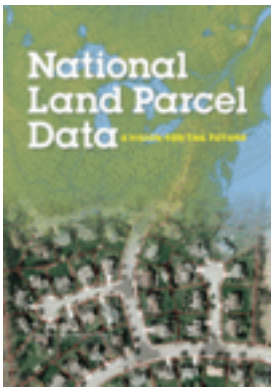

National Land Parcel Data: A Vision for the Future

Committee on Land Parcel Databases: A National Vision, Mapping Science Committee, National Research Council

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National Land Parcel Data

A VISION FOR THE FUTURE

Committee on Land Parcel Databases: A National Vision

Mapping Science Committee

Board on Earth Sciences and Resources

Division on Earth and Life Studies

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Acknowledgments

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their participation in the review of this report:

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Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of this report was overseen by Michael F. Goodchild, University of California, Santa Barbara. Appointed by the National Research Council, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Preface

Land ownership has been critical to the economic and philosophical development of the United States. Land parcel databases, which are also known as cadastres, describe the rights, interests, and value of property. These databases represent the distribution of the real property assets of a community and its ownership, form the basis for all land use and zoning decisions, and represent the location of residences, businesses, and public lands. In other words, almost every aspect of government and business can be associated with a land parcel.

In 1980, the National Research Council (NRC) issued a report titled *Need for a Multipurpose Cadastre*, which became, and still is, a guidebook for land parcel data systems throughout the world. The report advocated the development of a nationally integrated set of land parcel data and recommended a vision for achieving it. However, 27 years later, despite technological advances to make it more feasible and policy directives that support the development of national land parcel data, the United States has still not achieved this vision. Therefore, the NRC was requested by five organizations (the Bureau of Land Management, the Federal Geographic Data Committee, the Department of Homeland Security, the Census Bureau, and the Environmental Systems Research Institute) to reassess the 1980 vision for land parcel data and determine why it has yet to be achieved.

During the conduct of this study, the importance, complexity, and passion that surround a concept such as a national perspective on land parcel data became much more evident. It also became obvious that the study committee faced a huge challenge in trying to improve upon *Need for a Multipurpose Cadastre,* since much of what is recommended in that report is as relevant today as it was in 1980. The task therefore became to determine why its vision was not achieved, and how the technological and organizational changes of the last quarter century have influenced the vision and the potential for reaching it.

Fortunately, the committee consisted of an outstanding group of individuals who were up to the task. Committee members came from local and tribal governments that depend on parcel data to improve the delivery of services to taxpayers, and from state governments that are struggling to develop workable partnerships with local governments to acquire parcel data. The committee also included members from the private sector who know how to create parcel data and whose businesses depend on this. Finally, it included members of academia who are dedicated to improving the use

of geospatial data and technologies in public policy. The committee received invaluable input from a diverse group of participants from federal agencies, the private sector, and professional organizations at meetings held in the spring of 2006, including an information-gathering workshop called a Land Parcel Summit. The pulse of the producers and users of parcel data across the nation was measured through a web-based feedback system. This was an innovative approach that gained the perspective of 400 individuals who are working "in the trenches" with parcel data. The thousands of written comments provided by this diverse set of stakeholders helped the committee better understand the issues and formulate its recommendations. The input of all of these individuals has made this a much better report. Finally, the entire committee benefited from the guidance and tireless work of Ann Frazier from the NRC who helped us stay on course. The entire team appreciates the support of the sponsors who wanted us to objectively assess a complex situation and provide a vision for the future.

Finally, a unique aspect of this study has been the opportunity to revisit an issue that was first addressed in 1980. It is an obvious understatement to say that the world is a much different place in 2007. In 1980, personal computers were rare and few could have even described the capabilities that are now available to us over the World Wide Web. In 1980 no one had experienced the events of September 11, 2001, or Hurricane Katrina. Institutionally we did not have a Department of Homeland Security or a Federal Geographic Data Committee. The current framework of Spatial Data Infrastructure standards for data, technology, and discovery did not exist. Now, geospatial technology and related services are ubiquitous. These events and technological advances have changed the way we do business. In light of these factors the committee can only hope that that this report will be as highly regarded as the one written in 1980, but at the same time, we also hope that it will have a greater impact in terms of changing the way all levels of government create and use land parcel data. It is intended for those organizations that create and use land parcel data, and in particular those U.S. government agencies that play a role in coordinating and funding national land parcel data and other related themes of the National Spatial Data Infrastructure. The challenge is exactly the same one that faced the original NRC committee 27 years ago—how do we create workable partnerships to better serve our citizens?

David Cowen
Chair

Contents

Summary

Private ownership of land is a foundation of the financial, legal, and real estate systems of our society. Furthermore, open access to information about ownership and use of land has always been a cornerstone of our democracy and free enterprise system. In a modern land information system, land parcel databases describe a combination of the rights, interests, ownership, and value of property. Parcel data (also known as cadastral data) constitute the most appropriate level of geographic detail for a host of decisions and actions relating to the development of land, business activities, regulatory compliance, emergency response, law enforcement, and logistical support. Parcel data are also critical to the analysis of natural hazard risk, transportation needs, and even environmental issues. With this understanding, about a third of the counties in the United States have embraced digital parcel data as the core of their state-of-the-art information systems. At the same time, commercial firms in the United States are capitalizing on the public's interest in parcel data. For example, it is estimated that more than 2 million people a month access Zillow.com to anonymously obtain detailed property values and characteristics for more than 70 million properties. Many other private companies in the utility, insurance, or location-based services industries also maintain their own parcel databases. However, a nationally consistent set of parcel data does not exist in the United States. Other countries have acknowledged the benefits of such a national data set; for example, Australia has a unified system of parcel data for the entire country that even serves as the basis for automated address location through Google Maps.

In 1980, a National Research Council (NRC) study, *Need for a Multipurpose Cadastre* (NRC, 1980), asserted that parcel data should be the fundamental building block for a nationally integrated system of land information. Two other reports, *Modernization of the Public Land Survey System* (NRC, 1982) and *Procedures and Standards for a Multipurpose Cadastre* (NRC, 1983), built upon and added to the original report. However, despite major progress in the development of digital land parcel databases in many local jurisdictions, some directed and coordinated by state programs, little progress has been made toward the development of nationally integrated land parcel data since that time. Therefore, the current study, which was sponsored by the Bureau of Land Management (BLM), the Census Bureau, the Federal Geographic Data Committee (FGDC), the Department of Homeland Security (DHS), and Environmental Systems Research Institute (ESRI), was initiated to

assess the current status of a national land parcel data set and the challenges to developing it. The study included the following specific tasks:

- Identify the benefits of accurate parcel databases for all stakeholders (public and private);
- Describe the current status of parcel databases across the nation at all levels of government;
- Document what has been shown to be possible at a local, regional, and state level, using examples of successful systems; and
- Provide a vision of what could be possible nationwide, and identify a strategy to achieve the vision, including the role of the federal agencies, and accounting for challenges that must be overcome.

The committee concluded that complete national land parcel data are necessary, timely, technically feasible, and affordable. Although the benefits and needs for nationally consistent parcel data are much more clear and urgent than in 1980, there has been little progress toward the recommendations of the 1980 report. While a great deal of parcel data has been digitized at the local level, 30 percent of individual parcels still need to be converted, and there has been little progress toward an integrated national set. Many of the technical barriers have been overcome, so the remaining challenges are primarily organizational. The committee makes nine recommendations for overcoming these remaining barriers.

PROGRESS AND NEEDS

In reviewing the events of the past 27 years, there is ample evidence that the federal government has attempted to better coordinate its geospatial activities. Recent policy directives mandate that the federal government coordinate the development of important national geospatial data sets, including land parcel data. By including cadastral data as a framework layer of the National Spatial Data Infrastructure (NSDI) the federal government has acknowledged their importance. BLM has been assigned important responsibilities to serve as a coordinator for parcel data for lands managed by the federal government and the coordination of parcel data produced by all levels of government that are needed to meet federal programmatic needs. Therefore, progress has been made in enacting policies that enable the creation of a national land parcel data set.

Although much has changed over the past quarter of a century, the list of benefits of a national land parcel data system outlined by the early reports remains relevant for all levels of government, the private sector, and individual citizens. While only a few of the largest and most progressive counties had functioning parcel-based information systems in the early 1980s, now about a third of the counties are operating such systems. For many of them, parcel maintenance is the essential core of their information system. Nevertheless, even though the value of parcel data is better accepted, the benefits of nationally integrated parcel data are not as widely acknowledged. Stakeholder feedback to the committee highlighted that federal- and state-level employees who produce parcel data believe that nationally integrated parcel data are necessary, but many local governments create data for their own applications and do not see how a national effort would benefit their own local use. This becomes a challenge now that the need for complete national land parcel data has become even more urgent for one application in particular—emergency response. When Hurricane Katrina hit the Gulf Coast, critical parcel information that was urgently needed by emergency responders, public officials, and insurance companies was not readily available and, in many cases, was nonexistent.

CURRENT STATUS OF PARCEL DATA

An important part of this study was to assess the current status of parcel data in the United States. The committee found that a significant digital parcel data divide exists between various counties. In many parts of the United States, parcel data exist only as lines on paper maps stored in a local courthouse. While about 70 percent of the tax parcels in the United States now exist in digital form, the remaining 30 percent are located in the roughly 2,000 most rural counties. Although these counties have fewer total parcels, they also do not have adequate financial resources to convert their data to digital form. On the other side of the divide, many urban areas are covered by two or three versions of parcel data, and often anyone with a simple web browser can anonymously retrieve information about the ownership, taxes, and value of any parcel by owner name or street address. Many communities routinely align parcel boundaries using digital aerial photographs that precisely display fences, driveways, sidewalks, hedges, and other features that align with property boundaries. In fact, there are parcel data programs that reflect real-time changes in real estate transactions or new street addresses through field-based global positioning system enabled hand-held computers.

As mentioned earlier, there has been a fair amount of federal policy supporting a comprehensive approach to parcel data. However, while the FGDC has designated BLM as the steward for federal land parcel data and the coordinator of cadastral data, a coordinated approach to parcel data, even for federally managed property, does not exist. The most tangible and successful effect of federal efforts has been the FGDC Subcommittee for Cadastral Data, which has made significant progress in the development of standards and coordination with stakeholders. As for federal agency programs to develop parcel data, the National Integrated Land System is the closest thing to a coordinated program, but it remains much more of a set of technologies than a source of parcel data. Meanwhile, there is evidence that federal agencies are acknowledging their need for parcel data to fulfill their missions. For example, the Department of Agriculture's common land unit program is generating subparcel data to monitor fraudulent crop insurance claims, and DHS has included a detailed specification for parcel data in its geographic data model. This is a tangible recognition of the essential role parcel data can play in improving the level of service from federal agencies. The development of parcel data for Indian lands is also very inconsistent across the nation, due in part to the many additional difficulties that must be addressed when dealing with Indian trust lands.

CHALLENGES

The committee assessed the challenges, issues, and barriers to the development of a national land parcel data set and found these to be technological or data-related, financial, legal, organizational, and political, as well as problems unique to Indian lands. Although most of the technological barriers have been overcome, issues related to the accuracy and currency of the data still must be addressed. Appropriate funding mechanisms for a national land parcel data set are needed. However, the committee believes that the financial and technical issues are minor compared to the organizational and political ones. With thousands of counties or other government entities as potential producers of parcel data, the organizational issues are complex. It is not a simple task to assemble parcel data that span several counties or states. Overcoming the organizational barriers even among federal agencies has been difficult, as evidenced by the fact that there is no single inventory of federal lands. The lack of nationally integrated land parcel data has led to massive duplication of effort among various levels of government and between the public and private sectors. For example, in the absence of a coordinated public sector approach to parcel data, private firms have acquired local data and teamed with aerial photography companies and commercial digital map providers to develop their own versions of parcel data.

Many legal and political issues related to parcel data have arisen. Even when parcel data do exist in digital format they are often encumbered by restrictive local government licensing policies. Other issues arise related to data sharing, such as the Census Bureau's legal inability to share address data. There are many issues related to what data should be in the public domain and what should be considered confidential to protect privacy. Local governments have few incentives to adopt a consistent data content standard for parcel data or even to share the information beyond their borders. Local governments are also suspicious that development of a national land parcel data set may become another "unfunded mandate," under which they are required to provide their data for little or no compensation or benefit to them.

COMMITTEE'S VISION

The committee's vision for nationally integrated land parcel data is a distributed system of land parcel data housed with the appropriate data stewards but accessible through a central web-based interface. It would have a minimum set of attributes, and the development and integration of the national data set would be overseen by a national coordinator, working with coordinators for federal lands, Indian lands, and each state. These data would serve as the cadastral data layer of the NSDI. This vision is based on existing federal policies for national geospatial data and thus the data would be in the public domain, but in order to address issues relating to privacy and confidentiality, no information will be provided about private ownership, use, or value. This national system would be built on already existing parcel data systems at the state and local levels.

The envisioned system would link a series of distributed servers maintained by local and state governments. In a virtual environment the system could seamlessly assemble accurate and timely parcel information for any part of the nation. This would be analogous to "just-in-time manufacturing" in which parts required for assembly are obtained when they are needed, rather than having a large warehouse filled with inventory. For this to happen the national vision would require that each parcel be treated as a unique entity. The information about each parcel would be maintained by local government officials. These local parcel data stewards would share only geographic coordinates that define the geometry of each parcel and a minimal set of attributes including street address, unique identification number, a generalized category of ownership, and metadata. Since this system is not intended to replace the legal property record system, the geometry of each property could initially be represented as a single point while digital boundary data are developed. State coordinators would ensure consistency and work with the Census Bureau to use the parcel data to create accurate boundaries for governmental land units.

At the federal level there would be a federal land parcel coordinator who would focus on the development of parcel data for federal lands. There would also be a national land parcel coordinator who would be responsible for coordinating the development of complete and integrated nationwide coverage of parcel data from all levels of government. This national coordinator would build relationships with state and local governments to establish unfettered access to a comprehensive set of parcel data linked to a unique identification system. While this level of intergovernmental coordination may seem to be a daunting task it is exactly what is proposed by current initiatives at both the state and the national levels, such as the Fifty States Initiative developed by the National States Geographic Information Council (NSGIC) in cooperation with the FGDC to improve statewide coordination of geospatial information technologies and the Office of Management and Budget's (OMB's) Geospatial Line of Business (GLoB) to improve geospatial data coordination across the federal government. The national coordinator could also support the geospatial community in understanding the proper role of parcel data with respect to other NSDI data themes relating to land ownership, housing, buildings, and government boundaries.

Immediate and sustained funding for the program should be a shared responsibility among all stakeholders. The federal government would bear the incremental cost to integrate parcel data across county and state boundaries. New initiatives such as the proposed NSGIC Imagery for the Nation would help fund data acquisition needed for parcel data development. Cost sharing between federal and state and local governments would follow the successful model used by the U.S. Geological Survey to create the national mapping program. The private sector and local governments are already making substantial investments in parcel data. Therefore, they are critical stakeholders in the national vision for parcel data and would realize substantial benefits from a coordinated approach. Additional sources of funding would be required to establish new parcel programs in areas where they do not currently exist. Local governments with existing programs could retain their current licensing programs and receive new funding to cover the cost of data sharing.

In order to achieve this vision and overcome the challenges and barriers, the committee makes nine recommendations. A discussion of these recommendations follows.

RECOMMENDATIONS

The committee believes, first and foremost, that there is an urgent need to clarify and enforce federal agency responsibilities for land parcel-related geospatial data under OMB Circular A-16. In order to accomplish this, the committee recommends the following:

RECOMMENDATION 1. In order to achieve nationally integrated land parcel data, there should be both a federal land parcel coordinator and a national land parcel coordinator. A panel should be established to determine whether BLM has the necessary and sufficient authority and capacity to serve as the federal and/or national land parcel coordinator, and if not, either it should be given the authority and resources, or some other agency should be named. The panel should conduct a review of BLM's existing stewardship responsibilities for cadastral and federal land ownership status under OMB Circular A-16, as well as its current legislative authorities and budget priorities.

Next, the committee believes that there needs to be a better understanding of the interrelationships between land parcel data and the following OMB A-16 mandated data themes: Buildings and Facilities, Cultural Resources, Governmental Units, and Housing. This would provide for better integration of the data themes and avoid unnecessary duplication of effort.

RECOMMENDATION 2. As part of the Geospatial Line of Business process, the FGDC should identify the role of parcel data in the collection and maintenance of the following data themes: Buildings and Facilities, Cultural Resources, Governmental Units, and Housing.

Since the federal government is the largest land management agency, complete parcel data for federal lands are needed for a national data set. Therefore, it is necessary for the federal government to develop and maintain an inventory of its own property, which would be implemented through the following recommendation.

RECOMMENDATION 3. The Federal Land Parcel Coordinator should coordinate the development and maintenance of a single, comprehensive, and authoritative geographi-

cally referenced database for land parcels managed by the federal government, including public lands. This database should include the ownership, area, and use of all federally managed lands.

To create trust among the stakeholders and address the technical and legal issues identified in this report, a national program for parcel data must have a comprehensive and accountable business plan. Proven benchmarks and metrics for assessing progress have already been developed by the FGDC Subcommittee for Cadastral Data.

RECOMMENDATION 4. The National Land Parcel Coordinator should develop and oversee a land parcel data business plan for the nation. This plan should serve as the basis for evaluation of the program and as a model for state and local governments. Metrics should be based on the FGDC Parcel Management Program Business Plan Template.

There is a need for the federal government to maintain an inventory of tribal trust land; however, there are unique issues and requirements associated with tribal trust parcels.

RECOMMENDATION 5. The Office of the Special Trustee for Tribal Lands should establish an Indian Lands Parcel Coordinator who would manage a program to coordinate and fund the development and maintenance of a geographically referenced database for Indian trust parcels. The data should then be made available to the National Land Parcel Coordinator to be integrated with national land parcel data.

The Census Bureau is currently modernizing the Topologically Integrated Geographic Encoding and Referencing (TIGER) system of digital street data for the 2010 Census. It has worked to align TIGER streets and blocks to the same data used by local governments. It is also creating a point-level representation of properties with associated street addresses. Several commercial companies are doing exactly the same thing. While these companies will lease their data, the Census Bureau is prohibited by Title 13 of the United States Code from sharing these data with other federal agencies or with the local governments that provided much of the information. Since addresses and their location are publicly available information, the ability of the Census Bureau to release just building address point locations could serve a multitude of uses and would have major economic benefits while not revealing confidential information about individuals. The availability of address points could dramatically improve emergency 911 systems across the nation and provide a starting point for parcel data in rural parts of the country.

RECOMMENDATION 6. Congress and the Bureau of the Census should explore potential policy options, including modifications to Title 13, that would allow its digital data on building addresses and their geographical coordinates to be placed in the public domain while also maintaining important privacy protections. If publicly available, these street addresses and coordinates could be used to assist in the development of parcel data in areas where parcel data sets do not exist.

Coordination at the state level is a necessary element of nationally integrated land parcel data and could logically be a part of the NSGIC/FGDC Fifty States Initiative.

RECOMMENDATION 7. The National Land Parcel Coordinator should embrace the Fifty States Initiative and require that every state formally establish a state parcel coordinator. State coordinators should develop a parcel data business plan and manage the relationships among all levels of government involved in parcel production. The plan and program should achieve comprehensive border-to-border parcel coverage for all public and privately owned property within the state. The state parcel coordinator should either work with the state office responsible for the Census Bureau's Boundary and Annexation program or with local government offices if a statewide program does not exist.

There are many different sources of funding that could be used to complete the development of digital parcel data nationwide, including intergovernmental cooperation, shared funding, and various incentives. The federal government can play a major role in orchestrating a better use of these funds. Therefore, a major responsibility of the national land parcel coordinator is to develop a "top-down" funding model to support a "bottom-up" production process. The coordinator will also need to obtain funding for integrating the data and developing the system to make them available.

RECOMMENDATION 8. The National Land Parcel Coordinator should develop a plan for a sustainable and equitable intergovernmental funding program for the development and maintenance of parcel data. The plan must provide financial incentives to local governments that will produce and maintain the majority of the parcel data. Many of the funds for this program should come from existing federal programs that require parcel data; however, new funding will be required to establish an initial baseline, integrate the data, and make them available through a web interface.

Many of the property fraud cases associated with the hurricanes of 2005 are the direct result of poor or nonexistent parcel data. The federal government, in concert with local and state agencies, should aggressively correct this information void. The committee believes that a series of incentives and requirements could jump-start this program. Tying grant eligibility for federal funds related to property or participation in federal data sharing programs to the existence of digital parcel data would help promote parcel data development. Since many local governments have already developed digital land parcel data for their own internal purposes, this should not be an excessive burden for them. For others that do not yet have digital land parcel data, incentives and support will be needed to promote their development.

RECOMMENDATION 9. To participate in federal geospatial programs such as federal collection and dissemination of orthoimagery, a local or state government should be required to make the parcel geometry and limited set of attributes needed for the national land parcel data system available in the public domain. Further, in order to be eligible to receive federal funds that are directly associated with property, such as disaster relief or community development assistance, digital land parcel data necessary to effectively administer the program should be made available by local and state governments.

This study argues that nationally integrated land parcel data are necessary, timely, technically feasible, and affordable. The 1980 NRC study of land parcels was visionary when it laid out a multilevel intergovernmental partnership that would provide parcel data across the country. At the

same time, the report was overly optimistic about the ability of 1980 vintage technology to deal with millions of parcels. Today, with our current infrastructure of geospatial technologies and standards, along with web-based technologies, it actually is technically and economically feasible to implement such a vision. Establishment of the NSDI and associated geospatial data policies suggests that the question does not appear to be whether the federal government has the need, resources, or authority to implement a national parcel data program, but rather whether it has the motivation and incentives to confront difficult institutional and financial obstacles. This report has laid out a set of recommendations to establish the framework necessary for intergovernmental coordination and funding. The committee hopes that establishing this framework will be the first step in moving forward with a national land parcel data program.

1

Introduction

1.1 BACKGROUND

Land parcel databases, which are also known as cadastres, describe the rights, interests, and value of property. The legal boundaries of land parcels are defined in the deed to a property. A surveyor confirms these measurements anytime the property is subdivided or platted, or in boundary disputes. Ownership of land parcels is an important part of the financial, legal, and real estate systems of a society. Real estate tax parcels are typically graphic representations of the land ownership to support property taxing functions. These maps are often used as the parcel maps for a jurisdiction. The aggregate set of land parcels represents the distribution of the real property assets of a community and its ownership, forms the basis for all land use and zoning decisions, and represents the location of residences, businesses, and public lands. In other words, almost every aspect of government and business can be associated with a land parcel.

Land ownership has been critical to the economic and philosophical development of this country. Hernando De Soto (2000) describes how our Western system of clear private ownership of land allows entrepreneurs to launch successful businesses by borrowing against their real assets; this option is not available in his native Peru or other parts of the developing world. Richard Pipes (1999) argues that all individual freedoms tie back to individual property rights. The right to vote in the United States was originally restricted to those who owned property and, it was felt, had a stake in the government. Land ownership is seen as desirable and rewarded with income and property tax reductions. Americans' strong sense of identity and self-determination is closely tied to land ownership. Uniquely among developed countries, we trust our local government to manage our rights in the land—from recording documents to controlling land uses. We would not trust control over land to be handled at higher units of government.

This fragmentation of land information and control has been a problem for this country because it has allowed for a widely varying range of availability and quality of land parcel data across the nation. Some parts of the United States have been able to use this information about land to greatly improve the quality of life for their citizens, while others have not. In some places, local government has been able to use land information to create jobs, improve the environment, distribute the tax

burden equitably, and even save lives. Other, more remote and less affluent counties or local governments have not profited from this range of benefits. At a state or national level, we have been unable to rely on basic parcel information because of its spotty availability and nonstandard format.

Although many land parcel data exist in the United States, they are not entirely in digital form, they are not in a common format, and they are certainly not consistently available across the nation. In 1980, a National Research Council (NRC) study, *Need for a Multipurpose Cadastre* (NRC, 1980), asserted the importance of parcel data within an integrated system of land information to support the wide range of decision making necessary for effective land management. The report acknowledged that land parcel data can only be developed and maintained at the local government level, but that the federal government must foster the integration of these local data sets through a set of consistent standards, funding programs, and coordination with each state. Much of what was said in the 1980 report is still true today. The needs for a national land parcel data set are more widely recognized, and the benefits from maintaining a system have been clearly demonstrated by numerous local governments. Perhaps most importantly, although the 1980 report was optimistic about the development of a multipurpose cadastre, it was also realistic about the major organizational and institutional obstacles that existed.

Twenty-seven years later, much has happened. Early in the twenty-first century we are immersed in location-based information systems—we rely on in-car navigation systems to get us to new destinations, keep track of people on parole with global positioning system (GPS) enabled bracelets, and find restaurants and hotels through a web browser or cell phone. Citizens can now use their home computers to routinely access information about their property taxes, seek information about the purchase of their next house around the corner or thousands of miles away, or explore the world with virtual globes such as Google Earth.[1] In the current geographically aware age it is clear that the private sector has assessed user needs and determined how to take advantage of sophisticated GPS satellite location capabilities, easy-to-use and responsive mapping and geographic information system (GIS) technology, and database integration engines to attract millions of users and make a profit. However, even these sophisticated systems have a fundamental weakness. In many cases they can direct you to the right city, the right neighborhood, the right street, even the right block. Yet they cannot get you consistently to the correct property or the correct building.

Most city, county, state, and federal government agencies have not kept pace with many technical advances. While private companies such as Zillow[2] are able to retrieve and display maps of property values for much of the nation in a few seconds, digital records for property ownership along the Gulf Coast following Hurricanes Katrina and Wilma were largely nonexistent in the aftermath of the hurricanes, and public agencies were left scrambling to assemble some form of property information that could identify the location, value, ownership, and extent of damage to thousands of pieces of property and structures. The Government Accountability Office (GAO) recently reported that the absence of these critical documented property records resulted in millions of dollars in fraudulent claims (GAO, 2006a). Therefore, although it is clear that an integrated set of land parcel data is needed and possible, it still does not exist in the United States. The purpose of this study is to assess why and to determine whether the environment has changed to make such a system more palatable, plausible, and practical today.

[1]See *http://earth.google.com*.
[2]See *http://www.zillow.com.*

1.2 STATEMENT OF TASK AND APPROACH

The goal of this study was to highlight the status of land parcel databases in the United States, provide a vision for the future, and develop a strategy to complete this National Spatial Data Infrastructure framework data layer. Specific tasks included the following:

- Identify the benefits of accurate parcel databases to all stakeholders (public and private);
- Describe the current status of parcel databases across the nation at all levels of government;
- Document what has been shown to be possible at a local, regional, and state level, using examples of successful systems; and
- Provide a vision of what could be possible nationwide, and identify a strategy to achieve the vision, including the role of the federal agencies, and accounting for challenges that must be overcome.

This study was sponsored by five organizations, including the Bureau of Land Management, the Census Bureau, the Federal Geographic Data Committee (FGDC), the Department of Homeland Security, and Environmental Systems Research Institute (ESRI). The study committee was composed of 10 members with expertise in the development of cadastres, surveying, property assessment, county administration, the mortgage information services and insurance industries, and the use of geographic data and tools for public policy. The committee included representation from various levels of government, including county, state, and tribal. It also included members from academia and the private sector.

The committee met four times. One of the meetings was a Land Parcel Data Summit, which brought together senior representatives from federal agencies, the private sector, and professional organizations that develop and/or use land parcel data (see Appendix C). Comments on a national land parcel data set were also received from a much broader group of 400 practitioners, end users, and other stakeholders via an online forum. Finally, the committee made extensive use of published documents and reports on the current status of land parcel data in the United States, templates for cadastral standards, and examples of successful systems and case studies on the uses of cadastral data from various sources, such as the FGDC Subcommittee for Cadastral Data.

1.3 DEFINITIONS

Although there are several possible definitions for *land parcels*, one of the simplest and most persistent is the one included in *Multipurpose Land Information Systems: The Guidebook* (Epstein and Moyer, 1993, p. 13-2):

> A parcel is an unambiguously defined unit of land within which a bundle of rights and interests are legally recognized in a community. A parcel encloses a contiguous area of land for which location and boundaries are known, described, and maintained, and for which there is a history of defined, legally recognized interests.

The FGDC Content Standard for Cadastral Data uses a similar definition but recognizes that a parcel does not have to be contiguous. For the purposes of this report, a parcel is defined as the primary unit of surface ownership, including public and privately held lands. In many local jurisdictions (counties and cities), the surface ownership is represented by the real estate tax parcel. This is the unit of land ownership that is most often maintained and used by local governments, represents the immediately visible ownership, and provides a definition of the landscape that will meet most business needs. For publicly managed parcels, such as lands managed by local, state, or U.S. agencies, the comparable unit to the real estate tax parcel is the surface management parcel.

On federally managed lands, the surface management parcel is the area defined by management activities such as permits, leases, or acquisition areas.

For private property there is usually a one-to-one match between a real estate tax parcel and a deed that represents the legal title for ownership of the parcel.[3] Geometrically a parcel consists of one or more closed polygons that can be defined by geographical coordinates on the earth's surface and can be uniquely identified for indexing purposes. The parcel polygon graphics used for the purposes of nationwide data will not be sufficiently accurate to support title conveyance, but should be sufficiently accurate to support real estate taxation purposes.

Subsurface rights, such as mineral, oil, and gas or groundwater extraction rights, and fractionated surface interests such as solar easements and transferable development rights are an important component of the description of rights and interests in land. In most local jurisdictions the deed recording functions and real estate tax operations do not map, index, or track these nonsurface rights. The committee recognizes the critical importance of these rights and their management and also recognizes the initiatives of the FGDC Subcommittee for Cadastral Data to define the business case, the data needs, and the implementation challenges for these rights. Once a complete surface ownership inventory has been developed, issues related to these other interests can be addressed. Therefore this report focuses on surface ownership.

The set of parcels for a jurisdiction is often depicted on a parcel or tax map that is used by an assessor to publicly display boundaries of parcels. It is important that these maps be publicly available and accessible. "The land-transfer process in North America is founded on the principle of publicity, the concept that all information relating to the nature and extent of interests vesting in a legal parcel of land must be available for public inspection" (NRC, 1980, p. 9). While a tax map displays lines and areas (polygons), primarily it is a simple index to critical information that is associated with land parcels (Figure 1.1). Therefore it is common practice for a community to systematically collect and maintain a set of parcel information that is associated with each parcel and becomes the basis for queries, analysis, and reports.

Parcel information includes the various attributes linked to the parcel that describe properties such as ownership, improvements and easements, zoning restrictions, and values and assessments on the land and its improvements. Generally this information is found in deeds, plats, tax bills, assessment records, or zoning ordinances and building permits. Parcel information is collected and maintained across the nation in local government offices, assessors' offices, state agencies, and tribal and federal databases. Box 1.1 describes these common attributes of land parcel data.

Although easements and rights-of-way are important attributes of parcel data, these are often partial interests in the land that can be constructed on top of the parcels. Therefore, similar to the discussion of subsurface rights above, the committee felt that once the parcel data are completed the issues related to these other interests can be addressed.

In a local government information system, parcels become the primary units for managing information about land rights and interests. Land parcel data are closely related to the concept of a *cadastre*, which is the "record of interests in land encompassing both the nature and extent of these interests" (NRC, 1980, p. 5). Using this definition there can actually be several different cadastres. For example, the legal ownership information may be maintained by a recorder of deeds who is interested in the juridical cadastre. On the other hand, the tax assessor does not get involved with disputes over land ownership but does maintain a fiscal cadastre. (The 1980 NRC report contained an excellent historical perspective on the evolution of cadastre issues; see NRC, 1980, Chapter 1.)

[3]Condominiums and other forms of ownership may have multiple parcels and/or owners within a single tax parcel. For example, high-rise lofts will have parcels stacked in three dimensions. It is sufficient, for the purposes of this report, to map those parcels to their surface footprint, as long as ownership and tax records for component parcels can be related to that footprint. It is also recognized that one parcel may have fractional interests, but as long as the ownership interests can be related to the parcel footprint this is sufficient for the parcel coverage described in this report.

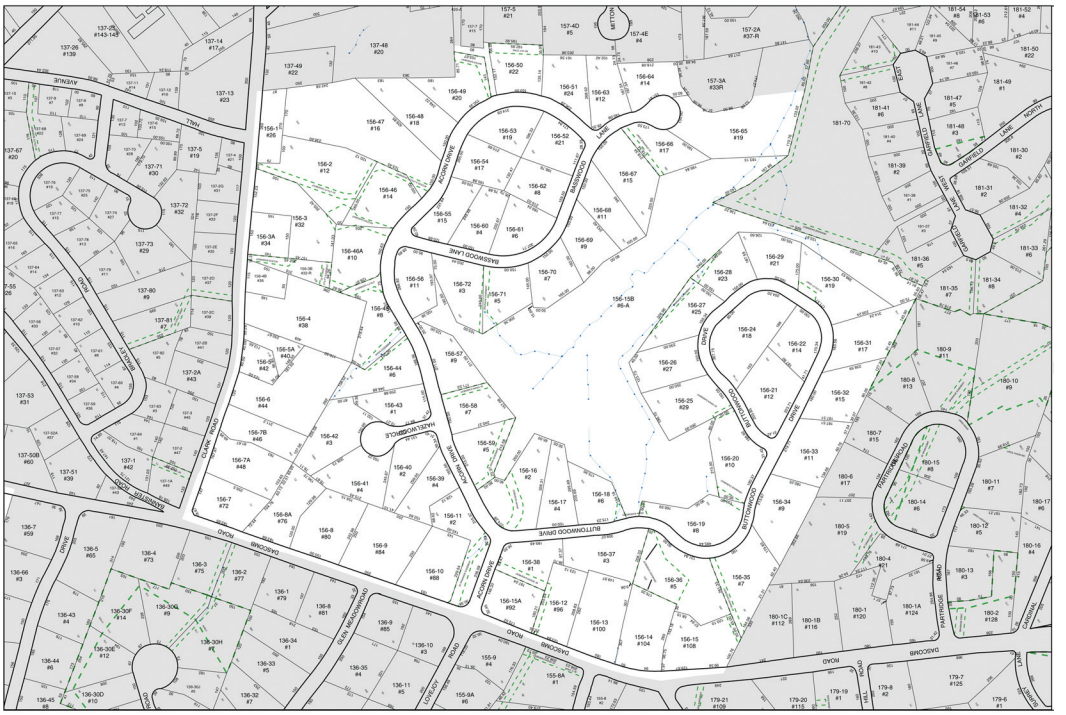

FIGURE 1.1 Sample of a tax map for Andover, Massachusetts. SOURCE: Town of Andover, Massachusetts. Prepared by Andover Engineering Department. Available at *http://gis.cdm.com/website/AndoverIMS/maps/FindTaxMap.htm* [accessed February 22, 2007].

The 1980 NRC report made a strong case for intergovernmental coordination to create a *multipurpose cadastre* that would benefit a wide range of stakeholders. It provided a definition that has become part of the history of the automated information systems (NRC, 1980, p. 13):

> The multipurpose cadastre system is designed to overcome the difficulties associated with these more limited approaches by (1) providing in a continuous fashion a comprehensive record of land-related information and (2) presenting this information at the parcel level. The multipurpose cadastre is further conceptualized as a public operationally and administratively integrated land-information system, which supports continuous, readily available, and comprehensive land-related information at the parcel level.

A *land information system* is a specialized GIS. Epstein and Brown (1989, pp. 1-5) provided the following definition of a land information system: "Land information systems are 'the data, products, services, the operating procedures, equipment, software, people—the sum of all the elements that systematically make information about land available to users.'"

In this report, the terms *land parcel database* or *land parcel data set* are used in the more general sense to refer to groupings of land parcel data for an area.

Finally, the county is often used throughout the report to refer to the fundamental unit of local government that produces parcel data. This is meant to include county equivalents such as boroughs, city and boroughs, municipalities, and census areas in Alaska, parishes in Louisiana, and cities

BOX 1.1
Common Attributes of Land Parcel Data

Value

The value of land and improvements is sometimes called assessment or appraisal and is information about the worth of the land and buildings. A property tax bill includes an assessed value of the buildings, land, and other improvements. This information is determined by assessors based on the rules for valuation in a specific jurisdiction. If land is sold or mortgaged, it is common to get an appraisal. This is a valuation by a private agency that determines value in terms of an asset.

Ownership

This information describes who owns or manages the land. Typically, it gives the name of the owners, but it also includes the description of how they own the land and exactly what rights they have on it. Information about ownership is contained in deeds, mortgages, and other documents that are commonly stored in county or local government registers of deeds offices.

Land Use and Zoning

This is information about regulations on the use of land established by a government agency. The most common of these is zoning. Regulations are different from the restrictions on use that may be in the chain of title, such as those from restrictive covenants. The term "regulations" is applied to government-imposed limitations, and restrictions are limitations that are in the chain of title. Terms and conditions agreed to by both parties in a lease are yet another potential type of limitation on use.

Address

Address is one of the first things we learn about parcel information. There are mailing addresses and site addresses. The site address ZIP Code might not be the same as the mailing address ZIP Code. The site address or parcel location might be in one town, but the mailing address in another town. When we talk about address with parcels, we are talking about the site address, sometimes called *situs*. This describes the location of the parcel with respect to the street from which it is accessed. The site address usually includes knowledge about the structures or improvements on the property and some information about those structures, such as whether they are multiresident, have multiple entrances, and other details.

Legal Descriptions

The parcel is an area of land that is constructed from legal descriptions contained in deeds, on survey maps and plats, and may be shown on tax maps. The legal description contains information on the boundaries that make up the parcel area, the relationship to other parcels and surveys, and gaps and overlaps between parcels, all of which are essential to accurate parcel maps. The legal description is the framework for the tax or ownership parcels and may be tied to boundaries and corners.

SOURCE: Adapted from von Meyer, 2004, pp. 5-6. Copyright © 2004 ESRI. All rights reserved. Used by permission.

that are independent of any county in various states. The committee also recognizes that individual incorporated areas such as towns in New England, or cities or municipalities in general, often maintain parcel data independent of the county. However for simplicity the term local government or county is often used in this report to refer to all government agencies below the state level that produce parcel data.

1.4 REPORT STRUCTURE

Chapter 2 includes background information that describes the changes since 1980 in geospatial data policy and technology that influence the development of parcel data. Chapter 3 discusses the needs for and benefits of nationally integrated land parcel data by entities at the federal, state, and local government levels, as well as private citizens and private industry. Chapter 4 describes the current status of parcel data in the United States, as well as in other countries for comparison. The challenges that must be overcome to develop complete national land parcel data are laid out in Chapter 5, and Chapter 6 provides a vision and model for what nationally integrated data could be. Chapter 7 makes recommendations for overcoming the obstacles and barriers to developing this national land parcel database and for achieving the vision described in Chapter 6.

2

Background and Current Setting

2.1 BACKGROUND: PREVIOUS NRC REPORTS

The National Research Council (NRC) issued a series of reports in the early 1980s related to land parcel data. These reports revolutionized the way the people think about local land records, the value they have to the nation, and the role of the federal government in developing systems to map those data. They not only focused on the technical issues, but examined the social, environmental, institutional, and economic issues as well.

As referenced earlier, the report titled *Need for a Multipurpose Cadastre* (NRC, 1980) envisioned a parcel mapping system that would support land titling, assessment and taxation, and land use management for optimal environmental and economic development. It retained primary responsibility for managing these operations with local government, but recommended state coordinating bodies and some level of federal financial support. The report also recommended that the federal government develop standards for use across the country and support academic centers of excellence to study and improve "land information science." The recommendations from that report can be found in Appendix B.

The second study, *Modernization of the Public Land Survey System* (NRC, 1982), recommended improvement of the spatial location information of the Public Land Survey System (PLSS). A large amount of land in the United States, and in particular federal land, was originally surveyed under the PLSS, which established the township and range system. Although many parcel boundaries are legally tied to these original surveys, many of the monument markers from those surveys are lost or lack good locational information. The report recommended the formation of a federal surveying and mapping agency to coordinate the geodetic, cadastral, and mapping activities necessary for modernization of the PLSS. It also recommended the formation of an interagency working group with the "participation of all relevant federal agencies and interested groups at the state, local, and private sector levels to integrate the geodetic, cadastral, and mapping activities necessary for the modernization of the Public Land Survey System" (NRC, 1982, p. 4) to perform this function until the new agency could be formed. The third study, *Procedures and Standards for a Multipurpose Cadastre* (NRC, 1983), focused on the implementation of the recommendations in the 1980 report,

including the technical and organizational procedures that would have to be followed and the technical specifications for the components of a multipurpose cadastre. The 1983 panel continued to view the multipurpose cadastre as a key component of how government should fulfill its mission. To fund the multipurpose cadastre, the study recommended federal grants to counties (or their equivalents) to cover about 40 percent of the cost for the multipurpose cadastre. It estimated that the cost of a matching federal program would be $90 million per year over a 20-year period for a total federal contribution of $1.8 billion.

The NRC has produced a number of other reports that are relevant to the present study in that they continue to document the need for national land parcel data and the roles of various players in developing it. For example, *Toward a Coordinated Spatial Data Infrastructure for the Nation* (NRC, 1993) provides the basic details of the National Spatial Data Infrastructure (NSDI) and lists the parcel (cadastre) as one of the primary components. It provides a strong rationale for federal involvement, including "aboriginal land tenure; the federal government's significance as a land owner; its role in real estate and asset/facilities management; its role in acquiring property for specific projects; various taxation roles; its regulatory role with respect to real estate financing, interstate commerce, agricultural support programs, environmental assessment, hazardous waste management, etc.; and civil defense and emergency preparedness roles" (NRC, 1993, p. 66).

Promoting the National Spatial Data Infrastructure Through Partnerships (NRC, 1994) and *National Spatial Data Infrastructure Partnership Programs* (NRC, 2001) focused on the need and value of cooperation among the various stakeholding partners. *A Data Foundation for the National Spatial Data Infrastructure* (NRC, 1995) highlighted the need for the federal government to coordinate integration of spatial data. It also suggested that there should be a single nationwide formatting system for cadastral data (NRC, 1995, p. 38).

Weaving a National Map (NRC, 2003a) examined the U.S. Geological Survey (USGS) concept of *The National Map.* This program was designed to replace paper USGS 1:24,000 maps with online maps containing the same data. A partnership of local, state, tribal, and federal sources would provide the raw material for this online system. The study committee raised the idea of including parcels and other critical data with this scheme. It also recommended retention of both a standardized medium-scale map and the original large-scale material.

Licensing Geographic Data and Services (NRC, 2004a) recognized the value of licensing data, even when they are available at no cost. Licensing allows local government to retain control over the use of its data, but this often conflicts with the principle that data are a public good. The report used a series of vignettes to show various ways of sharing data while maintaining control and recommended maximum use of standardized licenses.

GIS for Housing and Urban Development (NRC, 2003b) proposed that the U.S. Department of Housing and Urban Development (HUD) create an urban spatial data infrastructure that includes parcel-level data. The report also noted (NRC, 2003b, p. 46):

> The creation of a nationwide parcel-level dataset will require the participation of local government, finance agencies including Fannie Mae and Freddie Mac, realtors, and market researchers. States and metropolitan/regional-level governments (for example, the Twin Cities in Minnesota) have created programs to create or modernize parcel-level data. Because there is no nationwide source of parcel-level data, costly duplication and gaps can occur.

The 2000 Census: Counting Under Adversity (NRC, 2004b) looked at the Census Bureau's work with local government in updating its Master Address File (MAF) of residences and concluded that the partnership was flawed. "The Bureau should also give serious consideration to providing localities with updated MAF files" (NRC, 2004b, p. 149). For some communities, this file, complete with addresses and *x-y* coordinates, would be the only electronic means they have to map their parcels.

As the reports listed above indicate, there has been no lack of understanding or guidance over the past 27 years with regard to the development of land parcel data.

2.2 GEOSPATIAL DATA POLICY AND THE SPATIAL DATA INFRASTRUCTURE

Although the land parcel system that was envisioned in the 1980s reports has not developed, much has changed regarding the development of a spatial data infrastructure and the associated geospatial data policy that could influence the development of national land parcel data. The relevant changes are described in this section.

2.2.1 Circular A-16 and the Federal Geographic Data Committee

The creation of geospatial data and the desire to do it efficiently have been concerns of the federal government for more than two centuries. The Land Ordinance of 1785 defined the system of land surveys that denoted the lands to be sold or transferred to settlers. An executive order in 1906 "granted advisory power to the United States Geographic Board to review mapping projects to avoid duplication and to facilitate standardized mapping" (Office of Management and Budget [OMB], 2002). A more recent effort was the issuance of Circular A-16 in 1953 with the purpose "to insure that surveying and mapping activities may be directed toward meeting the needs of federal and state agencies and the general public, and will be performed expeditiously, without duplication of effort." Circular A-16 was revised in 1967, 1990, and 2002. The 1990 version created the Federal Geographic Data Committee (FGDC), to consist of representatives from the federal agencies that use geospatial data, and gave it the responsibility of coordinating federal geospatial data activities. Furthermore, the 2002 revision included the following powerful statement (OMB, 2002):

> Implementation of this Circular is essential to help federal agencies eliminate duplication, avoid redundant expenditures, reduce resources spent on unfunded mandates, accelerate the development of electronic government to meet the needs and expectations of citizens and agency programmatic mandates, and improve the efficiency and effectiveness of public management.

Figure 2.1 summarizes the evolution of federal geospatial data policy since the issuance of Circular A-16 in 1953.

One of the first tasks of the FGDC was to establish categories of geospatial data and to develop communities of interest for each of them. The most commonly used sets of base data were designated as framework data layers (geodetic control, orthoimagery, elevation and bathymetry, transportation, hydrography, *cadastral*, and governmental units). The FGDC established subcommittees with a lead agency to oversee the development of content standards for each of these themes (Figure 2.2), as well as for other commonly used themes as needed.

1953	1967	1990	1994	1997	2002	2002
A-16 issued to encourage coordinated mapping and surveying efforts.	A-16 revised to outline the responsibilities of Interior, Commerce, and State.	A-16 revised to include geographically referenced computer-readable (digital) data. FGDC created.	Executive Order 12906 established NSDI.	Strategy for NSDI published.	A-16 revised to reflect the changes in GIS, and to clearly define agency and FGDC responsibilities.	E-Gov Act of 2002 enacted. Geospatial One-Stop initiated.

FIGURE 2.1 Summary timeline of U.S. federal data policy since 1953. SOURCE: GAO, 2003b.

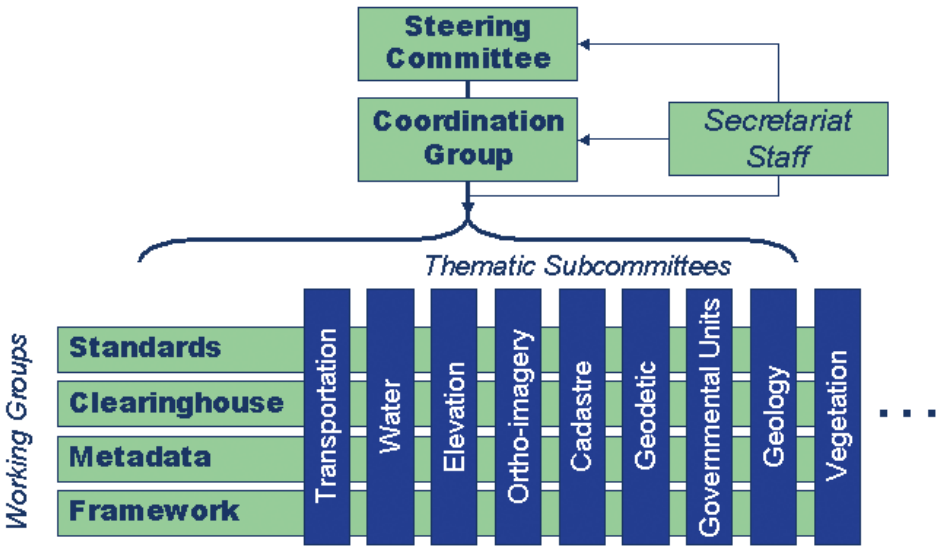

FIGURE 2.2 Organizational structure of the Federal Geographic Data Committee. SOURCE: FGDC website, *http://www.fgdc.gov/organization* [accessed February 13, 2007].

It is important to note that cadastre was established as one of the framework data layers. This elevates its importance and, according to Circular A-16, mandates that the federal government

- Coordinate and work in partnership with federal, state, tribal, and local government agencies, academia, and the private sector to efficiently and cost-effectively collect, integrate, maintain, disseminate, and preserve spatial data, building upon local data wherever possible (OMB, 2002, 8(a)(5)); and
- Search all sources, including the National Spatial Data Clearinghouse, to determine if existing federal, state, local, or private data meet agency needs before expending funds for data collection (OMB, 2002, 8(a)(10)).

2.2.2 Existing Federal Parcel Data Management Model

The committee found it useful to develop an interpretation of how the federal government could be operating under OMB Circular A-16 and the existing decisions of the FGDC. This interpretation is illustrated in Figure 2.3. This diagram relies heavily on the stated responsibilities that have been given to the Bureau of Land Management (BLM) under Circular A-16 to coordinate the cadastral framework layer for the NSDI. The responsibilities for these and other NSDI data themes were clearly articulated in Appendix E of Circular A-16 as described below. The lead department or agency identified for each data theme is indicated in parentheses.

Cadastral (Department of the Interior [DOI], BLM)

Cadastral data describe "the geographic extent of past, current, and future right, title, and interest in real property, and the framework to support the description of that geographic extent" (OMB, 2002). The geographic extent includes survey and description frameworks such as the PLSS,

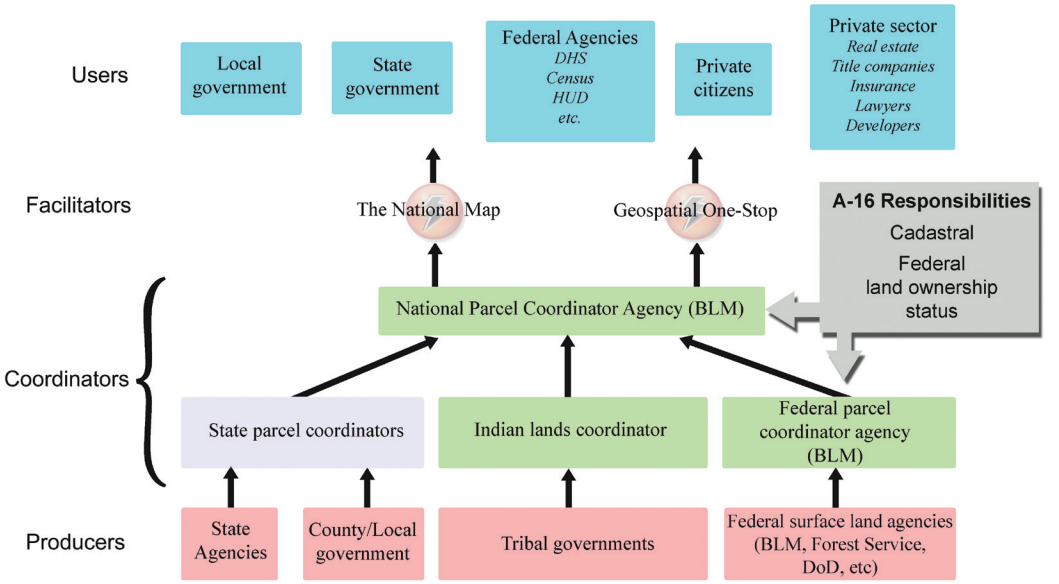

FIGURE 2.3 Interpretation of existing A-16 federal parcel custodian responsibilities.

as well as parcel-by-parcel surveys and descriptions. The land parcel is the fundamental entity in cadastral data.

Federal Land Ownership Status (DOI, BLM)

"Federal land ownership status includes the establishment and maintenance of a system for the storage and dissemination of information describing all title, estate or interest of the federal government in a parcel of real and mineral property" (OMB, 2002). The ownership status system is the portrayal of title for all such federal estates or interests in land. In this definition, the federal land parcel includes the mineral estate as well as the surface management activities. It is not unexpected that in the defined energy basins it is critical to have a good definition of the ownership of subsurface interests; however for the purposes of this report, the committee has focused on the surface management parcel as a first important step.

A literal interpretation of the Federal Land Ownership Status responsibilities suggests that BLM is mandated to serve as the federal land parcel coordinator. In a similar manner, as the designated steward for the cadastral framework layer, BLM would also appear to be designated to perform the functions of a national land parcel coordinator. The diagram includes a number of linkages from parcel data producers at the local, state, and federal levels to the federal and national coordinators and then on to the user community. It is important to recognize that many of these linkages are not just symbolic but actually exist. The most visible of these linkages are the National Integrated Land System (NILS) and the Geographic Coordinate Data Base (GCDB), which are discussed later in this chapter and in Chapter 4. Through these programs, BLM has established partnerships with other federal agencies, as well as state and local governments, to coordinate parcel data production and use. The diagram also includes a place for federal government facilitators between the national coordinator and the user community. The committee believes that *The National Map* and Geospatial One Stop programs of the National Geospatial Program Office in DOI are designed to fulfill that role

and are promoted as part of the federal enterprise architecture under its E-Government Initiative (as described in the next section). In fact, the North Carolina One Map program utilizes *The National Map* to serve parcel data for several counties. Therefore, if the extensive committees, OMB policy statements, executive orders, and standards efforts that have emanated from the federal government over the past century are to be followed, there is documented evidence that each of the components of Figure 2.3 is federally mandated and actually exists.

There are close relationships between parcel data and other FGDC data themes, and yet these layers generally have different theme coordinators and are developed separately. This is not the case at the local government level, where it would be standard practice to use parcel-based data either to create or to associate each of the following themes (theme coordinator is noted in parentheses). A better understanding of the relationship between parcel data and these data layers could help in development of all layers and avoid duplication of effort.

Buildings and Facilities (General Services Administration)

The facility theme "includes federal sites or entities with a geospatial location deliberately established for designated activities; a facility database might describe a factory, military base, college, hospital, power plant, fishery, national park, office building, space command center, or prison" (OMB, 2002). Facility data are submitted from several agencies, since there is no one party responsible for all the facilities in the nation, and facilities encompass a broad spectrum of activities. The FGDC promotes standardization of database structures and schemas to the extent practical. Buildings and facilities must rest on a parcel of land that has an owner, value, and use.

Cultural Resources (DOI, National Park Service)

"The cultural resources theme includes historic places such as districts, sites, buildings, and structures of significance in history, architecture, engineering, or culture. Cultural resources also encompass prehistoric features as well as historic landscapes" (OMB, 2002). Cultural features are located on land parcels; in fact, many sites are defined by the parcel boundary.

Governmental Units (Department of Commerce, U.S. Census Bureau)

"These data describe, by a consistent set of rules and semantic definitions, the official boundary of federal, state, local, and tribal governments as reported/certified to the U.S. Census Bureau by responsible officials of each government for purposes of reporting the Nation's official statistics" (OMB, 2002). Many incorporated areas are defined by parcel boundaries; in fact many local governments track annexations on the basis of parcels. Many parcel databases include a field for the incorporated area, which is used for designation of service providers such as law enforcement. At a meeting of this committee, a Census Bureau representative stated that the back edge of parcels is preferred to block boundaries for defining Census designated areas.

Housing (HUD)

"HUD's database maintains geographic data on homeownership rates, including many attributes such as HUD revitalization zones, location of various forms of housing assistance, first-time homebuyers, underserved areas, and race" (OMB, 2002). HUD has recognized that parcel data are critical to tracking information about housing units. HUD has numerous grant programs (as described in Section 3.1) for housing development and compliance issues that relate to specific land parcels, their owners, and their value.

2.2.3 Recent Geospatial Data Initiatives

Some of the most recent efforts to address issues relating to the coordination and funding of geospatial data are OMB's Federal Enterprise Architecture (FEA) Geospatial Profile and Geospatial Line of Business (GLoB). The purpose of the FEA is to "identify opportunities to simplify processes and unify work across the agencies and within the lines of business of the Federal government."[1] The FEA now has a Geospatial Profile in draft and available for use that establishes a framework for more effective use and management of geospatial data and services as part of agencies' enterprise architectures. (The development of enterprise architectures is a process now commonly being used to better manage and align an organization's business processes.) It describes how agencies can leverage geospatial data and technologies to enhance service delivery and mission accomplishment.[2] The GLoB is one of several lines of business within the FEA, with the goal of facilitating the identification of duplication of investments and opportunities for collaboration. The description of the GLoB is as follows:[3]

> To further refine the opportunities for optimizing and consolidating Federal geospatial-related investments to reduce the cost of government and, at the same time, improve services to citizens. Cross-agency coordination of geospatial activities can identify, consolidate, and reduce or eliminate redundant geospatial investments. Developing the Geospatial Line of Business (LOB) will result in a more coordinated approach to producing, maintaining, and using geospatial data, and will ensure sustainable participation from Federal partners to establish a collaborative model for geospatial-related activities and investments.

The committee believes that the GLoB could have a major impact on the way land records are managed and funded in the United States if it addresses the common need for land parcel data across many federal agencies and reduces the current duplication of effort. With respect to an intergovernmental model for parcel development and maintenance, the committee believes the following transformational activities proposed by the GLoB are significant (FGDC, 2006, p. 23):

- Holding data stewards responsible and accountable for key data sets;
- Facilitating data acquisition requirements through the Fifty States Initiative;
- Developing and implementing common grants language for geoinformation and services; and
- Increasing intergovernmental coordination activities.

The GLoB recognizes the need for the NSDI to include nonfederal data and specifically endorses the Fifty States Initiative developed by the National States Geographic Information Council (NSGIC) in cooperation with the FGDC. The Fifty States Initiative focuses on developing strong state coordinating bodies to organize and communicate effectively with their state agencies and local government, thereby eliminating waste and improving efficiency. Coordinating state efforts with those of the federal government delivers similar value. The state coordinator's work includes requiring standards and encouraging the sharing of data, thereby developing the NSDI across all levels of government.[4]

Finally the FGDC is in the process of establishing a new National Geospatial Advisory Committee (NGAC). The NGAC will have members from all sectors involved in geospatial data matters,

[1]For information on the FEA, see *http://www.whitehouse.gov/omb/egov/a-1-fea.html* [accessed May 18, 2007].

[2]For information on the Geospatial Profile, see *http://www.cio.gov/documents/FEA_Geospatial_Profile_v1-1.pdf* [accessed May 18, 2007].

[3]See *http://192.136.12.215/lineofbusiness/geospatiallob.cfm* [accessed March 15, 2007].

[4]For information on the NSGIC Fifty States Initiative, see *http://www.nsgic.org/hottopics/50states_initiative_handout.pdf* [accessed June 13, 2007].

including all levels of government, private industry, nonprofits, and academia. Its purpose is to provide advice to the federal government on national geospatial data programs and the NSDI.

2.2.4 Future Trends and Conclusions

It is clear that the concept of a spatial data infrastructure (SDI) and associated geospatial data policy has evolved significantly since 1980. In a recent article, Rajabifard et al. (2006) provide a useful comparison of the United States with the rest of the world in this area. They suggest that the United States and other developed nations have already progressed through two evolutionary stages and are entering a third stage. They categorize the first stage (1990-1998) as one dominated by products produced by a national or federal government influence. During the second stage (2000-2006) there was a shift to process-oriented developments dominated by an increased influence of subnational groups and the private sector. They suggest that the next stage will shift to the demands for a virtual environment that will be dominated by subnational and private sector activities or "people-relevant" data. The role of national governments in this next stage will change (Rajabifard et al., 2006, pp. 733-734):

> Although national governments will continue to play a coordinating role within SDI development, sub-national governments and the private sector are taking on the operational role within SDI development due to the increasing need for maintained and up-to-date large-scale people relevant spatial information.

In summary, there is ample evidence that the federal government has attempted to better coordinate its geospatial activities for more than 100 years. These efforts have accelerated since the 1980s with the advent of digital geospatial data. Recent policy directives emphasize that the federal government is mandated to coordinate the development of important national geospatial data sets, including land parcel data. By including cadastral data as a framework layer of the NSDI the federal government has acknowledged the importance of parcel data. There is also evidence that BLM has been designated important responsibilities to serve as a coordinator of parcel data for lands owned by the federal government and of parcel data produced by all levels of government that are needed to meet federal programmatic needs. Although nationally integrated land parcel data do not exist, if the trend suggested by Rajabifard et al. (2006) is correct, the next phase of the SDI will be focusing on large-scale, people-relevant data, which certainly must include parcel data. Because of the vital role of local and state governments in parcel data, and the emerging role of the private sector (as described later in this chapter), partnerships between the various levels of government and the private sector will be key to developing national land parcel data. Recent efforts of OMB and its GLoB initiative to promote partnerships with state government seem to reflect this trend. There are already existing partnerships that can be expanded, reinvigorated, or provided new resources. While there may also be new partnership opportunities, the key is likely to provide opportunities to fulfill the potential of existing relationships and achieve levels of cooperation that have not been possible in the past.

2.3 TECHNOLOGY CHANGES

To assess the feasibility of maintaining a national approach to parcel data in 2007 it is useful to examine how technology for the collection and use of parcel data has evolved over the past quarter of a century. Of course, the rapid advances in geographic information system (GIS) technology have had an immense impact on parcel data collection and on the evolution of conceptual models themselves. However, more recent advances in technologies that didn't even exist in 1980, such as web technologies and location-based services, are also having a profound effect.

2.3.1 Geographic Information System Technology

In 1980s-era parcel systems, data records were accessible only through nongraphic terminals directly connected to a stand-alone mainframe computer. Graphic input and output devices were extraordinarily expensive. Hard-copy maps were produced on slow pen plotters. The color raster displays on every home computer today were found only in dedicated scientific applications such as weather forecasting and remote sensing. In 1980, actual creation of the parcel data typically involved manual digitizing or tracing of existing tax maps. This was a tedious and error-prone process. Therefore, the decision to invest in a computerized system to create and manage land parcel data represented a major financial and institutional commitment. Nevertheless, there were some excellent pioneering efforts based on sound enterprise views of the importance of parcel data. For example, DuPage County, Illinois, was identified as an example of a local government that had implemented a parcel-centric system for integrating information (NRC, 1983) The cost of the DuPage system in 1983 was estimated to be $814,058 ($1,679,608 in 2007 dollars). In other words, a medium-size local government[5] would have spent the equivalent of $1.6 million to purchase and maintain a multipurpose cadastre system with extremely limited functionality compared to modern systems that are truly integrated into a local government information system. This might be contrasted with the recent investment of $200,000 in Roseau County, Minnesota (Harren and Johnston, 2006), for a robust system based on current personal computers, servers, and Internet capabilities.[6]

Conceptual Models for Parcel Data

Another useful way to examine the changes in the way that parcel data have been created and managed over the past 27 years is to examine the conceptual models, or the "stack of layers," used to represent geographic information within a local government information system.

Multipurpose Cadastre

The 1983 NRC report envisioned the relationship between parcel data and other data themes as digital versions of a registered set of transparencies that were manually registered with a set of pins (Figure 2.4).

This stack of layers provides a view of how parcel data (represented by the "property lines layer") are interrelated with addresses, floodplains, and zoning. This model reflected the state of the art at that time. In effect, each of these layers was created and managed as an independent theme, often at different scales. These layers may have been built on a firm foundation of geodetic control and may have been visually overlaid and inspected, but in 1980 it was difficult to draw parcel maps in relation to the other themes. More importantly, the GIS software tools at the time would not have provided very robust support for decision making. For example, it was difficult to determine automatically which land parcels were located in the floodplain or to generate the land area affected by flooding, although some prototype systems were being developed.

Land Information Systems (LISs)

Throughout the 1980s the concept of the multipurpose cadastre envisioned in the 1980 NRC report had evolved in many local jurisdictions within the framework of an LIS. Dane County, Wisconsin, was one of the major testing grounds for building an LIS. Chrisman and Neimann (1985) presented an early version of a parcel-based layer model for the Dane County Land Records Project in 1985. This model emphasized the importance of a digital map overlay to integrate parcel data with other layers such as zoning, floodplains, and wetlands. Over the next few years the concepts

[5]DuPage County is 334 square miles with a 1990 population of 781,625.
[6]Roseau County is 1,600 square miles with a 2000 population of 16,338.

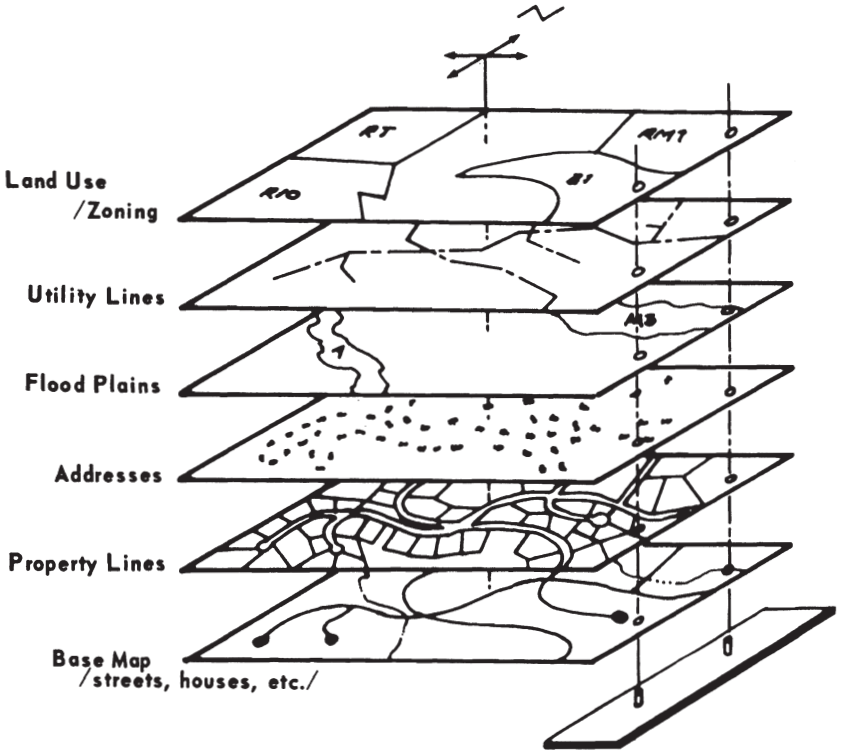

FIGURE 2.4 Stacked data layer diagram from the 1980s. SOURCE: NRC, 1983, p. 42.

and technologies behind this model matured. Many individuals involved in these efforts helped prepare the massive 25-chapter *Multipurpose Land Information Systems: The Guidebook* (Brown and Moyer, 1989 [NB: many of the chapters have dates of 1992, 1993, and 1994]). The guidebook was written to address many of the implementation aspects not addressed in the 1980 NRC report. Included in this guidebook was the stack of data layers for the town of Westport in Dane County (Figure 2.5). This diagram was widely regarded as the classic example of a multipurpose LIS. It is important to note that this model is a true intergovernmental one. In fact, Moyer (1990, pp. 7-15) made the following comments about what the diagram represents: "Building an LIS that is complete, comprehensive, and responsive requires the cooperation of all organizations that are organized vertically, to ensure the horizontal benefits of LIS are fully realized." In this model, the parcel layer sits on top of the stack and is maintained by county surveyors.

The layers were actually digital representations (often at different scales). They were maintained independently, but it was possible to perform digital overlays to extract information. GIS software provided powerful tools to support decision making. For example, tabular and graphical information could be generated about how individual pieces of property interrelate with floodplains, soils, slopes, and other geographically registered information that is often maintained by other organizations.

The term multipurpose cadastre was eventually replaced by the concept of multipurpose LISs, for several reasons. One, the name was confusing to people; LIS is easier to understand, and the term multipurpose cadastre was used very little by Epstein and Brown (1989). Second, the multipurpose cadastre required linking natural resources and other land attributes to the parcel. Because

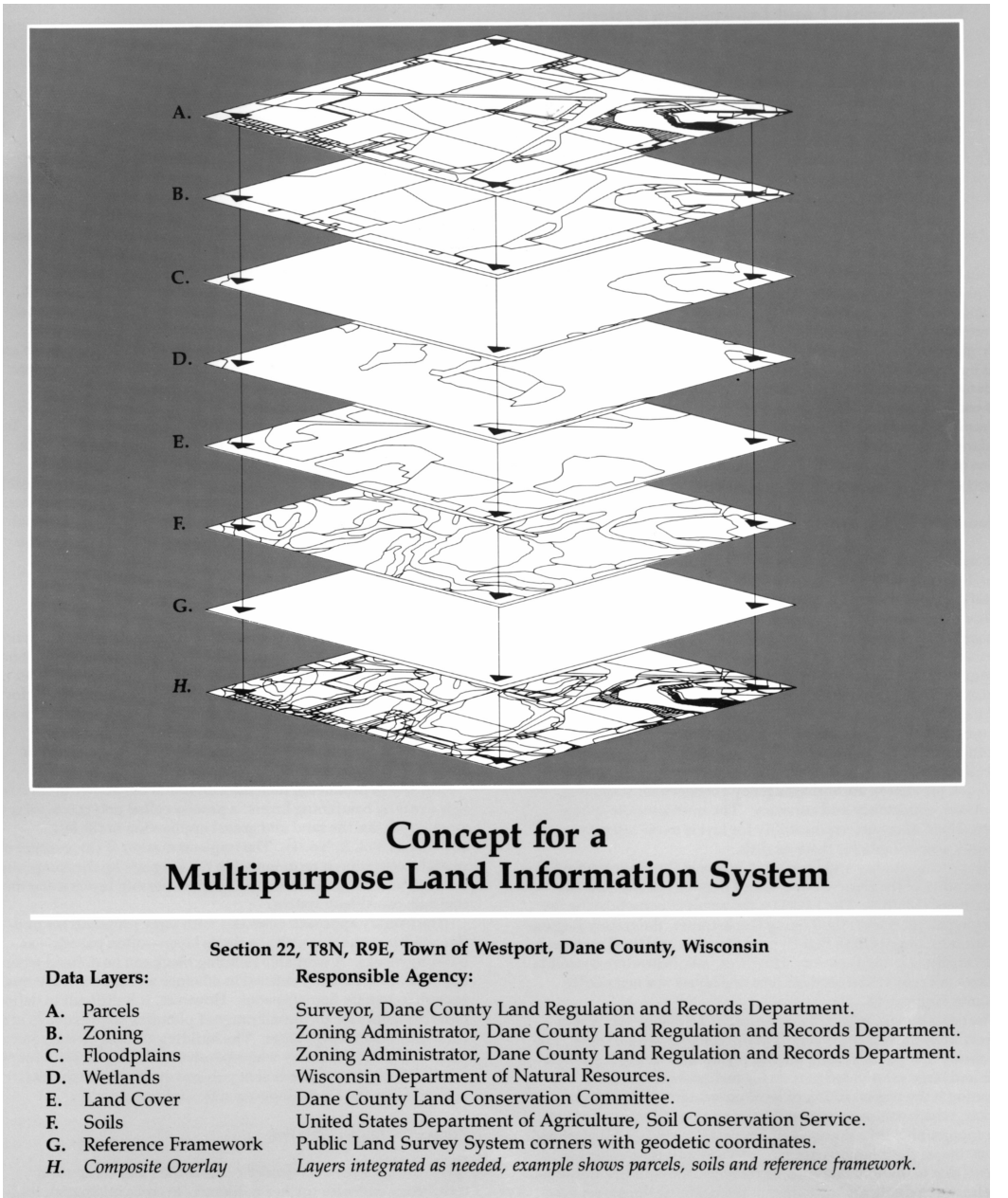

FIGURE 2.5 Vision of a multipurpose land information system that evolved throughout the late 1980s. SOURCE: Land Information and Computer Graphics Facility, University of Wisconsin, Madison. Image courtesy D. David Moyer.

of limited storage capacity and ability to rectify and reproject these other maps in 1980, all of these linkages were to be done during the establishment of the system (i.e., before digitizing). Therefore, the fundamental difference between a multipurpose cadastre and a multipurpose LIS was the data structure. In the multipurpose cadastre, all themes (e.g., land use, soils) were recast into a parcel polygon. This limits all questions to the parcel. The LIS concept evolved when there were improved techniques for registering and manipulating the many data layers and themes. The parcel becomes one of those themes. Much of this evolution was already under way by the time of the 1983 NRC report as can be seen by comparing conceptual diagrams from the two reports.

Modern Data Models

In the current age of information systems there is widespread appreciation that GIS applications have moved to a much higher level of granularity or resolution than was possible in 1990 or even 2000. This change represents a shift in emphasis that has had a major impact on the relationship between federal mapping organizations and local government. Local governments no longer struggle to ingest federal data or to digitize existing maps. Instead, they must deal with the complex problems associated with creating and maintaining very-high-resolution information that is derived from locally created information from surveys, legal documents, imagery, geocoding, and a wide range of field-based operations. These requirements have resulted in rigorous specifications for a parcel-based data model. In the United States, the development of this data model has been fostered by the FGDC Subcommittee for Cadastral Data (Figure 2.6).

In the contemporary model, each parcel is a unique entity that exists and must behave within a general framework that supports a wide range of applications and business functions. Parcel data become directly integrated with other themes and do not just float as an independent layer. Parcel boundaries are directly impacted by changes in other information. For example, the geographic position of all parcels may change on the basis of improved survey measurements. Parcel boundaries could be adjusted if a new road impacts the right of way. The parcel boundaries must also conform to a set of topological rules that impact how new parcels can be added and where utility lines can be run to connect to structures. At the same time, other themes that are dependent on parcel representations such as land use or zoning are synchronized with parcel boundaries. In other words, as parcels are created they can be adjusted to align with geodetic control monuments and rivers or other controlling features. In turn, dependent features such as political boundaries can be fit to the newly adjusted parcel boundaries.

Several software vendors and consultants have developed software tools and related procedures to implement this type of model. One software company provides a detailed conceptual depiction of the modern parcel GIS data model (Figure 2.7). The model clearly demonstrates how parcel production has evolved with changes in technology. This model is built on a firm foundation of very-high-resolution orthophotography, legal descriptions, and field measurements. The ability to translate the legal description of a parcel into a geographically defined polygon registered to points on the earth's surface makes this model possible. As coordinate geometry (COGO) and advanced optical character recognition become standardized and cost-effective, a greater number of parcel programs have decided to create parcels from the legal descriptions. For example, DuPage County, Illinois, which was cited in the 1980 report, has entered 100 percent of all of its parcels using COGO procedures.

An example of a current system that has adopted the parcel GIS data model is the National Integrated Land System. NILS is a joint project between the Bureau of Land Management, the U.S. Forest Service, several state and local governments, and private firms to provide a seamless representation of federally managed lands. NILS is billed as "the first step toward providing a common solution for the sharing of land record information within the government and the private sector. . . [it] implies the development of a common data model and a set of GIS tools that unify the worlds of surveying and GIS" (Cone, 2003, p. 227). The goal of NILS is to "improve the accuracy and quality

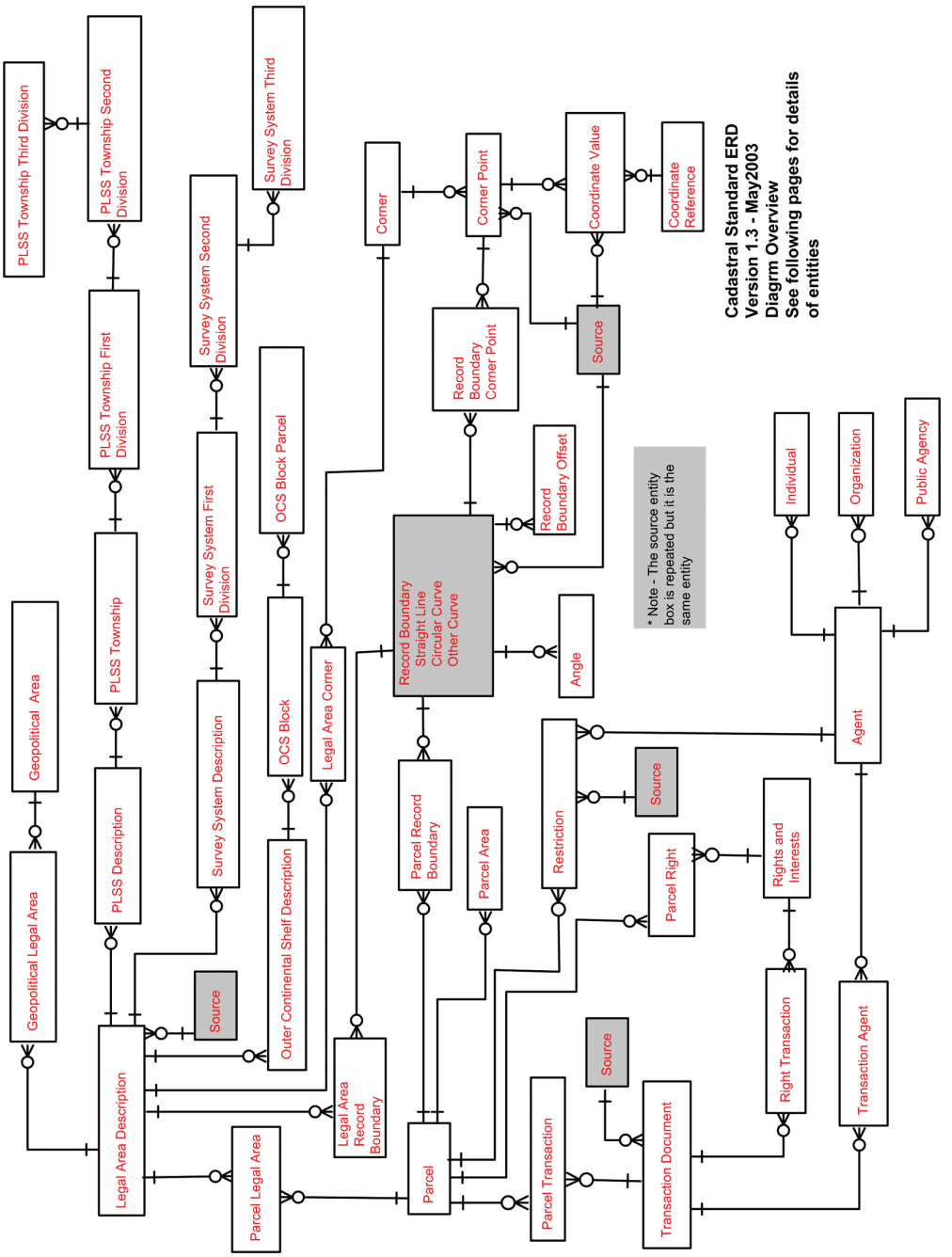

FIGURE 2.6 FGDC Cadastral Subcommittee—data content standard entities. SOURCE: FGDC, 2003, p. 15.

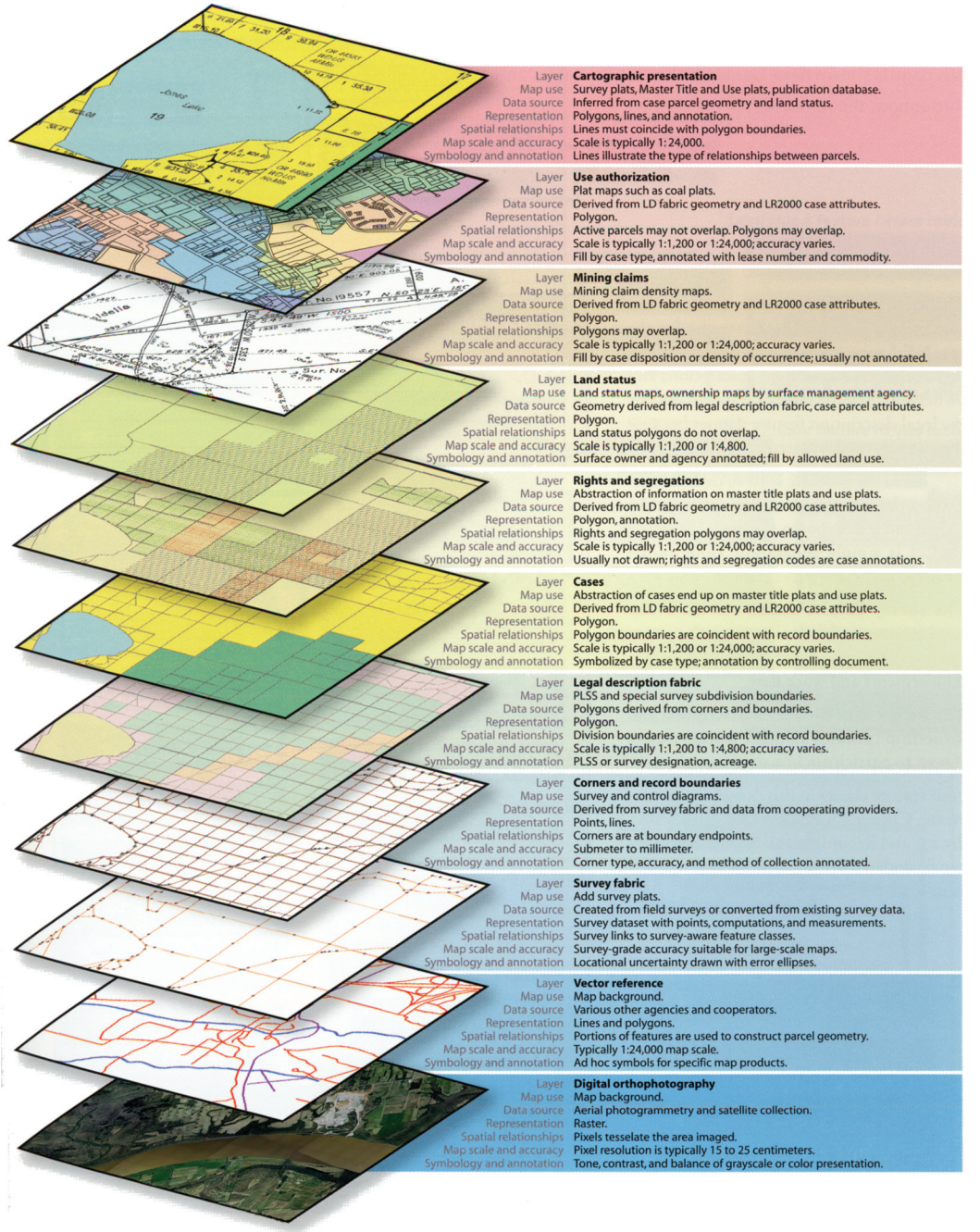

FIGURE 2.7 Modern version of a stacked diagram. SOURCE: Adapted from Arctur and Zeiler, 2004. Reprinted with permission of ESRI. Orthoimagery courtesy of USGS.

of data so as to create standard land descriptions and cadastral data that can be used by anyone." In effect, NILS is an effort by the federal government to utilize a structured intergovernmental model based on the type of firm foundations identified in 1980 and 1992. From a technological and organizational perspective, NILS is being created using several things that did not exist in 1980 or even 1990. These include (1) off-the-shelf GIS software to handle the complexities of parcel data including the input of measurements from surveyors; (2) the FGDC Cadastral Data Content Standard and the FGDC Content Standard for Digital Geospatial Metadata; and (3) object-oriented software (Figures 2.8 and 2.9).

While this discussion has shown how GIS-based parcel data systems have evolved in the last 27 years, nationally integrated land parcel data are unlikely to need the level of complexity shown here in terms of GIS capabilities. The greater challenge for national data will be in accessing source data and disseminating them effectively, which relate to technologies addressed in the next section.

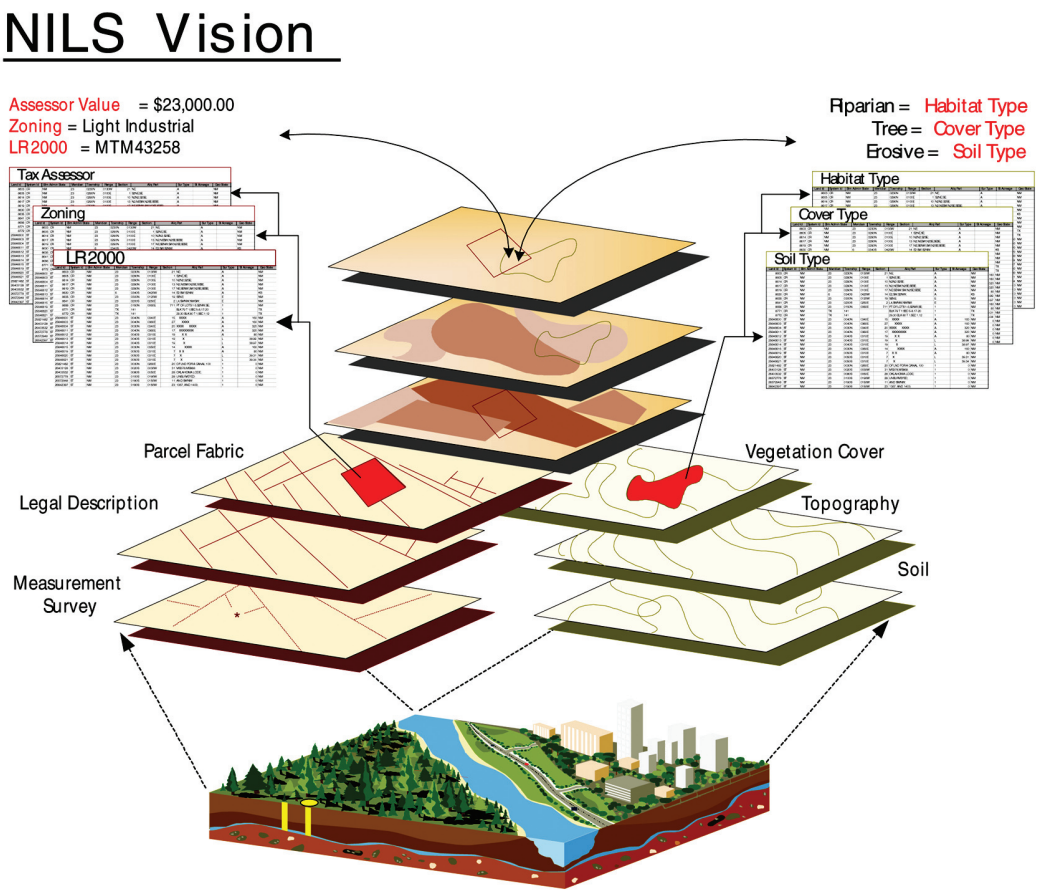

FIGURE 2.8 National Integrated Land System. SOURCE: BLM, 2001.

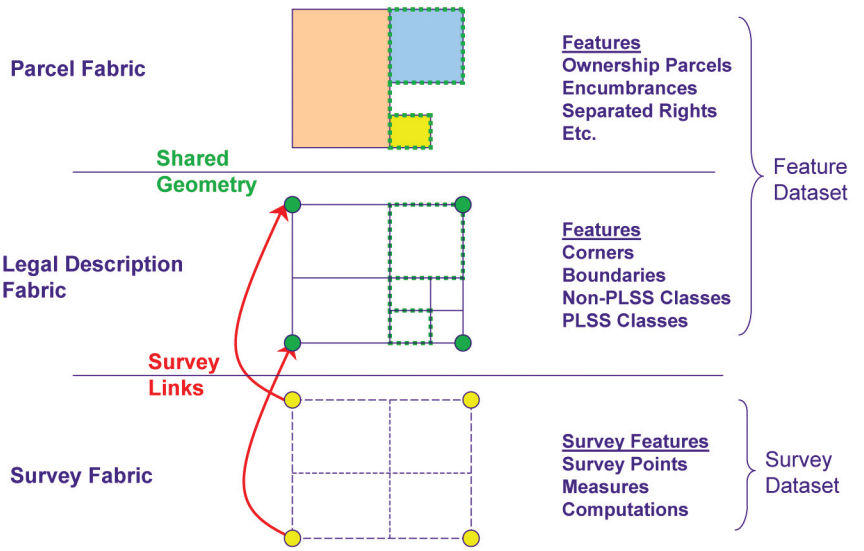

FIGURE 2.9 NILS conceptual data model. SOURCE: BLM, 2002.

2.3.2 Web-Based Technologies

While GIS technologies have revolutionized the development and use of land parcel data, the advent of the Internet and web-based technologies has revolutionized the ability to disseminate, access, and link data. These technologies did not exist in 1980. The current capabilities of web-based services are illustrated by the system in use by the Chicago Metropolitan Agency for Planning, described in Box 2.1.

It is clear from Box 2.1 that serious decision support is dependent on a parcel database that is maintained by transactions, totally integrated across departments and jurisdictions, and fully supported by the latest Internet-based applications. This example demonstrates what is possible even in a major urban area. Open Geospatial Consortium web services have had tremendous growth within the past few years. The Census Bureau has adopted the WebTIGER—a web feature service interface allowing requests for geographic features across the web. However, even the most powerful access systems provide little benefit if they deliver data stored in inconsistent formats or data incompatible with the user's application.

The implications of these web services for nationally integrated land parcel data are huge. In 1980 the ability to instantly access data on distributed servers had not even been conceived. Web services now make possible a decentralized network that allows a single-point access to land parcel data from multiple producers that continue to reside on the server where they are developed and maintained.

2.3.3 Location-Based Services

An emerging geospatial growth area is that of location-based services. The development of global positioning system (GPS) technology provided the ability to determine the geographic coordinates of any location. More recently, the process of automated address locating, or geocoding,

BOX 2.1
Chicago Metropolitan Agency for Planning Program

City, county, regional, state, and federal agencies can make data available via web services that can be called by other servers at any time. This means that all partners can incorporate the most current data available into their own data systems. The data can be fetched as needed from the most authoritative source, then displayed on a web form, pulled into a predictive model, or used to calculate aggregate statistics. Users of our data system conduct property surveys for a variety of zoning, economic development, and other purposes. They walk up to the property with a smart phone, open a browser, select a property address from the list and click "Go". Our web server issues consecutive data requests to various county and city services, renders the resulting data into HTML, and sends the whole batch down to the user's browser. All within less than a second. The latest data, straight from the source. Since the Assessor's teams continuously sweep through various parts of the county updating assessments, this is an important feature.

Web services are not just for data exchange with external partners; they also work well for cross-departmental sharing. A city government wishing to provide a one-page parcel profile for use by city employees might create a web form that pulls together property ownership, permits, physical characteristics, business licenses, court records, crime data, any public financing or subsidies, historic value of the structure, building condition and many other attributes. But typically these bits of information are housed and owned by various data stewards across several departments. A series of light-weight web services could be deployed as interfaces between departments.

SOURCE: Sanders, 2006. Reprinted with permission from the Urban and Regional Information Systems Association, *http://www.urisa.org*.

is the core of a host of location-based services that have become a common part of our everyday life. It is hard to overestimate the importance of the automated address matching systems. For example, MapQuest generates millions of maps and directions every day.[7] The capability is used for practical decisions such as finding the location of a party, a hotel, or the closest drug store. United Parcel Service and FedEx drivers use the same function to deliver a package to your house, and the local emergency 911 dispatcher uses it to route an ambulance. This has created a booming interest in digital geographic reference files that accurately locate addresses with geographic coordinates, and many private industry companies have been stepping up to fill this need, such as NAVTEQ and Tele Atlas. NAVTEQ and Tele Atlas also provide detailed street centerline files that are an alternative representation of street segments available from the Bureau of the Census in its Topologically Integrated Geographic Encoding and Referencing (TIGER) data set. The customers for these reference files include major U.S. companies such as Microsoft, Google, and MapQuest that support location-based services for thousands of clients. Firms that support location-based services are generally concerned only about the association between a street address and geographic coordinates, not about attributes of the building or property. However, because address location and parcel data are inextricably linked, this growing trend of generating address location data is having a huge impact on the development of parcel data as well and, thus, needs to be discussed here. There is another segment of the commercial market that has been concentrating on providing digital data sets with detailed information about property. (Chapter 4 provides a more detailed description of the status of private sector development of parcel data sets.) Customers for these products are concerned about various aspects of insuring, financing, exchanging, and developing property. They include major

[7]See *http://www.mapquest.com/*.

insurance companies, lending institutions, real estate brokers, and title companies. Since there is such a close tie between the parcel and its address, there is beginning to be some overlap between the generation of these two types of data sets and even the companies that are producing them.

The origins of automated address locating systems began about 40 years ago and were implemented by the Census Bureau for the 1970 decennial Census. The original Dual Independent Map Encoding (DIME) files provided the basis for the first large-scale system that could assign an address to an estimated location along a street segment and place it into the correct block. With the TIGER system in 1990 the Bureau provided a public domain set of street segments with associated address ranges that could be used across the nation. By using the TIGER street segments and address ranges, the location of specific addresses can be determined by proportioning an address along the length of the street. These resources fueled an entire industry and made it possible for firms such as Tele Atlas to develop a successful business application. However, the location of an address based on TIGER is simply an estimate that is directly related to the accuracy and completeness of the representation of the streets in TIGER. There is no information in a TIGER line segment about the actual addresses or their locations. A major goal of the TIGER modernization program is to improve the positional accuracy of the street centerline base and to replace this address interpolation method with a specific one-to-one address matching system for the 2010 decennial Census (discussed further in Chapter 4). Since these streets also form the block boundaries, their adjustment will cause dramatic changes in the geography of the census blocks as well. The legacy of the DIME and TIGER approaches to automated address matching can still be found in most of the current commercial geocoding systems.

Figure 2.10 provides an example of these concepts and the intersection between applications that focus on locating the street address and those that require information about the property. Using an actual address (116 Ila Lane, Columbia, SC 29206) the figure portrays various ways in which this address is located in a series of parcel data and automated address locating applications. Using a standard web browser the address can be entered into the Richland County, South Carolina, GIS web mapping system (Richland Maps) to retrieve the information displayed in Figure 2.10A, including the parcel boundary, the building footprint, and a high-resolution (one foot) natural color orthophotograph. This representation is used by local government as a close approximation of how the parcel is portrayed on a tax map and is linked directly to the official assessor information for the property (Figure 2.11).

Figure 2.10B shows how the address number of 116 is matched to a single street segment in the Census TIGER data. The address is estimated to be on the right or even-numbered side of a street that has a low address of 100 and a high address of 198. The exact location is interpolated to be 16 percent of the length of the street segment. Figure 2.10C demonstrates that the TIGER street centerlines need considerable adjustment to prevent them from intersecting the parcel boundaries for the block containing the sample address.

The problems associated with interpolation of street addresses are readily apparent from the next two maps in Figure 2.10. Two of the three major web-based services (Google Maps [Figure 2.10D] and MapQuest [Figure 2.10E]) placed 116 Ila Lane at the wrong end of the street, about 100 meters from the actual location of the house. This error is likely the result of reversing the "from and to" directions of the address range. Microsoft (Figure 2.10F) just recently updated their information for this area and now places the location more accurately. Nevertheless, with any of these services, it would still be necessary to reference the actual street number on the door or mailbox. The need for accurate geocoding has become especially obvious because of the extremely high resolution imagery that is now available in many local government GIS operations and even commercial applications such as Google Earth. Figure 2.10G shows recent imagery that is available for the sample address in Richland County, South Carolina. This image consists of pixels with a resolution of about 4 inches (note the automobiles), and the house location is clearly visible in the yellow circle. Nevertheless,

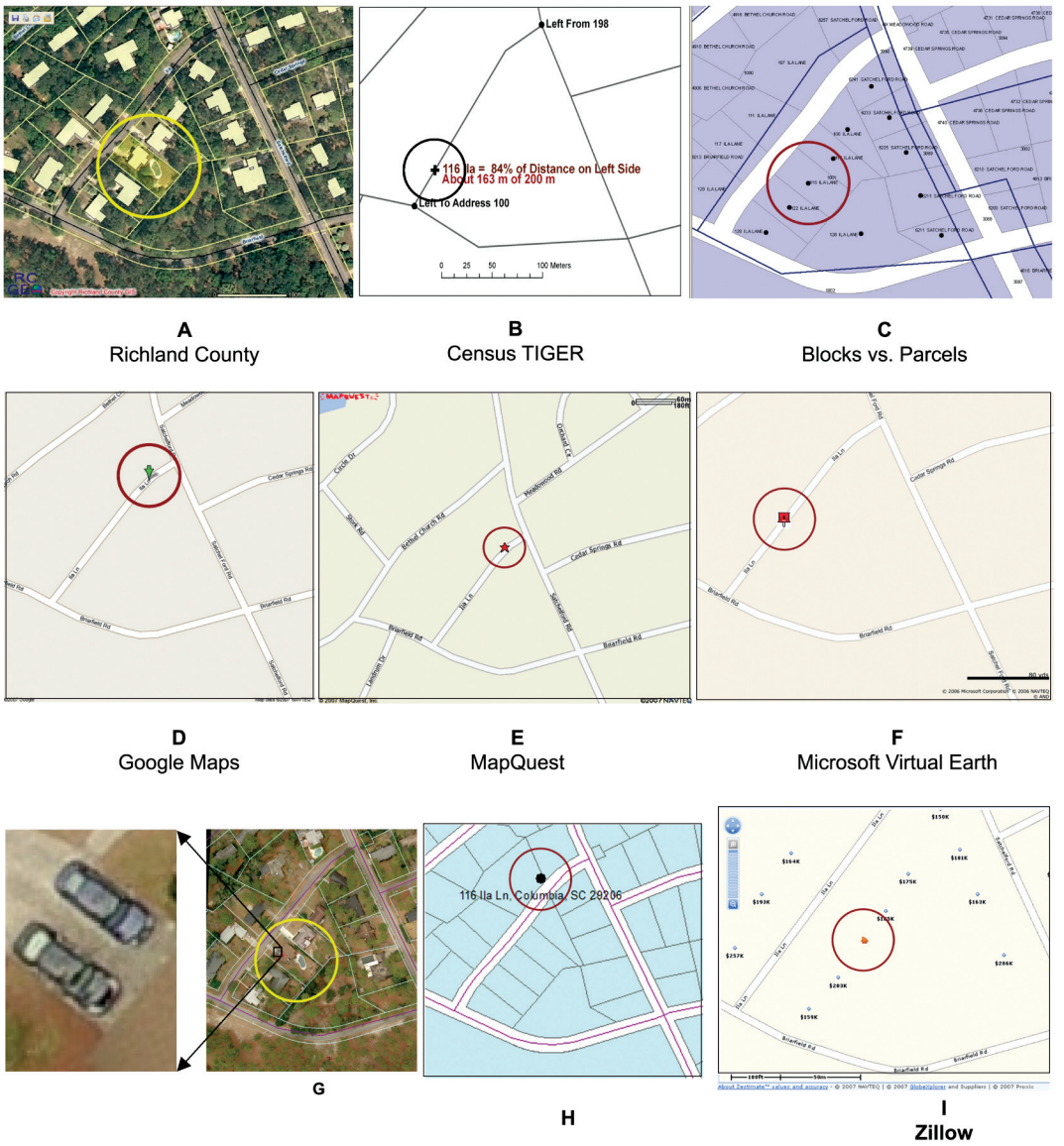

FIGURE 2.10 Various locations of a sample address through different automated address matching applications. SOURCES: (A) Image courtesy of Richland County, SC, www.richlandmaps.com; (B) data courtesy Census Bureau; (C) data courtesy of City of Columbia, SC, Census Bureau; (D) image courtesy Google Maps, copyright NAVTEQ; (E) Map content (c)2007 by MapQuest, Inc., MapQuest and the MapQuest logo are registered trademarks of MapQuest, Inc., used with permission; (F) image courtesy Microsoft Virtual Earth; (G) images courtesy of Pictometry, Inc.; (H) parcel data courtesy of City of Columbia, SC; (I) courtesy Zillow, map data copyright 2007 NAVTEQ, GlobeXplorer and Suppliers, and Proxix. Parts (D), (E), (F), and (I) (c)2007 NAVTEQ. NAVTEQ is a registered trademark of NAVTEQ Corporation. NAVTEQ map content is used with permission.

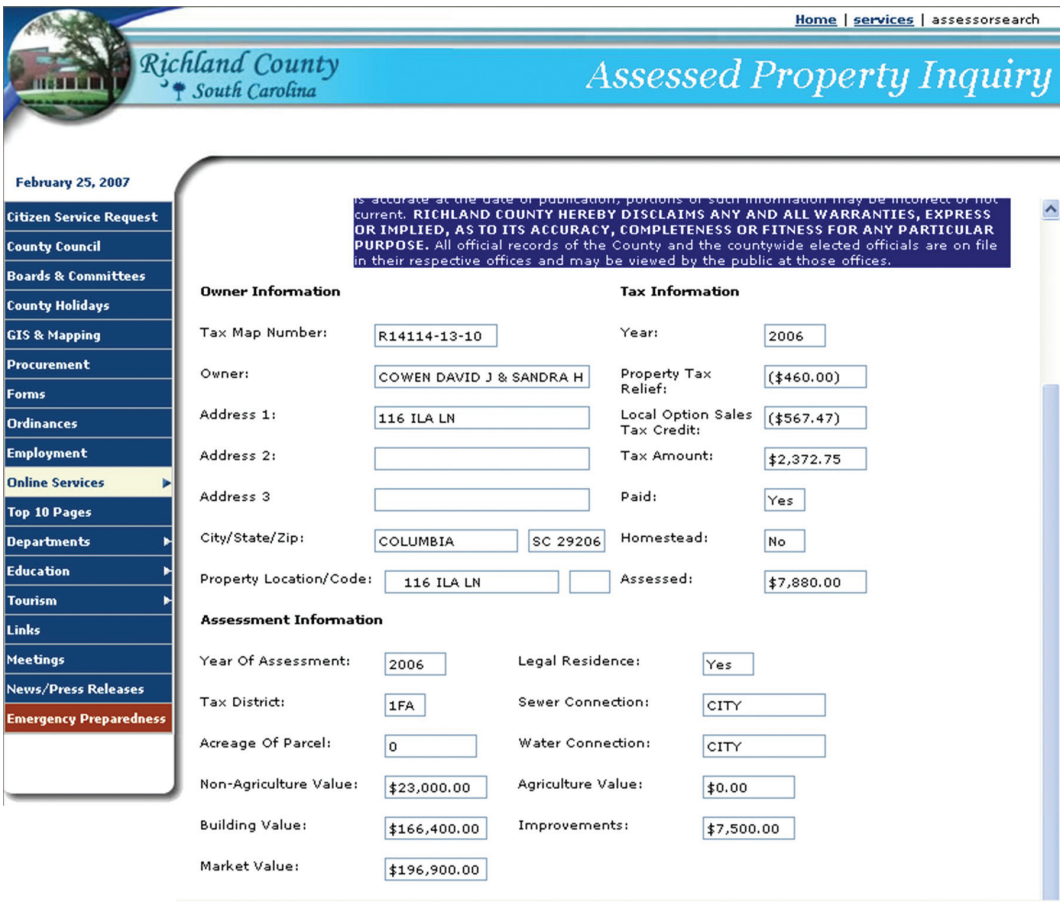

FIGURE 2.11 Detailed property information for the sample address. SOURCE: Richland County, South Carolina, Assessor's website: *http://www.richlandonline.com/services/assessorsearch/ assessorsearch.asp* [accessed May 29, 2007]. Image courtesy of Richland County, SC, *www.richlandmaps.com*.

the address geocoding service based on interpolation (available with the interface for viewing the imagery) not only placed the address at the wrong end of the street, but placed it on the wrong side of the street, thereby putting it in the wrong census block (Figure 2.10H). It is evident that errors such as these are unacceptable for an emergency 911 application, law enforcement officers conducting a "drug bust," any vehicle navigation system that announces "you have arrived," or home owners who need to determine whether they are in a 100-year floodplain. Clearly this is also unacceptable for any real estate oriented application that must identify the correct house. In order to meet this requirement, Zillow.com has obtained at least a point-level representation of the location of 70 million houses. The sample address demonstrates this functionality in Figure 2.10I. (Note that Zillow.com shows aerial imagery and parcel information for many areas, although it is not available for this particular location.)

The need to improve the address locating system is well known and being addressed not only by the Bureau of the Census but also by the private sector. The importance of accurate address

location systems is highlighted by a recent quote from William Gail, the director of Microsoft's Virtual Earth program (e-mail to D. Cowen, May 1, 2007):

> While geocoding based on interpolation of address ranges has been adequate for initial needs, it is far from satisfactory in the long run. In fact, even parcel identification is insufficient for many of the emerging internet needs, as a parcel may contain several buildings for which separate identification is desired. Microsoft Virtual Earth recently introduced rooftop geocoding to relate addresses to building locations, ensuring that addresses correspond properly to the relevant buildings. This is the most accurate geocoding currently available for applications such as route-finding, and we continue to improve our capability in this area. . . . Microsoft depends primarily on vendors to supply the most accurate possible information. At the same time we recognize that local governments often have the best first-hand knowledge of the current situation on the ground. Geocoding is likely to represent an ongoing challenge, both in the collection of raw data and in the algorithms that extract information from the data in response to user queries.

In summary, the information about a single address suggests that the backbone of nationwide parcel data already exists in the private sector and that several firms are actively competing to complete wall-to-wall coverage. This need is fueled by major firms such as Microsoft that plan to have "rooftop"-level representation of each address in the United States. Completing a point-level representation of parcels for improved address location is much easier than assembling full polygon representation of parcels and their associated characteristics. Nevertheless, there is considerable activity in the market for comprehensive parcel data and some fairly aggressive competition. Within the public sector the Census Bureau is also completing a nationwide point-level representation of all developed parcels; however because of legal restrictions, it will not be placed in the public domain. This is discussed further in subsequent chapters.

2.3.4 Future Trends

While a number of jurisdictions already offer web access to parcel databases, there is a benefit to creating a nationwide system or service in accordance with internationally recognized standards. The potential for people in very different places to access, view, and manipulate the data using the same interface has real promise in terms of driving new markets, encouraging employment mobility, and influencing the way we think about the information elements of accountable government. We have moved into an age where the impact of embedded GPS and "standard position" are just beginning to have the same impact as the introduction of pocket watches and "standard time" did back in the 1880s. It can be argued that while standard time was largely an outcome of "tech-push" (put in place largely because of the demands of the railroad and quicker communications via telegraph), it in fact changed the way in which people and groups over short and long distances organized their time. While standardized position is also a creation of tech-push, its influence—in terms of locating people and things, knowing where they have been, and knowing how long it will take them to get from their current location to a specified point—is now also starting to change the way in which organizations and people manage their time and their activities.

Organized and accessible land records will play an important role in what is becoming known as the global knowledge economy. The emergence of this knowledge economy has created a very competitive local government environment and is changing the way governments attract and retain businesses in their community. No longer can governments rely on "bricks-and-mortar"-type incentives, but they must find creative ways to market and promote their community. To this end, an organized land parcel data system allows government to assess and communicate the impact of changes in a more effective manner. In addition, access to online government content presents a more transparent form of government and thus supports a competitive advantage that one local

government may have over the next. The same could be said for state and national government levels as well; therefore nationally integrated land parcel data will become increasingly important as this global knowledge economy evolves.

2.4 SUMMARY

As the sections in this chapter have shown, since 1980 a great deal has occurred in terms of the guidance, geospatial data policy, and technological changes that have a direct influence on the development of national land parcel data. So the question remains, Why has the vision laid out in 1980 and the subsequent reports not been achieved? Technologically, the NRC panel in 1980 could point to existing systems that were used to manage parcel data in a digital environment, and although the panel stated that it did not see technology as a barrier, it was overly optimistic about what could be accomplished with the technology at that time. "Availability of technology" is not the same thing as a robust infrastructure that enables the average citizen in many different locations to be able to do something cheaply and transparently. It has taken a couple of decades to put the infrastructure in place—the advent of the Internet, the standards, the ubiquitous positioning, the heightened expectations with respect to online access to "content," and so forth—to finally make the original dream attainable, affordable, and more widely understood. Now, current technology and infrastructure are fully capable of supporting nationally integrated land parcel data and, in fact, have changed the vision of what nationwide land parcel data could and should be. Clearly, many private firms have proven that there are no technical or even financial obstacles limiting the implementation of national land parcel data. In the current context, the emphasis is on very-high-resolution data sources and structured work flow processes that attempt to dynamically reflect the current situation on the surface of the earth, all accessible through a distributed network. This type of information must originate at the local government level and be coordinated at the state and federal levels. This means that all levels of government need to learn to adopt and embrace technology. Although tremendous progress has been made with respect to geospatial technology and understanding, much remains to be done to reach the many organizations yet to adopt the technology. Therefore, one of the reasons that the 1980 vision has not been realized is that although the basic technology may have existed, the underlying infrastructure, network, and standards did not.

Likewise, there has been an impressive evolution of geospatial data policy since 1980. The advent of the NSDI and the FGDC show the recognition during this time of the importance of nationally integrated data and geospatial data standards. The idea of framework data layers was established, and cadastre was named as one of these important data themes to be integrated nationally. The 1980 report recommended that OMB designate a lead agency for the multipurpose cadastre, and through Circular A-16, OMB has designated BLM as the steward for the cadastre layer of the NSDI. BLM has supported the numerous cadastral coordination and standards activities carried out by the Subcommittee for Cadastral Data (see Section 4.1.1) and has also made progress on the 1980 report's recommendation regarding the PLSS through its work on the GCDB.

Analysis of other recommendations from the 1980 report reveals mixed success: parts of some have been implemented; others, not at all. Perhaps most important though is the recommendation "that federal legislation be prepared to authorize and fund a program to support the creation of a multipurpose cadastre in all parts of the Nation" (NRC, 1980, p. 3). The 1983 report recommended that about 40 percent of the funding for a multipurpose cadastre should come from federal agencies. Although BLM has received funding for the GCDB, NILS, and its FGDC activities, funding has not been authorized for a sustainable national approach to parcel data.

However, many of the other framework layers have been successfully developed during this same time, such as hydrography, elevation, and orthoimagery. The differences between these and the cadastral layer are telling. First, it was already part of the mission of the USGS to create some

of these layers. Although various federal agencies need parcel data in various parts of the country for various reasons, no single agency has the programmatic mission to create nationally integrated land parcel data. Second, layers such as hydrography and elevation could be created first at a small scale by a federal mapping agency. Parcel data, on the other hand, are meaningful only at a fairly large scale and are created by many thousands of entities across the nation. Therefore, development of the parcel data layer is one of data collection and integration, requiring the participation of many types of organizations.

There are doubtless many other reasons why the vision of the 1980 report has not been achieved. Perhaps the report did not argue convincingly enough for the needs and benefits of land parcel data. The 1980 committee recognized that the most difficult issues to overcome would be the institutional and organizational ones. The next three chapters attempt to analyze this question in more detail, by assessing the current needs for and benefits of national land parcel data (Chapter 3), the current status of land parcel data systems at all levels (Chapter 4), and the challenges that still remain to reaching this goal.

3

Needs and Benefits

Land parcel information provides a geographically referenced inventory of the use, ownership, and value of real property. The information stored with each land parcel can be used to generate a countless variety of maps and tables that display and summarize property values, land use, tax revenues, and ownership. In conjunction with other geographically registered information the parcel data provide a basis for calculating various measures such as property values for assessment, insurance risk, school attendance zones, and transportation planning. In a contemporary local government, land parcels form the basis for sound decision making. Having land parcel data in digital form not only allows for easier access and use of the data, but has other major benefits as well. It allows parcel data from different land managers within the same jurisdiction, or from neighboring jurisdictions, to join their respective land parcel information, providing for integrated and consistent maps of larger regions. This also facilitates the process of identifying and reconciling differences in boundary delineation. Likewise, nationally integrated land parcel data have benefits over individual parcel data sets. For example, they allow the data to be easily used for many other applications, such as emergency response or regional economic development and planning. This chapter describes the needs for and benefits of a national land parcel data program for various entities.

The National Research Council (NRC) report *Procedures and Standards for a Multipurpose Cadastre* (NRC, 1983) identified a list of benefits to different groups (or stakeholders) of a national multipurpose cadastre (Box 3.1). This list divided the users into local, state, and federal governments; private companies; and individuals. The list of benefits was remarkably comprehensive and remains relevant today. Combining land parcel data from various land managers into integrated land parcel maps for a jurisdiction, region, or the entire United States has benefits and uses above and beyond the original purpose for which the data were created.

In order to reassess the needs and benefits of national land parcel data and determine whether there is additional insight to be added to what was provided in the NRC reports of the 1980s, the committee used several information-gathering methods.

First, in order to talk directly with the agencies, businesses, and organizations involved in the production and use of land parcel data, the committee held two public meetings to gather input. The first meeting consisted of presentations by the sponsors of the study, including the Bureau of Land Manage-

BOX 3.1
Some of the Potential Benefits of a Multipurpose Cadastre to Each of the Major Types of Users

Potential Benefits to Local Governments

- Assures that the best available data are used in each public transaction
- Avoids conflicts among land records of different public offices
- Improves accuracy of real-property assessments
- Provides base maps for local planning and preliminary engineering studies
- Provides a standardized data base for neighborhood, municipal, county, or regional development plans
- Avoids costs of maintaining separate map systems and land-data files
- Encourages coordination among separate map systems affecting land
- Improves public attitudes toward administration of local government programs

Potential Benefits to State Governments

- Provides accurate inventories of natural assets
- Provides accurate locational references for administration of state regulations such as pollution controls
- Accurately locates state ownership or other interests in land
- Provides a standardized database for management of public lands
- Provides large-scale base maps for siting studies
- Simplifies coordination among state and local offices

Potential Benefits to the Federal Government

- Provides a flow of standardized data for updating federal maps and statistics, e.g., for the federal censuses
- Provides a database for monitoring objects of national concern, e.g., agricultural land use and foreign ownership of U.S. real estate
- Provides a reliable record of the locations of federal ownerships or other interests in land
- Provides standardized records for managing federal assistance to local programs such as housing, community development, and historic preservation

Potential Benefits to Private Firms

- Produces accurate inventories of land parcels, available as a public record
- Produces standard, large-scale maps that can be used for planning, engineering, or routing studies
- Speeds administration of public regulations

Potential Benefits to Individuals

- Provides faster access to records affecting individual rights, especially land title
- Clarifies the boundaries of areas restricted by zoning, wetland restrictions, pollution controls, or other user controls
- Produces accurate maps that can be used for resolving private interests in the land
- Reduces costs of public utilities by replacing present duplicative base-mapping programs
- Improves efficiency of tax-supported government services as described earlier in this table

SOURCE: NRC, 1983, p. 17.

ment (BLM), Census Bureau, Federal Geographic Data Committee (FGDC), Department of Homeland Security (DHS), and Environmental Systems Research Institute (ESRI). The second meeting was a Land Parcel Data Summit held on May 23, 2006, at the National Academy of Sciences in Washington, D.C. The summit consisted of structured presentations from 15 invited speakers who made formal responses to a set of questions and then participated in a question-and-answer session. The agenda and list of speakers are included in Appendix C. The speakers came from federal government agencies that had not been covered by the first meeting, the private sector, and professional organizations that represent a variety of parcel data producers and users. The summit provided an excellent opportunity to ascertain a current perspective on the need for and benefits of a national perspective on land parcel data. It also provided a forum for the exchange of ideas and interests among different user groups.

The second method of gathering information was a web-based forum of stakeholders to assess their views regarding the needs and benefits of nationally integrated land parcel data. Participants in the online forum consisted of a wide range of stakeholders and professionals from the field who decided to participate and provide feedback on this topic. Table 3.1 shows the range of professions among the respondents. Box 3.2 lists the questions asked of the stakeholders.

The input from the approximately 400 respondents provided an extremely beneficial synopsis of the perceived need for a national vision for land parcel data. Although many users were skeptical about how such a system would operate, there was a fairly consistent message that there would be substantial benefits, that this was a necessary function of intergovernmental cooperation, and that it is the right time to move ahead with system design and implementation. While the needs and benefits

TABLE 3.1 Representative Job Titles from Web-Based Stakeholder Forum

Addressing Coordinator	GIS Department Manager
Administrator	GIS Land Records Supervisor
Appraiser II	GIS Specialist—Property Tax
Assessor	GIS State Coordinator
Assistant Assessor Real Estate	Health Officer GIS
Assistant Director of Community Development	Information Systems Director
Assistant Planning Director	IT Director
Auditor	Land Information Officer
Biological Scientist	Land Records Manager
Cadastral Industry Manager	Landscape Modeler Hydrologist
Cadastral Planner	Management Information System, GIS Director
Cadastral Surveyor	Mapping Supervisor
Cartographer	Planner-GIS Coordinator
Chief County Assessment Officer	Program Manager
Chief Technical Officer	Property Lister
County Auditor	Real Property Lister
County Surveyor	Register of Deeds
Director of Information Technology (IT)	Research Scientist
E 911 Mapping Coordinator	Right-of-Way Technician
Engineer-Zoning Administrator	Senior Land Records Analyst
Environmental Analyst	State Geodetic Adviser
Epidemiologist	State Property Mapper
Geographer	Tax Assessor-Zoning Official
Geographic Information Officer Program Manager	Transit—GIS Planner
Geographic Information System (GIS) Administrator-Developer	Vice President-Corporate GIS Manager
GIS Analyst	Warm Water Habitat Development Consultant
GIS Database Administrator	

BOX 3.2
Subset of Stakeholder Questions

In the United States, a nationally integrated system of land records is

- Necessary?
- Technically feasible?
- Economically feasible?
- Timely?

What do you see as the major benefits to your organization that would result from the creation of a nationally integrated system of land records?

What do you see as the major benefits to the nation that would result from the creation of a nationally integrated system of land records?

What do you see as the major obstacles that inhibit the creation and maintenance of a nationally integrated system of land records?

Have you or your organization quantified the impact, cost, users, or benefits of digital parcel information or a nationally integrated system of land records in your jurisdiction?

Have you been impacted by incorrect or incomplete information about your property?

Do you have any overarching concerns or support regarding the premise of a nationally integrated system of land records?

Do you have any ideas, opinions, or concerns about the regulation of or regulated controls on a nationally integrated system of land records?

Do you have any ideas, opinions, or concerns about how a nationally integrated system of land records should be organizationally structured?

Do you have any ideas or opinions about the source of funding (for initial collection and/or ongoing maintenance) of a nationally integrated system of land records?

are much the same as those outlined by the panel in 1983, the clearly identified needs relating to disaster preparedness and response bring a new sense of urgency to the issue.

The following sections summarize the information learned from these information-gathering processes about the needs for and benefits of national land parcel data at the present time to the various groups listed in Box 3.1.

3.1 FEDERAL AGENCY NEEDS AND BENEFITS

A useful starting point for assessing the federal government need for a land parcel program is to examine each of the benefits articulated in Box 3.1 to assess whether it remains relevant in the current context.

Federal Benefit 1—Provides a flow of standardized data for updating federal maps and statistics, e.g., for the federal censuses.

Assessment—Under the FGDC implementation of Office of Management and Budget (OMB) Circular A-16 the Census Bureau is the designated federal custodian for government units. This role is linked directly to its requirement to conduct the decennial census of population and housing. In order to fulfill these missions the bureau must obtain information about the location of residential dwellings in relationship to streets and other features. It obtains this information from local government and through its own programs. In preparation for the 2010 Census it is making significant improvements to the positional accuracy of the street files and is creating a point-level representation of residential structures. Each of these needs relates directly to parcel data being maintained by local governments. Representatives from the Census Bureau reported at the Land Parcel Summit that parcel data are critical for determination of boundaries of incorporated areas. The following comment from the web forum also highlights the need:

> The Census Bureau uses a wide variety of sources to research addresses and update address ranges in our TIGER [Topologically Integrated Geographic Encoding and Referencing] mapping system to allow us to geocode addresses. Parcel data is one of our primary sources. A key piece of information in property records is the property owner's mailing address. However, we need the site address to determine precise addresses of each parcel. Many localities have online parcel information. Coverage and design is inconsistent. Having one spot to go to for address information for parcels would improve efficiency immensely. (Comment from web forum: David Wiggins, Geographer, U.S. Census Bureau, Charlotte, N.C.)

Federal Benefit 2—Provides a database for monitoring objects of national concern, e.g., agricultural land use and foreign ownership of U.S. real estate.

Assessment—There are several pieces of legislation that require the federal government to maintain an inventory of its real property (listed later in Chapter 5). Also the Department of Agriculture has established a common land unit to define an agricultural parcel. The U.S. Forest Service is using the National Integrated Land System (NILS) to display property it is offering for sale.

Federal Benefit 3—Provides a reliable record of the locations of federal ownerships or other interests in land.

Assessment—BLM is the designated custodian for federal land ownership. There are several federal programs that mandate an inventory of federal lands. BLM and the Forest Service are implementing the National Integrated Land Information System to meet these needs.

Federal Benefit 4—Provides standardized records for managing federal assistance to local programs such as housing, community development, and historic preservation.

Assessment—A representative from the Department of Housing and Urban Development (HUD) told the committee at the Land Parcel Summit that HUD has recently acquired parcel data for the Gulf Coast to support hurricane recovery as well as long-term needs. This may be the single best example of a federal agency specifically developing a long-term program based on acquiring parcel-level data from local government.

A quick analysis would suggest that each of these four benefits identified by the 1983 study has increased in importance. The committee also analyzed the current needs of specific agencies for parcel data.

Federal agencies fall into three categories based on how they use land parcel data. One group manages land across the states. A second group manages the land records of others, both federal

agencies and Indian tribes. The third group uses local parcel data for various programmatic activities. All would benefit from easy access to parcel data but are often unable to do so because of the limited availability of those data and the lack of a standard format.

The BLM and U.S. Forest Service are examples of agencies that manage land. In these cases, there is difficulty in reconciling property boundaries with those of private sector neighbors. This can be a major problem when there is a need to build new facilities, respond to fires, or just communicate with neighbors. The BLM and Forest Service are developing NILS, which they hope to operate in partnership with states, counties, and private industry. The federal government is the largest land manager in the United States and thus, like any land manager, needs parcel information to properly manage its land, as described by this respondent to the web forum:

> We constantly get calls to look into potential trespass onto federal or Indian Trust lands. If we had a complete land records database it would be easier to identify and resolve these types of problems. (Comment from web forum: John Sroufe, Cadastral Chief, BLM Cadastral Survey, Alaska)

Because the federal government is the largest land manager, it stands to gain the most from a national land parcel data set. However, since federal lands are managed by many different agencies, there are still issues with integration of land parcel data across agencies, as typified by this comment:

> From a federal taxing/funding view it appears that many agencies and offices have created stand alone title and survey (land tenure) recordkeeping systems, this trend seems to be growing, and seems ripe for consolidation resulting in increased efficiencies and cost savings. A citizen or an agency should not have to visit each individual federal agency and office to determine the extent of the federal interest in land in an area, that should be one stop. (Comment from web forum: Anonymous)

Two agencies that are examples of federal organizations responsible for managing land records are the General Services Administration (GSA) and the Office of the Special Trustee for American Indians. The GSA was given responsibility in 2004 under Executive Order 13327 to create and manage a centralized real property database of federal buildings. While this will allow the federal government to know something about the land it owns, it still excludes public domain and other land. The Office of the Special Trustee for American Indians manages trust and allotment land records across the country; at the Land Parcel Summit, the representative from that office told the committee he felt that local reservations needed better control of their own land records to support needed economic development. The needs of the two agencies are different, but both could benefit from easy access to local land records across the country. Examples of federal agencies that need parcel data in order to carry out their missions are described below. Since federal agencies have responsibilities in all parts of the nation, each agency may need parcel data in many different parts of the country. In many cases, in the absence of complete nationwide land parcel data, the agencies have begun collecting parcel data to meet their specific needs, as described further in Chapter 4.

HUD

The 1983 NRC report suggested that a major benefit from a national partnership for assembling parcel data would derive from having a standardized set of records for managing federal assistance to local programs (see Box 3.1). The most direct and long-standing regulations and assistance requirements are related to HUD. As noted earlier, a previous NRC report, *GIS for Housing and Urban Development,* recommended that HUD create an urban spatial data infrastructure that includes parcel-level data (NRC, 2003b, p. 46). Parcel-level reporting would help HUD meet many of its strategic goals, such as increasing home ownership opportunities, promoting decent affordable housing, and ensuring equal opportunities in

housing. These goals are accomplished through an extensive range of grant programs that are organized into the following categories.[1]

- Community Planning and Development (21 programs)
- Housing—Federal Housing Administration
- Single-Family Housing Programs (17 programs)
- Regulatory Affairs and Manufactured Housing (3 programs)
- Multifamily Housing Programs (17 programs)
- Public and Indian Housing (15 programs)
- Fair Housing and Equal Opportunity (7 programs)
- Policy Development and Research (3 programs)
- Government National Mortgage Association (Ginnie Mae) (4 programs)
- Healthy Homes and Lead Hazard Control

HUD also operates an Office of Federal Housing Enterprise Oversight that has the specific mission to promote housing and a strong national housing finance system by ensuring the safety and soundness of Fannie Mae (Federal National Mortgage Association) and Freddie Mac (Federal Home Loan Mortgage Corporation).[2]

Effective management of these programs requires the property information included in parcel data. While HUD has had long-standing programmatic needs for parcel-related data, the 2005 hurricane season thrust the federal oversight of housing issues into a new arena. In 2006, HUD was tasked by Congress with developing long-term housing assistance to Gulf Coast communities attempting to rebuild after Hurricanes Katrina, Rita, and Wilma, to which it has responded by collecting parcel data in the impacted communities. The existence of national land parcel data would provide HUD with data it needs for effective management of grants and would have avoided the critical time wasted gathering parcel data piecemeal in the wake of these recent hurricanes.

DHS

In 1983 the United States had not lived through the events of September 11, 2001, the 2004 wildfire season, or the 2005 hurricane season. The need for federal emergency managers to have ready access to accurate and current information to prepare for and respond to disasters and acts of terrorism has been highlighted by these recent events. In the wake of September 11, 2001, the FGDC published a white paper titled "How GIS and Mapping Technology Can Save Lives and Protect Property in Post-September 11th America," which emphasized the need for current geospatial data, including property ownership information, for emergency response.[3] This need was clearly articulated by DHS at an open meeting of the committee (Davis, 2006):

- Parcel data is the fundamental building block for all geographic analysis and serves as the raw material for most applications—most geographic analysis benefits from the ability to understand the result at the parcel level.
- A multipurpose cadastre enables a vast range of location-based services that will improve safety and increase efficiency of current operations.
- Local parcel data were still being sought eight weeks into the response to Hurricane Katrina.
- Impact from most disasters is best understood at the parcel level.

[1]See HUD Grant Programs at *http://www.huduser.org/resources/hudprgs/ProgOfHUD06.pdf* [accessed June 13, 2007].
[2]See *http://www.ofheo.gov/*.
[3]See *http://www.fgdc.gov/library/whitepapers-reports/white-papers/homeland-security-gis/* [accessed June 13, 2007].

- GIS is becoming the way disasters are managed. A common operating picture depends on an available multipurpose cadastre.
- National response centers such as Interagency Modeling and Atmospheric Assessment Center depend on the availability of local data for accurate hazard predictions and health recommendations such as shelter in place.
- Most DHS programs depend on geographic data that are at the parcel scale—for example, Critical Infrastructure Program.

The DHS needs provide a sound basis for wall-to-wall nationwide parcel-level data. Natural disasters include such varying events as hurricanes, tropical storms, floods, severe weather, blizzards, fires, Nor'easters, ice, heavy waves, drought, or freezes. Disasters can occur anywhere in the country and often cross multiple jurisdictions. The importance of parcel data for all phases of federal disaster management is echoed in the recent NRC report *Successful Response Starts with a Map: Improving Geospatial Support for Disaster Management* (NRC, 2007, p. 36), which concluded:

> Land-parcel data, one of the framework themes, are essential in managing disasters and in assessing damage, along with building footprints and the locations of infrastructure (power, telecommunications, water, sewage, and steam-heating networks).

However, it also notes that the primary issue is as follows (NRC, 2007, p. 90):

> Data on the ownership of land parcels, or cadastral data, provide a particular and in some ways extreme example of the problems that currently pervade the use of geospatial data in emergency management. Vast amounts of such data exist, but they are distributed among tens of thousands of local governments, many of which have not invested in digital systems and instead maintain their land-parcel data in paper form. As with many other data types, it is not so much the existence of data that is the problem, as it is the issues associated with rapid access.

The FGDC Subcommittee for Cadastral Data has conducted several in-depth studies that document the importance of parcel data in disasters, such as *Parcel Data and Hurricane Isabel: A Case Study,* which reached the following conclusions (Stage and von Meyer, 2004):

> 1. Parcel data provides intelligence to maps and imagery providing information about land ownership, property values, structures, and land use.
> 2. Integration of parcel data with other data sets and land characteristics provides a rich and stable data source.
> 3. Parcel data must be published in a format to meet national and local emergency response needs.
> 4. The use of parcel information must be integrated into emergency response protocols.
> 5. Develop programs to promote parcel data automation and maintenance in less urban areas.

Therefore, it is clear that parcel data are vital to emergency management operations. The development of national, integrated land parcel data is necessary if DHS is to utilize parcel data effectively. To meet these needs the DHS Geospatial Management Office is developing a Geospatial Data Model that provides details about how to ingest local government parcel-level data that include an extensive set of attributes, including parcel-related data (see Chapter 4 for a more detailed discussion).

U.S. Forest Service

There is a significant demand for parcel data by the U.S. Forest Service in its efforts to combat forest fires. The Rapid Assessment of Values at Risk (RAVAR) is a new tool designed to determine

the location of structures and assets at risk, and the program has been actively collecting parcel data in areas at risk of wildfires.

> The most important layer generated by the RAVAR model is the structure layer. The structure layer is generated by reaching out to local county offices including assessors, planners, natural resources, and GIS [geographic information system] staffs, to acquire the county's spatial (GIS) parcel records. A building clusters map is developed representing the general location of structures identified within the parcel records.[4]

Wildfires routinely cross administrative boundaries and often occur in rural areas. Again, this is an example of federal agency needs for parcel data that cross county and state boundaries and could be met by nationally integrated land parcel data.

Environmental Protection Agency (EPA)

In order to meet its responsibilities and keep the public informed, EPA has established a major GIS-oriented operation in its Office of Environmental Information. Through an EPA website a user can search to determine the location of brownfields, hazardous wastes, cleanup activities, and Superfund sites within a city, county, or zip code. Being able to link the location of such sites to other parcel data would be extremely useful; therefore the EPA has begun looking for sources of parcel data. If nationally integrated land parcel data existed, these data would be readily accessible for EPA to link to its own data set.

Other Agencies

A few more examples of agencies that use local parcel data to operate their programs include the National Oceanic and Atmospheric Administration (NOAA), the Census Bureau, and the Tennessee Valley Authority (TVA). The Census Bureau needs to know the location of homes and businesses to fulfill its programmatic mission. Parcel data help the bureau acquire information about structures and more accurate boundaries for incorporated areas. National land parcel data would provide the Census Bureau with an accurate and up-to-date source of this information for the decennial Census and avoid the costs of having to collect such data itself. NOAA needs parcel data in its work on coastal land planning, conservation, permitting, and public access. TVA has 17,000 miles of power line rights-of-way it needs to manage in cooperation with the current landowner. The records of those landowners are spread across 220 counties, so national data would be quite helpful. (The need for parcel data by the utility industry in general is discussed further in Section 3.3.)

As all of these examples show, federal agencies have a multitude of mission requirements that rely on parcel data for effective management or operations. The federal government has the largest need for nationally integrated land parcel data because it is the largest land manager in the United States. However, beyond its land management responsibilities, the federal government also has responsibilities to U.S. citizens as a whole, such as for emergency management in large disasters, which also make national land parcel data a necessity.

3.2 STATE AND LOCAL NEEDS AND BENEFITS

The best way to measure the benefits of or justification for building a system for accessing land parcel information would be to examine the commitments that have already been made to implement such systems and the value in aggregating these systems across jurisdictional boundaries. A review of current parcel data systems (see Chapter 4) provides ample evidence that an increasing

[4]See the RAVAR Executive Summary, available at *http://www.nafri.gov/Assets/imm/RAVAR_Executive_Summary_GJ%5B1%5D.pdf* [accessed May 23, 2007].

number of local governments have recognized the benefits of parcel data systems and voted with their pocketbooks to implement such systems. In fact, many counties simply could not function without a parcel data program as a core of their information system (Larry Stipek, Loudon County, Virginia, personal communication to D. Cowen, October 25, 2006).

At the state level, it is also clear that a growing number of state governments such as Tennessee, Oregon, and Arkansas have made a commitment to develop comprehensive statewide parcel data management systems. The reasons and drivers for aggregating parcel data at the state level can provide some useful insight into the benefits that may accrue at the national level as well. As shown in Box 3.1, the 1983 study categorized the benefits of a parcel data program to state government in terms of inventory of land and providing a basis for accurate development. While these issues are still relevant, they do not accurately portray the current situation and the desire of state government to assess and monitor the value and taxation of private property. A recent study titled *An Assessment of Best Practices in Seven State Parcel Management Programs* prepared for the FGDC Subcommittee for Cadastral Data (Stage and von Meyer, 2006a) offers an interesting view of the dramatic changes that are occurring and provides a glimpse of the future. The seven states (Alabama, Arkansas, Florida, Montana, North Carolina, Tennessee, and Wisconsin) varied in terms of their stage of development but were committed to the completion of statewide parcel programs. In terms of the business drivers for statewide parcel systems, the report concludes the following (Stage and von Meyer, 2006a, p. 8):

- Property assessment has become the primary business driver for the creation of digital parcel maps.
- The principal business requirements for the local assessor and the state assessment agency are for (1) the more efficient property assessment for local assessors, and (2) the ability of the state to ensure that there is a fair and equitable assessment of property values.
- It can be argued that in addition to the efficiencies that digital parcel data bring to the assessment community, the parcel layer used as a base map is the most information-rich database with the broadest utility to local, state, and federal agencies.

Although the states may have equitable assessment as their primary business driver, they also recognize the multitude of other users of parcel data, as acknowledged in the last item of the above quote. For example, Montana, one of the states included in the study, did a report on the various customers and clients for its cadastral data, which it summarizes into four categories: private sector, policy makers, individual citizens, and other government agencies (including federal agencies) (Stevens, 2002). As just one example, state departments of transportation are in regular need of contacting owners of land adjacent to highway rights-of-way as part of their duties to maintain and upgrade highways. In Minnesota, for example, the Minnesota Department of Transportation (MNDOT) has approximately 900 projects a year that require parcel boundary and ownership information. To get this information, MNDOT personnel research county records, usually requiring a visit to each courthouse along a right-of-way. Having parcel data online would simplify that work. Similar efforts are required by other state and local public landowners. Therefore, aggregating parcel data within the state not only meets the business needs of the state, but provides data needed by many others.

The same case could be made for nationally integrated land parcel data. As shown in the previous section, the federal government has many business needs for national data, but there would be benefits to state and local governments as well. One of the benefits recognized by state and local governments is the advantage of having data integrated across jurisdictional boundaries.

It is sometimes difficult to conduct region-wide projects that cut across multiple counties in

> our area. Not all counties have parcel data and not all counties that have data are willing to share it. Therefore, a national program would be very beneficial. (Comment from web forum: Melisa McLean, GIS Coordinator, St. Louis County Department of Planning)

> Montana currently serves statewide parcel data. I can get all surrounding counties from the state. However, since my county borders Idaho a national system may assist me in times of emergencies that straddle the Montana-Idaho border in my county. (Comment from web forum: Doug Burreson, GIS Supervisor, Missoula County, Montana)

Having nationally integrated data would also help resolve some of the issues dealing with incomplete data at the local level or inaccuracies of the boundaries among different landowners.

> Parcel data in our jurisdiction is incomplete. We do not track state and federal owned parcels. Also, our parcel data has been rubber sheeted, and we are only beginning to correct some of the spatial inaccuracies in the data. Most of the land area within our jurisdiction has not been surveyed. We provide a strong disclaimer with all of our map and data products. As with almost anything else in Alaska, the user consumes the products at their own risk. The potential for negative impacts is there. (Comment from web forum: Erick Johnson, GIS Technician-Data Analyst, Matanuska-Susitna Borough, Alaska)

> The Dept. of Environmental Protection has serious encroachment issues by private landowners onto our land. We risk losing substantial acreage to encroachment issues. This is due in part to inaccurate parcel data. (Comment from web forum: Jacqueline Mickiewicz, Environmental Analyst, Connecticut Department of Environmental Protection)

Another is the fact that a national set would enforce a set of standards for all parcel data.

> We would benefit not so much from the product of a national parcel map, but more so from the process to integrate all such data. Determining such standards would be of great benefit for all of us. (Comment from web forum: Pamela Kelrick, GIS Coordinator, GIS Consortium)

Finally, the potential for nationally integrated data to make land parcel data more accessible on a much faster time scale was also noted.

> Save time! We sometimes wait days to receive data and records. (Comment from web forum: Tony Bellovary, GIS Coordinator, Bay-Lake Regional Planning Commission, Wisconsin)

> The amount of time spent tracking down land record information would be dramatically reduced from days/weeks to hours. (Comment from web forum: Mike Juvrud, Programmer, Mud Labs)

Above and beyond the benefits listed above, however, having nationally integrated land parcel data would improve the functioning of the federal government, which would allow it to better support state and local governments in terms of distribution of federal grant money, federal support for emergency management, and better management of federal lands located throughout the country.

Despite these benefits, there are some at the local government level who think that national land parcel data would not be beneficial to them.

> I think this is primarily a "sales job" by individuals who stand to personally gain from a national cadastre. Because of the volume of change taking place in many areas of the Country, a national database would be consistently out-of-date and lead to decisions based on incorrect information. The value to this County would be minimal. Now, if some funding were attached to participation in a national effort, to help maintain the information, then I could see a benefit at the local level. (Comment from web forum: Richard Hanning, Greenville County Government, South Carolina, GIS Manager)

As this quote illustrates, there is concern at the local level about whether a national system could be implemented effectively and whether local governments would bear a financial burden for helping create it. Therefore a vision for nationally integrated land parcel data needs to provide a means for ensuring that the data are current, including incentives for local governments to maintain their data.

3.3 PRIVATE INDUSTRY NEEDS AND BENEFITS

It is difficult to categorize all of the private industry organizations with interests in land parcels. Some firms produce parcel data as a necessary business function. For example, many companies are major landowners (e.g., timber and agribusiness firms) and maintain parcel data in order to manage their assets. The utility sector provides services (e.g., water, electric, gas, telephone, cable television) from central sources through transmission and distribution networks. Network facilities are commonly located in rights-of-way or easements. In some cases these are owned by the utilities, and in some cases they are easements across other lands. Therefore, utilities use government parcel data to identify landowners for new easements or rights-of-way and to identify adjacent owners. Information on values, assessment rates, and real estate taxes can be used to manage the comparable values on utility holdings. Tax parcels can also be used to identify potential new customers, verify meter addresses and locations, and plan for new subdivisions and layouts.

Another group of firms relies on parcel data to support their core business. For example, at the Land Parcel Data Summit the committee heard from representatives in the land title and property insurance industry. An accurate parcel-level representation of the value and ownership of land is critical to their business; therefore, they often create and maintain parcel data independent of the local jurisdiction. Firms involved with the real estate market are users of parcel data, but a representative from the National Association of Realtors at the Land Parcel Summit indicated that there is not a consistent trend in the demand for parcel data and few of its members actually produce or purchase parcel data. However, the representative from Zillow at the Land Parcel Data Summit indicated that his company was aggressively acquiring parcel data across the country to support its website, which makes estimates of property values. More recently, Coldwell Banker has implemented a nationwide property listing website that relies on Microsoft's Virtual Earth.[5] In both of these examples, a parcel-level representation of property is required in order to align with high-resolution imagery.

Some firms produce digital parcel data as a data conversion service to customers in the public or private sector. Other companies acquire parcel data from various sources and add value by standardizing the attributes and data format. Because of the importance of parcel data to private companies, a wholesale sector has emerged. For example, one of the vendors in this sector, NAVTEQ, just recently announced a new product called NAVTEQ Parcel Boundaries. It lists potential uses for its product as follows (NAVTEQ, 2006):

- Real estate search and visualization
- Insurance risk determination
- Infrastructure planning
- Railroad planning
- Utility planning
- Building and site development
- Retail site selection
- Telecom planning

[5]See *http://www.coldwellbanker.com/servlet/SearchProperty?action=findByMap* [accessed March 15, 2007].

- Application development
- Environmental: lake and stream erosion control
- Business intelligence
- Construction of roads and public works
- Reverse 911
- Hazardous waste disclosure
- Emergency preparedness

There appeared to be considerable differences in the opinions of respondents to the stakeholder feedback from the private sector based on whether they identified themselves as a producer or user of parcel data. While only a third of the producers were positive about a national vision for parcel data, a clear majority of the users were positive. It is clear that the users of parcel data see the benefit of having a consistent source of parcel data in the public sector. At the same time, some producers may view such a system as competition for their products. Private industry firms that have created their own automated land parcel data systems have done so at significant cost. As data from the public sector become more accurate and available, the value of their data sets diminish. However, better land parcel data from the public sector would also streamline the private agency processes and reduce the costs of acquiring data.

While it has been beneficial for many private firms to create their own land parcel data systems, it has not been cost-effective to produce data sets that are complete in all locations across the nation. Depending on the mission of the company, it may need or want parcel data only in certain places, such as densely populated areas, since this is where the majority of requests come from. For example, Zillow does not believe it is cost-effective for it to acquire data for more than the 1,200 counties that represent 80 percent of the population (Ben Clark, oral statement at Land Parcel Data Summit, May 23, 2006).

3.4 PRIVATE CITIZEN NEEDS AND BENEFITS

Private property ownership is considered a key part of America's sense of identity and self-determination. In fact, Pipes (1999) has argued that individual property ownership is a basic aspect of our freedom. The need to protect individual property rights generated the political and legal institutions that also guarantee our liberty. Countries such as Russia, with a limited history of property rights, also have a limited sense of personal freedom. From the beginning, America has pressed for its citizens to be home owners, landowners, and free. While ownership of property is a cornerstone of American beliefs and institutions, public access to information about ownership and value is also critical for equitable taxation and efficient real estate markets. Therefore, information contained in land records is generally available to everyone, from the landowner to the curious to the entrepreneur.

In the United States, land ownership, land value, and land use controls are the responsibility of governmental bodies of cities, counties, or Indian reservations. Most land originally belonged to the colony or the federal government but was transferred gradually to private ownership over the past two centuries and all issues related to land moved to the local level. There were two reasons for this move. First, it meant that individuals could have ready access to their records, no more than a one-day wagon ride from their homestead. Second, it meant that public notification about land ownership and government regulation and control of private land was kept close to the owners. Historically, states and the federal government have been allowed to intervene in property rights only when larger societal or environmental issues are at stake. Issues relating to planning, zoning, and eminent domain are entrusted to local government officials who are directly accountable to taxpayers and voters and are conveniently close.

In 1983 when Box 3.1 was written, there was little if any direct involvement of the public with land parcel data. Typical home owners had deeds for their property and may have seen a paper tax map that depicted their property in relationship to streets and other parcels in their neighborhood. Today, in contrast, in many locations the general public can interact directly with local government through websites that enable individuals to perform a host of tasks and check the accuracy of information that is important to them.[6] However, the ease of access varies by the sophistication of the county record keeping system and the policies of the county board. Many local governments are willing to distribute such information over the Internet; they see this as service to their constituents. Individuals can find the information they want without needing to drive to local government offices. Furthermore, less staff time is spent responding to customer inquiries. There are no universal standards regulating how information relating to parcels is disseminated. Several local government policies allow property owners to "opt out" of allowing web-based searches of their data. Many communities also restrict access to property ownership information pertaining to judges and law enforcement personnel who could be targeted by criminals.

For many local governments, even today, parcel data are buried in paper maps and records and scattered across many offices. Home owners looking for information about their property may need to visit the county surveyor, recorder, or assessor or go to the offices for planning and zoning, inspections, water department, public works, or public safety. Even when records are automated, they often are automated department-by-department and cannot be integrated.

A growing number of counties are creating enterprise-wide computer systems that connect the land record files of individual departments. This embodies the vision of the 1980 NRC study, where unique parcel numbers on every record allowed the different files to be connected. For example, this allows the assessor and the planner to share information about land use. GIS allow environmental data, such as soils, to be overlaid on the parcel maps, so those two offices can include soil characteristics in their analysis of the fertility of a particular parcel. This is good for those offices, but also good for home owners looking for information about their property.

Protection of privacy is one reason given for not sharing data widely over the Internet. Some counties respond to this issue by removing names from their Internet inquiry system or at least removing names as the basis of a search. There are also counties in remote recreation areas that are even hesitant to show parcel boundaries because these indicate locations of seasonal homes where owners are absent much of the year.

Access to an electronic copy of the county database of all properties is a different issue. Often such access requires a license from the county as a way to protect its citizens and its rights to the data. Typically the database can be transferred on digital media such as a compact disc (CD) or digital video disc (DVD), but increasingly access is provided via web mapping services where the user accesses required data as needed from the county website.

In order to understand how private citizens would benefit from national land parcel data, it is useful to compare the U.S. model with that of Western Europe. Bengt Kjellson, chairman of the United Nations Economic Commission for Europe Working Party on Land Administration, provided an interesting comparative analysis in a paper "What Do Americans Pay for Not Having a Public LIS?" makes the following conclusion (Kjellson, 2002, p.1):

> In most developed countries, including those of western Europe, land registers and cadastres are kept—often in computer form and easily accessible—by public administration bodies or courts. There are often very long and strong traditions of doing so. Efforts are continually made by governments to enhance these systems, through legislative changes, technical development or changes to organizational structures. Transparency, low transaction costs and efficient property markets are key

[6]As just one of many examples, see the Crawford County, Arkansas, Assessor's Map Viewer at *http://apps.geostor.arkansas.gov/imf/sites/crawford_county/jsp/launch.jsp* [accessed June 13, 2007].

> objectives for this development. The development of these functions was also put high on the agenda as part of the recent dramatic political changes in eastern and central Europe. They were seen as very important steps in order to establish market oriented economies as well as strengthening democracy. The situation in the United States is very different. The US has a unique position among the most developed countries, having no state or federal system for land registration in a title system or computerized deeds system. Instead the property market relies on title insurance companies to provide stability and order. Public initiatives seem to be restricted to information about federal land.

He concludes that the American home owner is paying dearly for the inefficiencies in our real estate markets by paying extremely high property transaction costs because of the complexity in finding the needed property information.

Therefore, the development of nationally integrated land parcel data could provide private citizens with the benefits of increased access to property data and lower property transaction costs. Private citizens also benefit as a whole from the increased efficiency of government that would result from national data—for example, more effective emergency response operations.

3.5 SUMMARY

Many changes have taken place over the past quarter of a century, but the list of benefits outlined by the 1983 NRC report remains relevant for all levels of government, the private sector, and individual citizens. Besides needing parcel data for their land management responsibilities, many federal agencies need parcel data to carry out their mission responsibilities. In fact, as discussed further in the next chapter, in the absence of nationally integrated land parcel data many of these agencies are collecting parcel data to more effectively manage their programs. State governments are realizing the benefits of having statewide parcel data systems for property assessment as well as other purposes and are beginning to create such systems. Private citizens would benefit from more efficient property transactions and from more effective government operations at all levels that would be facilitated by national land parcel data. Also, while some sectors of private industry have developed their own parcel databases to meet their own business needs, other companies are capitalizing on the growing interest in and needs for parcel data by creating data sets for sale.

It was no surprise that almost all federal- and state-level respondents to the web forum who produce parcel data believe that a national parcel database is necessary, while only slightly more than half of the local government producers saw the need for such a program. Many local governments create data for their own applications and may not understand how a national effort would benefit their own local use. It is also not surprising that the vast majority of respondents to the online forum who consume or use land parcel data are anxious to have a national program that would facilitate access to the data. This desire was expressed by public sector parcel data users from every level of government.

Certainly, the nature of the various entities' needs regarding timeliness, coverage, and accuracy of land parcel data varies widely. For example, individuals are interested in data for a single property (e.g., its current value, a history of its owners). Some businesses want data that cover all or most of the country. Other users, such as those responding to disasters, need data for specific areas on very short time frames. Obviously no one system or database could meet all needs. Therefore the challenge of a national land parcel data program will be to meet the most basic needs while linking to parcel data producers who can provide access to more detailed data for those who need it.

Finally, many people believe that a national system of land parcel data is inevitable and it is important to move ahead, as illustrated in the following comments.

> The task to achieve this would clearly be huge and costly but is something which must ultimately be done. A State based system which could then be integrated to a federal system may in

practice be more manageable. (Comment from web forum: Roger Lee, Director, Geodata Information Systems Pty. Ltd.)

Currently municipalities and counties with 17th-century land records systems are systematically crippled in their ability to administer taxation equitably, conserve their natural resources, plan for rational growth, and educate their students in geospatial technologies. It's really amazing that there are no digital parcel maps readily available in large areas of the country. This is the 21st century, Hello????? (Comment from web forum: Donald Cooke, GDT Founder, Tele Atlas North America)

4

Current Status

One of the specific tasks of this study was to describe the current status of parcel databases across the nation at all levels of government. This chapter addresses that task by examining the status of parcel data programs from a variety of administrative levels including the federal, tribal, state, and local levels, as well as those developed by private industry. It also describes parcel data systems in other countries as context.

4.1 FEDERAL PARCEL DATA PROGRAMS

Although there is not a single dedicated program for development of nationwide parcel data within the United States, numerous ongoing programs within the federal government directly relate to creating, managing, or collecting parcel data. Some of these programs address parcel data for federal lands; others are related to national parcel data. This section looks at the current status of federal parcel data programs in terms of overall coordination and standards, parcel data production by various land management agencies, other federal programs that are using or collecting parcel data, and the framework for access to parcel data.

4.1.1 Parcel Data Coordination and Standards—the Federal Geographic Data Committee (FGDC) Subcommittee for Cadastral Data

The FGDC Subcommittee for Cadastral Data is the focal point for activities relating to parcel or cadastral information within the federal government.[1] Funding for the activities of the subcommittee has been provided by the Bureau of Land Management (BLM) Cadastral Survey Program, which is the designated custodian for cadastre information and federal land ownership status. As part of the FGDC, this subcommittee is charged with coordinating the interest in cadastral information of stakeholders at all levels of government. To support the coordination activities the subcommittee established an eastern and a western coordinator and steering committees. The committees focus on

[1]See *http://www.nationalcad.org.*

activities of regional concern as well as items of national interest. As discussed in Chapter 2, this subcommittee was instrumental in creating the content data standard for a modern land parcel data model. This standard is part of the Framework Content Data Standard, which is now going through its final approval at the American National Standards Institute level. Once approved, it will become an American National Standard applicable for adoption and use at all levels of government and industry. The FGDC subcommittee is extremely active and has extensive membership from federal, state, and local agencies as well as private industry. It meets regularly and has actively promoted the use of parcel data to correspond with directions from the Presidential E-Government Initiative, Western Governors' Association Policy on Cadastral Data, National Association of Counties, and Fifty States Initiative. In addition to the development of the content standard, the subcommittee has completed two surveys of parcel activities at the state and local levels, analyzed the role of parcel data to assist in emergency response activities, documented best practices, and developed business model templates with appropriate metrics (or measures) for assessing progress.

Some of the highlights of the most current activities include developing data element standards for energy, hurricane response, wildland fire response, and homeland security. These efforts have resulted in a series of case studies and best-practice examples that document the importance of parcel data for critical decision making. The FGDC subcommittee has also developed an extract from the Cadastral Data Content Standard to facilitate data discovery for Geospatial One-Stop. It has adopted a focus on states for the stewardship of parcel data. This resulted in a business plan template that describes how to go about setting up a parcel data development program including a framework for inventorying the current status and needs of all cadastral producers in a state. For example, Arkansas has developed the State of Arkansas Cadastral Spatial Data Infrastructure Business Plan, which is based on the FGDC Cadastral Data Core Content Standard (Arkansas Assessment Coordination Department and Arkansas Geographic Information Office, 2006, p. 7).

One recent activity that demonstrates how the subcommittee operates is its work to develop a parcel publication standard in three western states. This standard conforms to the BLM Cadastral Survey Geographic Coordinate Database. These data have been transferred to the states and are being hosted by those states. In Utah the data are used to coordinate the energy management programs and as data integration for county-produced parcel data. In return, Utah provides updated corner coordinates and parcel data for the Geographic Coordinate Data Base (GCDB). In Montana, the GCDB publication format is being used for the official Public Land Survey System (PLSS) and federal parcel representation. The state and federal agencies are using these data to coordinate further update of control and are in the process of a shared survey control project. This is an excellent example of the type of state and federal cooperation and coordination that is promoted by the FGDC and the new Office of Management and Budget (OMB) Geospatial Line of Business.

The subcommittee continues to be extremely active and has identified several specific objectives for 2006-2007. These include the following:

1. Develop priority business data profiles from the Cadastral Data Content Standard for cadastral data based upon national and Western Governors Association priorities.
2. Determine and track the status of parcel conversion to facilitate a national implementation strategy.
3. Maintain the Cadastral Data Content Standard, publication standards, and guidelines.
4. Promote the adoption of national standards by tribal, state, and local governments.
5. Maintain and support eastern, western, and national strategies for supporting the National Spatial Data Infrastructure (NSDI) including the U.S. offshore cadastral systems.
6. Provide technical assistance for implementing NSDI standards and guidelines.
7. Coordinate cadastral activities among participating and interested parties.

BOX 4.1
The National Integrated Land System (NILS)

The National Integrated Land System (NILS) is a joint project between the BLM and the USDA Forest Service in partnership with the states, counties, and private industry to provide business solutions for the management of cadastral records and land parcel information in a geographic information system (GIS) environment.

NILS provides a process to collect, maintain, and store parcel-based land and survey information that meets the common, shared business needs of land title and land resource management. The NILS project is being developed in four modules: Survey Management (S), Measurement Management (M), Parcel Management (P), and GeoCommunicator (G).

NILS provides the user with tools to manage land records and cadastral data in a "Field-to-Fabric" manner. The user can use field survey measurement data directly from the survey measuring equipment, manipulate these data into lines and points, and create legal land and parcel descriptions to be used in mapping and land record maintenance.

NILS has unified the worlds of surveying and GIS. This unification process is fundamental for land records managers and maintainers of cadastral mapping databases to improve the accuracy and quality of the data, to create standard land descriptions and cadastral data that can be used by anyone.

Commercial off-the-shelf (COTS) GIS technology forms the foundation of NILS. Based on industry standards, including the Common Object Model (COM) and object-oriented (OO) technology, the software provides a modern development platform for NILS. Object-oriented software engineering techniques will be used to extend the COTS to meet the specific needs of NILS users.

SOURCE: NILS website, *http://www.blm.gov/nils/*.

4.1.2 Federal Lands Parcel Data

From an operational point of view the most visible federal government parcel data activity is the National Integrated Land System (NILS). BLM and the U.S. Forest Service are jointly developing NILS as a seamless representation of federally managed lands (see Box 4.1). The primary purpose of NILS is to "automate the BLM cadastral surveying and land records business rules in a geographic information system (GIS) environment. The integration of surveying and GIS provides land managers with a complete field-to-fabric technology solution."[2] The technical innovations of NILS are discussed in Chapter 2. Currently, it is in a prototype phase and a limited set of federal parcel data is accessible through the GeoCommunicator component of NILS. GeoCommunicator is being used to provide a web-based query and discovery tool for general access to U.S. Forest Service property that is available for sale (Figure 4.1).

BLM also carries out other duties related to parcel data. It is responsible for surveying Indian lands, which is described further in Section 4.2. Because of the need for high-quality survey information and the special survey needs on tribal lands, BLM has initiated the Certified Federal Surveyor program. This will ensure that land surveyors performing surveys for tribes understand the special requirements of federal lands and tribal lands surveys. BLM has ongoing responsibilities for the PLSS and for the GCDB. The GCDB contains digital geographic information for the PLSS, and is computed from BLM survey records (official plats and field notes), local survey records, and geodetic control information. The GCDB was started in 1989 and currently includes approximately three-quarters of the townships in 10 western states and more than 300 townships east of the Mis-

[2]See *http://www.blm.gov/nils/NILS-overview.htm* [accessed February 15, 2007].

FIGURE 4.1 Screenshot from NILS. SOURCE: *http://www.geocommunicator.gov/NILS-PARCEL2/map.jsp?MAP=USFS* [accessed February 23, 2007].

sissippi River.[3] To improve the geodetic control, the National Geodetic Survey has worked hard to establish a geodetic state adviser in every state and to develop state partnerships to improve survey control. These programs have been very effective where they have been implemented; for example, good cooperative programs exist in Minnesota, North Carolina, Arizona, Florida, and Wisconsin.

Other federal land management agencies also develop land parcel data, such as the U.S. Fish and Wildlife Service, Bureau of Reclamation, National Park Service, U.S. Army Corps of Engineers, and Department of Defense, among others. A preliminary inspection by the FGDC Subcommittee for Cadastral Data determined that the larger land management agencies have programs to develop land parcel data in cooperation with the BLM Cadastral Survey Program. The status of agencies with smaller land management responsibilities is unknown. Other quasi-federal agencies such as the Tennessee Valley Authority (TVA) also have parcel data programs. A representative from the TVA at the Land Parcel Summit said that TVA is struggling to work with 220 counties across seven states, but has the best luck in Tennessee where the state has helped counties develop standard parcel maps.

4.1.3 Related Federal Programs

Numerous other federal programs are collecting or using parcel data to meet their programmatic needs. This section describes other parcel data-related programs in the federal government.

[3]See *http://www.blm.gov/gcdb/*.

Department of Agriculture, Farm Service Agency (FSA)—Common Land Units

The U.S. Department of Agriculture (USDA) Farm Service Agency (FSA) is producing a national coverage of more than 33 million farm and field boundaries, or common land units (CLUs) (Figure 4.2). CLUs are field-based polygons of individual contiguous agricultural parcels. In effect, this program is building a GIS layer of subdivisions of land parcels. The Common Land Unit Program was established to support the Agricultural Risk Act of 2000. As USDA documentation states (USDA, 2000, p. iii):

> Specifically, the Deputy Under Secretary, FFAS [Farm and Foreign Agricultural Service], and the RMA [Risk Management Agency] and FSA Administrators established a cross-functional team to implement a common information system that will eliminate the need for producers to report the same information to FSA and to reinsured companies; create efficiencies for producers, the agencies, and reinsured companies; and reduce the need for data reconciliation. The common information system (CIS) will enable the sharing of customer land use related information by utilizing USDA's e-Gov initiative and the Office of Management and Budget's (OMB) Geospatial One-Stop Initiative. The system is based on the common land unit (CLU), which identifies all farm fields, range land, and pasture land in the United States. USDA customers report and receive services related to land location, such as insurance, commodity payments, loans, conservation plans, and program contracts.

The Agricultural Risk Protection Act of 2000 was implemented to modernize and improve the oversight and reporting functions of the FSA. Because FSA is responsible for billions of dollars in loans, farm payments, and disaster assistance, and these payments are directly tied to what happens on the land and acreage reported by producers, an accurate map of field acreage is necessary (Heald, 2000).

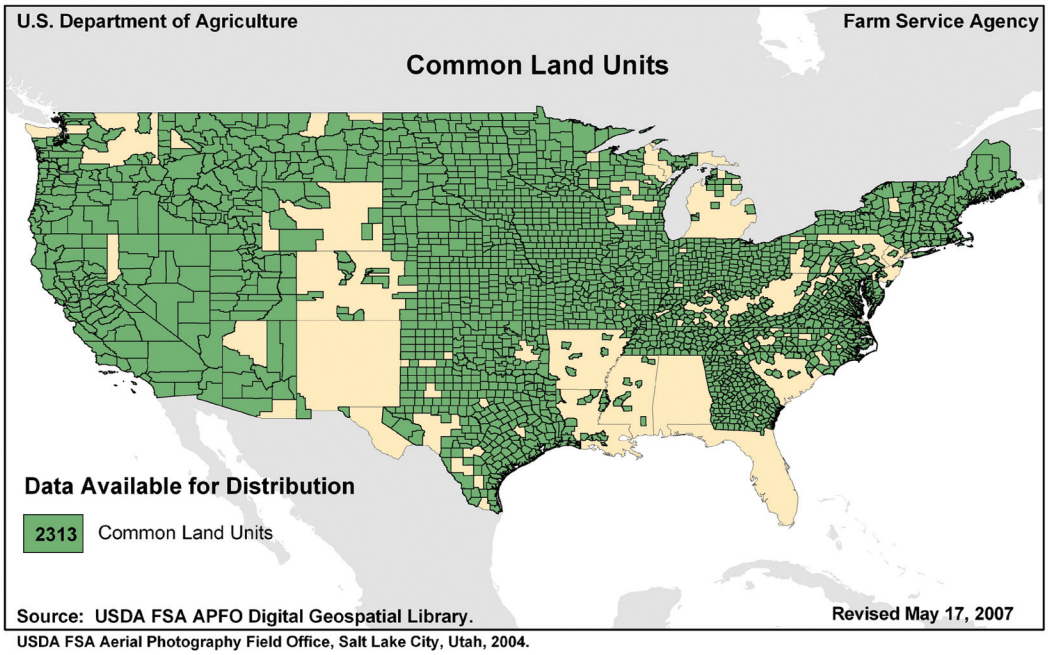

FIGURE 4.2 The current status of common land unit information. SOURCE: USDA FSA Aerial Field Photography Office Digital Geospatial Library. Available at *http://datagateway.nrcs.usda.gov/Catalog/GatewayStatusMaps/CLU.jpg* [accessed June 4, 2007].

Initially the USDA established a set of regional service centers to create the database. GIS analysts in the service centers digitized CLUs through on-screen digitizing of digital orthophoto quadrangles. They were saved as geographically registered polygons with associated attribute data. Updates and changes to the CLU are now done by the individual county offices (USDA, 2006).

The lessons learned through the creation of the CLUs can provide some valuable insight for the generation of national parcel data. Perhaps most importantly, this serves as a clear example of the federal government interest in parcel data in order to meet specific programmatic needs. By having subparcel-level data in a GIS format the USDA believes that it will be more accountable and improve its control over fraudulent claims. It has taken an open approach to the use of its data and has built a program of coordination with state and local governments. In fact, the FSA seems to understand that many other groups have interests in the CLU and has worked to partner with other organizations to pool resources. It believes that support from state offices is vital, and it encourages active participation from universities. It also has established a model for technology transfer that would be directly applicable to parcel data creation. The distribution of the CLUs also has interesting implications in terms of privacy and confidentiality. The integration of field-level geographic data provides an extremely easy manner for public scrutiny of land use activities on private property. In any county with a parcel database it is a simple procedure to link these activities to specific landowners. On the other hand, it did not appear to the committee that this program was done in coordination with any other federal programs related to parcel data.

U.S. Forest Service

As mentioned in Chapter 3, the U.S. Forest Service (USFS) uses local parcel data in wildfire management to identify the location of structures and assets at risk in a program called Rapid Assessment of Values at Risk (RAVAR). This will be a national program by 2008. The RAVAR program is part of a larger initiative spearheaded by the FGDC Subcommittee for Cadastral Data Wildland Fire Project Team. The team has attempted to contact each county in 13 western states to determine the availability of digital parcel data. The June 2007 status map from this project (Figure 4.3) provides an interesting illustration of the availability of parcel data. The map also identifies those counties that share their data on an emergency basis, those that cannot share their data, and those with incomplete parcel data.

Department of Homeland Security

As stated previously, a representative from the Department of Homeland Security (DHS) addressed the committee and highlighted the importance of parcel-level data to meet important programmatic needs. Current information on land ownership is essential for response and rescue operations during an emergency, fair distribution of recovery funds, assessing eligibility for flood insurance, and effective planning and mitigation activities. Organization of geospatial information within DHS has been a major priority. As part of this process, its Geospatial Management Office has developed a Geospatial Data Model (GDM) to support DHS mission requirements. The importance of parcel-level data to the DHS mission can be judged by the extensive level of parcel attributes that it has included in the GDM (DHS, 2006):

Improvement Assessment
Land Assess: Total value of the parcel
Owner Class: Primary owner classification
Owner Managing Agency: Owning agency or organization
Parcel Address: Parcel address
Parcel ID: Unique parcel identifier as defined by the jurisdiction
Public Parcel Name: Commonly recognized name of publicly owned parcel

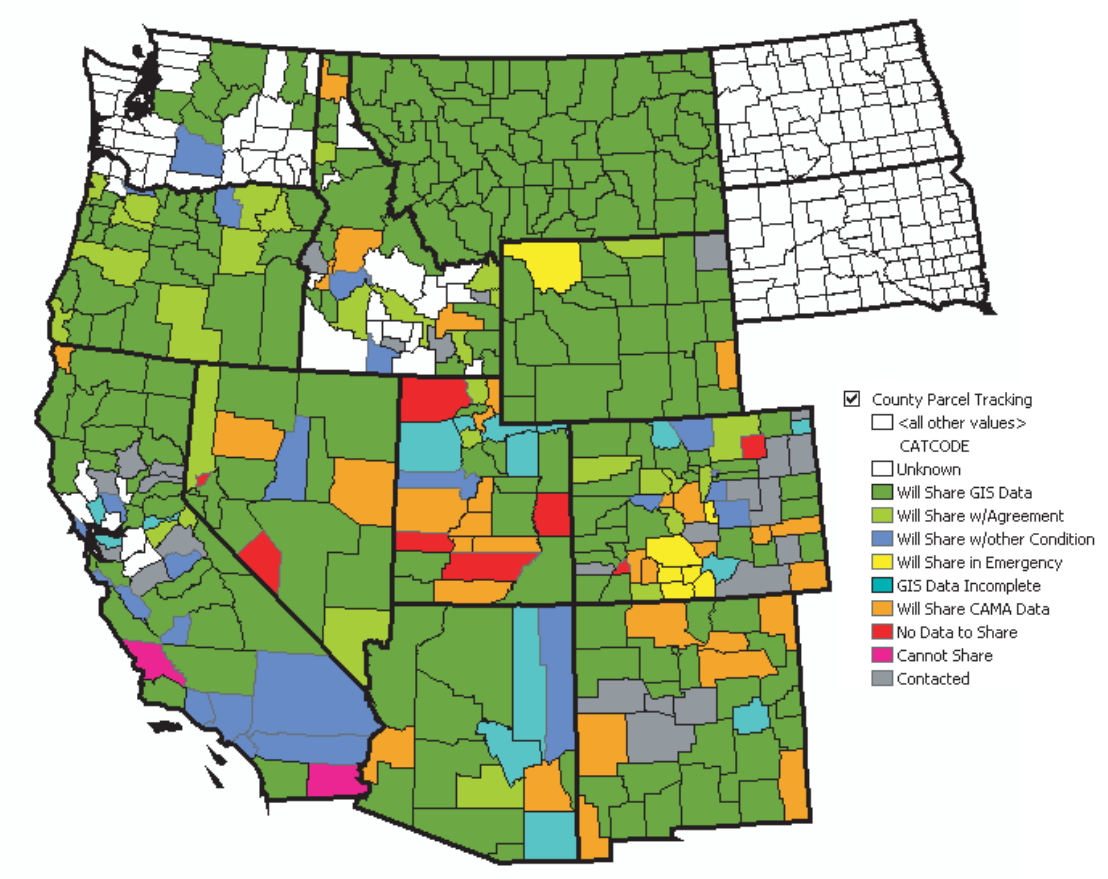

FIGURE 4.3 Availability of parcel data in June 2007 as collected by the RAVAR project. SOURCE: FGDC Cadastral Subcommittee. Available at *http://www.nationalcad.org/data/documents/County-Data-Status-June percent2022.pdf* [accessed July 10, 2007].

Source Ref: Source reference for the parcel
Source Ref Date: Source reference date
Subdivision Name: Subdivision name
Tax Address: Postal service address for tax bill mailing
Use Classification: Land use classification code
Zone Code: Current land use zoning code

DHS created the GDM based on various existing frameworks or standards, such as the FGDC Framework, the proposed FGDC street address standard (developed by Urban and Regional Information Systems Association (URISA) and sponsored by the Census Bureau), Project Bluebook (GIS for the Nation), and the National Information Exchange Model (NIEM). Each of these has a tie to parcel data. For example, the use of the FGDC framework translates directly to the use of the Cadastral Data Content Standard. The proposed URISA Address Standard was developed by URISA, the National Emergency Numbers Association, and the U.S. Postal Service. Project Bluebook is a set of templates that demonstrate how a GIS for the Nation would be created. (GIS for the Nation is

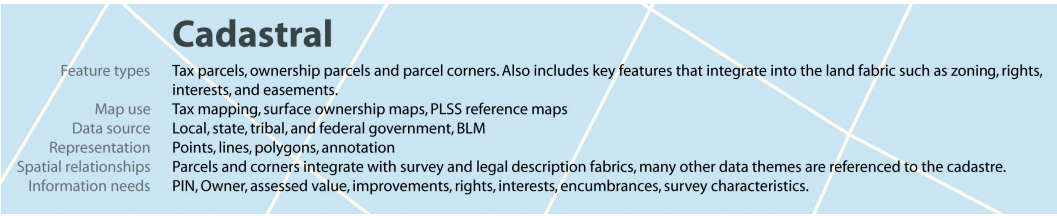

FIGURE 4.4 Cadastral component of GIS for the Nation. SOURCE: GIS for the Nation (poster), available at *http://www.geodata.gov/* [accessed September 27, 2007].

not formally endorsed by the FGDC but is accessible on the Geospatial One-Stop.) The Geospatial One-Stop model for GIS for the Nation includes a major description of its cadastral component, as shown in Figure 4.4. In this description, the source of cadastral data is listed as local, state, tribal, and federal government, BLM.

Finally, the GDM states that it will conform to the NIEM, which is a partnership of the U.S. Department of Justice and DHS. The NIEM is designed to

> . . . develop, disseminate and support enterprise-wide information exchange standards and processes that can enable jurisdictions to effectively share critical information in emergency situations, as well as support the day-to-day operations of agencies throughout the nation.[4]

Soon to be added to the GDM is the DHS National Asset Data Base content. It represents the planned data content to meet the base layer and mission layer geospatial needs of DHS and will be required at DHS for exchange of geospatial data. DHS has asked the FGDC Homeland Security Working Group, Content Subgroup to publicly vet the model.[5]

In summary, DHS received considerable criticism for its inability to respond promptly or efficiently to the needs of people and property in the fall of 2005. In fact, there are still significant issues relating to insurance claims and the efforts to rebuild communities along the Gulf Coast. There is little doubt that these events have led DHS to acknowledge the need for parcel-level information to fulfill its various missions. This also suggests that appropriate resources can be dedicated to meet these programmatic needs.

Department of Housing and Urban Development (HUD)

As mentioned earlier, HUD recognizes the need for parcel data to carry out its mission. HUD has recently been tasked by Congress with developing long-term housing assistance to communities ravaged by Hurricanes Katrina, Rita, and Wilma. In order to do this, HUD needs a clear picture of where damage occurred, the extent to which building permits have been pulled or grants provided to repair that damage, and whether (and which) neighborhoods are rebounding quickly or slowly. The first step was to gather parcel data, which HUD acquired from a commercial vendor for some of the Gulf Coast areas. Although it was not possible to collect complete data for the area, the data are being standardized and improved, and HUD is optimistic that the experiment will provide a sound basis for improved geocoding capabilities within HUD and will assist its efforts to meet the objectives laid out by Congress. The HUD Office of Policy Development and Research has also

[4]See NIEM website, *http://www.niem.gov/.*

[5]See *http://www.fgdc.gov/participation/working-groups-subcommittees/hswg/dhs-gdm/index_html* [accessed February 15, 2007].

initiated an exploratory research project to determine if it is feasible to link information on extent of damage with measures of recovery at the neighborhood, block, and individual parcel levels. If research finds this linking to be feasible and potentially useful, HUD will work with federal, state, and local agencies to establish data sharing agreements that would allow use of this information for careful planning while still protecting individual confidentiality promises made by each agency. In effect, this will enable local agencies to use land parcels as a common basis for damage inspection, Small Business Administration loans, Federal Emergency Management Agency grants, state Community Development Block Grant disaster grants and loans, and city building permit and progress data (Jon Sperling, e-mail to D. Cowen, February 26, 2007).

Census Bureau Programs

Although the Census Bureau does not create or explicitly use parcel data, it has several important programs that are closely associated with parcel information. Three of those programs follow:

1. *Boundary and Annexation Survey (BAS) program.* Under the FGDC framework data program that was mandated under OMB Circular A-16, the Bureau of the Census is the custodian for governmental units. These administrative units "describe, by a consistent set of rules and semantic definitions, the official boundary of federal, state, local, and tribal governments as reported/certified to the U.S. Census Bureau by responsible officials of each government for purposes of reporting the Nation's official statistics." To meet this obligation and support the programmatic needs of the decennial Census, the bureau conducts the Boundary and Annexation Survey. Counties and their equivalents, Minor Civil Divisions, incorporated places, and American Indian areas and off-reservation trust lands are asked to participate in the survey. This survey updates information about the legal boundaries and names of all governmental units. Participation in this annual survey is voluntary; however, in its letters to local government the Census Bureau includes the following statement suggesting that coordination of information regarding governmental units should be required: "Please note that in many states you are required to report your local and county annexations and deannexations to your state officials" (U.S. Census Bureau, 2006a; see also *http://www.census.gov/geo/www/bas/bashome.html*).

There are several aspects of the BAS that are relevant to this study. It is approved by OMB and is considered to be the primary source of information for legal boundaries, names of governments, legal status, types of government units, new governments, dissolved governments, and boundary changes. In effect, this survey serves as the legal basis for all administrative units in the United States. It not only serves as the basis for all levels of political representation but also serves as the official basis for allocation of funds for numerous federal programs.

An example of how parcel data can be used to assist the BAS is provided by the boundary of the Town of Port Royal, South Carolina (Figure 4.5). This map demonstrates clearly the complexity of the boundaries of incorporated areas. It would be extremely difficult for the bureau to accurately represent the limits of Port Royal with anything other than parcel data.

Furthermore, any changes to the current boundaries typically are based on annexations of specific parcels of land. Many local governments impose a set of topological rules to build boundaries of incorporated areas from parcels. In Beaufort County, South Carolina, the parcel database includes a code for the incorporated area. In effect, the boundaries of incorporated areas are defined by the parcels. At the same time, local governments also use parcel boundaries to build their own representations of census blocks, block groups, and tracts. A Census representative at a meeting of the committee indicated that the bureau recognizes the importance of using parcel boundary data to better define Census-designated areas. The back lot line of parcels is often much more useful

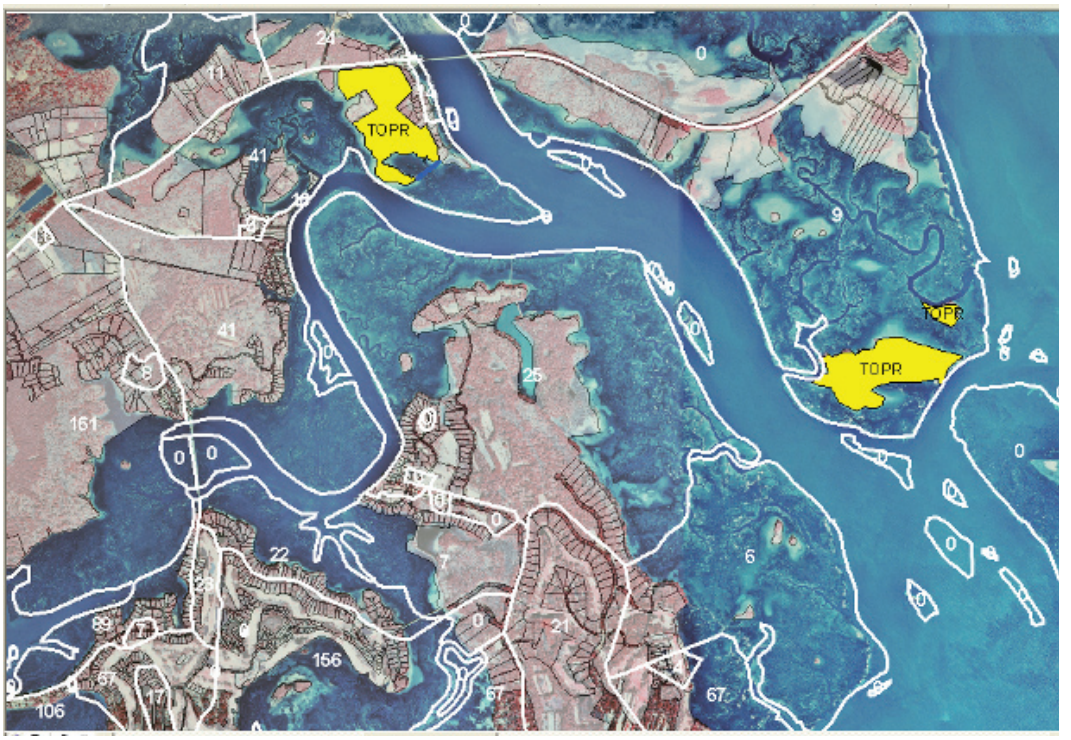

FIGURE 4.5 Boundaries of Town of Port Royal (TOPR), South Carolina (yellow), in relationship to the parcels (black lines) and census blocks (white lines). The figure demonstrates that the boundaries of incorporated areas often cannot be defined using census blocks. In this case the boundary of Port Royal includes only a selected set of parcels that are separated by more than 2 miles of water and marsh. Generated by D. Cowen from Beaufort County, South Carolina, parcel data, Census Bureau data, and U.S. Geological Survey orthoimagery.

in defining areas than the boundaries of the large census blocks that exist in low-density areas. Evidence of this is also provided in Figure 4.5.

Given the significance of this information a strong case can be made that participation in the BAS should be mandatory and that it should utilize the most appropriate data, which are often parcel data. Political boundaries are sometimes congruent with parcel boundaries and there are no physical features that could provide source information for proper BAS placement.

2. *Local Update of Census Addresses (LUCA) program*.[6] The LUCA program, also known as the Address List Review program, is a partnership program that allows the Census Bureau to benefit from local knowledge in developing its Master Address File (MAF). Participants contribute to a more complete and accurate census for their area. The LUCA program is made possible by the Census Address List Improvement Act of 1994 (P.L. 103-430), which for the first time authorized designated representatives of local and tribal governments to review the MAF. Under the program, local or tribal governments designate a liaison to review the portion of the MAF covering the area under their jurisdiction. The liaisons must treat the address lists as confidential information under Title 13 of the United States Code and participants must sign an oath promising to protect the

[6]From U.S. Census Bureau, 2006b.

confidentially of the addresses.[7] The Census Bureau sends the liaisons listings from the MAF (in either paper or electronic form), corresponding maps, and a tally of MAF records for each census block in their jurisdictions. In areas with city-style addresses, the liaison provides input regarding individual addresses on the list, as well as addresses missing from the list that should be added. The Census Bureau verifies this input and provides feedback to the participants about the results. In areas with non-city-style addresses (i.e., rural route and box number), the liaisons provide input regarding the completeness and accuracy of the housing unit counts for each block. The Census Bureau revisits the blocks identified as having a different number of housing units and provides feedback about the number of housing units found. Public Law 103-430 allows the local participants to appeal final Census Bureau decisions. While the LUCA program allows the Census Bureau to benefit from local review, local governments that provide the feedback do not receive comparable benefits. The restrictions on use of the MAF mean that new addresses included in the MAF cannot be incorporated into local databases. This restriction means that local governments must function with what may be erroneous or missing data. This limitation could actually result in the loss of life or property and discourages many local governments from providing feedback to the bureau.

MAF addresses and local parcels most often have a one-to-one relationship. If the county shows a home or business on its parcel map, there is at least one address that should be part of the MAF. Conversely, and especially for counties without a parcel map, MAF coordinates could provide the basis for a primitive parcel map.

3. *MAF/TIGER Accuracy Improvement Project (MTAIP)*. Under the MTAIP there will be a major improvement in the positional accuracy of the Topologically Integrated Geographic Encoding and Referencing (TIGER) line files and the location of residential dwelling units. In 2002 the Census Bureau awarded an eight-year contract to perform this project, which includes developing "a complete and current list of all addresses and locations where people live or work, covering an estimated 115 million residences, as well as 60 million businesses and other structures in the U.S. The TIGER portion of the project is a digital database that identifies the type, location and name of streets, rivers, railroads and other geographic features, and geospatially defines their relationships to each other, to the MAF addresses, and to numerous other entities."[8] In terms of this report and parcel data, the project represents a new approach to the way in which the bureau associates Census responses to the actual location on the ground.

The 1990 version of TIGER was a single integrated system of transportation features, hydrological units, and administrative boundaries that formed a set of census blocks. This approach forced an integration of several themes into a seamless wall-to-wall coverage of the United States. In preparation for the 2010 decennial Census, the bureau is taking a different approach. It is ingesting a wide range of local government street centerline data to improve the positional accuracy of TIGER to a standard of 7.6 meters (Broome and Godwin, 2003). At the same time it is creating a separate layer for residential structures that will be represented as points with an associated street address. The bureau plans to create these point-level representations by having Census employees armed with 500,000 hand-held global positioning system (GPS) units visit the front entrances of every dwelling in the United States. As a result, the federal government will be creating the type of address point layer depicted in the 1980 version of a multipurpose cadastre (Figure 4.6). However, unlike the TIGER line file representations of street features that include names and address ranges, this point-level layer will not be placed in the public domain, because of Title 13 of the United States Code.

[7]It should be noted that a local government may avoid any issues relating to Title 13 confidentially by simply providing a list of addresses to the Census Bureau with the understanding that it will receive no feedback.

[8]See *http://www.census.gov/geo/mod/maftiger.html* [accessed May 18, 2007].

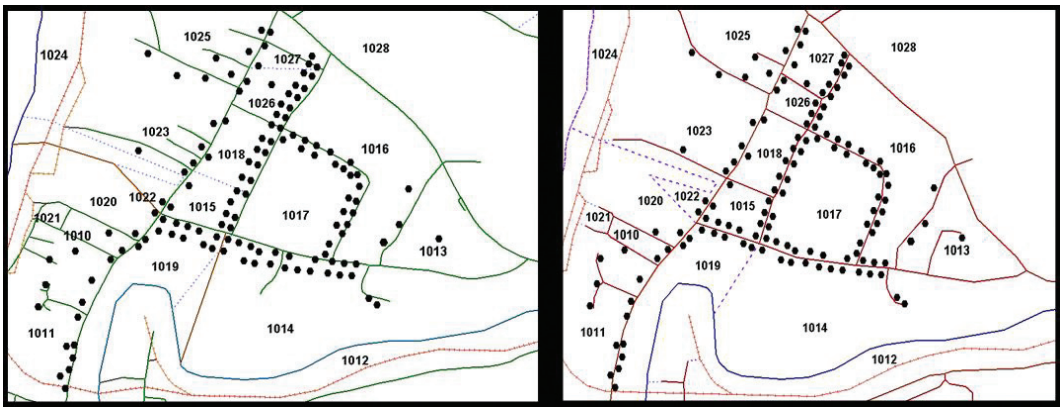

FIGURE 4.6 Example of how TIGER modernization procedures are improving point-level address locations to a minimum spatial accuracy of 7.6 meters to support field data collection with GPS: *left*, before realignment; *right*, after realignment. SOURCE: Krmenec, 2006.

4.1.4 Framework for Parcel Data Access and Distribution

In order to maximize the use of a nationally integrated system of parcel data it will be important to have a system that can dynamically and continuously acquire, support, and distribute geospatial data to a wide user community. The National Geospatial Program Office (NGPO) of the U.S. Geological Survey has been the focal point for this type of information service. In addition to staffing the FGDC, the NGPO also manages *The National Map* and Geospatial One-Stop programs. As stated on its website, *The National Map* is an "online, interactive map service . . . it provides public access to high-quality, geospatial data and information from multiple partners to help support decision making by resource managers and the public."[9] From the perspective of this report it is significant that the federal government has determined it appropriate to provide the technology that allows a broad user community to access, view, and even download a wide range of geospatial data from all levels of government. Since the technology supports a geographically distributed system of servers, individual counties and states can add their data to *The National Map*, and several county governments have already linked their parcel data to *The National Map*.

While *The National Map* is a federally supported system to generate interactive maps through a web browser, Geospatial One-Stop is a "geographic information system (GIS) portal that serves as a public gateway for improving access to geospatial information and data. Geospatial One-Stop is one of 24 E-Government initiatives sponsored by the Federal Office of Management and Budget (OMB) to enhance government efficiency and to improve citizen services."[10] This portal provides access to metadata records and links to various kinds of geospatial data. The Geospatial One-Stop initiative is a tangible example of the federal government's desire to move beyond providing national map products to the next level of technology support that would assist users in discovering and utilizing diverse geospatial data that are actually collected and maintained by all levels of government as well as the private sector.

As part of the larger federal involvement in geospatial information, *The National Map* and Geospatial One-Stop play an intermediary role in the flow of information. These programs do not

[9]See *http://nationalmap.gov/*.

[10]See *http://gos2.geodata.gov/gos/static/default/faq.htm* [accessed February 15, 2007].

actively produce or directly consume any geospatial information. In conjunction with the FGDC, the programs act to facilitate the discovery of and access to data. Therefore, they would be considered facilitators that form a linkage between the wide range of users and the producers of geospatial information, including parcel data.

4.1.5 Summary of Federal Parcel Programs

By reading all of the federal government circulars, mission statements, stewardship assignments, and program announcements described in Section 2.2, one could conclude that the United States has a comprehensive approach to parcel data. However, a detailed analysis of the situation suggests just the opposite. The FGDC has designated BLM to be the steward for federal land parcel data and the coordinator of cadastral data, and the FGDC Subcommittee for Cadastral Data, which the BLM sponsors, has made significant progress in terms of standards and coordination. However, it is difficult to ascertain the status of parcel data within the various federal agencies, and it appears that none of the federal land management agencies have a comprehensive and complete parcel data set for the lands they manage. NILS, which is the closest thing to a coordinated program, remains much more of a set of technologies than a source of parcel data. There is also evidence that many federal agencies that do not manage lands are acknowledging that they need parcel data to fulfill their missions and, in the absence of a national means to access the data nationwide, are creating data sets to meet their particular needs, often without coordination with other federal agencies that may have needs for the same or similar data. For example, the USDA's CLU program is generating subparcel data to monitor fraudulent crop insurance claims, and HUD has been collecting parcel data to deal with hurricane recovery along the Gulf Coast. DHS has been working recently to include a detailed specification for parcel data in its geographic data model. This is a tangible recognition of the essential role parcel data can play in improving the level of service from federal agencies.

4.2 INDIAN COUNTRY PARCEL DATA

Any national perspective on parcel data must include a discussion of the representation of land ownership on tribal lands. There are a total of 561 federally recognized tribes in the United States. The U.S. Department of the Interior Bureau of Indian Affairs (BIA) website reports that 55.7 million acres of trust lands are held for American Indians.[11] A report from the BIA's Land Title Mapper process indicates there are currently between 236,017 and 285,000 trust parcels mapped with a total GIS acreage of 37,878,202 and about 17,800,000 acres of unmapped land most likely found in the Eastern BIA Region, in Alaska, and on the Navaho Reservation (Colleen Keeling, BIA, personal communication to Frank Roberts, June 16, 2006).

The management of Native American lands in the United States is an extremely complex issue and the legal recognition of parcels is much different than for non-Indian-owned parcels. To understand the mapping of parcels in Indian Country one must understand the concept of trust ownership. Much of the Native American land in the United States is held in trust for the tribes or individual tribal members. Technically, the title of the land is not held by the tribe or individual but rather by the federal government. Therefore, the concept of ownership of trust land is not synonymous with other parcels in Indian Country.

When land is held in trust, no local or county taxes are assessed on the value of the land. In addition, the official record of survey is not kept on file with the local or county government. Often when a tribe purchases land (i.e., private nontrust land), it goes through a lengthy process to get the land put into trust status. This process can take years to complete. During this period these parcels are

[11]See *http://www.doi.gov/bureau-indian-affairs.html* [accessed February 15, 2007].

temporarily in the county tax rolls and hence mapped by the county or local government. Therefore, the creation of a national parcel framework will require inputs not just from local governments, but also from the federal government or tribes that track the parcel boundaries for Indian trust lands.

Within trust ownership there are two primary categories of parcels. The first category is tribal trust. In this category the lands are held by the federal government for the tribal government. Activities occurring on these lands are typically determined by the tribal government, much as a publicly held corporation makes decisions in the best interests of its stockholders. Activities occurring on these lands tend to be functions that benefit the tribe as a whole, such as casinos, timber land management, and other potential profit making ventures. Often, accurate tracking of these parcels and their boundaries is critical to the tribe. In addition, accurate mapping of these parcels may be very important for emergency response services.

The other category of trust land is tribal member allotments. The General Allotment Act of 1887 (Dawes Act) gave each individual head of household 160 acres of land on the reservation. Any remaining land on the reservation was opened up to non-Indian homesteading. Therefore, many reservations have vast amounts of non-Indian-owned land, and there may actually be more non-Indian land than trust land. Fractionated interest makes management on allotment parcels very difficult. Fractionated interest occurs when a tribal member passes away and interest in the allotment is divided among the heirs. Over the past century the amount of fractionation that has occurred is staggering. For example, on the Colville Reservation in Washington State, one 40-acre allotment has 400 individual allottees. Furthermore, these fractionated ownerships have no geographic dimensions. They are simply owned percentages of the original allotment. Since tribal members have deep ties to their allotments there is a strong desire for these parcels to be accurately mapped. Furthermore, since individual tribal members' homes are located on the tribal allotments it is important to represent them in any database used for emergency response. Unfortunately, in the current system the county database typically lists only the U.S. government contact. Finally, because of the federal government's trust responsibilities to tribes and tribal people, there are many legal issues with the release of trust parcel information. For example, the federal government and local tribes are not allowed to release the allotment owners' names.

The status of parcel data across Native American lands in the United States is very diverse. As with many local and county governments, creation of parcel data has taken several different paths. Ultimately, BIA and BLM have the official responsibility for creating and maintaining the parcel data and geodetic control for Indian Country. However, on most reservations these efforts have greatly lagged those in the local and county governments. At best, an antiquated version of digital parcel data exists for some tribes and is currently held by the BIA Geographic Data Service Center (GDSC). Until September 2006 the GDSC was a division of the BIA that provided GIS services to tribes. As of October 2006, those services have been provided by Office of the Chief Information Officer within a new BIA office called the National Geospatial Resource Center. The majority of up-to-date parcel GIS data is currently managed and maintained at the tribal level by tribal staff. There is no universal approach to parcel data creation on tribal lands. Some tribes have depended solely on the efforts of the BIA and BLM for their parcel mapping. These are often the tribes that have not developed other means of providing income for parcel creation or do not have resources on their lands that justify the investment of parcel mapping. Other tribes have taken the lead on the creation and upkeep of their parcel data. In many cases this has been driven by natural resource management activities such as forestry and farming. In other cases, the increase in land value has justified the tribe's investment in creating parcel data (e.g., Palm Springs Agua Caliente Tribe).

There has been a limited amount of resources and assistance available to tribes for surveys and parcel data creation. Some tribes with the knowledge of these resources have been able to successfully tap them to get better geodetic control and improved parcel locations. The majority of this

assistance has come from the BLM. The BIA GDSC has also developed a number of tools over the past 10 years to assist tribes in creating parcel data.

Example of Successful Land Records System at the Coeur d'Alene Tribe

An example of successful parcel creation program exists on the Coeur d'Alene Tribe Reservation in Idaho. The Coeur d'Alene Tribe's Reservation is approximately 343,208 acres in size, with trust land covering approximately one-third of the reservation. The tribe started its GIS program in the early 1990s and at that time acquired its initial trust parcel GIS data from the BIA GDSC. The primary thrusts of the GIS efforts were to support natural resource management on the reservation. In the mid-1990s the tribe took the leap of developing nontribal parcel data in watersheds of concern around the reservation. This was fueled by the needs of the Tribal Fisheries program. In the early 2000s the tribe completed the parcel fabric for the entire reservation, and the trust parcels GIS layer was merged with the non-trust parcels layer. In order to maintain that last effort, the tribe entered into Memoranda of Understanding (MOUs) with both counties in which the reservation is located. These MOUs have enabled the tribe to more effectively get updates of county data and to foster an environment of cooperation.

The success of the Coeur d'Alene Tribe has occurred because of four main components. The first component of successful parcel data development at the Coeur d'Alene Tribe is the institutional need for parcel data. The drive for parcel data has to be something that assists tribal programs and departments. For the Coeur d'Alene Tribe, the initial need was to assist the tribe with improving water quality for native cutthroat trout.

A second component of the successful parcel data program has been the desire of the counties and the tribe to work together. In the case of Coeur d'Alene Reservation, one county did not have any GIS data or the skills to create GIS data. This generated a need in the county assessor's office to work with the tribe and get an MOU in place. Once the MOU was in place the tribal GIS staff mentored the county assessor staff on how to update the parcel data and also provided technical support on how to use parcel data. The other county that did have GIS staff believed that the additional cooperation gained by an MOU would benefit the county and reduce duplication of effort. The need for up-to-date tabular information about parcel owners also increased the tribe's desire to work with the counties. Parcel data without up-to-date ownership information have little value. Now all three organizations share data on a regular basis.

Sufficient geodetic survey control on corners of the PLSS is another essential component of the parcel data creation in Indian Country. Due to the remote locations of most reservations, it is typical to have very poor geodetic survey control for the PLSS, and it is also expensive to establish such control. If parcel boundaries are anchored to this poor control, end users lose faith in the data. An equally important issue is that many reservations in the West have been allotted. This means that lands within the reservation boundaries were once surveyed and each tribal member was given a patent by the U.S. government. In many instances the records of the surveys of the allotments have been lost. Because these surveys were not recorded with counties, tribes, or the federal government, contemporary surveyors have been unaware of their existence. Furthermore, many of the corners set in the allotment surveys have been lost to farming and other destructive activity. Therefore, it is necessary to conduct new surveys to find or to reestablish corners of lands held in trust for the tribe.

In the western United States, the GCDB is the primary building block for parcel data. The BLM GCDB staff is continually improving the spatial reliability of GCDB data by incorporating new accurate resurveys of the PLSS into the database. However, in many places the GCDB is simply not accurate enough to encourage its use. Idaho has a nearly complete GCDB, and the Coeur d'Alene Tribe has been able to request numerous updates to the GCDB on the reservation to raise its accu-

racy to an acceptable level. In 2002, the BLM Cadastral Survey and the tribe worked together to improve the GCDB on the reservation.

Staffing is also critical in parcel data development. The Coeur d'Alene Tribe has more than 50 years of collective GIS experience, and three of the tribal GIS staff members have worked for the tribe for more than 10 years each. Two of the tribal GIS staff members have lived on the reservation most of their lives, and their knowledge of both the geography and the individuals on the reservation has made parcel data collection a success. Working relationships in Indian Country are typically face-to-face relationships, and trust comes with time invested in the tribal community. Understanding both county and tribal policy and politics is crucial for success.

The experiences of the Coeur d'Alene Tribe provide an excellent case study of what is possible when organizations agree to cooperate and share resources. Unfortunately, there are many more reservations that have not been successful at creating parcel data. The unique nature of land ownership on Indian lands and the substantial acreage involved highlight the need for the special attention that would be required to make any national system of land parcel data successful.

4.3 STATE AND LOCAL PARCEL DATA

The FGDC Subcommittee for Cadastral Data has performed an inventory of the current status of parcel data programs in the United States. Stage and von Meyer conducted surveys in 2003 and 2005 (Stage and von Meyer, 2003, 2006b). Their findings provide an interesting benchmark for such systems and are summarized in the following paragraphs. They estimate that there are about 144 million private land parcels in the United States and about 8 million publicly managed parcels. Of these, about 68 percent have been converted into digital representations. Stage and von Meyer estimate that there was about a 10 percent increase in the number of parcels that have digital data in the two years between the surveys due to an accelerated growth rate for parcel data programs, as well as further conversion of parcel data within existing programs. However, the status of parcel data conversion varies enormously across the nation. Digital parcel data programs are concentrated in only 24 percent of the counties. In fact, 19 states have converted 80 percent or more of their parcels to digital format. At the other end of the spectrum, more than three-quarters (2,389) of the counties in the United States do not have digital parcel data. The states of South Carolina, West Virginia, and New Hampshire are estimated to have only about 10 percent of their parcels converted. In effect, a major digital divide in terms of parcel data exists within the United States. Many communities such as DuPage County, Illinois, have maintained a digital parcel database since the 1970s, while more than 2,000 counties have land record systems that often rely on information recorded on paper maps and the memory of clerks.

Stage and von Meyer also found that all states, with the exception of Alaska, distribute the responsibility for collecting parcel data to local governments with varying degrees of oversight and support provided by a state agency. Twelve states indicated that they centrally manage parcel data and eight of these states indicated that the geometry is centrally managed. It is not surprising that states with statewide parcel programs have a much higher conversion rate (86 percent) than those that do not. Based on follow-up questions to the original survey, many states require local governments to submit all or a portion of their real estate tax information to a state auditing agency (typically the state department of revenue) that is responsible for ensuring equity of assessments across jurisdictions. Even though the data provided by the counties may not be in the form of a parcel GIS layer, the central reporting required in many states demonstrates that state-level coordination is being practiced.

The number of entities in a state that are responsible for collecting parcel data varies from less than 10 in Delaware, Hawaii, and Montana to more than 250 in Texas (253), Massachusetts (351), Vermont (255), Maine (500), and New Jersey (566). In most states the responsibility rests at

the county level, with a total of 2,925 counties acting as the primary responsible entity for collecting and managing parcel data. Eight states (Arizona, Arkansas, Florida, Maine, Montana, North Carolina, Oregon, and Tennessee) have taken on the responsibility for integrating or in some cases even developing parcel data. For example, in Montana, parcel boundaries are being maintained for 48 of 56 counties.

The 144.3 million privately owned parcels vary greatly in terms of density. The average number of persons per parcel is 2.0 (1.99) but ranges from 0.3 in Wyoming to 3.5 in New York. Another perspective on parcel density can be acquired by looking at the parcels per square mile. The average density is about 80 parcels per square mile. New Jersey and Rhode Island reported the highest parcel density with each having 373 parcels per square mile, and Alaska the least at 1.7 parcels per square mile followed closely by South Dakota at 4 parcels per square mile. Five states were at the lower end of the range, having densities of less than 10 parcels per square mile: Alaska (1.7), South Dakota (4), North Dakota (5), Montana (7), and Nevada (9). Four states were on the high end, having densities greater than 250 parcels per square mile: Connecticut (260), Massachusetts (281), Rhode Island (373), and New Jersey (373). The District of Columbia, which is the one representation of a 100 percent urban environment, reported 2,464 parcels per square mile.

By comparing Stage and von Meyer's 2005 survey with their 2003 survey it is possible to make some comparisons and to identify some trends:

- The number of parcels increased by 2 percent from 141.3 million to 144.2 million.
- The number of parcels converted from hard-copy maps or documents to digital format (points or polygons) increased from 61 to 68 percent.
- The persons per parcel remained about the same (1.99 versus 2.0 persons per parcel).
- The number of states with a large-scale orthoimagery program increased from 8 to 16 while the small-scale orthoimagery programs decreased from 30 to 22.
- Eighteen states indicated that they had some type of parcel management program to assist local governments. There appears to be an increased emphasis by states to support the efforts of local governments by acquiring large-scale imagery.

The conversion of parcel data into a format that can be used in a GIS continues to grow. An important part of this process is the acquisition of high-resolution imagery. Although the total number of parcels converted is approaching 70 percent, it seems likely that most of the conversion to digital format is taking place in the more urban areas and considerable effort will be required to assist the remaining counties. The experiences in Montana and Tennessee provide evidence that states can play a key role not just in coordination but in actual production of parcel data. While state government can play an important role in the initial creation of parcel data, experience demonstrates that even small counties can gain considerable benefits from maintaining and using their own parcel data. In fact, in many rural counties the parcel data can be integrated with USDA's common land units to monitor agricultural activities.

There are many examples of effective parcel data programs at the state and local levels. Table 4.1 summarizes a sampling of these programs.

TABLE 4.1 Examples of Online Parcel Data Systems at the State, County, and City Levels

Host	Website	Details
State of Arkansas	GeoStor *http://www.geostor.arkansas.gov/Portal/index.jsp*	GeoStor serves as the State of Arkansas' geospatial data clearinghouse. The system provides the state a consolidated hosting service for interactive Internet mapping. The system enables local, state, and federal agencies to store, publish, and distribute GIS data they produce for other organizations to use. The data can be searched, accessed, and retrieved for users to analyze in their own software. This cost-saving approach eliminates duplication of effort
State of Montana	Montana Cadastral Mapping Site *http://gis.mt.gov/*	This project is a unique intergovernmental collaborative program that produces and maintains parcel information in a consistent digital format for the entire state. The system is the foundation for the Montana Department of Revenue CAMA. In addition to demonstrating the feasibility of a statewide approach to parcel coordination, Montana has been a test bed for integrating the Bureau of Land Management GCDB with the Census Bureau's TIGER modernization plans
State of North Carolina	NC OneMap *http://gisdata.usgs.net/website/NC_OneMap/viewer.asp*	This system serves as an excellent example of how a state government can act as an intermediary between local providers and the user community. While each participating data provider stores and controls the release of its own parcel data, it can enlist the resources of the North Carolina Center for Geographic Information and Analysis to distribute the data. Since the NC OneMap portal is a partner in *The National Map* program it demonstrates the kind of flexibility that is possible with today's technology
State of Tennessee, Division of Property Assessments	State of Tennessee Comptroller of the Treasury Real Assessment Data *http://www.comptroller.state.tn.us/cpdivpa.htm*	The Tennessee Division of Property Assessments operates a statewide computer-assisted tax billing system and a long-range program for periodic reappraisal of locally assessed real property. As part of this program the state actually creates and maintains county-level parcel data to "ensure county property ownership maps are accurate and current so assessing officials can correctly locate property boundaries and related information." It updates parcel maps for 52 of the 95 counties. This is an important example of how a state agency has built parcel data to meet programmatic needs
Boulder County, Colorado	e-Maps *http://map.co.boulder.co.us/basemap/default.jsp*	Since 1987, parcel-oriented GIS technology has become an integral part of almost all of Boulder County's governmental functions. These include property assessment; land use and zoning issues; road construction and maintenance; emergency and law enforcement; snow plowing; open-space acquisitions, operations, and management; wildfire mitigation; health concerns; and precinct delineation

TABLE 4.1 Continued

Host	Website	Details
Delaware County, Ohio	DALIS Web *http://66.195.233.210/map.aspx?INITHEME=General*	The DALIS project was established in 1994 by the Delaware County auditor. Since then, the division has been recognized for its innovative use of parcel data to support an equitable property tax system and integrate parcel data with many other applications relating to planning, emergency response, and economic development. Every two weeks updated versions of the parcel data are posted on the website for free and anonymous distribution
County and City of Honolulu, Hawaii	Honolulu Land Information System (HoLIS) and Hawaii's Economic Development Property Locator Geographic Information System *http://gis.hicentral.com/*	The City and County of Honolulu have built a comprehensive parcel-based system for Oahu. The parcel data are the core of an extraordinary range of planning and emergency response applications. Hawaii's Economic Development Property Locator Geographic Information System locates available commercial real estate property and generates different types of demographic and business reports
King County, Washington	Parcel Viewer *http://www5.metrokc.gov/parcelviewer/Viewer/ KingCounty/Viewer.asp*	King County, Washington's GIS is one of the most comprehensive parcel data systems in the Northwest region. Through its website a user can access several parcel retrieval and mapping applications
Louisville and Jefferson County, Kentucky	Louisville/Jefferson County Information Consortium (LOJIC) *http://www.lojic.org/apps/index.htm*	LOJIC represents an example of a successful multiagency effort to build and maintain a comprehensive multipurpose parcel-based GIS that meets the need for property assessment as well as the concerns of the regional water and sewer districts. All participants are sharing the cost and effort involved in the full development and implementation of LOJIC
Oakland County, Michigan	Oakland County Enterprise GIS *http://www.oakgov.com/gis/*	The Oakland County Enterprise GIS is a multifaceted parcel data program that supports and promotes coordinated data development and access across jurisdictional and departmental boundaries. Oakland County has worked with the FGDC Subcommittee for Cadastral Data to develop and test a contemporary parcel data model. It also developed a series of popular value-added services that provide revenue to support its program
Wake County and City of Raleigh, North Carolina	iMaps *http://imaps.co.wake.nc.us/imaps/*	Raleigh and Wake County North Carolina have established a coordinated approach to GIS that enables them to share the cost of data, training, and joint application development activities. The coordinated city-county approach eliminates redundant activities and ensures that information is current and accurate throughout the county. The close working relationship that exists within the county is often cited as a model for intergovernmental coordination. Wake County and the City of Raleigh also participate in NC OneMap (described above) and *The National Map* program

continued

TABLE 4.1 Continued

Host	Website	Details
City of Milwaukee, Wisconsin	MPROP *http://www.city.milwaukee.gov/display/router.asp?docid=3480*	MPROP is a computerized inventory of all properties in the City of Milwaukee. It contains more than 90 elements of data describing each of the approximately 160,000 properties in the city. The file was created to provide current and accurate property information with enough flexibility to be accessed in a variety of ways. Since it was implemented and made available, the data are used by nearly every city department including law enforcement, elections, taxation, and planning
Minneapolis and St. Paul, Minnesota	MetroGIS *http://www.datafinder.org/cafe/index.asp*	MetroGIS is a collaborative parcel data effort of local and regional government in the seven-county area that focuses on the Twin Cities of Minneapolis and St. Paul. MetroGIS serves as a model for regional coordination of parcel data and demonstrates how such collaborations can benefit a community. Through its Datafinder.org, MetroGIS provides access to more than 142 data sets and 177 searchable metadata records. This includes the geometry and 65 attributes for nearly 1 million parcels. MetroGIS has implemented a collaborative parcel-level approach to regional issues that include transit and sewer services for the region. It is also used to assist with public health issues, bus routing, and long-range planning. The Metropolitan Council's data sharing agreements with the counties allows no-cost access to the regional parcel data set by any government (local, regional, state, and federal) or academic institution in the nation. These organizations can now acquire data for a single county or the entire region from a single site
City of Portland, Oregon	Portland Maps and GIS *http://www.portlandonline.com/index.cfm?c=cibda*	The City of Portland has implemented a parcel-oriented enterprise model across several application domains. The enterprise model employs a centralized hub of data and mapping servers and provides GIS services to city agencies and the public at large

NOTES: CAMA = Computer Assisted Mass Appraisal System; GCDB = Geographic Coordinate Data Base; DALIS = Delaware Appraisal Land Information System; MPROP = Milwaukee Master Property File.

4.4 PRIVATE SECTOR PARCEL DATA SYSTEMS

There are a number of firms in the private sector that are actively creating parcel data sets. The needs for parcel data can be divided into applications that require accurate geographic location for the address of the property and those that require detailed attributes about the ownership, use, and value of the property. There is a robust market for each of these application areas, and a sample of each of these types of companies is listed in Table 4.2. The firms that offer digital geographic files that support address locating services and vehicle navigation are listed first in the table, and the customers for these reference files include major U.S. companies such as Microsoft, Google, and MapQuest that support location-based services for thousands of clients. Companies dealing with location-based services are concerned only about the association between a street address and geographic coordinates, not about attributes of the building or property. The second set of com-

TABLE 4.2 Sample of Firms That Offer Parcel-Based Information

Company	Product	Points or Polygons	Internal Use / Distributed	Coverage
Firms that support improved address location and navigation				
NAVTEQ	ParcelBoundaries	Polygons	Distribute	U.S.
Tele Atlas	Address Points	Points	Distribute	U.S.
First American	ParcelPoint	Points and polygons	Both	U.S.
GDR	Addresspoints	Points	Distribute	U.S.
Proxix	PxPoint	Points and polygons	Both	U.S.
Firms that provide parcel information and boundaries				
Boundary Solutions	National Parcel Portal	Polygons	Distribute	U.S.
Parcel Quest	ParcelQuest	Polygons	Distribute	California
Sidwell Maps	Digital Tax Maps, Shapefiles	Polygons	Distribute	Illinois, Iowa, Indiana, Michigan, Minnesota
eMapsPlus	Digital Tax Maps	Points	Distribute	California, Alabama, Florida, Tennessee, Michigan, Missouri, Mississippi, Georgia, New Mexico, South Carolina
Netronline	Digital Tax Maps	Polygons	Distribute	U.S.

panies in Table 4.2 concentrates on detailed information about the property. Customers for these products are concerned about various aspects of insuring, financing, exchanging, and developing property and thus include major insurance companies, lending institutions, real estate brokers, and title companies. Some firms such as Proxix and First American provide a range of vertical markets that involve internal uses of the data as well as distribution. Box 4.2 lists marketing comments from these firms, which provide a clear image of their desire to build national parcel data sets.

Therefore, in the absence of any coordinated public sector effort, market forces are pushing for rapid completion of a national approach to parcel data. In fact, over the next couple of years we are likely to see several competing versions of databases that provide a link between at least a point-level representation of a parcel and a street address for the developed parts of the United States. This is being driven in part by the need for accurate address location systems, as highlighted by the following (W. Gail, e-mail to D. Cowen, May 1, 2007):

> The customers who utilize our Virtual Earth application currently demand that we correctly associate a street address to the proper features displayed in the imagery. Ultimately, the ability to distinguish even among multiple entryways into a single building will be required—particularly for business and emergency responder uses.

However, while this type of parcel information has great value for the location-based service industry and even public systems such as 911 that require accurate address locating systems, it does not meet the full suite of needs and demands for parcel information as described in Chapter 3 of this report. First, it is highly unlikely that the private sector would have the necessary motivation or financial incentives to create a complete coverage of parcel data across the United States. This point was emphasized by the private sector representatives at the Land Parcel Summit held as part of this study. Next, the committee believes that it is important to have a parcel data system operate within the controls of public sector accountability. Finally, it should be noted that private sector efforts are

BOX 4.2
Statements from Private Industry Companies Developing Parcel Data Sets

"PxPoint provides you with these unique geocoding capabilities: Geocode to a layer of any feature type—point, lines, or polygons. Geocode to parcel boundaries for the most accurate geocoding available in the U.S." SOURCE: *http://www.proxix.com/products/products_geocoding.htm* [accessed May 16, 2007].

"Boundary Solutions Inc. assembled the National ParcelMap Data Portal, or NPDP, the most extensive normalized database of parcel map data released for general use from jurisdictions throughout the United States. Finally, there is a single source of national parcel boundary-based location data to improve the accuracy, throughput and usefulness of your GIS operations." SOURCE: *http://www.boundarysolutions.com/* [accessed June 10, 2007].

"First American, the $8-billion leader in property information for the banking and insurance industries, has created a new solution that combines parcel and address information with exact latitude and longitude. The result? The most accurate database of property locations in the U.S." SOURCE: *http://location.firstam.com* [accessed June 10, 2007].

"The Tele Atlas Address Points product delivers the ultimate in accuracy by pinpointing discrete, actual street addresses to physical buildings or property parcels. This enables unparalleled geospatial analysis and navigation and offers users a faster, more precise method of locating addresses." SOURCE: *http://www.teleatlas.com/stellent/groups/public/documents/content/ta_004881.pdf* [accessed June 10, 2007].

"Our users save time with the convenience of our online maps and parcel information. No more wading through page after page of atlases to find the map you need; no more struggling to make a copy of a parcel map." SOURCE: *http://www.sidwellmaps.com/access_info_sidwellmaps.asp* [accessed June 10, 2007].

"Digital images of parcel maps from county assessing agencies. Not all maps are available in all areas. May be searched for by address or parcel number. Those who have signed up for our Professional Users service may also search by name." SOURCE: *http://www.netronline.com/products.asp?s=5* [accessed June 10, 2007].

"eMapsPlus is the most advanced online service available for accessing GIS property data. This powerful tool is perfect for the specific needs of the casual user as well as the wider, on-going commercial requirements of property related businesses." SOURCE: *http://www.emapsplus.com/* [accessed June 10, 2007].

"Addresspoints is a highly precise dataset that accurately displays rooftop level U.S. residential and commercial buildings with optional consumer and business data attributes enabling both precise routing to a building location as well as site-specific intelligence. Addresses are individually located by point and building structure on each map (not just estimated or geocoded), to display every structure in its actual location via a rooftop point." SOURCE: *http://www.gdr.com/solutions_addresspoints.htm* [accessed June 10, 2007].

"NAVTEQ Parcel Boundaries™, a collection of property boundaries encompassing over 50% of the US population. Never before have parcel boundaries been assimilated and standardized to the extent NAVTEQ Parcel Boundaries have, enabling use across a wide spectrum of industries while greatly improving decision criteria for land related visualization, analysis, and reporting." SOURCE: *http://news.thomasnet.com/fullstory/498996* [accessed June 10, 2007].

"ParcelQuest CD and ParcelQuest Online include the clearest parcel maps on the market. With ParcelQuest, even tiny lot dimensions are easy to read! Enlarge, rotate, print, and even measure to calculate lot area all with the click of the mouse. Print full maps or blow-up sections to fit any paper size. Include them in your reports to make lasting impressions!" "ParcelQuest contains County Direct Assessor data. Why? Because the Assessor is the only source that can physically verify property information! National property database companies outsource complex documents to offshore data entry plants. Recorded documents can, and do, frequently contain incorrect information. These facilities have no way to verify their information. Only the Assessor has the expertise to correct errors." SOURCE: *http://parcelquest.com/parcelquestmaps.html*, *http://parcelquest.com/data_better.html* [accessed June 10, 2007].

usually just aggregations of already digitized, publicly available data. Their efforts do not address communities for which no digital data exist or where their distribution is highly restricted.

4.5 INTERNATIONAL CONTEXT

To provide context for the current status of parcel data in the United States, the international status was also assessed. One of the important organizations that monitors the status of national parcel data programs and promotes their modernization has been the International Federation of Surveyors (FIG). In 1998 FIG produced a report entitled *Cadastre 2014: A Vision for a Future Cadastral System*, which it describes as follows (Kaufmann and Steudler, 1998):

> Cadastre 2014 is a methodically arranged public inventory of data concerning all legal land objects in a certain country or district, based on a survey of their boundaries. Such legal land objects are systematically identified by means of some separate designation. They are defined either by private or by public law. The outlines of the property, the identifier together with descriptive data, may show for each separate land object the nature, size, value and legal rights or restrictions associated with the land object.

The FIG report includes a summary of a list of six statements that it considers to be the trends that will exist in modern cadastre systems (Box 4.3).

The concept of a federally maintained cadastre is firmly planted in many nations and is closely associated with the way public services are provided in those countries. The most notable survey of federal parcel-level programs has been conducted by the Centre for Spatial Data Infrastructures and Land Administration, Department of Geomatics, University of Melbourne. Individuals from that center and the Centre for International Cooperation, Swiss Federal Directorate of Cadastral

BOX 4.3
Projections of the Status of Cadastre Systems in 2014

Statement 1— Cadastre 2014 will show the complete legal situation of land, including public rights and restrictions.

Statement 2— The separation between "maps" and "registers" will be abolished. (The division of responsibilities between surveyor and solicitor in the domain of cadastre will be seriously changed.)

Statement 3— "Cadastral mapping" will be dead. Long live modeling! (In 2014 there will be no draftsmen and cartographers in the domain of the cadastre.)

Statement 4— "Paper and pencil cadastre" will have gone. (The modern cadastre has to provide the basic data model. Surveyors all over the world must be able to think in models to and to apply modern technology to handle such models.)

Statement 5— Cadastre 2014 will be highly privatized. Public and private sectors are working closely together. (Public systems tend to be less flexible and customer oriented than those of private organizations. The private sector will gain in importance. The public sector will concentrate on supervision and control.)

Statement 6— Cadastre 2014 will be cost recovering. (Cost/benefit analysis will be a very important aspect of cadastre reform and implementation. Surveyors will have to deal more with economic questions in the future.)

SOURCE: Adapted from Kaufmann and Steudler, 1998, pp. 15-25.

Surveying, have been assessing the status of national cadastres throughout the world. In a recent article, "Assessing the Worldwide Comparison of Cadastral Systems" (Rajabifard et al., 2007), the researchers provided the best available status report on national cadastre efforts. They conclude (Rajabifard et al., 2007, p. 275):

> There is growing interest internationally in land administration and cadastral systems and especially in their role as part of a national Spatial Data Infrastructure (SDI). The important role the cadastre plays in supporting sustainable development is also well recognized. Both developed and developing countries accept the need to evaluate cadastral systems to help identify areas of improvement and whether their systems are capable of addressing future needs. Countries are continually re-engineering and implementing various aspects of the cadastre, comparing systems and trying to identify best practice within nations of the same socio-economic standing.

In 2006, 34 nations had completed a standardized template that requests information about land policy, laws and regulations, land tenure, land administration and cadastre, institutional arrangements, spatial data infrastructures, and technology as well as human resources and capacity. These nations range from Australia, Denmark, Belgium, Germany, Switzerland, and Sweden to Namibia, Uzbekistan, and Nepal. The authors concluded (Rajabifard et al., 2007, p. 285):

> In terms of the completeness and usefulness of spatial cadastral data within countries, only 10 countries (Belgium, Brunei, Czech Republic, Denmark, Germany, Hungary, South Korea, the Netherlands, Sweden and Switzerland) reported total coverage of their cadastral records. Data also showed that countries with a low level of completeness of registration had a high level of illegal occupation of land (with the exception of Japan).

One of the most important recent events to focus on the status of cadastral systems on an international scale was the 2004 Special Forum on Development of Land Information Policies in the Americas. This forum was sponsored by the International Federation of Surveyors, the United Nations Statistics Division, Department of Economic and Social Affairs, and the Permanent Committee on Spatial Data Infrastructures for the Americas (PC IDEA). It was hosted by the Mexican government's National Institute of Statistics, Geography and Informatics (INEGI) in Aguascalientes, Mexico. A keynote address at this meeting "Building Land Information Policies" (Enemark, 2004) provided a useful conceptual model of the importance of cadastre systems from a national perspective. As noted in Figure 4.7, in this model a cadastral system forms the basis for land value, land use, taxation, and development and supports a host of important societal needs including economic growth and land tenure. Enemark also suggests that a land information system based on the cadastre is required for sustainable development that incorporates effective land management and markets (Figure 4.8).

In contrast to the United States, Denmark represents an example of a strong centralized approach to parcel data management. At the national scale, Denmark maintains a cadastral map series that includes property boundaries, administrative boundaries, and other features. These maps have been in digital form since 1997 and have been created and maintained according to an accepted national specification for digital cadastral maps. While it is difficult and perhaps inappropriate to compare the situation in the United States with that in Denmark (Denmark is 43,094 square kilometers, or twice the size of Massachusetts, and has a population of 5,468,120; CIA, 2007), it is interesting to see how a parcel-based approach to information management can be implemented to great advantage on a national scale.

The United Kingdom provides an interesting contrast to the United States in the area of point-level address files. Unlike the confidential nature of the Census Bureau's new point-level address files, the Ordnance Survey (OS) in the United Kingdom maintains an official commercially licensed point-level representation of property and associated addresses (Figure 4.9):

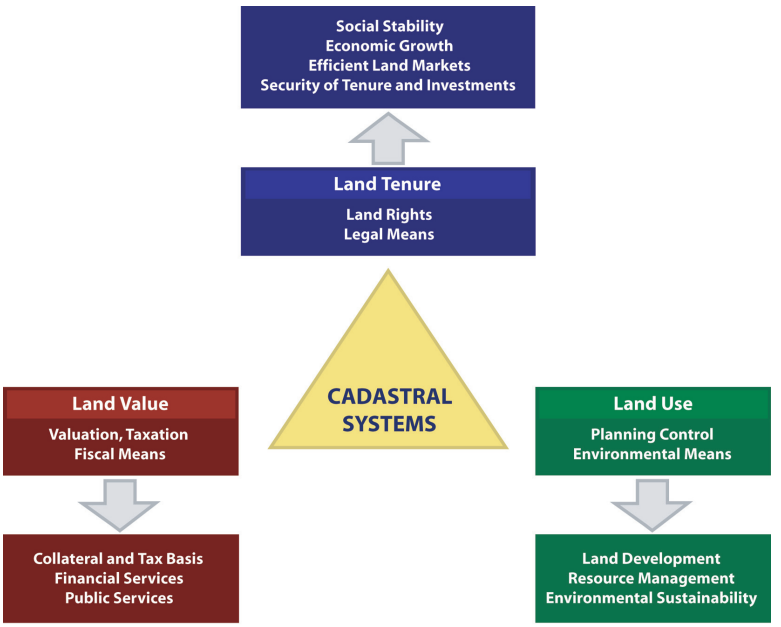

FIGURE 4.7 Conceptual model of the importance of the cadastral system. SOURCE: Enemark, 2004. Used with permission.

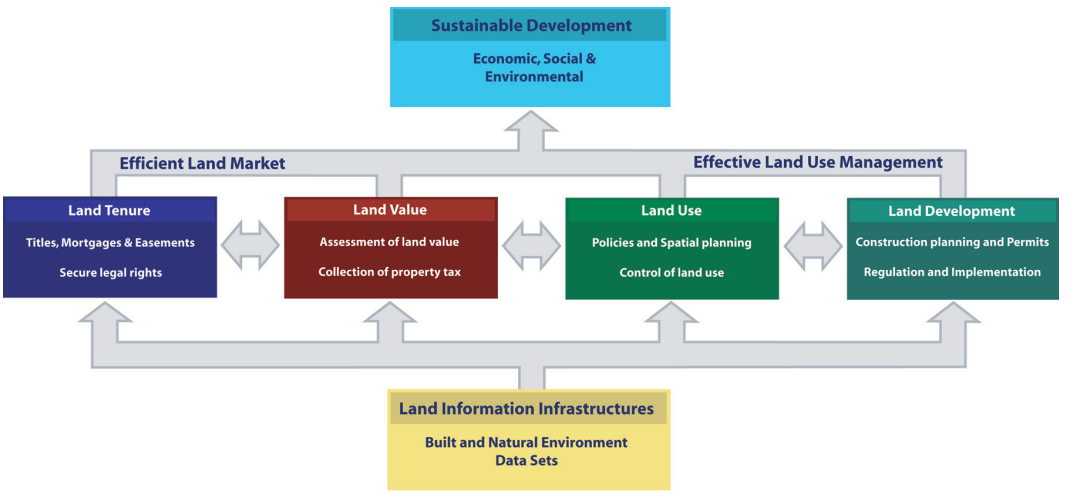

FIGURE 4.8 The relation of land information to sustainable development. SOURCE: Enemark, 2004. Used with permission.

FIGURE 4.9 An example of the U.K.'s OS MasterMap Address Layer overlaid on the OS MasterMap Topography Layer. Image courtesy of U.K. Ordnance Survey. Copyright 2007 Crown copyright Ordnance Survey. All rights reserved.

> The OS ADDRESS-POINT is a dataset that uniquely defines and locates residential, business and public postal addresses in Great Britain. It is created by matching information from Ordnance Survey digital map databases with more than 26 million addresses recorded in the Royal Mail® Postcode Address File (PAF®). Each address has a unique Ordnance Survey ADDRESS-POINT reference (OSAPR). In addition, ADDRESS-POINT carries a status flag to define the quality and accuracy of each address as well as indicators for change and source currency.[12]

The address point file is also used as the basis for Her Majesty's Land Registry. A quick view of that website provides a startling contrast with the role of the U.S. government in the entire process

[12]From *http://www.ordnancesurvey.co.uk/oswebsite/products/addresspoint/* [accessed May 25, 2007].

of land records. For example, the site is maintained under Crown Copyright and provides a set of fee-based services to meet the needs of various users. Her Majesty's Land Registry also provides a House Price Index.[13]

At another scale in Europe, the European Union recently established the Permanent Committee on Cadastre. The mission of this organization is:

> To create an adequate space in which to promote the full awareness of the activities developed by the European Union and the Member States related with Cadastre and, by means of this information, to develop strategies and propose common initiatives with the aim of achieving greater co-ordination among the different European cadastral systems and their users.[14]

There are two other activities in Europe that are also of interest. One is the series of "REGNO" conferences that provide a forum for voluntary efforts to coordinate and eventually integrate national registers (including cadastres) in northern Europe.[15] Second, the United Nations Economic Commission for Europe Working Party on Land Administration promotes land administration through security of tenure, establishment of real estate markets in countries in transition, and modernization of land registration systems in advanced economies.[16]

It would be impossible in this report to cover the full range of international government responses to the cadastre and land records. While their systems of government and distribution of federal, state, and local powers may differ from those of the United States, the experiences in Australia and Canada provide useful benchmarks for developed nations outside Europe.

Australia

The Australian experience provides an interesting example of public and private cooperation. Public Sector Mapping Agencies of Australia (PSMA) is a unique public-private partnership whose core business is the assembly and delivery of fundamental spatial data sets of Australia. To date, it has developed five national data sets and supplies data to more than 20 value-added resellers. A good description of the organization, its history, and its current mandate may be found in Holland et al. (2006), and its 2005-2008 strategic plan can be downloaded from the web.[17]

PSMA's portfolio of themed spatial data sets includes CadLite, Australia's 10.5 million land parcels including suburb names as well as property boundaries. (See Figure 4.10 for a PSMA map of parcels.) Today, through special licenses and using industry partners, PSMA assembles these data sets from state and commonwealth government sources across the country. Separate licensing arrangements with Australia Post and the Australian Electoral Commission cover use of address data. The success of PSMA relies to a large extent on the strength of its relationships with key stakeholders. These stakeholders include government shareholders, government agency data suppliers, and national coordinating forums such as the Spatial Information Council of Australia and New Zealand.[18] PSMA does not provide its data at no charge. Rather, its pricing reflects the value of each data set in different applications. The intention is to ensure that high-value products are

[13]For the U.K. Land Registry, see *http://www.landreg.gov.uk/* [accessed May 25, 2007].

[14]See *http://www.eurocadastre.org/eng/about2.html* [accessed February 15, 2007].

[15]See *http://www.vaestorekisterikeskus.fi/vrk/home.nsf/pages/0B4801132155BD9DC22572C9004570B8* [accessed May 4, 2007].

[16]See *http://www.unece.org/hlm/wpla/welcome.html* [accessed May 4, 2007].

[17]For the for the PSMA 2005-2008 Strategic Plan, see *http://www.psma.com.au/file_download/19* [accessed February 15, 2007].

[18]This was formerly known as the Australia New Zealand Land Information Council, or ANZLIC. Even though the name has changed, it has kept the acronym ANZLIC. For information about ANZLIC, see *http://www.anzlic.org.au/about.html* [accessed February 15, 2007].

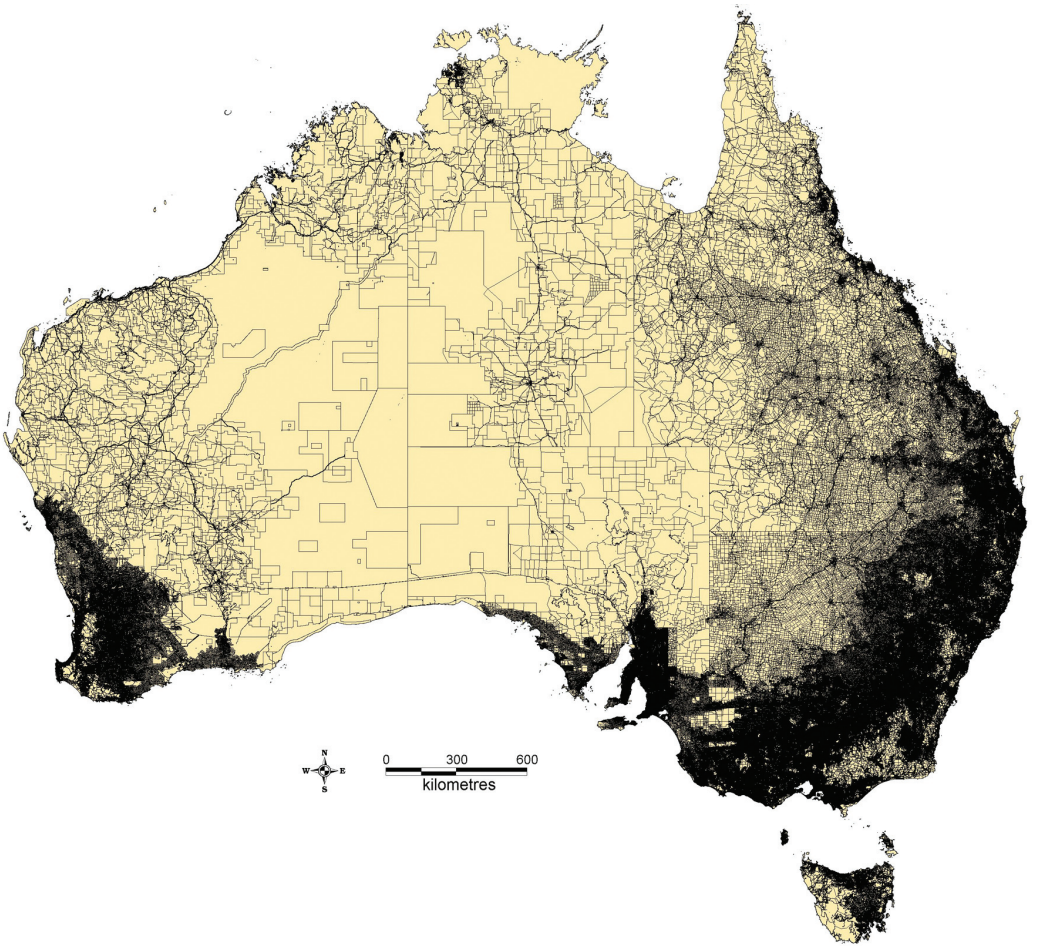

FIGURE 4.10 PSMA map of land parcels in Australia. Note the density of parcels in the more populated areas along the coast, while some parcels in the middle of the country are large enough to be discernible, even at this scale. Image copyright PSMA Australia, 2001, *http://www.psma.com.au*. Used with permission.

reflected in the pricing matrix, while also facilitating opportunities to have the data used ubiquitously in low-price digital products. A dual fee structure applies to PSMA data sets. Annual access fees and royalties are based on a matrix of data type, data volume, user applications, and number of users. On the other hand, many of the PSMA data sets provided to value-added resellers end up as part of the base data available on well-known web mapping services such as Google Maps and many others (see Figure 4.11). In effect, the Australians have managed to create a nationwide parcel data system by establishing a business model that is similar to one used by many regional governments in the United States. However, in this case a private enterprise has been established to handle the consolidation of data from the equivalent of state governments in the United States. The company has been able to develop value-added products that generate revenue that is shared with the state and local governments. It should be noted that the Australian Census Bureau funded (and continues to provide some funding for) the first national land parcel file. The Geocoded National Address File was funded later from the consortium using funds generated from the national land

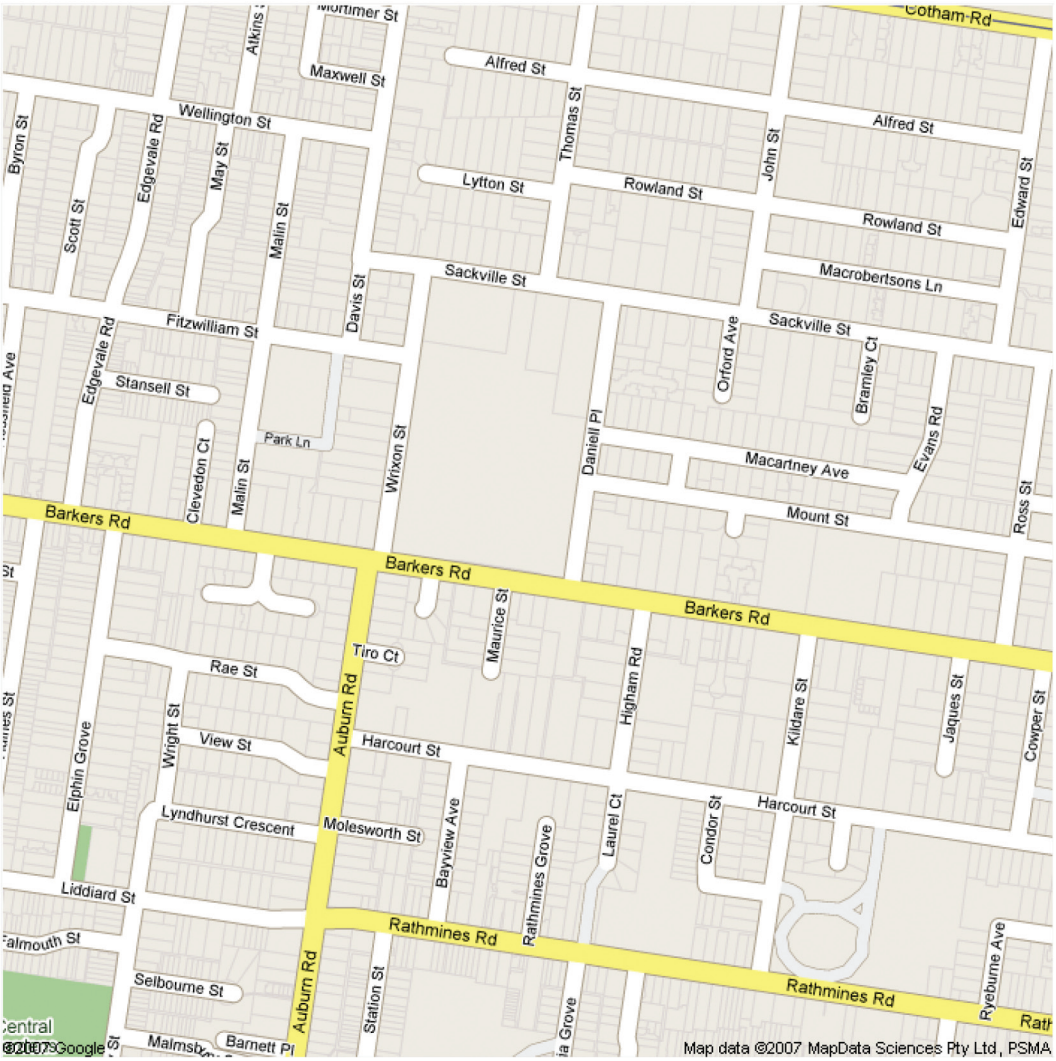

FIGURE 4.11 Example of parcel data from Australia available via Google Maps. Note PSMA listed as a source of data in the lower right. Map courtesy Google Maps™, copyright 2007, MapData Sciences Pty Ltd (*http://www.mapds.com.au*), PSMA.

parcel file. This is an interesting model that demonstrates the value of spatial data and the technical efficiencies that are possible. However, the Australian private sector model would appear to be contrary to the general U.S. federal policy regarding the dissemination of geospatial data under OMB Circular A-130.

Canada

Canadian federal and provincial government organizations have a long history of building and maintaining digital topographic mapping data sets, road network files, and property mapping databases in support of their own respective mandates and obligations. Beginning in the mid-1980s,

cooperative cost-sharing arrangements at both the federal and the federal-provincial levels were developed in support of accelerating several of these mapping programs (Coleman, 1999). Since 1996, a collection of these organizations has been instrumental in establishing and developing the Canadian Geospatial Data Infrastructure (CGDI) Initiative. Geomatics Canada,[19] an organization within the Earth Sciences Sector of Natural Resources Canada (NRCan), has the mandate for provision of nationwide geodetic control and topographic mapping frameworks. It is also responsible for the land survey system and cadastral mapping on Canada Lands.[20] Except for Canada Lands, provincial governments[21] are usually responsible for production and distribution of cadastral (property) mapping, while property valuation and taxation may be either a provincial or a local responsibility. Excellent integrated examples of such activities may be found in most provinces, although they may not be immediately apparent from the government websites since many service their customers on a password-protected, subscription basis. The Province of New Brunswick, for example, was the first provincial (or state) organization in North America to provide province-wide web-based property mapping, valuation, and registry-related data to its customers beginning in fall 1996 (Arseneau et al., 1997). Now managed by Teranet, Inc., the Province of Ontario's system provided from the early 1990s onward a very early example of using public-private partnerships to build a province-wide digital cadastral database.[22]

In partnership with other government organizations, the Legal Surveys Division[23] of NRCan supports the operation of the federal and territorial property rights systems on Canada Lands. Internally, various local, provincial, and even federal organizations have responsibility for managing their own properties and may originally obtain basic information from the relevant organization in the province(s) in which they operate. However, most will subsequently update their own attribute records and, in some cases, offer property map databases on their own websites. Large title insurance companies also maintain extensive property mapping databases covering selected parts of Canada. While communication exists through strong professional networks and informal relationships, there is no requirement at this time for regular operational contact between the land administration organizations in different provinces.

The Canadian government is also studying the feasibility of creating a comprehensive nationwide cadastral database or a national approach to land parcel data. In October 2006, NRCan's GeoConnections Secretariat collaborated with federal and provincial partners in issuing a Request for Proposals (RFP) to contract development of the business case for parcel data. Many of the goals of the RFP parallel those of this study. These include a user-needs analysis and cost-benefit analysis to help guide different levels of government in determining the various options for establishing a National Parcel Data System (or NPDS). Aside from possible internal initiatives, there had been no formal effort within Canada until 2006. The rationale of the partners involved was that "access to a national parcel database and integration of that data with other data sets within the CGDI would help improve coordination among CGDI user communities and would support decision making" (GeoConnections, 2006). The project was awarded in November 2006 and was still under way at the time this document was being prepared.

[19]Geomatics Canada website available at *http://ess.nrcan.gc.ca/geocan/index_e.php* [accessed February 15, 2007].

[20]Canada Lands consist of approximately 2,600 Indian reserves, the National Parks system (including historic sites and canals such as the Rideau and Chambly), the Yukon, Northwest Territories, Nunavut, and offshore areas of Canada.

[21]For a list of links to provincial government mapping organizations in Canada, see *http://www.geoconnections.org/CGDI.cfm/fuseaction/partners.welcome/gcs.cfm* [accessed February 15, 2007].

[22]For a description and examples of Teranet's current services to the real estate industry in Ontario, see *http://www.teranet.ca/services/realestate.html* [accessed February 15, 2007].

[23]For details on the Legal Surveys Division, see *http://www.lsd.nrcan.gc.ca/english/index_e.asp* [accessed February 15, 2007].

Clearly, the respective distributions of government powers in Australia and Canada differ from that found in the United States. Parcel mapping and land registration is almost fully a state or provincial government responsibility in both of those countries, offering more centralized control of the processes and standards involved, and meaning that there are fewer parties involved in trying to reach consensus on national initiatives. All Australian states, the western Canadian provinces, much of Ontario, and most recently, New Brunswick use a land titles rather than a deed registry system, implying a stronger parcel-based focus and smoothing the way toward more comprehensive and ongoing recording of all real property transactions in a given jurisdiction.

However, there is evidence of past practices in both countries suggesting duplication of parcel data collection efforts, different government departments and private companies maintaining their own parcel databases, and lack of shared standards among different jurisdictions. While there may be much left to do in both countries, Australia and Canada are examples of cooperative national initiatives that have begun processes to (1) recognize these past practices; (2) overcome them where appropriate; and (3) develop policies, practices, and incentives to create shared products and services that are accessible nationally.

As shown above, in many parts of the world a national system of land parcel information is viewed as a key part of the foundation of government services. In contrast, for a number of historic, geographic, and legal reasons, parcel- or cadastre-level information within the United States has not been viewed as a federal responsibility. However, it should be noted that the United States has devoted large sums of federal tax dollars to the U.S. Agency for International Development (USAID) and the World Bank to fund parcel data programs in other nations. The full extent of USAID involvement in funding land parcel and cadastre programs is difficult to measure; however a recent study provides an interesting overview of programs in sub-Saharan Africa, Asia and the Near East, Eastern Europe and Eurasia, and Latin America and the Caribbean (Bloch et al., 2003). One of these projects in Thailand involved a USAID loan of $118.1 million. The USAID website lists several former and current national cadastre programs that it is managing and funding. One of the most interesting is East Timor's Land and Property Unit (LPU), which USAID is supporting by providing maps and computer equipment. The LPU is responsible for land titling, cadastre, mapping, land management, and developing policy and drafting legislation on land issues.[24]

4.6 SUMMARY

A specific objective of this study was to assess the current status of parcel data. This chapter provides a systematic overview of parcel or cadastral data and programs from the international to the local government scales. The analysis suggests that the current situation in the United States may be unique in the world. At one end of the spectrum there are examples of county-level parcel data systems that have been operating for more than 30 years. Many of these counties have worked with the commercial GIS software industry in the United States to advance the technology to an extraordinary level. There are many examples of local governments that maintain parcel data in real time as real estate and other transactions are recorded. These data are immediately available to serve a wide range of applications and are available to the public through web browser-based applications. At the other end of the spectrum, about three-quarters of the counties in the United States do not maintain a digital parcel database. State involvement in parcel data is also inconsistent. While some states such as Montana and Tennessee have assumed the responsibility of statewide parcel coordination and even production there are several states in which fewer than 10 percent of the parcels are in digital formats. The role of the federal government in parcel data development and maintenance is also fragmented. Unlike many developed countries that operate a nationwide cadastre, the U.S.

[24]See *http://timor-leste.usaid.gov/SGHighlightsArchives/SGArchive3.htm* [accessed February 15, 2007].

federal government has not assumed that responsibility. There is no comprehensive land parcel data set for federal lands, although NILS is in development. In the absence of a system to access land parcel data across the nation, various federal agencies are collecting land parcel data to meet specific mission needs. The number of counties yet to develop digital parcel databases combined with large tracts of public lands and Indian territories that also do not have digital parcel data means there is no accurate digital representation of the parcel boundaries of the majority of land area of the United States. However, at the same time, several private companies appear to be competing to develop the most comprehensive set of parcel data for the nation. This robust market is fueled by an extensive and growing demand for location-based services and real estate applications.

The survey of parcel data programs also revealed some important trends. Perhaps the most significant is the estimate that digital parcel data increased by 10 percent between 2003 and 2005. This provides strong evidence that parcel data programs are necessary, feasible, and affordable. In many cases, state governments have assumed the responsibility for initial parcel conversion but there is also evidence that communities with as few as 20,000 residents can justify such a parcel program without any state or federal assistance. It is fair to conclude that local and tribal governments will continue to initiate parcel data programs. State involvement will accelerate the process in many parts of the country. The federal government lacks an effective program or set of incentives that would enable it to access and use this valuable set of parcel data.

5

Challenges

Numerous challenges must be overcome to develop nationwide digital parcel data that are comprehensive, current, accessible, and in a consistent form that can be used as a framework on which to build more sophisticated and seamless applications. The challenges fall into several broad categories: technical and data, financial, legal, organizational, and political. There are also challenges unique to creating a parcel layer for Native American tribal lands.

Many of the challenges can be overcome with a reasonable amount of thought, organizational skill, and financial incentives. Other challenges would require changes in existing laws, at both the local and the federal levels, and changes in attitudes on the part of stakeholders at all levels of government. Some of the challenges do not individually preclude the development of a national parcel layer, but they all must be solved before the vision of a national parcel layer can be achieved and yield maximum benefits.

5.1 TECHNICAL AND DATA CHALLENGES

Many of the challenges are related to the data themselves or to the technology used to create and maintain them. Because parcel data are dynamic, it is difficult to ensure that they are consistently accurate and up-to-date. Technology available today allows us to approach the development of land parcel data in ways that were inconceivable in 1980 or even a few years ago. Standard geographic information system (GIS) software is now used at all levels of government, high-resolution aerial photographs are available nationwide, vast quantities of data can be stored at relatively low cost, and the Internet has made it much easier to coordinate and communicate on a national level. Therefore, the technical challenges revolve less around the existence of required technology than ensuring that it is applied consistently and to its greatest advantage.

Of course, many localities lack the hardware, software, training, or personnel to automate their parcel data at all. These are, however, not strictly technical obstacles. The technology exists, but organizational and funding problems prevent its adoption in many jurisdictions. These problems are covered in other sections. The points here underscore the reality that even among those that have

the technical capability, some significant obstacles stand in the way of creating consistent, accurate, and timely digitized parcel data on a national basis.

5.1.1 Dynamic Nature of Land Records

Ideally parcel data reflect the current status of ownership, use, and value of a piece of real estate. Since there are numerous transactions that change any of these factors as well as the actual boundaries, there is often a time lag between the recorded or actual legal transaction and what is reflected in the published digital layer. Parcel maps are constantly changing with new subdivisions, annexations, corrections, and other routine modifications. Figure 5.1 shows how the parcel data for Kern County, California, changed from 2005 to 2006.

Keeping up with the large number of transactions that may occur in any jurisdiction's parcel database is time consuming and must be handled at the local level because current parcel information is needed for many aspects of local government. The current ownership status is used in permitting, emergency response, land use planning, real estate taxation, and many other local government functions. The number of people and the resources required to keep a parcel data set current vary with the number of new transactions, whether maps and documents are submitted digitally, and the level of automation of the transactions affecting new parcel creation. Sifting through all recorded documents in hard-copy form to find those that affect parcel geometry changes is a daunting task.

How these transactions are implemented varies greatly among local government. In some cases the deed and recorded transaction is updated almost instantaneously, and the real estate record and then the mapping follows. In other jurisdictions, all of the changes are made at once. Any combination of update cycles can be found across the country. Inconsistent maintenance cycles mean that, in many cases, the digital map may not have the most up-to-date attributes available or the mapping may not reflect the current transactions for splits, combination, or new parcels. Furthermore, many jurisdictions outsource this work and obtain a new digital parcel layer in-house only once a year to

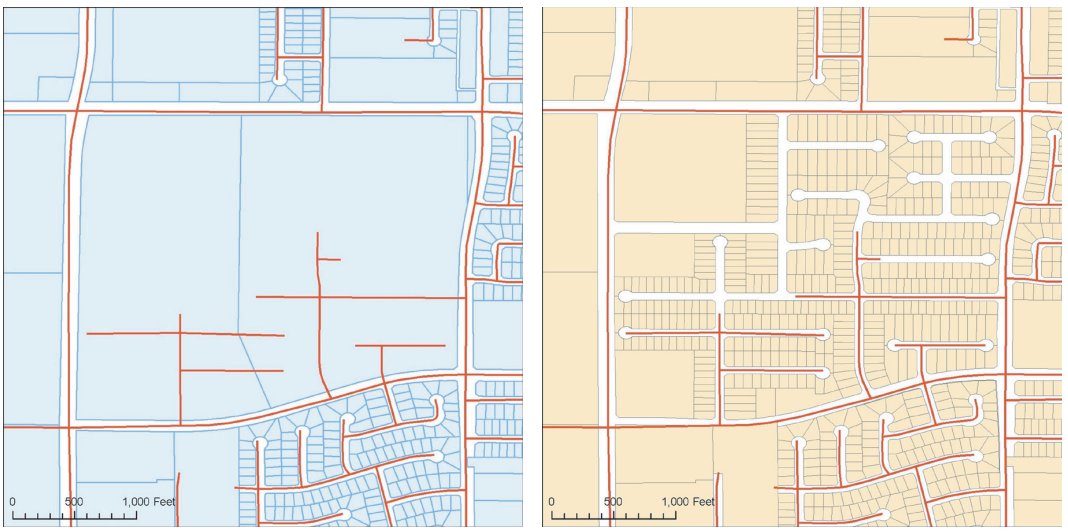

FIGURE 5.1 Example of parcel data in Kern County, California, in 2005 (left) and 2006 (right). SOURCE: Map created by First American Flood Data Services. Data provided by Kern County, California.

support a new real estate tax cycle. In other cases, inconsistent maintenance cycles are a result of local tax assessment rules. For example, in many local governments the tax bill reflects a property's status in the previous year. Transactions that occur during the year are by law not included in the tax rolls until the following year even though ownership or geometry may have changed.

The rate of increase of new parcel creation is about the same as the rate of population increase. Even though the general trend of parcel population density is about 2 people per parcel, in fast-growing areas, highly urbanized areas, or in rural areas, these numbers vary (Stage and von Meyer, 2006b). New parcels are reformed from existing parcels through splits and combinations as well as created in new plats and subdivisions. This often requires sorting through many documents to identify and interpret the information. The motivation for a local government to maintain these transactions is to support the local business processes such as real estate taxation, permitting, and law enforcement and public safety programs that require current and accurate information.

5.1.2 External Distribution of Parcel Data

Most local parcel data programs maintain a production and a publication version of their parcel data. The publication version is one that is made publicly available. The production version may contain much more detailed data, such as detailed survey work. In the most sophisticated programs the internal production system is maintained in real time as property transactions are recorded. Therefore, it is possible that applications *within* a county may be based on current data, but the community may update its external offerings only on a monthly, quarterly, or even annual basis. Even if the data in the local digital parcel layer are as accurate and current as possible, any data stored separately at a state or national level can easily get out of sync. It is technically possible to create a system where the data at a national level exactly match the data available locally, but the cost and administrative burden must be balanced against the need for real-time currency.

5.1.3 Quality of Data in Existing Digital Parcel Maps

Incomplete, out-of-date, and inaccurate data often exist in digital parcel maps. At the local level, parcel maps primarily support local property taxation and are usually adequate for that purpose. However, their underlying base maps can be many years old and they are often georeferenced incorrectly, do not align properly with high-resolution orthophotography, and may be internally inconsistent due to the original sources and methods used to create the data. Poor quality control, especially in terms of geographic accuracy, is understandable because of the cost of producing highly accurate data. Figure 5.2 shows how parcel data from King County, Washington, does not line up well with aerial imagery because of issues encountered during the conversion of hard-copy maps to digital format. Other errors can occur because the existing hard-copy maps may have been developed from "assumed" reference systems, such as presuming that Public Land Survey System sections are square or that individual parcel boundaries follow visual evidence such as fence lines or water edges.

There are many different approaches to the creation of parcel polygons that vary substantially in cost. Very few communities can afford the cost of compiling parcel data directly from the legal description on a deed because of the labor-intensive process of interpreting and resolving discrepancies in legal descriptions found in many deeds. Often the more exacting method using coordinate geometry and topology rules is employed for a subset of parcels such as those that have been recently surveyed and compiled on a plat of survey where the distances and bearings can be relied upon as being consistent and accurately presented. In most other cases the parcel fabric is created by digitizing existing hard-copy sources. In most jurisdictions, it is not legally required that the parcel legal descriptions in deeds be compiled and verified by a land surveyor. This often leads to

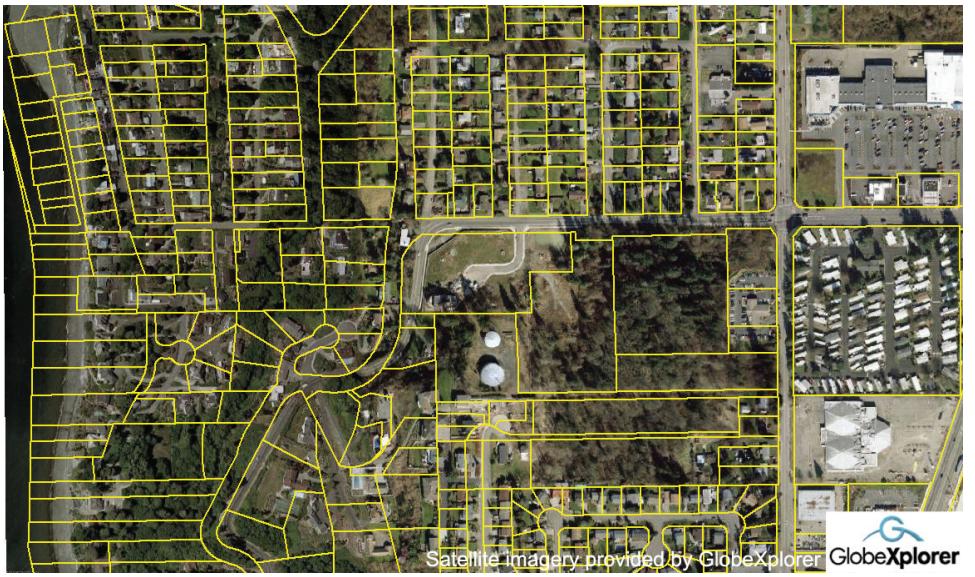

FIGURE 5.2 King County, Washington. The parcel boundaries line up well with the streets at the right side of the image but are increasingly misaligned toward the ocean. According to the county, a lack of control points on the original Mylar-based parcel records caused the shift when they were converted to vector parcel boundaries. SOURCE: Compiled by First American Flood Data Services using data from King County Washington Department of Natural Resources and Parks, Geographic Information Systems Center (parcel boundaries) and GlobeXplorer (aerial photo). Used with permission.

legal descriptions that are unclear, are nearly impossible to locate, and contain geometry errors. This is a bigger problem than the technical issue, since most GISs contain the tools needed to perform the coordinate geometry computations. It may take field work or legal interpretations to resolve inconsistencies in legal descriptions in deeds.

As information systems have become an integral part of our lives, many individuals are impacted by erroneous information about their credit ratings and other important personal information. Inaccurate or incomplete information about land records can also have a serious impact on individuals and their property. For example, the National Community Reinvestment Coalition (NCRC) has filed a complaint with the Federal Trade Commission regarding what it believes is the inappropriate role of Zillow.com in providing estimates of property values. In an article in Real Estate Technology News (2006), David Berenbaum, executive vice president of NCRC, stated:

> The crux of our complaint is that Zillow's over and under appraisals negatively impact on consumers' real estate and financial transactions, and injures entire communities. . . . While the focus of the attached complaint is upon all communities regardless of income, the fair housing complaint will argue that Zillow perpetuates the undervaluation of low-moderate income communities in violation of the Federal Fair Housing Act.

The complaint specifically charges that property owners can be harmed when information about their property is not being directly controlled by public officials who are accountable to taxpayers and voters.

The following comments reveal the importance of accurate parcel data:

> Cadastral mapping has taken on a new role in personal safety with the age of E911 [emergency 911] and homeland security. Inaccurate parcel data now can cause slow or non response to emergency situations that could cause harm. (Comment from web forum: William Cozzens, Land Information System Analyst, Waukesha County)

> Assessment records are good, but realtors have repeatedly misinformed taxpayers as to school boundary lines which causes the taxpayer to buy a home that is not in the district they wanted . . . and then when trying to enroll their child, they find out the property is not in the district. Even one case where someone ran for school board, won, and then found out that they were not in that district. Uniform parcel information might help realtors even though the info is there for them to discover. (Comment from web forum: Mapping Supervisor, County Assessor's Office)

5.1.4 Reconciling Data at Administrative Boundaries

Local parcel programs are operated as an internal business function. In many states there are no standards or requirements for these parcel data to be combined with those of adjacent counties. In fact, there are many examples of municipal governments maintaining data on parcels within their jurisdiction without any coordination with the county of which they are a part.

The independent nature of this production process leads to significant problems when reconciling data at municipal, county, and state boundaries. Each local parcel layer inserted into a national "fabric" must have its external boundaries reconciled with those of adjoining states, counties, and if appropriate, cities and towns. Figure 5.3 is an example of where the parcel data across two counties overlap. There have been a few successful efforts to merge parcel data across states or among counties at a regional level. Good examples are the seven-county MetroGIS region in the Minneapolis-Saint Paul area and the three-county Portland, Oregon, region. The only solution to this issue involves a comprehensive approach to accurately creating and maintaining administrative areas and establishing a clear understanding of data stewardship responsibilities. If there is a clear understanding of the stewardship responsibilities across jurisdictional boundaries and agreement on the location of those boundaries, parcel data can be seamlessly assembled.

A related issue is reconciling federal land parcels with local data. Information about parcels on federally managed land is usually not recorded with or stored in local government systems. For example, tribal trust lands and U.S. Forest Service (USFS) use areas are not recorded with the counties in which they exist. The western parts of Dade, Broward, and Palm Beach counties in Florida all have National Forest areas, but none of these counties maintain parcel features for those areas. Even if data on federally managed parcels are available and accurate (see Section 5.4.1), they must be reprojected and the boundaries reconciled with local data. This reconciliation process may reveal encroachments that have to be resolved politically or through the courts. This same situation can also occur with regard to state-owned lands. Figure 5.4 illustrates this issue.

This situation can be extremely problematic in areas where the federal-local jurisdiction is a checkerboard with the maximum possible edges to adjust and edge-match. With Indian trust lands, this can go down to the grain of individual parcels, since as mentioned in Chapter 4 there can be a large number of non-Indian-owned land parcels within a reservation. Since the development of nationally integrated land parcel data would involve reconciling parcel boundaries among different land managers, this will undoubtedly expose and ultimately force the resolution of issues with jurisdictional boundaries.

Much as with administrative boundaries, for full reconciliation and exact edge matching between areas with different maintenance agencies, a stewardship boundary needs to be agreed upon. By setting and agreeing to a common boundary, parcels on either side can be matched to the common boundary, reducing edge-matching issues. The committee recognizes that this is not

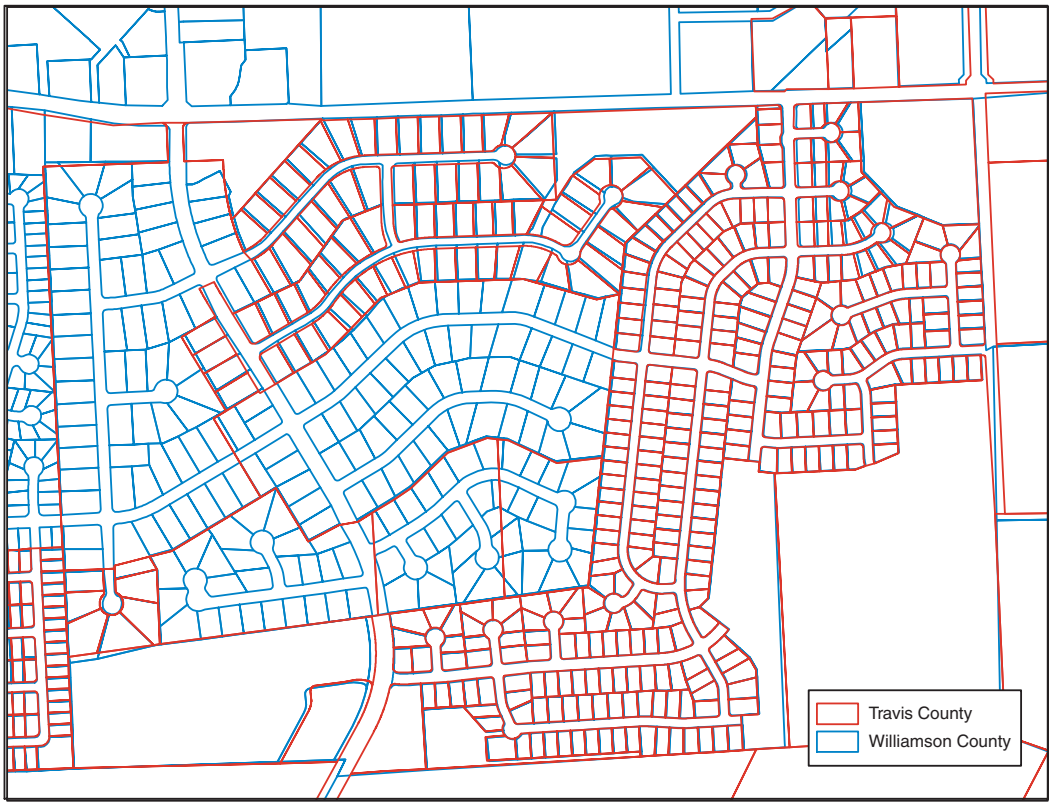

FIGURE 5.3 Parcel data maps from Travis County (red lines) and Williamson County (blue lines) in Texas, showing overlap in the parcel maps. SOURCE: Map created by First American Flood Data Services using data from Capitol Area Council of Governments (*http://www.capcog.org*).

an insignificant task and it will require dedicated effort and time on the part of all data stewards to reach resolution of the edge-matching issues. Eventually a single data steward will be identified for all surface ownership to create seamless parcels across stewardship areas.

5.1.5 Multiple Coordinate Systems

Parcel data are maintained in multiple geographic coordinate systems. Existing parcel data have been created using a variety of map projections and horizontal datums. In fact, some counties, such as Ada County, Idaho, or states such as Minnesota and Wisconsin have built custom coordinate systems specific to their geographic areas. Sometimes this important information is well documented and sometimes it is not. While most modern GIS software is able to adjust for any of these assumptions, a parcel aggregator must have complete and accurate metadata in order to fit any local parcel data into a continuous nationwide fabric.

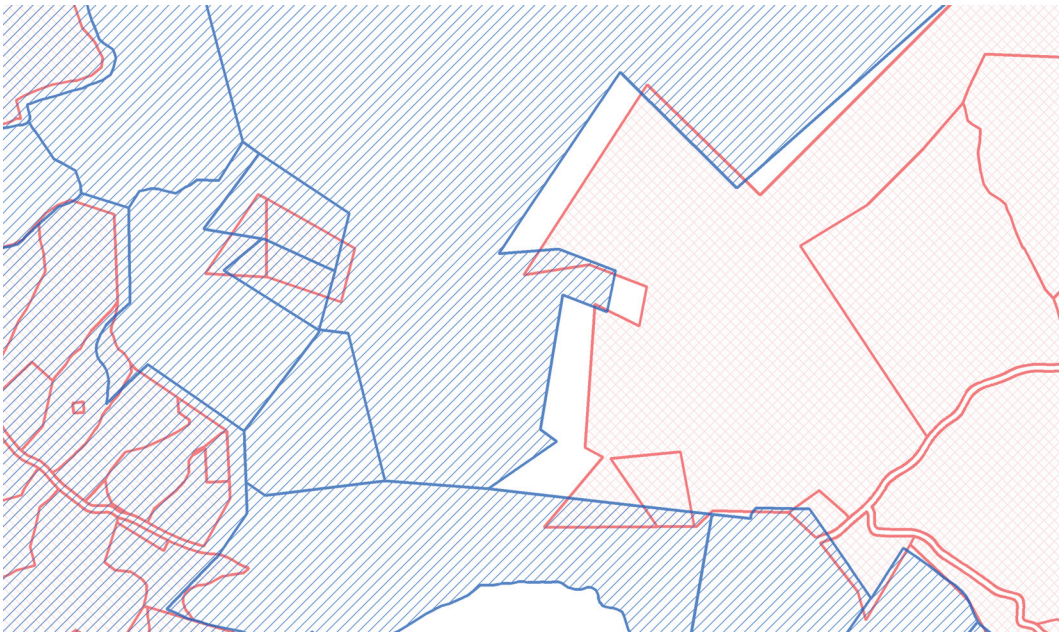

FIGURE 5.4 Cherokee County, North Carolina, tax maps (red) with USFS tracts (blue) on top. This data set was assembled from county parcel data downloaded from the county file transfer protocol site and adding USFS tracts shape files. This figure illustrates that when agencies with parcel data management responsibilities in the same area work independently, mismatches between parcel boundaries can develop.

5.1.6 Definition of Street Addresses

There are inherent problems with street addresses. An accurate site address is a key attribute of any set of digital parcel data and a critical part of any emergency 911 or package delivery system. In the case of a standard residential parcel containing one single-family home, the definition is straightforward. However, other parcels may contain multiple buildings, each with different occupants, or buildings with multiple occupants. Different users of the parcel data may have different interpretations of an "address," depending on whether they are looking at the parcel as a whole or whether they care about each structure, each dwelling unit, or even each utility connection. Address attributes currently found on many counties' parcel databases are often inaccurate. Furthermore, an address can be formatted and stored many ways (e.g., "120 NO MAIN," "120 NORTH MAIN STREET," "120 N MAIN ST"). In many jurisdictions, vacant or uninhabited parcels are not assigned an address.

As noted previously, the Urban and Regional Information Systems Association (URISA), sponsored by the Census Bureau, has worked with the National Emergency Numbers Association and the U.S. Postal Service to develop a proposed FGDC address standard. Parcel data standards and any developments in terms of standardized street addresses need to be synchronized.

5.1.7 Inconsistent Practices for Complex Parcels

Parcel maintenance programs often employ inconsistent practices when handling complex parcels. There is no standard way to represent more complex "parcels" such as condominiums or

other common interest areas, especially when the buildings have multiple units (i.e., the parcels are vertically "stacked" or include individual building footprints in addition to the surrounding parent parcels). Figure 5.5 shows an example of this type of parcel.

5.1.8 Poor Utilization of Consistent Standards for Data Quality

Although the Federal Geographic Data Committee (FGDC) Subcommittee for Cadastral Data has developed and adopted a standard for land parcel data, it is not widely used. The absence of consistent standards for data content and data quality can lead to serious problems. Any sound data management program must adhere to accepted data management practices to deal with locational attributes, period of ownership, consistent parcel identification numbers, retired parcels, missing parcels, related rights and easements, and bad survey data. Fortunately the FGDC standard and related best practices are gaining in acceptance, and states such as Florida, North Carolina, and Arkansas have adopted the standard as a statewide requirement. Also, the data content standard has been simplified so that the content reflects the data necessary to support a specific business need. With the adoption of the business-based "core data," there has been an increase in use of the standard.

Another set of relevant standards is developed through the efforts of the International Association of Assessing Officers (IAAO). The IAAO issues voluntary standards that guide professionals in the ad valorem assessment business. The IAAO has a strong presence in the 50 states at the local assessment professional level and also with state property tax departments. Of particular note are

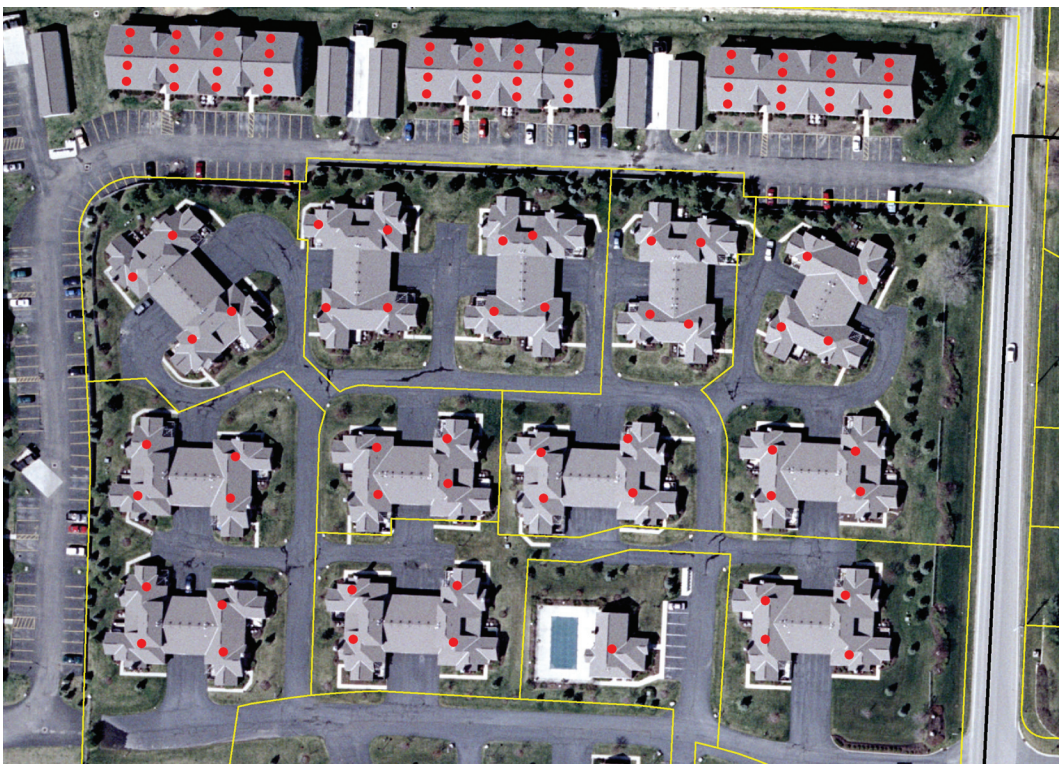

FIGURE 5.5 Example of parcels with multiple units in each parcel. Each dot represents a separate housing unit. SOURCE: Delaware County Auditor's Office.

the Standard on Manual Cadastral Maps and Parcel Identifiers and the Standard on Digital Cadastral Maps and Parcel Identifiers.[1] These standards are available to IAAO members online and to the public for purchase.

5.1.9 Existing Legacy Parcel Systems

The installed base of existing legacy systems for parcel data production is substantial. Many of these legacy systems are in major metropolitan areas that were the leaders in developing computer-based parcel management systems. A few of these are in heavily populated areas such as Los Angeles that are struggling with the need to migrate their original systems to a modern information infrastructure. Legacy systems have both data quality and political-financial issues. While these older systems may still serve local needs, the data may not adhere to modern standards and may have been compiled from original resources such as paper tax maps that were not as accurate as current resources. One might not expect that these counties, some of which are quite large, would require outside aid to contribute to a national parcel data system, but their substantial existing investment may make them reluctant to modernize. Similarly, they may feel it necessary to charge for their parcel data in order to recoup the costs of their investments. The Southeastern Wisconsin Regional Planning Commission is one example of an area that was a very early adopter and developer of a multipurpose cadastre for the counties in the region. In fact, this was one of the systems cited extensively in earlier National Research Council (NRC) reports as a stellar system. With a relatively large data holding based on the methodology and processes available in the early 1980s (including the North American Datum of 1927 reference system), moving to more modern systems and approaches regionwide was nearly prohibitive. Over time, individual counties in the region, such as Waukesha County, have undertaken migration and modernization, but at much cost and effort. The committee believes that while the need to migrate the GIS environment is a tangible issue in some communities, it is not unique to parcel data systems. Many local government budgets are strained by the constant need to modernize their information hardware and software.

5.1.10 Secure, Reliable Data Storage and Backup

Secure, reliable data storage will be a critical need. Any system that stores and serves data at an individual property level, particularly one that is federally sponsored, will have to meet strict security standards. However, a model that contemplates a national parcel data set of more than 144 million parcels as a federation of dispersed systems, as opposed to a single central repository, faces unique security and reliability challenges. The data must be protected from unauthorized modification and must not be stored in a way that creates the possibility of a single point of failure. For example, data physically stored only at a local level may not be accessible, or may be lost forever, in aftermath of a natural disaster, just when they are needed most. Therefore, backup of data at a physically separate location is important.

5.2 FINANCIAL CHALLENGES

Developing a funding model for nationally integrated land parcel data must take into consideration three different elements: (1) the cost to convert all parcel data that has not yet been digitized to digital format; (2) the cost to maintain the parcel data (i.e., to update them when new parcels are formed or information has changed); and (3) the costs to make the data consistent and accessible nationally. Each of these is discussed separately below.

[1]For IAAO standards, see *http://www.iaao.org/documents/index.cfm?Category=23* [accessed May 25, 2007].

The FGDC Subcommittee for Cadastral Data has estimated the costs for item 1, which are the costs to complete initial digital data coverage (Box 5.1) (Stage and von Meyer, 2007). The subcommittee estimated that it would require about $294.6 million in one-time costs and $84.7 million in recurring costs to complete the coverage of digital parcel data for the United States. This covers the costs of the initial digital conversion or reformatting required for getting to a published format and establishing the necessary institutional framework. The recurring costs include items that will have to be updated periodically (such as imagery as a backdrop) or the costs to fund ongoing activities (such as training or extracting a subset of the data to make an annual published view). The numbers of parcels yet to be converted is based on state surveys done in 2003 and 2005 and updated in the 2007 wildland fire inventory process.

The FGDC subcommittee estimates that there are about 152 million parcels that cover the United States: 8 million of these represent public lands and the remaining 144 million cover private land ownership. The subcommittee assumes that all public land parcels should be converted into a digital format as part of the stewardship responsibilities of the local, state, or federal agency that controls the property. It is estimated that about 68 percent of the 144 million private parcels are already in digital format. The remaining parcels are concentrated in approximately 2,200 largely rural counties, which are unlikely to have the resources or know-how to complete the parcel conversion. The subcommittee assumed a conservative estimate of the cost of creating a GIS representation

BOX 5.1
Estimated Cost for Producing Parcel Data for the Nation

The FGDC Subcommittee for Cadastral Data estimates that it would require $294.6 million in initial one-time costs, with recurring costs of $84.7 million per year to complete a national set of land parcel data.
The one-time cost includes the following:

- The creation of parcel management programs and training ($1.5 million)
- Improvements to the ground control ($3.1 million)
- Supplemental data acquisition (0) (there are no costs assigned to supplementary data because they either already exist or are considered the responsibility of other agencies)
- Hardware and software ($33.7 million)
- Conversion of hard-copy maps to a digital product ($240 million)
- Publication of the data by the counties in a standard format ($15.7 million)

The recurring cost of $84.7 million includes the following:

- Compilation and integration of the data received from the counties ($1.3 million)
- Acquisition of imagery for urban ($37.2 million) and rural areas ($37.2 million) on a three-year cycle
- Providing technical support and training to the counties ($5 million)

This estimate is based on a recent inventory of the status of parcel data in all 50 states. The figures assume that each county will be responsible for the conversion and maintenance of parcel data in its jurisdiction and that all counties and states with existing data will need resources for the publication of the county data in a standard format and the integration of these data into uniform statewide parcel data coverage.

SOURCE: Adapted from Stage and von Meyer, 2007.

of the geometry of the parcels as $2.00 per parcel for point-level representation and $5.20 per parcel for polygon representation, based on conversion cost averages nationwide from samples across the country. As independent verification of these estimates, the State of Tennessee estimates that it cost $9 million to convert 2.7 million parcels (about $3.70 per parcel) (D. Pedersen, State of Tennessee, e-mail to D. Cowen, May 14, 2007) and the State of Montana spent about $4 million to convert 1 million parcels (Stevens, 2002).

The challenge in funding the completion of digital parcel data coverage for a national parcel system is not primarily one of finding the money. For example, note that 88 percent of the recurring costs listed in Box 5.1 are for acquiring imagery on a three-year cycle. However, there are federal programs within the U.S. Department of Agriculture (USDA) and the U.S. Geological Survey that acquire or cost-share imagery. The Imagery for the Nation program proposed by the National States Geographic Information Council (NSGIC) would institutionalize imagery acquisition for the nation on the same three-year cycle. Therefore, recurring costs of imagery production in the estimates in Box 5.1 could be substantially lower. Furthermore, parcel data are so important to carrying on the day-to-day business of state and local governments, that many ways have been found to fund parcel data development. The State of Arkansas Cadastral Spatial Data Infrastructure Business Plan provides an example of how it proposes to fund parcel data (Arkansas Assessment Coordination Department and Arkansas Geographic Information Office, 2006):

> County Assessor hardware, software and training is funded by the Assessment Coordination Department. Additional training, technical support, supporting data, and the publication of web accessible cadastral data are funded by the Arkansas Geographic Information Office. The state is researching the feasibility of additional funding from the state to counties for more personnel. In the meantime both state agencies and the individual counties are opportunistic about pursuing additional outside funding resources and taking advantage of those when feasible. The statewide consistency with the data, technical, and business processes make Arkansas an outstanding candidate for completing a statewide cadastral database. This situation makes for a low risk, high return opportunity for federal, non-profit and private funding investments to accelerate and complete cadastral data throughout Arkansas.

Perhaps more importantly, it must be emphasized that the committee views the establishment of parcel programs by a local government to be at least revenue neutral. For example, a county assessor in Florida was able to find 8,000 acres that were not on the tax roll as a result of parcel conversion (Stage and von Meyer, 2006a).

However, much of the current funding to collect and aggregate existing digital parcel data is uncoordinated and duplicative. In fact, enormous amounts are already being spent on creating and maintaining digital parcel data and there are many examples where data on the same parcels are being maintained by a city, the county, and also private utilities and title and insurance companies. Unfortunately, some of these duplicative programs exist as a result of technical or institutional barriers that prevent collaboration. States, federal agencies, and numerous private sector users pay over and over to acquire and aggregate the same parcel data for their own purposes.

It appears that there are many potential sources and methods for funding completion of digital parcel data coverage. The challenge will be better coordinating existing opportunities, developing effective partnerships, and providing new funding where needed to complete the digital coverage.

The second cost element is maintenance of the parcel data once they have been converted to digital form. This includes the costs of keeping the parcel data current, such as adding new parcels or updating related information with new owners and new values. Maintenance of parcel data is often a modernization of the tax map operation that is required by most state departments of revenue and therefore is considered a cost of doing business. As noted earlier, having current parcel data is essential to many functions of local, state, federal, and tribal agencies. What portion of a government's

operations is just for parcel data maintenance costs, or what factors contribute to these costs, are difficult to estimate accurately on a nationwide basis. For this reason, the FGDC Subcommittee for Cadastral Data does not provide an estimate of these costs. This committee did a preliminary analysis of what maintenance costs might be based on several different methods. However, like the FGDC subcommittee, it was found that the cost of maintenance depends on so many factors (size of the county, how quickly the county is growing, who is maintaining the data) that a reasonable estimate could not be developed. Nevertheless, in terms of a national system for land parcel data, the costs of maintaining the data will in most cases be borne by the data stewards as a cost of doing business. The challenge will be in supporting those local government entities that cannot afford to maintain or publish the updated attributes needed for a national system in digital format. In some cases, states have already stepped in to cover this function for counties that are unable to do so.

Finally, there are costs for creating nationally integrated data that go above and beyond the development of the original parcel data costs. For example, there are costs associated with edge-matching parcel boundaries along county and state borders and reconciling public and private lands. Some of this work has already been done as regional groups or states have been compiling parcel data sets for their areas. Private industry has also had to address this issue as it has begun building parcel data systems. Another element of the cost would be to establish an infrastructure for accessing the most current data from the parcel producers and making them available in a seamless format. Systems with these capabilities exist for other purposes, so the major challenge is to find a source of funding. Finally, costs would be incurred to support the national coordination function. All of these elements of a national land parcel data system would most likely have to come from new funding.

Therefore, financial challenges must be addressed for the production of the initial parcel data coverage, the integration to make the data nationally consistent, and the infrastructure to make the data accessible. There is a concern among parcel data producers as to who would bear these costs, as illustrated by the comment below:

> Managing parcels for a county of 600,000 people is already difficult. I do not believe that the overhead of complying with a national mandate will provide, at the producer level, any benefits. Therefore I see the potential for increased costs and overhead, as a potential liability. (Comment from web forum: Stephen Marsh, Director, GIS Department, Jackson County, Missouri)

The big question is how to assemble the collective interest in parcel data to financially support a national land parcel data system that covers every part of the country. Ideally, all stakeholders would contribute to the program. A representative from Zillow told the committee at the Land Parcel Data Summit that it encounters major problems with acquiring consistent data from local governments at a consistent price. Zillow is willing to help support the production of parcel data but would like to see a reasonable and consistent price for it. Although there seem to be potential sources of funding, the committee recognizes that coordinating these opportunities and partnerships and developing an equitable funding model will be a challenge.

5.3 LEGAL CHALLENGES

5.3.1 Data Sharing Restrictions

Even though data about land ownership and value are considered to be public information, a number of barriers inhibit the exchange of parcel-related data. Since land parcel data are the basis of many legal and economic decisions within a community, they are also likely to have restrictive policies regarding licensing and distribution. The importance of these distribution issues was covered at length in the NRC report *Licensing Geographic Data and Services* (NRC, 2004a). It is

important to understand the concept of ownership and restrictions on the use of geographic data as they pertain to land parcels. These issues also directly impact the financial arrangements that may impede the type of federal and local government partnerships that would be necessary to support a successful program.

Copyright and Public Domain

While ownership of geographic data is inherently an ambiguous concept it is extremely important in terms of copyright and Freedom of Information Act (FOIA) requests. The NRC *Licensing* report provides a clear statement on copyright (NRC, 2004a, p. 107):

> Although geographic data equivalent to facts will not be protected by copyright, compilations of geographic data such as databases and datasets, as well as maps and other geographic works that incorporate creative expression, may have copyright protection.

From this definition, surveyor's coordinates, parcel corners, and unprocessed aerial photography fall into the category of raw data. In a legal context, courts have decided that such native data are facts and cannot be copyrighted and may be subject to public disclosure under most FOIA requests. However, fully attributed parcel data may be considered information rather than data and may be protected by a copyright.

The report also provides a useful definition of public domain (NRC, 2004a, p. 277):

> Information that is not protected by patent, copyright, or any other legal right, and is accessible to the public without contractual restrictions on redistribution or use.

There is a major difference between the way the federal government and other levels of government embrace the concept of public domain. Federal policy is based on the premise that data derive their value from use, and the government wishes to actively foster a robust market of secondary and tertiary users. Therefore, the federal model as specified by Office of Management and Budget (OMB) Circular A-130 can be summarized as (1) no copyrights of government data; (2) fees must be limited to the cost of dissemination; and (3) no restrictions on reuse of the data. The federal philosophy regarding sharing public data is encapsulated in the following statement (OMB, 1996):

> The free flow of information between the government and the public is essential to a democratic society. It is also essential that the government minimize the Federal paperwork burden on the public, minimize the cost of its information activities, and maximize the usefulness of government information.

This federal government public domain policy has profound impacts on the relationship between the federal and local governments. For example, when the Census Bureau acquires a file of street centerlines from a local government to use for its Topologically Integrated Geographic Encoding and Referencing (TIGER) modernization program it must place those data in the public domain. In contrast, many communities do not want to lose potential revenue and therefore have not agreed to provide the Census Bureau any data that they normally license to third parties.

Even though under OMB Circular A-130 the majority of federal government geospatial data are considered to be in the public domain there are several important exceptions, such as the Census Bureau's Master Address File (MAF). As described in Chapter 4, the MAF/TIGER Accuracy Improvement Project will result in a major improvement in the positional accuracy of the TIGER line files and the location of residential dwelling units. In addition to the extensive work that is being conducted by a private contractor the program will also utilize Census employees armed with

500,000 hand-held global positioning system units to support the Field Data Collection Automation program. The Government Accountability Office (GAO) has raised several issues about the reliability of this program and the lack of a successful dress rehearsal based on the use of the hand-held computers (GAO, 2006b). The information in this updated MAF will not be released to the public. Historically, the conduct of the decennial Census is tightly controlled by Congress. The procedures that the Census Bureau must follow are designed to ensure the highest level of confidentiality for individual responses. Many communities have requested some of the information resources that the bureau uses to conduct the decennial Census. In 1982 one of these requests led to Supreme Court decision in *Baldridge v. Shapiro* (455 U.S. 345, 1982). In that case the Supreme Court held: "The master address list sought by Essex County is part of the raw census data intended by Congress to be protected under the Act [Title 13]." In that decision the Court endorsed the Census Bureau's reading of Title 13. It wrote: "The unambiguous language of the confidentiality provisions, as well as the legislative history of the Act, however, indicates that Congress plainly contemplated that raw data reported by or on behalf of individuals was to be held confidential and not available for disclosure." Consequently, the bureau has interpreted the Supreme Court decision to mean that any data collected by bureau staff to assist with the Census itself is confidential. Furthermore, as described in congressional commentary, Congress does not want to make the MAF public for the following reasons (Sawyer, 1994):

> The subcommittee is well aware of, and sensitive to, concerns about personal privacy. It's probably true that most people do not view an address, without related names, as private information. Frankly, address information is widely available in today's society from public and private sources. However, for two reasons, the legislation allows for only limited access to this most benign piece of census information.
>
> The first reason is that it may be difficult to communicate clearly to the American public that the information in question does not contain names or any other identifying information besides the physical location of a housing unit. Given the special trust that must exist between the Census Bureau and much of the American public, we did not want to jeopardize the Bureau's ability to garner cooperation in future censuses.
>
> The second reason for limiting access is that the Bureau's definition of a housing unit is necessarily broad and may include information not generally known. For example, that definition includes illegally occupied garages, offices, basement apartments, and other structures not normally inhabited. But while the effort to include every structure where a person lives is essential for an accurate count, the Bureau might inadvertently have information on its address lists that indicates the existence of a structure not properly zoned for residential dwelling. If the census address information were misused, an individual might face some adverse result.

It should be noted that there are alternative ways to capture point-level residential features. For example, communities with good parcel production programs could provide the Census Bureau with a highly accurate and current set of street addresses and associated coordinate points. In many areas, addresses are assigned to parcels or to structures as part of a synchronized work flow. They become the official part of the attribute information stored with a parcel. Often the specific location is assigned to a structure within the parcel. These address files typically become the basis for updates to the emergency 911 dispatch system that enables emergency vehicles to respond to events. This approach was highlighted on a National Public Radio feature on this topic (Charles, 2006). Figure 5.6 shows an example of point-level address data collected by Delaware County, Ohio. A second source of point-level residential features exists in the private sector. For example, Tele Atlas has a file of more than 40 million address points and is working to expand it to 100 million (Tele Atlas, 2007). This file is being created from extensive field work and high-resolution imagery.

Conversely, the Census Bureau has determined that the TIGER street centerline data are only used as a tool for summarizing and reporting those data; therefore, they fall outside Title 13. While

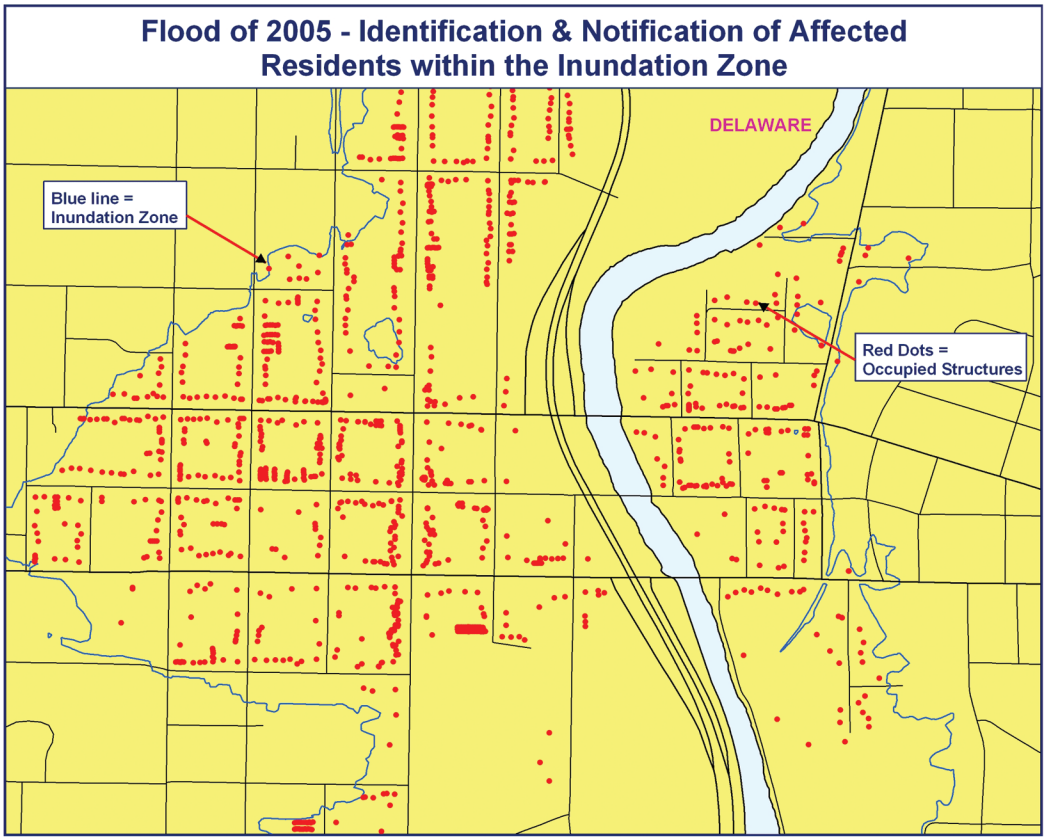

FIGURE 5.6 Point-level addresses in Delaware County, Ohio, in relationship to flood inundation zone. SOURCE: Delaware County Auditor's Office.

the committee appreciates the bureau's need to comply with the directives of Congress and the Supreme Court it believes that the address points are actually just an enhancement to the TIGER line file based address system. It is important to note that since the 1970 decennial Census the Census Bureau has always distributed GIS files with street names and address ranges that facilitate automated address matching. In fact, it provides public domain software (Landview) that enables a user to locate an address and associate census information and other themes to that location. It could be argued that the improved point-level locations for addresses are simply an enhancement of these address matching capabilities and have nothing to do with confidential information about the residents of the dwelling units. This issue is of relevance since these expensive and valuable point-level features could provide an excellent tool for creating a national parcel database.

There are also restrictions on address information relating to the National Flood Insurance Program (NFIP). These restrictions were upheld by the U.S. Court of Appeals (*Forest Guardians v. U.S. Federal Emergency Management Agency*, 410 F.3d 1214 [U.S. App. 2005], June 14, 2005, Filed) in a case where the nonprofit organization Forest Guardians brought an action under the Freedom of Information Act, 5 U.S.C. § 552, seeking to compel the Federal Emergency Management Agency to release GIS files that identify the location of structures insured under the NFIP. The court ruled

that the GIS files were exempt from FOIA because they would reveal policy holders' names and addresses, which would be an invasion of their privacy.

Local Government Licensing Issues

Outside of the federal government there is no standard set of practices or rules regarding access or distribution of geospatial data. At one end of the spectrum, a local government may establish very strict licensing agreements that control access to data assets and restrict the use and redistribution of the data. These arrangements are often related to the generation of revenue but can also exist to promote participation in consortia. Others use licensing as a way to control access to the data, as illustrated by the following comment.

> Because more than 50% of our private parcels (9.2% of our county is private) are seasonal in nature, we have a concern that certain elements might target those homes. Therefore, even though the information is public, we do not dispense the information on the internet. Everyone who gets electronic data must sign a license agreement. (Comment from web forum: Loretta Bloomquist, Cadastral Mapper, Cook County, Minnesota [retired], February 2006)

While these arrangements are most often found in local governments they also exist at regional levels such as the Metro GIS in the Minneapolis-St. Paul area and the Portland, Oregon, region. They even exist on a statewide basis in Tennessee. In Minnesota, where the state is one of the largest landowners, the state Department of Natural Resources (DNR) would like to share data with local counties. This has proven to be nearly impossible in the central region of the state. Each county has a unique license agreement for its parcel data that it strenuously enforces. DNR land managers have given up the effort, because of the time it would take its legal department to review and approve those licenses.

At the other end of the spectrum, several counties, including Delaware County, Ohio, and the entire State of Montana, provide a simple web interface for free download of a published version of parcel data without any fees or licensing agreement. The NRC *Licensing* report observed that over the past decade many state and local governments have experimented with fee-based programs with restrictions on the use and redistribution of data, and found that most of these fee-based programs (1) cannot recover a significant fraction of government data budgets, (2) seldom cover operating expenses, and (3) act as a drag on private sector investments that would otherwise add to the tax base and grow the economy (NRC, 2004a, p. 97).

There have been a number of important decisions relating to the legal and financial barriers that limit data sharing. Two cases have gained considerable national attention and relate directly to this study.

Greenwich Connecticut. In 2005 the Connecticut Supreme Court decided that the City of Greenwich had to release GIS data to a private entrepreneur. The court rejected the city's claim that trade secret exemptions could apply to the electronic GIS maps. It decided that all information contained in the maps is available from town departments; therefore it is not secret. The court also rejected the claims that release of the information could pose a risk to public safety.

The case is significant on the national level because of the interest of members of the press. The Reporters Committee for Freedom of the Press Society of Environmental Journalists Investigative Reporters and Editors, Inc. filed an *amicus curiae*, or "friend-of-the-court" brief in the case that drew the following argument (Klau, 2004):

> Publicly funded computerized Geographic Information System (GIS) records, and the maps generated from GIS systems data, have become a basic tool for government study and decision-making in fields such as environmental policy, public safety, and health. The public also requires

> access to GIS records and maps relied upon by government officials in order to conduct its own study and to monitor, criticize, and, as warranted, challenge decisions based upon that data. Journalists represented by *amici* play a key watchdog role in this process. They must be able to access original computerized GIS data and maps used by official decision-makers and disseminate them to the public. Thus, *amici* have a vital interest in ensuring that the government places no improper restrictions on the public's right to obtain those records.

California. In March 2006 the Los Angeles County assessor made a major change in policy regarding the distribution of its parcel data. The county reacted to the California state attorney general's opinion that "parcel boundary maps maintained in electronic format by a governmental entity are subject to public inspections and copying under provisions of the Public Records Act and therefore must be provided for the cost of duplication in accordance with the parameters set forth in the California Public Records Act" (Auerbach and Wolfe, 2006). As a result, the price to access Los Angeles County parcel data changed overnight from $100,000 to the cost of reproduction. However, 13 other counties, including Santa Clara County, continued to charge high fees for their parcel databases. A suit was filed against Santa Clara County by the California First Amendment Coalition (CFAC), claiming that these are public data that should be freely available. In May 2007, the California Superior Court for Santa Clara County ruled in favor of CFAC that the county must release its data at the cost of reproduction.[2]

In some cases local governments operate under Memoranda of Understanding that allow vested business operations such as energy management, wildfire response, or hurricane response to have full access to parcel data when needed for specific situations. These most often limit subsequent data distribution, but they do open the door for the use of parcel data in these specific situations. However, as seen from the discussion above, licensing and restrictions on distribution of parcel data constitute an issue that must be addressed in order to develop national land parcel data.

5.3.2 Liability for Incorrect Data

There is always a risk that a user may have an unrealistic expectation about the accuracy of parcel data and misuse them. For example, if an emergency responder is directed to the wrong address, a police-warranted search breaks down the wrong door, property is incorrectly, inaccurately, or improperly assessed or taxed, or data in hand are used for an analysis rather than getting newer and more current data and improper decisions are made, the aggregator(s) and original creators of the data could be subject to official complaints or even lawsuits. This fear of litigation or concern about downstream users not having the most current available information may make some local governments reluctant to participate in a national initiative. Liability issues may raise concerns regarding incorrect parcel data.

These issues were explored in detail in the recent NRC report *Licensing Geographic Data and Services* (NRC, 2004a). This study found that the use of a license with a disclaiming warranty helps both data acquirers and providers allocate risk and that licensing has become a common mechanism as a result of this increasing concern over potential liability. While concerns over liability issues may be considered a serious challenge to a national parcel data program, the aforementioned NRC report found that "well-designed disclaimers have little or no impact on consumers' ability to extract, use, or manipulate data" (NRC, 2004a, p. 201). As an example, the Delaware County, Ohio, GIS program simply includes the following statement on its website and requires a user to agree to these restrictions as part of a registration process.

[2]See *http://www.opendataconsortium.org/* or *http://www.cfac.org/content/index.php/cfac-news/press_release/* [accessed May 29, 2007].

DISCLAIMER: The material on this site is made available as a public service. Maps and data are to be used for reference purposes only. Delaware County and its agents, consultants, contractors, or employees provide this data and information "AS IS" without warranty of any kind, implied or express, as to the information being accurate or complete. Map information is believed to be accurate but accuracy is not guaranteed. With knowledge of the foregoing, each visitor to this website agrees to waive, release and indemnify the Delaware County, its agents, consultants, contractors or employees from any and all claims, actions, or causes of action for damages or injury to persons or property arising from the use or inability to use Delaware County GIS data. SOURCE: *http://www.dalisproject.org/(S(5afpu145mizkmlvujxoyiaff))/pages/downloadreg.aspx* [accessed June 14, 2007].

5.4 ORGANIZATIONAL CHALLENGES

There are a set of issues regarding how a national land parcel program would be managed and coordinated. There is no question that a standardized integrated national system for land parcel data would be complex and its success would depend on intergovernmental cooperation and adherence to standards. There is certainly a risk that the system would attempt to meet too many objectives. As in any information system the risk of failure would increase with the scope of the project.

5.4.1 Federal Agency Coordination

As described in Chapter 4, there are numerous federal programs related to land parcel data, but coordinating across the various agencies to create a consistent database has been difficult. GAO found that more than 30 federal agencies control hundreds of thousands of real property assets worldwide, including facilities and land, worth hundreds of billions of dollars (GAO, 2003a). Even though the Bureau of Land Management (BLM) has been designated the steward for federal land ownership it is not the single focal point for those functions. For example, the General Services Administration (GSA) manages information about real estate, buildings, and facilities, and a variety of land agencies (USFS, National Park Service, BLM) manage information about surface and subsurface land depending on the mission of the agency. A complete list of federal properties does not exist, let alone with accurate geospatial information. This poses technical challenges to the creation of national land parcel data. The federal government's poor management of its real property assets is one of the high-risk activities of the government, as identified by GAO (2005). In testimony before the House Interior Appropriations Subcommittee on March 2, 2005, then-Interior Secretary Gale A. Norton said, "The Department currently uses 26 different financial management systems and over 100 different property systems. Employees must enter procurement transactions multiple times in different systems so that the data are captured in real property inventories, financial systems, and acquisition systems. This fractured approach is both costly and burdensome to manage" (Norton, 2005).

Congress has repeatedly called for inventories of federal lands, but these have often been single-purpose, single-agency requirements. For example, Section 1711 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1711) requires that the Secretary of the Interior prepare and maintain a continuing inventory of public lands, including their boundaries. A similar inventory of forest and agricultural lands by the Secretary of Agriculture has also been stipulated by several acts. The Agricultural Foreign Investment Disclosure Act requires all foreign owners of any U.S. land used for agricultural, forestry, or timber production to report their holdings to the Secretary of Agriculture so that USDA can provide an annual report. Other provisions of law have required the federal government to inventory land for various purposes, such as for (1) an Abandoned Mine Land Inventory, (2) a National Wetlands Inventory, (3) siting a refinery, (4) identifying facilities and properties that can be used to provide emergency housing in case of disasters, or (5) assess-

ing the value of lands for management of the recovery of any species included in a list published under Section 4(c) of the Endangered Species Act of 1973 and for addition to the National Wildlife Refuge System.

The Bush Administration is attempting to address this problem. Executive Order 13327, issued February 4, 2004, calls for the creation of "a single, comprehensive, and descriptive database of all real property under the custody and control of all executive branch agencies." However, there are shortcomings with the executive order and its implementation. First, public lands are exempt (Federal Real Property Asset Management, 69 Fed. Reg. 5897, 5900 [February 6, 2004]):

> Sec. 7. Public Lands. In order to ensure that Federally owned lands, other than the real property covered by this order, are managed in the most effective and economic manner, the Departments of Agriculture and the Interior shall take such steps as are appropriate to improve their management of public lands and National Forest System lands and shall develop appropriate legislative proposals necessary to facilitate that result.

Second, the inventory being developed by GSA in response to this executive order does not have a cadastral, mapping, or geospatial component. To improve the government's land inventory, legislation known as the Federal Land Asset Inventory Reform Act (H.R. 1370, 109th Congress), has been introduced. This bill would "require the Secretary of the Interior to develop a multipurpose cadastre of Federal real property to assist with Federal land management, resource conservation, and development of Federal real property, including identification of any such property that is no longer required to be owned by the Federal Government, and for other purposes."

5.4.2 State Coordination

Only 12 states administer digital parcel programs through a centralized state system. In most states there is no established organization to act as the coordinator of a statewide land parcel data set. While there are successful models, these programs are often the result of unique situations where strong leadership found the right issue and set of resources. In the remainder of states, additional leadership and strong incentives would be needed to encourage state participation. Even though NSGIC has become a recognized entity it has not tackled the issues relating to intergovernmental coordination that would be required for a parcel program. Most states do not have regulations that require a timely and consistent flow of information from local governments to state and federal agencies. In fact, many local governments resist sharing parcel-level information with state agencies unless it is required by statute. This leads to major discrepancies in the information used at different levels of government. For example, most states are not able to even maintain a current representation of incorporated boundaries. Only a few states provide coordination of this information to the Census Bureau for completion of the annual Boundary and Annexation Survey.

5.4.3 Personnel

Managing an integrated parcel data program would require a variety of technical skills at all levels. These skills relate to a range of tasks during the creation and maintenance of the parcel representation and the database management for the attribute information. There are serious questions about whether the labor force exists to handle the task. The U.S. Department of Labor identified geospatial-related occupations as one of the 12 high-growth employment sectors for 2000-2010, with employment in those occupations projected to increase from 8 to 29 percent over the decade (U.S. Department of Labor, 2003). There is also evidence that GIS use is increasing at the local government level. A 2003 survey of 1,156 local governments by Public Technology, Inc. (PTI, 2003) (now called Public Technology Institute) documented that GIS is an integral part of the work

environment of more than 75 percent of the respondents. A few important trends were identified in the survey (PTI, 2003, p. 8):

> On the horizon, GIS technology will become a key component of every government applications system. In addition to the visual analysis of data, a key driver for enterprise GIS applications is that location is the connection point for the interoperability of disparate systems.

- 77 percent of respondents use GIS technology to view aerial photography.
- 70 percent use GIS technology to support property record management and taxation services.
- 57 percent of respondents use GIS technology to provide public access information.
- 41 percent use GIS technology to support capital planning, design, and construction.
- 38 percent use GIS technology to support permitting services.
- 38 percent use GIS to support emergency preparedness and response activities.
- 33 percent use GIS to support computer aided response activities.

However, despite this growth in the use of GIS, it is questionable whether many small local governments can attract employees to some environments at existing salary ranges. Only 23 percent of the respondents to a 2003 geospatial industry salary survey by URISA were employed by counties, and only 12.7 percent were employed in the assessor's office where the vast majority of parcel data are created and maintained (URISA, 2003).[3] An FGDC state survey found that attrition of GIS-skilled workers in smaller counties has become a big issue because the mapping person may not be making much more than minimum wage (Stage and von Meyer, 2006a, p. 18). Alternatively, GIS workers may be required to carry out multiple duties other than geospatial work. In a field that is in high demand, once people have gained skills, they often move to higher-paying jobs elsewhere. These findings suggest that workforce issues may be greatest at the primary source for parcel data creation and maintenance. In medium- and smaller-sized counties where personnel fulfill many functions there is little time available for parcel conversion work. Conversion and maintenance work is time consuming and requires attention to detail, and so is a risky area for multitasking.

A digital divide clearly exists with respect to the management of land parcel data. The lack of current GIS, database, and network support is particularly acute in rural areas. This isolation also pertains to a support network of other practitioners and colleagues engaged in similar work. A social support network of practitioners can often learn quickly from each other when access is easy. In rural areas an e-mail list server or technologies such as NetMeeting or GOTO Meeting (Citrix) can help but are less effective than face-to-face learning from neighbors.

5.5 POLITICAL CHALLENGES

In addition to technical, financial, legal, and organizational challenges, a national program of coordinating land parcel data faces many political obstacles. In fact, the lack of political will may be the most difficult hurdle of all.

5.5.1 Return on Investment

It is difficult to calculate a clear financial return on investment for developing a national program for parcel data. It is much easier to estimate the costs of a national parcel data set than to quantify its benefits. Some tangible benefits can be quantified, such as improved tax compliance and efficiencies within specific government agencies and private sector industries. However, these issues are unlikely to be persuasive by themselves when measured against the substantial cost to develop a national system. The real benefits of a nationally integrated system accrue to larger groups and to

[3]See *http://www.urisa.org/prev/store/salary_survey_2003.htm* [accessed June 13, 2007].

society as a whole. These include fraud reduction, fairer assessments, improved decision making, more effective emergency management and response, and the improved economic development that better information can facilitate.

5.5.2 Motivation from Local Government

Much of the feedback from stakeholders in the parcel community suggests that local governments who operate digital parcel data programs have little motivation to participate in a national system, as illustrated by this comment:

> At a local level, there is little to no thought of this as an issue. It is not important. We have and maintain the information that we need to conduct our business. If we need some info from an adjoining jurisdiction, I call my one of my friends and ask for a file, he sends it to me and vice versa. This is more of an issue for the state and federal levels of government. (Comment from web forum: Stephen Marsh, Director, GIS Department, Jackson County, Missouri Director)

For local governments that have invested in and built their parcel data systems there is a sense among a small percentage of them that their systems suit their own needs and they see little or no benefit from a "national" system. They assume that any system at a state or national level could never be as accurate or current as their own data and they rarely need to consolidate data with other communities. Furthermore, some are hesitant to "give away" data that their community has worked hard to finance and create. Even the most successful local government parcel programs will be reluctant to change existing practices to adopt a different federal standard. They view this as a drain on resources with no direct return. It is clear that strong incentives will be necessary to overcome this reluctance to provide data for a national land parcel system.

5.5.3 Distrust of Unfunded Mandates

Many local governments currently face serious budget restrictions, some because of property tax limitation initiatives. Funding for additional personnel or new projects is limited by the need to provide more services for less cost. Therefore, there is often distrust at the local level of federal initiatives, a distrust borne of past experience with unfunded mandates and the forced sharing of data with nothing in return.

> The Census Bureau BAS [Boundary and Annexation Survey] survey is an excellent example. As a single resource GIS shop for my county, I am very busy and my immediate future is downright insane. . . . They assume, if there are a few changes, the survey could take about 20-40 hrs to complete. . .. If I care to submit digitally, I then have TONS of hoops to jump through. And all this hassle is for . . . what? Where is my incentive? Hopefully, next year I will have some staff and we can work on it. (Comment from web forum: David Weisgerber, Polk County, North Carolina, GIS Technician)

Another example is the Census Bureau's Local Update of Census Addresses program as described in Chapter 4, in which locals must provide updated addresses but then are not allowed to use the updated Census files.

Unfortunately, the last 25 years have not had many demonstrated successes of intergovernmental cooperation. The federal government has struggled for years to create a national system of consistent geospatial information. Geospatial One Stop and *The National Map* have yielded only mixed results (NRC, 2003a; NACo and NSGIC, 2005), and the National Integrated Land System, as described in Chapter 4 is still in the prototype phase. There is a risk that a national land parcel data program will be viewed as just another "mapping program du jour" and will not be taken seri-

ously. The challenge is to clearly distinguish this program from the others and to highlight how this approach is more likely to succeed.

5.5.4 Private Sector Seen to Benefit at Expense of Local Governments

Many firms in the private sector are assembling parcel data for large parts of the country. These firms use parcel data to drive business applications or to provide better address matching (geocoding) services. Others are building real estate applications or serving as wholesale aggregators of land parcel data. While some of these firms provide revenue to local governments, there is widespread perception that they are simply harvesting data created by local governments for commercial gain, as the following quote from the stakeholder feedback illustrates.

> It kills me when the private sector can make a fortune of a database that I have worked on for years. (Comment from web forum: James Myers, GIS Technician, Sedgwick County Court House, Kansas)

Some local governments will lose revenue from licensing fees if local data are available through a national system. Many local governments currently charge third parties for the use of their parcel data. In some cases, these charges are nominal and simply cover the cost of duplication. In others, the charges can be quite high because they are intended to recoup prior investments in expensive systems or even to be a source of revenue. For example, Dallas County, Texas, offers its digital parcel data for $50,000 and Nassau County, New York, sells its data for $40,000. These local governments may view a national parcel database as a "giveaway" to private companies and others who currently purchase the data directly from them.

5.5.5 Local Political Realities

Very few elected county commissioners and others who approve budgets have a strong background in technology, let alone geospatial technology. This makes it challenging for them to evaluate budget requests for technical items, especially when it involves funding the sharing and distribution of local government assets. A large budget request for a parcel conversion project therefore faces greater scrutiny and skepticism because the outcome cannot be foreseen. Clearly there must be significant financial incentives or state regulations to gain the participation of many local governments.

5.6 UNIQUE CHALLENGES OF CREATING PARCEL DATA FOR INDIAN COUNTRY

There are many unique challenges to creating a national parcel layer for Indian Country. These challenges can be divided into four areas: legal, political, social, and the juxtaposition between the tribes and the Bureau of Indian Affairs (BIA).

5.6.1 Legal and Policy Challenges

Many legal challenges affect the availability of parcel information in Indian Country. The primary area of concern is Code of Federal Regulations 25 Chapter 24 Section 2216, which sets restrictions on the availability of land ownership information. Technically the BIA or a tribe is not allowed to release this information. At this time special clearance is needed by users to access this database. A trust database has been set up by the Department of the Interior Special Trustee's office. The system for accessing and inputting information is called Trust Asset and Accounting

Management System (TAAMS). However at this time TAAMS contains only tabular data about the allotments.

In addition, the ongoing *Cobell v. Kempthorne* litigation has increased the security for trust information. *Cobell v. Kempthorne* is a class-action suit brought against the U.S. government by Native American representatives, claiming that Indian trust assets have been accounted for incorrectly. One of the findings of the *Cobell* case is that the BIA has been unable to adequately track individual allotee names and that the prior system was insecure. Since individual allottee information is ultimately tied back to distribution of income derived by trust land, this database and its integrity are of great concern to tribal people.

Even at the tribal level there is a great desire to keep trust land information confidential. Tribes such as the St. Regis Mohawk Tribe in New York keep tight control of their trust information. Information is not permitted to leave the office, even for in-house projects.

5.6.2 Political Challenges

Public Perception

Another challenge to the release of information on parcels is related to the internal politics of the tribes. As mentioned earlier, many reservations have significant non-Indian ownership among the trust land on the reservation. However, the general public's perception of Indian reservations typically comes from state highway maps and other maps that show the reservation as one homogeneous polygon. This has led individuals to believe that the entire reservation is composed of tribal trust land. Some people feel that depiction of the tribal presence as a reservation line bolsters tribal sovereignty more than displaying individual parcels or trust land.

Unwillingness of Tribes to Accept Current Delineations

Another concern tribes have with the release of land parcel data is that some tribes do not wish to accept the current land parcel delineations as defined by the federal government. In addition, there is fear that acceptance of those lands will set a precedent, or interfere with current land claims. Many tribes have ongoing land claim disputes across the United States.

Inability of Tribes and Counties to Work Together

Yet another difficulty that tribes face in the political arena is the inability to effectively work with county governments where counties also have some jurisdiction. This problem makes the creation of a homogeneous parcel layer across the reservation extremely difficult. Since trust lands are not taxed, some county officials see tribes as a burden on the tax rolls or even a threat. This is especially the case today when tribes have used gaming revenues to start buying back land on the reservation and convert it to trust land, essentially removing it from the tax base. Sometimes tribes may have better access to resources and training for creation of a GIS parcel database than do counties. This is because the tribes fall within the Department of the Interior's licensing agreement for GIS software. This licensing agreement provides the complete suite of GIS software at no out-of-pocket cost to the tribes. This perceived technological advantage may be threatening to county governments. Tribes may have strong capabilities in GIS, but the real power of a parcel layer is in the owner's names. Regular acquisition of parcel tabular data is necessary to make the parcel layer useful. Creation of a useful parcel layer is a team effort and requires tribes and counties to work together.

5.6.3 Social Challenges

Many tribes still have deep, conflicted feelings about land ownership and the creation of parcels for Indian Country. One statement commonly heard is, "How can you sell your mother?" In some native cultures the idea of carving up the landscape into parcels is very distasteful. This is not the case everywhere; however it is an issue that runs very deep.

5.6.4 Juxtaposition of Tribes and BIA

Lastly, the juxtaposition of tribes and the BIA when it comes to trust parcel mapping is a very interesting issue. On many reservations across the United States, the BIA plays a very minor role in mapping trust land in the local office. Many tribes have contracted the BIA roles on reservations (e.g., forestry, transportation, and land services) via Public Law 93-638 (Tribal Technical Assistance Program, 1994, pp. 1, 7). This has given the tribes better control of these types of programs on the reservations and has typically included some sort of GIS role occurring at a tribal level. On other reservations, parcel mapping services come from the BIA due to lack of local funding, skills, or interest. Tribal programs need up-to-date parcel information for management decisions, planning, development, and emergency response. This often includes mapping non-Indian lands on the reservation. As tribes have become more self-supporting and proactive in management, they have acquired finances to fund parcel data collection. Unfortunately, the BIA has a very low level of on-the-ground involvement on many reservations; hence there is no institutional need for the BIA to create up-to-date parcel data. The problem then becomes that the BIA is the "official source" of trust parcel mapping. However the data the BIA maintains are most likely not kept up to the standard needed and used by most tribes.

5.7 SUMMARY

In this chapter the committee has outlined the technical, data, financial, legal, organizational, and political challenges that would inhibit the creation of a nationwide program for parcel data. Although there seem to be numerous technical, data, and financial challenges, there are also numerous examples where these types of challenges have been overcome or resolved in particular communities or in other countries. Therefore, the committee believes that these types of issues are minor compared to the legal, organizational, and political ones. With more than 3,000 counties, tribes, and other local government entities as potential producers of parcel data, the organizational issues are complex. Also, other countries have created national land parcel data, which shows that it is feasible to do so. The next two chapters describe the committee's vision for a national land parcel data system in the United States, and what needs to be done to overcome the challenges described in this chapter to achieve that vision.

6

Vision and Model

Based on the information gathered for this study, the committee believes that a national approach is necessary to provide a rational and accountable system of property records. These national land parcel data would be truly multipurpose. They would support law enforcement needs, improve disaster planning and response efforts, facilitate real estate transactions, promote equitable property taxation, assist in the identification of fraudulent insurance claims and real estate appraisals, and help in a host of other administrative and business activities.

The committee has developed a vision and model for a national land parcel data program. The vision is a distributed system of land parcel data housed with the appropriate data stewards but accessible through a web-based interface. It would have a minimum set of attributes, and the development and integration of national data would be overseen by a national coordinator, working with coordinators for federal lands, Indian lands, and each state. These data would serve as the cadastral data layer of the National Spatial Data Infrastructure (NSDI). This model is based on an assessment of user needs and an analysis of the requirements to make such a model successful. This model combines modern geographic information systems capabilities, sound database management practices, existing Internet capabilities, and pooled financing with a shared organizational structure. The system that the committee envisions is based on ample evidence that large-scale parcel data systems are technically feasible and affordable. The committee was guided by the following principles as it developed the details of the proposed model:

- The parcel data will continue to be controlled and maintained locally. Communities will accurately locate, uniquely number, and assign a street address, if one exists, to each parcel.
- Only a minimum set of attributes will be available on a state and national level in order to minimize privacy concerns and keep the scope reasonable. The unique parcel identification number would be used to link to other data that the community may make available.
- The system will operate in the public domain under the existing federal policy (Office of Management and Budget [OMB] Circular A-130). There will be no limitations on the use of the national parcel data.

- The committee is not proposing a centrally maintained database. The vision is a federation of systems, all of which serve as conduits for data aggregated "virtually" at state and national levels.
- State and federal coordinators will set and enforce standards, provide technical assistance, reconcile boundaries, coordinate and distribute funds, and act as aggregators and delivery mechanisms. They will maintain data on state and federally managed lands.
- The federal government should assist with the costs of initial conversions as well as the incremental costs of standardization and distribution. However, ultimately, the program should follow a collaborative model and be supported by all parcel producers and users.
- Development of nationally integrated land parcel data will be an ongoing process. Single points may be used to represent some parcels in the initial phases, to be replaced by polygon representations as they become available. Boundaries will be reconciled and accuracy improved as time goes on.

Once established, the parcel system would provide an unambiguous set of land parcel data that completely cover the United States. When attached to appropriate attributes, these parcel data would provide a clear basis for all decisions relating to land ownership and use. A by-product of this approach would be a system of accurate, current, and unambiguous geographic coordinates for all street addresses in the United States. As in many developed nations, the local government parcel database would be the definitive source for all street addresses. These geographic representations of street addresses would form the basis of a consistent emergency 911 (E911) system, as well as robust location-based services. No matter what service one used—an E911 dispatch program, a web-based map, or a vehicle navigation system—a street address would be associated with the same location on the earth. Therefore, the national parcel system would support the needs of the postal service and the Bureau of the Census as well as the average citizen and entrepreneur. The committee believes that this system could become a widely adopted and highly valued resource. Over time, various stakeholders could form an authoritative chain of transactions that would keep the system current, so that the information is timely enough to be valuable to the consumer market.

6.1 MODEL FOR FEDERATED COORDINATION

It is not feasible for a single entity to interact with the large number of counties, municipalities, regional bodies, school districts, and special districts in the United States that produce parcel data. Therefore, an intergovernmental framework involving local, state, and federal agencies would have to be established and promoted in order to develop nationally integrated land parcel data. In their article about local government data sharing, Harvey and Tulloch (2006, p. 764) characterize this type of arrangement as a "Federation by Mandate" in which

> . . . an agency (or group of agencies) is given special authority with regard to data production and sharing. An example would be a regional planning agency that is designated by the state as the official producer of specific data layers. Their authority may extend to requiring other jurisdictions to submit data to be incorporated into the official dataset. Unlike the hub-and-spoke model, this would be a more complex network, in which many of the participants are major data producers. The mandated participation creates a significant opportunity for consistent data across a jurisdictionally complex landscape. The federation by mandate has a high reliability over time, wherein participants can generally count on the availability of the same data under roughly the same terms year after year across a fairly wide area.

Need for a Multipurpose Cadastre (NRC, 1980) recognized that organizational and institutional issues would be the major barriers to implementation of a national system of land parcel data.

Therefore, in order to address these concerns, the current committee carefully analyzed the logical flow of parcel data in a nationwide federated model (Figure 6.1).

This model provides the core of the committee's vision of how a unified and nonredundant parcel system would operate. It recognizes that parcel data are created and maintained by several public entities. Each of these organizations has a recognized legal mandate to produce parcel data and a set of related attributes. For example, local governments produce parcel data to support the administration of property taxes while other levels of government need an accurate representation of their interests and rights relating to property they own or manage. While private firms involved in real estate and insurance may produce parcel data for their own internal business needs, these data are not considered part of a national system. In fact, one of the goals of the national system would be to encourage private firms to utilize and financially support the public sector parcel data system.

The model identifies an important role for parcel data coordinators at the state and federal government levels and a coordinator to deal with the special needs associated with Indian lands. These coordinators would assemble and reconcile parcel data from the relevant parcel data producers. For example, a state coordinator would deal with edge-matching parcel boundaries along county boundaries and inserting and reconciling state-owned lands with privately owned land. In fact, several states already have such coordination offices. The federal land parcel coordinator would specifically deal with inventorying and managing the geographical representation of all property managed by the federal government. The Indian lands coordinator would work with tribal governments, Bureau of Indian Affairs, and Office of the Special Trustee to reconcile the parcel data for tribal and Native lands. This position will be particularly tasking because it will often require determining which of the above organizations' data to use, since there is a great amount of duplication and variation between organizations. There is also a need for a national land parcel coordinator, who would have the ultimate responsibility of creating wall-to-wall coverage of land parcel data across the United States. The national coordinator would be the conduit for a diverse user community to access a trusted and authoritative representation of all land parcels. Technically, all adjustments to parcel data made by coordinators at any level would be maintained with appropriate digital time stamps that

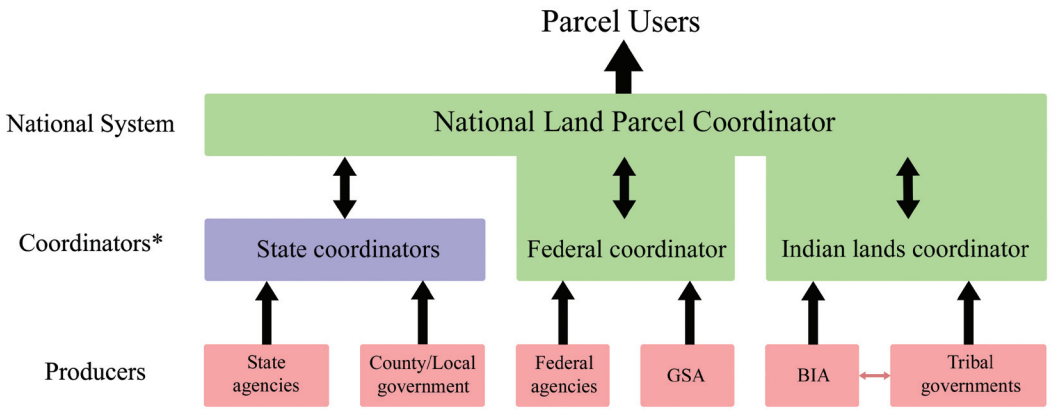

FIGURE 6.1 Flow of parcel data from producers to a national system. NOTE: BIA = Bureau of Indian Affairs; GSA = General Services Administration.

would enable parcel data producers to synchronize their data with any changes. It is also understood that parcel data producers are likely to have a set of parcel data that is used for internal operations and decision making and another set that is periodically published for distribution. As a mandated intergovernmental federation the producers and coordinators would operate under an established set of standards and practices such as those that have been established by the Federal Geographic Data Committee (FGDC) Subcommittee for Cadastral Data.[1]

6.1.1 Local Government Responsibilities

In this model the county or equivalent unit of government would be the primary producer and manager of parcel data within a county or equivalent jurisdiction. It is acknowledged that these representations are not legal definitions of the parcel ownership information. Typically, the county government would coordinate with other jurisdictions in the county to ensure that there are no redundant or overlapping parcel production programs. The local agency would be responsible for continuously creating and maintaining a comprehensive seamless set of land parcel data that are integrated from all public and private lands. Each county would be the ultimate point of contact for any modifications to the parcel fabric. It would reconcile the graphic representation of all parcel boundaries within its jurisdiction. It would also create and maintain a parcel-based jurisdictional area file that accurately represents incorporated and unincorporated areas, with metadata for published data sets. The local stewards may build the parcel data with any tools or methods they desire and may collect any set of attributes that are required for their local business and regulatory functions. Local governments in areas without existing digital data would receive assistance in the form of grants and training to equip them with skills that would enable them to maintain a digital representation of at least a point-level feature for each parcel on an annual basis and assign it a unique parcel identification number and a street address, if one exists. On an annual basis, or more frequently if desired, the county would provide the state integrator with parcel boundaries, attributes, and jurisdictional boundaries conforming to the format and quality standards established by the coordinators.

6.1.2 State Government Responsibilities

The state government coordinators would serve the parcel business needs at a state level. This would include functions such as property tax revenue, law enforcement, transportation planning, and emergency preparedness and response. At a minimum, the state would assemble a comprehensive set of parcel data on at least an annual basis. It would produce and maintain parcel data for counties that are not financially or technically able to handle such a program. It would provide Internet-based services for those counties that cannot afford or prefer not to maintain such a system. It would maintain a secure archive of the parcel data. It would maintain parcel data for state-owned land and ensure that all state-owned property parcel information is provided to the counties. A state coordinator would enforce standards and reconcile data at boundaries as needed. It would also serve as the authoritative point of contact to the Bureau of the Census for the Boundary and Annexation Survey program. The state would assume the responsibilities for coordination of funding and other cooperative agreements with federal agencies. It would also develop a technology transfer and training program and metrics for assessing progress.

[1]These are part of the Framework Data Content Standard, which will soon be approved as an ANSI (American National Standards Institute) standard. See *http://www.fgdc.gov/standards/news/fdcs-begins-approval* [accessed June 14, 2007].

6.1.3 Federal Government Responsibilities

In the committee's vision, the federal government would provide two essential services: ensuring (1) that parcel data representing federally managed lands are included in the system (federal land parcel coordinator) and (2) that all other parcel data sources are integrated into a seamless system (national land parcel coordinator). The exact organizational location and responsibilities of these two coordinators would be determined by a review of the current OMB Circular A-16 mandates. The two offices could be co-located in the agency that is determined to have the clearest overall mission for parcel data coordination or they could be in separate agencies.

The federal land parcel coordinator would respond to the various mandates for a comprehensive inventory of federal property and develop and maintain parcel data for federal lands. This would require coordinating with all federal agencies that manage land and develop land parcel data.

The national coordinator would establish a robust Internet portal for discovery, navigation, download, and mapping of all parcel data on a national basis, including all public and private lands. The portal would ensure that parcel data can be displayed in conjunction with other data such as street centerlines, census geographic areas, imagery, hydrological, and transportation features (e.g., *The National Map*). The national coordinator would develop a comprehensive business plan to coordinate the development of national data. This would include funding and regulatory activities. The national coordinator would set standards and develop policies and procedures to ensure that there are smoothly functioning lines of communication with the states such as through the Fifty States Initiative. He or she would also coordinate requests for additional parcel attribute data under the Department of Homeland Security (DHS) Critical Infrastructure Program or as part of the Homeland Security Infrastructure Program Gold geospatial data inventory, which might include assembling snapshots of the parcel data for multijurisdictional areas for specific programs such as hurricane preparedness. Other responsibilities would include developing decision support systems that retrieve the necessary parcel data in near real time from the state and local producers, and evaluating and monitoring the states' and local governments' quality of performance and progress in general.

6.1.4 Private Sector Role

As described in earlier chapters, the private sector is involved in many aspects of parcel data development. It already provides contractual services to parcel data developers at various levels of government for such things as data conversion or web services. The committee envisions that private industry could play a role in the development of nationally integrated data as well, through contracts for such tasks as completing the initial data, developing the network that accesses updates to the parcel data from the appropriate data stewards, and building a web-based interface for easy and efficient access to the data. As shown in Chapter 4, many companies already exist with the expertise in parcel data that could apply their skill and knowledge to the development of nationally integrated data. Also, since private industry is currently compiling data sets of address points and parcel boundaries, these data sets could be assessed and purchased as needed to complete initial coverage. After that, updates to the data would come from the data steward. Because U.S. data policy as stated in OMB Circular A-130 (OMB, 1996) requires that national data sets be in the public domain, a model in which private industry compiles the data and sells them is not possible. However, private industry would be free to take the national land parcel data, enhance them, and develop value-added products that would fit the business needs of specific sectors, similar to the way in which the Census Topologically Integrated Geographic Encoding and Referencing (TIGER) data set spawned whole new products.

6.2 PARCEL DATA MODEL

6.2.1 Geographic Representation

It is estimated that the United States covers 3,586,498 square miles, which includes 144.2 million privately owned and 8 million publicly owned land parcels. Each parcel has at least one public or private owner. In this model, each of these parcels would be represented as a closed polygon that approximates its legal boundaries or at least a point in the initial phases. Eventually, as in many developed countries such as Australia there would be a set of mutually exclusive and comprehensive polygon features with geographic coordinates that define every part of the United States. It is estimated that about 70 percent of the parcels are already represented in digital form and that the effort to complete the coverage is technically and economically feasible. In fact, most state governments require local governments to produce tax maps that depict the boundaries of each parcel. Even though these parcel polygons are only a sketch of a legally defined parcel they can fulfill the basic needs for a national system. Once the initial set of parcels has been established, over time further integration can be done to address the more complex accuracy issues, including the absolute accuracy of the boundary data. There are several acceptable procedures for converting existing tax maps into digital parcel data. Furthermore, many communities have utilized legal descriptions and ground survey measurements to produce highly accurate parcel boundaries. For those parts of the country that are not covered by tax maps or definitive descriptions of parcel boundaries it will be acceptable to initially represent a parcel with a single point. These points can be gathered directly on the ground through global positioning system technology, geocoding information from the legal description, or capturing them from geographically registered imagery. Following this approach it would be possible to quickly represent each land parcel in the United States as a polygon or point-level feature that can be associated with an owner or owners. Of course, the long-range goal would be to have complete coverage of nonoverlapping parcels with shared boundaries that are as accurate as possible.

6.2.2 Attributes

The benefits of any parcel data system are associated with the information relating to the parcel. While a tax map can provide a graphic depiction of parcel boundaries it does not convey information about the ownership, surface rights, easements, land use, or value of the land. Local governments require this information to build an equitable property tax system and many also use it to support applications relating to land use and emergency response. There are common needs in each community and there are also needs for regional coordination. At the national level the need for sufficient parcel attribute information must be balanced with legitimate concerns about personal privacy and confidentiality. Therefore this national model should be limited to only a basic set of attributes that would support discovery and navigation of relevant parcels. From a functional viewpoint the base set of attributes would enable one to

1. Uniquely identify each parcel in the national database;
2. Link a parcel uniquely back to its source provider;
3. Provide basic information concerning the parcel geometry;
4. Locate its street address; and
5. Identify the owner type.

(Note that in cases where parcels do not normally have a street address, such as agricultural or timber lands, address information would not be required, and the address field would be empty or null values.)

BOX 6.1
Descriptions of Attributes for National Land Parcel Data

Metadata—The metadata will contain information about the data such as the data steward, the parcel contact, the date of the data, and other information that would support the use and application of the information (e.g., projection, coordinate system).

Parcel Outline (Polygon)—The geographic extent of the parcel, the parcel boundaries forming a closed polygon.

Parcel Centroid (Point)—A point within the parcel that can be used to attach related information. This may be a visual centroid or a point within the parcel. It may not be the mathematical centroid because this point needs to be contained within the parcel polygon.

Parcel ID—A unique identifier for the parcel as defined by the data steward or data producer. The parcel identifier should provide a link to additional information about the parcel and should be unique across the data steward's geographic extent. (Note: To obtain a unique nationwide Parcel ID, the jurisdiction's Federal Information Processing Standards [FIPS] code could be added to the front of the parcel ID when the source data are posted to the publication site. This can be done transparently so that data producers do not have to worry about changing their parcel numbers. In the case of federally owned parcels, data concerning federal agency code and state FIPS code may be incorporated transparently as well.)

Owner Type—The classification of the owner. In some local governments, tax parcels are tagged as either taxable or exempt and the owner classification is not known. In these cases owner types of taxable and exempt may be added to this list: international, tribal, federal, state, county, local or municipal, private, not for profit, other, or unknown.

Parcel Street Address—The street address (site address) for the parcel. If there is more than one, select the first or primary site address. (Additional site address may be provided in a related file.)

Parcel Area—The area of the parcel expressed in acres.

Public Parcel Name—For publicly owned parcels, this is the commonly recognized name of the parcel (e.g., Dad Dunham Park or Yellowstone National Park).

SOURCE: Descriptions adapted from FGDC Subcommittee for Cadastral Data, 2006a.

Therefore, in the committee's vision, national land parcel data would include the attributes listed in Box 6.1. Descriptions of each element are based on those developed by the FGDC Subcommittee for Cadastral Data.[2] Based on a study done by the subcommittee, these are the most commonly needed attributes for a wide range of business needs, with the addition of the parcel address (FGDC Subcommittee for Cadastral Data, 2006a). After much deliberation the present committee has decided that the parcel address was an important addition to the attributes suggested by the Subcommittee for Cadastral Data. It is important to note that these basic attributes do not include information about private property ownership, use, value, or improvements. The base-level parcel data would support map display in relationship to other features such as imagery, administrative boundaries, or transportation features. By reference to the unique parcel identification number and geographic coordinates it would be possible to use database tools to associate these parcels with additional information on a "need-to-know" basis. Additional attributes may be included and shared under DHS's Critical Infrastructure Program.

[2]These attributes are all currently part of the FGDC Cadastral NSDI Data Content Standard.

6.2.3 Format and Distribution

The national land parcel data system would function as a trusted virtual system of uniquely identified and certified land parcel data. The parcel boundaries would be distributed as simple geographic features in an open standard. The geographic coordinates (e.g., latitude and longitude) would enable the polygons to be displayed in relationship with other features on a national basis. The attributes would be a simple flat file data table that could easily be downloaded. The published version of the parcel data would be updated on at least an annual basis. Access to the parcel polygons and the minimum set of attributes would be in the public domain and conform to federal guidelines under OMB Circular A-130. To address issues relating to privacy and confidentiality, no information will be provided about private ownership, use, or value.

At a minimum, local government parcel stewards would provide a published copy of the parcel data and limited attributes to the state coordinator on an annual basis. These data would be considered the official data for the national parcel system. The local agency would be encouraged to establish a dynamic linkage that would provide access to current data. The same local agencies could continue to operate their existing parcel distribution programs in parallel with the national system. There are several examples of similar levels of data sharing between local governments and the Bureau of the Census. It is assumed that existing technology can easily support the exchange of data and operate parallel systems. Where appropriate and necessary the state coordinator could assist the local agencies with various aspects of parcel data conversion and maintenance. In all cases, the state coordinator would serve as a backup for the local stewards. State coordinators would reconcile the boundaries between public and private land parcels. They would also deal with county boundary issues. In a similar manner the national land parcel coordinator would have appropriate linkages to the state coordinators to access the official version of parcel data. The national coordinator would also integrate the parcel data representing federal lands.

At a given time, it would be possible to assemble a snapshot of parcel data for any part of the nation. The actual source for delivery of parcel data would be determined by the spatial extent of the request. However, there would always be only one source for the official parcel data. For example, if a local government established a dynamic linkage with the state coordinator, then it would be possible for these data to be accessed through the national parcel portal. In effect this entire data flow process could reflect the situation on the ground, be updated on the basis of transactions, and be transparent to the user. Producer-level metadata would always enable the user to identify the source and the distribution channel. The parcel geometry and minimum attributes could be downloaded and used locally or accessed remotely via a web service.

It is assumed that the most dynamic aspects of the system would occur at the local level where new developments result in the subdivision of existing parcels. As a normal local business function, any new parcels would be given a unique identification number and address. They would also be reconciled with the boundaries of any affected parcels. Local parcel stewards could establish their own procedures and practices to determine when these transactions are reflected in the national parcel program. They would only be required to meet the accepted schedule. It is assumed that fewer updates will be required at the state and federal coordination levels. As a standard practice, parcels that include county boundaries have already been identified and resolved for tax and administrative reasons. At the state level these parcels could be flagged for special attention. A critical component of the system would be to develop parcel data for all publicly owned property and tribal lands. It is acknowledged that this will be a challenge. However, it is widely recognized that completing such an inventory is necessary and long overdue. Once completed, these parcel data should become relatively permanent parts of the system. They could easily be discovered and retrieved through existing attributes or metadata.

The general characteristics of both the downloadable parcel data and the corresponding web service would adhere to the following characteristics:

- **Data Contents**—Both the data and the web service would consist of graphics, attribute data, and related metadata designed and structured to offer seamless coverage of all 50 states as well as U.S. insular areas.
- **Geographic Reference**—National parcel data would employ a single, well-defined geographic reference framework based on North American Datum of 1983, consistent with NSDI specifications and sufficiently documented to allow easy transformation into the respective coordinate systems that may be employed by different users.
- **Coordinated and Authoritative**—Parcel data would be created from and maintained through a distributed network of individual "authorized" suppliers at the state, county, and local levels.
- **Limited Basic Functionality**—Parcel information should be viewable by panning and zooming across a national map and be searchable by attributes—centering the view on a given city, street address, zip code, or even a local parcel identification (ID) number (PIN).
- **Navigation Through Place Names**—Names of key public sites may also be used to center the view on a given geographical area.

An already existing visual illustration of the committee's vision can be seen in Figure 6.2. This figure shows parcel data across the boundary of two states, accessible through *The National Map*. This is just one aspect of what the committee envisions for the whole nation.

6.3 FUNDING MECHANISMS

Any successful funding model would address two different aspects: (1) the production of digital parcel data where they do not yet exist, and (2) the additional costs needed to ensure the data are consistent and have been reconciled across boundaries, and can be accessed and used as a seamless national data set. Getting support for the program will involve a marketing strategy and the proper identification of the products and service. If the service and product are properly defined, clients will become eager customers. There are many stakeholders, which makes it possible to create a sustained program for parcel data development.

The funding model would first address the concerns of local governments that are the primary producers of parcel data. There are literally hundreds of different models for local parcel data production, and as noted in Chapter 4, there is considerable evidence of sufficient return on investment to justify the creation of parcel data even in smaller communities. Local governments have discovered that the cost of a parcel system is often offset by the addition of many new properties to the tax rolls and by having an improved basis for property assessment and taxation. Many of them are also supporting their systems with fees attached to real estate transactions. These same local governments are also realizing that as parcel data become the authoritative source for street addresses, they can justify non-real estate-based sources of funding. Most importantly, first responders and law enforcement personnel would have access to accurate locations of a street address. As the source of street addresses, parcel data can not only save lives but also provide a justification for funding from E911 fees and even federal funds from DHS and the Department of Housing and Urban Development (HUD). Much of the existing revenue that comes through collaboration agreements, licensing agreements, real estate transaction fees, or E911 fees would not be significantly affected by a national program. Local government licensing fees are often (but not always) based on the attributes associated with the data above and beyond the geometry, address, and PIN required for a national system. Therefore, the national data will provide an advertisement for the detailed data

FIGURE 6.2 Parcel data conjoined across North and South Carolina and accessible through *The National Map*. The black line shows the North Carolina-South Carolina border—above the border is Mecklenberg County, North Carolina, and below is York County, South Carolina. The blue lines show parcel boundaries. SOURCE: North Carolina OneMap, *http://gisdata.usgs.net/website/NC%5FOneMap/* [accessed February 26, 2007]. Image courtesy North Carolina Center for Geographic Information and Analysis.

that are valuable to the real estate and insurance industries and that are available only from the data steward. The release of this more detailed information can still be subject to any local policies, whether this involves making it available for free, licensing it, or selling it outright.

Despite all of these potential funding mechanisms and benefits, the committee recognizes that incentives or additional support will still be needed for many local government entities to be willing or able to provide their parcel data for a national land parcel data system. One can consider four different issues that need to be addressed: (1) how to reward those local governments that already have parcel data and distribute it only for a fee under licensing agreements, (2) how to acknowledge those local governments that currently freely distribute their data, (3) how to assist local governments that need help in establishing their programs, and (4) how to manage parcel programs for those local governments that will never be able to support them on their own. The national land parcel coordinator will have to establish proper incentives for these various cases. However, the committee envisions that a major incentive for categories 1 through 3 above would be requiring digital parcel data for participation in geospatial data programs such as the National States Geographic Information Council's (NSGIC's) proposed Imagery for the Nation, which would represent substantial long-term cost savings to all local governments on data that are needed for parcel data production. For categories 3 and 4 above, the committee believes that the states or regional consortia can sup-

port initiation of a program or even take over creation and maintenance of parcel data for those jurisdictions that are simply not able to afford this. States would help fund parcel data production and integration because of the benefits for assessing and monitoring property values. An increasing number of states such as Tennessee and Arkansas are already building statewide parcel data programs. In much the same manner as local government parcel data programs, state governments are managing and even creating parcel data to comply with existing mandates and regulations that are linked to equitable funding for public education and property tax relief. Therefore, states are an additional potential source of funding for both parcel data production and parcel data integration.

The federal government has an important role in funding a national land parcel data program. In order to be successful the program will require mechanisms for federal agencies to contribute funds and other resources. There are already several existing models that can be used or extended for parcel data development. For example, both HUD and DHS are able to provide grants to state and local governments to support parcel data programs, among many others. There are also some excellent examples such as the U.S. Geological Survey National Mapping Program in which federal and state agencies have established effective cost-sharing programs to create geospatial data. In this context, OMB's Geospatial Line of Business is a perfect approach for intergovernmental partnerships, such as with NSGIC's Imagery for the Nation, which can be the umbrella to finance data acquisitions.

Finally, because the federal government has the most to gain from nationally integrated data, it would fund any additional incremental costs to integrate parcel data across county and state boundaries so that nationally consistent data are possible. This would be funded as defined in a business plan developed by the national land parcel coordinator. Since private companies that depend on parcel data to support their businesses, such as real estate, insurance, or location-based services, are major beneficiaries of a national parcel data system, they could also financially support the system.

In summary, the committee envisions two different elements to the funding model for national land parcel data. Completion of full coverage will be funded through incentives and grants in partnerships between all levels of government. States will step in to support local governments that are unable to develop and maintain their data. The costs to integrate the data nationally and develop a system to make them accessible would be funded by the federal government.

6.4 SUMMARY

In this chapter the committee has proposed a federated intergovernmental model for the development of nationally integrated land parcel data. The proposed model would provide a certified and consistent set of parcel data for the nation that would be in the public domain. The model would require a series of parcel coordinators who are empowered to create and promote the system. The system would be built on a simple data model that protects privacy while providing the necessary functionality. The committee believes that many aspects of existing OMB and FGDC mandates provide the legal and financial basis for implementing the proposed model. The many current organizational and financial issues are not trivial. However, the renewed interest in an expanded federal role in providing funding and coordination for geospatial data under the Geospatial Line of Business holds promise that the model outlined in this chapter could become a reality.

7

Conclusions and Recommendations

The final element of the committee's charge was to develop a strategy for achieving the vision described in Chapter 6, including the role of the federal government, and accounting for the challenges to be overcome. Since the federal government manages more than a quarter of the land within the United States and has the greatest need for data that cross jurisdictional boundaries, it is appropriate for it to take a leadership role. The federal government is also the only entity with the authority and purview to coordinate such a program. At the same time, it is neither feasible nor appropriate for the federal government to produce data for the millions of private property parcels. These data can only be accurately maintained by local governments that require them to support their normal daily business functions.

A series of federal mandates and policy statements that span more than a century provide plenty of precedents for the federal government to assume a proactive role in the coordination of relevant geospatial data. Clearly Office of Management and Budget (OMB) Circular A-16 and more recently the Geospatial Line of Business (GLoB) actually mandate that the federal government take a leadership position. OMB has specifically identified cadastral data and federal land ownership information as critical geospatial data themes. Unfortunately, the federal government has never developed a coordinated approach to parcel data, which are different from other framework data layers. Parcel data are produced and maintained by a large number of state, tribal, and local government entities. This shifts the federal role from one of production to coordination. Therefore, in order to provide effective leadership the federal government must adopt a radically different approach to intergovernmental relationships that has a focus on partnerships.

In Chapter 5 the committee has attempted to provide an honest assessment of the real challenges that will have to be addressed for a national land parcel data program to become a reality. On the other hand, there are numerous examples in which the private sector and several states have successfully overcome these issues. Probably the most difficult challenge will be establishing workable partnerships among local, state, and federal organizations. The committee is optimistic about the possibility of developing these partnerships for the following reasons:

1. The federal government has been taking steps to organize its geospatial data efforts, led by OMB.

2. The federal government understands the need for large-scale parcel data that can only come from local governments.

3. The proposed Imagery for the Nation program would provide valuable incentives to local governments.

4. The National States Geographic Information Council (NSGIC) is an extremely viable organization and has worked with the Federal Geographic Data Committee (FGDC) to establish the Fifty States Initiative.

5. The private sector has very recently been creating sets of parcel data throughout the country for the location-based services industry.

6. Homeland security and emergency response issues have taken on heightened importance and require parcel data for effective operations.

Although these points show that necessary progress is being made and awareness of the need for parcel data has been growing, there are still many challenges. In order to overcome the issues listed in Chapter 5 and achieve the vision outlined in Chapter 6, the committee offers specific critical recommendations. Most of the recommendations address organizational issues so that the basic organizational framework needed to build national data can be established. Two recommendations are related to funding that will address the financial and many of the political issues. Once the basic framework is set up, it will then be the responsibility of the various coordinators to start resolving the technical and legal issues discussed in Chapter 5.

RECOMMENDATIONS

Issue 1. The need to clarify and enforce federal agency responsibilities for land parcel-related geospatial data under OMB Circular A-16.

OMB Circular A-16 requires the federal government to establish the National Spatial Data Infrastructure (NSDI) and authorizes the FGDC to provide appropriate leadership. This requirement includes the assignment of custodial responsibility for different NSDI framework geospatial data layers. The NSDI specifically mandates that the federal government has a key responsibility to create and maintain geospatial representations for both federal land ownership status and cadastral information. The interpretation of how these two themes are defined and how they are being implemented is critical to this study. According to Circular A-16, federal land ownership status includes the "establishment and maintenance of a system for the storage and dissemination of information describing all title, estate or interest of the federal government in a parcel of real and mineral property. The ownership status system is the portrayal of title for all such federal estates or interests in land" (OMB, 2002).

In the context of the modern E-Government strategy outlined in the recent OMB GLoB, this definition of federal land ownership status would logically mandate an inventory and geographic representation of land managed by the federal government. According to the vision laid out in Chapter 6 such an inventory should be consolidated into a single federal agency and be managed by a federal land parcel coordinator with an appropriate team.

In a similar manner the cadastral framework NSDI layer is defined by Circular A-16 as "the geographic extent of past, current, and future right, title, and interest in real property, and the framework to support the description of that geographic extent. The geographic extent includes survey and description frameworks such as the Public Land Survey System, as well as parcel-by-parcel surveys and descriptions" (OMB, 2002). Again, the interpretation of this description is critical to this study. The committee found ample evidence that the intent of federal agency stewardship for

any NSDI data layer extends to all levels of government including tribes. Therefore, the inclusion of cadastral data as an NSDI framework layer is significant evidence that the federal government recognizes the need to coordinate parcel data from all sources, not just federal property boundaries. The committee believes that stewardship of the cadastre framework data should be handled by a national land parcel coordinator. This function is distinct from that of the federal land parcel coordinator, in that it will address the development of nationally integrated land parcel data from all land managers, whether public or private. This individual and his or her team should manage a program that integrates parcel data from all levels of government. The committee believes that such a program would address the programmatic needs of the various federal agencies. It also believes that numerous federal E-Government initiatives such as the Federal Enterprise Architecture promote and actually require such a proactive approach to intergovernmental data coordination. In other words, the committee believes that all the necessary authority and precedents already exist to implement its vision for a national program for parcel data. Furthermore, the existing U.S. Geological Survey National Map and the Geospatial One-Stop programs could facilitate the discovery, visualization, and distribution of parcel data.

The question does not appear to be whether the federal government has the need, resources, or authority to implement a national parcel data program, but rather whether it has the motivation and incentives to confront difficult institutional and financial obstacles. Therefore the debate is whether these parcel-oriented designations under OMB Circular A-16 are meaningful. In many ways the Government Accountability Office (GAO) answered the question in its 2004 report *Geospatial Information: Better Coordination Needed to Identify and Reduce Duplicative Investments* (GAO, 2004). This report draws the following conclusions (GAO, 2004, pp. 7-8):

> OMB, cross-government committees, and individual federal agencies have taken actions to coordinate geospatial investments across agencies and with state and local governments. However, these efforts have not been fully successful for several reasons:
>
> - A complete and up-to-date strategic plan is missing. The existing strategic plan for coordinating national geospatial resources and activities is out of date and lacks specific measures for identifying and reducing redundancies.
> - Federal agencies are not consistently complying with OMB direction to coordinate their investments.
> - OMB's oversight methods have not been effective in identifying or eliminating instances of duplication. This has resulted from OMB not collecting consistent, key investment information from all agencies. Consequently, agencies continue to independently acquire and maintain potentially duplicative systems. This costly practice is likely to continue unless coordination is significantly improved.

Federal response in the aftermath of hurricane events demonstrates that federal funds are being spent for parcel data without proper coordination. Therefore, the committee agrees with the general analysis of the GAO that Circular A-16 is not being fully implemented and believes that the issues relating to parcel data are further exacerbated by the lack of clout or incentives to deal with difficult intergovernmental relationships.

In order to move forward with a national vision for parcel data it is essential to establish clear and unambiguous authority within the federal bureaucracy. The proper starting place would be to analyze the existing OMB A-16, FGDC, and NSDI related documents that appear to have designated the Bureau of Land Management (BLM) to be both the federal and the national land parcel coordinators. Furthermore, there is considerable evidence that BLM has been performing many of the tasks associated with these roles. For example, it has fostered the development of an accepted standard for parcel data, surveyed the current status of parcel data, and identified best practices. It has also spearheaded the effort to create the National Integrated Land System and the Geographic Coordinate Data Base.

Based on mission statements and programs, the BLM is one organizational choice to house both the federal land parcel coordinator and the national land parcel coordinator. However, there are other candidate agencies. The Department of Homeland Security (DHS) could be directed to establish national land parcel data under the assumption that they are needed for homeland security. The General Services Administration (GSA) is the largest public real estate organization in the country. Its Office of Real Property Asset Management provides services for all federal agencies and has an inventory of more than 342 million square feet of workspace for 1.1 million federal employees in 2,100 American communities. Other federal agencies such as the Department of Housing and Urban Development (HUD) and the Census Bureau do not manage land but deal heavily with property issues and thus need parcel data to accomplish their missions effectively. However, the exact organizational location and responsibilities of these two coordinators needs to be determined by a review of the current OMB Circular A-16 mandates and an assessment of various agencies' missions and capabilities to house the coordinators.

Conclusions. Effective federal leadership for coordination of parcel data is needed, both in terms of federal land ownership (federal land parcel coordinator) and cadastral data provided by nonfederal agencies (national land parcel coordinator). BLM has been given responsibilities in both of these capacities and has engaged in several meaningful efforts to address these tasks, but it has not been successful in developing either federal or national land parcel data. It was beyond the scope and purview of this committee to determine which federal agency could best carry out the federal and national parcel data coordination activities; however, these designations must be assessed and clearly stated, and appropriate budget and authority must be assigned if the nation is to achieve a national land parcel data program. Therefore, the committee makes the following recommendation as a way for this decision to be made.

RECOMMENDATION 1. In order to achieve nationally integrated land parcel data, there should be both a federal land parcel coordinator and a national land parcel coordinator. A panel should be established to determine whether BLM has the necessary and sufficient authority and capacity to serve as the federal and/or national land parcel coordinator, and if not, either it should be given the authority and resources, or some other agency should be named. The panel should conduct a review of BLM's existing stewardship responsibilities for cadastral and federal land ownership status under OMB Circular A-16, as well as its current legislative authorities and budget priorities.

Issue 2. Clarification of the role of parcel data in the representation of buildings, cultural features, governmental units, and housing.

The committee believes that several FGDC data themes other than cadastre and federal land status are closely linked with parcel data. For example, it is standard practice in local government to use parcel-based data to either create or associate most information relating to structures, housing, and governmental units. The committee believes that if a national parcel program existed, the federal government could use the parcel data in the development and/or representation of the following themes (theme coordinator is noted in parentheses).

- ***Buildings and Facilities*** (GSA): Buildings and facilities must rest on a parcel of land that has an owner, value, and use.
- ***Cultural Resources*** (National Park Service): Cultural features such as archeological sites are located on land parcels. The ownership of that land has a direct impact on access to and use of those sites.

- ***Governmental Units*** (U.S. Census Bureau): Because of events such as annexations, the boundaries of incorporated areas are not fixed over time. Many local governments track annexations on the basis of parcels and are required by state law to submit plat maps or tax maps to identify jurisdictional boundaries. Governments issue business licenses and collect sales taxes based on the location of a parcel.
- ***Housing*** (HUD): According to the FGDC "HUD's database maintains geographic data on homeownership rates, including many attributes such as HUD revitalization zones, location of various forms of housing assistance, first-time homebuyers, underserved areas, and race. Data standards have not yet been formalized" (OMB, 2002). HUD has recognized that parcels are critical to tracking information about housing units and is experimenting with parcel data along the Gulf Coast.

Conclusions. The committee believes that land parcels are closely linked to other FGDC data themes such as Buildings and Facilities, Cultural Resources, Governmental Units, and Housing. Therefore, there should be a systematic review of how these themes would be managed if a national parcel data program existed.

RECOMMENDATION 2. As part of the Geospatial Line of Business process, the FGDC should identify the role of parcel data in the collection and maintenance of the following data themes: Buildings and Facilities, Cultural Resources, Governmental Units, and Housing.

Issue 3. The need for the federal government to maintain an inventory of its own property.

The federal government is the single largest land manager in the nation. However, despite numerous attempts, there is no single inventory of federal real property assets. In fact, the absence of such an inventory is one of the high-risk activities of the government, as identified by the GAO (2005). In testimony before the House Interior Appropriations Subcommittee on March 2, 2005, then-Interior Secretary Gail Norton said that "the Department currently uses 26 different financial management systems and over 100 different property systems" (Norton, 2005). Furthermore, many of the existing inventories lack the geographic coordinates of boundaries and cannot be directly incorporated into a modern geographic information system (GIS) environment. Several times, Congress has called for inventories of federal lands; however, these have often been single-purpose, single-agency requirements. For example, Section 201 of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1711) requires that the Secretary of the Interior prepare and maintain a continuing inventory of public lands, including their boundaries. Further programs have called for inventories of forest and agricultural lands, abandoned mines, wetlands, and endangered species' habitat.

There is evidence that the current administration is also interested in conducting an inventory of federal lands. For example, Executive Order 13327 issued February 4, 2004, calls for the creation of "a single, comprehensive, and descriptive database of all real property under the custody and control of all executive branch agencies." However, there appear to be limitations on this requirement that would exclude public lands and not require geographic coordinates for the boundaries. The latest debate on this issue is encapsulated in the Federal Land Asset Inventory Reform Act (H.R. 1370, 109th Congress), which was introduced in 2005.[1]

Conclusions. A national vision for land parcel data must include the delineation of the 30 percent of the land area (about 650 million acres) that is managed by the federal government (GAO, 1996, p. 2). There is considerable pressure to complete and maintain such a geographically refer-

[1]See *http://www.govtrack.us/congress/bill.xpd?bill=h109-1370* [accessed February 15, 2007].

enced inventory that would be an integral part of the National Land Parcel Data system. There are major benefits to be realized from a single, geographically registered database that would replace the various inventories currently maintained by numerous federal agencies. The committee believes that such an inventory is mandated as part of the FGDC designation of Federal Land Ownership Status as part of the NSDI under the stewardship of BLM.

RECOMMENDATION 3. The Federal Land Parcel Coordinator should coordinate the development and maintenance of a single, comprehensive, and authoritative geographically referenced database for land parcels managed by the federal government, including public lands. This database should include the ownership, area, and use of all federally managed lands.

Issue 4. The need for a formal business plan for parcel coordination.

The cadastre is identified under OMB Circular A-16 as one of the seven framework layers for the NSDI. In fact, the cadastral layer explicitly includes parcels. Other than naming BLM the lead agency for the cadastre framework there is no coordinated federal program for parcel data. The committee believes that it is essential that such a program be created and that it operate in an efficient and accountable manner. For the program to be successful it would need clearly defined goals and milestones. The committee believes that the FGDC Subcommittee for Cadastral Data's Parcel Management Program Business Plan Template can serve as a roadmap for establishing and monitoring a national land parcel data program. It outlines the following stages that include milestones and outcomes (FGDC Subcommittee for Cadastral Data, 2006b, p. 3):

Initial Collection and Conversion is the phase where landownership, parcel or survey data are first automated.

Maintenance is the phase where landownership, parcel and survey data are kept current and updated as transactions occur.

Local Publication and Distribution is the phase where cadastral information is made available to all potential users and applications.

Regional or Statewide Integration occurs when the published data from available counties or other producers is compiled into a statewide or regional coverage.

These steps present a logical progression and constitute a well-constructed business model that has been adopted by several states and could readily be adapted to a national effort.

However, the national coordinator will also have to specifically resolve the technical and legal issues outlined in Chapter 5. As mentioned earlier, there are generally examples where the technical issues have been overcome on a smaller scale. It will be the task of the national coordinator to seek out the potential resolutions for these issues and apply them to the national data through establishment of standards or promotion of best practices. The FGDC Subcommittee for Cadastral Data has already proven to be a very effective forum for working on these types of issues and could continue to act in that role. Similarly, the national coordinator will have to facilitate the resolution of the legal issues related to data sharing, licensing, and liability in order to successfully implement nationally integrated land parcel data.

Conclusions. In order to create trust among the stakeholders a national program for parcel data should embrace a comprehensive and accountable business plan. Proven benchmarks and metrics

for assessing progress have been developed by the FGDC Subcommittee for Cadastral Data. The national coordinator will need to address the technical and legal issues outlined in this report in order to effectively establish nationally integrated land parcel data.

RECOMMENDATION 4. The National Land Parcel Coordinator should develop and oversee a land parcel data business plan for the nation. This plan should serve as the basis for evaluation of the program and as a model for state and local governments. Metrics should be based on the FGDC Parcel Management Program Business Plan Template.

Issue 5. The federal government needs to maintain an inventory of tribal trust land; however there are unique issues and requirements associated with tribal trust parcels.

The federal government is required to map Indian lands in order to carry out various activities, as described in numerous acts, policies, and Department of the Interior manuals such as the following.

- The American Indian Trust Fund Management Reform Act of 1994 (P.L. 103-412; 108 Stat. 4239; 25 U.S.C. 4001 et seq.; AITFRA) assigns the Secretary of the Interior the responsibility of "appropriately managing natural resources located on reservations and trust lands."
- The National Environmental Policy Act of 1969 (P.L. 91-190; 83 Stat. 852; 42 U.S.C. 4321; NEPA) requires "federal agencies to consult with tribes and interested persons/organizations when Indian lands may be affected."
- The Federal Land Policy and Management Act of 1976 (P.L. 94-579; 90 Stat. 2743; 43 U.S.C. 1701; FLPMA) directs BLM to integrate Native American concerns into land use planning.
- The U.S. Department of the Interior (DOI) manual 512 DM section 2.1 states: "It is the policy of the Department of the Interior to recognize and fulfill its legal obligations to identify, protect, and conserve the trust resources of federally recognized Indian tribes and tribal members, and to consult with tribes on a government-to-government basis whenever plans or actions affect tribal trust resources, trust assets, or tribal health and safety." It would be most tribes' position that the DOI cannot fulfill its legal obligation to "identify and protect" tribal trust resource if the U.S. government does not first have those lands mapped.

Therefore, it is clearly the federal government's trust responsibility to map tribal lands, and the Bureau of Indian Affairs (BIA) has mapped approximately 75 percent of Indian lands. However, as described in Chapter 5, there are numerous challenges associated with parcel mapping on Indian lands. Currently, parcel data are being maintained by multiple entities for tribal trust land. Those entities include private companies, BLM, BIA, tribes, and state and local governments. Current federal policy for Indian trust land is causing duplication of effort in mapping trust lands, primarily due to the current litigation of *Cobell v. Kempthorne*. In most cases, the parcel data maintained by individual tribes are the most accurate data available since the tribes have the most vested interests in accurately mapping their lands.

Conclusions. It is the federal government's trust responsibility to map tribal trust lands. There are many issues unique to tribal trust parcels, which must be taken into consideration in development of nationally integrated land parcel data. Creation of a successful and useful parcel database for tribal trust parcels will require modifications of existing Indian trust mapping procedures and would have to involve consultation of each individual tribal and Native entity to complete.

RECOMMENDATION 5. The Office of the Special Trustee for Tribal lands should establish an Indian Lands Parcel Coordinator who would manage a program to coordinate and fund the development and maintenance of a geographically referenced database for Indian trust parcels. The data should then be made available to the National Land Parcel Coordinator to be integrated with national land parcel data.

Issue 6. The benefit of placing Census Bureau address data in the public domain.

The Census Bureau creates its own confidential Master Address File (MAF), which under the provisions of Title 13 of the United States Code it is not allowed to release to the public. For the 2010 Census, at a cost of hundreds of millions of dollars the Census Bureau is creating point-level representations of residential and business structures and associated street addresses (the modernization of Topologically Integrated Geographic Encoding and Referencing [TIGER] data and the mechanics of improving the address information were covered in depth in the National Research Council [NRC, 2004c] report *Reengineering the 2010 Census: Risks and Challenges*). Local governments are asked to review their portions of the MAF prior to the decennial census, but they cannot use that information to correct their own data sets and must destroy the MAF immediately after the review process. Consequently, many local governments choose not to participate in this system. As a result the GAO reported that for the 2000 Census there were

- 0.7 million duplicate addresses,
- 1.4 million housing units not included,
- 1.3 million housing units improperly deleted, and
- 5.6 million housing units incorrectly located on census maps (GAO, 2006c, p. 8).

It is only logical that information that is legally required to be visible cannot be private or confidential. With current technology such as global positioning systems or high-resolution orthophotographs it is a very straightforward task to associate geographic coordinates for structures with street addresses that are prominently displayed on the door or a mailbox. In fact, package delivery companies associate geographic coordinates with addresses every day. This is done routinely without the permission or knowledge of the occupants. As described in earlier chapters, numerous private industry firms are also developing address point files. This issue has been discussed in earlier NRC reports, including the following from the report *The 2000 Census: Counting Under Adversity* (NRC, 2004b, p. 149):

> The Bureau should also give serious consideration to providing localities with updated MAF files, which would not only facilitate continuous updating of the MAF for the Bureau's purposes but would also provide a useful tool for local planning and analysis. An issue for concern would be that sharing of MAF files might violate the confidentiality of individuals—for example, by disclosing overcrowding of housing units in violation of local codes. However, our view is that the confidentiality issues could be resolved; street addresses do not, of themselves, identify information about individual residents or even indicate whether an address is occupied. . . . However, Title 13 of the U.S. Code would probably require amendment similar to the 1994 legislation that authorized LUCA [Local Update of Census Addresses], since U.S. Supreme Court precedent views the MAF as covered under Title 13 confidentiality provisions. There is national benefit in having an accurate address list for statistical uses that can be continuously maintained in a cost-effective manner.

One way to overcome concerns over privacy and confidentiality is to restrict sharing to information about the building itself. This could lead to significant benefits for many with no harm to anyone. The Census Bureau would be allowed only to provide address and coordinate information to the local government for structures listed in the MAF. No data about number of units or unit

identification numbers would be made public. In this open environment, local governments would be more likely to assist the Census Bureau with its Local Update of Census Addresses efforts. Local governments already have nearly all of the building addresses. However, if they do not have the associated geographic coordinate data, it could be of great benefit.

The U.S. government commitment to create new and greatly improved versions of streets, boundaries, and point addresses represents a landmark in the evolution of geospatial data for the United States. The committee believes that this investment of taxpayer dollars should be used to provide the maximum benefit of services to the public and private sector business opportunities. These new resources have direct bearing on the creation of parcel data. If national parcel data are to be successful, they must include a consistent and current set of street addresses that are linked to buildings and property. In addition, the new Census Bureau address points could serve as a temporary substitute for parcel boundary data and aid in their development. For example, in the State of Arkansas a county that does not have a polygon-based parcel data set may use the point-level data set as a starting point for its cadastral database. In such a system the local government could use these points to handle many of its business needs relating to real estate, planning and even emergency response (E911) related applications.

Finally, as described in Chapter 4, countries such as the United Kingdom have realized the extensive benefits of having a national geocoded address file along with land parcel data. Chapter 4 also described how, internationally, many countries view their digital land parcel data as a key element in supporting the administration of many of the operations needed by society, not just as an index for deeds and local government services. A national street address file in combination with land parcel data provides governments and society with powerful tools in a world that is becoming more and more centered on the organizing function of place or location.

Conclusions. A data set of street addresses assigned to a structure or group of structures could be used to create the skeleton of a parcel fabric anywhere in the United States. As part of its modernization program the Census Bureau will be releasing greatly improved TIGER street centerline files with address ranges. These files will be used to generate block and other boundaries. The additional step of releasing the address point locations could serve a multitude of uses and would have major economic benefits while not revealing confidential information about individuals. This combination of high-resolution geospatial resources generated to serve the needs of the Bureau of the Census would also accelerate the completion of nationally integrated land parcel data.

RECOMMENDATION 6. Congress and the Bureau of the Census should explore potential policy options, including modifications to Title 13, that would allow its digital data on building addresses and their geographical coordinates to be placed in the public domain while also maintaining important privacy protections. If publicly available, these street addresses and coordinates could be used to assist in the development of parcel data in areas where parcel data sets do not exist.

Issue 7. The need for state-level coordination of parcel data.

It is not feasible for the national land parcel coordinator to interact with the large number of counties, municipalities, regional bodies, school districts, and special districts in the United States that produce parcel data. Therefore, an intermediate level of coordination would have to be established, most logically at the state level. As described in Chapter 6, this type of arrangement can be described as a "Federation by Mandate" (Harvey and Tulloch, 2006). The committee views this parcel-oriented function as a logical component of the Fifty States Initiative. One of the goals of this initiative is to have state GIS coordinating councils in all 50 states that support the governance of

the NSDI. The NSGIC and the FGDC have been working together on this initiative as a significant partnership with purpose. In fact, "the FGDC requested that NSGIC take the lead on this objective since it represents the national "voice" of state coordination activities as they relate to geospatial technologies" (NSGIC, 2005, p. 2).

With respect to parcel data, the model would follow programs that have been implemented in several state revenue departments. Where available, parcel data produced by local government would be provided to the state. A central state office would produce parcel data for jurisdictions that are not actively producing parcel data. As a result, statewide parcel data coverage would be created and updated on a periodic basis. The state would also provide technical advice and support, enforce standards, help administer funding, and sustain parcel data management. It could also reconcile boundaries between local data sets. The state should develop a state parcel business plan to clarify the roles and responsibilities of the state parcel coordinator and define how land parcel data will be developed and integrated. The FGDC Subcommittee for Cadastral Data has developed a template for a state parcel business plan and associated metrics.[2]

It would also be beneficial for an official state parcel coordinator to work hand in hand with the Census Bureau's Boundary and Annexation Survey program. In fact, the committee believes that it is not possible for the Census Bureau to accurately delineate incorporated and unincorporated places without parcel data. Therefore, the local government is in the best position to maintain a jurisdictional boundary file. This can be shared with the state government to support state mandates and then forwarded in digital format to the Census Bureau as needed.

Conclusions. Coordination at the state level is a necessary element of national land parcel data and could logically be a part of the Fifty States Initiative.

RECOMMENDATION 7. The National Land Parcel Coordinator should embrace the Fifty States Initiative and require that every state formally establish a state parcel coordinator. State coordinators should develop a parcel data business plan and manage the relationships among all levels of government involved in parcel production. The plan and program should achieve comprehensive border-to-border parcel coverage for all public and privately owned property within the state. The state parcel coordinator should either work with the state office responsible for the Census Bureau's Boundary and Annexation program or with local government offices if a statewide program does not exist.

Issue 8. Coordination of funding for parcel data production.

An appropriate funding model for a national system of land parcel data must be established and supported by the federal government. This funding model must address the need to support the development of parcel data that it does not produce. This is an enormous shift in roles and responsibilities from the period in which the federal government produced maps and geospatial data for the nation. This shift from a "top-down" to a "bottom-up" production process appears to be acknowledged in the GLoB, which states the need to "develop [a] sustainable funding strategy for collaboration with state, local, and tribal government partners" (FGDC, 2006, p. 16). There are many ways for the federal government to participate. There are many precedents for the state and federal cost-sharing agreements and even direct federal grants to support geospatial-related activities. These include cost-sharing agreements for topographic mapping, orthophotography, and data conversion. They also include grants from the FGDC to support data clearinghouse and metadata

[2]This business plan template is available at *http://www.nationalcad.org/data/documents/Parcel-Mgt-Prog-Business-Plan-v1.pdf* [accessed June 14, 2007].

activities. There are also many examples of programs such as *The National Map* that provide technical infrastructure to support the discovery, display, and distribution of geospatial data. In fact, there are counties that currently share their parcel data through *The National Map* interface. There are even excellent examples of state coordination of local data resources that are subsequently shared to *The National Map*. Furthermore, there are numerous examples of congressionally budgeted funds to support state parcel data production, such as in Montana. Finally, some states have been able to receive funds for training and infrastructure to support parcel production from DHS and HUD.

As described in Chapter 5, the cost of completing parcel data for the nation is estimated to be about $300 million with recurring costs of less than $100 million per year (Stage and von Meyer, 2007), and about 70 percent of all the parcel data have already been digitized by state and local governments (Stage and von Meyer, 2006b). The committee believes that many of the remaining parts of the country that do not have parcel data are likely to engage in local or state government parcel conversion processes even without federal involvement, although some areas may still require federal funding in order to complete their conversion. Therefore contributions for creation and maintenance of nationwide parcel data could come from (1) state and local governments, (2) in-kind and overlapping program interests, (3) seed money and contractual services, and (4) private sector contributions to local efforts. The state and local government resources would come from those organizations that need parcel data for their regular business operations, such as the local assessor and the state department of revenue. Overlapping or in-kind services include acquisition of orthoimagery, improving the accuracy of the spatial reference system, completing Census annexation and boundary information, ground control, and improving local surveys. Seed money and resources on the order of $240 million are estimated to be necessary to complete the conversion of the remaining parcel data. This would be money directed to states to support initiating parcel conversion and data publication efforts.

The committee believes that the burden of the federal responsibility will be to establish efficient systems to integrate and access the data, as well as completion of federal land inventory activities. The amount of integration work needed will vary from state to state. For example, all of the parcels for Montana are already integrated and can be accessed easily across the Internet. Other states are not at this level and do not have the same basis for funding or history of state-federal partnerships for parcel data. The national land parcel coordinator will also need funding to develop the system that will access the most recent data from local sources and make them available through a web interface. Finally, there will also be the costs required to support the national and federal coordinators and any staff.

Conclusions. Many different sources of funding could be used to complete the development of digital parcel data nationwide, including intergovernmental cooperation, shared funding, and various incentives. The federal government can play a major role in orchestrating a better use of these funds. Therefore, a major responsibility of the national land parcel coordinator is to develop a top-down funding model to support a bottom-up production process. The coordinator must also obtain funding for integration of the data, development of a system for accessing the data from local sources and making them available in a web interface, and the federal and national coordination functions.

RECOMMENDATION 8. The National Land Parcel Coordinator should develop a plan for a sustainable and equitable intergovernmental funding program for the development and maintenance of parcel data. The plan must provide financial incentives to local governments that will produce and maintain the majority of the parcel data. Many of the funds for this program should come from existing federal programs that require parcel data; however, new funding will be required to establish an initial baseline, integrate the data, and make them available through a web interface.

Issue 9. Federal requirements relating to parcel data by state and local governments.

The vision for a national program of parcel data is based on effective partnerships among all of the stakeholders. Ideally, all the stakeholders would see the benefits of participating in a collaborative environment. All the current parcel data-producing groups would develop a shared and coordinated vision that would eliminate redundant and overlapping programs. The committee found numerous examples of this type of coordination across the nation. It also found unbelievable examples of duplicative and competing parcel data production programs. For the national vision to succeed there must be a series of rewards and benefits that stakeholders will recognize as incentives for participation. These incentives could include grants, cost-sharing arrangements, and access to additional resources such as high-resolution imagery. The committee believes that it will also be necessary to balance incentives with some mandates and requirements. For example, one way to expedite development of land parcel data would be to require local and state governments to make digital land parcel information available as a prerequisite for participating in federal geospatial data programs—for example, national programs to collect and disseminate orthoimagery. Similarly, as part of their requests for grants related to property, such as for disaster relief or community development assistance, communities should be required to make their parcel data available. This would be similar to the stipulation in the Disaster Mitigation Act of 2000 (P.L. 106-390 [2000]; 114 Stat. 1552; codified in scattered sections of 42 U.S.C.) that requires communities to develop a mitigation plan in order to be eligible for increased levels of hazard mitigation funds. A recent NRC report recognized the importance of states including requests for funding for geospatial data development in such plans, and recommended that "states should include geospatial preparedness in their planning for homeland security" (NRC, 2007, p. 132). Alternatively, DHS could require that parcel data be provided as part of such plans. In a similar manner, the numerous HUD grant programs would be enhanced and become more accountable by requiring a community to submit parcel-based analysis in grant requests. Tying federal grant eligibility to the existence of parcel data that meet a set of minimum standards would help prevent fraud and encourage development and maintenance of valuable databases. Such a requirement would serve as an incentive for a local government to modernize its business practices. For the approximately 1,000 counties that already have digital parcel data, complying with such a requirement would not be an issue. For the remaining counties, the requirement will serve as a catalyst for promoting a parcel production program. With phase-in periods and reasonable exceptions (i.e., distinguishing between real emergency aid and longer-term rebuilding funds), these counties should be able to comply.

Conclusion. Requiring a requesting government agency to make its parcel data available in the public domain in order to participate in federal geospatial data programs or funding opportunities or to receive grants related to property, is a logical and justified part of any business model. Such a requirement should be viewed as the "regulatory stick" that would complement the various "carrots" that would be provided to local and state government to participate in a national parcel data system. Since local governments are generally developing digital land parcel data for their own purposes, tying participation to submittal of parcel data should not be an excessive burden.

RECOMMENDATION 9. To participate in federal geospatial programs such as federal collection and dissemination of orthoimagery, a local or state government should be required to make the parcel geometry and limited set of attributes needed for the national land parcel data system available in the public domain. Further, in order to be eligible to receive federal funds that are directly associated with property, such as for disaster relief or community development assistance, digital land parcel data necessary to effectively administer the program should be made available by local and state governments.

CONCLUSION

The quarter of a century since the publication of the original NRC report on a multipurpose cadastre has been one of unprecedented change in both geospatial data technology and policy. Although geospatial technologies were in their infancy in 1980, the committee at that time could still envision their capability to build a national cadastre. What it probably could not have foreseen was the infrastructure that was needed to truly make it possible—the Internet, standards, and the widespread use and understanding of geospatial technologies throughout all segments of society, even the general public. The concept of an NSDI has emerged and is even mandated as the way federal agencies should conduct their business. Many elements of the NSDI have taken shape, but the federal government has not developed nationwide land parcel data. At the same time, hundreds of local governments, several states, and many private companies have invested in parcel data systems that serve a multitude of needs. Internationally, national cadastres are widely accepted as a necessity for effective governance.

So why is the United States still struggling to create nationwide parcel data? One reason is that unlike the other NSDI framework data layers, most parcel data are developed and maintained by thousands of local government entities. To develop nationally consistent data requires a different operational model, based on coordination and partnerships among all levels of government. It has been suggested that the next phase in the development of spatial data infrastructures will require national governments to assume a coordination role while state and local governments and private industry take the lead in data production. The committee is optimistic that recent trends in geospatial data policy and initiatives show that the federal government is moving in this direction and is willing to seriously analyze the need for parcel data across the nation. Second, although many federal agencies need parcel data for various parts of the country at various times to carry out their missions, no single agency has had the combination of the need, mandate, and resources to integrate parcel data across the whole nation. This report has demonstrated that a national approach to parcel data is necessary, feasible, affordable, and timely, but challenges remain. Therefore, the committee has laid out a set of recommendations to help clarify the mandate and establish a practical framework for sustained coordination and funding. The committee hopes that establishing this framework will be the first step in moving forward with a national land parcel data program that will provide a new level of responsiveness and accountability in the way federal agencies serve the public.

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Appendixes

Appendix A

Acronyms

ACSM	American Congress on Surveying and Mapping
AITFRA	American Indian Trust Fund Management Reform Act
ANZLIC	Australia New Zealand Land Information Council
BAS	Boundary and Annexation Survey
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CAMA	Computer Assisted Mass Appraisal
CD	compact disc
CFAC	California First Amendment Coalition
CGDI	Canadian Geospatial Data Infrastructure
CIS	common information system
CLU	common land unit
COGO	coordinate geometry
COM	Common Object Model
COTS	commercial off-the-shelf
DALIS	Delaware Appraisal Land Information System
DHS	U.S. Department of Homeland Security
DIME	Dual Independent Map Encoding
DNR	Department of Natural Resources
DOI	U.S. Department of the Interior
DVD	digital video disc
E911	emergency 911
EPA	U.S. Environmental Protection Agency
ESRI	Environmental Systems Research Institute

FEA	Federal Enterprise Architecture
FGDC	Federal Geographic Data Committee
FIG	International Federation of Surveyors
FIPS	Federal Information Processing Standards
FLAIR	Federal Land Asset Inventory Reform
FLPMA	Federal Land Policy and Management Act
FOIA	Freedom of Information Act
FSA	Farm Service Agency
FTP	file transfer protocol
GAO	Government Accountability Office
GCDB	Geographic Coordinate Data Base
GDM	Geospatial Data Model
GDSC	Geographic Data Service Center
GIS	geographic information system
GLoB	Geospatial Line of Business
GPS	global positioning system
GSA	General Services Administration
HUD	U.S. Department of Housing and Urban Development
IAAO	International Association of Assessing Officers
INEGI	National Institute of Statistics, Geography and Informatics (Mexico)
IT	information technology
LIS	land information system
LOB	Line of Business
LOJIC	Louisville/Jefferson County Information Consortium
LPU	Land and Property Unit
LUCA	Local Update of Census Addresses
MAF	Master Address File
MNDOT	Minnesota Department of Transportation
MOU	Memorandum of Understanding
MPROP	Milwaukee Master Property File
MTAIP	MAF/TIGER Accuracy Improvement Project
NCRC	National Community Reinvestment Coalition
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGAC	National Geospatial Advisory Committee
NGPO	National Geospatial Program Office
NIEM	National Information Exchange Model
NILS	National Integrated Land System
NOAA	National Oceanic and Atmospheric Administration
NPDS	National Parcel Data System
NPS	National Park Service
NRC	National Research Council
NRCan	Natural Resources Canada

NSDI	National Spatial Data Infrastructure
NSGIC	National States Geographic Information Council
OMB	U.S. Office of Management and Budget
OO	object-oriented
OS	Ordnance Survey
OSAPR	Ordnance Survey ADDRESS-POINT reference
PAF	Postcode Address File
PC IDEA	Permanent Committee on Spatial Data Infrastructure for the Americas
PIN	parcel identification number
PLSS	Public Land Survey System
PSMA	Public Sector Mapping Agencies of Australia
PTI	Public Technology, Inc.
RAVAR	Rapid Assessment of Values at Risk
RFP	Request for Proposals
SDI	Spatial Data Infrastructure
TAAMS	Trust Asset and Accounting Management System
TIGER	Topologically Integrated Geographic Encoding and Referencing
TOPR	Town of Port Royal
TVA	Tennessee Valley Authority
URISA	Urban and Regional Information Systems Association
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

Appendix B

Recommendations from *Need for a Multipurpose Cadastre* (NRC, 1980)

I. FEDERAL ROLE

Lead Agency: "We recommend that the Office of Management and Budget designate a lead agency for the multipurpose cadastre" (p. 3).

Bureau of Land Management: "We recommend that the Bureau of Land Management proceed with its plans to position the network of Public Land Survey monuments that mark the corners of sections and quarter sections that are located on federal land and to integrate them with the national geodetic control network" (p. 83).

Funding: "We recommend that federal legislation be prepared to authorize and fund a program to support the creation of a multipurpose cadastre in all parts of the Nation" (p. 3).

Cooperative Agreements: "We recommend the establishment of federal cooperative agreements with state and/or local governments to conduct, for example, survey control operations, mapping and remonumentation of property corners under federal or state guidelines and to provide technical assistance and funding for these efforts" (p. 88).

Federal Program Requirements: "We recommend that all federally funded programs that produce components of a multipurpose national cadastre, such as right-of-way surveys or large-scale maps, should be required to adhere to a federal plan that establishes the format for these components or, until such a plan is adopted, to the individual state plan, if any" (p. 89).

Land use restrictions: "We recommend that federal agencies that impose restrictions on the use of lands should be required to file those restrictions with the appropriate state or county recording office" (p. 89).

II. STATE'S ROLE

State Offices of Land Information: "We recommend that each state authorize an Office of Land Information Systems, through legislation where necessary, to implement the multipurpose cadastre" (pp. 3, 78).

Details

The report recommended (pp. 91-92)

> that the Office of Land Information Systems established by each state . . . be responsible for
>
> - Promoting effective, efficient, and compatible land-information systems among governmental levels, in cooperation with the federal government to ensure compatibility on a national basis;
> - Setting standards for state, regional, and local government surveying, mapping, and land-data-collection efforts making use of federal technical studies;
> - Providing guidance to those local offices with major responsibilities for land information, namely, recorders, assessors, surveyors, engineers, and planners;
> - Serving as the focal point and clearinghouse for state and federal agencies collecting or mapping land information, taking responsibility for the quality of the information that is forwarded;
> - Enlisting the resources of other state agencies having important contributions to make to the development of the cadastral system, especially those responsible for land assembly, construction, management of public lands, and efficiency of state administrative services; and
> - Recording and transmitting land-related documents and information filed by out-of-state groups such as private, federal, and alien organizations.

State Legislation: "We recommend that states enact legislation to ensure the compatibility of county and local records with the multipurpose cadastre" (p. 92).

III. LOCAL GOVERNMENT ROLE

County Offices of Land Information: "We recommend that each county government (or municipality where appropriate) create an Office of Land Information Systems in coordination with such offices as the recorder of deeds, county surveyor, assessor, planner, and county abstractor, if any" (p. 4).

Details

The functions of the new office would include the following (p. 93):

- Standardization of procedures among all the responsible county and municipal agencies to assure efficient acquisition, storage, maintenance, and retrieval of land information and records within the county;
- Supervising, or at least monitoring, the production and maintenance of a system of county base maps and cadastral overlays that meet state standards for the multipurpose cadastre . . .; and
- Creation and maintenance of the land-parcel register . . ., including the recording of land information or restrictions emanating from municipalities or special-purpose districts within the county, the filing of which by those other offices would be mandatory, by state legislation.

Local Government as Primary Access Point: "We recommend that local governments be the primary access point for local land information" (p. 4, 77).

Local Government Data Requirements: "We recommend that local governments maintain land data compatible with a multipurpose cadastre and transmit these data to higher levels of government when needed" (p. 77).

IV. TECHNICAL ISSUES

Technical Studies: "We recommend that technical studies continue to be sponsored by the federal government to identify consistent land information and display standards for use among and within federal agencies and between federal and state governments. These studies should rely on the authority of state governments to adopt the standards and organize the data collection, in cooperation with the federal government to ensure compatibility on a national basis, delegating these functions to local governments where appropriate" (p. 3).

Details

The report stated that the following technical subjects should be addressed (p. 105):

> 1. Integrating mechanisms for cadastral, cartographic, engineering, and geodetic surveying for federal and federally supported programs;
> 2. Integrating mechanisms for storage and retrieval of other land information in data files; [and]
> 3. Procedures for development of local systems, leading to the distribution of prescribed methods and rules for ties to geodetic coordinate systems and adjustment of state plane coordinates for property boundary surveys. . . .

- **Map Compatibility:** The report also recommended that the technical subject of "compatibility among the large-scale maps to be produced by the individual counties within each state" should be addressed (p. 87).
- **Standard Manuals:** "We recommend that standard practice manuals describing specific survey methods and rules of adjustment for reliable determination of coordinates for property boundary corners be made available to the local land surveyor and enforced at each government level" (pp. 49-50).
- **Vertical Datums:** "We recommend that local vertical datums be referenced to the latest National Geodetic Vertical Datum" (p. 51).
- **Tidal Benchmarks:** "We recommend that tidal benchmarks be established along the east, west, and Gulf coasts at adequate intervals to permit local land surveyors to define riparian boundaries correctly and accurately" (p. 51).
- **Base Maps:** "We recommend that base maps be grid oriented, tied to the national geodetic control system, and updated regularly" (p. 53).
- **Cadastral File:** "We recommend that there be created a new cadastral file containing the records of boundary information referenced to the identifier number of each cadastral parcel" (p. 59).
- **Field Notes:** "We recommend that the cadastral agency adopt minimum standards for field notes and mandatory filling thereof" (p. 72).

IV. SOCIETAL ISSUES

Boundary Law: "We recommend improvements in survey and boundary law giving greater priority than now exists in the use of coordinates for boundary descriptions" (p. 59).

Legal Issues: "Following the lead of the Modernization of Land Data Systems (MOLDS) II conference (North American Institute for Modernization of Land Data Systems, 1979),[1] we recommend that

1. Lawyers and surveyors promote state legislation that would make the recording of survey plans for conveyance or subdivision mandatory; all new deeds be based on a reliable survey, similar to those required by the plat laws or section corner filing acts that exist in some states; and the American Congress of Surveying and Mapping and American Society of Civil Engineers propose model standards.

2. Title insurance companies agree that all future policies be accompanied by a survey plan; and the American Land Title Association and the American Bar Association propose model standards.

3. All title insurance surveys be recorded for the benefits of abutters and future users; and the American Bar Association and American Land Title Association propose model standards.

4. All boundary-survey plans show deed references of land owners and adjacent land owners until a parcel identifier system has been adopted" (p. 71).

Centers of Excellence: "We recommend support by the federal government for the establishment of a center or centers of excellence in land-information science, for the purpose of providing a program that develops scholars and professionals. The curriculum should include direct experience with land-data-systems problems" (p. 4).

Professional Organizations: "We recommend that professional organizations such as the American Public Works Association, American Society of Civil Engineers, American Congress on Surveying and Mapping, American Society of Photogrammetry, American Bar Association, and American Right of Way Association should jointly develop practical methods for the creation of a utility cadastre" (p. 74).

[1]North American Institute for Modernization of Land Data Systems. 1979. Proceedings of the Second MOLDS Conference, October 1978, Washington, D.C., 283 pp.

Appendix C

Land Parcel Data Summit

Agenda

SUMMIT ON LAND PARCEL DATABASES: A NATIONAL VISION
Committee on Land Parcel Databases: A National Vision

May 23-24, 2006

Members Room
NAS Building
2100 C St., N.W.
Washington, DC 20001

AGENDA

Tuesday, May 23

OPEN SESSION

9:00 a.m. **Welcome and Introductions** *David Cowen, Committee Chair*
Purpose and Goals of the Summit
Structure of panel discussion sessions

9:30 a.m. **SESSION 1: FEDERAL AGENCIES**
Moderator: Will Craig
Robert Cunningham, U.S. Forest Service
Jon Sperling, Department of Housing and Urban Development
Robert Harding, General Services Administration
Roy Teal, Tennessee Valley Authority
John Bennett, Office of the Special Trustee for American Indians
Tim Trainor, Department of Commerce

11:30 a.m. Lunch in meeting room

12:30 p.m. **SESSION 2: PRIVATE SECTOR**
Moderator: Cindy Domenico
Jay Sibley, American Land Title Association and Title Data, Inc.
Joseph Dittrich, Insurance Services Office
Russell Riggs, National Association of Realtors
Don Cooke, Tele Atlas
Ben Clark, Zillow

2:30 p.m. Break

3:00 p.m. **SESSION 3: PROFESSIONAL ORGANIZATIONS**
Moderator: David Coleman
Pedro Flores, National Association of Counties
Dave Dennis, Geospatial Information and Technology Association
John Palatiello, Management Association for Private Photogrammetric Surveyors
Curt Sumner, American Congress on Surveying and Mapping
Statement, International Association of Assessing Officers

5:00 p.m. Wrap-up and Adjourn

Appendix D

Biographical Sketches of Committee Members and Staff

David J. Cowen, *chair*, is the former chair of the Department of Geography at the University of South Carolina. He is also a Carolina Distinguished Professor of Geography. He earned his B.A. and M.A. from the State University of New York at Buffalo and his Ph.D. in geography from the Ohio State University. He is past president of the Cartographic and Geographic Information Society of the American Congress on Surveying and Mapping and serves on the Editorial Boards of the *International Journal of GIS* and *Transactions in GIS*. He has served on the National Research Council (NRC) Mapping Science Committee (1987-1992, member; 2001-2005, chair) and the GIS Commission of the International Geographical Union. He has also been chairman of the Association of American Geographers GIS Specialty Group and the South Carolina State Mapping Advisory Committee. Dr. Cowen is a National Associate of the National Academies.

David J. Coleman is professor and dean of engineering at the University of New Brunswick. He holds B.Sc.E. and M.Sc.E. degrees in surveying engineering from the University of New Brunswick and a Ph.D. from the University of Tasmania in Australia. He has also spent 15 years in the Canadian geomatics industry, as a project surveyor and engineer initially; as general manager and vice-president in one of Canada's largest digital mapping firms; and as a partner in a GIS (geographic information system) and land information management consulting firm. He has been involved as a consultant on projects in Canada, Australia, the United Kingdom, and South America. Dr. Coleman was a member of the NRC Mapping Science Committee from 1998 to 2000.

William J. Craig is associate director at the Center for Urban and Regional Affairs at the University of Minnesota. Dr. Craig is also active with MetroGIS and the Minnesota Governor's Council on Geographic Information. He is a current board member of the National States Geographic Information Council (NSGIC). He earned his M.A., and Ph.D. in geography from the University of Minnesota. His current research interests focus on the institutional impediments to the use of GIS and the societal impacts of its use. Dr. Craig served as president of the University Consortium for Geographic Information Science in 1997. He was a member of the NRC Mapping Science Committee from 2000 to 2005.

Cindy Domenico is the Boulder County assessor in Colorado, where the development of Boulder County's GIS and implementations of the technology for appraisal analysis have been a focus of her work. She is president of the Urban and Regional Information Systems Association (URISA), where she has been active on conferences on GIS and Computer Assisted Mass Appraisal. Ms. Domenico is also a member of the International Association of Assessing Officers (IAAO) and has served on the IAAO Mapping Council since 1990. She is also past president of the Colorado Assessors' Association. She has a B.A. in environmental science and is a certified general appraiser.

Shoreh Elhami is GIS director for Delaware County, Ohio, and an adjunct professor at the Ohio State University. Prior to this, Ms. Elhami was GIS coordinator and principal planner for the Delaware County Regional Planning Commission and a regional planning analyst in the Ministry of Interior in Iran. She has more than 20 years of professional experience in GIS and planning, and has taught at the Ohio Wesleyan University. Ms. Elhami is a member of the URISA Board of Directors and currently chairs the GISCorps committee. In 2002, she received the Ohio State University College of Engineering's Distinguished Alumni Award, and she has been involved as a committee member or participant in three NRC studies, including as a member of the Mapping Science Committee. Ms. Elhami has a degree in architectural engineering with a minor in planning from the National University in Tehran, Iran, and a master's in city and regional planning from the Ohio State University.

Shelby Johnson is the state geographic information coordinator of Arkansas, directing the Arkansas Geographic Information Office organized under the state chief information officer. He previously worked as a research specialist at the University of Arkansas' Center for Advanced Spatial Technologies, where his consulting work on GIS ranged from individual citizens to international agencies, and he developed and taught university classes and professional development courses. He has served in many leadership roles in Arkansas and was instrumental in organizing the State Land Information Board in 1998. Since 1999, Mr. Johnson has been responsible for assisting the State Land Information Board in building a coordinated GIS system to meet the needs of the people of Arkansas. He served on the NSGIC Board of Directors from 2001 to 2005. Mr. Johnson has a B.A. in geography.

Susan Marlow is founder and chief executive officer of Smart Data Strategies, Inc. (SDS), which provides software and data conversion and maintenance services to the land records industry. Throughout her career, Ms. Marlow has personally managed hundreds of cadastral conversion projects and has in-depth knowledge of the conversion and software implementation process. SDS is involved in more than 10 percent of the nation's properties with either its conversion services or the implementation of its software. Ms. Marlow currently serves as the chairman of the board at the Institute for GIS Studies (IGISS), chairman of the Management Association for Private Photogrammetric Surveyors (MAPPS) Federal Cadastral Task Force, chairman of the Transportation Research Board's Panel for Integrating Geospatial Technologies into the Right-of-Way Process, and a member of the Federal Geographic Data Committee's (FGDC's) Subcommittee for Cadastral Data; she is actively involved as an instructor for the IAAO's GIS for Assessors course 651.

Frank Roberts is the GIS manager for the Coeur d'Alene Tribe in Idaho. His primary interest is in empowering the Coeur d'Alene Tribe and other indigenous groups by developing applications, teaching individuals how to use geospatial software, developing tools to help indigenous people to preserve Native culture, and integrating geospatial technology into decision-making processes. He was sponsored by the Smithsonian Institute and the Bioresource and Development Conservation Programme to be a guest speaker and training session leader at a conference for Nigerian foresters

and wildlife biologists in Calabar, Nigeria. He is responsible for GIS data and applications development for all aspects of tribal governance and land management. This responsibility involves development of a land parcel database for the tribe, as well as mapping private ownership on the reservation. Mr. Roberts is a metadata trainer for the FGDC and is a member of the InterTribal GIS Council Technical Working Group and the Indigenous Mapping Network. Mr. Roberts has B.S. and M.S. degrees in forest resources.

Michael T. Swartz is senior vice president and chief information officer for First American Flood Data Services, which is the leading provider of guaranteed flood zone determinations to the mortgage lending and insurance industries. Carrying out this function requires a comprehensive library of nationwide, digitized, vector parcel data in a common format. First American has built such a system by obtaining or creating the vector parcel data; therefore, Mr. Swartz brings the perspectives of both a developer and an intensive user of a national parcel data system and is very familiar with this topic. Prior to his employment with First American, Mr. Swartz spent 11 years in various systems and financial research positions on Wall Street, including vice president and manager of futures research for J. P. Morgan. Mr. Swartz holds an M.S. in computer science from New York University and a B.A. in computer science from Dartmouth College.

Nancy von Meyer is vice president of Fairview Industries, providing consulting, education, and GIS implementation services to government agencies and the private sector. She received her Ph.D. in civil and environmental engineering from the University of Wisconsin-Madison in 1989. Dr. Von Meyer works with many counties and local governments on parcel, land records, and system design for automation and modernization projects. She is also active with federal initiatives related to the FGDC Cadastral Data Content Standard, the National Integrated Lands System, eastern states cadastral initiatives, and other land records projects. She is a registered professional engineer and a registered professional land surveyor and has recently published a book entitled *GIS and Land Records*. Dr. Von Meyer served previously on an NRC ad hoc committee and on the NRC Mapping Science Committee from 1994 to 1997.

NATIONAL RESEARCH COUNCIL STAFF

Ann G. Frazier is a program officer with the Board on Earth Sciences and Resources, coordinating mapping science activities. She has 25 years of experience in science and engineering, including 10 years with the U.S. Geological Survey (USGS) in geographic sciences. She focused on land cover change, urban growth, ecological modeling, and application of geographic analysis and remote sensing in interdisciplinary environmental studies. Prior to the USGS, Ann worked for 13 years in the aerospace industry on the Space Shuttle and Space Station Programs. Ann has a B.A. in physics-astronomy, an M.S. in space technology, a certificate in environmental management, and an M.S. in geography.

Amanda M. Roberts is a science assistant at the Office of Integrative Activities of the National Science Foundation. Previously, she was a senior program assistant with the Board on Earth Sciences and Resources. Amanda also interned at the Fund for Peace in Washington, D.C., working on the Human Rights and Business Roundtable, and worked in Equatorial Guinea, Africa, with the Bioko Biodiversity Protection Program. She is a master's candidate at the Johns Hopkins University in the Environment and Policy Program and holds an M.A. in international peace and conflict resolution from Arcadia University, specializing in environmental conflict in sub-Saharan Africa.

Jared P. Eno is a research associate with the Board on Earth Sciences and Resources. Before coming to the National Academies, he interned at Human Rights Watch's Arms Division, working on the 2004 edition of the *Landmine Monitor Report*. Jared received his A.B. in physics from Brown University.