A Geospatial Approach to Santee Parks
Park Asset Data Collection, Correction, and Submission

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Disclaimer

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About The Sage Project

The Sage Project is a partnership between San Diego State University (SDSU) and a local government in the San Diego region. Students, through their course work, engage in meaningful real-world projects and contribute to pressing social needs in a community in SDSU’s service area. Students from across the University assist local governments with partner-directed projects that address their livability and sustainability goals. SDSU students and faculty connect with high-priority, high-need, highly interdisciplinary community projects, thereby generating interest and fresh ideas that create momentum and provide real service to the community. Each year, the Sage Project at SDSU engages hundreds of students from diverse disciplines who invest thousands of hours assisting communities in our region as they seek to build a more equitable and sustainable future. The Sage Project is part of the Educational Partnerships for Innovation in Communities (EPIC) Network, and is based on the highly successful and award winning Sustainable City Year Program at the University of Oregon.
The City of Santee

The City of Santee, recently incorporated in 1980 is a mid-sized city in the hills of Eastern San Diego. With a large majority of the city surrounded by sets of tall rolling hills, the city is one of the few in the county with room to grow. Santee from the beginning has prided itself on building a city designed with high quality of life in mind. In fact, much of their development shows they are doing just that. Especially, their focus on recreation areas, such as Town Center Park—a 700 acre lot of mixed use, has earned them praise in an urban-dominated locale. Santee has additionally taken on the Sustainability Project, starting in 2008, in an effort to revitalize the community with a green thumb. Partnering with the Sage Project at SDSU has proved a mutually beneficial relationship for both parties; Santee receives low cost assessments of three key projects for community character development, and SDSU students gain firsthand experience with field work and professional delivery of results.
Executive Summary

This report is a reflection of the work of numerous students in Geography courses at SDSU which incorporate real-world issues into the classroom curriculum. The City of Santee, in collaboration with the Sage Project, developed three focus areas for this project: park asset geodatabase creation; storm water inlet collection and hydrological analysis; and using geospatial technology to improve compliance with the Americans with Disabilities Act (ADA).

The park asset portion of the project is a large portion of this document. Improvement of process management is a key feature of this section. Creating a geodatabase of park assets across eight different parks and over 70 acres of land is difficult and technical. This document provides a step-by-step approach for future users to recreate the process for any geotagged image collection project, not limited to park asset data. A majority of the process is reliant on technology produced by Environmental Systems Research Institute (ESRI), using their line of Arc products. As a result of this project, over 2,000 data points now have representation in the custom geodatabase for the city.

In addition to the park asset project, storm water inlets also incorporated the concepts and technology for geotagged data collection. Using a set of boundaries defined by Santee, students split up to collect data on missing storm water inlets. The San Diego River divides the City of Santee, making tracking of waterborne pollutants across the surface a hot topic. Using the data collected on missing storm water inlets, the city is better prepared to manage their runoff and track sources of pollution. In addition, advanced datasets were created, including a Digital Elevation Model (DEM) and hydrological analysis toolboxes.

Finally, the City of Santee placed adaptation to the new standards set out by the ADA revision in 2010 as a high priority. Looking at over 115 roadways ranging in size and age, the group conducted a sweep to identify issues with ADA compliance standards, such as missing sidewalks or sidewalk ramps. The report concludes with considerations for environmental responsibility and social and economic equity.
Project Site Background

Big Rock Park

Size: 5 Acres

Amenities:
- Barbecue Grills
- Basketball Court
- CSD Activity Building
- Open Green Space
- Site Parking
- Park Shelter/Gazebo
- Picnic Tables
- Playground Equipment
- Restroom Facility
- Tennis/Pickleball Court

Mast Park

Size: 108 Acres

Amenities:
- Barbecue Grill
- Basketball Court
- Disc Golf Course
- Open Space
- Site Parking
- Park Shelter/Gazebo
- Picnic Tables
- Playground Equipment
- Restroom Facility
- Trail System
Shadow Hill

Size: 5 Acres

Amenities:
- Barbecue Grills
- Basketball Court
- Open Green Space
- Site Parking
- Park Shelter/Gazebo
- Picnic Tables
- Playground Equipment
- Restroom Facility
- Tennis Court
- Trail System

Sky Ranch

Size: 1.3 Acres

Amenities:
- Barbecue Grills
- Open Green Space
- Site Parking
- Park Shelter/Gazebo
- Picnic Tables
- Playground Equipment
Town Center Community Park and Santee Aquatic Center/ YMCA

Size: 55 Acres

Amenities:

**Western Portion**

- Three lighted softball/baseball fields with artificial turf outfields
- Two arena soccer fields
- Parking
- Restaurant with indoor and outdoor seating

**Eastern Portion**

- Lighted synthetic turf football and soccer fields
- Playgrounds
- Concession stand
- Restrooms
- Walking trails
- Picnic shelters
- Nature interpretive panels
West Hills Park

Size: 8.5 Acres

Amenities:

- Arboretum
- Ball Field(s) Adult
- Ball Field(s) Youth
- Barbecue Grills
- Concessions
- Open Green Space
- Site Parking
- Park Shelter/Gazebo
- Picnic Tables
- Playground Equipment
- Restroom Facility
- Sand Volleyball Court
- Sports/Multipurpose Field
Walker Preserve Trail
Size: 100 Acres
Amenities:
• Walking trails
• Picnic shelters
• Nature interpretive panels
• Bike repair station
• Picnic tables
• Parking and restrooms (Located at Lakeside baseball fields)

Woodglen Park
Size: 10 Acres
Amenities:
• Ball Field(s) Adult/Youth
• Barbecue Grills
• Basketball Court
• Open Green Space
• Site Parking
• Park Shelter/Gazebo
• Skate & BMX Park
• Picnic Tables
• Playground Equipment
• Restroom Facility
• Sports/Multipurpose Field
• Tennis Court
Introduction

The City of Santee and students in Geography 484 collaborated to create a database of all park assets in order to give the city Park and Recreation Committee (SPARC) a spatial understanding of where all assets were located. Previously, this information was stored off-line and few of the city assets were described in a visual software program. ArcGIS is a product developed by ESRI, an established name in Geographic Information Science (GIS), which is built to construct and analyze geospatial realities. By introducing ArcGIS to the systematic process of maintaining and placing park assets across the eight locations, city employees and students will be better equipped to manage community parks.

In an effort to facilitate replication for future sustainability projects, this document outlines three phases of implementation. In the first phase, we will look at the steps necessary in creating the tools for field data collection. Second, the field work phase will discuss how the field work was collected. Some of the issues we faced will be referenced, as well as what was done to mitigate future issues in the data submission phase. Finally, phase three describes the systematic process for collecting the 2,500+ data points across the eight parks. Due to the nature of submitting professional-grade work to a civil service, this section will also discuss the aesthetics of data visualization and management. In conclusion, this report will highlight the mutual outcomes for student learning and prospective uses of the work discussed here.
Phase 1: Pre–Field Work

Geography’s Desk Job

For successful field work collection, much time is invested in preparing the mediums and processes for data collection at the front end. Prior to student learning outcomes and curriculums, the first task to complete was a negotiation between Dr. Nara, the Sage Project, and the City of Santee for what was to be collected.

Three foci were selected: park assets, missing sidewalks and pedestrian ramps, and missing data on storm water inlets. All are the targets of the interaction between the Sage Project and the City, but park asset data is the focus of this section of the study. After identification of what to collect, students would then have to head to the field to begin the process of recording location and other information related to park assets.

There are three ESRI products that will continually come up in this report. ArcMap/ArcCatalog are the desktop services which provide the user with a great deal of features and is highly technical in nature. ArcOnline is a GIS web service run by ESRI which emphasizes sharing capabilities and simplicity over technical complexity and editing capabilities. ArcCollector is the mobile application intended to give users greater access to the world of Volunteered Geographic Information (VGI).

For the pre–fieldwork phase of this project, the primary obstacle to tackle was identifying a medium for collection that allowed us to use pre-constructed domains with drop-down style lists. In short, there needed to be a clear way for students to choose exactly what they intended to collect. Figure 1 explains how all the data was arranged, beginning with the ArcOnline database. Faculty in the department office used their licensing agreement with ESRI to construct a group specific for Geography 484 students to use for park asset data collection. Using that group, eight individual park maps were constructed in ArcMap and uploaded to the Geography 484 ArcOnline account The user would open a map in ArcOnline, locate the park, and use the multi–point line feature to outline the boundaries of data collection for each park.
Then, the user would save the map to the group Sage folder with the park name as the park title. Each park required this process. With each of the parks visually centered on a map where the data would eventually be displayed, a few additional steps needed to occur in order for the data collection in the field to be displayed as a drop-down style list.

At this point, any data collected would only be organized by three basic categories; point, polyline, and polygon. Although these are necessary to organize the data later in the submission process, they would prove to be too limited to sort into the six categories seen in figure two. Rather than relying on a single geodatabase to hold all of the data points, lines, and polygons, six separate geodatabases were created. The benefit of creating six geodatabases is the simplicity it takes to edit, arrange, and control the placement of features in all three portions of the project. Figure 2 illustrates how each of the separate databases are configured for each park. Notice the presence of point, polyline, and polygons in each description. Because there were many more point than polyline and polygon features at each park, point features were broken into three separate categories to facilitate a hierarchal approach to organizing the many points collected. With hierarchy, the user is able to easily view features of interest by simply toggling the geodatabase layer on or off, eliminating the need to shuffle through hundreds of points all configured under one geodatabase.

Figure 2

Figure 3
The most efficient way to create these geodatabases is using ArcCatalog. Once the desktop application is open, right-clicking an open folder will give the user access to a range of features, one of which is geodatabase creation. Once the geodatabase is created, the user will right-click the new geodatabase and select properties near the bottom of the list. Now, the user will need to populate the domains with possible asset types one might encounter once they are out in the field. For example, the Park Asset Light database has its domain populated with: Park Security Light; Sport Field Light; Ornamental Light and Other (as seen in Figure 3).

Although what is shown here is the finished product in ArcCollector, one can see that once the domain is populated and then uploaded to preconceived online maps, there is a user–friendly platform for data collection. With the database configured, now the user needs to establish a sense of ‘where’ with digital imagery.

Regarding the imagery used, SDSU has access to 2012 and 2014 orthophotos with 3–meter accuracy. ESRI’s world imagery is also a reliable source of spatial imagery with 3–meter accuracy, taken around the same time. Regardless, the most influential aspect of digitizing real–world features from spatial imagery is going to be the quality and temporal data. The higher the resolution, and the sooner the photo, the more precise the data will be. (Precision pertains to the trueness of the information about the data, where accuracy is the trueness of the location of the data point). With this focus on precision, the user is able to provide the city with a curved–to–fit walkway polygon that more closely reflects actual total area.

**Going Mobile**

One of the fundamental reasons for choosing the mobile app over hand–held GPS units was the simplicity of operating and transferring data from the unit. A traditional approach to conducting fieldwork in geography often requires access to expensive surveying equipment. For both the City of Santee and SDSU, this was not a feasible option. Sending student volunteers to operate equipment of that level is expensive and time consuming. Using a GPS–enabled phone allowed up to 3–meter accuracy with relatively little training to operate the program, which was appropriate for the scope of this project. Furthermore, the application is also free and widely accessible. The application also includes a mini–map for user correction and placement of the data point.

The type of field work required for this project requires a large amount of data collection across multiple locations, which would be difficult for only a few individuals. A team–based approach helps to reduce the time spent in the field.

In this case, students from SDSU provided the teams that tackled this data collection across sites. The first student group, from Geography 484, collected Town Center Community Park and Santee Aquatic Center/YMCA data points. The second group, consisting of 18 students from Geography 101, visited Mast Park, Woodglen Park,
Shadow Hill Park, Big Rock Park, and West Hills Park for data collection. Based on the projected collection amounts for each park, Sky Ranch Park and the Walker Preserve Trail were not selected as field trip sites due to their size. Rather, small groups of two to four students collected the data for those smaller and less data-intensive sites. Training for the field volunteers was completed with a 20-minute sign up to ArcCollector via their mobile phones. Signing up the students before they headed to the field ensured that any foreseeable issues were resolved ahead of time and students were more familiar with their responsibility once they reached the project site.

Phase 2: Field Work

Even with the technological advances in land use planning tools, fieldwork remains a crucial component of data collection. The fieldwork phase is the shortest of the three portions, but failure in any one of the steps for collecting field data results in a headache for the data manager. The success of phase two relies on the user’s correct selection of the previously mentioned domain drop-down lists. For this reason, once each of the students received their 20-minute training, they are run through a small refresher once on the project site. This reduces the amount of correction that needs to be done in the third phase. Unlike the other two phases, this phase is relatively low-tech. As discussed earlier, each of our field operatives was equipped with the ArcCollector app. The application is capable of storing the data until wirelessly connected to the internet, or using the cellular network to collect and upload geotagged features. Each of the feature submissions also contains user-inputted metadata. The connection at each of our sites was reliable with little to no
issues, so most students relied on the cellular network. To reduce error, within each park, one senior user was assigned to each group of two to three students. The ArcCollector mini map also eliminated redundant geotagging; as field team members added points, these points would be displayed across all mobile screens, preventing multiple tagging of the same asset. Despite these steps taken to reduce human error, as with any form of field work, the possibility of its impact on the results should be taken into consideration.

Each of the fieldwork visits were scheduled in two–hour time blocks. In the most successful approach, the park was sectioned off for individual groups that were assigned on the morning of the site visit. Each user scanned across the designated region with their group in a sweeping manner. With group members in constant communication, much of the data was collected in a single sweep.

To ensure that data was correctly collected, a senior user sampled twenty to thirty points across the park to ensure complete collection of all data points and accuracy of user–collected notes and photos.

The geotagged photo is a cornerstone submittal for each data point. The presence of a photo for each point provides additional context as to the quality, quantity, and positional accuracy of the data. ArcCollector allows users to add a photo for each data point, either by taking a new photo or selecting one stored on the mobile device’s memory. In most cases, a new photo was taken on the spot. A good submission photo is one that contains both the focus on the data point being collected and a smaller scale view of what lies near the object. When photos were missing one of these components, editing a data point relied on using the spatial imagery used for that site.

After collection of 1386 point, 81 line, and 103 polygon features in the first round of fieldwork, 1570 total points where collected. Now all those features need to be cleaned and corrected, and the imagery digitized. The data submission phase creates a more conclusive data set that displays all of the park assets, elaborated in the following section.

**Phase 3: Data Submission**

Data submission is the process of cycling through the raw collected data and creating a systematic representation that accurately and precisely displays the park asset data for the city to review. This involves a standardized approach to attribute table management, symbology, and feature placement across eight different maps representing eight different parks. The complexity of this step requires a technical approach that involves observing, orienting, deciding, and acting in a repetitive cycle until the data presented is of professional quality. This section will guide future users on just how to achieve that success.
Cloud to Drive

All of the data submitted to the ArcOnline group at this point was limited to the capabilities of the online software. Adding features using the online tool is possible—but for the sheer amount of digitizing and data management still to be completed, ArcMap offers much more to the user. The user should be able to click the view in ArcMap option for each map and save the entire map at once. However, due to the pathway configuration of the downloaded database, the data is only able to be viewed. In order to download the maps from ArcOnline with all the data points and subsequent metadata (photos included), the user must navigate the back alley of ESRI’s servers for ArcOnline. Once the user is able to log into the portal for ArcOnline where the Sage group is found, he/she may access all of the online maps. Then, to gain editing capabilities, each of the geodatabases has to be downloaded separately. Figure 5, below, describes that process.
As mentioned, this procedure is for a single geodatabase; therefore, only one geodatabase such as Park Asset Lights at Mast Park will be downloaded. The user must go through and do this six times for each of the eight parks to download all 48 geodatabases. Unfortunately, ESRI doesn’t have the capability to download a single map of VGI while still retaining the editing capabilities and linkages to metadata such as photos. Each of the folders are downloaded as .zip files and need to be unzipped for use. To keep organization and cleanliness, create a master folder and eight subordinate folders labeled with the park titles. Then download all six geodatabases for a single park, un–zipping those files into the specific park folder, and repeating this step for all park folders.

Open ArcMap and add the orthoimagery to a blank data frame. The draw time for the many tiles that make up Santee can be a bit prolonged, so the best way to reduce computer processing time is to reduce the number of tiles that need to be drawn. By selecting a single tile of orthoimagery, ArcMap is able to draw more rapidly.

Choose the title where the park exists and delete the rest, saving the result as park_name.mxd within that park’s folder. Now, the user will use the add data tool and import both the shapefile and the table for the six park geodatabases. The final result will be a .mxd file that contains location–specific imagery and all the VGI collected at each park. Now the correction process begins.

Volunteered Geographic Information to Contractor Quality Submittal

First, there are two ways to approach the data cleanup of all the raw points. The most appropriate way to begin this process is by beginning with the attribute table. The attribute table is the overarching branch that contains all features collected per each geodatabase. For every geodatabase, this table will display a number of different forms of metadata that combine to create one unique point. For example, take a look at Figure 7, an attribute table for a polygon feature:

<table>
<thead>
<tr>
<th>OBJECTID</th>
<th>SHAPE</th>
<th>created_user</th>
<th>created_date</th>
<th>last_edited_user</th>
<th>last_edited_date</th>
<th>asset_type</th>
<th>note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Polygon</td>
<td>sage_13</td>
<td>2015-10-16 17:31:13</td>
<td>ANOVAK</td>
<td>2015-1-29 19:23:58</td>
<td>other</td>
<td>Plant Garden (some missing)</td>
</tr>
</tbody>
</table>

Figure 6

Each column has a header that contains a defining feature for each data point. By beginning with the attribute table first, one transitions from a somewhat dispersed and chaotic maze of points to a top–down list of organized features. Each column header is capable of serving as the sorting baseline; the notes column can organize
the entire table A–Z or Z–A, based on what the user typed in that text box. The data manager is then able to sort through that note column and standardize the response. For example, now when one sees a Parking Lot Sign feature, all of the Handicapped signs will have their note column compiled with text reading “Handicapped Parking Only.” Providing a single response for one feature creates a simpler way to approach asset management for city officials.

The second approach relies purely on the spatial perspective on data. In this step, the data manager must cycle through each geodatabase or layer and ensure the points are accurately located by looking at how they are arranged on the spatial imagery. Having a point feature for a basketball hoop in the middle of the street won’t do the city any good, so one must preemptively arrange the points in a fashion that displays each asset accurately. The process entails viewing the layers in a sweeping motion so that each point is arranged logically, even when the spatial imagery fails to provide a clear perspective (e.g. a tree blocks the view of a bench in orthoimagery). Once the edit toolbar is prompted (Figure 7) and the tool initiated, the user is asked to select one of the six geodatabases to edit. With the vast capabilities of the editing and advanced editing toolbar, the user is free to drag, drop, create, and stratify features to their liking. Two additional features of the editor toolbar seen to the right side are going to be extremely useful during this third phase. Both the create features and the attributes tools prompt a separate window to open inside ArcMap (Figure 6 and Figure 8).

The attributes window is an alternative to the identify tool, displaying the metadata for each point selected (Figure 8). Therefore, the user can select features individually, or using the selection tab, select an entire database of points. For all features with an attachment, there is a small paper clip with a down arrow.
that allows users to view, add, save, or delete the attachment for each point. The photos taken by students during the field trip are most easily viewed in this manner, but the identify tool works as well. The items in the table in a darker shade of black are editable; lighter grey items are automatically updated or uneditable. In this way, the attribute dialog is an extension of the attribute table presented in a simpler manner for larger scale data management (less data to sort through).

For the create feature tool, the process is rather simple. Thinking back to when the editing process began, we remember that the user must select a specific database to edit and therefore only one of the six categories is active (see Figure 3). Once the create features tool is activated, the predetermined domain options are presented to the user just as if in the field collecting data with ArcCollector (Figure 9). The polyline and polygon features have a greater diversity of options for shapes. Users can select from a variety of options for each feature type, which allows for improved feature precision. Users are not limited to lines or polygons; options such as free-handing, a set shape tool, and autocomplete are also available. Once the features are created and their attributes populated with the appropriate wording, we are able to begin closing up the data management portion of this project.

One of the final steps is to address symbology. The number one rule to keep in mind for symbology is clarity. In this project, with so many layers on a map, symbology was kept simple and straightforward to allow holistic management of all data points. If all the layers are to be included, a simple, categorical approach should be taken with medium-sized colored icons across all categories. If the city plans for a more focused approach to the data features, they could turn off non-essential layers, making more unique symbology appropriate. Double-clicking the small icon next to any feature type, such as the green dot next to Entrance Sign in Figure 8, prompts the symbology dialogue to open. This dialogue gives the user access to a wide array of options through a selection of categories and a search bar. ESRI has developed a descriptive set of different feature symbols to display data points with more flare and trueness to real life, as compared to the traditional colored dot.

Finishing Touches

Now that each of the park databases is a best-fit representation of the multitude of points, lines and areas that exist at each park, it is time to wrap up the lab work. Ideally most of the surfaces at each park by now are digitized using spatial imagery so the user would only need to return to the field site to take some photos of those...
surface types at each park. Large fields, blacktops, playgrounds, etc. need some sort of imagery so city managers can develop a visual understanding for managing park assets. The best way to add photos is through the use of the attributes tool as discussed earlier. Simply take the photos, upload them to the desktop, and then add them using the paperclip icon. If time permits, the assets without photos or bad photos should be replaced with quality photos.

Cloud or Drive

After all of the parks have been completed, the user must establish organization and decide the submission format. To prevent mixing of old and new files, rename the new .mxd files clearly so they can be distinguished from the old ones. For example, MastPark.mxd would become NEW_MastPark.mxd. At this point, everything created, collected, and organized will have been saved to the computer as a File Geodatabase. Now the user must initiate the transfer of data. ArcOnline may seem the simpler route, but the reality is that the final product would then have to be downloaded again by the product recipient, database by database. Using ArcOnline does have benefits, though. Any maps uploaded to the ArcOnline group will automatically show up in the ArcCollector application. Once the user opens the map on their mobile device, the new map with all of the updated points will appear. Clicking on any one of those points gives access to the same attribute management and photo attachment options. A simpler approach is using an external hard drive. The drive feature is a more efficient way to hand over a finished product. Multiple copies can be made for multiple parties, sample copies can be made for interested parties, and the original raw data is saved in its as-is format. Keeping that original raw data in the cloud is also important because it provides the user with a source of backup data should anything go wrong.

Additional Projects

Mapping Storm Water Inlets

One of the datasets handed over to the Sage Project and SDSU was a single shapefile with storm water layout information. Three types of features were included in the shapefile. Point features display all of the inlet locations, not including the outflow points. Lines act as a graphic representation of underground pipes. Polygons define the target areas and use a two color scheme to distinguish between commercial and industrial focus sites. Storm water is defined as excess water across

Figure 10
a surface that is a result of rain or snow. Storm water, unlike sewer water is not treated but directed to an area where water is naturally dealt with, such as a river or permeable soil. The major issue that requires intervention is the missing data points in some of the commercial and industrial lots. The city is lacking the necessary information to track the flow of rainwater through these lots with missing data points. The City of Santee is divided topographically by the San Diego River and is located entirely in the watershed region of the river. One of the biggest issues with the San Diego River is the high rates of pollutants found in the water, negatively affecting the river’s ecosystem. Santee has conducted research in previous semesters determining the hot spot areas for pollutants. Reverting back to the directional nature of storm water systems, the only way to eliminate those pollutants is to track their source and mitigate the environmental damage. By filling in the missing storm water inlet data, the flow of pollutants can be more closely tracked for prevention efforts.

To collect storm water inlet data, Geography 484 students, Kristen Monteverde, Roberto Marquez, Eduardo Cordova, and Dr. Nara went into the field armed with ArcCollector. When viewing the data on the mini-map, each of the polygons seen in Figure 11 are shown so that wayfinding is simply a matter of getting your GPS location inside one of those lots. Most of the lots had physical boundaries, such as streets and fences, as well. Students and Dr. Nara then individually collected data at sites provide by the City of Santee. The blue sites are the target areas due to their high commercial and industrial usage. Accessibility was more of a site-based concern, as some of the industrial sites had physical barriers, such as fences and shrubbery, to prevent concerns of trespassing. The volunteers collected as much data as possible in public areas first. Some environmental considerations affected data collection, such as heavy traffic along streets, full parking lots, and weather that increased the difficulty of finding the inlets and creating their data point.

Once on site, the collection process once again relied on the submission of a geotagged image and any user notes. The user must follow the same process as before with downloading the data from ArcOnline. Refer to Figure 5 for clarification. Once the features are downloaded, the users were able to interact with the data features by viewing their photos and adjusting their symbology for better
aesthetics and practicality. We developed a complete hydrological analysis of the region. First, using Light Detection and Ranging (LiDAR) data, the team worked to create a LASer (.las) data file. This type of file displays the surface across the earth in a formation of small points called point cloud data, as seen in Figure 12.

Using this .las file with point cloud data, the user must now create a Digital Elevation Model (DEM). ArcMap has conversion tools that allow any user to convert a .las file to a raster which will serve as the DEM for further analyses. Figure 13 is an example of the DEM created which displays changes in elevation via a gradual color scheme. Using this DEM as base, the city now has access to a much more comprehensive set of analyses. Kristen Monteverde and Timothy Schempp worked in their Geography 584 class to prepare a set of highly capable tools with Santee’s GIS support services. The City of Santee does not have as large of a range of GIS capabilities as is available at SDSU, so the students worked to develop products the city could use. Using the simple nature of layers, Kristen Monteverde and Timothy Schempp created a watershed polygon layer and other polygon layers to help the city track and observe drainage at various thresholds. In addition, they created a working toolbox to run various analyses easily without requiring knowledge of the complexities involved with ArcMap tool boxes. Over 70 new data points for missing storm water inlets were created and added to the layer.

**Missing Sidewalks and Pedestrian Ramps**

With the revision of the Americans with Disabilities Act (ADA) in 2010, local city governments must now incorporate new design elements into community development. City governments are required to provide a handicapped-accessible route for 60% of public entrances, which include sidewalks and city streets. The development and management of the sidewalk program is best handled with a GIS database.

Jonathan Cuaycong, Ellen Hart, Kenneth Gervais, and Tim Nolan worked to collect data on 96 roadways. They obtained totals for missing sidewalks, missing ramps, and
number of driveways. Using a combination of orthoimagery and Google Maps Street View, the students worked with an Excel spreadsheet, examining each roadway one at a time. The spreadsheet was formatted to calculate total cost for each of the imputed figures, but still more had to be done to satisfy the ADA standards. As the students cycled through each street, they also worked with ArcMap to create point and line features to identify four different scenarios; ADA ramps, non–ADA ramps, no ramp, and missing sidewalks. As shown in Figure 14, each of the scenarios has a specific symbol which represents the location and status.

With this graphical approach, the City of Santee is much better equipped to approach the continued process of complying with ADA standards. All in all, their results pointed to over 97,000 ft. of missing sidewalk, 332 ADA ramps, 883 non–ADA ramps, and 313 missing ramps.

Conclusion

Environmental Responsibility

As communities continue to focus on sustainability, greater importance is placed on how we interact with the environment. With Santee’s high growth rate and internal goals of preserving suburban nature, this project remains green at heart. The park asset collection project helps land use planners better analyze how people use, and in turn change these parks through use. Questions about placement of trash containers and water drainage ditches, as well as most appropriate types of pavement can all be answered by creating a geodatabase. A spatial perspective improves city parks’ relationship with the surrounding environment by improving planning and environmental impact mitigation efforts.

The storm water inlet collection project assists Santee in better understanding how water travels across the surface of the city and beyond. With the San Diego River running through its center, there is an implied emphasis on the city’s environmental responsibility in protecting that ecosystem. Tracking high volumes of runoff and toxins is extremely difficult without a complete storm water database, as suggested by this project.

Economic Equity

It is imperative that any city project funded by tax payer money take into consideration its fiscal impact. Generally, the projects presented in this report are designed to save the city money. Though the sidewalk collection process uncovers a potentially costly revision for the city, incorporation of geodatabases increases the efficiency of the improvement process, likely to save the city thousands. Similarly, tracking the placement and inventory of park assets improves their management.
This prevents unnecessary buying, more effective asset placement, and an easier system for improvement at these parks. These measures save time, and reduce costs associated with labor or unintegrated data management.

Additionally, improving the tracking process for pollutants and sources of toxins flowing into the San Diego River enhances response and cleanup efforts. Building the complete system of storm water inlets and subsequent pipes saves taxpayer money in future research the city is likely to conduct in discovering pollutant sources. There is also room for future development where integrated systems of sensors and metadata can be derived and used to managed storm water, all at a much more efficient and cost effective rate.

**Social Equity**

The City of Santee is small in size, but nonetheless a growing community. All three portions of this project improve the standard of living in the city. The Santee Park and Recreation Committee is capable of improving community character by upgrading and constructing parks. The storm water department is better equipped to track the flow of water and possible pollutants, improving community health and wellness. The ADA sidewalks project promotes livability in the city by making transportation more feasible for those with disabilities. Each project equips the city to better develop the sense of community that exists in the small valley.

The deliverable result of this project to the City of Santee is a unique database that describes city management of parks and recreation in its first virtual graphic form. The integrated database is designed to pull together all aspects of the park asset management and creation process for a streamlined approach to visualizing what goes into these parks. By defining what exists in actuality at each location through a virtual database, city officials are equipped with a multifaceted tool to battle the challenges of improving community character, sustainable city milestones, and fiscal responsibility of taxpayer money. This tool is also the starting point for the collaborative approach of VGI in the broad spectrum of life, where any community member may soon be able to use an application to improve the overall community character where before the opportunity did not exist. GIS alone is not going to transform the way city management is done. However, the introduction of GIS technology to city management, and specifically parks and recreation will improve the processes that goes into making where we live much more of a community.