but a number of other studies examined cancers, asthma and lead poisoning. The environmental data included ambient air monitoring, air emissions inventory, public water supply monitoring, SuperFund sites, landfills and toxic release inventories. Data were also obtained from the Oklahoma Corporation Commission (OCC), Oklahoma Department of Agriculture, Food and Forestry (ODAFF) and the Oklahoma County Tax Assessor.

GIS software was heavily used in OKPHETS research, including ESRI's ArcInfo as well as the TerraSeer Space Time Intelligence System. GIS was used primarily for geocoding and to create kriging (data interpolation method) maps but was also used to map disease rates, overlay environmental data with health data, and measure distances from homes to sources of environmental hazards. In addition to GIS, the project also used GPS technology.

The OBDR has been the only program within OSDH to actively make use of global positioning system (GPS) technology to enhance the geographic information in their dataset. During the OKPHETS project, staff focused on identifying relationships between environmental exposures and certain types of birth defects. They realized that they needed very complete and accurate geographic variables in their dataset to

accurately assess exposures. As a result, they acquired GPS units, ArcPad software (mobile GPS data collection software) and ArcGIS licenses. They developed GPS data entry manuals and trained county health department field staff (mostly sanitarians but also nurses, health educators and temporary summer staff) to collect GPS coordinates for homes of children with birth defects that could not be mapped by address (rural route addresses). Most of the work was done intensively over the course of a year to enhance the data collected since 1994, but GPS data collection continues on an as-needed basis as new birth defects data are collected.

Unfortunately, funding for the OKPHETS program ended in early 2007 and this limits continuing environmental health research in OSDH. However, with the creation of the centralized GIS system, there is the capacity to continue GIS research in some manner in the future. Potential GIS projects can build off of previous research done within the OKPHETS project and expand to incorporate cluster analysis as well as other health outcomes that were not previously examined.

SoonerStart

SoonerStart is an early intervention program for children with disabilities or developmental delays. It serves children and families from birth to age three. It is a joint program between OSDH, the Oklahoma State Department of Education (SDE), the Oklahoma Department of Human Services (DHS), the Oklahoma Department of Mental Health and Substance Abuse Services (ODMHSAS), the Commission on Children and Youth (OCCY), and the Oklahoma Health Care Authority (OHCA). The SDE is the lead agency for the program, but OSDH supplies the staff that provide home- and clinic-based services to families.

The OSDH arm of SoonerStart has not used GIS mapping in the past and it is unclear if the partner agencies have used GIS or not. SoonerStart at OSDH has used Microsoft PowerPoint to create maps of the SoonerStart service areas and team locations. There are several potential GIS projects for this program, but also obstacles to using GIS.

Potential primary GIS applications for SoonerStart include using GIS to evaluate staffing patterns and assess access to services. Secondary applications include using GIS to plan routing for home visits as well as estimating future caseloads or program utilization by mapping population demographics, program referrals and prevalence of disorders. There is a lot of enthusiasm for using routing capabilities in the network analyst extension in ArcGIS to plan for home visits. Therefore, when that software capability can be made available to SoonerStart staff in county health departments it may be used to improve staff workflow.

There are several reasons why GIS may not be immediately utilized in this program despite many useful applications for program management and evaluation. The first obstacle is that the OSDH SoonerStart staff are focused primarily on managing the provision of services to families and may have limited time to spend on program

evaluation. Additionally, all diagnostic and much client information are held by SDE so some of the listed GIS projects may require data requests/linking through SDE. Finally, the program does not yet have access to software or trained staff, although this will be addressed during the coming year.

Lead Poisoning Prevention Program

The Lead Poisoning Prevention Program (LPPP) provides blood lead surveillance in children between the ages of six months and six years of age as well as lead poisoning prevention activities. They also provide surveillance and services to adults with elevated blood lead levels (EBLLs). Many children are screened for EBLLs at county health departments and others are screened at physicians' offices or other health clinics. If an EBLL is detected, case management services are provided to families based on the blood lead level detected. The program is primarily funded by the CDC but also receives state funding for lead testing.

The staff in this program have not used GIS or other mapping thus far, although there were two lead poisoning mapping projects completed by another OSDH staff person under the OKPHETS program. A grant was recently awarded to the LPPP that includes using GIS to identify zip codes with older homes that could pose high risk for lead exposure. The maps created and information derived from the GIS analysis will be used to target screening and education to high-risk zip codes. An LPPP staff person has access to and has been trained to use the GIS software to begin this GIS project.

There are several other potential GIS projects for the LPPP. Most of these focus on the childhood lead poisoning prevention activities. These include mapping lead testing locations to assess distribution as well as mapping health care providers in high-risk zip codes to target education and outreach activities. Using GIS as a visualization tool will also be helpful to supplement their annual reports to the CDC with maps. A secondary GIS application that could be helpful, but might be more difficult to execute (due to barriers in acquiring timely datasets), would be to map active oil rigs in Oklahoma to compare with rates of adult EBLLs and to target education activities.

Women, Infants and Children Service

The Women Infants and Children (WIC) Service at OSDH runs the Women, Infants and Children Supplemental Nutrition Program to provide health and nutrition resources to pregnant and postpartum women and their children. The Service consists of the nutrition program, the supplemental food program, and the nutrition education program. The Service supports WIC clinics at county health departments and independent clinic sites where clients obtain supplemental food instruments, nutrition education, breastfeeding support and referrals to other programs. The Service also approves grocers to accept WIC food instruments.

The WIC Service has been using GIS software for approximately five years. They use MapInfo software that was acquired with a one-time software purchase. They have not used ArcGIS software, although one staff person has attended the ArcGIS training in anticipation of using that software eventually. Their GIS mapping activities have included mapping facility locations and mapping clients and rates. They have mapped the locations of existing clinics in order to visualize the distribution and evaluate the need for new clinics. They have also mapped the locations of WIC vendors (grocers that accept WIC) to determine market saturation and evaluate requests by grocers to be approved to accept WIC. Several of these maps have been used in court to justify their decision to decline a grocer's application. They have mapped program participant origin by clinic used and vendor used to see where participants are coming from and how far they traveled. Finally, they have mapped the breastfeeding rates of their program participants by county.

3.2.2 Protective Health Services

The Protective Health Services (PHS) area contains five services. These services oversee the delivery of health care in the state. To date, there has been very little use of GIS in PHS programs, although there is much interest in using the technology to support program activities. PHS staff have been primarily limited in their GIS use by lack of access to software and trained staff, although they have had maps created for them by staff in other Deputy areas.

The vision of the Deputy of PHS is to recast all their information into geographic information systems. All PHS data are geographically located in some way and therefore ideally suited to being stored and utilized in a GIS database. PHS could provide a valuable service to the public by locating all health resources that are present in the state and evaluating those health resources as one health system. The barriers to this, however, include problems with how the current, non-geographic databases function as well as the surprising numbers of errors in location information (e.g. street addresses, zip codes) in the databases. The vision of making all PHS databases geographic is a long-term goal but in the short term, GIS can ensure and demonstrate effective use of resources by PHS programs and provide a tool to communicate the location of health resources to the public.

Long Term Care Service

This Service regulates all long term care (LTC) facilities in Oklahoma, including nursing homes, residential care facilities, assisted living centers, adult day care centers, hospice programs and home care agencies. Staff field activities include conducting surveys of facilities, building evaluations and enforcement activities. Surveyors work in survey teams that are assigned to regions in the state. This service also maintains data about each of the LTC facilities as regulated by state and federal guidelines.

LTC has not had access to any GIS software in the past. Community Health Services staff, at the request of LTC staff, have previously mapped certain LTC facilities but this has been limited and only on an as-needed basis.

There are several primary GIS projects for LTC that relate to identifying certain types of facilities, managing surveyors and planning for emergency response. Implementation of the primary GIS applications can lead to more efficient use of surveyor time and better targeted emergency response as it relates to vulnerable populations.

Health Resources Development Service

The Health Resources Development Service (HRDS) has three programs that serve to monitor and regulate health resources in Oklahoma. The Managed Care Division works with health maintenance organizations and certified workplace medical plans.

The Health Facility Systems program licenses LTC facilities and assesses the certificate of need for new LTC facilities. The nurse aide registry tracks nurse aides in the state, including their residential locations and their employment locations.

Although much of the work in HRDS is geographically oriented and location-based, there has not been any use of GIS in this Service area to date. There has been limited geographic analysis completed but the work was done manually rather than with computer assistance. In Health Facility Systems, they have traditionally calculated service areas for facilities (7.5 mile radius or 15 driving miles around each facility) by using a state road map and estimating distance from that map. Automating this process with GIS would improve its accuracy and save staff time. There has also been use of pushpin maps to identify locations of LTC facilities but these maps are difficult to keep up to date and hard to interact with. GIS will enable more accurate and timely mapping of all health facilities in Oklahoma.

Managed Care Division

The Managed Care division works with all the Health Maintenance Organizations (HMOs) that do business in the state. Much of their data are inherently geographic since HMO coverage areas and provider networks are defined geographically and HMO customers often obtain health care with geography in mind.

This division has not used GIS or other mapping in the past but has interest especially in mapping HMO and Certified Workplace Medical Plan (CWMP) provider networks to evaluate provider coverage by geographic area. They have recently begun the process of obtaining data to map the locations of CWMP providers by case management company and compare those to locations of employers that use each company.

Health Facility Systems

Health Facility Systems licenses LTC facilities and evaluates certificates of need for new LTC facilities. Staff in this program have not used GIS in the past but they have identified several potential uses of GIS. The projects include calculating distance- and time-based service areas for LTC facilities, overlaying facility locations with demographic data, and comparing change over time in the distribution of health resources.

This program maintains a directory of licensed LTC facilities on the OSDH website which is organized alphabetically and by county. Displaying the facilities on an interactive Internet GIS map would enhance the directory and allow the public to search based on distance and to view LTC information by clicking on points on the map.

Nurse Aide Registry

The nurse aid registry oversees training, testing and certification of nurse aides and maintains an abuse registry. There has not been GIS use in this area but they have interest in mapping the nurse aides by residence and place of employment to evaluate their distribution across the state. There is a problem with understaffing of nurse aides, and staff in the Nurse Aide Registry would like to evaluate this phenomenon geographically in a variety of ways as listed in Appendix 2.

Medical Facilities Service

The Medical Facilities Service contains three divisions that license, regulate and enhance health care facilities in Oklahoma: the Medical Facilities Division, the Emergency Medical Services Division and the Trauma Division.

There has been limited use of GIS in this service by staff but widespread GIS use has been limited primarily by a lack of access to GIS software. There are many potential GIS applications, though, relating to health care facility locations, distribution and transport of injured and ill people.

Medical Facilities Division

The Medical Facilities Division licenses and certifies non-long term care health facilities in Oklahoma as required by federal and state laws. This also includes home health agencies and hospice programs. They provide access to a directory of these facilities in PDF format on the OSDH website listed by facility type and then alphabetically.

The potential GIS applications for this division include: mapping all the licensed health care facilities, hospice program service areas, and home health agencies. They also include analyzing the distribution of these facilities versus populations served. The health care facilities directory can also be enhanced by the use of Internet GIS mapping to allow the public to better interact with and use the directory.

Emergency Medical Services Division

The Emergency Medical Services Division (EMS) regulates and develops emergency response services in Oklahoma. Their focus has been primarily on regulation through inspections of ambulance services and training facilities, data collection and licensure activities. However, they would like to expand on their development activities, if funding allows, by creating new data systems for small EMS agencies, evaluating prospective EMS systems, and establishing regional EMS authorities.

There has been some mapping done in the EMS Division, although not with GIS technology. Staff have used Microsoft PowerPoint to map the locations of ambulance service offices, training institutions and field coordinator areas. There is much interest in using GIS to automate updates to these maps and expand upon these initial mapping efforts.

The Division can benefit from many types of GIS mapping and analysis but especially from the network analysis capabilities available with GIS. Network analysis can be used to calculate time-based service areas for ambulance services and determine how much of Oklahoma's population is or is not served by emergency services within a critical time window. Network analysis can also be used to evaluate ambulance run routes to determine if the most appropriate transport route was used and to develop/support recommendations for improvements to transport protocols.

Initially, many of the benefits of GIS to the EMS Division will be limited by the location accuracy within their datasets. There is currently a place for entering spatial coordinates (obtained with a Global Positioning System – GPS – device) on the standard ambulance run report form. However, submission of the spatial coordinates is not currently required, and they are rarely submitted. The timeliness and accuracy of GIS analyses (especially those that use patient pickup location data) by EMS staff would be greatly enhanced by a program to make GPS units available to rural ambulance services (EMSA ambulances currently have GIS capabilities) and requiring that pickup location coordinates be submitted on the form.

Trauma Division

The Trauma Division is charged with developing a trauma system for Oklahoma that includes data collection, medical audits, education, and trauma fund disbursements. Division staff work closely with hospitals, EMS agencies and physicians to make improvements to the trauma system. The Division also administers the EMSystem, a web-based communication tool, in which data about hospital staffing and bed capacity is reported as well as status of air ambulance resources.

There has been limited use of GIS by this Division. In the summer of 2006, they worked with an individual (Shawn Schaefer) from the OU Tulsa Campus Urban Design Studio to have all medical facilities geocoded. Trauma staff were provided with image files of these maps but could not make use of the GIS files because they did not have access to the GIS software. In addition to the digital map image files, they have used a paper road map to delineate the trauma regions and pushpins for facilities. They also have a PowerPoint map of the trauma regions.

There is a lot of interest in using GIS within the Trauma Division. A trauma system is inherently geographic because it addresses the locations and the distribution of facilities equipped to care for trauma patients as well as regional variations in traumatic injuries and emergency response. The potential GIS applications in this

area involve mapping facilities, regions and patient transports as well as the distribution of resources throughout the state.

There is also interest and opportunity to integrate GIS with the Internet-based EMSystem to provide a visual, geographic interface to system users. The system, as it is currently set up, utilizes table reports and one static map graphic in a variety of "views" to communicate the availability of emergency services. The table "views" are arranged geographically into a western view of the state and an eastern view of the state as well as surrounding states. This setup lends itself well to interfacing with GIS mapping, and the EMSystem administrators believe that a GIS-based view may be more user friendly for their users. The administrators believe that the company that created the EMSystem may be working on a mapping component to the site, although they are not sure of the timing, and it might be best to work on that component from within OSDH.

Consumer Health Services

Consumer Health Services protects the public health by regulating facilities and services in Oklahoma. This area is composed of three divisions: the Consumer Protection Division, the Occupational Licensing Division and the Professional Counselor Licensing Division.

There has not been any GIS use within this area although they do make use of paper maps. Within the Consumer Protection Division, there is a large, laminated state map on an office wall on which they write the number of facility inspections per county. They also draw in lines to represent the different sanitarian regions. This map has served their purposes, although it is not well suited to sharing with staff outside of the Chief's office, nor is it convenient to archive and make changes. There is interest in using GIS to some degree within each of the divisions. This area could greatly benefit from setting up an Internet mapping application to communicate information to the public. Many of the mapping applications within this Service can benefit Consumer Health Services staff and clients but will also be of great value to other OSDH programs including: newborn screening and newborn hearing screening programs; family support and prevention service programs; child guidance service, acute disease service and terrorism preparedness and response service.

<u>Consumer Protection Division</u>

Potential GIS applications within the Consumer Protection Division revolve primarily around sanitarians and inspected facilities. GIS can be used to better allocate sanitarians to regions and facilities. Mapping the locations of inspected facilities can assist with communicable disease investigations, bioterrorism preparedness and communication with the public. Routing capabilities in network analysis could be used by sanitarians for planning inspection routes and by managers to verify travel claims.

There is currently a section of the OSDH website that allows the public to search for restaurants and view their inspection records. This function could be improved and expanded upon by incorporating an Internet mapping feature that would allow a person to locate all inspected facilities in his or her area and view inspection-related information about those facilities. This type of website could be set up to best serve the needs of the Consumer Protection Division as well as the need for an informed public.

Occupational Licensing Division

The Occupational Licensing Division has fewer GIS needs than Consumer Protection. In Occupational Licensing, they could map the locations of licensed home inspectors and licensed hearing aid dealers on an Internet map to help the public locate these resources in their areas. A potential difficulty with this could be that the database very often contains mailing addresses for the inspectors and dealers rather than physical addresses. Physical addresses would need to be obtained to accurately map locations.

Professional Counselor Licensing Division

The Professional Counselor Licensing Division can use GIS to map the office locations of the four types of counselors that they license: professional counselors, marital and family therapists, behavioral practitioners and genetic counselors. The locations of these offices can then be made available on an Internet mapping site for Oklahomans to locate counselors in their area. There are currently lists of counselors on the OSDH website (organized both alphabetically and by city) but an Internet map might be more user-friendly and provide more detailed location information. Staff in other OSDH programs can also use the counselor maps to refer clients for services.

Quality Improvement and Evaluation Service

The Quality Improvement and Evaluation Service (QIES) performs quality assurance activities for Protective Health Services. Much of their work focuses mainly on long term care facilities although they do analyze statistics on the restaurant industry and occasionally analyze data on other medical facilities.

This service has completed previous digital mapping using MapPoint, a Microsoft mapping software. They have mapped nursing home metrics as well as the number of nurse aides and nursing facilities per area. The capabilities of the MapPoint software are limited, however, to mapping aggregated numbers rather than point data, and the analysis capabilities are more limited than with ArcGIS software.

Staff in this service have much interest in using the ArcGIS software to expand the mapping capabilities in PHS. As support staff for other services within PHS, they reiterated the need to map restaurants, long term care facilities, evaluate nursing

homes certificates of need geographically, plan routes for sanitarians/surveyors with network analysis, and locate key health department personnel for emergency response. They also identified that GIS could be used directly within their office to better target areas in need of QIES training on data submission.

A challenge that the QIES staff recognize is that of database quality. They indicated that OSDH lacks standards on dataset development and maintenance and should address the need to normalize datasets to make them more conducive to both statistical and geographic analysis. They would like to see more effort placed on developing datasets that can be used effectively rather than being simply storage for data that might never be used to improve OSDH services.

3.2.3 Community Health Services

The Community Health Services (CHS) Deputy Commissioner area contains two services, one division, and the county administrators. The two services are Nursing Service and Community Development Service (CDS), and the division is Record Evaluation and Support. The county administrators oversee county health departments throughout the state. There has been some use of GIS in CDS in the past couple of years, although work has been limited to what one trained staff person has been able to accomplish with one ArcInfo license.

The Deputy Commissioner of CHS, Steve Ronck, and the Assistant Deputy Commissioner, Toni Frioux, are very supportive of the initiative to increase the use of GIS in OSDH. They believe one of the biggest challenges facing OSDH in the coming years is budget shortfalls and they see GIS as being a useful tool for better managing and targeting OSDH resources. They see the best uses of GIS for CHS falling into three categories. The first is related to demographics. They would like to see GIS used to pinpoint demographic data at a finer geographic scale to better assess the social determinants of health and more effectively target resources to specific areas of the state. Secondly, they see GIS as being extremely useful for management decision-making. Management GIS activities could include mapping staff distributions vs. populations and services, and mapping client residences vs. the locations of services accessed to identify client utilization patterns. Finally, they believe GIS will be extremely valuable for enhancing presentations and communications to better portray data and facts to the public, legislators, partners and others.

County Health Departments

There are sixty-nine county health departments (CHDs) in Oklahoma with 110 offices in seventy counties. These county health departments administer programs to maintain healthy communities. Services and programs offered in a CHD may include: consumer protection (i.e. food establishment inspections), HIV/STD testing and counseling, WIC services, health promotion, adult health screenings and education, communicable disease investigations, dental screenings and education, and maternal and child health services (i.e. immunizations, child guidance, family planning, maternity, Children's First, and Early Intervention).

There are 19 county administrators who oversee the CHD operations of the 67 CHDs dependent on OSDH. There are two CHDs, Oklahoma City-County (OCCHD) and Tulsa City-County (TCCHD), that operate independently of OSDH and have their own Directors and Health Boards, although they do work closely with OSDH on many programs. The OSDH county administrators manage between two and seven counties each and interact closely with program staff in the central office. For this needs assessment, three of the county administrators and two county staff persons were interviewed.

To date there has been no direct use of GIS within the 67 OSDH CHDs, although there has been limited use in both the OCCHD and the TCCHD. The OSDH CHDs have benefited from GIS mapping that was completed by central office staff. It has been primarily a lack of GIS software and trained staff that have prevented the utilization of GIS within the CHDs but there are many ways that the technology can be implemented at the county level.

There are many potential GIS projects that could be completed by CHD staff either by training the staff to use Desktop GIS software or by giving them GIS software access and tools via Server solutions. Many of the potential GIS applications listed in the table in Appendix 2 were mentioned in all three interviews that were conducted with CHD administrators. One of these is the ability to use GIS in the CHDs so that staff can map their own county-specific health data at smaller geographic scales. This will be helpful for them to target their programs more efficiently as well as assist with meeting data requests from other agencies within the community. Another common GIS project idea is to use GIS to map staffing numbers and evaluate staffing patterns, especially when there are vacancies or when they need to recruit for high-demand specialties (such as nurses, therapists, etc). GIS can also be used to map services to which CHD clients are commonly referred. These maps can then be made available to clients in hard copy at the CHD or on an Internet mapping website. Finally, there is much interest among the interviewed CHD staff in using network analyst to assist in routing to and locating facilities for inspections or homes for home visits.

Although there are ways that CHD staff can use GIS, there are potentially more barriers to its use in CHDs than there are for central office staff. For example, the network infrastructure might make it cumbersome for CHD staff to access large GIS datasets that are housed at the central office. For this reason, it may be beneficial to provide CHD staff software access over the Internet using server-based solutions rather than Desktop installations. This issue will be addressed more fully in the design phase of the GIS implementation. Also, it will be more difficult for the GIS coordinator to provide GIS support and training to CHD staff than to central office staff. This can be addressed, however, by developing GIS training that can be incorporated into existing program training and by developing Internet GIS tutorials that can be accessed through online training resources.

In addition to network issues, there are some considerations for the GIS projects that involve using maps to enhance client referral services. First, access to color printers by CHD staff will be beneficial in providing useful, customized referral maps for clients, although the availability of this resource in CHDs has not been investigated for this report. If color printers are not available to the staff that interact with clients, they would need to be obtained or maps would have to be designed with black/white printing in mind. Finally, it is unclear if many CHD clients have Internet access at home, so it could be beneficial to provide Internet kiosks in CHDs for clients to use to view and print maps. This would require extra funding and IT resources to support such a setup.

Nursing Service

The Nursing Service oversees the OSDH nursing staff that deliver OSDH public health programs. The Service develops guidelines and clinical orders that allow nurses to deliver program services to the public without direct physician supervision. The Service has three components: clinical services, education and advanced practice. There are 19 district nurse managers who oversee nursing staff throughout the state and each has a designated region.

There has not been GIS mapping in the Nursing Service although they do use a PowerPoint map to keep track of the district nurse manager regions. In addition to mapping the nurse manager regions with GIS, there are a few other potential GIS projects for this Service. These include mapping the number of nurses in each county health department and district nurse manager region to evaluate the assignment of nurse manager regions and identify staffing shortages. These also include mapping certain communicable disease data such as active tuberculosis cases, as well as using GPS units to accurately locate clients' homes for home visits.

Community Development Service

Community Development Service (CDS) strives to create healthy communities by developing partnerships with agencies at the community-level to support activities that improve health. The programs within CDS work very closely together and many of their projects overlap as they work towards similar goals. CDS programs include: Health Equity and Resource Opportunities (HERO), Arthritis Program, Health Promotion, Minority Health, Primary Care and Rural Health Development, and Turning Point (TP).

There has been quite a bit of GIS use in CDS during the last few years since they have had access to the GIS software and a trained staff person to use the software. The staff person, an epidemiologist, has been meeting the mapping needs of all the CDS programs, although the demand has started to outpace her availability for mapping projects. There has also been previous non-GIS mapping with pushpin maps and PowerPoint maps. PowerPoint has been used by Health Promotion to map health educator regions and by Turning Point staff to map field consultant areas and partnership locations. The Arthritis Program has used a paper road map and pushpins to show the location of arthritis resources.

Previous GIS mapping in CDS has included mapping arthritis services in order to justify the locations for new arthritis programs. CDS has also used GIS to map health care resources such as community health centers, rural health clinics, physicians' offices and others to evaluate the health care "safety net" in Oklahoma.

Health Equity and Resource Opportunities

The Health Equity and Resource Opportunities (HERO) program addresses health inequities that result from social determinants of health such as social institutions, surroundings, and social relationships. The program serves to promote community involvement to address these health inequities. The program is a new one in OSDH so does not have any prior use of GIS mapping, but the Director has experience with GIS.

This program would like to use GIS to integrate data from many sources and attempt to create a comprehensive picture of health inequities in Oklahoma. The hope is that by mapping health resources and measures of the social determinants of health against health outcomes, they can further understand health disparities and assist communities in addressing them.

Arthritis Program

The Arthritis Program provides evidence-based training on activities that help prevent the effects of arthritis. These activities include exercise programs and self-help programs. Program staff work closely with community groups to evaluate and promote these health activities.

As described above, mapping has been used in this program both in paper media and computer mapping to evaluate resource locations. They have mapped the demographics for seniors with arthritis versus the location of arthritis programs. GIS has also been used for market analysis for media campaigns by identifying the locations of Hispanic businesses to target with brochures. This allowed the program to better make use of volunteer staff time. Future GIS projects can expand upon this previous mapping.

Health Promotion

The Health Promotion office educates the health educators who work in county health departments across the state. They provide standardized training for the health educators and a health education manual. This office also runs the Coordinated Approach to Child Health (CATCH) program, which is a detailed intervention program for child health administered through after-school programs. In addition to the CATCH program, Health Promotion also contains the OSDH Employee Wellness program that develops wellness activities for central office employees.

To date, Health Promotion staff have used PowerPoint to map the 29 health educator regions in Oklahoma. Potential GIS projects for this office include using GIS to map and evaluate health educator distribution as well as mapping schools for

evaluation in the CATCH program. There are also many potential projects for the Wellness Program.

The Wellness program can use GIS to map the locations of employee residences and use that information to develop and promote wellness activities. GIS can be used to create a carpool-matching database to link up employees who live close to one another and have an interest in carpooling together. GIS can also be used to identify employees who live within walking or biking distance to work and promote these activities to groups of people. Finally, the network analysis capabilities of GIS can allow Wellness staff to assist employees in identifying safe biking and walking routes to work.

Minority Health

The Minority Health office was created to address the elimination of health disparities in Oklahoma. The staff's priority is to develop a culturally competent workforce within OSDH but they also respond to minority health data requests and evaluate access to health care for minorities.

There have not been mapping projects in this office to date, however there are potential GIS projects. Several projects could involve mapping the distribution of minority populations to evaluate their locations in relation to health care resources. GIS can also be useful for visualizing the distribution of foreign language interpreters in county health departments versus the foreign language speaking client populations.

Primary Care & Rural Health Development

The office of Primary Care and Rural Health Development works with communities and Turning Point partners to establish community health centers, both federally qualified health centers (FQHCs) and "look-alikes". To do this, they monitor the existence of health care providers, medically underserved areas (MUAs) and health professional shortage areas (HPSAs) to evaluate health care access and identify underserved areas in need of community health center development.

To date, this office has worked with the CDS epidemiologist to evaluate the health care "safety net" in Oklahoma and to map the locations of MUAs and HPSAs (this is also available from the Health Resources and Services Administration (HRSA) website). They also see several potential uses of GIS for the future, such as using GIS analysis tools to calculate provider/population ratios, identify geographic barriers to health care, and identify the best sites on which to establish new community health centers. This office can also make use of GIS network analysis to calculate travel times to health care providers and to calculate time-based service areas for providers.

Turning Point

The Turning Point program at OSDH is part of a national initiative to improve health infrastructures by building community support and participation in developing solutions to local health problems. The key activity is developing community partnerships, and to date, there are 54 partners across the state with six field consultants to work closely with them.

This program has used PowerPoint to map the regions for the six field consultants as well as to depict the counties that have Turning Point partnerships in place. They would like to expand their mapping by using GIS in several ways. First, using GIS as a visualization tool will be extremely helpful in communicating with community partners and the public. Staff have pointed out that community partners don't react well to charts and graphs but would probably respond well to maps, especially those that highlight regions of the state that are doing particularly well. Secondly, it will be helpful to map health resources in communities, such as grocery stores, community gardens, fitness centers and others to help with targeting their activities in communities. Another use for GIS will be to map the exact location of partnerships and symbolize them based on their priorities and activities to assess the coverage across the state. Finally, they are interested in mapping funding sources going into communities and local ordinances that affect health. All of these GIS projects have the potential to be very informative and useful. Although the projects could be somewhat challenging since the data may be difficult to obtain, it would be worth pursuing.

Record Evaluation and Support

The Record Evaluation and Support (RES) office works with county health departments to evaluate and improve their operations. They have seven field staff, called record consultants, who visit CHDs and help local staff with their use of PHOCIS and other computer programs. They address finances, legal issues and retention of records among other things. They also conduct periodic reviews of billing and records. The RES director acts as a liaison between the CHD clinics, Community Health Services and OSDH program staff in the central office. The director also is the administrator of the PHOCIS system and assisted with its original development.

PHOCIS is the database in which CHD client data are stored. There is a Desktop program in which CHD staff enter data into program-specific modules. At the time of this report, there are over one and a half million individual client records in the database. CHD staff set up links between family members in the database and certain updates made to one individual (such as address changes) can be automatically copied to other linked family members. The PHOCIS dataset is also dynamically linked to the Oklahoma State Immunization Information System (OSIIS)

database, and updates to PHOCIS or OSIIS are automatically reflected in the other dataset.

GIS has not been used in RES although record consultant regions were mapped with PowerPoint. Potential GIS projects for RES include those that can be used to evaluate CHD services as well as those to manage RES staff. Mapping clients by county of residence (or by another geographic entity) and by active CHD clinic (the clinic in which the client's data in PHOCIS was last updated, also considered to be the last clinic from which the client received services) will be helpful for CHD staff and OSDH program staff. Mapping record consultant regions will help the RES director evaluate the staffing pattern and justify recommendations for more staff or a reallocation of staff.

There are concerns regarding quality of data in PHOCIS when it comes to using the dataset for spatial analysis. There is currently no validation of address or zip code data in the PHOCIS system and it is known that there are many errors in the address and zip code fields (i.e. wrong zip code entered, city misspelled, etc). There would need to be an address validation process in place before any geocoding of this dataset could be considered accurate and reliable. Aside from geocoding to the address or zip code level, there are other options for mapping PHOCIS data. There is a field in the database to enter the client's county of residence, however, it is not a required field and not always entered. There is also a field for entering the client's finding address and there is a guideline that says if there is not valid street address to enter, then finding directions should be entered. However, it is not clear if this guideline is strictly followed. Based on this information, the best course of action would probably be to institute an address validation process for the street, city and zip code fields to enable accurate geocoding.

3.2.4 Disease & Prevention Services

The Disease and Prevention Services (DPS) Deputy Commissioner area has eight Services and also houses the Offices of the State Epidemiologist and State Public Health Veterinarian. The Services in this area act to control infectious diseases, chronic diseases, and injuries among Oklahoma's population. The DPS Services are: Acute Disease Service, Chronic Disease Service, HIV/STD Service, Immunization Service, Injury Prevention Service, Terrorism Preparedness & Response Service, Tobacco Use Prevention Service and Public Health Laboratory Service.

The former Deputy of Disease and Prevention Services, Joe Mallonee, was in that position at the time of the DPS interviews for the needs assessment. He was supportive of using GIS to strengthen programs by conducting good science and making more efficient use of resources. He saw GIS as being an effective tool for use in scientific research within OSDH as well as a planning tool for allocating resources. When the economy worsens and funding for state government declines, he saw GIS as being a good tool for the "smarter" use of resources by targeting staff time and money to specific geographic areas.

In the Deputy's view, some priority areas within DPS that might be best addressed with GIS technology include programs in the Chronic Disease Service and Immunization Service. In Chronic Disease, evaluating cancer clusters is very important, including evaluating relationships between residences and environmental exposures. Also for Chronic Disease, it is a priority to better target breast and cervical cancer programs and staff deployment through the use of GIS to identify high-risk areas. Within the Immunization Service, GIS will be important to identifying pockets of need for more interventions related to immunization coverage.

Offices of the State Epidemiologist and State Public Health Veterinarian

The State Epidemiologist and State Public Health Veterinarian work closely with Acute Disease Service (ADS) staff and Terrorism Preparedness and Response Service (TPRS) staff to address problems associated with communicable disease spread by humans and zoonotic diseases spread by animals. The veterinarian also works closely with partner agencies, such as the Oklahoma Department of Agriculture, Food and Forestry (ODAFF) and the Oklahoma Department of Wildlife Conservation (ODWC).

This office has previously used several kinds of maps. These have been PowerPoint maps depicting rates of diseases by county, such as West Nile Virus and rabies. They have also used road maps in discussions about communicable disease outbreaks. The veterinarian has also loosely participated in field data collection with GPS units in conjunction with ODAFF, for example, when documenting the location of cattle infected with a disease. The office also recently had a visitor participating in a CDC externship who worked on using GIS to map

West Nile Virus cases in Oklahoma to evaluate associations with environmental variables and changes over time.

There are many ways in which this office would like to use GIS. They would like to expand on mapping disease trends over time; for example, continuing to document the spread of West Nile Virus as well as other diseases. This would help them better target resources in preventing and addressing disease outbreaks. They would also like to do more ecological analyses that would pull together numerous data for epidemiological analysis. GIS mapping will also be helpful to map disease data at finer spatial scales than what has been done in the past. A variety of maps will enhance reports such as the State Vector-borne Disease report and others. Finally, GIS can be used for cluster analysis, hypothesis-generating and predictive modeling within much of the ADS and TPRS work.

Acute Disease Service

The Acute Disease Service (ADS) controls the spread of communicable diseases through disease surveillance, outbreak investigations, research, and public education. The Service consists of two divisions: the Communicable Disease Division and the Tuberculosis Division.

ADS staff have used both PowerPoint maps and GIS maps in the past. PowerPoint maps have been used to map disease rates by county for reports, presentations and the website. GIS was first used by ADS in 2005 to incorporate a mapping component into the Public Health Investigation and Disease Reporting of Oklahoma (PHIDDO) system. PHIDDO is an electronic system for reporting communicable disease cases to OSDH. There is a list of required reportable diseases. Physicians, hospitals, and laboratories report suspected or confirmed cases of these diseases through PHIDDO. There is a GIS component to the PHIDDO system in which disease cases are geocoded and displayed on an interactive web map. Authorized users (i.e. county health department nurses and central office ADS staff) can interact with the PHIDDO map to create customized views of the data and create specific maps. The system uses ESRI's ArcIMS software to power the interactive maps and requires manual geocoding of the disease data. In the past, geocoding was completed once a week. Geocoding has been completed more sporadically since December of 2006 when there was a staffing change.

The extent to which the mapping component of PHIDDO is used across the state is unknown but ADS staff believe it is not widely used by county health department staff at this time. There is more potential for using it, however, and a redesign of the interactive map might look and function better to meet user's needs. Also, the map might prove to be more reliable and informative if geocoding is completed in real-time and better reflects actual residence or actual place of exposure to the disease as much as possible.

In addition to the PHIDDO system, ADS has had several licenses of ArcView and ArcInfo. The ArcInfo license was used primarily to geocode the PHIDDO records. Since early 2007, one of the epidemiologists has also been using the ArcInfo license (as well as an ArcView license on her laptop) to create maps for the website and journal articles. GIS mapping has enabled her to more efficiently create and update the county rate maps for the website.

Aside from improving PHIDDO mapping, there are many other ways in which ADS would like to expand their use of GIS. They could incorporate GIS into the OK Health Alert Network (HAN). The HAN is used to communicate emergent health-related information to healthcare providers, and GIS could be used to assist with identifying providers or other facilities to notify during a health-related event. GIS can help with selecting individuals in an affected area as well as provide tools for plume modeling. The HAN was designed to integrate an ArcGIS license with the base system, although this has not yet been completed. In addition, ADS would be supportive of mapping restaurants, schools, food distributors, physicians, jails/prisons, and laboratories to assist with the HAN system as well as their day-to-day activities that involve these types of facilities, such as disease investigations.

ADS could also benefit from using GIS in a web service that would display communicable disease data to the public. Maps would display aggregate data by county for use by students, researchers and the media, something similar to OK2SHARE. This would provide another way to meet data requests that the Service receives periodically.

ADS would also like to expand its use of GPS (geographic positioning system) units by field staff. They would be used to collect latitude and longitude coordinates for un-geocoded addresses when nurses make home visits. This would help to improve the reliability of mapped data and prevent data from slipping through the spatial analysis cracks due to incomplete geocoding.

Finally, ADS staff would like to see the agency develop a way to centralize an address database so that programs could collaborate on geocoding efforts. In this way, if one program does the work of obtaining a highly accurate address geocode (or GPS coordinate), another program could use those mapped data for the same address rather than repeating the geocoding effort. This could be done in such a way that confidentiality and privacy are protected.

Chronic Disease Service

The Chronic Disease Service (CDS) works to prevent death and disability from chronic diseases through screening, surveillance, education, and health system change. CDS has six areas encompassing programs that focus on a variety of chronic diseases and conditions. These areas are: Asthma Prevention and Control Program; Cancer Prevention and Control Programs; Diabetes Prevention and Control Program; Heart Disease and Stroke Prevention Program; Oklahoma

Physical Activity and Nutrition Program; and, Southern Plains REACH US. These programs rely heavily on a variety of survey and surveillance datasets, and many focus on specific populations. Prevention and intervention are key concepts in CDS programs. CDS only collects data for two systems – the Central Cancer Registry and the Breast and Cervical Cancer Early Detection Program – however, they partner with many other OSDH programs and outside agencies to obtain data to support their programs.

CDS staff have been using GIS technology since 1996 when an ArcGIS license was purchased to support geocoding of data for the Oklahoma Central Cancer Registry. The service has since acquired three more GIS licenses. There is one epidemiologist who uses the GIS software frequently and two to three others who have been trained to use the software and do so occasionally. The GIS software has primarily been used to geocode data from the cancer registry but has been used in other capacities as well. Staff have done a little mapping of disease rates, usually by county, but sometimes by zip code or substate planning districts. They have also mapped facilities such as mammography clinics and hospitals as well as distribution cities for the automatic external defibrillator program. They have conducted some GIS analysis, including buffer analysis, to evaluate access to mammography facilities, and cluster analysis, to test for cancer clusters in certain parts of the state. They have used GIS to create maps for reports and to support policy change/systems change with partners by using maps to augment discussions with partner agencies. Communications with other states have been greatly enhanced by the use of their heart disease and stroke maps. Finally, smoothing techniques have been used to create maps of breast cancer rates that help to focus screening program efforts in rural and urban areas.

In addition to continuing current mapping activities, there are several ways in which CDS would like to expand their use of GIS. They would like to map additional types of facilities, including fitness centers, farmers markets, healthy businesses, schools, prisons/jails, rape/domestic crisis centers and others. This mapped data could be used to target and evaluate programs as well as contribute to a resource referral dataset for county health departments and BRFSS surveyors. CDS staff would also like to conduct more analyses that incorporate high quality environmental GIS data to assess the effect on health from environmental factors.

There are specific, new projects that CDS would like to pursue that could be facilitated with GIS technology. One project is to analyze stroke mortality in different areas of the state in relation to ambulance transport times. Another project is to map rates of female incarceration by county to formulate a picture of how these rates are spatially distributed and where incarceration-related health outcomes in women and their children could be addressed. Due to the importance of geocoding to the Central Cancer Registry, CDS would like to see geocoding processes at OSDH enhanced through the acquisition of better roads data and trained geocoding staff or an external geocoding contract. Finally, they would like to link past infectious disease outbreaks with current chronic disease rates by geographic area to evaluate

relationships. An example of this would be linking past hepatitis C outbreaks with current liver cancer rates.

HIV/STD Service

The HIV/STD Service works to intervene in the transmission of HIV and other sexually transmitted diseases. The Service has two divisions: the Division of Prevention and Intervention and the Division of Surveillance and Care Delivery. The latter division contains three programs: the Hepatitis Program, the HIV/STD Surveillance Program, and the Ryan White Part B Program.

There has been mapping previously used in this Service. For the Hepatitis Program, they used PowerPoint to create maps of county rates to highlight potential outbreak areas. The Service has also used PowerPoint to create maps of HIV/STD rates by county. They noted that using PowerPoint to create maps is not ideal because it is time-consuming, the counties are easily moved on the map by accident, and it's difficult to create shaded choropleth maps that print well in black and white. The Service has purchased an ArcView GIS license in the past, but, at the time of the needs assessment interview with staff, the license maintenance had been discontinued and no staff were using the license. It could not be determined that the software was installed on any staff computers. However, one staff member was trained to use the ArcView software, and the Service was working on the process to reactivate the ArcView license.

There are several potential GIS projects that the HIV/STD Service would like to do. First, they would like to continue to map rates of disease to assist with planning and evaluation. Several other projects would involve mapping the locations of facilities such as testing centers and clinics. They would like to evaluate access to services by mapping service providers (including providers in neighboring states) in relation to client locations. This type of project would be created and used by internal staff only, as the data are highly sensitive and protected. They would like to map the HIV/AIDS out-of-care cases to determine the distribution of that population. Finally, as staff skills and software availability grow, they would like to make use of network analysis to evaluate distances traveled for care access and case manager visits, as well as cluster analysis to evaluate disease outbreaks and trends.

Immunization Service

The Immunization Service promotes vaccination in Oklahoma by supporting immunization laws and programs and by providing vaccines through county health departments. The Service operates the "Vaccines for Children" (VCF) program in Oklahoma, which provides federal funds to vaccinate un-insured or under-insured children. The Service's primary database is the Oklahoma State Immunization Information System (OSIIS). This database is the statewide immunization registry, which collects immunization records from doctors and clinics for Oklahomans of all ages.

There has been limited use of maps in this Service in the past. They have used PowerPoint to map immunization coverage rates by county. They have also used road maps and pushpins to pinpoint specific communities and their coverage rates. This pushpin map project included approximately 600 communities with data. The map was messy and not very efficient but effective in communicating the information. This Service has not had access to GIS software, although recently one staff person attended GIS training in anticipation of having access to the software at some point. There is much interest in using GIS for several projects in the future.

The Service would like to continue mapping immunization rates by county and extend this mapping to include finer geographic scales, including zip codes. This will help to better identify pockets of under-immunized populations and pockets-of-need for services. They would like to map demographic data in conjunction with immunization rates to assess the impact of race and ethnicity on immunization coverage. They would also like to map immunization providers (i.e. physicians, clinics, VCF providers) to identify gaps in their geographic distribution as well as identify dominate providers in each area. Finally, as the software tools become available, they could use network analysis to plan caseloads and routing for day care audits.

Injury Prevention Service

The Injury Prevention Service works to identify injury problems in Oklahoma and develop, implement, and evaluate programs to respond to those problems. There is a list of reportable injuries for which data are collected in a statewide surveillance system. Programs in the Injury Prevention Service include: the Residential Fire Injury Prevention Program, Child Safety Seat Program, Traumatic Brain Injury Program, and the Oklahoma Violent Death Reporting System (OKVDRS). Other topics that this Service addresses include: all-terrain vehicle safety, occupational injuries, sexual violence prevention, intimate partner violence, and disasters that cause injury, such as the Oklahoma City Bombing and recent ice storms.

This Service has created and used maps many times in the past. Mapping has been done with paper resources, in PowerPoint, and in ArcView. Prior to 1990, the Service mapped the locations of house fire injuries using pushpins on a road map. This was used to target their prevention efforts. After the OKC bombing in 1995, the locations of injured people inside the Murrah building were mapped using AutoCAD floor layout files. The Service has also mapped the locations of tornado-related injuries. They have geocoded the addresses of domestic violence incidents to the nearest intersection and have plans to overlay these data with census data. Finally, they also have used PowerPoint to create maps for legislative reports, such as one that was created to highlight ATV injuries. Since 1998, they have had one ArcView license and a few trained staff to use it. However, it has not been used widely in their work in recent years due largely to a lack of guidance and support on the mapping activities.

The staff in this Service would like to expand their GIS mapping activities to all of their programs. They would like to continue creating maps for reports and presentations. For the Residential Fire Injury Prevention Program, they would like to continue previous mapping, especially mapping the locations of house fires to better target their prevention and education efforts. In addition, they would like to map the locations of homes that have received smoke alarms through their program to determine the distribution of that service. Further, they want to use GIS to help select a sample of homes in targeted communities to survey for smoke alarms. This application could incorporate county assessor and demographic data.

The Injury Prevention Service recently hired a senior epidemiologist to conduct the Traffic Data Linkage Project (TDLP). It is a joint project between the Oklahoma State Department of Health and the Oklahoma Highway Safety Office. The TDLP is housed in Injury Prevention Service. The goal of the TDLP is to link the traffic crash data from the Department of Public Safety with the OSDH's hospital discharge data, death data, and emergency medical services data in order to obtain comprehensive information on traffic crashes. These linked/combined datasets will be analyzed and the results will be used to develop, inform, and evaluate traffic injury programs in Oklahoma. The GIS software will be one of the main analytical and statistical tools in analyzing the combined traffic database in determining injury prevention priorities for this valuable project. The newly hired senior epidemiologist has extensive training and experience working with GIS software. The epidemiologist will serve as the GIS analyst and a resource person for the overall Injury projects related to analyses and mapping using the GIS software

For other Injury Prevention programs, the Service would like to map the locations of injuries or deaths, such as pedestrian/bicyclist injuries, submersion injuries, violent deaths, and intimate partner violence. These mapped data could be combined with a variety of other GIS datasets to provide spatial analysis that would enhance existing knowledge and better guide the efforts of the Service. Finally, mapping the locations of facilities, such as brain injury rehabilitation facilities, will be useful for making referrals and identifying gaps in coverage.

Terrorism Preparedness & Response Service

The Terrorism Preparedness & Response Service (TPRS) coordinates public health and medical systems preparedness and response for Oklahoma. They develop, train and exercise an all-hazards response system in preparation for natural and man-made disasters. They place much emphasis on protecting critical infrastructures and special needs populations in their preparations. The Service, along with several state partners, coordinates the Strategic National Stockpile (SNS) program in Oklahoma, which involves stockpiling large amounts of medicine and medical supplies for use in health emergencies. This program includes a plan for mass dispensing of medicines, called the Mass Immunization/Prophylaxis Strategy (MIPS) that is present in 35 communities in Oklahoma. The MIPS plan also includes

about 160 Points of Dispensing Sites (PODS), which are satellite distribution sites for the MIPS supplies.

There has been quite a bit of map use in TPRS in the past, although not in a GIS environment. Staff have used free online mapping tools, purchased map graphics, or other graphic software to create maps for emergency response support. The staff have also used hand drawn maps, pushpin maps and dry erase maps to assist in planning and response efforts. These types of maps, however, have not been as helpful as they could be to TPRS operations because of the great amount of time/money to create the maps and the potential inaccuracies in prepackaged datasets used to make the maps. In addition, the hard copy maps are difficult to quickly share across a wide disaster-response audience that can potentially cover a large geographic area. There has not been GIS use in the service due to a lack of software and trained staff. There is one staff person who has a strong desire to use and implement GIS technology in the service, in particular to support the OSDH Situation Room operations, but that person does not currently have access to GIS software. The Service leadership and staff, however, believe that several of their people should be trained to use the GIS software and have access to it.

There are many potential applications of GIS technology to support TPRS activities. These applications can be grouped into three categories: mapping data, creating maps for specific purposes, and conducting GIS analysis. The first category of mapping data could be very useful for TPRS staff when planning for and responding to emergencies. Data to be mapped include locations of infrastructure for emergency response such as MIPS sites, PODS sites, schools, hospitals, physicians, medical reserve corps volunteers, public health responders, and others. The databases underlying the mapped data would include important variables such as assets in a facility. It will also be important to map data relating to the numbers and locations of special needs populations such as elderly populations and individuals requiring oxygen. For these mapped data to be useful to emergency response efforts, it is vital that the data be maintained in a central location and updated at regular intervals to ensure timeliness. In addition, efforts should be made to increase and maintain the spatial accuracy of these datasets. This would include utilizing GPS technology, when possible, to obtain highly accurate locational information for sites and facilities. Having a dataset of accurate, relevant geographic information will help with providing a comprehensive picture and allowing for information-based planning in emergency events

The second category, creating maps, refers to activities that would use the mapped data created in category one to make informative, complete maps for use in specific situations. For instance, one activity could include creating a map of detailed GIS data for a localized region for response efforts. This would include overlaying many different datasets to provide a complete picture of the situation on the ground. The benefit of making these maps in a GIS system as opposed to using road maps or other published atlases is that the types of data displayed on the map can be customized to any level and users can interact with the maps in a digital

environment if they want to. A long-term goal of the TRPS division would be to include an interactive GIS map into the Web Emergency Operations Center (WebEOC), the Emergency Management System (EMSystem), EMSystem or another emergency response system. This would allow users across the state to have access to up-to-date, comprehensive spatial data. The GIS maps can also be created and customized to be included in grant applications and reports to provide graphics that support text. In fact, the TPRS staff have been required in the past to include maps on grant applications but they have not had a very good mechanism for creating these maps.

The third category of GIS applications for TPRS is spatial analysis. The spatial analysis applications include buffer analysis, data overlays, risk assessment and network analysis. Each of these types of analysis can be useful to TPRS both for emergency planning and response. Network analysis would be particularly useful for routing deliveries to MIPS sites. The usefulness of these spatial analysis applications will depend heavily on the accuracy and timeliness of geospatial data used in the analysis. This may be more important for TPRS than any other service in OSDH due to the potential mortality and morbidity that could result from misguided emergency response efforts.

Tobacco Use Prevention Service

The Tobacco Use Prevention Service provides programs to prevent tobacco use among Oklahoma's population. Most efforts are focused on community-based programs. The Service's programs include: the Clean Indoor Air program, Community Outreach, School Programs, and Evaluation & Surveillance. The Service has "Communities of Excellence" partnerships with communities through 16 coalitions around the state in 26 counties. Some of the most pressing issues of this Service include: the tobacco tax, smoking in public places, reducing youth access to tobacco products, and tracking tobacco-related city ordinances. The Service is also starting to focus on health disparities and access/use of tobacco products by disparate populations, including minorities, the economically disadvantaged, and youth.

Staff in this Service have used mapping in the past. They have not had access to ArcGIS software; however, one staff person has used EpiMap (the free CDC GIS software) for several mapping projects. One on-going project involves mapping the locations of school districts that have adopted 24/7 tobacco-free school zone policies. This staff person has also created PowerPoint-based animations of these maps to demonstrate the increase in the number of tobacco-free school districts over time. Another mapping project that was done involved mapping Oklahoma counties by the number of restaurants that are smoke-free. There has also been some use of PowerPoint mapping. The locations of counties with Communities of Excellence partnerships were mapped with PowerPoint, and that map is still in use and updated periodically.

Tobacco Use Prevention staff would like to continue and expand their mapping activities with support, including support for access to ArcGIS software and training. They would like to continue mapping data for the Communities of Excellence program, mapping tobacco-free schools, and continue creating maps for reports, presentations and legislative discussions. They have found that maps can be very effective to show communities or schools how many of their neighbors have adopted tobacco-related policies.

There are also new mapping projects that this Service area could do, such as mapping the origin of calls to the Oklahoma Tobacco Helpline. In the past, the Service has received at least one call from a reporter who was mapping calls to the Oklahoma Tobacco Helpline by county per population. There is a thought that if OSDH were proactive about doing this before the media does, the agency would have control over the representation of that data and be able to provide it to the media. Other mapping projects could include: mapping BRFSS data related to the Helpline, mapping individual restaurants that are not 100% smoke-free, and mapping tobacco retailers. Much of this data could be overlaid together. For instance, two interesting projects would involve overlaying the locations of schools and tobacco retailers or overlaying disparate population data with tobacco retailer locations.

This Service could also engage in certain GIS analysis. They would like to use cluster analysis to determine if the implementation of tobacco-free school policies happens in a geographically clustered pattern or not. They would also like to analyze the distance between schools and tobacco retailers to assess youth access to tobacco.

Despite a growing interest in using GIS for Tobacco Use Prevention work, there are obstacles to effective mapping that are inherent to the Service's data resources. Much of their survey data is difficult to map because the sample populations are generally too small to map without compromising confidentiality. In addition, many of their surveys are not geographically representative. Finally, the Service uses BRFSS data frequently but the reports generated by OK2SHARE are not formatted for easy use in the GIS software. The user must reformat the data before it can be easily mapped. These issues could be addressed in the future to enable effective mapping.

Public Health Laboratory Service

The Public Health Laboratory provides essential public health laboratory services to support the agency's public health goals. These services include: analytical services; specialized procedures and reference testing; training, technical assistance, and consultation; applied research; and, pharmacy services for county health departments.

There have not been any mapping activities in this Service to date. They do not have access to GIS software but one staff person has received training to use GIS software. The activities of the Service are not highly related to geography. One exception is training and interaction with other laboratories/physicians in the state. The training director maintains a database of laboratories that could be mapped to assist with planning trainings. These labs could also be symbolized based on their certifying bodies - CLIA (Clinical Laboratory Improvement Act) or CAP (College of American Pathology), and based on their capabilities, such as being equipped for microbiology. A laboratory map could also be useful to assist with rapid response to a public health issue by helping to identify the closest laboratory for testing. Additionally, the OSDH pharmacy was looking for an inventory control system to assist with shipping and tracking products between the central office and county health departments. Such a system could involve a GIS component.

3.2.5 Administrative Services

The Administrative Services (AS) Deputy Commissioner Area consists of seven Services that fulfill the administrative needs of the agency: Accounting Services, Budget and Funding, Building Management and Internal Services, Procurement, Federal Funds Development, Information Technology, and the Office of Human Resources.

This Deputy area is one with fewer potential GIS applications than others, although there are many ways that GIS could help to improve and streamline workflows in most Services of AS. The Deputy Commissioner, Tim Tall Chief, can anticipate several uses of GIS within his area. With regard to Human Resources (HR), he would like to know where concentrations of OSDH employees are located throughout the state as well as where concentrations of clients are served by OSDH programs. By combining this information, he would like to be able to better allocate funds and efforts to locations of the state where there is the greatest need. Other HR applications that the Deputy would find useful include: mapping where the majority of employees come from, mapping the areas of highest employee turnover, and visualizing employee locations by specialty groups.

For Building Management and Internal Services, Tim thinks maps of floor layouts and the locations of floor marshalls would be helpful to determine if the distribution of floor marshalls is appropriate. Also for this Service, Tim would like to have a way to track inventory as it moves from the central office to county health departments and wonders if a GIS system could assist with that. Physical tracking of inventory and also the ability to make a visual picture of where supplies are going would be useful.

Accounting Services

Accounting Services (AS) manages the accounting functions of OSDH and consists of five units. These units are: the payables unit, the grants unit, the receipts unit, the reconciliation unit, and the payroll/time & effort unit. Within these units, the Service completes functions such as managing payroll for all employees, paying bills and contracts, collecting funds from outside sources, balancing OSDH systems with the Office of State Finance, grant reporting, and providing receipts for all funds.

There has not been any use of GIS software in Accounting Services to date although there are potential applications that could be completed within AS or as a collaboration between AS and other Services in this area. One family of applications would be to evaluate cost data by using GIS to determine if it costs more to provide a service in one area of the state than in others. One part of this would be to map areas of the state where staff time is devoted largely to travel time to show where travel costs are greatest. Related to this, the Service could map employee payroll location, from the Time and Effort (T&E) system, vs. work location to evaluate how employee time and resources are allocated across the state. Aside from this, the Service would like to create maps showing the origin and destination of funds used

by OSDH. The trauma fund is one source of money that could be mapped to show which regions of the state contribute more to that fund than others.

Budget and Funding

The Budget and Funding Service manages budgets and allocates funding for OSDH. There has not been any use of GIS in this Service and there are no obvious uses of the technology for this office since they do not collect or use spatially referenced data. However, the Chief is generally supportive of the technology for enhancing services in our public health programs.

Building Management and Internal Services

Building Management and Internal Services (BM&IS) manages the OSDH central office and grounds as well as inventory receiving and management. The Service consists of three areas: Building Management, Shipping, Receiving, and Inventory. There has not been use of GIS in this Service in the past.

Building Management controls access to the central office building, and monitors systems for utilities, fire, telephones, and others. Aside from a few state-owned buildings, the county health departments are managed locally with local funds. There was recently a space study completed for the central office by an architectural firm who provided computer-aided design (CAD) files of all floors. This Service would find it useful to use GIS to manage and manipulate the CAD files of floor layouts in order to assist with managing the infrastructure of the building. The Chief envisions that a GIS map could contain several layers of information about the location of infrastructure. For instance, there would be one layer that represents floor layout, another layer showing the location of phones on each floor (linked to a table with phone numbers and assigned users), a layer of other equipment, a layer representing the locations of elements of the fire system, etc. The combination of this information in the GIS system would allow building management to plan and track maintenance activities as well as locate particular offices and staff for use by floor marshalls and general space allocation.

Receiving tracks the receipt of goods into the central office and Shipping tracks all products shipped to county health departments and various clinics throughout the state. Inventory manages the goods and keeps track of where they are located. Tracking the products and keeping shipping costs affordable are big challenges for these areas. GIS may be useful for shipment planning and supply tracking, depending on how it could integrate with current systems.

Procurement

The Procurement office processes purchase requests for the agency. This office does not work with spatially located data, so, although GIS staff will work closely

with Procurement to coordinate future software and hardware purchases, the office will not have any direct use of GIS to assist their work functions.

Federal Funds Development

The Office of Federal Funds Development (OFFD) assists OSDH programs with applying for federal grants and also oversees OSDH participation in the Medicaid program. Many OSDH county health department clinics are Medicaid providers, and OSDH has an interest in ensuring that Medicaid claims for clinic services are billed effectively to maximize that revenue for the agency.

This office has not used GIS in the past, but they have a lot of interest in the application of this technology to their work with Medicaid claims for OSDH clients. They would like to map Medicaid claims data by residence of the client as well as by the county where services were received.

Mapping client data by county of residence would allow the OFFD to determine where their Medicaid clients are coming from and determine whether or not Medicaid recipients are relying heavily on OSDH county health department (CHD) Medicaid services despite geographic barriers to access. Mapping the service county would allow the OFFD to meet several needs. OSDH has the opportunity to identify Medicaid services that were provided by county health departments in the last 3 years in medically underserved areas and health professional shortage areas to receive bonus payments from Medicaid. GIS could assist with this. Finally, GIS mapping can also help this office identify potential populations that could be served by more OSDH Medicaid providers. This will help to justify whether CHDs in counties where there is more than one CHD should all be Medicaid providers. This will also allow the OFFD to identify where non-OSDH Medicaid providers are located and identify gaps in service where OSDH might want to have the CHD in that area become a PCP for Medicaid and/or a fee-for-service provider for DHS foster children.

Information Technology Service

The Information Technology Service (ITS) serves the computer software, hardware, networking and application development needs of the agency. There are three areas of the service: the Support & Operations Area, Planning & Mainframe Support Area, and Integrated Systems Area. This Service has not used GIS in the past to support their own work, but they have worked with other programs on mapping applications, such as the PHIDDO system. They have also supported GIS activities by assisting with software installation through their Helpdesk division.

There are not many identified uses of GIS mapping to benefit ITS. One possible application would be to map the IT technician regions of field staff that serve CHD computing needs. This map, in a GIS format, could be more easily shared and updated than a PowerPoint map as staffing patterns change. Field staff could also

potentially make use of GPS technology and GIS base maps to plan travel time and routes.

One other potential application would be for the Helpdesk staff to use maps of the central office floor layout to locate staff offices when they are trying to fulfill a request for technical assistance that requires a visit to the person's desk. This type of application might not be a significant improvement upon the existing protocols but may save phone, email and exploration time that is spent in locating someone's office.

The role of ITS as it will relate to GIS at OSDH will likely be geared more towards GIS support than GIS use. The various areas of ITS will be involved in software installation, server maintenance and security, and consultation on GIS system design as it relates to the hardware infrastructure and network.

Office of Human Resources

The Office of Human Resources (HR) serves OSDH staff and the public through a variety of departments. These departments include: Benefits and Safety; Employee Assistance Program; Office of Civil Rights; Office of Program Integrity; Personnel; Recruitment, Retention and Recognition; and Training, Education and Development. The office serves both central office staff and county health department staff. They have not previously used GIS, although their databases do contain geographic information, and they have at least one staff member interested in obtaining GIS training.

There are several ways in which HR might be able to use GIS to assist them in their work. The department that might best use GIS is the Recruitment, Retention and Recognition department. They can use GIS to assist with recruitment in several ways. They can design and target ads to specific geographic areas based on demographics of the population and educational resources in the area. They can also map staffing needs by area and compare to the population in need to determine high priority staffing areas. They can also compare maps of areas with many vacancies to locations of training schools in those areas. Additionally, they can geographically track applicants to further identify where to focus their efforts. To evaluate staff retention, GIS could be incorporated into a larger absence management system in which data from the T&E system could be mapped to identify areas of the state where more sick-leave is used, if there is indeed a geographic disparity to sick leave use. More training and intervention could then be targeted to those areas in an attempt to reduce sick-leave rates.

To potentially benefit employees, HR could map employee residences to evaluate a need for or request for telecommuting benefits. HR could also use GIS to support a commuter-matching database to help employees find fellow commuters to share rides with.

Finally, in conjunction with TPRS and other OSDH programs, HR could support GIS initiatives to map employee residences for the Oklahoma Public Health Responder database. This would help to identify potential public health responders in specific areas during emergencies. This could also help OSDH with workforce depletion analysis by helping to identify and quantify numbers of employees potentially affected by an emergency, such as a chemical spill, ice storm, or other natural disaster.

There are concerns within HR about potential misuse of GIS or unease among employees about certain potential applications of the technology. Some employees may be uncomfortable with having their home addresses mapped depending on how that information would be used or shared. It would be important to stress that individual mapped addresses would be protected just as the employee address in a database would be protected. In order to protect privacy, aggregation methods should be used to display employee data on maps that are intended to be viewed by people outside of HR or TPRS. In addition to confidentiality issues, there is concern about data reliability. Many employees do not report changes of address in a timely manner, so this source of error would need to be accounted for.

3.2.6 Commissioner's Direct Reports

Center for Health Statistics

The Center for Health Statistics collects, analyzes and disseminates health statistics for Oklahoma. The Center consists of two divisions: the Vital Records division and the Health Care Information division. Vital Records (VR) collects, maintains and issues Birth and Death Certificates. Health Care Information (HCI) collects, processes and disseminates health care data related to a variety of health services.

HCI collects and maintains data about health services and vital statistics. The division addresses the entire spectrum of health care information from collection and quality improvement to data enhancement and analysis. HCI has developed and maintains the statistics web query called Oklahoma Statistics on Health Available for Everyone (OK2SHARE), which provides online access to statistical information in aggregate form for several agency datasets, including Birth, Death, Induced Termination of Pregnancy (ITOP), Inpatient Discharge, the Behavioral Risk Factor Surveillance System (BRFSS), the Youth Risk Behavior Surveillance System (YRBSS), Cancer, and Injury. The system provides data in tabular format based on parameters set by the user.

HCI houses the Call Center, which conducts many surveys for HCI and other OSDH program areas. Some of these surveys include the BRFSS, Intimate Partner Violence survey, Racial and Ethnic Minority Health, asthma prevalence, and Oklahoma Tobacco Helpline. HCI also houses the agency GIS Coordinator and the Data Warehouse Coordinator.

There has been previous use of mapping in HCI. GIS has been used to geocode records from several HCI datasets, including Hospital Inpatient/Outpatient Discharge, Outpatient Ambulatory Surgery Centers, Births, and Deaths. One staff member who has GIS training completes this geocoding. The Division would like to continue this geocoding and improve its accuracy and timeliness.

GIS maps and analysis were not created in-house with HCI data until the GIS Coordinator was hired into that division. Prior to that, maps were created with PowerPoint. The division received good feedback on maps that were created to display data in past Vital Statistics reports, and maps have been included in past State of the State's Health reports. Additionally, a previous Health Disparities Task Force report has included a number of maps.

There are many ways in which HCI staff would like to expand their mapping and spatial analysis with GIS technology. These include Internet mapping, data reporting, data quality evaluation and statistical analysis. They would like to incorporate mapping into OK2SHARE so that maps are generated as one type of output when users execute data queries. They would also like to have maps generated through the Data Warehouse when it is up and running. In addition, there

is interest in developing a Health Care Atlas similar to what other states have, such as Kentucky and South Carolina.

HCI produces and collaborates on many reports that can be enhanced with maps. The division would like to continue and increase their use of maps in reports. Population demographics, vital statistics, and health statistics could be mapped at the county level or finer scales, when possible, to provide another avenue for data reporting. Maps can also be useful in communicating with hospitals and other facilities that provide data to HCI.

The use of GIS in HCI can assist with improving data quality. The staff would like to map the location of deaths with misclassified race to evaluate if those deaths occurred far from the person's residence (and family and friends that would know the person). They would also like to map that data and overlay it with the location of funeral homes to target outreach and education related to race reporting on death certificates. They might use GIS to estimate small areas (community-level data) from county-level demographics and rates.

Finally, HCI wants to incorporate spatial analysis into their analysis plan for their datasets. Some of this analysis might be done by HCI alone or as collaborative research with other OSDH programs. For example, they would like to map patient movement from residence to hospital to evaluate patient migration. They would also like to map hospital patient safety indicators to assess geographic variation and identify problem areas of the state. They would like to evaluate associations between environmental variables and hospital discharge and emergency room data. They would also like to apply GIS statistical analysis to quantify perceived geographic variation in health outcomes or health care utilization.

Office of State Nutrition and Physical Activity

The Office of the State Nutrition and Physical Activity director coordinates OSDH participation in Governor Brad Henry's "Strong and Healthy Oklahoma" (SHO) Initiative. This initiative involves the collaboration of many agencies in Oklahoma, but OSDH is the lead agency. The list of partner agencies includes: the Fit Kids Coalition, Department of Transportation, Department of Human Services, Department of Insurance, Department of Education, Governor's Council on Physical Fitness and Sports, Department of Agriculture, and others. There are four areas of the initiative each with specific recommendations, activities and action steps. The areas are: Social Marketing, Where We Live, Where We Work, and Where We Learn.

This office is very new to OSDH and has not used GIS in the past, although much of its work is related to geographic space and influenced by where things are located. There are many potential GIS applications for this office and the SHO initiative overall. These applications will be grouped by how they pertain to the four areas of the initiative.

Social Marketing

A major project recommendation in the Social Marketing area was to develop and launch a SHO website. This has been completed, but the website only includes one static map (of the Turning Point programs) despite the fact that the website serves partly as a resource for Oklahomans to locate nutrition and fitness resources in their area. The OSDH SHO staff see much value in adding an interactive web map to the SHO website to assist the public with finding resources.

A second potential GIS application for this area of the initiative is to use GIS to assist with targeting the social marketing campaign to particular geographic areas and specific populations. By layering multiple types of data in the GIS, it can assist with targeting funds and other resources to areas that might benefit most from the SHO campaign.

Where We Live

GIS contributions to the Where We Live part of the SHO initiative involve primarily mapping the location of resources and facilities. Initiative planners can use maps of physicians and self-management health education programs to promote disease prevention. Mapping and analysis of the built environment (the infrastructure and other manmade features in our environment) could help identify and promote walkable and bike-friendly communities throughout the state. Finally, mapping farmer's markets and restaurants (including data about "healthy" restaurants) can assist with promoting healthier eating.

Where We Work

The two primary applications for the Where We Work area involve businesses in Oklahoma. The initiative would like to support and recognize businesses that encourage healthy habits in their employees. GIS mapping can support this through showing the location of "Certified Healthy Businesses" and mapping places where businesses can obtain "Make It Your Business" healthy business training.

Where We Learn

GIS mapping to support the Where We Learn area includes mapping educational institutions such as schools and churches. Maps of these institutions can highlight the locations of schools with Healthy and Fit School Advisory Committees, with After-School programs, with Farm to School programs, and with school nurses to determine the availability of these resources in different parts of Oklahoma. As the SHO initiative matures, GIS analysis could be used to partly evaluate the impact of SHO activities on health outcomes.

The many possibilities for using GIS for the SHO initiative can seem somewhat daunting to an OSDH office with only a couple staff people. However, OSDH has

many partner agencies in this initiative, several of which already use GIS extensively, and a collaborative effort can make GIS a useful tool for this initiative.

Office of Communications

The Office of Communications has responsibility for internal and external communications for the agency to ensure that they are accurate and timely. They focus on media relations, electronic communications, and publications. They assist with web development and management and also organize media communications. Their staff includes graphic artists who enhance publications.

This office has not used maps for their own purposes, although the graphic artists have experience with incorporating map graphics into publications. There is one potential use of GIS for this office. They often need to identify all media resources in a particular area, including television and radio. It could be helpful to have this information mapped to improve the ease and speed with which they locate specific media resources. The office already has a list of radio stations by town but a map that combines the location of different types of media would be helpful.

Aside from their own use of GIS for their work, the Office of Communications might be involved with GIS through their graphic artists and web staff. The artists might be consulted on map templates or a map review process. The web staff may be asked to participate in the development of an agency interactive web map as will other communications staff who will evaluate the map as a form of external communication for the agency.

Office of Scientific Affairs

The Office of Scientific Affairs promotes scientific analysis, research and development at OSDH. The office facilitates scientific research and strives to develop skills among staff related to writing, presenting and methodological design. The office also provides guidance such as: providing consistent review of scientific writings and presentations; exposing staff to peer-reviewed journals and scientific reports; promoting cross-program data sharing and report sharing; reviewing reports intended for the legislature; leading the agency Health Informatics Council; and, organizing quarterly “Science in Action” research seminars.

Due to the nature of this office, there is no data analysis or program management that is completed without large input from other areas of the agency. This office plays more of an advisory role. For this reason, there has not been any mapping done by the staff for this office. However, the Director has experience with GIS mapping through her previous positions and is generally supportive of the technology. She would like to promote better use of maps by encouraging people to provide written interpretation of maps on posters and in presentations or papers. She would also like to encourage the creation of maps that are more easily

understood by the viewers with appropriate choice of data and interpretation displayed.

3.2.7 Summary of Potential GIS Applications in OSDH

There are many common themes and similarities across Deputy Areas and programs in OSDH pertaining to potential GIS use. There are common "mapping" needs that relate both to the creation of specific maps but also to the application of specific types of GIS analysis. There are also common requests for geospatial data across programs. Table 2 lists these common mapping and data needs in descending order by the number of programs expressing the need. These potential applications are listed by Service Area in Appendix 2.

Table 2: Common GIS Needs Across Programs

Common GIS needs expressed in the needs assessment interviews:	Number of programs identifying this need:
Common mapping needs:	
Programs who want to use maps in reports:	42
…….map their regions, districts, service areas:	22
…….use network analysis:	20
…….have an interactive web map:	16
…….use GIS to evaluate and plan staffing patterns:	12
…….use advanced spatial analysis:	8
…….use GPS:	7
Common geospatial data needs:	
Programs to use mapped census demographics:	42
……..legislative districts:	42
……..county health departments:	24
……..client addresses:	18
……...medical facilities:	17
……..educational facilities:	13
……...health and dental clinics:	12
……..longterm care facilities:	11
……...physician's office locations:	8
……..child care facilities:	8
……..restaurants:	5
……...special needs population:	4

4. Review of GIS Infrastructure at OSDH

In this chapter, the current state of GIS infrastructure in OSDH will be described. Three topics related to infrastructure will be covered including: geospatial data, GIS software resources and computational infrastructure.

4.1 Geospatial data holdings

The geospatial data stored and in use at OSDH can be classified into four groups. These are: free downloaded datasets; free in-house datasets; free, shared datasets; and, purchased datasets. Many OSDH GIS users store and use a combination of data from each of these categories.

The free, downloaded GIS datasets include those acquired from online data warehouses such as the “OU Center for Spatial Analysis Data Warehouse”, the “OSU Center for Geospatial Information”, the “Geography Network”, and others. Examples of these data include: TIGER files such as roads, county boundaries, and other census boundaries; municipal boundaries; digital orthophotos; and, legislative districts. These datasets are freely available to download and use. Many are provided to the data warehouses by other government agencies that create and maintain the datasets. There is no cost to OSDH to download or use these GIS data. These downloaded datasets comprise the majority of stored GIS data at OSDH.

The free in-house GIS datasets are those that have been created, through geocoding or digitizing processes, from data that are collected and maintained by OSDH. Examples of these include: geocoded hospital data from the medical facilities licensing database; geocoded nursing homes from the long term care databases; feature layers of OSDH program regions; and, feature layers of EMS service coverage areas digitized from EMS Division data. Currently, these GIS datasets are freely available to all OSDH staff (though not always easily accessible), and many are shared with outside agencies directly or via a data warehouse. The only cost associated with using these datasets is that incurred by individual program for geocoding/digitizing the data and performing periodic updates.

The free, shared GIS datasets include those provided to OSDH directly from other government entities. Examples include geocoded data about physician locations; rural health clinics, FQHCs and community health centers; concentrated animal feeding operations; and, environmental hazard sites. Other government agencies that have directly shared GIS data with OSDH in the past include: the OSU Center for Rural Health, ACOG, City of Tulsa, OK Water Resources Board, OK Department of Agriculture, Food and Forestry, OK Department of Environmental Quality, and OK Department of Commerce, among others. There is no cost for using these shared datasets.

The purchased GIS datasets include those acquired from commercial companies at a cost to OSDH. Until recently, this included a roads dataset, from a company called Tele Atlas, which was purchased by Acute Disease Service (ADS) and used to support the PHIDDO system. At the time of this writing, the maintenance agreement for the Tele Atlas roads data had been terminated so that ADS and the GIS Coordinator could evaluate other options for purchased or free roads data. Other purchased data include the ESRI data provided with the GIS software. Although not directly purchased, most of this data is only available through the purchase of an ESRI GIS license. The ESRI data actually consists of many datasets from a variety of sources. Some of the data can be freely used and redistributed and some cannot.

The storage of geospatial data at OSDH is de-centralized. Data is stored on individual computer hard drives, personal network folders and program-specific network folders. There is not a single individual who has knowledge of and access to all GIS datasets in the agency. In fact, there is little knowledge across programs of what GIS data layers are currently stored in-house. This current arrangement evolved slowly as more and more staff took an interest in using GIS and began to acquire GIS data to assist in their work. At the same time that interest in GIS grew, there was not a plan, support, or infrastructure in place to organize the acquisition and storage of these datasets.

It is unknown how many copies of GIS data are stored on OSDH disk space but the amount can be estimated to be at least 250 GB. This number is estimated by calculating the file size of GIS base data layers given out at GIS trainings and multiplying by the number of OSDH GIS users who have that data stored on their hard drives or personal network drives. If the GIS data is centralized on one server, much of the 250 GB of drive space would become available for other data storage needs.

4.1.2 GIS software resources

There are several brands and versions of GIS software in use at OSDH. The primary brand of GIS software used is the ESRI ArcGIS product line. There are also three other GIS software products in use in the agency. They include MapInfo; the CDC's free GIS software, EpiMap, which is included in the EpiInfo software suite; and SAS GIS. Table 3 shows the number and types of GIS licenses owned by OSDH.

Table 3: GIS Software in Use at OSDH

Software Name	# of Licenses	Approx. # of Users
ArcView 9.2 Concurrent Use+*	12	50-60
ArcView 9.2 Single Use	6	6
ArcInfo 9.2 Concurrent Use	3	8-10
Network Analyst Extension 9.2, Concurrent Use+	1	**

Software Name	# of Licenses	Approx. # of Users
Publisher Extension 9.2, Concurrent Use+	1	**
Spatial Analyst Extension 9.2, Concurrent Use	1	**
Spatial Analyst Extension 9.2, Single Use	2	2
Geostatistical Analyst Extension 9.2, Single Use	3	3
3D Analyst Extension 9.2, Single Use	1	1
ArcPad 6.0.3	10	10+
ArcPad Application Builder 7.0.1	1	1
ArcGIS Server 9.2, Standard, Enterprise	1	1
Trimble GPS Pathfinder Office	1	1
MapInfo Professional 7.0	1	1
EpiInfo EpiMap (CDC)	unknown	unknown
SAS Bridge for ESRI	1	1
SAS PC Enterprise GIS	50	unknown

+ Recent purchase
* 12 ArcView Concurrent Use licenses were upgraded from previously owned Single Use licenses.
** Number of users for the extensions is not yet estimated, but should be at least five.

The use of multiple types of GIS software in the agency has been somewhat problematic because data sharing and training between users of different GIS software brands is difficult. The ESRI and MapInfo software, in particular, do not interact well together. However, this problem is minimized by the fact that there is only one MapInfo license/user in the agency, and there is also widespread support for standardizing to ESRI software to leverage the current software resources and training environment.

4.2 Computational infrastructure

Much of the computational infrastructure in OSDH is adequate to support GIS use. The infrastructure components that must be considered in planning an enterprise GIS system include desktop PCs, servers and the network.

4.2.1 Desktop Computers

Most new desktop computers that the agency purchases meet the minimum system requirements to run ArcView. Special purchases may be required in order to meet the minimum specifications to run ArcInfo. Tables 4 and 5 list the minimum requirements for ArcView and ArcInfo.

Table 4: Minimum Requirements for a Computer Running ArcView

ArcView Minimum Requirements	
Platform	PC-Intel
Operating System	Windows 2000 or Windows XP (Home Edition and Professional)
Memory	512 MB RAM
Processor	1 GHz

Table 5: Minimum Requirements for a Computer Running ArcInfo

ArcInfo Desktop Minimum Requirements for Windows XP	
Platform	PC-Intel
Operating System	Windows XP (Home Edition and Professional)
Memory	1 GB minimum, 2 GB recommended or higher
Processor	Intel Core Duo, Intel Pentium or Intel Xeon Processors
CPU Speed	1.6 GHz recommended or higher
Disk Space	1.2 GB
Screen Resolution	1024 x 768 recommended or higher at Normal size (96 dpi)

4.2.2 Servers

There are two servers that support GIS activities at OSDH. The servers were originally purchased to support the Communicable Disease Division PHIDDO system and, to date, have only been used for GIS purposes to serve maps and spatial data for that system and to serve out the ArcInfo license keys. Tables 6 and 7 show the specifications for these two servers. The software that runs on the servers is ArcIMS 9.1 and ArcSDE 9.1. Since OSDH owns the new GIS server software, ArcGIS Server 9.2 (current version at the time of writing), the GIS servers will be used to run that software. Table 8 shows the minimum server requirements to run ArcGIS Server on the PC-Intel Platform.

Table 6: Specifications for Current ArcIMS (Web) Server

Current ArcIMS Server Specs	
Platform	PC-Intel
Operating System	Windows 2000 Server
Memory	4 GB
Processor	4 processor, XEON Hyper-threading
CPU Speed	1.6 GHz
Disk Space	540 GB Raid HDD

Table 7: Specifications for Current ArcSDE (Data) Server

Current ArcSDE Server Specs	
Platform	PC-Intel
Operating System	Windows 2000 Server
Memory	8 GB
Processor	4 processor, XEON Hyper-threading
CPU Speed	1.6 GHz
Disk Space	540 GB Raid HDD

Table 8: Minimum Server Specifications to Run ArcGIS Server

Minimum* Server Specs to Support ArcGIS Server 9.2	
Platform	PC-Intel
Operating System	Windows 2000 Server**
Memory	1 GB min, 2 GB recommended or higher
Processor	Intel Core Duo, Intel Pentium or Intel Xeon Processors
CPU Speed	1.6 GHz recommended or higher
Disk Space	352 MB

* Listed specifications are minimum requirements but not necessarily optimal
** Several other server platforms are supported

4.2.3 Network

There is a one-gigabit Ethernet connecting each floor in the central office to the core switch in the server room. County health departments are connected to the central office via T1 lines through the OneNet and servers at the Office of State Finance. The T1 lines are taxed pretty heavily by access to the PHOCIS system and by video conferencing (this uses 1/3-1/2 of the available bandwidth), so there would be little bandwidth available for county staff to access large GIS data files stored at the central office.

4.2.4 Other Infrastructure resources

A couple programs in OSDH have Global Positioning Systems (GPS) units. They have been used for field data collection out of the county health departments but are generally stored in the central office when not in use. Table 9 shows the number, locations and types of GPS units in OSDH.

Table 9: Global Positioning System (GPS) Units and Associated Hardware Owned by OSDH

Program/Service	GPS unit type	Number of units
Acute Disease Service	Trimble GeoExplorer 3	1

Acute Disease Service	Trimble GPS Pathfinder Pocket GPS Receiver	2
Acute Disease Service	Trimble Beaon-on-a-Belt Receiver	1
Birth Defects Registry	Trimble GPS Pathfinder Pocket (Receiver)	11
Birth Defects Registry	Pharos iGPS-360 with Bluetooth Dock (Receiver)	5
Birth Defects Registry	HP iPAQ h4300 (pocket PC)	11
Birth Defects Registry	Dell AXIM X51V (pocket PC)	5

5. Summary of Key Findings and Recommendations

In this chapter, the findings and recommendations listed in the Executive Summary and touched on in various other sections of this report will be addressed in more detail. The key findings are organized into seven categories which are: Coordination and Capacity; Data Creation and Maintenance; Computational Infrastructure; Client Services and Outreach; Metadata and Standards; GIS Staffing; GIS Training and Resources; and, GIS Priority Applications. For each finding, the text from the Executive Summary is listed, followed by detailed explanation of the finding and recommendation.

5.1 Coordination and Capacity

Historically, the model of GIS coordination at OSDH has been decentralized.	OSDH can better focus mapping activities by continuing with and expanding upon the centralization efforts that were initiated in 2006 with the hiring of the GIS Coordinator and strengthened by the creation of the GIS Advisory Committee. Carefully guided centralization efforts will provide for efficient and effective application of GIS technology.

The use of GIS technology was implemented slowly throughout the agency by individual programs. Often, there was little to no communication between programs about their use of GIS and no infrastructure in place to support data sharing or collaboration. With the creation of the GIS Users Group, hiring of the GIS Coordinator and creation of the GIS Advisory Committee, the agency initiated efforts to coordinate and centralize GIS activities and resources. There is much support for this centralization among current GIS users and managers, although there is a modicum of apprehension that centralization will take resources away from programs that previously invested in them.

Understanding and utilization of GIS technology within OSDH programs is extremely varied.	Support for GIS training at differing levels for interested staff will allow for more effective use of maps and spatial analysis.

Several OSDH staff have a lot of experience and background knowledge about GIS through their schooling or encounters at conferences and meetings. Others have heard of GIS but have no experience using the software. Many others have no familiarity at all with GIS. DPS, FHS, and CHS generally have more staff that know

about and have used GIS but there are staff in all OSDH areas that recognize the utility of mapping their data even if they do not know how to go about doing it.

Many managers and staff can benefit from basic GIS training to have the knowledge on which to base their requests for maps or spatial analysis. There is no need to train all employees to use the software; however, basic education for everyone could help to orient them to the technology so that it can be used.

OSDH is an extremely varied agency with a wide range of services and priorities. Nevertheless, almost all programs have some kind of geographic component to their data/work and share a common desire to incorporate the use of GIS in their work.	Continuing efforts to move toward a more centralized GIS system will prepare OSDH to meet the mapping needs of all programs. Collaboration of GIS work across programs would maximize efforts and resources.

The missions and goals of OSDH programs cover a broad spectrum. There are programs that provide direct client services, others that provide surveillance and others that canvas the state inspecting facilities. It is difficult to grasp all the services provided by the agency. However, in almost all programs, data are geographically or spatially referenced in some way or business processes are related to geography. In most cases, GIS has the potential to interact with those data to augment current analysis and decision-making.

Partly due to the size and diversity of the agency, there is much duplication in effort for GIS activities. The same geographic data files are created or obtained independently by different programs simply because of a lack of knowledge about what everyone is doing with GIS. Maps and data are created in one program that could also be used by another program but there has not been any way to easily make those available to each other. By centralizing the GIS resources, the agency can overcome the challenges that diversity places upon it.

OSDH senior leadership has expressed support of GIS use by supporting the establishment of a Coordinator position and funding software centralization.	The GIS system could best maximize this support by focusing early GIS work on projects that will provide the greatest return on investment to encourage continued support of the technology.

In 2006, OSDH senior leadership was approached for their approval to hire a GIS Coordinator. They granted that approval and also subsequently offered visible support for the GIS Needs Assessment process by urging participation by their staff as well as participating themselves in the interview process. In 2007, the senior leadership was approached with a request to identify funding to upgrade and centralize the GIS software licenses. They were informed of the costs and benefits

and chose to support the software centralization with funding and encouragement of their staff to participate in the process.

The senior leadership has made monetary and organization investments in GIS without immediate and highly visible returns on their investments. While the GIS system is still in its infancy, it will be difficult to deliver on all the potential of GIS applications right away; nevertheless, emphasis can be placed from the start on key GIS applications that will demonstrate the utility of GIS to streamline agency procedures or improve outcomes. Those applications that provide agency-wide benefits could also be prioritized.

OSDH staff have been motivated to organize GIS interest groups, including the GIS Users Group and the GIS Advisory Committee.	The GIS system will be most successful if it is designed with input from the GIS interest groups and its use promoted through these groups.

The GIS Users Group was created in 2004 to provide an avenue for OSDH GIS users to meet, share data, and share experiences/problems with using the technology. The group has meet approximately one time per month since its inception. Out of this group, came the desire and support to hire the GIS Coordinator.

The GIS Advisory Committee was created in 2007 to provide a group environment in which to develop the centralized GIS system and develop policies and procedures related to the use of GIS in OSDH. This group and the GIS Users Group can continue to provide input and support for the centralized system.

5.2 Data Creation and Maintenance

Many of the mapped data at OSDH are not in GIS formats (ex. PowerPoint maps), thus they are not easily updated or shared. Because of this, much staff time is used to re-create maps from scratch.	Staff time and effort can be saved by making available base GIS data and frequently used maps to agency map authors via a central database that can be accessed over the Intranet. These data are most useful and reliable if they are quality-assured and updated by GIS staff on a regular schedule.

Although various programs have been using GIS for several years, many of them and most other programs still rely on using PowerPoint maps, road maps or other map products to visually display data in a geographic format. These maps have served their purpose but fail to take advantage of technology that allows for easily updating and sharing maps. The PowerPoint maps, in particular, are easy to

mistakenly edit, and it is difficult for staff to locate the most up-to-date versions of these maps.

By centralizing GIS software and data and training program staff to use them, maps can begin to be more easily shared and updated. The centralization could take some burden off of program staff by streamlining mapping processes. However, the centralization will require oversight by the GIS staff to keep data layers maintained, in an accurate and timely manner so program staff can have confidence in their maps that are created with central data stores.

There is an initiative in the Health Care Information Division to create a data warehouse that will ultimately be expanded agency-wide.	Incorporating the GIS database into the larger agency data warehouse will allow for the GIS database to be integrated with other agency data systems, and data users will be able to easily locate GIS data.

Staff in the Health Care Information Division will be working over the next couple of years to design and construct a data warehouse that will store program data in a way to facilitate data linking and data access for program evaluation and analysis.

The centralized GIS database could be incorporated into the agency data warehouse to facilitate mapping program data in the warehouse. This will also facilitate incorporating maps into data queries, cubes or web interfaces that originate with warehouse datasets.

Programs have a need to access GIS data pertaining to neighboring states for consideration of border issues in health care utilization evaluation, emergency response, and disease investigations.	Efforts to include health resources data from bordering states in the OSDH GIS database will be recognized by many staff.

Although OSDH only has “jurisdiction” in the state of Oklahoma, political boundaries are many times irrelevant when it comes to public health. People will travel across political boundaries in their quest to locate appropriate health care, emergency response teams will look for the closest resources available, and communicable diseases are not constrained by political boundaries alone. In light of these things, it is extremely important to consider health resources and populations in states that border Oklahoma.

The centralized GIS database may not be considered fully functional without the inclusion of data from neighboring states. The GIS staff can take advantage of existing relationships between OSDH programs and corresponding programs in

border states and also forge new relationships to obtain as much data as is needed to address border health issues.

There is a need to normalize datasets and to create agency-wide identifiers for people and facilities to enable higher quality analysis and program evaluation. The Health Informatics Council and its subcommittees are addressing people identifiers.	Normalizing and applying data cleaning standards to databases will facilitate easier GIS mapping. Also, the GIS Advisory Committee would be an ideal group to collaborate with other agency workgroups that will develop common facility identifiers (i.e. for hospitals, long term care facilities).

Many datasets within OSDH programs were not designed to accommodate rigorous analysis or complex data manipulation as is required for GIS mapping and analysis. Many datasets, such as the restaurant inspection database, are not normalized or cleaned to be useful for mapping, although there is a need to map those data. Normalization and data cleaning standards can improve this situation.

The Health Informatics Council, through the Master Person Index Subcommittee, is working on creating an agency-wide identifier for clients, but agency-wide facility identifiers do not yet exist. Linking facility information between program datasets is very difficult since there are not common identifying numbers and names are not standardized. It would be helpful for the GIS staff and members of the GIS Advisory Committee to play a role in developing these identifiers to facilitate easier data maintenance and linking.

Geocoding of client data and facility locations is not complete, highly accurate or standardized. Addresses are not often cleaned and rarely validated prior to geocoding.	Data quality can be improved by implementing standardized geocoding procedures that include address cleaning and validation. The GIS Advisory Committee and Master Person Index Committee have initiated this effort.
Base geographic data used to geocode is out-of-date.	Evaluation and purchase of high-quality roads and zip code datasets would support accurate geocoding efforts.
Most programs collect mailing addresses for clients, facilities, or other entities, but it is not clear if these represent physical residence location or not.	Programs can improve their ability to map their data by emphasizing the value of geocodable addresses and implementing guidelines to obtain that information when collecting data.

Many OSDH client records and facilities are geocoded to street address or zip code including: the Cancer Registry, Birth and Death records, Hospital

Inpatient/Outpatient Discharge, Licensed Hospitals, Long Term Care facilities, and various other program datasets on an irregular basis. Currently, at least 10 to 20 percent of OSDH data that are run through a geocoding process do not geocode to a location on the map because of incomplete reference data, such as missing zip codes and missing streets. Spatial analysis of these data can never be complete or reliable if the geocoding is not complete and reliable. The adoption of geocoding standards and the purchase of high-quality reference data can improve these outcomes and allow for more reliable mapping and analysis.

The geocoding system can also be greatly improved through program initiatives to improve address quality. These initiatives could include requiring reporting and collection of physical address in addition to mailing address, and encouraging reporting of 9-1-1 addresses as opposed to rural route addresses or post office box addresses.

There is the perception that a centralized GIS database would contain program datasets.	Users will have more confidence in a centralized GIS database that does not contain program or client data, adheres to HIPAA and other state and federal data confidentiality guidelines, and is designed to limit access to sensitive geographic datasets.
There is concern in several programs about data security and access issues.	Users will be more confident in and likely to participate with the GIS database if they are reassured by communication about a high level of data security in the geodatabase, which will include varying levels of user access.

There are two primary concerns that program staff have when they perceive that the GIS database will store their program data (client or facility information). The first concern is about data security. Many staff believe that they would have to give their datasets to the GIS database, thereby losing control of data security and ownership. The second concern is that data will be duplicated in the agency if program data are stored in program databases and in the GIS database. Even when staff understand that specific program data should not reside in the GIS database (only geographic data will reside there), they still have concerns about who might have access to the geographic data, some of which is sensitive or protected.

There will be much more agency-wide support and confidence in a centralized GIS database if it is made clear what types of data will be stored in it. There will also be more program buy-in if data access and security safeguards (such as restricted access settings and user-specific read/write privileges) are clearly communicated.

5.3 Computational Infrastructure

Most staff has access to desktop computers with sufficient capabilities to use GIS software.	This level of computing access can be maintained if GIS software computing needs are considered in future hardware purchases and efforts are made to provide GIS computing resources to all staff by adding some free GIS software to the standard computer image. Computing resources may be more difficult to provide to some county health department staff.
There are data and web servers already being used to support GIS activities. IT staff maintains these servers.	Continued IT support for the GIS servers, as well as server access for the GIS Coordinator to manage the GIS system, will contribute to its strength and reliability. GIS Strategic Plan recommendations regarding a timeline for future server upgrades will support an expanded GIS program.
OSDH owns some Global Positioning System (GPS) units but they are under-utilized.	Existing GPS resources could be used more efficiently if they are shared among programs and made available to OSDH field staff. The use of GPS by field staff could reduce travel costs and improve staff efficiency.
There has been a previous investment in purchasing GIS software licenses. The license maintenance has been centralized to better utilize the resources.	Several OSDH programs have been proactive in supplying GIS software to their staff people. The agency can continue to build on this previous investment by supporting maintenance for software licenses and responding to needs for more licenses as use of the technology grows. Equipping most staff with free GIS software could reduce demand for purchased licenses.

The computational infrastructure - both hardware and software - at OSDH is well suited to agency-wide GIS implementation. It can be considered a huge benefit to the agency to already have this infrastructure in place, as the potential cost of purchasing these resources at one time could be very high. Agency staff are fortunate to have high-powered computing resources, cutting edge software and specialized GPS tools available to them as they begin to implement or expand GIS use. GPS units are currently under-utilized but setting up a system in which units

can be shared with regional field staff via centralized distribution points could increase their use.

In spite of the adequacy of current infrastructure, OSDH would benefit from planning for improving and growing the infrastructure as needed and as funds allow. Having a plan for future hardware and software acquisition that aligns with GIS goals will support the growth of GIS in the agency. The GIS plan for future hardware acquisitions should take into consideration and align with the IT long-term plan for hardware acquisition and architecture.

5.4 Client Services and Outreach

Programs would like to have a web-based approach to sharing mapped data and information with the public and partners.	GIS staff can address this need by developing an interactive web map (or series of maps) to be accessed by the public to locate public health information and resources. Web mapping can also be incorporated into current systems, such as OK2SHARE and PHOCIS.
Supplying map-based referrals can enhance client services in county health departments.	By providing access to an online mapping system integrated as a module in PHOCIS, OSDH can equip county health department staff to customize client referrals for services by their distance from a point of reference (i.e. client's home, work, transportation network).

Within the OSDH central office and in county health department interactions with clients, there is a desire for interactive web-based mapping. This type of mapping is common among government agencies, and many other Oklahoma agencies have their own interactive web maps. This mapping for OSDH could serve to provide a visual means of communicating information to agency staff, clients and partners. There are several programs that would like to integrate web mapping into existing systems, such as OK2SHARE and the EMSystem, and many others that would like to implement web-mapping into their programs outside of any existing system. There is broad support for having one agency-wide interactive web-map that could display geographic data from many programs. This same web map could be used to customize and communicate referrals and resources to clients. The public is becoming more and more web oriented and Internet savvy, and they turn to the Internet to discover information often before consulting any other resources. OSDH is in an ideal position to offer an authoritative Internet source for geographically referenced public health information in Oklahoma.

OSDH programs have a need to target resources (staff time and funds) by using a geographic approach.	With program budgets in decline in several areas, programs could benefit by utilizing GIS, when possible, to target staff time and funds to specific geographic areas of the state.

Many programs that offer statewide services deploy staff and resources based on client population, facility distribution or region delineation. To date, this has been done outside of GIS. However, there are tools and methods in GIS that might help programs to target their staff and other resources in a systematic manner that is logical and defensible. This technology could prove more and more useful as budgets decline; staff vacancies remain unfilled and demand for services increases.

5.5 Metadata and Standards

There is little creation of metadata for GIS data in OSDH.	Data quality and appropriate data use can be improved by OSDH adopting an internationally recognized metadata standard to be applied to all OSDH-created GIS datasets. Training and education about metadata will encourage staff to use and create thorough and standardized metadata.
There is no standard roads dataset used for geocoding at OSDH.	Consistency and reliability of geocoding results could be improved through the evaluation and adoption of a standard roads dataset to be used for all geocoding at OSDH. This will help to ensure that geocoding is consistent across programs and that GIS data will align correctly on maps.
There is no standard map projection and coordinate system identified for OSDH. Inappropriate or inconsistent use of map projections could result in misleading or, at least, inconsistent maps and analysis.	The reliability of agency mapping and spatial analysis can be improved by the adoption of agency standards to guide the use of map projections and coordinate systems. It can also be improved through training on the appropriate use of projection standards for mapping and analysis.

There are no standards applied to the creation of maps for use in presentations and published documents (printed and electronic). There is no use of disclaimers on maps that could protect OSDH from inappropriate use of agency maps.	Development and adoption of a series of standard map templates and map design recommendations, including standard map disclaimers, can ensure that there is consistency to the look of maps across the agency.

Due to the fragmented and de-centralized implementation of GIS at OSDH, there has not been any adoption of standards for GIS use to this point. This can tend to be a problem in many agencies, even those with much longer GIS histories. However, standardization is essential to establishing and maintaining the value of GIS products produced in an agency. Standardization of geocoding and map projections contributes to reliable and accurate spatial analysis. Standardization of map presentation and metadata preserves the OSDH image as a professional agency and makes GIS products more useful and effective.

As more staff begin to use GIS, the agency can benefit from implementing and communicating standards to establish uniformity and reliability to GIS outputs, especially those that will be communicated externally.

5.6 GIS Staffing

Some program staff conduct GIS work in addition to their regular job duties. Fulltime GIS staff are best equipped to provide support and expert advice to programs regarding their mapping activities.	Learning basic GIS skills will allow OSDH staff to create maps and perform spatial analysis as needed to support their primary work activities. However, consideration should be given to hiring additional fulltime GIS specialists to support program-specific GIS activities.
There is only one staff person (the GIS Coordinator) who is devoted fulltime to supporting the centralized GIS system that enables program staff to efficiently use GIS technology.	In order to support an agency-wide GIS system that includes shared software, a GIS database requiring frequent updates, and a variety of mapping systems to maintain, it would benefit the agency to support hiring additional FTEs in GIS staff positions.

OSDH staff, especially epidemiologists and program evaluators, but increasingly every type of staff person at the agency, have taken a keen interest in using GIS as a tool to help them accomplish their primary work responsibilities. These staff are enthusiastic and willing to put in time and effort to learn to apply GIS technology to the problems they face in their work. They have asked for more training and

software resources and have been very receptive to incorporating GIS into their work even when the utility was not immediately clear to them.

This staff enthusiasm for GIS can be fostered through the provision of training and resources. There is a need for more fulltime GIS staff to support the centralized system to ensure that GIS resources are available to interested staff. Geospatial data quality and timeliness can be best preserved by the work of qualified GIS Technicians who can devote their work time to ensuring that the GIS system is available and reliable. Additionally, program staff will rarely have time to become experts in GIS analysis and could benefit from having a fulltime GIS Analyst available to consult on analysis.

5.7 GIS Training and Resources

There are introductory GIS trainings available to all central office staff at least two times per year.	OSDH can continue to save on training costs by offering these trainings and eventually expanding the offerings to county health department staff. By offering internally developed trainings, the content can be customized to suit agency needs and money can be saved by not sending agency staff to external trainings, which incur travel and registration costs.
There is a need for multiple levels of training geared to managers and support staff that introduces them to the capabilities for using GIS technology for program management and evaluation.	Providing support for the development of additional trainings will help expand the technology and educate managers and support staff about the possibilities for incorporating GIS into program evaluation and management of people and resources.
There are several specialized software extensions that OSDH has purchased but are rarely used because staff are not trained to use them.	The agency will make better use of these currently held software resources by supporting the development and offering of trainings that will teach staff the use and applications of the GIS software extensions.

GIS training can be costly. The authorized ESRI training prices range from $900 to $1500 per class plus travel costs. Many programs do not have the travel funds to allow staff to pursue much outside training at those prices. Additionally, GIS implementation in public health agencies is fairly new so there is not much training designed specifically for public health staff. For these reasons, it will be helpful to OSDH to continue to support the availability of GIS trainings that are developed and

taught by in-house GIS staff. In addition to the full introductory GIS trainings that have already been developed, OSDH can benefit from shorter "manager" trainings and specialized software extension trainings to expand overall understanding of GIS technology and utilization of current software resources.

In many programs in the agency, primarily in the GIS Coordinator office, there are printed GIS reference materials, such as books, magazines, and manuals that could be shared with GIS users across the agency. There is not currently a system to organize that sharing.	A GIS library that resides in a central location in the OSDH central office will provide a place where staff can peruse GIS reference materials and potentially borrow those materials. Establishment of borrowing guidelines and a system to track the materials can facilitate this process.

GIS users in programs across the agency have purchased GIS reference books or received free books or other materials. Many of these users would be happy to share these materials with others with assurances that the materials will be returned at some point. At the same, time many other staff would prefer to borrow a book than have their program spend money to buy a book that is already at OSDH. A GIS library can facilitate this sharing by providing a central location to store reference materials and a system to track materials and borrowers. All GIS users in the central office can benefit from an established system that allows everyone to share their resources.

5.8 GIS Priority Applications

There is a need to identify underserved areas.	OSDH can benefit from using GIS to identify geographic areas of the state that are underserved by its programs, staff or other health resources. This mapping can help direct and support decision-making regarding areas of the state in which to focus efforts.
OSDH frequently has interactions with the Oklahoma legislature that could be enhanced with maps.	By providing access to maps of current legislative districts in the GIS database, and encouraging staff to customize these maps for legislative communications, OSDH will support agency efforts to communicate program data and/or priorities in a relevant and visual format.

Routing and network analysis is a common need throughout the agency. There is a need for more efficient in-state travel planning that could be supported by the GIS system and specialized routing tools. There is also a common need for identifying service areas based on travel time rather than straight-line distance.	The use of GIS technology for network analysis could support planning for staffing and evaluation of service area size. OSDH can maximize this potential by encouraging training in and use of the network analysis tools.
There is interest in using advanced spatial analysis methods (i.e. cluster analysis, kernel density analysis, network analysis) to enhance research and program evaluation.	The use of advanced spatial analysis methods can be supported by emphasis on training and collaboration and by hiring additional Geostatistical analysts to support advanced GIS implementation.

In the final section of Chapter 3, the agency's most common GIS mapping needs were listed. Of those, there were four that stood out the most in Needs Assessment interviews as commonly requested functions of GIS mapping and analysis. Identifying underserved areas incorporates both spatial analysis (to locate the areas) and mapping (to communicate findings to program managers). Creating maps for legislators may communicate information derived from spatial analysis but focuses mainly on the quality of mapping. Network analysis, cluster analysis and other advanced spatial analysis methods focus most heavily on the analysis but benefit from good mapping guidelines to communicate results most effectively. Some focus on these four areas of GIS utilization will touch all OSDH programs.

Appendix 1: Key Informants by Deputy Area

Notes:
* During the course of the needs assessment, from interviews through completion of the report, many staff changes took place at OSDH. Staff locations at the time of the interview are an important reference for understanding this document. For that reason, the following table lists the program or position of each staff person at the time of the needs assessment interview.

+ Indicates that the staff person was interviewed as part of the Protective Health Services interviews.

Deputy Area	Service	Division/Program/Position*	Staff Interviewed
Family Health Services		Deputy Commissioner	Edd Rhoades
	Family Support & Prevention Service	Program Evaluation	Mary Beth Cox
			Amber Sheikh
		Child Abuse Prevention Service	Chris Fiesel
		Children First Program	Mildred Ramsey
	Child Guidance Service	Chief	Debra Andersen
			Vera Bouse
		Program Evaluation	Amy Fletcher
		Speech, Language, Pathology	Beth Martin
		Early Childhood Mental Health	Pat Damron
		Warmline for Child Care Providers	Melissa Griffin
			Anna Powell
		Abstinence Education Project	Marilyn Lanphier
			Nadine Bonds
	Dental Health Service	Chief	Michael Morgan
			Susan Potter
			Patricia Brown
	Maternal & Child Health Service	Chief	Suzanna Dooley
		MCH Assessment	Dick Lorenz
			Thad Burk
			Paul Patrick
			Crystal Johnson
			Alicia Lincoln
	Screening, Special Services and SoonerStart	Chief	John Corpolongo
		Newborn Screening/Genetics Program	Pam King
		Newborn Hearing Screening Program	Jim Schmaelzle
		Birth Defects Registry	Kay Pearson
			Mohammed Serghini

Deputy Area	Service	Division/Program/Position*	Staff Interviewed
Family Health Services	Screening, Special Services and SoonerStart	SoonerStart	Glenda Rogers
		Lead Poisoning Prevention Program	Cheryl Barr
			Fahad Khan
		Oklahoma Public Health Environmental Tracking System	Elizabeth Kruger
	Women, Infants and Children Supplemental Nutrition Program	Chief	Terry Bryce
			Carrie Zeman
			Lisa Ning
Protective Health Services		Deputy Commissioner	Hank Hartsell
	Long Term Care Service	Chief	Dorya Huser
			James Joslin
	Health Resources Development Service	Chief	Hank Hartsell
		Admin	Onekia Smallwood
		Health Facility Systems	Darlene Simmons
			Kay Determan
			Kathy Waller
		Managed Care Division	Boyd Murphy
			John Judge
			Joseph Ndifor
			Espaniola Brown
			Todd Foglesong
		Nurse Aid Registry	Lisa McAllister
	Medical Facilities Service	Chief	Tom Welin
		Emergency Medical Services Division	Shawn Rogers
			Lynda Williams
			Linda White
			Sharon DellaVecchio

Deputy Area	Service	Division/Program/Position*	Staff Interviewed
Protective Health Services	Medical Facilities Service	Trauma Division	Patrice Greenawalt
			Tabitha Garwe
			Kenneth Stewart
			Kwadwo Amankwah
			Bill Henrion
			Grace Pelley
	Consumer Health Services	Chief	Ted Evans
		Consumer Protection Division	Tressa Madden
		Occupational Licensing Division	Vernon Bolz
		Professional Counselor Licensing Division	Nena West
	Quality Improvement and Evaluation Service		Walter Jacques
			Michael Jordan
			Greg Feggman
Disease & Prevention Services		Deputy Commissioner	Joe Mallonee
	Acute Disease Service	Chief	Lauri Smithee
		State Epidemiologist/State Veterinarian	Kristy Bradley
		Communicable Disease Division	Laurence Burnsed
			Anthony Lee
			Carmen Clarke
			John Bos
		Medical Division	Tim Cathey[+]
	Chronic Disease Service	Chief	Adeline Yerkes
			Janis Campbell
			Anne Bliss
			Carrie Daniels
			Peng Li
			Allen Badgett
			Kathy Johnson

Deputy Area	Service	Division/Program/Position*	Staff Interviewed
Disease & Prevention Services	HIV/STD Service	Division of Prevention & Intervention	Scott Goldman
			Janet Willson
		Division of Surveillance and Care Delivery	Jan Fox
			Debbie Purton
			Nicole Diehl
			Terrainia Harris
			Sam Nimo
	Immunization Service	Chief	Don Blose
			James Daughtery
	Injury Prevention Service		Pam Archer
			Sylvera Demas
			Sheryll Brown
			H. Julien Kabore
			Angie Bowles
	Terrorism Preparedness & Response Service	Chief	Shawna McWaters-Khalousi
			Ed Kostiuk
			Scott Sproat
			Sam Cannella
	Tobacco Use Prevention Service	Chief	Doug Matheny
			Janet Love
			Malinda Douglas
			Joyce Morris
	Public Health Laboratory Service	Chief	Jeff Mathewson

Deputy Area	Service	Division/Program/Position*	Staff Interviewed
Community Health Services	County Health Departments	Deputy Commissioner	Steve Ronck
		Asst. Deputy Commissioner	Toni Frioux
		Administrative Director	Tina Johnson
		Administrative Director	Shari Kinney
		Administrative Director	Linda Axley
	County Health Departments	Administrative Programs Officer	Darla Thompson
		District Nurse Manager	Kelli Rader
	Nursing Service	Chief	Diana Pistole
	Community Development Service	Chief	Neil Hann
		Epidemiologist	Miriam McGaugh
		Wellness Coordinator	Traci House
		Health Promotion	Kathy Payne
			Debora Adams
			April Combs
		Minority Health	Demetrio Gutierrez
			Dedric Anderson
		Primary Care & Rural Health Development	Jana Castleberry
		Arthritis Prevention & Education Program	Marisa New
			Adrienne Chambers
		Turning Point	Larry Olmstead
			Beverly Williams
			Lana Shaffer
			Tammy Randazo
			Arlinda Copeland
			Brandie O'Connor
			Tracy Norsworthy
	Record Evaluation & Support		Mike Ewald

Deputy Area	Service	Division/Program/Position*	Staff Interviewed
Administrative Services		Deputy Commissioner	Tim Tall Chief
	Accounting Services	Chief	Grace Brown
			Bonnie Hartzell
	Budget and Funding	Chief	Dennis Johnson
	Building Management & Internal Services	Chief	Tamela Gibson-Agahnia
	Procurement	Chief	Tina Hicks
			Ashley Hillemeyer
	Federal Funds Development	Chief	Yvonne Myers
			Jo Lynn Johnson
	Information Technology	Chief	Joe Camp
			Phil Brundage
	Office of Human Resources	Chief	Doyle Fortney
			Kara Kearns
Commissioner's Direct Report Offices	State Nutrition & Physical Activity	Director	Misty Fuzzel
	Office of Communications	Director	Leslea Bennett-Webb
	Center for Health Statistics	Director	Kelly Baker
		Vital Records	Derek Pate
		Health Care Information	Binitha Kunnel
	Scientific Affairs	Director	Sue Mallonee
Other Agencies	EMSA	MERC	Mike Curtis
	OK Dept of Agriculture, Food and Forestry		David Wheelock
	OK Water Resources Board		Michael Sughru
	City of Edmond		Sara Cobb

Appendix 2: Primary and Secondary GIS Applications by Deputy Area

Notes:
* Use of the term map or mapping implies that the features should be mapped with GIS as opposed to using paper maps or another software such as PowerPoint or a graphic design software; using GIS to map will allow for more timely and frequent updates of the maps and allow for use of the data in GIS analysis.

** Use of the phrase "map individuals" implies mapping the location of an individual's residence as recorded in the program dataset.

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Family Health Services	Family Support & Prevention Service	Child Abuse Prevention Service	mapping* child-advocacy centers and multi-disciplinary teams	
			mapping OCAP and CATC districts	
			assess presence of program services in counties	
			identify areas with more at-risk families	
			determine need for new OCAP contracts	
			assess overlap of OCAP, CATC and C1 programs in counties	
				determine ease of access to services
				map respite fund use
				map licensed childcare facilities
		Children First Program	maps for reports (high-need areas)	
			determine access to prenatal care	
			nurse caseload management	
				network analysis for planning home visits
	Child Guidance Service		map locations of child care provider consultations services to see the big picture of where all are located (OSDH consultants and those from other agencies)	
			map clinician service areas overlaid with locations of child care providers to evaluate staffing patterns	
			map and symbolize CHDs to indicate which ones have child guidance clinics and determine where funding is needed to establish new clinics	
			map schools	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Family Health Services	Child Guidance Service		map teen birth rates and overlay with abstinence-only programs	
			map birth rates to unmarried parents	
			locate high risk youth (ethnic minorities, foster kids)	
			map rates from Adverse Childhood Experience survey to justify services or expand services in certain areas	
			map origin of calls to Warmline in order to evaluate use of the service and target advertising	
			map data by legislative districts for communication with lawmakers	
				use network analysis for home visits and on-site consultations with day care providers
	Dental Health Service		map six dental regions	
			map dental health service program areas with staffed and unstaffed dental clinics in CHDs	
			map dentist office locations to assess coverage and communicate with public and reduce calls to Dental Service; symbolize by specialty and specify Medicaid providers	
			map free dental clinics	
			map fluoridated community water systems to assist public and alleviate calls to Dental Service staff	
			map schools and symbolize by water fluoridation status	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Family Health Services	Dental Health Service			map tobacco rates and oral cancer rates
				map dental data from a variety of surveys (3rd grader dental survey, BRFSS, TOTS, YRBS) to pull together a complete picture of dental health
	Maternal & Child Health Service	MCH Assessment	map data for the Infant Mortality Task Force	
			use cluster analysis to identify any clusters of infant deaths	
			map clinic sites such as family planning clinics, maternity, child health - those that contract with MCH	
			map physicians by specialty to evaluate access to health care	
			map pharmacies that carry emergency contraception	
			map use of contraceptive methods	
			map minority populations overlaid with clinic locations to determine if they coincide	
			map schools with school nurses	
			map schools with dental hygienists	
				map PRAMS survey population
				map YRBS survey population
	Screening, Special Services, and SoonerStart	Newborn Screening/Genetics Program	map individuals** with genetic disorders (internal use only) to assess need for specialty services in an area	
			identify locations of certain ethnic populations to assess need for testing and treatment	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Family Health Services	Screening, Special Services, and SoonerStart	Newborn Screening/Genetics Program		identify areas where babies are potentially not getting screened for genetic disorders to focus outreach efforts (requires link to vital records database)
				test for clustering of genetic disorders (esp. sickle cell disease)
		Newborn Hearing Screening Program	map locations of children diagnosed with hearing loss and determine if there is a geographic disparity to which families do or do not follow-up for more testing and services	
			map locations of children who have not been screened to target outreach efforts (requires link to vital records data)	
			map hearing screening locations to determine access and also for referral resources for families	
			map speech/hearing clinicians to identify pockets of need and target efforts for increasing services	
			map testing and clinician locations on an Internet map for public use to alleviate calls to program staff; also include maps in mailouts	
		Birth Defects Registry	map individuals with birth defects to assess clustering and link with environmental data	
			continue using GPS technology to enhance geographic data in the surveillance dataset	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Family Health Services	Screening, Special Services, and SoonerStart	Oklahoma Public Health Environmental Tracking System	continue previous research to examine relationships between environmental hazards and health outcomes and expand to include additional data sources and innovative GIS methods	
		SoonerStart	map locations of specialized staff (social workers, nutritionists, hearing consultants, etc)	
			map schools and symbolize by capacity to provide developmental disability services to students	
			map locations of SoonerStart staff overlaid with client populations to assess staffing patterns	
			map SoonerStart service areas and team locations	
				use network analysis to plan home visits and visits to childcare providers
				use maps of population demographics and population density to predict future caseloads and future staffing needs
				map referrals to SoonerStart program by region and overlay with caseloads by region to identify areas where families are not following up on referrals
				map prevalence of certain disorders by geographic region to look for patterns and plan for services provision

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Family Health Services	Screening, Special Services, and SoonerStart	Lead Poisoning Prevention Program	map high-risk areas for lead exposure (target zip codes with older homes) to focus outreach and screening efforts; inspect specific homes, target mailings to specific homes	
			map homes with EBLLs in multiple residents	
			map CHDs and symbolize by type of lead testing that can be done to assess coverage of testing resources and identify gaps in coverage	
			map physicians, dentists, WIC clinics to focus on working with those in high-risk areas	
			supplement reports to CDC with maps	
				map locations of active oil rigs to compare with rates of EBLLs in adults; target education
	Women, Infants and Children Supplemental Nutrition Program		continue mapping clinic and vendor sites; make available to public on an Internet mapping site	
			continue evaluating new vendor applications using GIS; use service area analysis	
			map population density (children under 5) overlaid with clinic/vendor locations to analyze distribution	
			continue to map program participant addresses for specific clinics to assess where clients are coming from and how far they are traveling	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Family Health Services	Women, Infants and Children Supplemental Nutrition Program		continue to map breastfeeding rates and other client data for program guidance and management	
			map WIC program consultant areas	
			continue to map participant addresses by WIC vendor used	
				map H.323 telecommunication sites for video conferencing
Protective Health Services	Long Term Care Service		map* all LTC facilities; provide Internet map access to public to find facilities (supplement Nursing Home Compare website)	
			identify skilled bed facilities	
			identify facilities that could serve as distribution points for immunizations, medical care, etc	
			identify facilities located in potential disaster zones	
			map all permanent hazard locations (flood plains, chemical plants, etc) in relation to LTC facilities	
			map where surveyors live to evaluate staffing	
			map survey teams and surveyor regions	
				evaluate if substandard quality of care situations are occurring at a higher rate geographically
				identify where Federal Oversight Surveys have occurred in the state
				use network analysis to plan routes for facility inspections

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Protective Health Services	Health Resources Development Service	Managed Care Division	map and assess Certified Workplace Medical Plan (CWMP) provider networks in relation to employers	
			map employers by zip code for each HMO	
			map geographic coverage by managed care organizations	
				map member counts by service area for an HMO
				map location of physicians and symbolize by HMO (allow public to search)
		Health Facility Systems	map licensed LTC facilities and make available to public for searching by location; augment online directory of LTC facilities with an Internet map	
			calculate distance-based service areas around facilities to evaluate certificate of need; overlay with special populations demographic data	
			calculate driving-time service areas around nursing facilities	
				compare change over time in distribution of health resources
		Nurse Aide Registry	map nurse aides by residence and employment location	
			map nurse aide training locations	
			identify geography of understaffed nursing facilities	
				map prevalence of nurse aides with abuse allegations to evaluate geography of the problem
				analyze distribution of nurse aides vs. workforce population data

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Protective Health Services	Health Resources Development Service	Nurse Aide Registry		map prevalence of nurse aid training waivers and compare to understaffed facilities and training facilities
	Medical Facilities Service	Medical Facilities Division	map all facilities contained in the Directory of Medical Facilities and make available to staff and public; also map non-state-licensed facilities (i.e. IHS hospitals, VA hospitals, etc)	
			map hospice service areas	
			analyze distribution of facilities vs. populations served to assess coverage	
		Emergency Medical Services Division	acquire and use GPS coordinates in databases	
			map current EMS service areas (ground and air), make available online, and assess coverage compared to time-based service areas	
			map air and ground ambulance storage posts within service areas and ambulance status (primary or secondary) to assess coverage and to facilitate inspections	
			map base and satellite office for EMS service agencies	
			map ambulance runs (origin and destination locations) to evaluate transport trends	
			map field coordinator regions	
				map EMT training institutions and compare to population
				identify areas that may need more training locations
				map first response agencies and identify their time-based catchment areas

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Protective Health Services	Medical Facilities Service	Emergency Medical Services Division		map location of homes of first responders
				analyze population demographics to identify high concentrations of elderly population and compare to EMS resources
				map amount of ad valorem taxes by area (taxes fund many EMS agencies)
				real-time tracking of helicopters and ambulances using GPS and GIS
		Trauma Division (including EMSystem)	map hospitals and symbolize by trauma levels	
			map trauma specific ambulance runs (origin and destination locations) to evaluate transport trends	
			map trauma regions	
			map hospital to hospital trauma transports by facility and by trauma region	
			map physicians, blood banks, hospitals, EMS agencies in each trauma region and analyze to assess capacity to meet needs of trauma patients within regions	
				integrate GIS mapping website with EMSystem to provide visual display of emergency resources; include aerial photos to assist in planning for helicopter landings
				map established intercept sites for ambulance-helicopter meetups
				map RN locations
				map locations of medical audit cases
				map amount of money from trauma fund going to each region

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Protective Health Services	Consumer Health Services	Consumer Protection Division	map number of sanitarians and number of facility inspections by state quadrant to assess staffing levels	
			overlay sanitarian areas with county administrator regions to avoid splitting sanitarians between multiple administrators	
			figure staffing needs and workload assignments based on spatial distribution of inspected facilities, regions, and road network	
			provide GPS units to sanitarians to record coordinates for inspected facilities	
			overlay maps of food-borne illness with locations of restaurant facilities	
			map locations of inspected facilities, including inspection info, for public to view on an interactive Internet map	
			map locations of Oklahoma food manufacturers (processors and warehouses) to assist with bioterrorism preparedness	
			map locations of inspected X-RAY tubes to identify the locations of that resource in an emergency	
			map licensed tattoo shops to assist public in finding a reputable tattoo artist in their areas	
				use network analysis to allow sanitarians to plan inspection routes to improve efficiency and to allow managers to verify travel claims
				map hot spots of health violations in order to effectively target education, training and more frequent inspections

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Protective Health Services	Consumer Health Services	Occupational Licensing Division	map licensed home inspectors to allow public to find one in their area	
			map licensed hearing aid dealers to allow public and physicians to locate those in specific areas; mapping these would also allow other programs (such as the newborn hearing screening program) to assess the distribution of dealers across the state	
		Professional Counselor Licensing Division	map office locations of licensed counselors and therapists to aid public in identifying resources in their areas and to assist other OSDH programs in directing clients to counselors	
	Quality Improvement and Evaluation Service		track areas where people have not attended QIES data submission training vs. current training locations to evaluate training plan	
Disease & Prevention Services	Acute Disease Service, State Epidemiologist, State Public Health Veterinarian		continue to map* communicable disease cases; enable real-time geocoding of PHIDDO reports	
			map temporal spread of diseases	
			map schools, restaurants, food distributors, physicians, jails/prisons for use in communicable disease investigations	
			map laboratories and symbolize by type of testing capabilities	
			map rabies cases in real-time to alert veterinarians	
			map immigrant populations to target response efforts for certain diseases	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Disease & Prevention Services	Acute Disease Service, State Epidemiologist, State Public Health Veterinarian		map special resource centers for ethnic groups to help in alerting non-English speaking populations	
			incorporate GIS into Health Alert Network System for plume modeling and calling system	
			produce high-quality maps for reports, research	
				use spatial predictive modeling to estimate spread of disease
				use cluster analysis to identify risk areas for diseases and target warnings, educational materials
				use GPS units to acquire case locations during field investigations
				use network analysis to plan routes for field investigations
	Chronic Disease Service		continue to map chronic disease rates to evaluate trends and make available on an Internet map for public access	
			continue to map health facilities (i.e. mammography facilities, hospitals, etc) to evaluate access to care	
			continue to use maps in reports, communications with partners	
			map fitness and nutrition resources for use in making referrals from CHDs or BRFSS surveyors	
			map obesity data in relation to nutrition and fitness resources	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Disease & Prevention Services	Chronic Disease Service		map businesses that have health and fitness programs for employees	
			map cancer treatment facilities (radiation/chemotherapy) to evaluate access to care	
			map breast/cancer cervical screening rates to identify pockets of risk and target outreach	
			map stroke mortality rates and compare to EMS infrastructure	
			map schools (including private schools and Indian schools) included in the school health inventory and symbolize by their health policies related to chronic disease initiatives	
			map rates of female incarceration to determine the spatial distribution and target program planning	
				acquire more high-quality environmental data for researching environmental health
				expand use of cluster analysis and kriging for evaluating and presenting chronic disease data
	HIV/STD Service		continue to map hepatitis and STD outbreaks	
			map HIV/STD cases to identify geographic trends	
			map HIV testing centers (CHDs and contracted centers)	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Disease & Prevention Services	HIV/STD Service		map location of STD clinics	
			map HIV client residences versus location of services for the Ryan White program to evaluate access to services (incorporate data from neighboring states)	
			map residences of clients who use HDAP program versus locations of case managers to evaluate travel burden	
			map out-of-care HIV/AIDS cases	
				use network analysis to evaluate access to care
				use cluster analysis to evaluate disease outbreaks and trends
	Immunization Service		continue to map immunization rates and extend this to finer geographic scales (esp. zip code)	
			identify pockets of need for immunization outreach	
			map demographic data and compare to immunization rates (esp. race/ethnicity)	
			use maps on an Internet system to communicate with immunization providers about coverage rates in their areas	
			map Vaccines for Children providers and identify gaps in the geographic distribution	
			map all immunization providers and identify dominant providers in an area	
				use network analysis to plan routing for day care audits

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Disease & Prevention Services	Injury Prevention Service		continue to map house fires to target prevention/education efforts	
			map locations of homes that have received smoke alarms from OSDH	
			use GIS to select a sample of homes in targeting communities to survey for smoke alarms (incorporate tax assessor and demographic data)	
			continue to create maps for use in reports and presentations	
			map pedestrian/bicyclist injuries to identify problem areas; use maps for communication with local government to encourage improvements	
			map locations of violent deaths	
			map data about submersion injuries/deaths to assess if there are problem public water recreation areas; use to target interventions	
			map incidence of intimate partner violence versus mapped socioeconomic data	
			map locations of rehabilitation facilities for brain injury patients for use in making referrals and identifying gaps in coverage	
			map MIPS sites for evaluation and planning	
			map PODS sites	
			map and symbolize hospitals by their "assets"	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Disease & Prevention Services	Terrorism Preparedness & Response Service		map special needs populations/facilities for emergency response planning	
			map residences of OSDH employees as part of a Public Health Responder database to use in emergency response	
			map and symbolize CHDs by their emergency response capacity (isolation rooms, satellite phones, etc)	
			map critical infrastructures for planning and response, including mapping locations of hazardous materials (plants, refineries, etc)	
			map schools, churches for emergency response (have concentrated populations and can also act as staging areas for emergency responders or shelters)	
			use GIS to generate quick, detailed maps of specific areas during an emergency	
			use GIS maps in reports, grant applications, and communications	
			map EMS agencies, including locations of ambulances	
			use buffer analysis to identify affected/threatened facilities/infrastructures in an emergency	
			use GIS to integrate many data sources to provide a complete picture	
			map residences and work locations of medical reserve corps volunteers to support effective deployment	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Disease & Prevention Services	Terrorism Preparedness & Response Service		map physicians and clinics for notification purposes	
				integrate a live Internet map with the EMSystem and/or the WebEOC system
				use GIS and HAZUS to identify flood risk areas
				use network analysis to route TPRS deliveries to MIPS sites and estimate delivery time
				use GPS to acquire highly accurate locational data for MIPS, PODS and other key facilities
	Tobacco Use Prevention Service		continue to map service areas for Community of Excellence grantees	
			continue to use maps in reports, presentations, communication with legislators	
			map origin of calls to the Tobacco Helpline to evaluate use and plan for advertising	
			map BRFSS data that assesses knowledge about the Helpline and compare to advertising trends	
			continue to map school districts that have tobacco-free school zone policies; use GIS animation tool to illustrate changes over time	
			map tobacco retailers and analyze distance to schools	
			map locations of restaurants with smoking rooms to target outreach efforts	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Disease & Prevention Services	Tobacco Use Prevention Service		map tobacco retailers versus disparate populations (minorities, lower SES, kids, etc)	
			map cities that have tobacco related ordinances	
			map smoking rates by county and evaluate chronologically	
				use cluster analysis to evaluate distribution of school tobacco policies
				map Adult Tobacco Survey data by region
	Public Health Laboratory Service		map laboratory locations and symbolize by capabilities/certifications	
				incorporate GIS into an inventory control system for the pharmacy
Community Health Services	County Health Departments		map* disease incidence rates at small geographic units (zip codes, census tracts) by county for analysis, planning and response to data requests from the community	
			map all inspected facilities	
			use GIS to plan and adjust staffing patterns	
			map referral services for use by CHD staff and clients (allow for printing maps to give to clients)	
			map origin of CHD clients	
			map nurse practitioner utilization in counties to identify where more nurses are needed	
			map health services to assess access to care in the county	
			map all program regions to evaluate overlaps and assist with CHD administration	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Community Health Services	County Health Departments		provide Internet mapping services for CHD clients to find health care services and other services	
			map and evaluate locations of clinics vs. client populations	
			map OSDH staff homes to locate staff for emergency response	
				use network analysis to plan routes for sanitarians (utilize aerial photography data in GIS maps)
				use network analysis to plan routes for home visit staff (C1 nurses and SoonerStart staff)
				map disease outbreaks and analyze (use to communicate trends to other staff)
				enhance grant applications with GIS maps
				use GPS units to locate clients, facilities, resources
	Nursing Service		map district nurse manager regions; compare to county administrator map to determine which administrator(s) each nurse reports to	
			map number of nursing staff by county and district nurse manager region	
			symbolize CHDs on a map by number of nurses working in each	
			map active tuberculosis cases	
				use GPS units to collect locations of homes during home visits
	Community Development Service		identify pockets of health disparities in the state by mapping the social determinants of health and the health status indicators	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Community Health Services	Community Development Service	Health Equity & Resource Opportunities	integrate data from many sources on a map to provide a complete visual picture of populations and resources	
			map prevalence of Medicaid population	
			map public transportation routes, esp. buses	
			map public housing locations	
			map community resources such as schools, employers, grocery stores, WIC sites, hospitals, physicians, correctional facilities, EMS services and others	
		Arthritis	map arthritis prevalence data overlaid with community resources/demographics	
			continue to use GIS for market analysis	
		Health Promotion	map health educators' regions and evaluate coverage across the state	
			map schools and symbolize by those that have a Safe and Healthy Schools Advisory Committee	
			match individuals from the CHDs with schools that have the advisory committees	
			map schools not served by health educators in order to evaluate staffing needs	
		Wellness Program	map employees' homes and create a GIS-based carpool-matching database	
			map fitness centers around the state and locate those close to employees' homes	
			identify employees who live within walking or biking distance from work to encourage healthful alternatives to driving	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Community Health Services	Community Development Service	Wellness Program	map farmers markets and u-pick farms for staff	
			map OUHSC tunnel walking routes	
				use network analysis to help employees find safe biking/walking routes
		Minority Health	map distribution of minority populations overlaid with other demographic data (i.e. SES)	
			compare locations of minority populations to health resources to evaluate access to care	
			map CHDs and symbolize by whether or not they have foreign language interpreters available	
		Primary Care and Rural Health Development	continue to map MUAs and HPSAs to identify health services needed	
			use GIS to calculate physician to population ratios by a variety of geographic divisions	
			use GIS to identify geographic barriers to accessing health care	
			continue to map community health centers (FQHCs and look-alikes) and rural health clinics	
			use site suitability analysis to place new community health centers	
			map locations of free health clinics	
			map origin of clients using free clinics	
				use network analysis to calculate travel times and service areas for health resources
		Turning Point	map grocery stores to analyze access to healthy food	
			map Angel Food distribution sites	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Community Health Services	Community Development Service	Turning Point	map Turning Point partnerships by priority and activities to evaluate dispersement	
			use maps to more effectively communicate with TP partners	
			map community gardens as well as farmers markets	
				map local, state and federal funding sources going into communities
				map cities with local ordinances of interest (seat belts, youth tobacco access, tobacco free schools, sidewalks, etc) and compare with TP partnership locations
	Record Evaluation & Support		map record consultant regions	
			map number and types of clients by consultant region	
			map number of clients by their active county and compare to map by county of residence to evaluate client travel for services	
				use network analysis to determine number of highway miles in record consultant regions in order to evaluate staffing numbers and placement
Admin. Services	Accounting Services		map* employee payroll location vs. T&E work location to evaluate how employee time and resources are allocated across the state	
			map areas of the state where staff time is devoted largely to travel time	
			map origin and destination of funds used by OSDH (esp. trauma fund)	
				incorporate GIS into supply tracking system

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Admin. Services	Building Management and Internal Services		incorporate CAD building layout data files into GIS system; use for planning renovations, locating offices/staff	
			use GIS to track maintenance requests/locations	
			provide building floorplans to floor marshalls for emergency response	
			provide building layout maps for staff to use to locate offices	
			map locations of phone jacks of floor layouts	
			map fire system on floor layouts	
			overlay multiple floor layouts with different data to generate a complete picture of physical infrastructure of building	
	Federal Funds Development		map client's residence and location of services rendered from Medicaid claims files	
			map all Medicaid providers to identify gaps and determine when CHDs should be Medicaid providers	
			map Medicaid claims from 2005 to identify those located in MUAs or HPSAs to justify request for additional Medicaid payments to CHDs	
	Information Technology Services		map IT field staff regions	
			Helpdesk use mapped floor layout to locate staff for computer maintenance	
				fField staff could use GPS and network analysis to plan travel and routing for field visits to CHDs

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Admin. Services	Office of Human Resources		map employee training locations across the state and overlay with number of employees per area to evaluate access to training	
			map staffing needs by CHD or region and compare to map of populations served	
			target job advertising to specific populations	
			map vacant positions and compare to locations of training schools to plan recruitment efforts (esp. for hard to fill positions such as nursing, IT, specialists, etc)	
			map employee residences to evaluate need for more telecommuting	
Comm. Direct Report Offices	Center for Health Statistics	Health Care Information	continue to geocode HCI datasets	
			incorporate mapping into the OK2SHARE website	
			map location of patient residence vs. location of hospital used to assess hospital use patterns	
			communicate with hospitals by using maps	
			map data for hospital safety indicator report; symbolize hospitals by safety rating	
			overlay hospital discharge data and emergency room data with EPA air quality data	
			map obesity rates overlaid with health/fitness intervention activities	
			map location of misclassified deaths and overlay with location of funeral homes to target education/outreach	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Comm. Direct Report Offices	Center for Health Statistics	Health Care Information	incorporate maps into the State of the State's Health Report and other HCI reports	
			use animated mapping to show changes in health statistics over time	
			Use statistical GIS analysis to quantify geographic variation in health measures	
			Incorporate geography into continuum of care studies	
				use GIS to estimate small areas for BRFSS data
	Office of Communications		map all media resources in each county	
	Office of the State Nutrition and Physical Activity Director		incorporate Internet mapping into the Strong and Healthy Oklahoma website to allow public to find health and nutrition resources	
			use GIS to plan and target the SHO social marketing campaign	
			map community recipients of SHO awards	
			map health and nutrition resources	
			map and analyze elements of the built environment to assess walkability, safety for biking, etc	
			provide maps/assessment of walking and biking trails	
			map certified healthy businesses to analyze distribution and recognize efforts	
			map locations of Healthy Business training	
			map locations of schools with Healthy and Fit Advisory Committees	
			map all schools, day care, churches to plan outreach activities	

Deputy Area	Service	Program	Primary GIS Applications	Secondary GIS Applications
Comm. Direct Report Offices	Office of the State Nutrition and Physical Activity Director		map restaurants and symbolize by "healthy" rating	
				use network analysis to locate and map Safe Routes to Schools

Appendix 3: Acronyms and Terms Used in the Report

Acronym	Full Name
BRFSS	Behavioral Risk Factor Surveillance System
C1	Children First
CAD	Computer Aided Design
CATC	Child Abuse Training and Coordination Council
CDC	Centers for Disease Control
CDS	Community Development Service
CHD	County Health Department
CWMP	Certified Workplace Medical Plan
DC	Deputy Commissioner
DEQ	Department of Environmental Quality
DHS	Oklahoma State Department of Human Services
EBLL	Elevated Blood Lead Level
EMS	Emergency Medical Services
EMSA	Emergency Medical Services Authority
FQHC	Federally Qualified Health Center
GIS	Geographic Information Systems
GP	Genetics Program
GPS	Global Positioning System
HIPAA	Health Insurance Portability and Accountability Act
HMO	Health Maintenance Organization
HPSA	Health Professional Shortage Area
HRDS	Health Resources Development Service
HRSA	Health Resources and Services Administration
IT	Information Technology
ITOP	Induced Termination of Pregnancy
LPPP	Lead Poisoning Prevention Program
LTC	Long Term Care
MCH	Maternal and Child Health
MDT	Multi-disciplinary team
MIPS	Mass Immunization/Prophylaxis Strategy
MRC	Medical Reserve Corps
MUA	Medically Underserved Area
NHSP	Newborn Hearing Screening Program

Acronym	Full Name
NSP	Newborn Screening Program
OBDR	Oklahoma Birth Defects Registry
OCAP	Oklahoma Child Abuse Prevention
OCC	Oklahoma Corporation Commission
OCCY	Oklahoma Commission on Children and Youth
ODAFF	Oklahoma Department of Agriculture, Food and Forestry
ODMHSAS	Oklahoma Department of Mental Health and Substance Abuse Services
OFFD	Office of Federal Funds Development
OHCA	Oklahoma Health Care Authority
OK2SHARE	Oklahoma Statistics on Health Available for Everyone
OCCHD	Oklahoma City-County Health Department
OKVDRS	Oklahoma Violent Death Reporting System
OMH	Office of Minority Health
OSDH	Oklahoma State Department of Health
OSIIS	Oklahoma State Immunization Information System
PCP	Primary Care Provider
PHIDDO	Public Health Investigation and Disease Reporting of Oklahoma
PHOCIS	Public Health Oklahoma Client Information System
PHS	Protective Health Services
PODS	Points of Dispensing Sites
PRAMS	Pregnancy Risk Assessment Monitoring System
RES	Record Evaluation & Support
S, SS, & SS	Screening, Special Services & SoonerStart
SDE	Oklahoma State Department of Education
SES	Socioeconomic Status
T&E	Time and Effort
TCCHD	Tulsa City-County Health Department
TOTS	Oklahoma Toddler Survey
TP	Turning Point
VCF	Vaccines for Children
WIC	Women, Infants and Children Supplemental Nutrition Program
YRBS	Youth Risk Behavior Survey

Term	Definition*+
Coordinate System	A reference framework consisting of a set of points, lines, and/or surfaces, and a set of rules, used to define the positions of points in space in either two or three dimensions. The Cartesian coordinate system and the geographic coordinate system used on the earth's surface are common examples of coordinate systems.
Data Warehouse	A large analytical database, which derives its data from a variety of production systems and is structured for querying, reporting, and analysis. It is typically used as the foundation of a decision support system that aims to meet the requirements of a large business user community. The data in a data warehouse can be accessed using a variety of front-end, easy-to-use, data-access tools.
Feature	A representation of a real-world object on a map
Feature Layer	A layer that references a set of feature data. Feature data represents geographic entities as points, lines, and polygons.
Geocoding	A GIS operation for converting street addresses into spatial data that can be displayed as features on a map, usually by referencing address information from a street segment data layer.

Term	Definition
Geographic Information System (GIS)	An integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. A GIS provides a framework for gathering and organizing spatial data and related information so that it can be displayed and analyzed.
Global Positioning System (GPS)	A system of radio-emitting and -receiving satellites used for determining positions on the earth. The orbiting satellites transmit signals that allow a GPS receiver anywhere on earth to calculate its own location through trilateration. Developed and operated by the U.S. Department of Defense, the system is used in navigation, mapping, surveying, and other applications in which precise positioning is necessary.
Metadata	Information that describes the content, quality, condition, origin, and other characteristics of data or other pieces of information. Metadata for spatial data may describe and document its subject matter; how, when, where, and by whom the data was collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard. Metadata consists of properties and documentation. Properties are derived from the data source (for example, the coordinate system and projection of the data), while documentation is entered by a person (for example, keywords used to describe the data).

Term	Definition
Projection	A method by which the curved surface of the earth is portrayed on a flat surface. This generally requires a systematic mathematical transformation of the earth's graticule of lines of longitude and latitude onto a plane. Every map projection distorts distance, area, shape, direction, or some combination thereof.

***** GIS definitions come from the ESRI online dictionary, http://support.esri.com > Knowledge Base > Dictionary

[+] Data warehouse definition came from “Data Warehousing 101: Concepts and Implementation” by Arshad Khan, Khan Consulting & Publishing, LLC, 2003

Appendix 4: GIS Advisory Committee Members as of July 2008

Name	Deputy/Service
Nduta Ahmad	AS/Office of Human Resources
Kelly Baker	DR/Center for Health Statistics
Anne Bliss	DPS/Chronic Disease Service
Susan Boyd	CHS/Nursing Service
Sam Cannella	DPS/Terrorism Preparedness and Response Service
Jeff Carlisle	AS/Information Technology Services
Carmen Clarke	DPS/Acute Disease Service
Dana Coles	FHS/Maternal and Child Health Service
Mary Beth Cox	FHS/Family Support & Prevention Service
Kristen Eberly	DPS/HIV-STD Service
Amy Fletcher	FHS/Child Guidance Service
Brittney Foy	DR/Physical Activity and Nutrition Office
Connie Hall-Jones	AS/Building Management & Internal Services
Bonnie Hartzell	AS/Accounting Services
Jo Lynn Johnson	AS/Federal Funds Development
Michael Jordan	PHS/Quality Improvement & Evaluation Service
James Joslin	PHS/Health Resources Development Service
Vicki Kirtley	PHS/Consumer Health Services
Elizabeth Kruger	DPS/Injury Prevention Service
Miriam McGaugh	CHS/Community Development Service
Susan Mendus	DPS/Immunization Service
Becki Moore	DR/Health Care Information
Joyce Morris	DPS/Tobacco Use Prevention Service
Imad Mrani	DR/Health Care Information
Derek Pate	DR/Health Care Information
Paul Patrick	DR/Health Care Information
Katy Rich	DR/Health Care Information
Cari Thompson	CHS/Record Evaluation & Support
Larry Weatherford	DR/Office of Communications
Carrie Zeman	FHS/WIC Service

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