

Parcel Identifiers for Cadastral Core Data: Concepts and Issues

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July 2002

Thanks to David Moyer, FGDC Cadastral Subcommittee, for his careful review and suggestions for this document.

Thanks to the members of the Core Data Teams for their discussion and reviews

INTRODUCTION

“Cadastral data represent the geographic extent of the past, current, and future rights and interests in real property.” (FGDC, 1997, Framework Introduction and Guide, p. 21) Cadastral core data are a minimum set of attributes about land parcels that is used for publication and distribution of cadastral information by cadastral data producers and maintainers. The core data are intended to provide sufficient information to support integrating basic land parcel information across jurisdictional boundaries and answering fundamental questions for business processes that need cadastral information.

The Cadastral Core Data Standard proposed by the FGDC includes an attribute for parcel identifiers called Parcel ID. This paper discusses some of the details and design issues concerning the Core Data Parcel ID attribute. In the course of this discussion, some related topics such as Parcel ID maintenance and linkage to related data sets, are also reviewed.

The Parcel Identifier is defined as a label or tag for a parcel that is unique within a jurisdiction. The parcel identifier can be a numeric or alpha-numeric, but it must uniquely identify an ownership parcel, which may include multiple polygons, within a system. The type of parcel that is being identified depends on the system. For example if a county is managing tax parcels, then the parcel identifier uniquely identifies tax parcels. Other types of parcels might be ownership parcels or documented transaction parcels, which are parcels that represent land related transactions, such as Case Actions in the Bureau of Land Management or Tracts in the US Forest Service. In the latter case the parcel identifier points to the documented transaction that created the parcel.

The business process analysis for the Cadastral Core Data identifies three potential uses for the Parcel ID. These are:

- 1. Locating more information about the parcel** – In this use the parcel identifier is a key to finding additional details about the parcel from the source that posted the core data. For example, if a county publishes its tax parcels as its core parcel information, then the parcel identifier would provide the linkage to retrieve tax billing or tax assessment information from the County. There has been no further discussion of how this might occur. As examples the parcel identifier might be a

hyperlink to a published database that contained added attribute information, or the parcel number might link to a an assessment sketch and digital photo, or the parcel identifier might be supplied to a county official who would then provide that information either free or for a fee. The options can vary greatly, but the concept in this scenario is that the parcel identifier is maintained by the agency or jurisdiction that is posting the core data and it is unique within the producers data system. (How information is extracted from the producer's system is not discussed in this paper.)

2. Linkage for value added information – For this task the parcel identifier is used in other systems that have information about the parcel that is not maintained by the parcel producer. For example, a mortgage company might use the parcel identifier to link core data and core parcel maps to mortgages. The third party, the mortgage company, keeps the additional information about the mortgage but the core data with its parcel identifier provides a national context for the mortgage information. Another example might be emergency relief payments from the Federal Emergency Management Agency (FEMA) that could be tied to a core data parcel identifier. The relief payment information would be maintained and tracked by FEMA and the parcel identifier would provide a linkage between the payment system and the core data set. The potential for value added information is limitless.

1. **3. Provide a geographically significant national identifier** – In this use the parcel identifier is related to a point in or near the parcel and the identifier is geographically significant in that the general location of the parcel can be ascertained from the identifier. In this use the parcel identifier is used as surrogate for the parcel polygon and provide a relatively rapid point mapping system for parcel information. Building a parcel point map and then coloring the points based on whether the parcel has improvements has been suggested by one user as a quick method for analyzing information from multiple counties and the federal agencies in the case of a wild fire. Other uses for a nationally unique geographically significant parcel identifier include the provision of a universal system for independent relative parcel locations. That is, because points are a simple geometric feature, they could be mapped in almost any software, even a spreadsheet or a hand held device, and could be used for a wide variety of consumer and business applications. In these uses or applications the parcel identifier provides access to core data plus some rudimentary mapping functions.

Because the Core Data concept is to provide parcel level information across multiple jurisdictions that can be used for decision-making and other applications, it is reasonable to explore the potential to have a parcel identifier in the core data that meets all of these needs. Two basic parcel identifier approaches have been explored to meet these needs.

1. Source System Parcel Identifiers – In this case the parcel identifier would provide the index number, or other key value to obtain more information about a

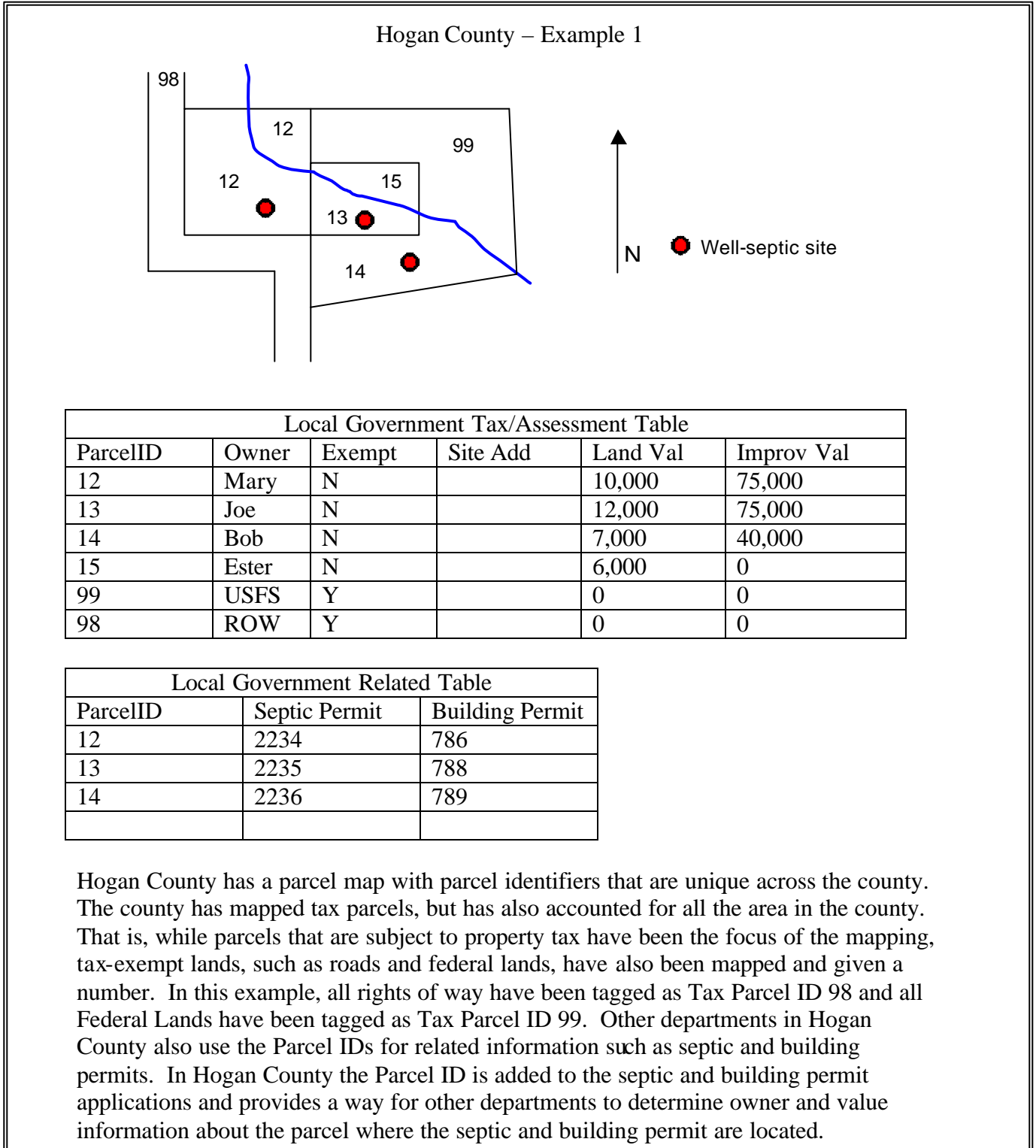
parcel in the data producers systems. The parcel identifiers would be defined by the parcel producers and would conform to their existing systems. In some cases parcel producers may need to consider how they provide uniqueness but the premise of this approach is to not disturb current data producer's parcel identification methods. In this case an agency or jurisdiction code could be appended to the parcel identifier to provide uniqueness across the core data sets or the jurisdiction code for the provider could be stored as a separate attribute.

2. Nationally Unique Number – In this case the parcel identifier would be assigned from a national perspective and would be uniquely assigned in the core data set. This identifier would need to be either generated when the core data set is published or developed in a way that it could be maintained by separate parcel producers yet be unique across the nation. Specifically the US National Grid (USNG) number has been explored as a possible national parcel identifier. The USNG Standard has been adopted by the Federal Geographic Data Committee (FGDC) and provides a system to label points uniquely to one meter accuracy. Recognizing that there are parcels that are smaller than one meter by one meter, the parcel identifier based on the USNG would provide a unique index value and an approximate location but would not presume to exactly or precisely map the parcel.

There are data creation and data maintenance issues with both of these approaches. The following sections describe some of the underlying technical and use considerations for these two approaches, the Source System Parcel Identifiers and the Nationally Unique Number. The down stream user needs that have been identified to date are also discussed for each of these approaches.

SOURCE SYSTEM PARCEL IDENTIFIERS

In this approach the parcel producers generate and maintain the parcel identifiers. Some of the technical and use considerations are described using typical examples.



In Hogan County Example 1 the Parcel ID for the core data would be linked to the Hogan County information through the Hogan County assigned tax number. This information may include the Tax Roll and other related information in the County. The parcel map includes parcel outlines and examples of tables with related data that is tied to Parcel IDs.

Note also in Hogan County that the Parcel IDs are unique within the County. In Example 1 the Parcel ID for Bob's land is 14 and PID 14 would not be used for any other parcel in the County so that a unique link to the tax roll and other information can be made from this identifier. Note also in Hogan County all rights of way are tagged as 98 throughout the County and that all federal lands are tagged as 99. This means that PIDs 98 and 99 may apply to multiple polygons but they link to the same record in the tax roll and other systems. Note also that Parcel ID 12 in Example 1 applies to two polygons. This also does not violate the non-repeating rule because again Parcel ID 12 links to the unique tax roll information for that tax parcel. The multiple polygons may not always be contiguous as they are in Example 1, they could also be non-contiguous.

Parcel information changes frequently and is therefore a dynamic set of information. When maintenance is done, parcel information is updated and the tax roll, related information and the parcel outline, as shown on the parcel map, may be changed. Also the update frequency will vary widely across the County. Some jurisdictions may do nightly updates while others may only do weekly, quarterly or even yearly updates.

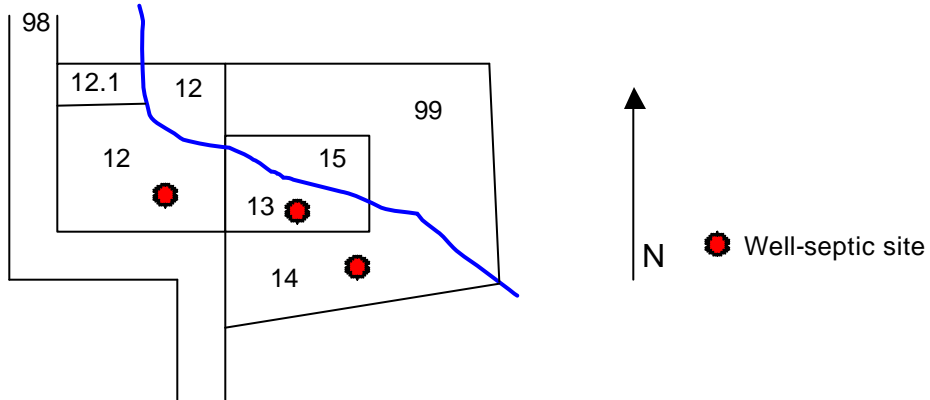
Parcel changes may be handled in a number of ways. The complete data set for the County may be replaced or only the changes. If the complete data set is replaced then the current information is always what is available but it may be difficult to detect what has changed. For larger jurisdictions replacing the entire data set may take an inordinate amount of time and may not be feasible. In these cases only the changes may be updated. Again the current information is what will be available but there may be technical issues with posting only changes such as maintaining a continuous and integrated parcel map. An advantage to posting only changes is that it may be possible to link parcel data sets to the GeoCommunicator so that users could subscribe to a notice of change service and be notified of the changed parcel information.

There are two additional issues regarding data maintenance. The first is how will historical information be tracked. Historical information is not currently included in the Proposed Cadastral Core Data Standard. Many jurisdictions do not track ongoing updates and instead "snapshot" the information at various points in time to establish an archive. There are many strategies for tracking historical parcel information and these issues have not been thoroughly discussed in terms of publishing core data. For the initial version of the core data, the published information will be the currently available data with the understanding that jurisdictions will have varied timelines for updates and for posting changes and updates.

Reuse of Parcel IDs

The second maintenance issue has to do with how new Parcel IDs are assigned. In Example 2, a new parcel has been created along with a new tax roll entry.

Example 2 – Hogan County Tax Parcel Split



Local Government Tax/Assessment Table

ParcelID	Owner	Exempt	Site Add	Land Val	Improv Val
12	Mary	N		8,000	75,000
12.1	Red	N		2,000	0
13	Joe	N		12,000	75,000
14	Bob	N		7,000	40,000
15	Ester	N		6,000	0
99	USFS	Y		0	0
98	ROW	Y		0	0

Local Government Related Table

ParcelID	Septic Permit	Building Permit
12	2234	786
13	2235	788
14	2236	789

In this example, Mary has sold a portion of her land to Red. The land values have been apportioned accordingly and a Parcel ID has been assigned to Red’s land (12.1) and the parcel, Parcel ID 12, has remained with Mary’s land.

The reuse of parent Parcel IDs is a common practice in many jurisdictions. In these jurisdictions the Parcel ID helps track the parent-child relationships among the parcels. These systems are founded on early hard copy map, text dependent systems. The other

term for the parent-child parcel relationship is sometimes called remainder parcels. That is, Mary's parcel is a remainder after the northwestern portion was sold. Remainder parcels also occur with subdivisions. In these cases only part of a parcel is included in the subdivision and there may be "remainder areas". There is also concern in some jurisdictions about losing tax records. By keeping a parcel number active, that is reusing it and keeping it in the system, there is some assurance that the records for that parcel, perhaps past due taxes and other linkages, such as the link to the well and septic records, are not lost.

The reuse of the Parcel ID for parent or remainder parcels can create problems in tracking historical parcel information and in third party use of the parcel information. Historical parcel tracking is not part of this version of the Core Data Project but the applications for third parties or value added systems to connect to Parcel information is an important use. Just as the reuse of parcel numbers provides continuity for County systems, it can provide continuity for third party users as well. For example, if a mortgage company linked their records to a parcel identifier and that number was reused for a now smaller remainder or parent parcel, the linkage to mortgage system, would exist, but it would be to a different area of land. If a jurisdiction or agency reuses parcel numbers then this will need to be made clear to the downstream users, and other information such as the area or the date of creation may be necessary to track changes.

Retirement of Parcel IDs

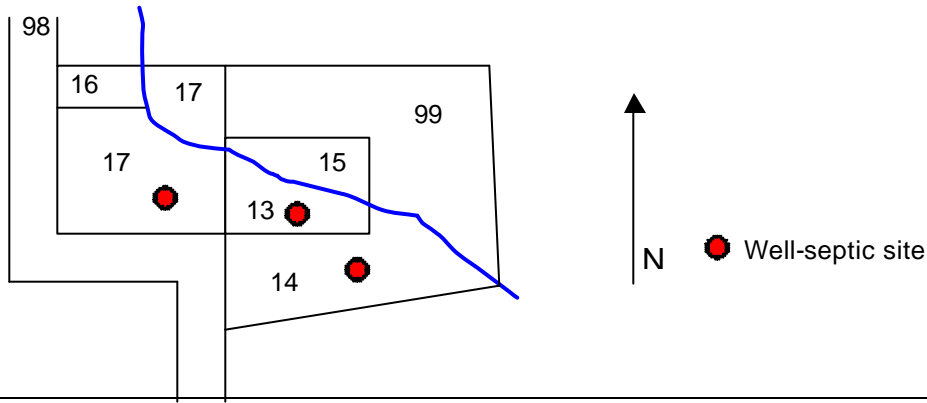
Not all jurisdictions reuse Parcel IDs. Example 3 shows how the new parcel might be handled in an area where new parcel identifiers are assigned with every new parcel. In this example, the resulting new parcels have both been assigned a new number. The old record has been noted as inactive. This note of inactivity would probably be in a separate field, but for the purposes of explanation it is shown in the exempt field.

There are several outcomes of this process. The Well and Septic records that were tied to Parcel ID 12 are no longer linked to the active tax records. The former Parcel ID 12 has now become Parcel ID 16 and Parcel ID 17. At the time the new parcels are created, the Well and Septic Records could be updated to point to the correct parcel. In this case a determination would need to be made as to which parcel gets the Well and Septic Records. In Example 3 this is relatively straightforward, but in actual practice it is not always this clear. The other problem is that the person or department maintaining the parcel records may not be responsible for the Well and Septic Permits. In this case editing the Well and Septic records would not be possible and the separate person or department would need to be notified of the changes so that the updates could be made.

In this case storing the X, Y and possibly Z or elevation value of the Well and Septic location could solve the changing Parcel ID problem. If the physical location of the permitted facility is stored, either in a table or on a map, then the link to parcel information can be done spatially. For example, a simple point in polygon analysis could be run to determine which parcel should be related to the permit. This process could be run any time a query is done so that the current information is always retrieved and the maintenance workload for linking these two systems is reduced.

The second question with generating new Parcel IDs is when to do it. That is, should a new Parcel ID be assigned anytime the geometry changes? If any parcel has a new legal description does it get a new Parcel ID? Example 3 is a clear example of assigning a new Parcel ID, but what if there is a boundary adjustment between two parcels? How much area change should occur before there is a new Parcel ID? Or, are new Parcel IDs only assigned when there is a new parcel created either by splitting an existing parcel or merging or combining two existing parcels? The answers to these questions may vary from place to place and thus create slight variations in what the parcel identifier means within a jurisdiction and how it can subsequently be applied.

Example 3 – Hogan County Tax Parcel Split – With New Parcel Numbers



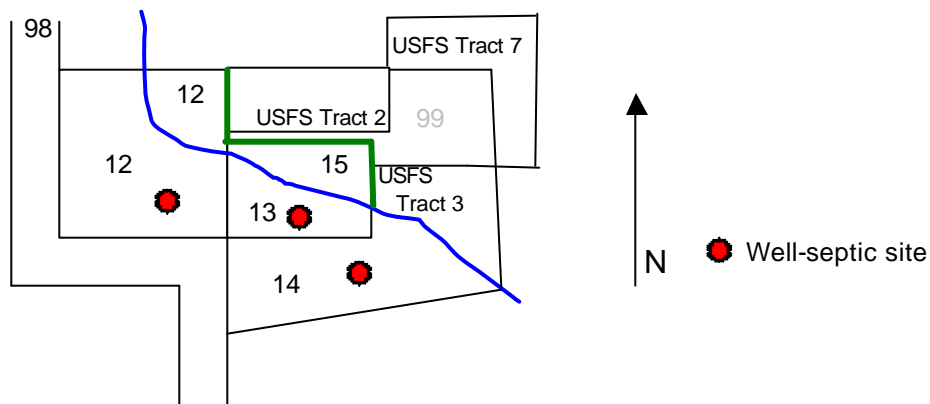
Local Government Tax/Assessment Table					
ParcelID	Owner	Exempt	Site Add	Land Val	Improv Val
17	Mary	N		8,000	75,000
16	Red	N		2,000	0
13	Joe	N		12,000	75,000
14	Bob	N		7,000	40,000
15	Ester	N		6,000	0
99	USFS	Y		0	0
98	ROW	Y		0	0
12	Mary	inactive			

Local Government Related Table		
ParcelID	Septic Permit	Building Permit
12	2234	786
13	2235	788
14	2236	789

In this example, Mary has sold a portion of her land to Red. The land values have been apportioned accordingly and new Parcel IDs have been assigned to Red's land (16) and the remainder or parent parcel has also been assigned a new Parcel ID, (17). The record for Parcel ID 12 has been noted as inactive. In some systems a separate table may indicate which new parcels were created out Parcel ID 12.

Linking published parcel data to existing information may create overlapping parcel definitions. That is, in any one area there may be more than one jurisdiction or entity that is maintaining information about the same parcel. In Example 4, the US Forest Service also has parcel information for this portion of Hogan County.

Hogan County – Example 4 – USFS Parcel Data



Local Government Tax/Assessment Table

ParcelID	Owner	Exempt	Site Add	Land Val	Improv Val
12	Mary	N		10,000	75,000
13	Joe	N		12,000	75,000
14	Bob	N		7,000	40,000
15	Ester	N		6,000	0
99	USFS	Y		0	0
98	ROW	Y		0	0

USFS Tract Information

ParcelID	Case Number	Restrictions
USFS Tract 2	KA-234	Reserved Oil and Gas
USFS Tract 3	AR-92	Recreation
USFS Tract 7	KA-301	None

In this example the US Forest Service has parcel information for the area they manage. There are three tracts shown, Tracts 2, 3 and 7. The US Forest Service has related tables with additional information such as rights and restrictions, acquisition dates, boundaries and resources information. The US Forest Service Tracts are the parcels describing the extent of US Forest Service management. There may be areas within the a National Forest that are not held by the federal government, called inholdings, but for the purposes of this example the US Forest Service holdings are as illustrated with continuous, non-overlapping tracts.

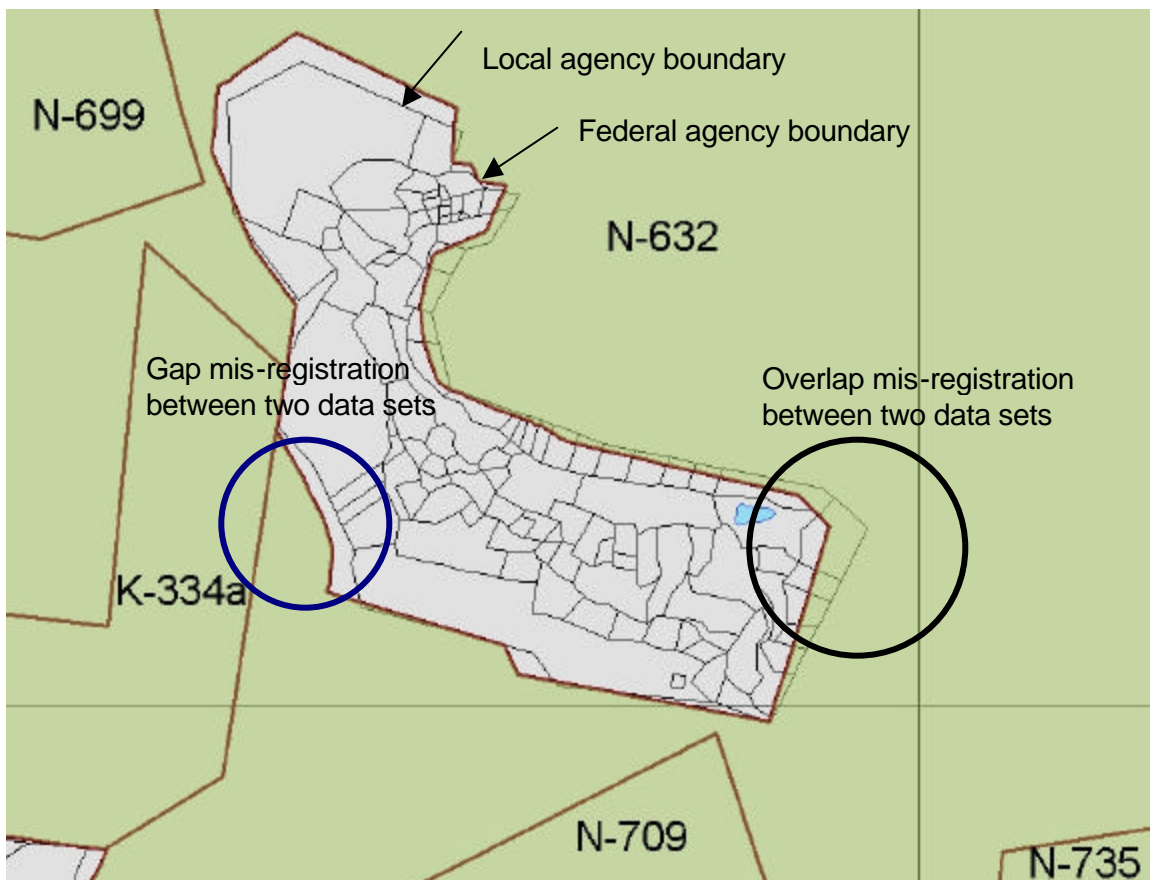
In Example 4 the common boundary, shown in green, between the US Forest Service and County match, but within Forest lands the Forest Service shows more detail, three tracts instead of the one large parcel shown by the County . Forest Service Tract 7, in Example 4, extends beyond the one county parcel.

As Example 4 illustrates, the one parcel mapped by the County has three parcels on federal government side. In this example of federal lands, the US Forest Service parcel identifier links to US Forest Service records and the County identifier links to County records. This is an overlapping information situation because there are two agencies that are managing information about parcels with similar geographic extent.

In Example 4 the common boundary between the US Forest Service and the County are in agreement. The two agencies have agreed to the spatial representation of the common boundary and this is shown as a green line in Example 4. This is an example of horizontal spatial integration. That is, there is a spatially seamless representation of the parcels across jurisdictional boundaries.

Even if there were not spatial horizontal integration, the parcel identifier for each agency would still point to the additional records in each agency's databases.

Hogan County – Example 5 – County and Federal Data



In Example 5, the red outline shows the federal representation of an inholding. In this case the federal representation shows the outline of one parcel that is not managed by the federal agency. In this example there are no federal records for this area, but its outline has been described. The County records show many parcels, indicated in a light green outline. The County Parcel ID points to the County records for the parcels within the County's delineation of the parcels. There is some mis-registration between the federal and county mapping, but this does not hamper the ability to identify core parcel attributes and to find linkages to the two agencies records.

The exception to this is the area shown inside the blue circle where there is an apparent gap between the two agency data sets. In this area the County information would point to a federal parcel with an indication of exempt from taxes and there would not be a corresponding record in the federal data sets. Likewise overlap creates the appearance of uncertainty in who owns some areas, such as the area shown in the black circle in Example 5. In these areas there would be federal records and county tax records for the same land each showing different ownership and status.

If the county wanted to incorporate the federal data into their parcel maps and likewise if the federal agency wanted to incorporate the county parcels into their system, then this spatial mis-representation would need to be resolved within the two systems. An agreed upon spatial representation would make it easier to fully incorporate records from the two agencies. It would also eliminate the uncertainty in the gap and overlap areas.

If the parcel identifier points to records in source agency files then the other core data for each parcel would be generated by the related records in the source agency files. Every agency that maintains parcel information can publish their information and the downstream users will be able to see a summary of all available parcel information for an area. The Parcel ID would point to additional information in the agency's and the jurisdiction's databases. The individual variances on the definition, form, format, and content of the Parcel ID would vary. However, appending local Parcel ID's with an agency or jurisdiction code could attain national uniqueness.

NATIONALLY UNIQUE NUMBER

A second approach or an additional approach to a parcel identifier for the core data is to generate a nationally unique number that also has relative geographic location information. There are many approaches that could be taken for this type of identifier. Some examples of these approaches are:

1. Latitude and longitude coordinate values of a point,
2. State plane coordinate x and y values,
3. An interleaved state plane coordinate value, much like the North Carolina system, or
4. The US National Grid (USNG Standard adopted by the Federal Geographic Data Committee.

The first three options have not been discarded and may be continued after further study. Using x and y or northing and easting coordinate values means that the datum, the state plane coordinate zone, the units of measure, the format (such as decimal degrees or degrees, minutes, seconds) and in the case of options 1 and 2 the character for separating the two values in one field would need to be resolved and then either reported as part of the core data or defined as part of the standard.

The US National Grid (USNG) the fourth alternative. The USNG standard (FGDC-STD-011-2001) was formally adopted by the FGDC on December 13, 2001. The use for this standard as proposed here is not one of the intended uses of the standard described in the standards document. The disadvantage of the USNG is that it cannot be translated directly into a coordinate position, that is the value needs to be run through a translator program to produce a coordinated location. The second disadvantage is that it is in meters and most land records information are in feet. The advantage of the USNG is that it is one number that can be placed in the core data attribute field and the translator program will determine the latitude and longitude, universal transverse Mercator (UTM) or State Plane Coordinate (SPC) value for the USNG label.

The proposed use of the USNG within the core data would be to provide a relative location, within or as close to the parcel as possible that would resolve the location of the parcel within one meter. For parcels whose dimensions are smaller than one meter square the USNG designation would need to be approximate to the parcel.

The following explanation of the USNG is based on information contained in the National Geodetic Survey web site: <http://www.ngs.noaa.gov/TOOLS/usng.html>

The U.S. is divided into 6-degree longitudinal zones designated by a number and 8-degree latitudinal bands designated by a letter. Each area is given a unique alphanumeric Grid Zone Designator (GZD) (i.e. 18S). Each GZD 6 x 8 degree area is covered by a specific scheme of 100,000-meter squares where each square is identified by two unique letters. (i.e. 18SUJ - Identifies a specific 100,000-meter square in the specified GZD).

The UTM grid coordinates are expressed in terms of Easting (E) and Northing (N) values to determine a point position within the 100,000-meter square. An equal number of digits are used for the east and north coordinate values where the number of digits depends on the precision desired in position referencing. In the USNG standard the reading is from left with Easting first and then Northing.

If the precision of a national Parcel ID system is 1 meter, then an example ParcelID would be 18SUJ2348306479, where 18S is the Grid Zone Designator, UJ is the 100,000 by 100,000 meter area within the grid zone and 23483 is the easting in meters and 06479 is the northing in meters. This would locate this point within a precision of 1 meter.

The number of digits in Easting and Northing can be varied, depending on specific requirements or application. For example, ParcelID=18SUJ23480647 would locate a point with a precision of 10 meter, note the easting and northing values are four digits each not five digits each.

The proposed Parcel ID will be 15 characters long and will have the following format:

GZD (3 char)	e.g. 18S
Square Identification (2 char)	e.g. UJ
Easting (5 char)	e.g. 23483
Northing (5 char)	e.g. 06479

If two parcels had exactly the same grid number one could be offset since the geographic significance of the ParcelID is to provide an approximation and not an exact mapping of the parcel.

In addition to providing a standard several tools have been developed to support the standard. There are interactive, point-by-point conversions available on the NGS web site for:

- Latitude/Longitude to USNG
- USNG to Latitude/Longitude
- UTM to USNG
- USNG to UTM

and a downloadable program that can be run locally and in conjunction with other applications.

There are many ways the USNG could be used with the core data. One of the attributes in the Proposed Core data Standard is a parcel centroid. This attribute could be modified to be a parcel point, which would be defined as a point in or near a parcel that approximates the location of the parcel. Within any one dataset the parcel points should be separated by at least one meter so that a USNG value can be computed for the parcel point. In the Core Data set the attribute value for the parcel point could be the USNG value.

With each core data set including a coordinate value for a parcel point a conversion program could be run, at the time the data set or new parcels are published in the core data set, to generate the USNG number.

The USNG could meet the requirement to have an approximate geographic point location for the parcel information. However this value does not resolve problems with parcel gaps and overlaps from adjoining data sets and does not solve any problems with parcel maintenance workflows. In the context of the Core Data the USNG is a geographically related value for a point in or near the parcel. This value can be used to attached value information, to support point mapping or for combining information from varied sources.

HYPOTHESIS FOR CORE DATA PROJECT

For the Core data Projects the following hypothesis regarding Parcel IDs will be tested and described. Alternatives to this hypothesis may be developed in some of the Core Data Projects

Parcel ID – This will be the identifier or label for the parcel as generated and maintained by the data producer. The requirement on the parcel data producer is that parcel numbers are not reused when the geometry of the parcels changes such as with splits or combines. Improvements to the spatial representation of a parcel, such as better mapping or updated coordinate values for the corners of parcels does not constitute a parcel change that would require the assignment of a new parcel identifier.

Source Agency – This will be an identifier for the source agency or source jurisdiction that provided the parcel information. In many cases this will be a county, but it could be a state or a regional organization or a non-profit or a private sector firm. In the case of counties and states the FIPS Codes for the State and or County will be used for the source agency code. For federal agencies the Agency FIPS Code will be used. The Core data Projects will explore unique identifiers or labels that can be used for non-profit and private sector firms as well as a determination of the frequency of these agents being the primary parcel data providers.

USNG – This is the US National Grid Number as described above. The Core data projects will verify that the one meter resolution is sufficient for parcel identification and that an algorithm can be run that will generate the number as well as work flow processes for maintaining the USNG for core data.