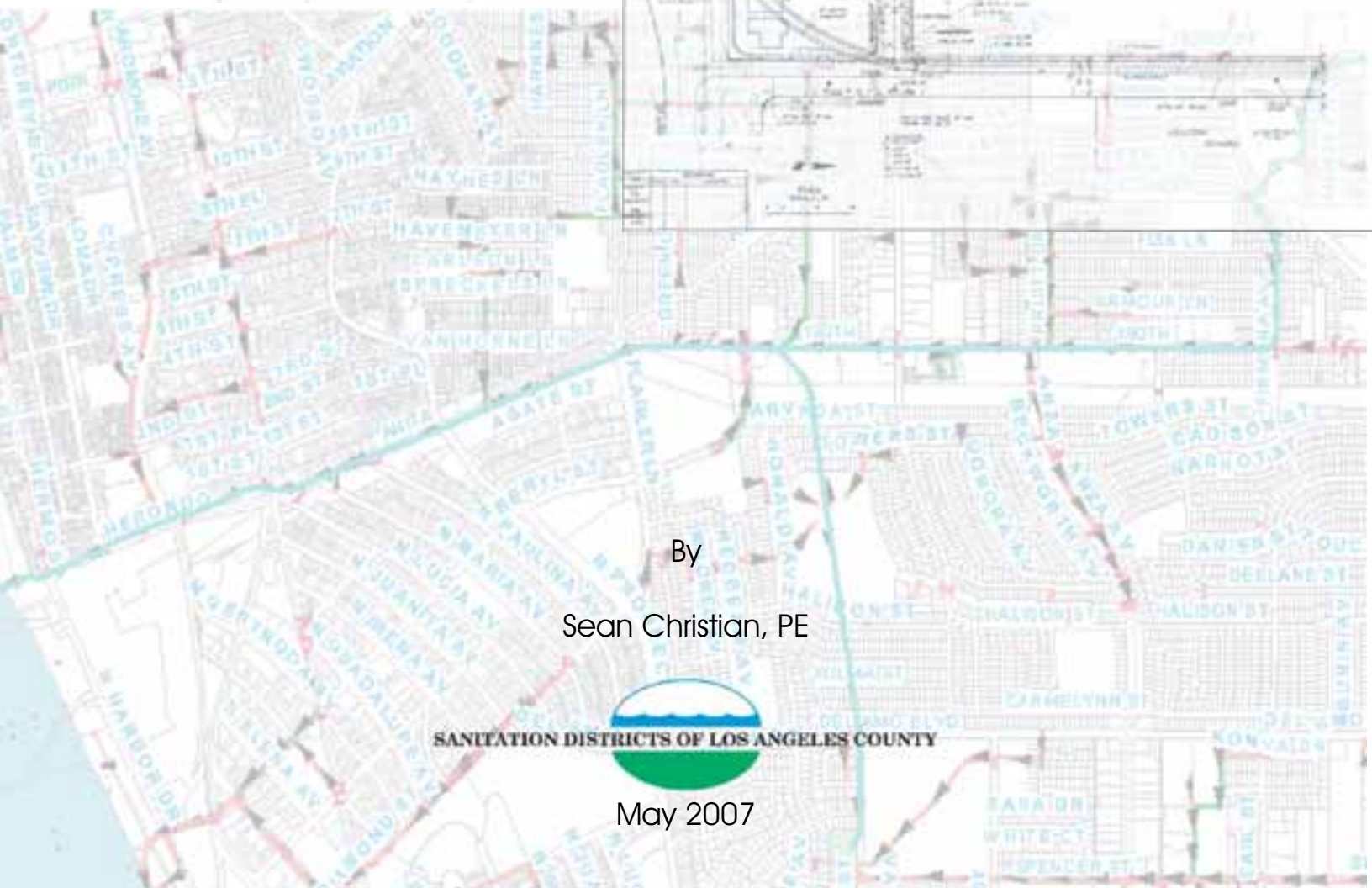


Los Angeles County Storm Drain Initiative



By

Sean Christian, PE

SANITATION DISTRICTS OF LOS ANGELES COUNTY

May 2007

TABLE OF CONTENTS

STORM DRAIN INITIATIVE ABSTRACT	2
PROJECT BACKGROUND, NEEDS, AND OBJECTIVES	2
Project Needs	2
Project Objectives	2
TIMELINE	3
Agency and Stakeholder Outreach	3
Task Force	3
Project Kick-Off	4
Investigate and document potential sources of data	4
Develop data standards	4
Develop a geodatabase model	4
Pilot Project	5
Project Implementation	5
RESULTS AND DERIVED BENEFITS	6
Captured Stormwater Features	6
Network Tracing	7
SDI Application	8
SDI Website	9
Data Hosting and Maintenance	9
Stakeholder Acceptance	9
Derived Benefits	9
Single Source of Information	10
Customized Application	10
Network Tracing	10
NPDES Permit Requirements	11
Local Agency Benefits	11
Special Interest and Academia Benefits	11
The Future of SDI	12

STORM DRAIN INTITATIVE ABSTRACT

The Storm Drain Initiative (SDI) is a cooperative effort to capture and maintain a complete geographical information systems (GIS) layer of the storm water management infrastructure within Los Angeles County. The Sanitation Districts of Los Angeles County are spearheading this effort for the benefit of local cities, county and regional authorities, and environmental interest groups.

This presentation will provide valuable insight on how the SDI will provide the foundation for future benefits to local agencies and jurisdictions within Los Angeles County. Potential future applications of this data could include emergency spill response, Best Management Practices, dry-weather diversions, source identification, TMDL and permit enforcement, maintenance management, and watershed delineation. Data access and analysis tools have been developed for county stakeholders through an ArcIMS application, which will be demonstrated as a part of the presentation. Experiences gained through implementation and management of a countywide collaborative effort will be shared.

PROJECT NEEDS AND OBJECTIVES

Project Needs

Stormwater conveyance facilities within Los Angeles County are owned by several jurisdictions that maintain information on the collection systems independently. In addition, smaller cities contract with Los Angeles County Department of Public Works (LADPW) for operation and maintenance services. Because of this, information on the path stormwater takes to reach the ocean or a river is segmented, making it difficult to analyze regionally.

Cities and county agencies are increasingly being held responsible for knowledge of the collection systems tributary to their jurisdictions. This has increased the need for countywide storm drain information. In addition, access to information of stormwater facilities within the county is compartmentalized. Regulatory agencies, academia, and special interests lack data resources and knowledge of the stormwater collection system.

Project Objectives

The Sanitation Districts spearheaded the creation of a countywide storm drain database and GIS layer for the benefit of local communities. Project elements include:

- ❑ Digitize storm drain infrastructure (pipes, junction structures, catch basins, channels, and access driveways) from paper or scanned imagery.
- ❑ Develop logical network topology consistent with the direction of flow for tracing and analysis.
- ❑ Piece together a comprehensive dataset of information from numerous sources including paper maps, construction drawings, scanned imagery, CAD data, and existing GIS resources.
- ❑ Capture attribute data of storm drain components such as age, jurisdiction, size, stationing, name, type, shape, size, material, and other related information to support application development.

- Make the data widely accessible to project stakeholders to facilitate its use and maintenance.

TIMELINE

Agency and Stakeholder Outreach

Since there is no single agency responsible for all existing storm drains within Los Angeles County, the creation, update, and maintenance of this data required close collaboration of key stakeholders. This group consisted of cities, CalTrans, U.S. Army Corp, and LADPW. Other groups not responsible for storm drains but requiring information as a part of existing business needs included regional watershed management groups, special interests, academia, and regulatory agencies. Extensive outreach to public agencies and stakeholders was a critical first step of the SDI. These efforts included several presentations to existing GIS and water quality groups. Interest in the SDI grew and representatives knowledgeable about GIS or stormwater collection were identified.

Close cooperation with LADPW was also critically important to the overall success of the project. During routine meetings, LADPW staff expressed interest in eventually owning and maintaining the data. This was a logical outcome since they manage the majority of stormwater infrastructure within the county and could best maintain the data once the project is complete.

Task Force

The Storm Drain Initiative Task Force (Task Force) was also key to the success of this project. Task Force members can be described as either potential users or owners of storm drain data. It is critical that users of the data have a firm understanding of the limitations and liabilities associated with the creation and eventual maintenance of the data. It is their task to ensure that the data is used responsibly. Users, on the other hand, must gain ownership of the final product and agree to its routine maintenance if the data will ever prove to be useful. Task Force members include:

- CalTrans
- City of Long Beach
- City of Los Angeles
- City of Pasadena
- Community Conservancy International
- Environmental Systems Research Institute
- Green Info Network
- Heal the Bay
- Los Amigos De Los Rios
- Los Angeles and San Gabriel Rivers Watershed Council
- Los Angeles County Department of Public Works
- Los Angeles County Municipal NPDES Executive Advisory Committee
- Los Angeles County Sanitation Districts
- Regional Water Quality Control Board – Los Angeles Region
- South Bay Cities Council Of Governments
- Southern California Association of Governments
- University of Southern California

The Task Force was formed early in the process to help develop a scope of work. This was done through exercises that helped define applications whose primary data requirement is a complete GIS storm drain layer. Applications are summarized in Table No. 1 and were segregated into two

Table No. 1 - Summary of Applications Supported by the Storm Drain Initiative

Storm Drain Initiative Matrix		Features to be Captured within the Proposed Scope of the Project													Desired Interfaces with Databases/Coverages Maintained by Others												
		Pipes/channels/connectors								Manholes/connections/structures					Water bodies			Access driveways		Watershed Delineations	Water Quality	BMPs	NPDES Dischargers	TRI/W	Basin Plan Objectives		
Stakeholder Interests	Contribution the Proposed Scope Makes towards the Stakeholder Interests	Flow direction	Open/closed	Size	Material	Shape	Owned by	Maintained by	Project name	Drawing#	Stationing	Owner/Maintainer ID?	Type	Owned by	Maintained by	Project name	Drawing#	Stationing	Owner/Maintainer ID?							Name	Type
		Mapping/CMMS A tool to help locate storm drain infrastructure, especially as a part of routine maintenance. Also included in this application is the ability to schedule routine maintenance and view past reports/activities.	This project will develop a comprehensive map of storm drain features to the catchbasin level of detail. Additionally, the ownership and maintenance responsibility will be identified where data are available.					✓										✓									
Spill Response/Containment A tool to help prevent accidental spills within the watersheds from impacting the beneficial uses of receiving waters.	This project will provide connectivity of storm drain features to allow users to trace a spill from an entry catchbasin through the downstream flow path. Potential containment locations (i.e., pump stations and daylighting locations) can be identified.					✓										✓											
Source Control/Enforcement A tool to help identify and eliminate potential point sources of contamination within the collection system.	The comprehensive map of the flood control system (to the catchbasin level of detail) will provide the ability to estimate the boundaries of an area to be investigated.					✓										✓								✓			
TMDL Development A tool to help develop TMDLs for a given watershed.	The coverage developed by this project can be combined with water quality monitoring, land use, and jurisdictional coverages to support TMDL development.					✓										✓									✓		✓
BMPs A tool to help NPDES dischargers evaluate the performance of BMPs.	This project may provide a repository for BMP locations to facilitate information sharing between agencies. This needs to be discussed.					✓										✓											
Jurisdictions A tool to identify ownership and maintenance responsibilities for storm drain infrastructure.	This project will attribute the features with ownership and maintenance data.					✓										✓											
Compliance A tool to help regulators manage compliance.	This project will provide immediate access to a map of the system and the jurisdictions responsible for individual elements. Additionally, the development of a county-wide feature ID will allow regulators to standardize incoming data for ease of analysis.					✓										✓											✓

categories: those that only need storm drain data, and those that require additional data resources. Data needs were quickly identified and issues such as data accuracy and standards were debated in a technical sub-committee. A project scope was developed from this information, which eventually formed the scope of work within the RFP. Task Force participants were given the opportunity to comment on the RFP before it was advertised. Nobel Systems was selected through a competitive process to develop the data at a cost slightly less than the amount budgeted.

Project Kick-Off

A project kick-off meeting included a more detailed discussion on the approach for developing the data. It was agreed that the following tasks were necessary before data production could begin.

- Investigate and document potential sources of data
- Develop data standards
- Develop a geodatabase model

Investigate and document potential sources of data

Storm drain information is managed by an array of small and large public agencies within Los Angeles County including cities, CalTrans, U.S. Army Corps of Engineers, and LADPW. Initial contact was made through a formal letter with all 88 cities in Los Angeles County as well as county, state, and federal agencies that have jurisdiction over storm drains. Nobel Systems followed up with each jurisdiction to document a point of contact and the sources of storm drain information. Only information that was made available through official requests or follow up conversations was digitized.

LADPW represented the most significant source of information. They had recently imaged their entire collection of stormwater as-built drawings, which proved to be the best source for building the database and GIS layer. This allowed detailed construction data to be captured and provided the best source for positional accuracy.

Other sources of data included existing GIS layers of information. Fourteen of the cities, including Los Angeles and Long Beach, contributed their GIS data, which was incorporated through a similar process of data conversion from as-built resources.

Develop data standards

Data standards come from an understanding of the source information. Based on the level of accuracy and format, general standards were developed to help guide the consultant during data production. The data standards that were developed addressed the following issues:

- Level of accuracy
- Digitizing methodology
- Information sources
- Missing information
- Special circumstances

Task Force members were provided and agreed to the data standards document. This document was later published on the website as a resource for stakeholders.

Develop a geodatabase model

A geodatabase model is the structure in which the captured data is stored. It is critically important that the geodatabase model be developed with the end user in mind. Several cities had already developed a GIS for their stormwater collection system and maintain individual models. A significant amount of work was needed to ensure that the geodatabase model adopted for the SDI could also communicate with existing models.

The City of Los Angeles had recently completed development of a detailed model to describe their system, which proved to be an excellent starting point. This model was compared to that of each other city. Changes were made when necessary to ensure compatibility. Finally, the information was also compared to the needs identified in the SDI. The result was a geodatabase model that is a lot more descriptive than what the SDI originally needed but would form a good foundation for incorporating existing GIS data.

Pilot Project

A pilot project is a good way to test assumptions made when developing the data standards and geodatabase model. The location of the pilot project should be simple enough to complete but incorporate enough complexity to put the assumptions to the test. The South Bay Cities area within Los Angeles County fit these criteria. Several cities within this region have developed GIS data independent of each other. LADPW owns and manages the large diameter backbone system serving this area, which is described in the scanned as-built imagery received from the county. The GIS community is well organized through a Council of Governments committee that meets monthly. This committee provided a good venue to discuss issues related to the pilot project.

The pilot project was successfully completed within 2 to 3 months. Also included in the scope of this project phase was development of a customized on-line GIS application. The purpose of this application was to provide stakeholders an intuitive tool to access the data and track the overall progress of data development. Nobel integrated each city's GIS database and links to scanned as-built drawings if provided. Links to all of LADPW's scanned as-built drawings were also made available. Other features of the application include network tracing upstream and downstream of a chosen point and rich interaction with the county's parcel database. Nobel Systems provided free access to any stakeholder during the course of the project. This application is heavily used, receiving over 100 instances of user logons per month.

There were no significant changes to the data standards or geodatabase model upon successful completion of the pilot project. QA/QC procedures were developed based on the outcome. Detailed printed maps of each jurisdiction were sent to contacts with a formal letter requesting their comments. Several cities also requested a digital copy to perform field checks. The City of Carson reported 90% accuracy by comparing SDI data to field verifications.

Project Implementation

With a proven concept achieved through a pilot project, the focus transitioned to the remainder of the county. For accounting purposes, the county was geographically segregated into eight zones, with the South Bay Cities area designated as zone one. The digitizing team worked to digitize each zone based on the standards developed at the beginning of the project. Once a zone was completed, it would go through QA/QC checks before being published on-line. A few cities presented additional as-built drawings after realizing the value of what was being produced. Given the budgetary constraints on the project, the additional work was held to the end. The majority of these were eventually added, which depleted the remaining budget allotted for this project. Other sources of funding for maintenance of the data will likely need to be secured before any additional as-builts can be incorporated.

RESULTS AND DERIVED BENEFITS

The stated goal of the SDI was to build a complete GIS layer of the storm drains within Los Angeles County using available information from responsible jurisdictions. Results of the SDI included:

- ❑ Captured stormwater features to the catch basin level
- ❑ Enabled network tracing in support of analysis
- ❑ Deploy an on-line application for stakeholders use
- ❑ Develop a project website for updating users on progress
- ❑ Provide a hosted data solution for update and maintenance

Captured Stormwater Features

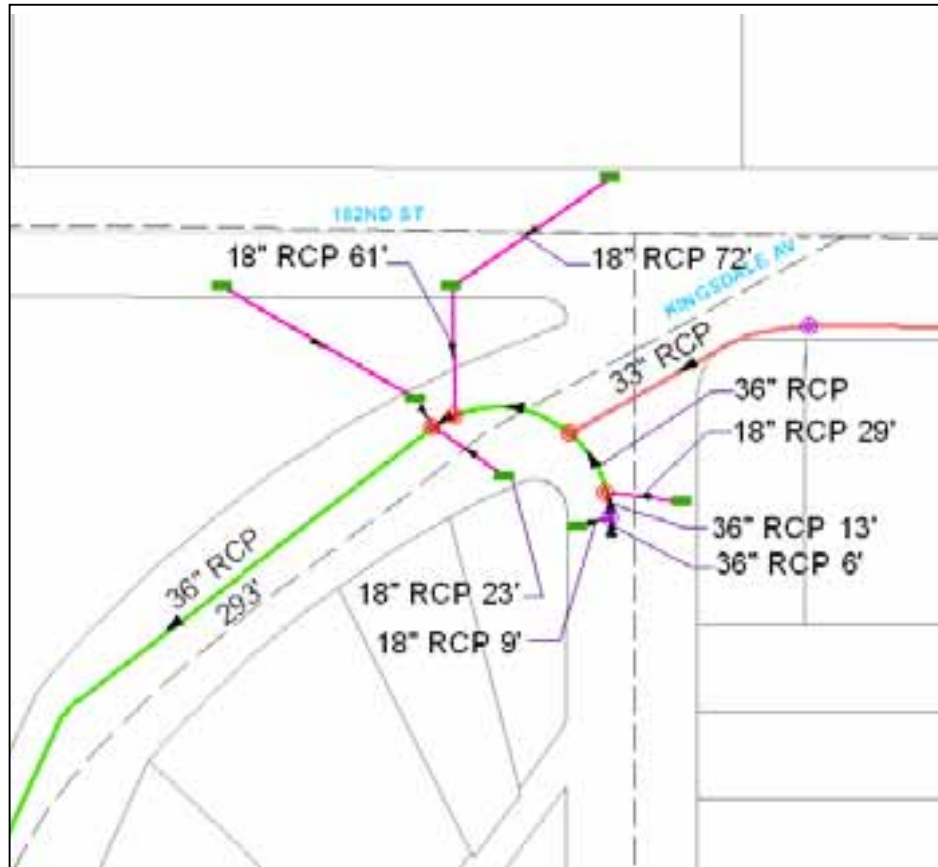
Although 14 cities provided digital data that was incorporated into the SDI, the majority of stormwater features were captured from as-built drawings. LADPW provided the largest source of as-built drawings. Overall, the SDI processed over 60,000 as-built drawings. The following statistics in Table No. 2 summarize the amount of physical structures captured in the completed database and GIS layer for the SDI.

Table No. 2
Summary of
Captured Storm Drain Features

Storm Drain Feature	Number	Storm Drain Feature	Number
Catch Basins	163,317	Pump Stations	121
Clean Outs	269	Force Mains (Miles)	4
Fittings	10,090	Channels (Miles)	675
Inlets	18,879	Storm Mains (Miles)	5,094
Energy Dissipaters	61	Lateral Lines (Miles)	1,523
Maintenance Holes	136,788	Casings	288
Network Structures	34,889	Easements	2,334
Parkway Drains	34	Misc. Structures	340

Figure 1 shows the level of detail for annotated maps. Different colored lines denote ownership (city versus county) or function (local versus main). These maps can easily be organized and outputted for future maintenance map production.

Figure 1
Typical Map Annotations Captured



Network Tracing

Capturing storm drain data within a GIS allows for future analysis of the stormwater collection system using a rich set of tools. More than analysis, GIS allows for communication across jurisdictional and stakeholder boundaries. Providing network connectivity within the collection system is critical to give stakeholders the functionality they need. The completed SDI provides network tracing capabilities throughout the stormwater collection system, allowing users to quickly identify sources and direction of flow.

Figure 2 is an example of a single downstream trace of the stormwater collection system within the City of Redondo Beach. The light blue line represents a stormwater line originating for the selected point at the upper right of the image that either ends up at the ocean or a retention basin owned and operated by LADPW.

Figure 2
Network Tracing



SDI Application

The consultant, Nobel Systems, developed an Internet GIS application for viewing and analyzing the data. The SDI application contains many useful tools that take advantage of GIS technology. Some of the features of the SDI application include:

- Access to the SDI data
- Stormwater features annotated with the direction of flow
- Upstream and downstream tracing from a defined point
- Interaction with county parcel and ownership information
- Links to scanned as-built imagery
- Access to cities' stormwater infrastructure database alongside SDI data
- Local and regional sewer data maintained by LACSD

The SDI application was made freely available to all countywide stakeholders during the course of the project. This proved valuable for participants to track progress and provide feedback. The application requires a secure logon and password to begin use and can be accessed on any computer with Internet capability. This is especially useful for quick deployment in the field, requiring only a tablet or laptop computer with a wireless connection to the Internet. Since project completion, Nobel Systems has offered the application at a low cost to cities and county agencies. Several cities have already committed to accessing the data using the SDI application.

SDI Website

A project website (www.lastormdrains.net) was developed to help with agency outreach and allow stakeholders to track progress. Information regarding the geodatabase design and data standards was published for easy access. The website also provides access to the SDI application. Metadata, or data about the data, will also be published in the future to provide direction on proper use. Details on how to obtain the data and future Task Force actions are potential website enhancements as the project transitions into a maintenance phase.

Data Hosting and Maintenance

One of the challenges facing the overall success of the SDI is on-going maintenance and updates to the data. SDI data is currently the most up-to-date and complete source for information on storm drains within the county. However, this information loses its value over time if it is not updated. In addition, improvements to the data can be made much more efficiently if it can be easily accessed.

LACSD and LADPW have worked cooperatively to provide a solution for meeting update and maintenance needs of countywide stakeholders. Updates and maintenance to SDI data can be made easily by utilizing current web-based technology. LADPW plans to host the SDI data through a web service, which would allow stakeholders to access the data on-line and provide their input to the SDI data dynamically. LADPW is committed to taking ownership of the SDI data and responsibility for its long-term maintenance.

Stakeholder Acceptance

Agency outreach and acceptance was as important to overall project success as developing the data. Working closely with the responsible agencies for stormwater management within the county ensures that the data is utilized and maintained. Task Force meetings held throughout the course of the project informed stakeholders on the value of the data and educated them on its proper use.

Through the course of the project, it was clear that the data produced was gaining widespread acceptance. This was evident by the high level of participation by most cities and county agencies. Those cities that had Storm Drain GIS data freely shared this information after understanding the benefits of a countywide layer. LADPW, being the largest stakeholder, expressed early interest in owning and maintaining the information upon project completion. They also agreed to take a lead role in the Task Force and make the data available through a hosted solution. During the QA/QC process, many cities requested digital copies of the data to correct the information through field verifications. Correcting the data added value to the completed layer as well as the end product for each of these cities. Other cities and LADPW marked up paper maps with changes to be incorporated. In some instances, cities were reluctant to return these marked up maps after realizing the value of the data contained on the maps.

Derived Benefits

The purpose of the SDI was to develop a complete GIS layer of the stormwater collection system for the benefit of cities and county agencies. While several benefits were realized upon completing the project, the true value of the SDI is the foundation that has been laid for the future. Benefits realized by completing the project include:

- Development of a single source of information for the entire county
- Provide analytical and decision-making tools through a customized application

- Support network tracing functionality to quickly identify sources or downstream facilities
- Meet RWQCB requirements for development of GIS information
- Provide better data resources for local agencies, special interests and academia

Single Source of Information

Given the availability of stormwater collection and conveyance system data available for decision makers, maintenance crews, regulators, and emergency responders, developing a better source of information in of itself provides a large benefit for the watershed management community. Investigating the sources of information revealed that jurisdictions traditionally responsible for management of stormwater facilities only had knowledge of their own systems with little or no understanding of how water moved between them.

The SDI delivers the most current information regarding the stormwater collection system using GIS technology. Hosting this information through a web service allows all jurisdictions access to the data as it is being updated and maintained. Agencies that traditionally maintain this information can pass along updates electronically using this technology. Jurisdictions can also incorporate this information into their own customized applications to meet existing business needs. A GIS can also make use of mapping technology to develop and print maintenance map books for field crews and engineers. Attribute data includes information about ownership, maintenance, and construction related details. Prior to the SDI, this information was not readily available for jurisdictions themselves. Having this data published through a web service provides the same detail to all jurisdictions within the county and have access to updates as they are made. Additional data resources such as independent storm drain data or drawings were also added to the SDI. Cities that maintain independent databases can now view each other's information through the SDI application. Available scanned as-built drawings maintained by all jurisdictions within the county can also be viewed through the same interface.

Customized Application

The customized application to view and interact with the stormwater data offers significant benefits for all cities and county agencies. The application ties all of the data together and delivers it over the Internet through a secure website interface. Other significant data, such as local and regional sewers, add functionality for putting this information to use. Emergency spill responders and maintenance crews can easily access all of the SDI information and related data and drawings in the field using a tablet or laptop PC with a wireless Internet connection. This makes deployment of the data to the people that need it a simple and inexpensive solution.

Network Tracing

The obvious benefits of network tracing are its abilities to quickly identify sources of stormwater and downstream facilities. This capability lends itself to several future enhancements. Although direction of curb and gutter flow remains unknown, having the ability to trace upstream from any given point in the system to the catch basin level helps to delineate smaller drainage areas within watersheds. This is helpful to the Sanitation Districts in current efforts for characterizing potential dry weather diversions into the sewer collection system. The same technology coupled with water quality monitoring systems could provide the ability to trace sources of contamination upstream to its end. A network of monitoring devices could also provide early warning of contamination within the stormwater network. Network tracing also will help in emergency spill response since rapid deployment and decision-making are keys to successful containment. Researching the correct jurisdiction to contact or identifying a place to intercept and contain contaminated flows takes

valuable time. The SDI application can easily be deployed in the field, giving responders a valuable tool for containing and treating contamination.

NPDES Permit Requirements

The RWQCB has begun to require local jurisdictions within the county to develop and maintain storm drain information within a GIS. Several cities and LADPW confirmed that this was a priority given likely restrictions being imposed in the future. The RWQCB was an active participant in the SDI from the very beginning and has agreed that participating in the SDI will meet discharger requirements for developing GIS data. The RWQCB plans to use this information to help manage its NPDES permit and enforcement programs. Several cities and LADPW are also interested in using this as a tool to communicate BMPs between each other and the RWQCB. Coupled with monitoring devices, permitted dischargers and the RWQCB can analyze the system to investigate the usefulness of BMPs.

Local Agency Benefits

During the SDI project, several jurisdictions and interest groups contacted the Sanitation Districts with requests for the data ahead of the completion deadline. This was largely due to existing projects that would benefit directly from this data. The cities of Lakewood and Southgate were beginning master planning efforts for their storm drain systems but lacked good sources of information. The SDI will help them by providing an excellent source of data. The following cities have already made requests for the data and intend to incorporate it into their existing maintenance management and GIS programs.

- | | |
|--|--|
| <input type="checkbox"/> Alhambra | <input type="checkbox"/> La Canada |
| <input type="checkbox"/> Arcadia | <input type="checkbox"/> La Habra Heights |
| <input type="checkbox"/> Carson | <input type="checkbox"/> Lakewood |
| <input type="checkbox"/> Calabasas | <input type="checkbox"/> Lancaster |
| <input type="checkbox"/> Cerritos | <input type="checkbox"/> Long Beach |
| <input type="checkbox"/> Claremont | <input type="checkbox"/> Los Angeles |
| <input type="checkbox"/> Diamond Bar | <input type="checkbox"/> Manhattan Beach |
| <input type="checkbox"/> Downey | <input type="checkbox"/> Monrovia |
| <input type="checkbox"/> Duarte | <input type="checkbox"/> Rancho Palos Verdes |
| <input type="checkbox"/> El Monte | <input type="checkbox"/> Redondo Beach |
| <input type="checkbox"/> Gardena | <input type="checkbox"/> San Marino |
| <input type="checkbox"/> Glendale | <input type="checkbox"/> Southgate |
| <input type="checkbox"/> Hawthorne | <input type="checkbox"/> Torrance |
| <input type="checkbox"/> Hermosa Beach | |

Special Interest and Academia Benefits

Several special interest groups have participated in the project or contacted the Sanitation Districts during the project. The majority have existing studies or projects that would benefit by having access to a complete GIS layer of stormwater features within the county. For instance, the Los Angeles And San Gabriel Rivers Conservancy plans to use the data to better define sampling points within San Gabriel River. This work could also be duplicated for the Los Angeles River. The SDI data would also be helpful in their efforts to characterize sources of stormwater and dry weather diversions.

Community Conservation International (CCI) in close cooperation with LADPW and GreenInfo Network are currently working toward a 2009 ballot proposition for funding future watershed management projects. Their initial focus was to fund the creation of a complete GIS layer of stormwater features. After learning of the SDI, this group is now interested in helping to further the use of this data through project implementations. An example of an implementation would be to tie monitoring information to the GIS layer for flow quality and quantity monitoring or equipping first responders with tools to access the SDI data in the field in the event of a spill. CCI also recognizes the value of this data in gaining support for the initiative. The Sanitation Districts and LADPW are working in a supporting role to provide statistics and maps of the storm drain data for presentation purposes.

The University of Southern California participates in the Task Force and has been heavily involved throughout the project. USC's interest is in a joint project with the San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy called *The Green Visions Plan*. The focus of this plan is to investigate watershed modeling and innovative ways of estimating runoff routing. They are also interested in using SDI data in a recharge suitability study.

The Future of SDI

Although the project for creating the data has been completed, the initiative is far from over. The results provide a rich source of data to improve watershed management and environmental protection. Task Force participants have expressed great interest in continuing the work that was started through the SDI. LADPW has agreed to take a leadership role in maintaining and hosting the data. Special interest groups have begun to take notice and are now looking into ways of funding implementation of this data resource. Several cities have already requested this data to address their business needs. LACSD also plans to utilize this information heavily for existing programs such as dry weather diversion and spill response.