Final Report

Version 2 Statewide Parcel Map Database Project

November 15, 2016

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OVERVIEW

The Version 2 Statewide Parcel Map Database Project (V2 Project) was a joint effort between the Wisconsin Department of Administration (DOA) Division of Intergovernmental Relations and the Wisconsin State Cartographer's Office (SCO). This document describes the V2 Project, which ran from October 2015 to December 2016 as part of the Statewide Parcel Map Initiative established by Act 20 of 2013.

Project Objectives Achieved

- **Establish a statewide parcel database** and map layer by integrating county-level datasets
- **Develop and institute a standard for parcel data known as the "Searchable Format,"** which is tied to Wisconsin Land Information Program grant funding for local governments
- **Assess county progress in achieving the Searchable Format** and communicate this to counties
- Display statewide parcel layer online and provide database for download
- Supply a prototype solution for collection and display of zoning information maintained by counties

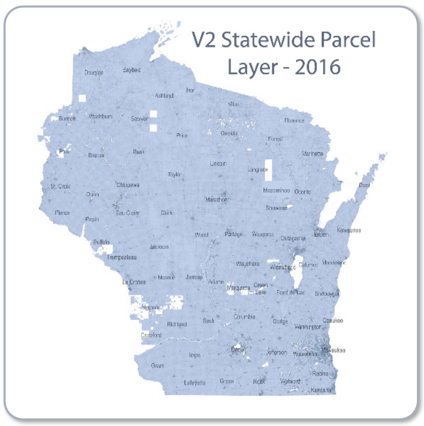
The V2 Project successfully aggregated all known digital parcel datasets within the state, resulting in a statewide GIS parcel layer of 3.47 million parcels. The statewide data was standardized to meet the Searchable Format and made publically available online on August 31, 2016. The V2 Project represents another successful step in the Statewide Parcel Map Initiative, an effort important for improving the quality of Wisconsin's real estate information, economic development, emergency planning and response, and other necessary citizen services.

PROJECT CHARACTERISTICS

The V2 Project was another phase in the incremental approach towards the Parcel Initiative— improving the statewide parcel map with each annual iteration. The V2 Project builds upon the experience of the V1 Project and the LinkWISCONSIN project, both of which aggregated county parcel datasets into digital statewide parcel map layers. However, V2 was the first to request that parcel data be submitted in the Searchable Format, which the legislature directed the Department of Administration to create in coordination with counties as part of Act 20 of 2013. In the Searchable Format, county data submittal is ready for immediate aggregation into the statewide parcel layer, which requires less work by GIS technicians at the state level and allows for more frequent update of parcel data. Counties are to achieve the Searchable Format by 2018.

TECHNICAL APPROACH

The technical approach by SCO staff involved several steps, including geoprocessing tool development, preparation and ingest, local-level processing, aggregation, state-level processing, and quality assurance/quality control. To support counties in achieving efficient and accurate adherence to the Searchable Format, the SCO developed a suite of seven publicly available geoprocessing tools. Intake assessment revealed that nearly all of the county datasets submitted fell short of the Searchable Format, with missing or unusable data in some cases, and the vast majority requiring at least a few aspects of data cleanup and manual edits. Nineteen counties re-submitted data because the initial data submittals were incomplete or did not meet basic requirements, which delayed processing of the statewide data.


V2 Statewide Parcel Layer - 2016

DATA ASSESSMENT

The final V2 layer represents parcel coverage of 98.5% of the possible square mileage of the state. Eight counties have yet to complete their digital parcel mapping. On an attribute level, the notes from assessment were communicated to counties through documents called *V2 Observation Reports*. The reports were individualized for each county to document progress in meeting the Searchable Format and describe steps still necessary to meet the standard. Overall, data assessment indicated that there is work yet to do in order to achieve the Searchable Format statewide by 2018.

DATA DISTRIBUTION

Data was distributed in several formats via a custom website and a web-based mapping application. The V2 web app allows someone without GIS software to view the statewide parcel map. It reflects functional and cosmetic updates from V1 implemented via Web AppBuilder, with added value through custom coding. Statistics show the V2 database was downloaded over 800 times in the first two months for use by GIS practitioners. In general, users of the V1 and V2 layers report benefits of saving staff time and hassle, because they do not need to make individual requests for county parcel data which can be incomplete and vary in format. Positive testimonials have come in from a range of users, from private businesses to state agencies.

RECOMMENDATIONS

Further developments might include improvements at the level of the native data and export process, additional data to be requested, and a change in method of aggregation, with at least three model options for implementation. Whichever method of aggregation is chosen for the future, a content validation tool should be developed to ensure uniform county adherence to the Searchable Format.

1 PROJECT CHARACTERISTICS

1.1 Background

The **Version 2 Statewide Parcel Map Database Project** (V2 Project) was a joint effort between the Wisconsin Department of Administration (DOA) Division of Intergovernmental Relations and the State Cartographer's Office (SCO) that ran between October 1, 2015 and December 31, 2016.

Wisconsin Act 20, the biennial state budget for 2013-2015, created statutory directives through s. 59.72 and s. 16.967 for the state and local governments to coordinate on the development of a statewide digital parcel map, which is referred to as the Statewide Parcel Map Initiative, or "Parcel Initiative." One of the statutory requirements was for DOA to determine a Searchable Format for parcel data and for all county data to be posted online in this standard.

The V2 Project followed successful collaboration between DOA and SCO on similar efforts. DOA and SCO have already partnered on a project to create statewide parcel and address point layers for the LinkWISCONSIN Address Point and Parcel Mapping Project (2013-2014) and the Version 1 (V1) Project (2014-2015). [1]

The V2 Project took the approach of DOA toward the Parcel Initiative of improving the statewide parcel map with each annual iteration through a process that allows for much involvement and collaboration with data contributors, who are primarily county land information offices, and data users—a wide array of persons from state agencies, private companies, and other entities and individuals.

1.1.1 V2 Project Goals

As part of the implementation planning for the statewide digital parcel map, the goals of the V2 Project were established in a memorandum of understanding between DOA and SCO:

- **Efficiency and Sustainability.** Develop and prototype a process to update the statewide parcel layer to facilitate asynchronous updates on a county-by-county basis, creating a dynamically updated "living" data layer. Demonstrate and document how this update mechanism can be achieved using stored procedures and methods. Identify components of the process that still require manual intervention, and make recommendations on how to automate them and improve their efficiency. Enhance field mappings, tools, and stored procedures to reduce the amount of labor required to update the parcel layer.
- **Refining Data Submissions.** Re-orient the call for data in coordination with the annual tax roll cycle. Refine verbiage and format of call for data to make requests less onerous, more explicit, and ultimately achieve a better rate of return. Ensure that the request is routed correctly within the county.
- **Incorporation of Feedback.** Work with counties and municipalities to determine optimal submission methods to ensure county and local timetables are considered, and identify low-cost, low-impact ways to standardize components of county data to facilitate more efficient update and integration. Work with data contributors and data users (e.g., state agencies, private sector) to meet the needs of users and to accommodate local policies (e.g., redaction of sensitive data).
- **Zoning Data.** Based on feedback from counties and local governments, produce a prototype solution to display zoning data.
- **Benchmarking and Standardization.** Evaluate counties against current benchmarks and provide additional options and recommendations on benchmarking for 2017 and beyond. Include data standards within these benchmarks for data contributors to improve data collection and make it more efficient.
- **Public Access.** Build an online web app to provide public access to the parcel database, including basic viewing, query, search, and download capabilities.

[1] For information on the V1 Project, see the *V1 Interim Report* (June 2016) and *V1 Final Report* (November 2015). For information on the LinkWISCONSIN Project, see *Final Report: LinkWISCONSIN Address Point and Parcel Mapping Project* (September 2014).

1.1.2 Project Timeline and Milestones

V2 Statewide Parcel Map Database Project Milestones	
Date	**Version 2 Project Milestone**
October 1, 2015	V2 Project Start
January 26, 2016	Call for Data and Finalization of Searchable Format for V2
August 31, 2016	Final V2 Parcel Database Made Available Online
October 17, 2016	V2 Parcel Layer Hosted and Displayed Online
November 15, 2016	V2 Final Project Report
December 31, 2016	Report to Legislature Due

1.1.3 Project Team

V2 Statewide Parcel Map Database Project Team	
Howard Veregin, Project Co-Lead	Wisconsin State Cartographer's Office
Peter Herreid, Project Co-Lead	Wisconsin Department of Administration
Codie See, Project Coordinator	Wisconsin State Cartographer's Office
David Vogel, GIS Specialist	Wisconsin State Cartographer's Office
Chris Scheele	Wisconsin State Cartographer's Office
Jim Giglierano	Wisconsin Department of Administration
Davita Veselenak	Wisconsin Department of Administration

1.1.4 Outreach

V2 Conference Presentations and Outreach To-Date	
WLIA Spring Regional Meeting June 2015	County Parcel Data Standards and Benchmarks for the Statewide Parcel Map Initiative
WLIP Outreach Visits to All 72 County Land Information Council Meetings Completed October 2015	Visits by WLIP Grant Administrator
Minnesota GIS/LIS Annual Conference October 2015	Status of the Wisconsin Statewide Parcel Map Initiative
2015 Governor's Northern Wisconsin Economic Development Summit November 2015	Remarks by Department of Administration Secretary Scott Neitzel
67th Wisconsin Society of Land Surveyors Annual Institute January 2016	The Role of PLSS Data in Wisconsin's Statewide Parcel Map
WLIA Annual Conference February 2016	Wisconsin's Statewide Layer: Benefits and Uses of the Wisconsin Statewide Parcel Map; The Role of PLSSFinder with the WLIP 2016 Strategic Initiative Grants
Forum to Align County Surveying and Parcel Mapping Efforts in Wisconsin March 2016	Wisconsin Statewide Parcel Layer and the PLSS
SWRPC Regional GIS Forum August 2016	WLIP Grants and V2 Data Access Requirements, Southwestern Wisconsin Regional Planning Commission
WLIA Regional Conference October 2016	WLIP Plan Implementation Discussion

1.2 Benchmark Standards & Schema Design

Research and conceptualization of statewide parcel data standards for V2 involved several steps, including applying previous lessons learned, development of data standards and the attribute schema, and finalizing the schema.

Figure 1. Overview of Workflow Part I: Benchmark Standards & Schema Design

1.2.1 Lessons Learned from Project Predecessors

LinkWISCONSIN

The LinkWISCONSIN project set a valuable precedent in terms of data sharing. All known address point and parcel datasets were shared with DOA for the purposes of this project. This required participation by all 72 counties and several cities. While the LinkWISCONSIN project simply aggregated parcel geometries in their native form and under a simple attribute schema, the address point layer was aggregated to a schema supporting 39 total attributes. Several of the 39 LinkWISCONSIN attributes—mostly those pertaining to parsed address information—were included in the V1 and V2 parcel attribute schemas. The LinkWISCONSIN project was a valuable opportunity for the SCO and DOA team to better understand the nature of addresses and how they are annotated across the state. It also served as a pilot project informing address-related standards might be applied across the state and is documented in detail in *Final Report: LinkWISCONSIN Address Point and Parcel Mapping Project*.

V1 Schema

Building off the knowledge gained through the LinkWISCONSIN project, the project team conceptualized an attribute schema for the V1 Project. However, before finalizing and enforcing the V1 standards, they were derived from national standards, carefully researched, and took into account a number of criteria.

- **Act 20 Requirements.** Several fields were developed specifically to fill requirements defined by Wisconsin s. 59.72(2)(a). These attributes, in both the V1 and V2 schema are: full physical address, total assessed value, assessed value of land, assessed value of improvements, assessed forest value, estimated fair market value, net property tax, gross property tax, class of property, assessed acres, and deeded acres.
- **Technical Requirements.** Several attributes were not directly required through statute but were required for inclusion in the attribute schema for technical purposes related to maintenance and utility of the layer.
- **Added Value.** Several fields were included in the attribute schema as auxiliary elements, which were intended to build value into the parcel layer beyond that which was required by s. 59.72(2)(a).
- **Parsed Site Address Elements.** Parsed addresses are advised by the FGDC *Thoroughfare, Landmark, and Postal Address Data Standard*, which targets address data management requirements for local address administration, postal and package delivery, emergency response and navigation, administrative recordkeeping, and address data aggregation. It is a relatively new standard, endorsed by the FGDC as the official data standard for the United States in 2011. This standard is focused on building a forward-looking framework for developing address repositories.
- **Practical Perspective.** With the background knowledge gained through the LinkWISCONSIN project, the project team was able to posture the attribute schema to be most practical in aggregation, ultimately setting the schema up to be most successful from the perspective of continuity, contiguity, and accuracy. In some cases, this meant choosing an element definition that is the least common denominator in how an attribute is maintained across Wisconsin's localities. In other cases, it meant setting standards for data submission and creating precedence for localities to strive for.
- **Inclusion of County-Maintained Zoning Data.** Zoning data was requested and collected but not aggregated for the V1 Project because data was too sparsely contributed to aggregate. However, the attribute schema for V2 zoning data was in-part conceptualized through assessments made about data submitted for V1.

1.2.2 Improvements Over V1

Implementation of Wisconsin's First Statewide GIS Standards

The V2 Project was the first of the three statewide aggregation projects that aimed to request data adhering to formal data standards. Continuity in a statewide dataset relies heavily on data standards and as a result, standards were implemented with the V2 schema, tied to WLIP Strategic Initiative grant funding. Adoption of data standards by local-level data contributors is paramount to the eventual goal of the Parcel Initiative, for parcels to be aggregable through **the "Four A's"—authoritative, automated, asynchronous aggregation**. These "four A's" support the submission of individual datasets at any time or interval by county data stewards by automatically merging the local data with the most current statewide database, and are heavily dependent on data that is standardized.

Standards implemented for V2 fall into three general dimensions.

- **Attribute Field Standards.** Standards that define the nature of an entire field or "column" of data. These standards define the membership of data to a certain field and determine which field, fields, or portions of a field within the local data should be included in a particular statewide attribute field. They define which local data aligns with the statewide schema and are the basis upon which attribute cross-walking is conducted.
- **Attribute Domain Standards.** These standards define the nature of the individual records included within a given field and are more semantic in nature. Instead of defining what data is classified under a certain statewide attribute, these types of standards define *how* the data is presented within the attribute field such as acceptable ways of annotating a street or a property class.
- **Geometric Representation Standards.** These standards define the geometric nature of the data submitted and include such aspects as the coordinate reference system of the submitted data, the spatial extent and completeness of the layer, as well as how condominiums were to be represented.

Attributes Additions From V1 to V2

The vast majority of attribute elements and attribute element definitions implemented for V1 persisted in the V2 Project, after being highly scrutinized for their technical, practical, logical consistency, and semantic coherency. However, the V2 schema grew, with the addition of three attributes.

- **Assessed Acres.** Assessed acres was included as a supplementary field to the deeded acres field. This additional field was created to accommodate for the distinction between assessed acres and deeded acres, as there is sometimes a difference in the parcel area as specified within the legal property description and the total assessed acres number established for taxation purposes. The acreage information on a land deed can often be missing from old deeds as well. To differentiate these two types of acreage values, the additional field was created.
- **Latitude/Longitude.** Latitude and longitude of parcel centroids were calculated by the project team using GIS and included as attributes to each parcel in the V2 final deliverable as an added value, as requested by users after utilizing the V1 parcel layer.
- **Standardized Auxiliary Class of Property.** Auxiliary class of property was included in V1, however, standardized domains were added for V2 in order to account for standard codes for tax exempt property classifications from the Department of Revenue.

Other Improvements Over V1

While the V1 Project was considered to be an overall successful and unprecedented aggregation of parcel and tax attributes, there were some shortfalls that were targeted for improvement in the V2 Project.

- **Reduction of Geometric Errors.** The V1 Project offered the project team and other users an opportunity to assess the geometric nature of parcel datasets across the state for the first time. Through these assessments a variety of unique qualities became apparent within the parcel layer that could be considered erroneous or anomalies. Through the V1 layer, some of these issues were discovered and resolved, some were discovered and unable to be resolved, while others were simply identified, with their exact nature and location unknown. For the V2 Project, the team was able to anticipate that some of these issues exist and were able to spend time further examining the nature of these issues, to correct for them where possible.
- **Attribute Accuracy.** For V2, local contributors were required to field-map their data, making attribute accuracy another improvement. Local level data stewards are the most knowledgeable about the nature of their data and thus are able to interpret and marry it to the statewide schema most accurately. The V1 Project required that project staff infer, to the best of their ability, the appropriate fields in matching local data model attributes to that of the statewide schema. In many cases this was a complex task that would have been extremely difficult to validate. Therefore, there is the possibility that some attributes might have been cross-walked inaccurately in the V1 layer. The V2 Project corrected this, which is of particular relevance to the PARCELID attribute. Parcel ID is a field that has few natural specifications tied to it and is thus more difficult to distinguish without firsthand knowledge. Therefore, the cross-walking requirement in V2 improved accuracy of attributes like PARCELID through county-verification.

The Addition of Condo Model Specifications

A final improvement over the V1 schema was the addition of standards for condo modeling. Condominium properties and other collective ownerships are modeled in various ways across localities in Wisconsin. For the V1 Project, the project team maintained whatever model the locality practiced in GIS natively. For counties who modeled their condominiums through a relational database scheme, condominium units were not perfectly represented in the V1 final deliverable. Due to the lack of condo representation in some geographic areas, the V1 layer was missing some records.

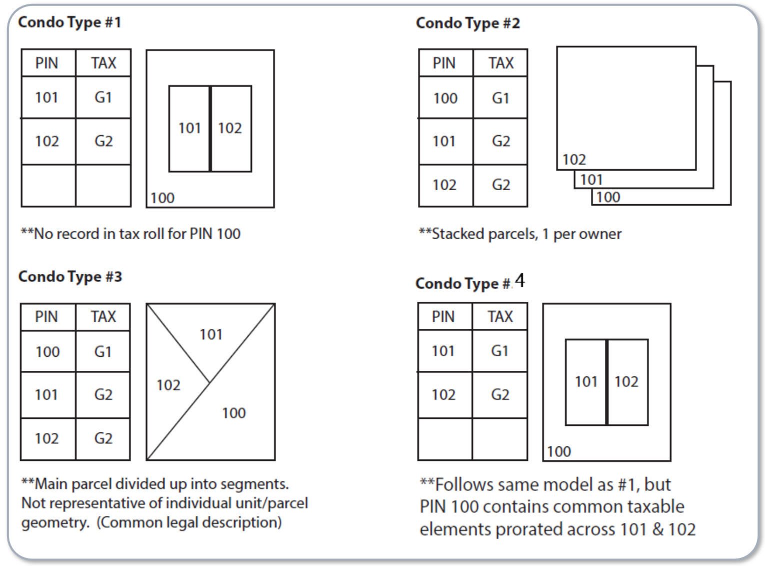
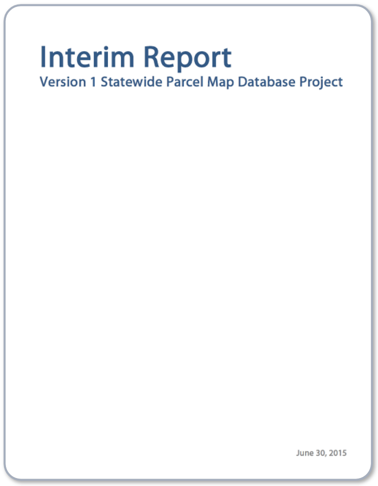


Figure 2. Condo Model Scenarios #1-4 from the V2 Schema

In contrast, the V2 Project corrected this by properly and consistently modeling condos across all counties, resulting in a more complete record of land ownership statewide. Data contributors were asked to represent condominiums or other collective real property ownerships geometrically—not relationally—so that each tax record was attached to one and only one parcel geometry. The determination of condo standards occurred through phases of research, coordination, documentation, and data contributor support.

- **Condo Research.** Throughout V1, various assessments were made on the native data that was submitted. One aspect of this assessment involved identifying the how condos exist within the native GIS data (the nature of their geometries), as well as how they were annotated tabularly in the tax information submitted (the nature of their attributes). Throughout the process of assessing the V1 data, the project team was able to generalize each county's native condo practices into five categories. These five categories include four geometric models and one relational model. The four geometric models are defined by a one-to-one relationship between the parcel's geometries and the parcel's attributes, while the relational model follows a one-to-many model, where the geometry of a parcel is "attached" to more than one attribute record. Figure 2 demonstrates the geometric nature of each observed geometric condo model.
- **Condo Model Coordination.** Using the detail gathered about condo practices for each county, the project team was able to identify a condo standard to target in the V2 layer by identifying "least common denominator" parameters. The goal in this effort was to establish parameters to a condo standard that were feasible to expect every county to achieve. It was determined that translating geometrically modeled condo datasets into relationally modeled datasets would not be efficient and could also be erroneous, thus the geometric modeling scenarios were pursued in developing the V2 standard. Furthermore, it is not practical to expect one single geometric modeling strategy to be achieved by all counties. For example, *Condo Type #2* cannot be transformed into *Condo Type #4* without manually editing the parcel. Thus, all four condo model scenarios were determined acceptable for data submission.
- **Condo Model Documentation.** In order to help counties understand the expected condo format for submission to the V2 Project, the project team wrote detailed documentation into the *V2 Submission Documentation*.
- **Data Contributor Support.** To facilitate efficient routes to preparation of local data for submission, the project team identified several of the most common, difficult, or time-consuming tasks that might be encountered. The team created tools and supportive documentation to help address the issue of translating a relationally modeled condo data into geometrically modeled data (described in the following chapter).

1.2.3 Documentation and Communication of Standards



Data Standards/Schema Development

The Searchable Format for the V2 attribute schema and data model was developed based on the experience gained in creating statewide parcel databases and map layers for V1 and the LinkWISCONSIN projects, as well as public comment and a V2 practice data submittal.

This draft standards were first made open to public feedback through the *V1 Interim Report* during the summer of 2015. In the V1 Interim Report, the concept of "benchmarks" for parcel dataset appeared as a way to implementation standards associated with WLIP Strategic Initiative grants.

The original four benchmarks were offered in summary form in the 2016 Strategic Initiative grant application. Together, **Benchmark 1 and 2 make up the Searchable Format standard for parcel data**.

In the Searchable Format, county data submittal is ready for immediate aggregation into the statewide parcel layer. The county performs all data standardization and clean-up before submitting data. Counties are to meet the Searchable Format by March 31, 2018 at the latest and are eligible for grant funding assistance to meet this standard.

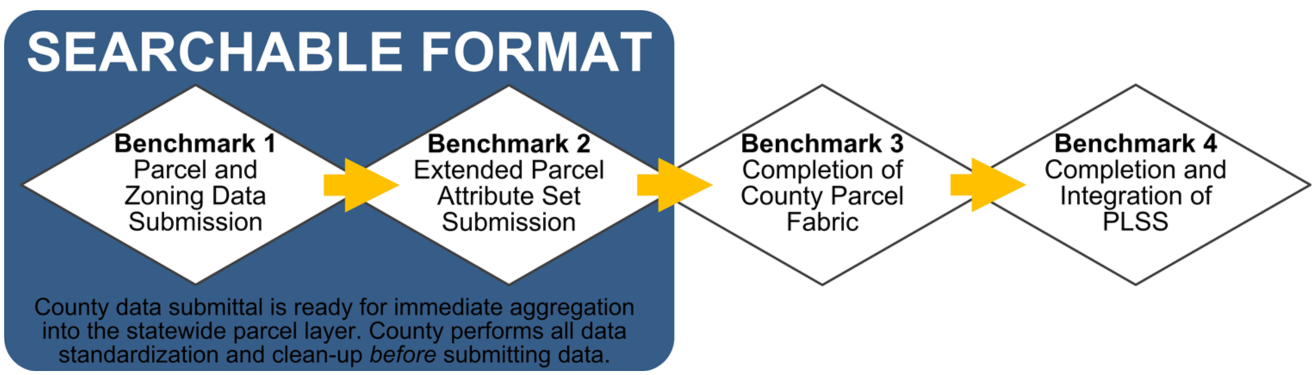
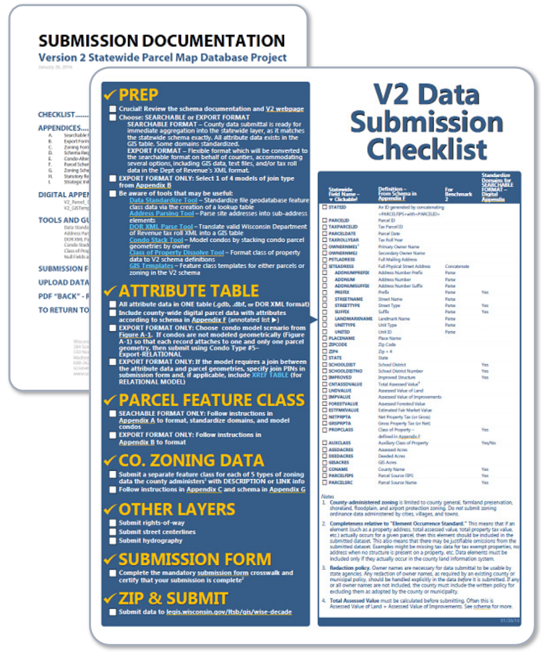


Figure 3. The Four Benchmarks for Parcel Data Submission, with Benchmarks 1-2 Comprising the Searchable Format

Standards/Schema Finalization

V2 took the WLIP's first set of standards to the implementation stage, through the data submission requirements. The Searchable Format was detailed in full in the *V2 Submission Documentation* manual, which was released with the V2 Project call for data on January 26, 2016.

The V2 parcel schema for the Searchable Format, with 44 total attributes, appears as Appendix F in the *V2 Submission Documentation* and in summary form in the table below.



Final V2 Schema

Statewide Field Name	Definition – From Schema in V2 Submission Documentation Appendix F	For Searchable Format
STATEID	ID generated by concatenating <PARCELFIPS> with <PARCELID>	
PARCELID	Parcel ID	
TAXPARCELID	Tax Parcel ID	
PARCELDATE	Parcel Date	
TAXROLLYEAR	Tax Roll Year	
OWNERNME1	Primary Owner Name	
OWNERNME2	Secondary Owner Name	
PSTLADRESS	Full Mailing Address	
SITEADRESS	Full Physical Street Address	Concatenate
ADDNUMPREFIX	Address Number Prefix	Parse
ADDNUM	Address Number	Parse
ADDNUMSUFFIX	Address Number Suffix	Parse
PREFIX	Prefix	Parse
STREETNAME	Street Name	Parse
STREETTYPE	Street Type	Parse
SUFFIX	Suffix	Parse
LANDMARKNAME	Landmark Name	Parse
UNITTYPE	Unit Type	Parse
UNITID	Unit ID	Parse
PLACENAME	Place Name	
ZIPCODE	Zip Code	
ZIP4	Zip + 4	
STATE	State	
SCHOOLDIST	School District	
SCHOOLDISTNO	School District Number	
IMPROVED	Improved Structure	
CNTASSDVALUE	Total Assessed Value	
LNDVALUE	Assessed Value of Land	
IMPVALUE	Assessed Value of Improvements	
FORESTVALUE	Assessed Forested Value	
ESTFMKVALUE	Estimated Fair Market Value	
NETPRPTA	Net Property Tax (or Gross)	
GRSPRPTA	Gross Property Tax (or Net)	
PROPCLASS	Class of Property	
AUXCLASS	Auxiliary Class of Property	
ASSDACRES	Assessed Acres	
DEEDACRES	Deeded Acres	
GISACRES	GIS Acres	
CONAME	County Name	
LOADDATE	Date of aggregation into statewide database	
PARCELFIPS	Parcel Source FIPS	
PARCELSRC	Parcel Source Name	
LONGITUDE	Longitude of parcel centroid	
LATITUDE	Latitude of parcel centroid	

Note. Underline indicates standardized domains required for the Searchable Format.

1.2.4 Practice Submission Phase

Along with best practices research and schema conceptualization, the project team provided a window of time for counties to volunteer "**practice submissions**" to the team in what was essentially a V2 data submission pilot project. This phase was mutually beneficial to the project team and contributing parties for several reasons.

- **County Feedback.** Opportunity for counties to receive feedback regarding the quality of their submission and how close it was to meeting benchmark requirements.
- **Documentation Testing.** Opportunity for the project team to review the ways that counties interpret the schema documentation, allowing for improvements before the formal call for data.
- **Schema and Tool Refinement.** Opportunity to identify common pitfalls in trying to adhere to the schema and submission requirements, so that workflows could be created and tools could be improved so as to provide a more effective set of directives for preparing submissions.
- **Project Education and Outreach.** Practice submissions drew some extra attention to the project prior to the formal call for data, which was beneficial in drawing county attention to the scope of work involved in preparing data for submission.

Counties that submitted practice datasets included Barron, Chippewa, Columbia, Douglas, Green Lake, Marinette, Outagamie, Pierce, Portage, Sawyer, Vilas, Washburn, and Waupaca—some in coordination with contractors or vendors of tax parcel software.

For each practice submission, the project team assessed data related to the submission's benchmark status, geometric adherence to the data model, attribute adherence to the attribute schema, as well as the quality and completeness of submission standards such as the submission form and file naming conventions. All participating counties received some feedback. The condition of the submitted practice data varied from a close fit to the Searchable Format, with few changes required, to a poor fit, so the nature of the feedback varied. Some counties submitted as many as three test datasets, once upon each level of feedback provided to them. For all participating counties, there were significant improvements upon subsequent submissions, reinforcing the value of conducting a pilot data submission.

1.2.5 Call for Data

The official V2 data request was submitted to each county land information officer on January 26, 2016 via email, and appears as Figure 4. It included a link the *V2 Submission Documentation*, which serves as a manual detailing the requirements of the Searchable Format.

Dear Land Information Officer,

On behalf of the Department of Administration, I am writing to request a subset of your GIS data. The data acquired through this request will be used to develop a statewide parcel layer for the next version of the Statewide Parcel Map Database Project, Version 2.

This is an important and new data request, as we are asking that counties standardize parcel and tax roll data to the statewide schema. Your data submittal is necessary in order to execute your county's 2016 Strategic Initiative grant agreement and receive the first payment.

As a reminder, on your grant application, you indicated that you would be submitting parcel data for V2 to meet the following standard:

SEARCHABLE FORMAT

Checklist and V2 Webpage

The V2 checklist summarizes the data we are asking you to submit and the format. The digital PDF checklist contains hyperlinks to attribute definitions, the schema (which has been updated with some minor technical corrections and clarifications since the V1 Interim Report), and several tools to help you format your data.

In addition, the V2 webpage contains all the necessary submission information, including the required "submission form."

Submit Data Through WISE-Decade

Your parcel data will be collected through the WISE-Decade platform, where you should log in with the user information you received on December 29th from the Legislative Technology Services Bureau. Please submit your data by **March 31, 2016**.

Feedback and Help

We expect that you may have questions about making your data align with the statewide schema. Your peer counties are a great resource, as is the FAQs section on the V2 webpage.

For technical questions, you can contact Codie See at 608-890-3793 or csee@wisc.edu. Feel free to contact me with general questions as well.

We know that it could take a considerable amount of work to get your data into the statewide schema. Strategic Initiative grants were designed to aid in this task. We sincerely appreciate your effort.

Thank you,

Peter Herreid
Grant Administrator
Wisconsin Land Information Program
608-267-3369

Figure 4. V2 Call for Data

2 TECHNICAL APPROACH

This chapter describes the strategy or a high-level version of the approach employed by the technical team in processing and aggregating local-level data for inclusion in the V2 final deliverable and statewide parcel map.

After the schema and standards had been developed and the call for data made (previous chapter), local parcel datasets began to stream in. The workflow to handle and aggregate the data proceeded through several processing steps, broken down into the general phases illustrated below.

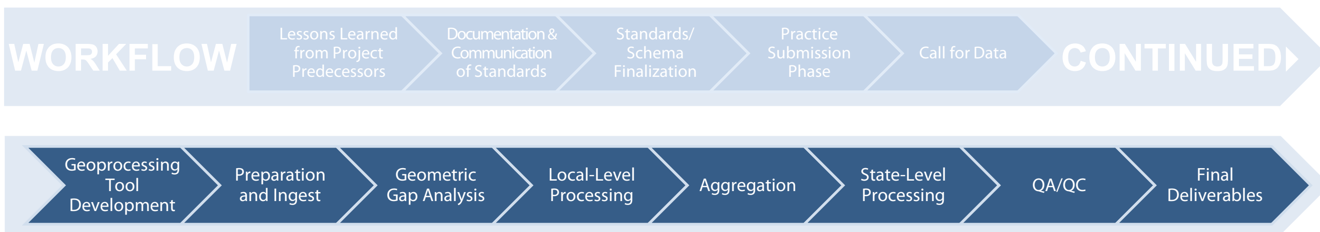


Figure 5. Overview of Workflow Part II: Execution of Technical Approach

One of the more challenging factors of the V2 Project was the aggregation of more than 72 different datasets—each with distinct data models—into a single file geodatabase with a consistent and contiguous data model. Due to the nature of this complexity and experience built through past projects, there were a number of considerations made when deciding which integration software to use for V2.

- **Variety of Expected Data Formats.** Shapefile, file geodatabase, .dbf, .xml.
- **Data Interoperability.** Continuity between county, municipal, and state software platforms .
- **Repeatability.** Facilitation of as much workflow and processing repeatability as possible.
- **Processing Power/Flexibility.** Support for custom processing tools for use by localities.
- **General Software Performance.** Bearing in mind the significant size of statewide layer at 3.47 million features.
- **Usability.** Anticipated and most commonly used distribution format for GIS data.

Various options exist for GIS data integration software, some open source and others proprietary. The team chose to use the Esri ArcGIS platform for the majority of assessment, processing, and data distribution tasks. It includes broad support for out-of-the-box GIS processing tasks while also offering the capabilities of creating custom geoprocessing tasks. The platform also includes support for a wide variety of data formats and is able to handle large GIS datasets. While it is a proprietary platform that uses some proprietary data formats, it is used as the main GIS software platform in land information offices across the state.

The widespread use of the Esri ArcGIS platform is of particular importance because avoiding excessive transformation of GIS data from one format to another improves accuracy and efficiency in data interoperability, and because targeting a common platform in GIS software made it feasible for the team to develop desktop-based geoprocessing tools specifically designed to aid counties in preparing data for submission.

2.1 Geoprocessing Tool Development

To support counties in achieving efficient and accurate adherence to the standards in the *V2 Submission Documentation*, the SCO developed a suite of publicly available geoprocessing tools using the ArcGIS ArcPy Module, Python 2.7, and Open Source libraries. In total, seven tools were created, and made publicly available through the V2 data submission webpage.

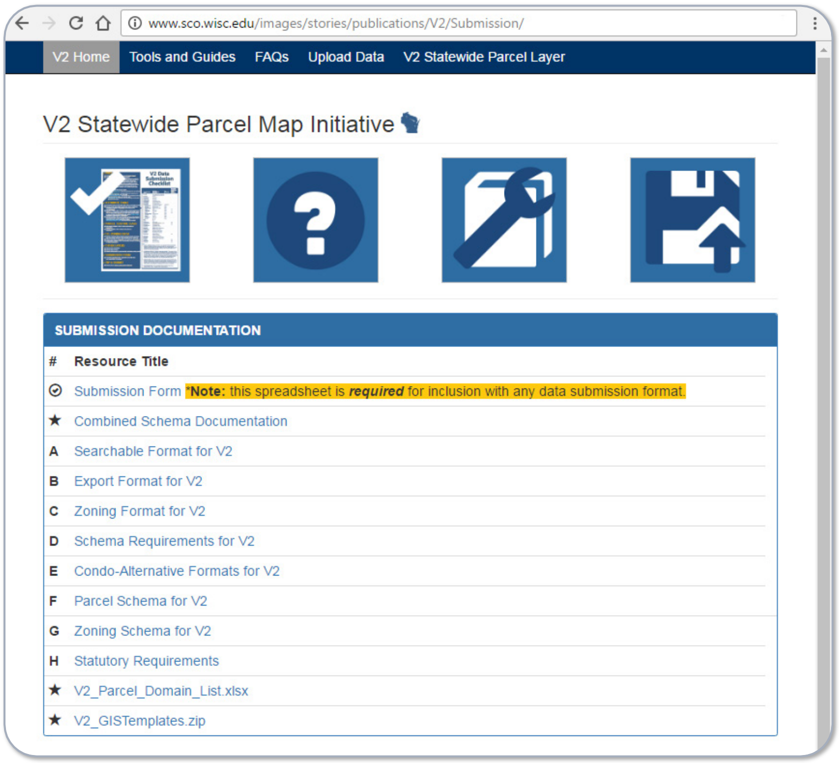


Figure 6. V2 Data Submission Webpage with Links to Schema and Tools

The tools were supported under ArcGIS version 10.1 through version 10.4, the dominant GIS platforms for local governments. Each of these tools were designed to enable efficient solutions to the most common and time-consuming problems related to preparing parcel and tax roll data to be submitted to the statewide schema. Accompanying the tools were user guides that documented how to prepare the data, run the tool, and troubleshoot if necessary.

Address Parsing Tool

Allows the user to parse site addresses from one long string into sub-address elements. Data submitters might use this tool if the county's parcel SITEADDRESS data is not available as fully parsed address elements meeting the V2 attribute schema and they would like to use the given site address data to help meet the Searchable Format.

DOR XML Parse Tool

Allows the user to translate Wisconsin Department of Revenue Tax Roll XML into a GIS table. Data submitters might use this tool if their county's tax roll data is already in DOR XML format and they would like to use that XML data to help meet the Searchable Format.

Data Standardize Tool

Allows the user to standardize a file geodatabase feature class data via the creation of a lookup table through a two-tool sequence. The first tool may be used by a data submitter to create a summary table of a field. This table would then be edited by the submitter and subsequently used as input to the secondary tool. The output of the second tool would include all original field domains as well as newly standardized domains in a new field as defined by the submitter.

Condo Stack Tool

Allows the user to model condominiums by stacking condo parcel geometries by owner. A data submitter might use this tool to model condo parcel geometries to match tax roll records with a 1:1 relationship.

Class of Property Dissolve Toolset

Allows the user to format class of property data to V2 schema definitions. This suite of tools may be helpful if a submitter wishes to reformat their class of property information so as to meet the requirements of the V2 schema definitions of PROPCLASS and AUXCLASS. This tool also handles various common formats that class of property exists as and may be helpful if the submitters data exists in one of these formats.

Null Fields and Set to Upper-Case Tool

Allows the user to format all attributes within a feature class to <Null> and upper-case. This tool may be helpful to a submitter if they wish to format their blank fields or fields annotated with a specific string to a true SQL <Null> or if they wish to set all fields to upper-case alpha characters.

Field Mapping Workflow Documentation

Allows a user to map parcel or zoning attributes to the V2 Parcel Schema. This is not a tool but rather guide that may be useful to a submitter if they have PARCEL or ZONING data formatted to the schema specifications of the V2 Project but the fields do not have the appropriate FIELD NAME, ALIAS NAME, DATA TYPE, or PRECISION.

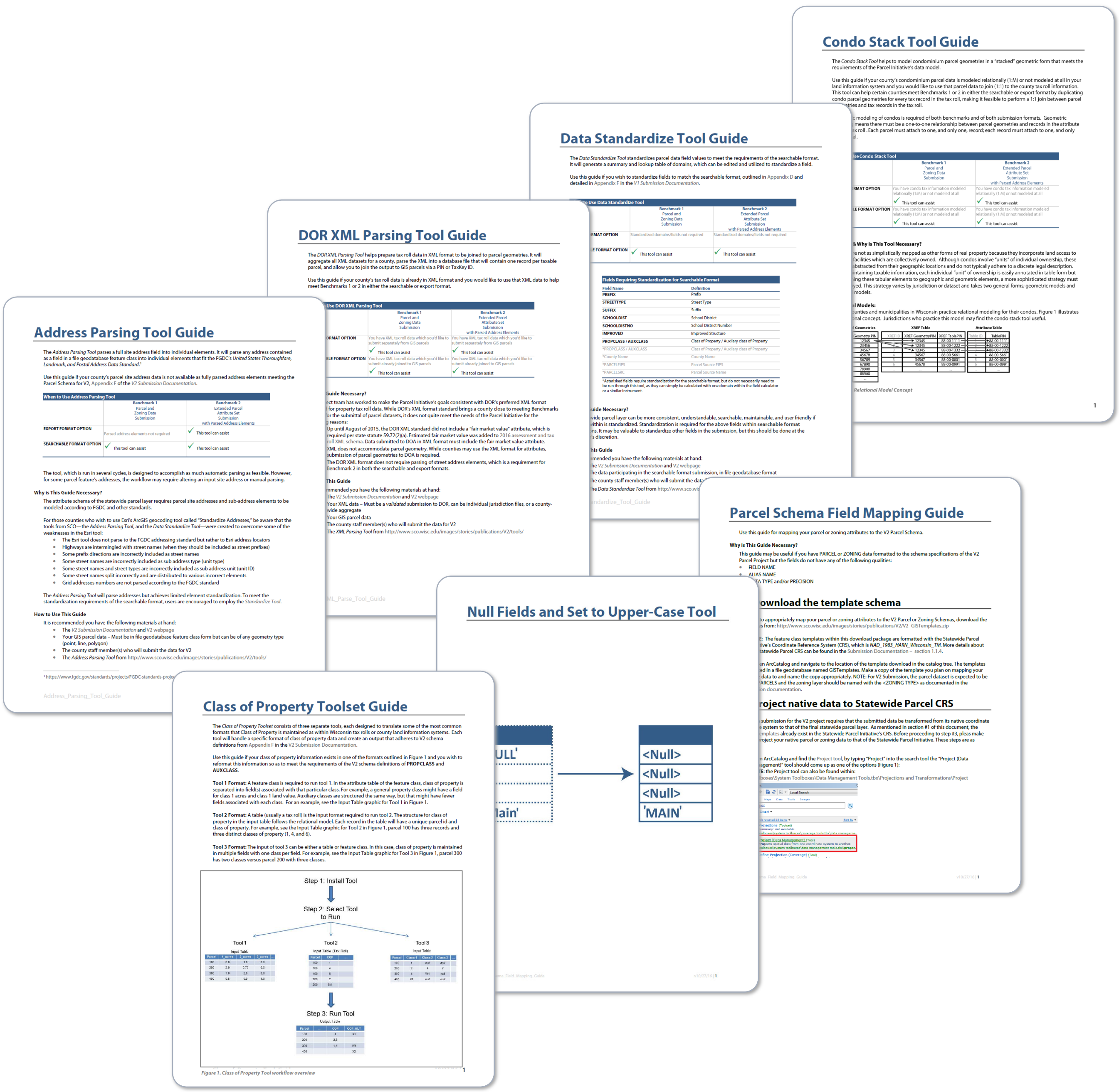


Figure 7. Tool Guides for the 7 Separate Tools Created to Assist Counties with V2 Data Prep and Standardization

2.2 Preparation and Ingest

In the data request, land information officers were asked to submit data to the Legislative Technology Services Bureau (LTSB) of the Wisconsin State Legislature, through their WISE-Decade platform. WISE-Decade is LTSB's suite of mapping tools designed to assist counties and municipalities with legislative and legal requirements as required by state statute. Some file uploads were also accommodated using UW-Madison's enterprise Box.com account through an upload widget.

The ingest phase began after the call for data. An automated email notification was sent to the project team any time a data submission to the WISE-Decade platform occurred. Once notified, SCO project staff would download the data via FTP login through Windows Explorer. After download, the data would undergo a brief inspection, was documented as submitted, and then classified within the project's file directory. Depending on the amount of data submitted at any given time, the new data would either be assessed immediately or be queued for assessment according to the date the data was received.

Also upon receipt of data, the county data directory was backed-up locally, while additional data backups were routinely made to an external drive throughout the development phases.

2.2.1 Primary Intake Assessment

Once data was copied to local directories and notes were made regarding the submission, project technical staff performed an intake assessment. This served as a way to quickly provide feedback to counties, keeping in mind that time would be needed to make any corrections to the data, so that submissions would meet the minimum requirements upon which hinged the first half of Strategic Initiative grant payments.

As a part of this primary assessment, the team performed and recorded general notes related to geometry, attribute quality, and metadata. The focus of this assessment was general and egregious oversights in data submission in order to determine if a submission met the requirements or if a data steward needed to be re-approached for missing elements.

If a county was determined to have not met the requirements, it was provided an explanation of elements to improve upon and reapproached for a secondary submission. Subsequent submissions were solicited if the secondary submission was still missing elements, which only occurred in a handful of cases.

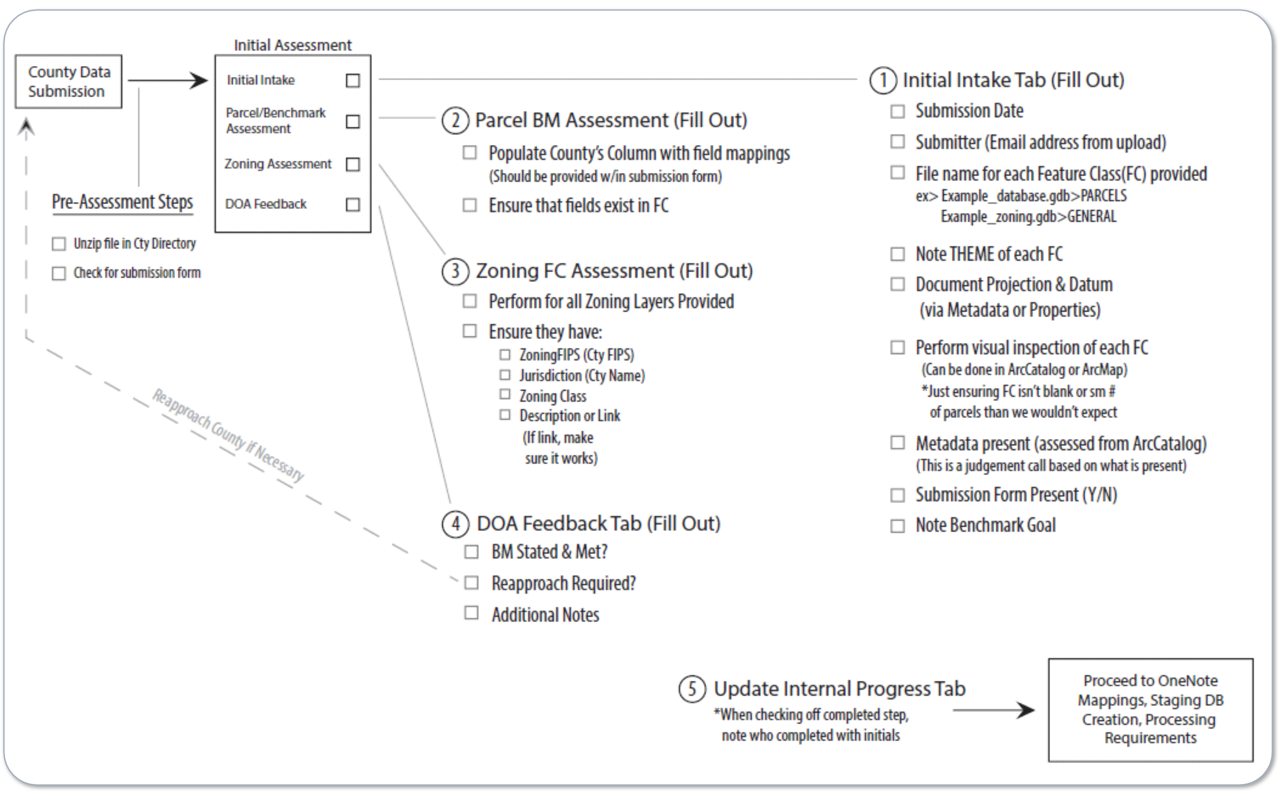


Figure 8. Primary Intake Assessment Sub-Processes

Primary Intake Assessment Documentation

All assessments were recorded in spreadsheet format and used to communicate with the project team throughout the project, as well as later in the accountability, reporting and feedback phase of the project.

The decision was made not to re-approach counties for data that could be efficiently manipulated into a usable format or manually cleaned by project staff. Instead of requesting additional data from the county in these situations, the team recorded the missing attribute data or processing steps needed. In other words, the V2 Project team—the “aggregators”—conducted work on behalf of the counties to groom the data.

The outcomes of the primary intake assessment included the following **aspects of missing or unusable data that delayed data processing**.

- **Missing Required “Submission Form.”** No Submission Form with initial submission, which is where crosswalking of attributes by data stewards occurred.
- **“Show Stoppers.”** Missing complete data files or an entire portion of the data, such as a required field.
- **Missing Tax Roll or Attributes Required by Statute.** Some municipalities were missing tax roll data or portions of tax roll data, including the City of Madison, City of Ashland, and the City of Two Rivers.
- **Unusable Data Components**, such as field(s) not standardized correctly.
- **Missing Geometries**, including municipal gaps or instances of incomplete parcel fabric.
- **Data Containing Errors**, such as data not of the appropriate vintage or not complete to the degree expected.

The project team re-approached all counties with essential missing data, making a new data request. This added significant time to the project, as following-up with counties and locating the missing data took several months in some cases. It took as many as seven months for re-submitted data to be collected, with data coming in up to the days prior to finalizing the statewide layer.

Resubmissions ranged from partial to total. Nineteen counties, or **one quarter of all counties statewide were required to re-submit data** to meet the minimum project requirements.

2.3 Geometric Gap Analysis

To identify gaps in the statewide parcel coverage where unparcelized areas exist, a manual inspection was performed on every parcel dataset submitted. If a parcel dataset was missing parcels in places where they were expected to appear, the county was reapproached for another data submission. Inspecting the completeness of parcel geometries across a given county is necessary because parcel gaps are sometimes bounded by the borders of incorporated (city/village) jurisdictions, while in other cases they are more widespread and include unincorporated areas (towns). When visually inspecting a county dataset for gaps in the parcel coverage the gaps can often be obvious and easy to pick out, appearing as distinct gaps in the GIS layer.

Missing data included cases of gaps where parcel data is maintained by a municipality but not aggregated to county-level parcels, as is the case with the cities of Eau Claire, Antigo, and Janesville. Parcel data requests were made separately to these cities.

The completeness of the submitted datasets is summarized in the tables below, including the geometric completeness of the V2 statewide parcel layer and the **8 counties who have yet to complete county-wide digital parcel mapping**. Notably, since V1, three counties completed digital parcel mapping—Clark, Marathon, and Rusk.

County	Cities With Gaps in Tax Roll Data – Called On and Included in V2 Deliverable
Ashland	City of Ashland
Dane	City of Madison
Manitowoc	City of Two Rivers

County	Cities With Gaps in Parcel Coverage – Called On and Included in V2 Deliverable
Eau Claire	City of Eau Claire*
Langlade	City of Antigo*
Rock	City of Janesville

*Note. Municipality is split by county boundary and gap exists in given county only

County	Total	Municipalities With Gaps In Parcel Coverage
Buffalo	11	Part of: Maxville (T), Mondovi (C), Naples (T), Nelson (T), Nelson (V), Alma (C), Waumandee (T), Buffalo (C), Glencoe (T), Cochrane (V), Belvidere (T), plus several very small parcel gaps in various townships
Burnett	7	Part of: Blane (T), Swiss (T), Oakland (T), Union (T), West Marshland (T), Grantsburg (T), Anderson (T)
Crawford	15	Entirety of: Bridgeport (T), Prairie du Chien (T), Prairie du Chien (C), Wauzeka (T), Wauzeka (V), Eastman (V), Lynxville (V), Gays Mills (V), Soldiers Grove (V), Ferryville (V) Part of: Eastman (T), Seneca (T), Scott (T), Freeman (T), De Soto (V)
Langlade	2	Entirety of: Langlade (T), Evergreen (T)
Marquette	6	Entirety of: Oxford (V), Montello (C) Part of: Montello (T), Oxford (T), Westfield (T), Westfield (V)
Polk	3	Part of: Sterling (T), Georgetown (T), Balsam Lake (T)
Sawyer	2	Part of: Draper (T), Winter (T)
Vernon	24	Entirety of: Sterling (T), Franklin (T), Genoa (V), Coon Valley (V) Part of: Kickapoo (T), Liberty (T), Viola (V), La Farge (V), Stark (T), Union (T), Greenwood (T), Webster (T), Viroqua (T), Jefferson (T), Harmony (T), Genoa (T), Chaseburg (V), Hamburg (V), Stoddard (V), Bergen (T), Clinton (T), Ontario (V), Forest (T), Hillsboro (T)

2.3.1 Secondary Intake Assessment

More detailed assessment notes were taken during the secondary assessment phase. In-depth assessment was performed immediately prior to and during the local-level processing phase. Upon start of processing a county submission, the technical team gathered additional detailed information on the condition of the data through summaries, statistics, and manual observations. It was through this assessment that a freeform list of directives was compiled, per county, prior to any actual data manipulation. The project team chose to use Microsoft OneNote to compile these lists of data observations and directives. OneNote offers a stable collaborative environment, with no locked files or version conflicts, while also supporting the freeform nature of annotating the various aspects of data assessment through images, tables, and organized tabs.

Notes from data assessment that were more uniform in nature were tracked within Excel spreadsheets for submission tracking. Both OneNote and Excel notes were used throughout the project to organize objectives, coordinate and track progress, report on findings, and to ultimately provide feedback to counties as an accountability measure.

2.4 Local-Level Processing

Upon the preparation and ingest of a submitted dataset, further processing was performed on attributes and, albeit infrequently, on geometries. This processing was performed so as to fit the local data to the statewide attribute schema as best possible. This processing entailed concatenating, parsing, interpreting, listing, and transposing data. In some cases, it required deleting geometric elements or stacking parcel elements so as to appropriately model condominiums.

While in theory, all Searchable Format submissions should have required no processing, **the majority of counties who self-reported an intent to submit in the Searchable Format required at least a few aspects of data cleanup**.

“Phantom geometries,” as referred to by the project team, occur when one set of polygon vertices is identical to another set of vertices resulting in Shape_Area or Shape_Length equal to zero. These geometries were removed from the statewide dataset.

Phantom Geometries

	Count
City of Antigo	1
Washburn	1
Waupaca	1
Pepin	3
Racine	5
Buffalo	6
Marquette	11
Outagamie	13
Trempealeau	22
Monroe	35
Oconto	48

2.4.1 Staging Databases

Once a county-submitted dataset was determined to be satisfactory for the project needs, a staging database was created in Esri file geodatabase (.gdb) format. At least one staging database was created per contributing jurisdiction, each including all geometric and attribute data required for subsequent phases of data processing. For counties that required significant amounts of data processing, additional staging databases were created. These were named following a semantic versioning scheme, which is beneficial when processing data so as to provide backups of the data en route to its fully processed condition.

As per the schema documentation, geographic transformations were supposed to take place on each dataset prior to data submission. If the transformation was not performed on the local-level parcel datasets, then the coordinate reference system (CRS) was transformed to the CRS of the statewide parcel layer, NAD_1983_HARN_Wisconsin_TM. In cases where it was applicable, this was accomplished using the “Project” tool from the Transformations and Projects toolset in ArcGIS.

In the *V2 Submission Documentation*, the two general formats for data submission included that of Searchable Format and the Export Format, with the Export Format being the less refined of the two. Of the 72 counties, 18 self-reported an intent to submit in export format, while 54 self-reported an intent to submit as searchable. For the 18 export format submissions, tax roll data was submitted as an auxiliary file for ten of them. These ten submissions required further processing in order to tie the tax roll information to the proper parcel geometries.

During the staging database phase, various fields of attribute information needed to be processed in order to bring the attribute data into a format that was consistent across the state. The steps taken to accomplish this varied across contributing datasets. **No two counties required the same staging procedures**. Data processing of this nature requires an experienced GIS professional with various data processing skills, as well as domain knowledge of parcel and tax roll data idiosyncrasies across the state and within the statewide schema.

2.5 Aggregation

The process of aggregating all individual county datasets began upon completion of local-level processing. After ensuring processing was complete and verifying that the final version-ed feature classes were in the Searchable Format, the final feature class of each individual county was then pushed into a statewide database. This process was applied to both parcels and zoning datasets.

In the case of parcels, the individual county parcel datasets were pushed into a "working" file geodatabase. Zoning was exported in the same fashion to the respective working databases.

Once complete, these databases contained the processed feature classes for all 72 counties. Isolating each county's individual feature class, allowed the project team to return and make alterations to a given county dataset if it was determined that further processing or a correction was necessary.

Next, a new statewide database was created to contain the merged feature class of all the individual county datasets. This database contained a single feature class called "V2_Statewide_Parcels_Merged." Aggregation of zoning data followed the same process, but the merged feature classes were contained within a single database.

2.6 State-Level Processing

2.6.1 Statewide Logic

The steps to perform statewide logic proceeded as below.

- Casting of fields from string to double
  - CNTASSDVALUE, LNDVALUE, IMPVALUE, FORESTVALUE, ESTFMKVALUE, NETPRPTA, GRSPRPTA, ASSDACRES, DEEDACRES, GISACRES
- Completion of missing SCHOOLDIST/SCHOOLDISTNO (via DPI School District Domain Directory list lookup)
- Construction of STATEID attribute for all counties
- Calculating/correcting IMPROVED attribute
- Set all attributes to upper-case
- Set all attributes be stripped of any leading or trailing whitespace and carriage returns
- Set empty strings to <Null>
- Creation of LATITUDE and LONGITUDE fields containing parcel centroid (inside) latitude/longitudes
- Creation of a parcel centroid (inside) point file containing all of the same attribute information of the parcel layer
- Various other aspects of QA/QC
  - Creation of an atypical AUXCLASS list, for data assessment purposes, with anything other than classes of W1, W2, W3, W4, W5, W6, W7, W8, X1, X2, X3, X4
  - Summary tables constructed on: PREFIX, STREETNAME, STREETTYPE, and SUFFIX

2.7 Quality Assurance/Quality Control

Again, the V2 call for data requested for the first time in WLIP history, that submitted data meet certain documented standards from the *V2 Submission Documentation*. These attribute field standards, attribute domain standards, and geometric representation standards were assessed as part of QA/QC.

2.7.1 Manual Cleanup Tasks

The cleanup tasks performed across all 74 data submitters varied extensively. Although no two clean-up tasks were the same, some common trends were observed. The following lists the **types of manual edits that were performed on the data** during the staging database phase of the project.

- **Address Element Standardization.** Standardization of PREFIX, SUFFIX, STREETTYPE, and other site address elements to V2 schema domains.
- **Address Number Cleanup.** Removal of secondary address numbers, address ranges, and in some cases, address number prefixes/suffixes.
- **Site Address Parsing.** Parsing of site address into respective element fields.
- **Mailing Address Cleanup.** Removal of excess punctuation like commas, removing addresses that only included "city, state, zip," and other mailing address clean-up.
- **Population of County Name, Parcel FIPS, and Parcel Source.** These fields were required for all submitted records.
- **Zoning Feature Class Standardization.** Pushed submitted zoning data into V2 template to remove excess fields and allow for seamless statewide integration.

- **General Data Cleanup.** Removal of property descriptors ("vacant," "unknown address," "none"), miscellaneous record corrections, and other general data cleanup.
- **Auxiliary Class of Property Values.** Mapping of provided AUXCLASS values to V2 schema domains.
- **School District Number Correction.** Addition of leading/trailing '0's where needed and stripping of leading two digits for counties that submitted six-digit codes.

The average number of elements requiring editing was approximately eight per county.

2.7.2 Data Exploration Through Summary Tables, Maps, Scripts

With the number of parcel records in the state totaling 3.47 million, it was not practical for the project team to manually verify every record. In order to validate records efficiently but accurately, as throughout the early stages of the project, the project team employed several strategies to target errors and shortfalls in meeting the statewide standard in the statewide QA/QC phase, including summary tables, maps, SQL queries, and custom script tools.

- **Summary Tables.** Summary tables, such as the tabular output provided by the ArcGIS "Frequency (Analysis)" tool, offer the ability to summarize a given attribute field into discrete domains through statistics. Identifying frequency of a domain within a field allowed the team to narrow down and isolate erroneous records, allowing corrections to be made efficiently and accurately. Other summary functions, such as the Microsoft Excel pivot table were of great value in exploring the nature of tabular data, allowing staff to efficiently analyze one or more field at a time by summarizing the relationship between the fields.
- **Maps**. Maps were of great value in identifying spatial trends in the nature of the submitted data. When analyzing a dataset, both at county and statewide levels, the project team would create maps that display attributes, typically using a choropleth scheme. Maps will display obvious trends that may be exclusive to a specific county, township, or area. Some things that would be difficult to identify when looking at tabular data become very obvious when displaying spatially.
- **SQL Queries**. SQL queries were used to isolate records that meet a certain criteria. Building SQL queries is a powerful way that the project team was able to test conditions of the data, across multiple fields. Queries of this nature could be stored and reused with only minor modification needed. Typically queries were most useful when searching for a particular condition of data within a dataset but they were also useful for general data exploration. Typically, these queries were executed in the ArcGIS environment.
- **Custom Script Tools.** Custom tools were employed in addition to the suite of public data preparation and geoprocessing tools created and distributed. These various additional tools and scripts were created by the project team to explore and validate the data. Tools were written in Python using ArcPy module and ArcGIS environment. Writing code generally takes more time to prepare in creating the tool, but has fewer limitations/barriers to achieving the end result and once complete, the tool can be easily used many times over. Tools were usually created when no other out-of-the-box solution was available for assessing the data.

2.7.3 Distribution of Data to State Agency Groups for Testing

The V2 interim database was distributed to a select number of state agencies for testing. The Wisconsin DNR Division of Forestry requested access to preliminary V2 parcel dataset information in order to include it as an input for updating Wisconsin's fire risk analysis. The interim database was also shared with Wisconsin's Legislative Technology Services Bureau before public release, allowing these agencies to provide feedback to help improve the final database.

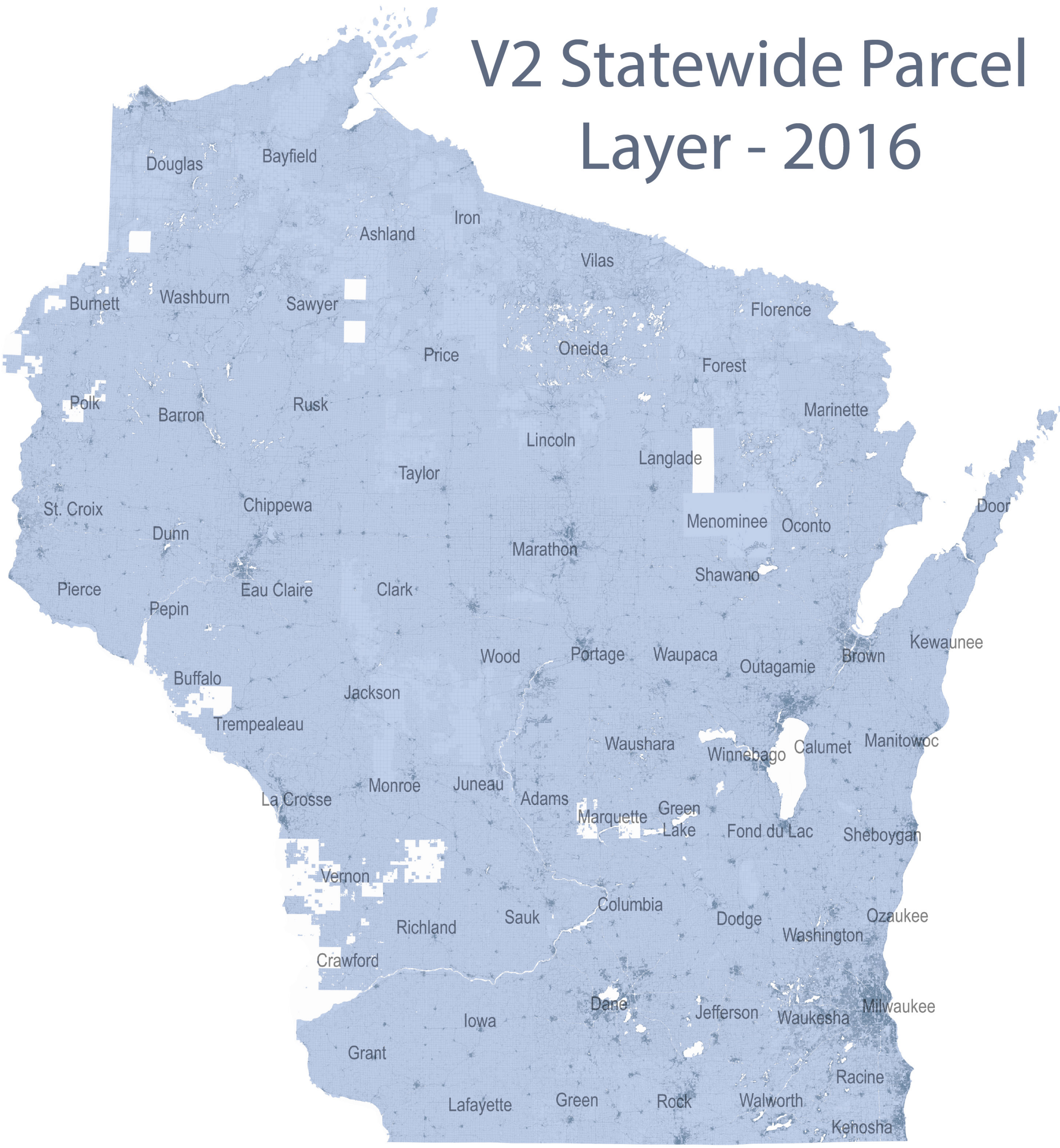
2.8 Documentation

2.8.1 Metadata, Schema Documentation, and Project Reporting

As the V2 Project was the second iteration of the Statewide Parcel Map Initiative, writing of the metadata, change log and schema documentation were approached as a revision and augmentation to the existing V1 documents. However, the V2 Project included some distinct characteristics that required a different approach to documentation than the previous parcel aggregation efforts. These include the introduction of submission standards, the introduction of Strategic Initiative grant funding tied to statewide standards, and the cumulative knowledge of the project team. The experience of team members facilitated more comprehensive and accurate data submission and aggregation due to better understanding of the parcel and tax roll landscape from a technical, administrative, and political perspective. As such, each phase of the project was documented for accountability, transparency, and for the benefit of future efforts.

2.9 Final Deliverables

The final parcel layer totaled 3.47 million parcels and is shown in Map 1 on the following page.



Map 1. Version 2 Statewide Parcel Layer Completed in August 2016

2.9.1 Final Zoning Deliverables

As defined by state statute, aggregation of statewide county-administered GIS zoning data was also an objective of the V2 Project. **Five separate zoning layers were aggregated** to best meet these requirements, each of these zoning layers includes GIS shapes of each zoning type as administered by each county.

These zoning layers include the following zoning types:

- County General Zoning
- Airport Zoning
- Farmland Zoning
- Floodplain Zoning
- Shoreland Zoning

Figure 9 illustrates the geographic coverage of the final zoning layer. Note that all five layers share the same attribute schema, which has been designed to be flexible in accommodating varying zoning types, zoning classes, and their respective jurisdictions and definitions. The statewide zoning layer downloads are available as five separate feature classes within an Esri file geodatabase.

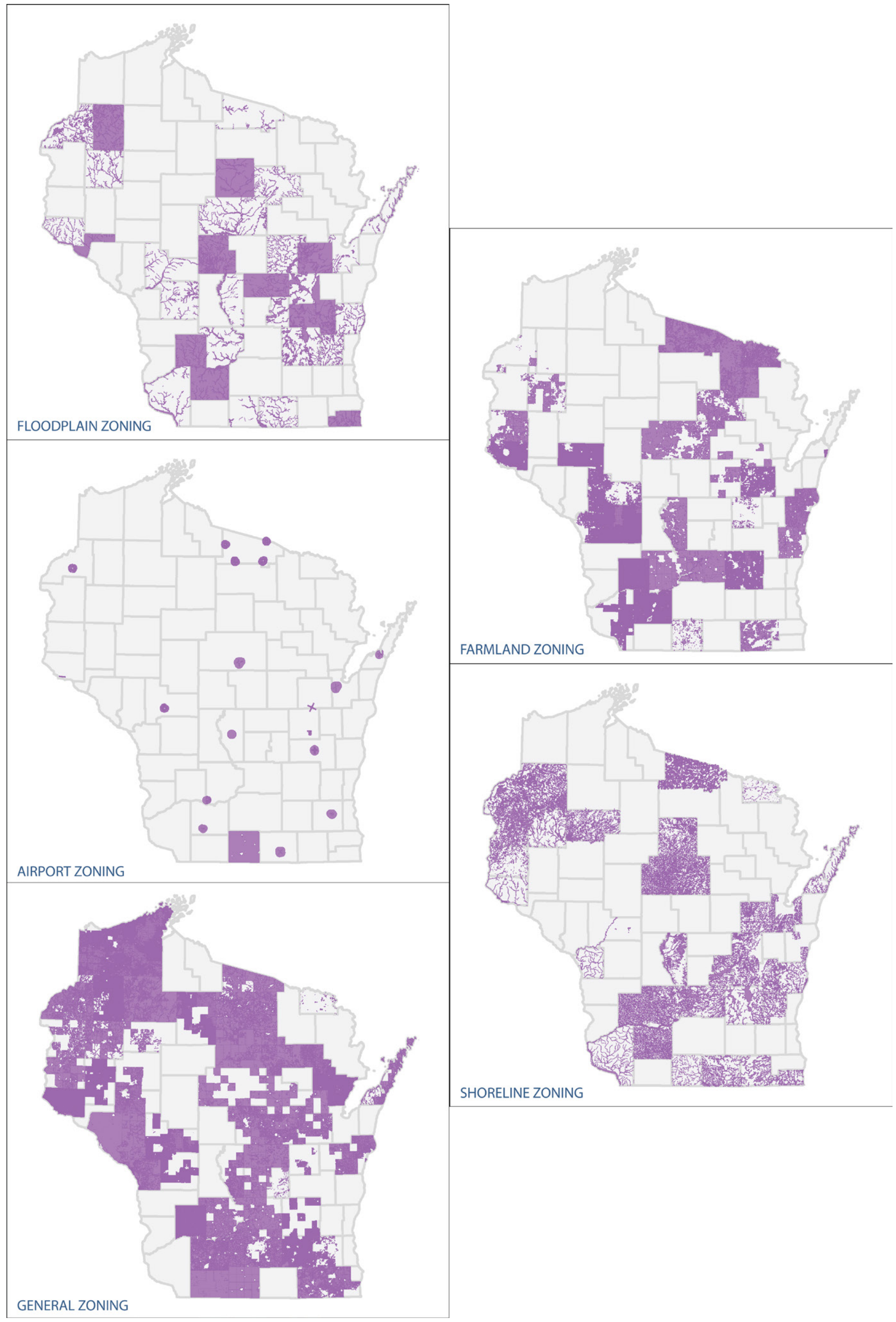


Figure 9. Illustration of Coverage of Final Zoning Deliverables

Common Zoning Terms

Zoning Type. Zoning type, in contrast to zoning class, is a more general categorical classification of zoning ordinance. While membership within a given zoning type may vary by classification breadth, jurisdiction, and definition, V2 targeted the aggregation of the five county-maintained zoning types. The V2 Project aimed to appropriately categorize native GIS zoning data within the above zoning types. While the types listed are relatively homogenous in definition, there is a degree of translation when aggregating domain-specific county data to the statewide level.

Zoning Class. Zoning class, in contrast to zoning type, is a more granular categorical classification of zoning ordinance and is categorically nested within zoning types. Like zoning type, membership within a given zoning class may vary by classification breadth, jurisdiction, and class definition. V2 did not attempt to standardize, crosswalk, or otherwise harmonize zoning classes at the statewide scale as this would denature the specificity of each class and the corresponding classification. For that reason, **the definition of each zoning class was left specific to the county which it resides within**.

3 DATA ASSESSMENT

3.1 Parcel Dataset Observations

With an eye toward accountability and in an effort to check county progress on benchmark achievement, each version of the Parcel Initiative has included assessment metrics and reports. The V2 Project included efforts to assess the quality and completeness of county datasets, as well as the V2 Project deliverables.

3.1.1 Statewide Dataset

Attribute Completeness

It is expected that significant attribute improvements against the V1 layer exist in the V2 layer, especially with relation to attribute completeness. Although the improvements were not quantified on a per-attribute basis, from the intake process and the verification of attribute completeness prior to aggregation, it could be inferred that V2 attributes are more complete.

More Complete Spatial Coverage

Improved spatial coverage was achieved within the V2 layer when compared to the V1 layer, as illustrated in the final coverage statistics. **The V2 layer represents statewide parcel coverage of 98.5%**, or 55,280 of the roughly 56,082 square miles possible.[2] The improvement can be attributed to parcel coverage, as well a few other additions:

- The inclusion of the Menominee Indian Reservation in Menominee County, a single feature that equals 356.03 square miles. The Menominee Reservation and Menominee County share nearly identical boundaries (with the area known as Middle Village being the exception), so a polygon was added to represent the area.
- The inclusion of non-parcel features, like right-of-ways and hydrography. For the V2 call for data, it was requested that counties submit road right-of-ways and hydrography (rivers, lakes, streams, marsh) as features integrated within the parcel geometry layer. The inclusion of non-parcel features added value to the layer and significantly increased the amount of measured coverage over V1.

V1 Versus V2 Spatial Coverage

	V1	V2	Additional Coverage in V2	Percent Additional Coverage in V2
Number of features	3,434,149	3,466,359	32,210 features	0.90%
Coverage (in square miles)	53,656	55,280	1,624 square miles	3.02%

3.2 County Feedback Reporting

The notes from the primary and secondary feasibility and benchmark assessment, along with general intake observations, were communicated to counties through documents called the *V2 Observation Reports*. The reports were individualized for each county, and contained observations related to the data submitted, with focus on how local data compared to the statewide schema. The *V2 Observation Reports* showed precisely how local data compared to the benchmarks for parcel data laid out in the 2016 WLIP grant application and the *V2 Submission Documentation*, evaluating how close counties came to the Searchable Format for submission of parcel data.

SCO staff documented what must be done yet to achieve the Searchable Format and thus meet Benchmarks 1 and 2 for 2017 Strategic Initiative grants. The intention was that the action items from the *V2 Observation Report* be used as a checklist to help develop and groom the county's data to meet the Searchable Format.

Figure 10 on the following page shows an example of a *V2 Observation Report*.

[2] Note that the state is often annotated to be roughly 65,497.82 square miles in size, the value recognized by US Census Bureau as Wisconsin's land area. Due to the fact that this figure includes large sections of Lake Superior and Lake Michigan, this value is significantly larger than the area of possible parcel coverage.

Version 2 Statewide Parcel Map Database Project OBSERVATION REPORT **Waukesha County**

ACTION REQUIRED TO MEET STATEWIDE SCHEMA

ATTRIBUTES

✔ PARCELID	
✔ TAXPARCELID	
✱ PARCELDATE	▪ **PARCELDATE**: Field with all the same date (12/31/2015), we assume this is the data cut date. Populate PARCELDATE with the date (MM/DD/YYYY) that best describes when the parcel geometry was last edited. With future data submissions, if date of last geometric edit is unknown, populate PARCELDATE with <Null>. For future updates to individual parcels, maintaining a modification date for the parcel geometry is advised.
✔ TAXROLLYEAR	
✔ OWNERNME1	
✔ OWNERNME2	
✔ PSTLADRESS	
✱ SITEADRESS – PARSED ADDRESS COMPONENTS?	▪ **PARSED ADDRESES**: Parse site addresses for future data submissions
✱ SITEADRESS	▪ **SITEADRESS**: Parse site addresses for future data submissions ▪ Recommend doing some cleanup prior to parsing (i.e., removal of '---' from ~5000 addresses, removal of secondary address numbers, etc.)
✱ ADDNUMPREFIX	▪ **ADDNUMPREFIX**: Populate (as component of parsed addresses)
✱ ADDNUM	▪ **ADDNUM**: Populate (as component of parsed addresses)
✱ ADDNUMSUFFIX	▪ **ADDNUMSUFFIX**: Populate (as component of parsed addresses)
✱ PREFIX – with standardized domains	▪ **PREFIX**: Populate (as component of parsed addresses)
✱ STREETNAME	▪ **STREETNAME**: Populate (as component of parsed addresses)
✱ STREETTYPE – with standardized domains	▪ **STREETTYPE**: Populate (as component of parsed addresses)
✱ SUFFIX	▪ **SUFFIX**: Populate (as component of parsed addresses)
✱ LANDMARKNAME	▪ **LANDMARKNAME**: Populate (as component of parsed addresses)
✱ UNITTYPE	▪ **UNITTYPE**: Populate (as component of parsed addresses)
✱ UNITID	▪ **UNITID**: Populate (as component of parsed addresses)
✔ PLACENAME	
✱ ZIPCODE	▪ **ZIPCODE**: ~144256 records with SITEADRESS, but missing ZIPCODE value. Populate if zip code is available in land information system.
✔ ZIP4	
✔ STATE	
✱ SCHOOLDIST – with standardized domains	▪ **SCHOOLDIST**: Field exists in submission, but is not populated. Field can be populated using processed SCHOOLDISTNO field and domains of the statewide schema. Populate this field for future data submissions.
✔ SCHOOLDISTNO – with standardized domains	
✔ IMPROVED – with standardized domains	▪ **IMPROVED**: Field exists, but is all 'NULL' ▪ Populate this field for future data submissions.
✔ CNTASSDVALUE	
✔ LNDVALUE	
✔ IMPVALUE	
✔ FORESTVALUE	
✱ ESTFMKVALUE	▪ **ESTFMKVALUE**: Value missing for ~35% of records (City of New Berlin, City of Waukesha, City of Brookfield). Per discussion with County, this was not available for V2. Please provide for future data submissions.
✱ NETPRPTA	▪ **NETPRPTA**: Value missing for ~35% of records (City of New Berlin, City of Waukesha, City of Brookfield). Per discussion with County, this was not available for V2. Please provide for future data submissions.
✱ GRSPRPTA	▪ **GRSPRPTA**: Value missing for ~35% of records (City of New Berlin, City of Waukesha, City of Brookfield). Per discussion with County, this was not available for V2. Please provide for future data submissions.
✱ PROPCLASS – with standardized domains	▪ **PROPCLASS**: Field contains a value of 'F6' for ~8 records. It is unclear what this code maps to. Map to statewide schema domains for future data submissions.
✱ AUXCLASS – with standardized domains	▪ **AUXCLASS**: ~2 records with value = 'F8.' No domain value mapping provided in submission form, so codes left as is for statewide V2 database. Populate AUXCLASS field according to statewide schema specifications for future data submissions.
✔ ASSDACRES	
✔ DEEDACRES	
✔ GISACRES	
✔ CONAME – with standardized domains	
✔ PARCELFIPS – with standardized domains	
✔ PARCELSRC – with standardized domains	

PARCEL FEATURE CLASS

- ✔ Projection met statewide schema
- ✔ County parcel fabric was complete (lacked gaps)
- ✔ Condo modeling met statewide schema

CO. ZONING DATA

✔ County general – with attributes	
✱ Farmland preservation – with attributes	▪ Submit zoning data as a GIS layer according to statewide schema (lowest priority)
✱ Shoreland – with attributes	▪ Submit zoning data as a GIS layer according to statewide schema (lowest priority)
✱ Floodplain – with attributes	▪ Submit zoning data as a GIS layer according to statewide schema (lowest priority)
✱ Airport protection – with attributes	▪ Map data to statewide zoning schema template, to remove excess fields and allow for seamless integration at statewide level.

SUBMISSION FORM

- ✔ Submission form provided with initial submission

MISCELLANEOUS

- Your efforts to standardize your data to the statewide schema are appreciated.
- Thank you for sharing your data to help make the V2 Project a success!

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Figure 10. Example of V2 Observation Report

3.2.1 Common Observation Report Findings

The table below shows a summary of how well the counties met the statewide schema, with figures based on a total of how many counties had comments in the *V2 Observation Report* noting that action was needed in order for their data to meet the specifications of the Searchable Format.

Statewide Observation Report Stats	Percent of Counties That Failed to Meet Statewide Schema*
ATTRIBUTES	
PARCELID	4 %
TAXPARCELID	1 %
PARCELDATE	56 %
TAXROLLYEAR	10 %
OWNERNME1	1 %
OWNERNME2	0
PSTLADRESS	43 %
SITEADRESS – PARSED ADDRESS COMPONENTS?	3 %
SITEADRESS	26 %
ADDNUMPREFIX	17 %
ADDNUM	49 %
ADDNUMSUFFIX	24 %
PREFIX – with standardized domains	26 %
STREETNAME	47 %
STREETTYPE – with standardized domains	51 %
SUFFIX – with standardized domains	21 %
LANDMARKNAME	11 %
UNITTYPE	22 %
UNITID	31 %
PLACENAME	15 %
ZIPCODE	82 %
ZIP4	11 %
STATE	15 %
SCHOOLDIST – with standardized domains	11 %
SCHOOLDISTNO – with standardized domains	26 %
IMPROVED – with standardized domains	25 %
CNTASSDVALUE	10 %
LNDVALUE	4 %
IMPVALUE	4 %
FORESTVALUE	6 %
ESTFMKVALUE	10 %
NETPRPTA	10 %
GRSPRPTA	8 %
PROPCLASS – with standardized domains	19 %
AUXCLASS – with standardized domains	28 %
ASSDACRES	3 %
DEEDACRES	3 %
GISACRES	1 %
CONAME – with standardized domains	10 %
PARCELFIPS – with standardized domains	8 %
PARCELSRC – with standardized domains	10 %
PARCEL FEATURE CLASS	
Projection met statewide schema	26 %
County parcel fabric was complete (lacked gaps)	13 %
Condo modeling met statewide schema	24 %
CO. ZONING DATA	
County general – with attributes	26 %
Farmland preservation – with attributes	42 %
Shoreland – with attributes	64 %
Floodplain – with attributes	53 %
Airport protection – with attributes	42 %
SUBMISSION FORM	
Submission form provided with initial submission	15 %

**Note. Number indicates percentage of counties who had content validation comments denoting shortfalls in meeting statewide schema (not the number of records.) Source data is V2 Observation Reports. Every attempt was made to document all items necessary to meet the Searchable Format, however, the V2 Observation Report data may not be exhaustive.*

OWNERNME1 – Redaction of Owner Names

For the owner name attribute, some counties redacted owner names. Partial owner name redaction was conducted by five counties, while two counties—Kenosha and Outagamie—withheld all owner names, consistent with a local county board resolution. However, this was an improvement compared to the V1 database, in which 22 counties did not permit owner name display in the V1 statewide layer.

V2 Owner Name Redaction	
Columbia	Partial
Dane	Partial
Kenosha	Entire county dataset
Oneida	Partial
Outagamie	Entire county dataset
Sauk	Partial
Vilas	Partial

OWNERNAME1 – Annotation of Owner Names

The statewide database it is evident that parcel owner names are not uniform. Some may or may not include middle initial. Some order first then last name, or vice versa.

- Based on how the native data is maintained, owner name can take many possible formats:
    - JOHN SMITH
    - JOHN R SMITH
    - SMITH, JOHN R
    - JOHN R & SUE SMITH
    - JANE, JOHN & SUE SMITH
    - SMITH, SUE & JOHN
    - Other(s)

The V2 schema did not require standardization of the order or format of owner names.

PARCELDATE

Across the state, 56% of counties had a shortfall in how they populated parcel date. For many counties, no attribute is maintained that denotes the date of geometric editing, resulting in a value of <Null>. In other cases, this field was populated with a value that reflected the “cut date” or date the data was extracted for submission. In the *V2 Observation Reports*, counties were advised to: “Populate PARCELDATE with the date (MM/DD/YYYY) that best describes when the parcel geometry was last edited . . . . For future updates to individual parcels, maintaining a modification date for the parcel geometry is advised.”

SITEADDRESS

SITEADDRESS was populated incorrectly in 26% of counties. In most cases, this was due to “city, state, zip” being attached to the end of the street address. Other common mistakes were the presence of partial site addresses (only STREET and STREETTYPE), and in a few cases, the existence of address number ranges or multiple address numbers. The schema advises that when a true site address does not exist, the field should be populated with <Null>.

A larger issue was that the SITEADDRESS field is meant to be a concatenated field comprised of individual parsed address elements. However, the *V2 Submission Documentation* was confusing in this regard, offering that counties could submit full physical address “as-is.” Therefore, the SITEADDRESS field was typically not comprised of individual address elements with standardized domain types.

One example of challenges related to un-standardized site addresses occurs with highway annotation. Highway annotation (county, state, and U.S.) varies from one county to the next.

- Highway annotation can take many possible formats in the statewide database:
    - COUNTY HIGHWAY
    - CO RD
    - COUNTY HWY
    - STATE HIGHWAY
    - STATE HWY
    - US HIGHWAY
    - USH
    - CTH
    - COUNTY TRUNK HIGHWAY
    - CTY RD
    - STATE ROAD
    - STH
    - US HWY
    - Other(s)

Again, this is how the native data is maintained. The V2 schema *did* require standardization of STREETTYPE, however, the that counties that did not concatenate to arrive at SITEADDRESS may have had un-standardized street types—such as highways—in the street type.

In other words, while the individual site element fields may have been standardized, that did not necessarily mean that SITEADRESS was standardized. In other words, SITEADRESS would have had to been created via concatenation *after* individual address element had been broken out and had standardization applied to domains. In most cases, this did not occur. This is also noteworthy because the *V2 Observation Reports* did not point out this error for those counties who engaged in the practice of submitting unstandardized data for full physical address.

STREETNAME
In nearly half of all cases, the STREETNAME field did not meet the requirements of the Searchable Format. Most often, this was the result of PREFIX values still being attached to this field (e.g., CTH, STH, etc.) or STREETTYPE values still being attached. Also, some counties had extraneous information attached to STREETNAME, such as building descriptors.

ZIPCODE and ZIP4
With 82% of counties not providing complete ZIPCODE and thus the vast majority also not providing complete ZIP4, zip code elements were the two most sparsely populated attributes in the V2 parcel dataset. There are a few reasons behind these poor return rates. Zip codes are address elements that are not necessarily assigned by an addressing jurisdiction, such as a county or municipality. They may be inferred by a county or municipality but not created or assigned. Instead, the zip code is assigned to an address by the postal service and it directly aligns with the business purposes of the US Postal Service. The first digit of a zip code designates a state, the second two digits designate a USPS Sectional Center Facility (which are processing and distribution centers), and the final two digits designate a section of a municipality or town. In addition, not all addresses in the United States have had a zip+4 assigned to them, and zip codes and zip+4 can change at the will of the USPS.

Note that zip code is not commonly maintained with site address. Site address is used for the purposes of addressing on-site parcels, and indexing properties in a local jurisdiction. Site address is not necessarily intended for mailing purposes. If counties do have a zip code with the site address, it was likely created as a look-up or merge from the USPS list of zip codes.

Tax bills go to the parcel owner's "mailing address," wherever it may be on the globe. This is one likely explanation why zip code was not populated by most counties for V2.

PLACENAME
The V2 schema asked for a more granular and more detailed placename—the authoritative jurisdiction the parcel belongs to—than the postal placename. Like zip code, postal place name serves the business uses of the USPS, as it is related to USPS service area. In asking the for the jurisdictional placename for V2, the data submissions were actually a mix of both postal and jurisdictional placename.

SCHOOLDIST AND SCHOOLDISTNO
Together, 37% of counties did not meet schema specs for school district attributes. Many did not include the leading zero(s) on school district codes, which is necessary per the schema specs. In other instances, a six-digit value was provided, that required the leading two digits be stripped, in order to meet the schema specs.

DATASET PROJECTION
Across the state, 26% of counties submitted data in a projection other than that identified in the schema specs. Most often, this was a result of submissions being in the county's native projected coordinate system (PCS). In a select number of cases, counties pushed their data into the parcel schema template available for the project, but did so without re-projecting the data first. This resulted in datasets that appeared to be within the appropriate PCS based on the metadata, but upon visual inspection, it was apparent they were not and required re-projecting.

Perfect Match to the Searchable Format
Only one county, Barron County, submitted data that exactly matched the Searchable Format. Marinette County also matched the Searchable Format correctly, but they noted with their submission that they did not have ZIPCODE and ZIP4 associated with each parcel.

3.3 Zoning Observations

3.3.1 Zoning Observations
The V2 Project established a precedence for aggregated statewide county-administered zoning layers as publicly available statewide layers. Because this was the first such attempt it was somewhat of an exploratory exercise.

While there is a statewide inventory of county general zoning and shoreland zoning ordinances from 2011, there is not a current, comprehensive listing of the five types of county zoning ordinances. If a county zoning ordinance was not submitted, it is due to the fact that it does not exist or is not available in GIS format. County land information offices are an authoritative resource for current information on county-administered zoning. If a zoning ordinance does not exist or was not in GIS format, the county was instructed to report this on its data submission form.

Zoning Aggregation Project Timeline

- Act 20 specified that "any zoning information maintained by the county" should be aggregated with the ability to relate this information to individual land parcels per s. 59.72(2)(a)2.
- The V1 Project called for county-administered zoning data with the V1 call for data on October 23, 2014.
- Zoning submissions were received from 44 counties.
- The V1 Project team assessed the data and identified:
  - The nature of **county-administered zoning types: Airport Protection; County General Zoning; Floodplain; Farmland Preservation; and Shoreland**.
  - Zoning schemas, zoning types, and zoning classes were studied to understand the least common denominators for a schema to aggregate these types statewide.
  - It was determined that zoning types do not conflate, as zoning types vary by definition. Zoning classes also vary by definition. Therefore, no two zoning layers are compatible across county boundaries.
  - Found that only some zoning layers are built from parcel boundaries, others follow natural features and are typically much larger than a single parcel.
- Based on assessment, a simplified schema was proposed for defining parameters under which counties could submit zoning data to V2.
  - Details were first published in the *V1 Interim Report*. The *V2 Submission Documentation* specified how counties were to submit county-administered zoning for V2.

V2 Zoning Data

- Participation and submission coverage
  - Not all counties administer all five zoning types, some administer all, some administer some, some do not administer any.
  - Even counties that administer zoning may not have the zoning as GIS files, or the GIS files may not be up to date.
  - Without an authoritative list of county zoning ordinances, V2 has no precedent to compare submission expectations against.
- V2 zoning schema
  - Schema that was deliberately flexible and simple so as to be able to accommodate to the varying nature of the five zoning types requested.
  - It was expected that no two zoning layers would be the same, thus presenting a challenge to maintaining accuracy and the authoritative nature of the zoning layers while aggregating to a seamless statewide layer.
  - The attribute schema is the same for all five layers and includes the following attributes: ZONINGFIPS, JURISDICTION, ZONIGCLASS, DESCRIPTION, and LINK.
  - The key to the zoning schema lies in the DESCRIPTION and LINK fields. It was determined unfeasible to accurately domain map zoning classes across jurisdictions (e.g., "G1" may mean something completely or slightly different in two different counties, and thus these classes are not compatible across county lines). One of the two DESCRIPTION or LINK fields were required for submission. Each of these fields accommodate the description of a given zoning class in the context of the specific jurisdiction that it serves, giving the user access to accurate zoning definitions statewide.

Common Zoning Challenges

- Counties who submitted "inverse" zoning layers, layers that covered everything that was *not* said type of zoning.
- Across all types:
  - Including more fields than what schema called for—in some cases this might have been due to counties not being able to rationalize cross-categorized features.
  - Jurisdiction being populated with the jurisdiction of the area, not the zoning jurisdiction/zoning authority (in the V2 case, the only possible jurisdiction was the county).
  - LINK field containing link to general zoning page, as opposed to zoning type-specific documentation.
  - ZONINGFIPS field requiring minor alterations to meet the V2 requirements.
  - Existence of useful information in non-V2 zoning fields that were moved into the description field.
    - e.g., 'Body of Water' + "Setback" + 'setback'
    - e.g., "Height Limitation: " + 'height_limitation' + "FT"
  - Zoning feature classes submitted in projection not meeting the Searchable Format requirements.
  - Single submitted zoning layer containing multiple zoning feature classes requested.
    - e.g., single zoning feature class containing both GENERAL and SHORELAND zoning
  - Required attribute fields needing to be created and populated by the project team since not provided upon submission.
  - Processing of FEMA floodplain zoning attributes required in order to meet the Searchable Format.

4 DATA DISTRIBUTION

4.1 Database Download Webpage

The data was distributed via two primary means: a website with download links and a web-based mapping application. The V2 database was formally released to the general public on August 31, 2016, through the DOA land information email listserv and the V2 database download webpage.

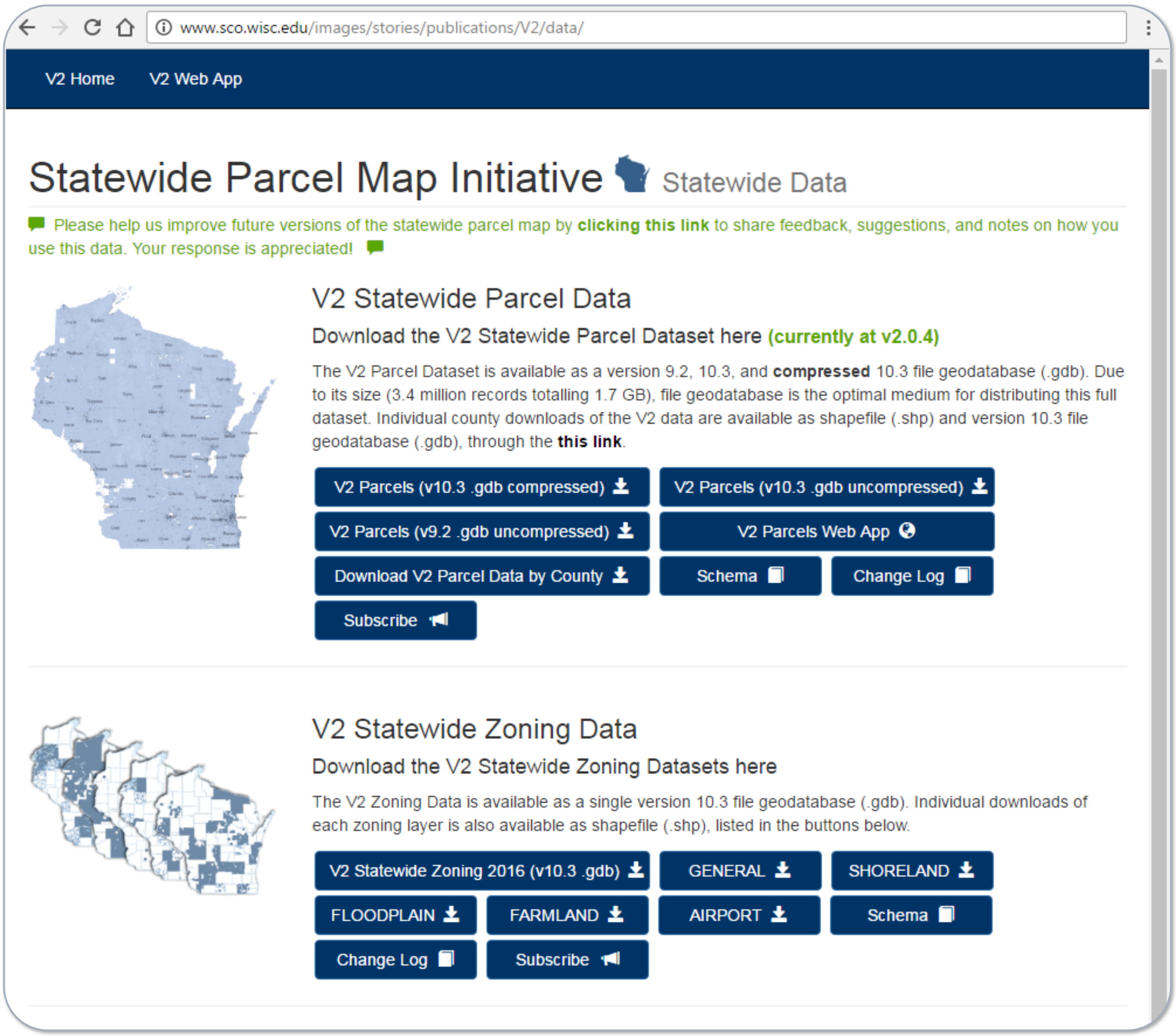

Figure 11. V2 Database Download Webpage

4.1.1 Webpage Improvements From V1 to V2

The webpage was built for the purpose of having more flexibility hosting the data, compared to the V1 distribution pages. The product of the V1 Project was hosted on ArcGIS Online, and while this was a very successful means for distributing the data, there were several shortfalls to this distribution mechanism. The following improvements were targeted through the V2 Project's custom data distribution site.

- **Centralized and Organized Data Downloads.** As the second iteration of the project, the V2 deliverable included several separate V2 downloads, a legacy V1 layer, and could look forward to subsequent statewide parcel databases to distribute in the future. With multiple distributable databases, it is important to organize and centralize all database downloads in one common place. The new data distribution page offers legacy downloads, V2 zoning downloads, and the V2 parcel downloads all in one location. Centralizing these resources also becomes useful in efficiently routing users to the particular file format and extent of data that the user seeks.
- **Project Branding.** Creation of a custom distribution site offered the opportunity to brand the site in a consistent manner to the rest of the project's resources. This is valuable to return users who expect consistency in procuring data. It is also important for general project public relations, offering a mechanism for gaining exposure to the geospatial community as well as the general public, as with the corresponding web application.
- **Memorable URL.** A memorable URL benefits the user by making it easier to find the data they are looking for. For V1, publicly distributed data was posted to generic cloud directories that inherently incorporate long, incomprehensible URLs. The V2 data distribution webpage and app are shorter and more intuitive.
- **Google Analytics for Webpage.** To target more granular download and usage data, the project team engaged Google Analytics on the distribution page. Google Analytics will offer the ability to understand the geographic distribution of users; number of downloads; time and date at which downloads take place; download type (file format, county downloaded, parcel version); browser and platform of user; and return users.
- **Analytical Granularity of User Statistics.** Across the five separate formats that were offered, the V1 layer received a total of 3,625 downloads in its first year of public distribution. According to ArcGIS Online, the data distribution site for the V1 layer, public downloads for V1are broken down as follows:

V1 Usage Statistics	Number of Downloads	
V1.0.0 (10.2)	1,085	since 07/28/15
V1.0.1 (10.2)	2,071	since 08/26/15
V1.0.1 (10.2–Uncompressed)	247	since 09/29/15
V1.0.1 (9.3)	1	since 10/13/15
V1.0.1 (9.2)	221	since 09/01/15
Total	**3,625 Downloads**	

Averaging about 10 downloads per day and almost 4,000 downloads in the first year it was offered, these numbers speak to the utility of the Wisconsin statewide parcel layer. However, the V1 app did not permit the collection of detailed end-user data. Knowing more about the users who are downloading the data for V2 and in the future will offer the opportunity to recognize patterns across consumers and help drive improvements.

4.1.2 Database Distribution Formats

The V2 parcel layer is available in several different formats, each targeting a specific type of user in the geospatial community and the general public. The data distribution page offers parcel data in ArcGIS 10.3 compressed and uncompressed formats, as well as ArcGIS 9.2 file geodatabase, and county shapefile formats.

ArcGIS File Geodatabase

The file geodatabase (.gdb or fgdb) is one of the most ubiquitous GIS formats in use today. It is a proprietary database format developed by Esri, however, an ever increasing level of support for the format is becoming natively incorporated into open source and proprietary GIS software. While some counties and municipalities in the United States still use CAD formats to model cadastral information, this practice is waning. Most of Wisconsin's 72 counties submitted their data in file geodatabase, with a few submitting in shapefile format.

The file geodatabase is able to handle massive amounts of data in comparison to some other GIS formats. This is a significant issue for the statewide parcel layer, as **the data amounts to roughly 1.7 GB in uncompressed size and totals 3.47 million records**. Because of its popularity, software support, performance, and ability to handle massive amounts of data, the file geodatabase was chosen as the best format for public distribution. There were three variations made available for different types of user.

- **Uncompressed Version10.3 File Geodatabase.** At the time of V2 data release, the Version 10.3 file geodatabase was known to be the most common and stable version of the .gdb in use. Version 10.4 file geodatabase was the most contemporary format available at the time of the data release, however it is conventional to not follow too closely behind a data format release, as bugs and patches have yet to be established. This format was released to suit most users.

- **Compressed Version10.3 File Geodatabase.** This file format is the exact same Version 10.3 format as that of the uncompressed version. However, applying compression to the .gdb reduces the size of the downloadable file from a 764 MB zipped file to a 529 MB zipped file. The compressed version offers slight performance improvements in some ArcGIS operations but slows slightly over other types of operations. The compressed file geodatabase is read only, but it can be uncompressed using ArcGIS software. Because there are no known open source software packages for uncompressing .gdbs, uncompressed formats were also offered.
- **Uncompressed Version 9.3 File Geodatabase.** This file format is very similar to the Version 10.3 uncompressed format. However, 9.3 is a legacy .gdb format that is intended to support users of legacy software or other software that are not yet compatible with version 10.X file geodatabases.

Shapefile

Like the file geodatabase, the shapefile is one of the most ubiquitous and popular GIS data formats, especially amongst county and municipal land information systems. In contrast to the file geodatabases, the shapefile is more interoperable and is well supported in most open source or proprietary GIS applications. For this reason the shapefile could be considered the GIS industry standard. However, the major limitation to the shapefile format is that file size cannot exceed 2 GB for any of the files that the shapefile is comprised of. Due to the way shapefile features are encoded, the V1 and V2 statewide layers would exceed 2 GB in size if they were exported to shapefile, making it unfeasible to distribute the entire statewide parcel layer as a shapefile.

On the contrary, it was both possible and desirable to distribute individual county shapefiles, which have smaller file sizes. Based on user feedback from V1, **the V2 statewide layer was made available as 72 individual county packaged files** in both shapefile and 10.3 uncompressed format at the county section of the V2 data download webpage.

4.2 Web Application

Development of the V2 web application followed suit with the technology used in developing the V1 web application—Web AppBuilder for ArcGIS. In contrast to the V1 app, however, the V2 app design reflected both functional and cosmetic updates implemented via Web AppBuilder, with added value through custom coding.

As a GIS layer and application covering the entire state of Wisconsin, functionality for displaying and querying parcel data at statewide and regional levels—in addition to county and neighborhood levels—was important. Due to the sheer amount of data in the parcel layer, a unique strategy had to be employed to provide users with a seamless, fluid, and cost-effective experience at all map levels. While there is a well-established precedent for implementing parcel viewing and querying apps at smaller-scale levels (e.g., Dane County's interactive web map, DCiMap), statewide and regional apps displaying millions of records are relatively uncommon, presenting technical hurdles due to size limitations.

4.2.1 App Tile Specs

Until the recent and rapidly growing popularity of the "vector tile" spec, it has been generally considered unfeasible to render millions of parcel geometries in a browser. At the time of the development of the V2 app, the Esri vector tile spec was showing signs of maturity and readiness for use as a solution to the challenge of displaying millions of parcel records. Although it was not ultimately employed, the project team first designed a test app around the vector tile spec.

Vector Tile Application Model

- **Vector Tile Layers In Lieu of Raster.** A vector tile parcel layer would be used in the web app in lieu of a raster tile layer as the "viewable" parcel elements in the app. The benefit to using vector tiles instead of raster tiles is that they are quicker and easier to produce, they offer more dynamic styling capabilities, and they offer smoother zoom transitions within the web app.
- **Feature-Click Functionality with Invisible Raster Layer.** An invisible raster tile layer would be engaged in the background in order to achieve feature-click functionality. ArcGIS Online offers the functionality to tie a raster layer to a feature service so that a user can click on screen and retrieve the features (parcel records) that correlate with the given lat/long of the click. However, this functionality is not available yet with the Esri vector tile spec. Creating an invisible raster layer enables this functionality using a sort of hybrid approach. The project team termed this type of layer a "ghost layer" because of the nature of the tiles it contains, 100% transparent .png map tiles, which are very small in size due to the fact that they contain essentially no information.
- **Web Feature Service.** Finally, the feature service was provided by Wisconsin's Legislative Technology Services Bureau as an ArcGIS REST Feature Service. This element provides the underlying database and

query capabilities, so that the application can request sections of millions of parcel records on the fly and provide the user with only the records they are seeking.

The vector tile application model had impressive functionality in most contexts. The exceptions, however, proved serious enough that the vector tile model was not pursued. Upon browser, platform, and mobile testing, the team uncovered problems from within contemporary versions of Internet Explorer, Chrome browser on Android, and Safari and Chrome implementations on iOS (iPhone and iPad).As an alternative solution, the project team chose to pursue the application model employed under the V1 application. This strategy—the raster tile application model—was implemented in the V2 app.

Raster Tile Application Model

- **Raster Tiles.** A raster tile layer was created that displays parcel geometries from level 7 (view of Midwestern region of the Unites States) through level 17(neighborhood-level view). This layer is responsible for achieving the "viewable" parcel elements, replacing the functionality of the vector tile layer. It also achieved the feature-click capabilities mentioned above, replacing the need for a ghost layer.
- **Web Feature Service.** The feature service, an ArcGIS REST feature service provided by Wisconsin's Legislative Technology Services Bureau, functions in the same manner as with the vector tile application model. It provides the underlying database and query capabilities.

4.2.2 Improvements from V1 to V2 App

In contrast to the V1 app, the V2 app targeted some additional aspects that were left out of the V1 app. In most cases, elements were left out of the V1 app owing to a lack of support for such functionalities through ArcGIS Online's Web AppBuilder. In order to better customize elements and to add custom functionality, the project team pursued a custom deployment. **Through the custom option, the Web AppBuilder code was downloaded, altered, added to, and then deployed on a local server**. Web AppBuilder offers the capability for a user to begin their app within the Web AppBuilder interface and then export the app to JavaScript, HTML, CSS, and other supporting web standard files.

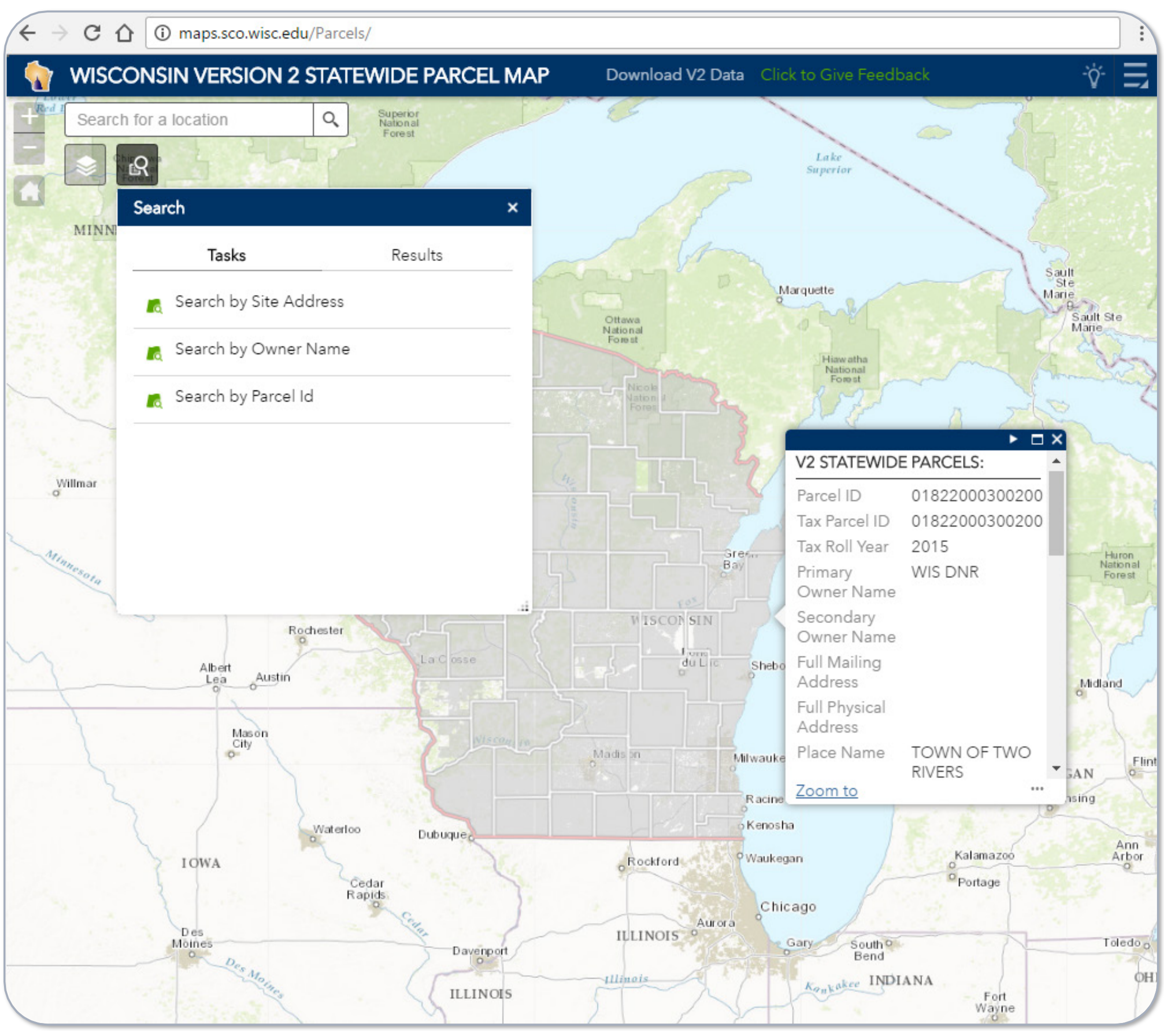

Figure 12. V2 Web App

V2 Web App Customizations

By following the raster tile application model with customizations, the project team was able to establish a web app code base with the majority of critical functionality, as well as several aspects of added value.

- **Cosmetic Improvements.** Various cosmetic items, such as color, size, and other aspects of HTML element appearance, which better fit the app to the branding of the project.
- **More Intuitive Layer List.** Presenting the user with only one layer button for each of the two layers (raster tile, and feature service) used to implement the raster tile application model, even though there is no direct way of combining these layers in Web AppBuilder. Through custom code, the project team was able to efficiently combine these elements in the layer list for all layers available (V1 and V2 parcels, along with county-maintained general zoning, farmland preservation, shoreland, floodplain, and airport protection zoning).
- **Table View of Attributes.** The "table view" is a powerful and useful new module added to Web AppBuilder in the last year, the project team intended to use this feature but determined it unfeasible to expect this feature to work at scales larger than county-level. With custom code, the feature was able to be turned off when viewing the statewide parcel layer at smaller or more regional scales.
- **Google Analytics for App.** The project team was able to engage some Google Analytics code on elements of the application. Engaging Google Analytics allowed the team to track and learn how users engage with the application, identify popular characteristics, and ultimately posture the app for improvements.
- **Custom Domain.** By downloading the application's source code the application was able to be deployed on a custom domain and path, maps.sco.wisc.edu/parcels, in contrast to the less desirable URL at which the V1 application was located.
- **Search Parameter and Search Scope Optimization.** The default functionality for Web AppBuilder was altered for improved functionality, as described below.

Search Optimization

The default functionality for Web AppBuilder offers the option to execute attribute searches across the entire statewide dataset by engaging the parcel web feature service (WFS) through Web AppBuilder's "Query" widget. Again, due to the large size of the parcel layer, modifications were needed to optimize the performance of the query widget after determining that search results were less than acceptable due to high failure and query timeout rates.

- **Search Performance Testing.** To establish a baseline to the search performance, the project team executed a series of automated tests against the web application in order to collected performance statistics on the widget. The automated tests, written as a Python script with use of the Selenium Python binding, traversed the V2 webpage in a manner that emulated a user's exact actions. The script opens a browser instance and clicks or enters text on the appropriate elements, thus collecting results as if a user were doing it themselves. This strategy allowed the team to collect adequately sized samples quickly and with less human error or other variation. The assessment compared two different search strategies, one using the "current extent" parameter for spatial filter in the query and the other using the "full extent" parameter for spatial filter in the query.

V2 App Search Performance

	Sample Size	Mean Accuracy Rate
Full Extent	2,066 samples	100%
Current Extent	1,662 samples	89%

Note. Queries each used 50 samples chosen at random of OWNERNAME1 records known to exist in the V2 dataset. A statistical t-test confirmed this was not due to chance.

- **Current Extent Parameter** queries the WFS using a spatial envelope which is defined by the map extent of the user's browser, so, if a user is zoomed into a neighborhood in Wisconsin, then only that very neighborhood will be included in the search.
- **Full Extent Parameter**, in contrast, always searches against the spatial extent of entire V2 parcel layer and does not use a spatial envelope. The selenium tests supported that the inclusion of a spatial envelope in the query added overhead to the query. The spatial envelope directly correlates with degradation of query performance when searching at regional or statewide scales. Thus, there is a scale threshold at which the current extent option is actually is better, meaning faster yet still reliable). This threshold is determined by parcel density for a given area and varies across the state.
- As a result of testing, some modifications were made to the application:

- Full extent made the default search parameter upon page load.
- Removed user's ability to choose between current and full extent until scale threshold is passed.
- Scale threshold determined to be optimal at zoom level 10.
- Code implemented to automatically toggle between full extent and current extent when the zoom threshold is crossed by the user. This provides the user the option of choosing full or current extent when viewing the map at about county or larger zoom scales.

4.2.3 Limitations of V2 Web App

The V2 web app allows a user to search for parcels across the entire state rather than having to visit 72 county websites, as well as some city websites. The one point of access and one website to learn and navigate provides a large advantage for consumers of parcel data who do not need as comprehensive and current of information as provided on county websites.

However, because the V2 web app is searching through millions of parcel records statewide, it operates much slower than the typical county website parcel search tool. Also, the V2 web app search function is not as "fuzzy" as most county interactive parcel maps or land records search tools. This means that a user must type an exact string match for owner name or street address in order for results to be returned. For example, if the county system includes a middle initial in owner name, the user most enter the middle initial or substitute the wildcard symbol (the percent symbol, "%") if the character for middle initial is unknown.

Many users, especially local consumers of parcel data, will still find county websites preferable because the county website has more current and comprehensive parcel information, which often includes:

- Linkages from a given parcel to a wide variety of documents recorded at the Register of Deeds, such as a warranty deed, quit claim deed, or certified survey map.
- Tax and assessment history for a given parcel.
- Parcel history.
- Permit information.
- In some cases, building data and other information from the Department of Revenue PA-500 Property Record Card that is used for appraisal of real estate for tax assessment purposes.

To accommodate for users who seek this data, the splash screen and the "About" section of the V2 app include a "contacts" link for county websites for more current and comprehensive parcel information and documentation.

4.3 Data Access and Download Statistics

V2 Download and Access Statistics	
Statewide Parcel Database	**Downloads**
V2.0.2 Parcels (Compressed 10.3)	
V2.0.1 Parcels (Compressed 9.2)	
V2.0.3/4 Parcels (Compressed 10.3)	**119**
V2.0.2 Parcels (Un-compressed 10.3)	
V2.0.1 Parcels (Un-compressed 10.3)	
V2.0.3/4 Parcels (Un-compressed 10.3)	**30**
V2.0.2 Parcels (Un-compressed 9.2)	
V2.0.1 Parcels (Un-compressed 9.2)	
V2.0.3/4 Parcels (Un-compressed 9.2)	**37**
All Full GDB Downloads	**Total 186**
Individual County Downloads	**Downloads**
County parcels (both .shp and .gdb), all 72 counties combined	**Total 633**
Zoning Databases	**Downloads**
V200_Wisconsin_Zoning_SHORELAND	10
V200_Wisconsin_Zoning_GENERAL	14
V200_Wisconsin_Zoning_FLOODPLAIN	9
V200_Wisconsin_Zoning_FARMLAND	11
V200_Wisconsin_Zoning_AIRPORT	9
	Total 53
Web Mapping Application	**Views**
Wisconsin Statewide Parcels Version 2	**Total 518**

Note. Access stats through November 1, 2016. Initial release of all databases was August 31, 2016. V2 web app went live on October 17, 2016.

4.4 Success Stories and Reported User Benefits

Since the release of the V1 statewide parcel map, the project team has endeavored to collect user feedback. Beginning with V1, the webpage has featured an online survey form that allows users to share whether the statewide parcel map has benefitted their organization, which specific business use cases they employ the data for, and how the product might be improved.

In general, for V1 and V2, **many users have reported that the statewide parcel map saves staff time and hassle** in not having to request parcel datasets from multiple counties. Instead, they can immediately download all of the parcels in Wisconsin, in a uniform format and with a high degree of completeness for attributes.

State Agency Use

Many state agencies have reported using the statewide parcel layer for a multitude of uses, including:

- Department of Natural Resources – Wildfire risk analysis
- Department of Revenue – Manufacturing assessment
- Department of Trade, Agriculture and Consumer Protection – Farmland preservation program mapping
- Department of Public Instruction – School district mapping
- Department of Military Affairs – Emergency management planning, mitigation, response, and recovery
- Other state agency purposes

Local Government Use

Local government also use and benefit from the parcel map. Counties benefit in that they need to respond to fewer requests for parcel data, because users can access their data via the statewide parcel map. The more consumers of county parcel data, the greater the return on investment for the county. Counties sometimes have a need to access neighboring county datasets for land use planning or projects that may affect parcels across county boundaries.

The statewide parcel map database has also been a tool to show which counties have gaps in their parcel map coverage (eight counties which incomplete maps yet), progress in meeting the Searchable Format Standard, and a rallying tool to motivate county governments to continue to complete and improve their parcel maps.

Private Sector and Non-Profit Use

A wide array of private sector users have reported benefits, from those in the real estate industry, natural resources management, and even international organizations. Some testimonials are included below.

- **Northstar Multiple Listing Service Operating in Wisconsin**
  - Used to improve the accuracy of Real Estate listings both locationally and characteristically
  - Data cross-referencing includes:
    - Parcel acreages
    - Postal location
    - Property values
    - Tax values
    - School district
    - Waterfront adjacency
  - V1 layer used to update over 10,500 current and historical property listings
  - Continued use of the parcel layer to improve accuracy and consistency for new listings
  - *"We are in the process of incorporating the parcel database into an error checking and updating process to insure that Real Estate listings are correct and accurate with regard to property characteristics and location. We will be correlating the property data that has been inputted into a Real Estate listings database against the data contained in the parcel dataset and using the parcel data to improve accuracy of the Real Estate listing data . . . . Without the statewide parcel source, we wouldn't be able to utilize the parcel data at all. It is simply too expensive to buy from each of the counties we serve. This has been an especially important improvement to our data quality program. Thank you!"*
- **WEC Energy Group in Green Bay**
  - *"I was able to merge parcels in a specific area and quickly create an overview map of a planned [utilities] outage area that was then communicated to the public. Using the parcels along with available road . . . files saved me a day of work instead of converting our Mapinfo tab data to shapefiles and manipulating our company parcel data that is not as extensive or accurate as the Statewide Parcel database. . . . The statewide parcel database will make it easier to gather the necessary data instead of contacting 20+ counties that cover our service area."*
- **Envirotek Forestry Consulting, LLC**
  - Used V1 layer extensively for researching and locating property lines of land owners
  - Created GPS output for use when cruising a given area and setting up timber sales

    - Previous parcel data available was over 10 years old and required extensive cross-referencing on individual county mapping sites to ensure accuracy
    - V1 layer allows for much higher degree of confidence than previously available
    - Cost savings are passed onto the client
    - Potential for future marketing of timber sales via a map showing buyers the area of sale ahead of time
- **Commonwealth Heritage Group, Inc. For Cultural Resource Management**
    - Used the V1 layer to identify landowners
    - Required by clients to contact landowners before conducting surveys
    - State law requires identification of landowners because of the need to obtain permits to conduct surveys on public lands
    - This data is critical to which landowners within a specified project area are public entities
    - The use of this layer has saved the company time and improved the accuracy of project work
- **Wisconsin Geological and Natural History Survey**
    - Currently working on a project to inspect all large volume springs in the state
    - Used V1 layer to:
        - Identify land owners
        - Verify spring existence and characteristics
        - Request permission to examine springs
        - Load subsets onto mobile platforms for us in the field on various projects
        - Substantial cost savings

The testimony of state agency and private sector users, when viewed alongside download statistics, clearly demonstrate that the statewide parcel map has great value for the citizens of Wisconsin.

5 RECOMMENDATIONS

This chapter addresses recommendations for further development of the statewide parcel layer, including sustainability recommendations, data submittal recommendations, and other recommendations from V2 lessons learned.

5.1 Statewide Parcel Layer Recommendations

5.1.1 County Recommendations

County Corrections to Native Data
Accurate attribute information is a crucial component of any dataset. The continued improvement of tax roll database and parcel attribute tables submitted by counties will benefit not only end users of the data, but also aid in decreasing time devoted to data assessment and integration. The *V2 Observation Report* provided to each data contributor is an optimal starting point for identifying data elements that require manual manipulation or cleaning. Improving data in its native format at the county and jurisdictional level will help enable more rapid data export and submission by the contributors and allow for a single edit of data, as opposed to making duplicate corrections each year prior to data submission for the Parcel Initiative.

Develop Sound Internal Workflow for Exporting and Formatting Data
As the Parcel Project works towards more automated methodology for integrating and updating county datasets, it is recommended that counties work to develop a standard internal workflow for submitting data to DOA. The development of automated processes for completing tasks such as joining attribute data, stacking condo parcels, formatting the information, and exporting data for submission will help decrease the amount of manual processing and human labor hours that need to be devoted to submitting data to the project.

Develop Protocol for Entering New Data Into Tax Roll Database
The most optimal time to catch errors within attribute information is when that data is being entered into the native system. Creating a standard protocol for entering data, along with a solid quality control process, can aid in eliminating error and reducing time needed for making corrections or alterations to data already in the system.

Preview and Summarize Data Prior to Submission
Using tools created by the Project team, data contributors can run summary tables of fields requiring standardization prior to submission. These summary tables are a great way to identify errors or errant data that exists within fields that require a set of standard domains. Identifying and remedying these errors prior to submission allows for a quicker assessment and aggregation with the statewide parcel layer. This is also a good method for identifying errors that exist within native data. These summary tables can aid contributors in making corrections to native data and eliminate the need to make duplicate corrections each year prior to data submission for the Parcel Project.

Submission Form
Counties should ensure the required submission form is completed prior to submission, in order to aid in seamless integration with the statewide dataset. While the submission form for V2 worked well when fully completed, the project team observed numerous instances of incomplete submission forms with initial data submissions. This resulted in the need to contact the contributor to have them resubmit the form, answer questions about incomplete fields, or for the project team to investigate the incomplete fields.

5.1.2 Lessons Learned By Project Staff

Submission Form
From the perspective of the project team, It is worth exploring the idea of **a different type or format of the submission form that would not allow a contributor to submit unless all required fields are completed**. This or another similar solution could help eliminate the need to re-approach counties and would aid in increasing the efficiency of the data intake process.

Municipal Gaps
Small gaps in data are not uncommon in the statewide parcel dataset, as a small number of counties continue to work towards completing their parcel digitization. In at least one case, a municipal gap covered by a large placeholder polygon was not uncovered until near the completion of the aggregation process. Although the city was ultimately able to provide the data, it pointed to the need for a more thorough assessment of gaps in submitted data during the ingest phase. This would allow ample time for the county or municipality to be

contacted to supply required data. An alternative would be to emphasize that complete municipal data should be integrated with the county's initial data submission.

Small Spatial Shifts

Incorrect projections were observed with a number of data submissions, which were obvious when overlaying the submitted data with a statewide base map. The project team did observe an instance of a small spatial shift persisting with one county dataset and the subsequently created tile layer—for Waukesha County. This shift only became apparent when zoomed very far into the map. With this minor shift noted, future efforts will seek to identify such inconsistencies during the primary ingest assessment phase, as opposed to the aggregation phase.

Document Assessment and Processing Time

The assessment and processing phases of the V2 Project were simplified and streamlined when weighed against the processes employed for V1. The project team worked to more thoroughly assess the data upon initial submission and improved the documentation of the processing steps that were required to make a given county dataset perfectly match the Searchable Format. Moving forward, the project team should attempt to document the amount of time spent on the various processing phases for each county's submission. Having a better understanding of the amount of time required to assess and process the data would be beneficial when working to develop future workflows and when providing feedback to counties. It would also be beneficial when evaluating the progress a county has made in preparing their data for integration into the statewide parcel database.

5.2 Recommendations for Additional Layers and System Components

5.2.1 Call for Data Content

Continue Submitting ROW, Hydro, Street Centerlines, Etc.

The continued submission of these ancillary datasets allows further analysis and assessment to be performed over the statewide parcel dataset. Understanding the variation that exists between counties and the way these datasets are maintained can lend itself to further understanding of how parcels are maintained within a county and assist in illuminating various anomalies that are observed when processing data.

Recommend Submission of Address Points

Understanding the important roll address points play in emergency management, NextGen911, and other public service capacities, it is recommended this layer be included in the future calls for data. Understanding that address points could be one of the next fundamental layers on which the state of Wisconsin focuses its efforts, having some data to explore and examine can be very beneficial when thinking about future schema additions and possible enhancements.

5.2.2 Additional Parcel Attribute Considerations

Postal Placename

The V2 Project collected the "PLACENAME" attribute. This field contains the *jurisdictional* placename associated with a given parcel (e.g., City of Milwaukee, Village of Menomonee Falls, Town of Smith). Understanding that this placename value is not necessarily the placename most people associate with the site address of a given parcel, it is recommended that this additional placename field be included. This field would contain the **placename correlating to the address recognized by the US Postal Service**. This field would be beneficial for end-users attempting to mail information to a given parcel, as well as aid users in understanding a parcel's location if they are not familiar with the jurisdictional placename concept.

Site Address Standardized

The V2 Project collected the "SITEADRESS" attribute for all applicable parcels. This field, which comes directly from the data contributor, did not require any standardized address elements or format for V2. The site address field could be created from the standardized address elements provided for the project and would aid in providing a more standardized site address field for performing searches and for other uses. This field could be created during the statewide logic phase of data processing by the technical team.

Owner Name Standardized

Across the data submitted, there was a large amount of variation in the way that owner name was annotated, as detailed in the previous chapter. A field that contained owner name in a more standardized format would be beneficial in allowing for more accurate and timely searches. However, this field could be a difficult one to produce given the variation that can exist within a given contributor's dataset. Still, it is worth exploring whether logic cold be written to push this owner name data into a format that is semi-standardized.

Parcel Extraction Date

As the project team looks towards developing an asynchronous workflow for the future of the project, a new field such as "parcel extraction date" would be very useful. Parcel geometries, unlike tax roll data, can be modified and appended to numerous times throughout the year. Knowing that some counties update their parcel data on a weekly, monthly, or bi-annual basis, a field identifying when the contributor cut this copy of their data from the master dataset would be very important. This would help the user determine if they are using the most up-to-date information available for a given county or if they are working with an older version of the data.

Legal Description

A field that contains the legal description associated with a given parcel should be considered. Interest has been expressed at having this field included within the attribute schema by end-users. Based on previous iterations of the Project, it is not clear how many data contributors have this available within their system. If available, it is unsure whether it can be guaranteed that this field has not been truncated or modified to meet the field length requirements of the native database system. But even in a truncated form, there could be value to including this field as an element of the Searchable Format.

Additional Address Elements

It has been suggested that additional address element attribute fields be added to the statewide schema. These suggestions involve further segmenting our current fields of PREFIX and SUFFIX.

- PREFIX field would be divided into:
    - **PREMODIFIER** – Street name pre modifier – e.g., **OLD** NORTH MAIN ST
    - **PREDIR** – Street name pre directional – e.g., **N** MAIN ST
    - **PRETYPE** – Street name pre type – e.g., **CTH** JJ
- SUFFIX field would be divided into:
    - **POSTDIR** – Street name post directional – e.g., MAIN ST **NW**
    - **POSTMODIFIER** – Street name post modifier – e.g., W BELTLINE RD **FRONTAGE ROAD**

This additional modification could have benefits, although there is reason to be concerned about the ability of data contributors to submit in this format if they do not maintain their data in such a format. This is based on how long it has taken counties to get data in the V2 attribute schema, which contained fewer address element fields. It would be advisable to strongly consider what type of further labor adding these fields would put on the data contributors.

5.3 Data Submittal Recommendations

5.3.1 Move to “Contributor” Model of Aggregation

Upon completion of V1, the project team reported on top-level models to consider for data submission and aggregation for subsequent versions of the project. These models posed strategies to automate, streamline, or otherwise improve the submission, validation, and aggregation of local datasets, as well as updates to those datasets. The V1 recommendations suggested a paradigm shift in the role of the state’s aggregating team over the immediately forthcoming projects (e.g. , V3 and V4). In this model, the role of the state as “aggregator” shifts to more of a role as a “steward.”

At the same time, it is important to recognize that this shift implies an increased onus be placed on the data contributor to ensure their data meets required formats and standards.

This proposed paradigm shift was generally well-received. The following section of this report will elaborate on some technical options that will define how this “steward” role could be pursued in V3 or V4.

5.4 Contributor Model Options

The *V1 Final Report* referred to the shift to a stewarding role as the “contributor model,” based closely on a model that it emulates—the Esri Community Parcels solution. The *V1 Final Report* defined the contributor model to stipulate that:

> Aggregation happens on a server through an automated process. Because the process is highly automated, there is no direct involvement of the steward in aggregation of the data. This type of automation is only made possible through coordinated, standardized, and well-formatted data submissions from contributors.

This statement is explained in detail in what follows. However, note that this is not the only implementation under which the contributor model could be conceived. Alternative methods are also posed below.

5.4.1 Server-Side Processing and Aggregation

The contributor model under a "server-side" implementation would feature a web-based interface for contributors to submit their authoritative data. Through this web interface, the user is able to manually configure a data submission by identifying some parameters that describe the nature of the data, and then the user submits by uploading a zipped package of the properly formatted and standardized GIS data. Once a contributor submits data, the data asynchronously replaces the contributor's previously existing data in its entirety through server-side geoprocessing scripts.

As this is an automated and asynchronous process, a data submission could be performed at any given time and at any interval. The amount of time between a data submission and publishing to public distribution links would not necessarily be instantaneous, but it could be complete in short durations of as little as 1-2 hours. The targeted amount of time between submission and publishing might be daily, weekly or monthly, however, as it would be recommendable to have some extra time for manual validation to take place before distributing the data. Figure 13 depicts the broad-level flow of the technical process for the server-side implementation.

Pros of Server-Side Implementation

- **Faster.** Due to server computing power one could expect that data processing and aggregation steps to complete faster due to increased computing power. The benefits may be marginal, however, as desktop computing times are not significantly high (e.g., a 75% reduction on 5-10 minutes is fairly insignificant).
- **More Responsive.** Due to the less passive nature of this model—where updates trigger the aggregation processes instead of routines defining them—the model would accommodate more instantaneous updates. If instantaneous results are desired, this model should be pursued.
- **Precedent Set by LTSB.** Wisconsin's Legislative Technology Services Bureau is currently implementing a similar model through WISE-Decade for the collection and aggregation of wards, MCDs, and county supervisory districts. Note, however that the size and nature of the statewide parcel data and schema poses crucial deviations from LTSB's implementation and possible barriers to implementing the model.

Cons of Server-Side Implementation

- **Costly.** This model would require an instance of ArcGIS Server, which can have significant costs associated with it. A general estimate would be between $5,000 and $40,000 for the ArcGIS Server software license. However, LTSB has expressed willingness to deploy such process on LTSB's ArcGIS Servers.
- **Less Experience.** Project staff is more experienced, and has precedence success with desktop computing in contrast to server computing. Server computing should be considered more complex.
- **More Project Overhead.** In addition to budgetary overhead, server computing employs more overhead and project dependencies.

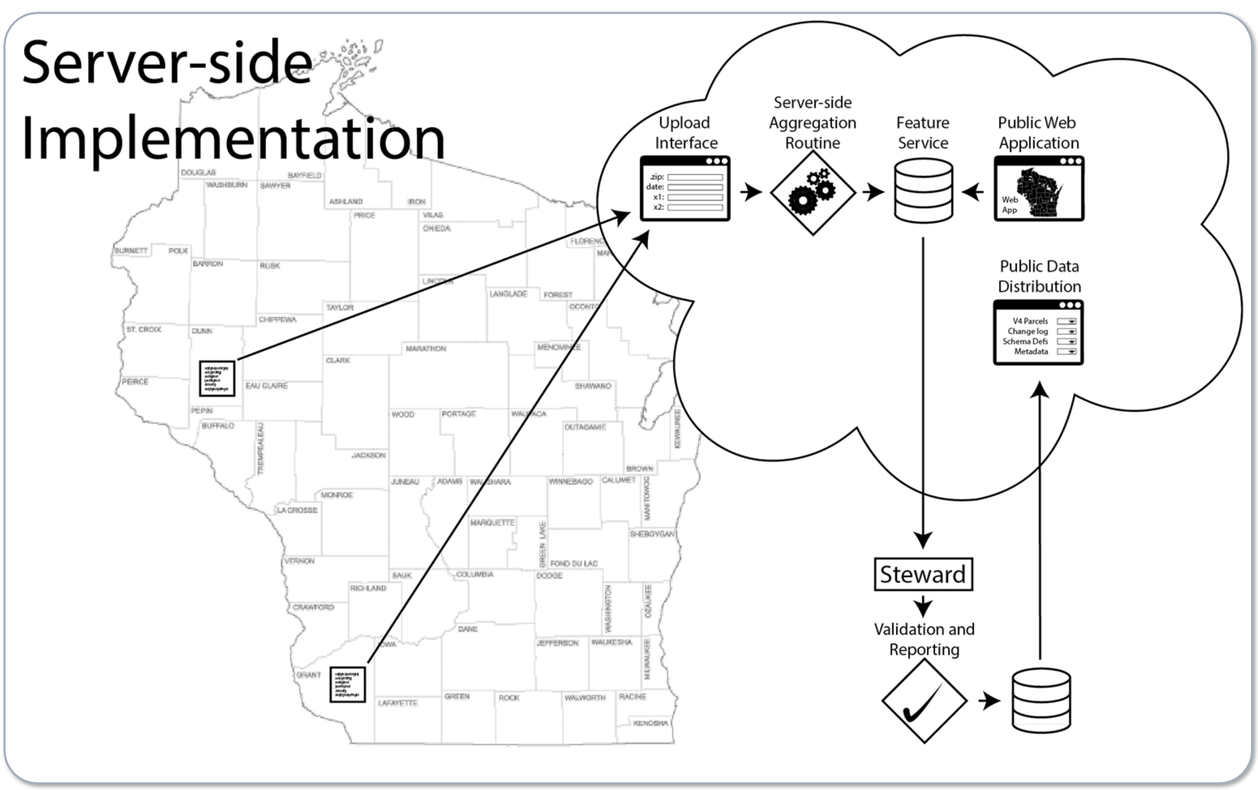

Figure 13. The "Server-Side" Implementation of the Contributor Model of Aggregation

5.4.2 Steward-Side Processing and Aggregation

Similar to the server-side implementation, the "steward-side" implementation would present a single web interface through which a data contributor could configure a data submission. The interface would feature a form for identifying metadata and other vital information to the data submission, as well as a mechanism for submitting a zipped package of all the GIS and tax roll data. However, in contrast to the server-side implementation, the steward-side implementation of the contributor model would simply save all of the data associated with a submission directly to a server without any server-side processing done. A separate mechanism would routinely check for submission updates at a defined interval—such as daily, weekly or monthly—through an auto-running desktop script. Such a script would exist on the local machines of the project team and could be run at intervals or on demand. Upon script execution, it would check the server for any new data submissions, download the new submissions, and process the data locally using routines that the team has used over the V1 and V2 Projects to process, validate, and aggregate the submitted data into a local database. The database could then be published to a feature service and other data distribution sites as needed.

Pros of Steward-Side Implementation

- **Less Costly.** This solution requires little more than an FTP server or Box space, and does not require additional spatial server licensing such as ArcGIS Online or ArcGIS Server.
- **More Control.** With the lack of spatial server software requirements, less control is in the hands of third parties, such as ArcGIS Online or server other administrators. Keeping all of the implementation's logic under the control of the steward is easier to implement, often more timely, and less complex.
- **Less Shift From Existing Aggregation Routine.** This implementation would make use of the majority of logic and tools established through the LinkWISCONSIN, V1, and V2 Projects.
- **More Accessible Intermediary Data.** Steward-side implementation also offers more easily accessed points in the model where human intervention can be used to troubleshoot a data error. Since all the processing will be done on local or desktop machines, project staff could easily correct issues in the data or tools should they arise.

Cons of Steward-Side Implementation

- **Less Responsive.** The model is passive, as it only updates the data at the defined intervals. Further, the data is only published when intended. Thus, if an instantaneously-updated public parcel layer is desired, this implementation may not be the most desirable option.
- **Slower.** Due to desktop computing power, one could expect that data processing and aggregation would perform slower than if performed on a server. This difference would be negligible though.

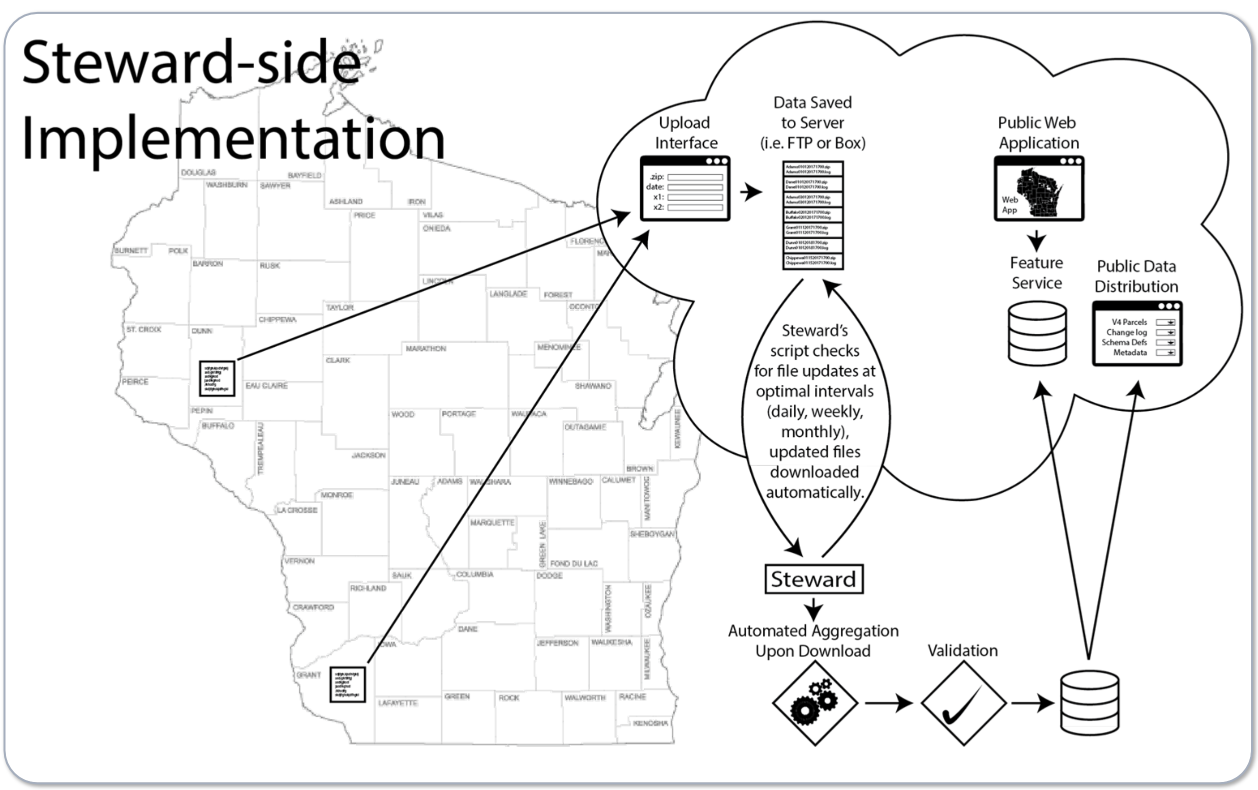

Figure 14. The "Steward-Side" Implementation of the Contributor Model of Aggregation

5.4.3 Cloud Processing and Aggregation (ArcGIS Online/Community Parcels Model)

A third option is the cloud aggregation model that is exemplified by Esri's "Community Parcels" solution. This implementation follows a server-side model closely, however, under this model the project team would not leverage an exclusive ArcGIS Server deployment. Instead, they would utilize cloud functionality provided by ArcGIS Online for aggregation of features to a statewide feature service (in the context of ArcGIS Online, this is referred to as a "feature layer"). Another way this model differs is that there would be a required desktop tool that contributors would download and deploy in order to contribute data. Such a tool already exists as a part of the Community Parcels solution. This tool could be altered to meet the needs of the Searchable Format attribute schema. As reported in the *V1 Final Report*, the project team assessed the Community Parcels solution for the V1 Project and decided to only partially employ the workflow by using an altered version of the aggregation tool.

Pros of Cloud Implementation

- **More Responsive.** Similar to the server-side implementation—where data submission updates trigger the aggregation processes instead of routines defining them—this model would accommodate more instantaneous updates. If instantaneous results are desired, this option should be further researched.
- **Precedent Set by Esri.** As this model is a wholesale solution set forth by Esri, in theory it should be ready to go by following existing documentation and modifying the model to meet project needs. This model may also be subject to support and maintenance assistance from Esri's solutions engineers.
- **Popularity and Trajectory of Cloud Computing.** As cloud computing is becoming more popular, one should expect this technology will evolve to be more supportive, cost effective, and reliable over time.
- **Cost Effective.** In comparison to server-side implementation, this type of aggregation model could be considered more cost effective in that it adheres to the concept of "elastic computing," where server resources can be scaled up or down automatically by a cloud service provider. Elastic computing provides flexible computing such as geoprocessing tools, processing power, storage, and bandwidth when needed.

Cons of Cloud Implementation

- **Costly.** This model would require at least 10,000 credits in ArcGIS Online annually, which equates to $1,000. From past experience with ArcGIS Online, it can be difficult to estimate costs, due to unintelligible credit consumption rates. ArcGIS Online also requires a subscription license, which DOA has as a part of their enterprise software licensing with Esri.
- **Less Experience.** Project staff has had prior success with desktop computing, but less experience with server computing. Server computing can be considered more complex and, in the case of cloud computing, it sets a degree of reliance on a third party—like Esri—for troubleshooting.
- **Primary Assessment of Community Parcels.** In the initial assessment of Community Parcels in 2014, this model was determined unfeasible due to complexities in parcel geometries causing errors in uploading to ArcGIS Online. However, improvements may have been made since the initial assessment.
- **Possible Lack of Intermediary Processing.** Under this model, any pre-aggregation validation or processing would need to take place within the county's locally installed tool. Custom server processing may be significantly limited.

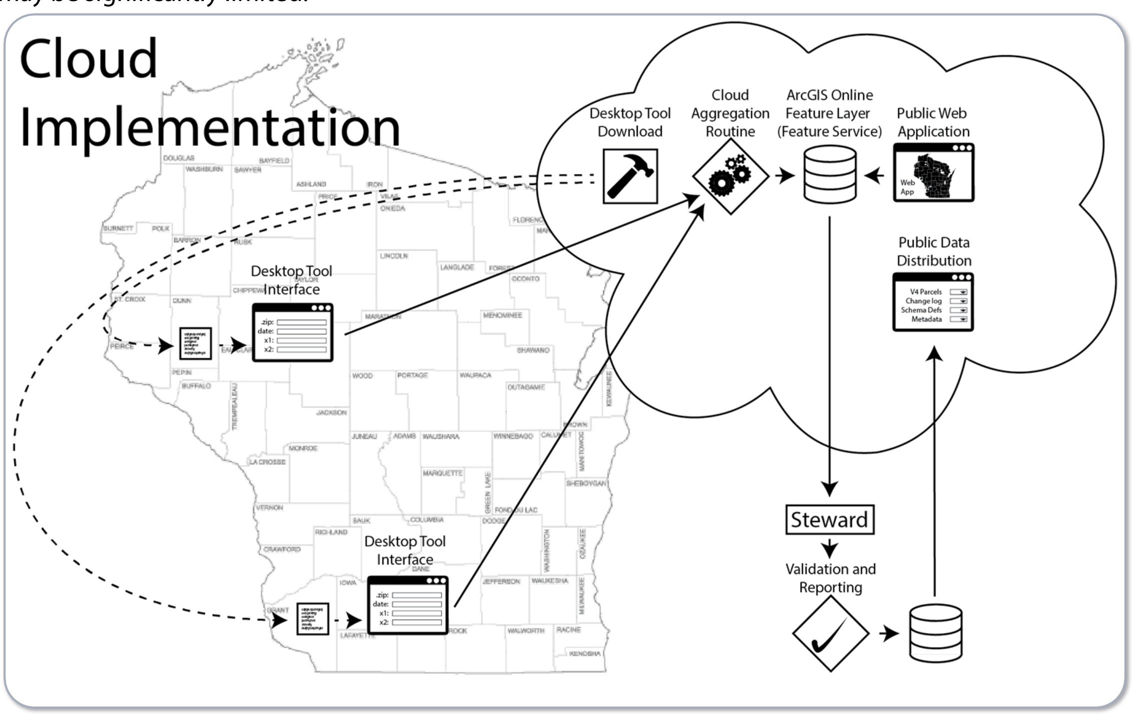

Figure 15. The "Cloud" Implementation of the Contributor Model of Aggregation

5.4.4 Aggregation Implementation Summary

Given the three potential implementations of the contributor model, it is recommended that the project team discuss the pros and cons of each so as to come to a desirable pathway to pursue. It should be noted that none of these implementations necessarily need be implemented in whole—hybrid approaches are possible and alternative concepts or mechanisms may be available as well. Regardless of the implementation strategy pursued, it should be emphasized that **an important degree of onus is placed on the county adhering to data standards before data is submitted in order for any automated aggregation strategy to be successful**.

For this reason, a data validation tool is recommended, which applies to any of the possible pathways for aggregation.

Searchable Format Data Validation Tool

With an increased onus placed on the county to submit data which adheres to the Searchable Format, and the history of the un-standardized data submitted in the past, a new desktop tool should be developed that can identify errors in a parcel dataset prior to the data submittal. Wisconsin's Legislative Technology Services Bureau has been successful in employing a similar tool called WISE-Inspector for their data aggregation efforts. **The data checking tool should be designed to achieve the following**.

- **Pose No Technical Barriers to Use In All 72 Counties.** The tool should be compatible with all counties ArcGIS software.
- **Identify Common Mistakes.** Through the V2 intake assessment, the project team identified many common mistakes that were made with data submissions. These lists should be used in developing the data validation tool, beginning with the most common errors.
- **Deliver Clear and Concise Reports.** The tool should provide clear results and directives to help the user correct the data as quickly as possible.
- **Model Builder.** The tool should be compatible with model builder and scripting environments so counties can build the tool into their automated routines, should they exist.
- **Validation Stamp.** The tool should produce a validation stamp on the data. This would allow the project team to confirm that the data passed the inspection before attempting to automate its aggregation into the statewide parcel layer and ensure that all county data submissions are truly in the Searchable Format.