

Use of GIS Technologies to Facilitate the Transportation Project Programming Process

The William and Barbara Leonard UTC CSUSB

Prime Award No. 65A0244

Sub-Award No. GT 70769

Awarding Agency: California Department of Transportation

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May 2008

This project was funded in its entirety under contract to the California Department of Transportation.

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EXECUTIVE SUMMARY

Transportation project programming in a transportation agency is a process of matching potential projects with available funds to accomplish the agency's mission and goals of a given period of time. Result of this process is normally a transportation improvement program (TIP) or a Capital Improvement Program (CIP) that sets up the financial plan as well as the scope and schedule of transportation improvement projects to be implemented by a transportation agency.

Many transportation agencies (including Southern California Association of Governments (SCAG) and the Orange County Transportation Authority (OCTA)) recently have employed Geographical Information System (GIS) technologies to facilitate their project programming process. The geographical representation of transportation projects greatly helps decision-makers prioritize transportation projects visually. It also helps notify the public of transportation improvement projects in an easy-to-read, graphic format on the Web.

This project has conducted an assessment of cities in the Inland Empire region on their transportation project programming process and the use of GIS technologies for the programming process. Based on the assessment, the project has provided recommendations and methodologies that could be used to incorporate GIS and project programming tools in the development of transportation improvement programs. Also the project has developed a GIS-based conceptual framework and a work plan whose purpose is to implement the programming methodologies for the cities within the Inland Empire region.

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1. INTRODUCTION

Transportation project programming in a transportation agency is a process of matching potential projects with available funds to accomplish the agency's mission and the goals of a given period of time. Result of this process is normally a Transportation Improvement Program (TIP) or a Capital Improvement Program (CIP) that sets up the financial plan as well as the scope and schedule of transportation projects to be implemented by a transportation agency.

Projects listed in a TIP may include improvements of highways, upgrades of transit, rail and bus facilities, provisions of carpool lanes, synchronization of traffic signals, and improvements of intersections, freeway ramps and other related facilities. Projects included in a CIP are all the projects to be implemented within a city. These projects may include activities such as road and sidewalk improvements, tree projects, park/playground equipment upgrade, building maintenance, water and sewer maintenance and improvements, traffic signal upgrade, and park maintenance.

Many regional transportation agencies (including the Southern California Association of Governments (SCAG), Orange County Transportation Authority (OCTA), and Chicago Area Transportation Study (CATS)) recently have employed GIS technologies to help the agencies 1) determine which projects should receive funding and which projects should be postponed or completely removed from consideration, 2) set priorities for project implementation, and 3) display projects graphically on transportation networks and inform them to the public. The geographical representation of potential transportation projects, which shows where the projects are, provides visual aids in programming transportation projects. Also, the presentation helps the public and decision-makers know the critical tasks (TIP or CIP projects) to be undertaken by transportation agencies.

Transportation agencies or cities in the Inland Empire region (or in the San Bernardino and Riverside counties) have used GIS technologies to collect, store, and manage location-based information for land use planning, economic development, emergency management, transportation system improvement, pavement preservation, environmental analysis, etc. Example GIS applications include:

- Hardcopy or Internet-based GIS maps that represent city streets, parcels, and sanitary and storm utilities,
- Interactive GIS tools/services to allow the public to download GIS maps in PDF format through Internet,
- GIS-based Online permit system that allows citizens and developers to obtain a variety of information regarding proposed developments/redevelopments for properties within cities,

- GIS displays that help people view land use and zoning maps and maps of neighborhood boundaries, historic resources, redevelopment projects, parks, trails, parking facilities, and traffic flows.

However, the use of GIS technologies to facilitate the general plan as well as the transportation project or the CIP development process within the Inland Empire cities is not clear.

The objectives of this research project are to have an assessment on the general plan and CIP development processes (including the level of GIS use in CIP) that have been used by the cities in the Inland Empire region. Based on the assessment, the project provides recommendations and methodologies for incorporating GIS and project programming tools in the development of transportation improvement programs. Also the project develops a GIS-based CIP conceptual framework and outlines a future work plan to promote the use of GIS in the CIP development.

In order to archive the above objectives, the project team has conducted the following tasks:

Task 1 Assessment of General Plan and CIP Development Process

All the available general plans and CIP documents that can be found in the cities of the Inland Empire region have been reviewed in this task. Also, the general plan and CIP development processes have been assessed. The levels of GIS use in facilitating the general plan and CIP development process have been summarized. The assessment is conducted through an extensive review of materials published on the web sites of the Inland Empire cities.

Task 2 Selection of a City for Case Study

The City of Ontario has extensive GIS applications for project development and management. Therefore it is selected in this research to further evaluate their general plan and CIP development process and the level of GIS use in CIP.

Task 3 CIP Development Process Investigation

The general plan and CIP development processes of the City of Ontario are further assessed through interviews with the City's engineers and planners. A summary of the general plan and CIP development processes and the GIS use in CIP for the City is provided.

Task 4 GIS-based CIP Conceptual Framework and Future Work Plan

A GIS-based CIP conceptual framework has been developed for project development and prioritization in this task. This framework incorporates public involvement, city's inputs for CIP, as well as GIS technologies in the project development and programming process. A future work plan has also been outlined to implement this framework.

2. GENERAL PLAN AND CIP DEVELOPMENT PROCESS

Inland Empire is a region in Southern California that refers to incorporated cities and unincorporated communities in Riverside and San Bernardino Counties. Figure 1 shows the location of Inland Empire in relation to Greater Los Angeles area, Orange County, and San Diego in the Southern California. Tables 1 and 2 list the incorporated cities within the Inland Empire area.



Figure 1 Boundary of the Inland Empire Region
Source: <http://www.ieep.com/acrobat/map.pdf>

Since the 1950s, Inland Empire has developed from a rural to a suburban environment. Expanding from existing cities such as Ontario, Riverside and San Bernardino, the Inland Empire region is now composed of numerous suburban cities with affordable houses. Because homes are less expensive than ones in Orange and Los Angeles counties, Inland Empire has experienced significant growth in population, strong demand for housing, and solid needs to convert agriculture, vacant land for use for more intensive purposes (such as single-family houses, shopping centers, industrial warehouses, etc). This continuous development has become seemingly challenges to the development of general plans and capital improvement programs for planned and controlled suburban sprawl.

Table 1 Incorporated Cities in Riverside County

City	Population ¹	City Size (Square Miles) ²
Banning	23,562	23.1
Beaumont	11,384	27.2
Blythe	12,155	25
Calimesa	7,139	15.6
Canyon Lake	9,952	4.7
Cathedral City	42,647	19.5
Coachella	22,724	20.8
Corona	124,966	35.2
Desert Hot Springs	16,582	23.3
Hemet	58,812	25.6
Indian Wells	3,816	13.4
Indio	49,116	26.7
Lake Elsinore	47,634	26.7
La Quinta	41,415	32.2
Moreno Valley	186,000	50
Murrieta	97,257	28.4
Norco	24,157	14.1
Palm Desert	41,155	24.4
Palm Springs	45,731	95.1
Perris	36,189	31.4
Rancho Mirage	13,249	24.3
Riverside	291,398	78.4
San Jacinto	23,779	25.3
Temecula	97,935	26.3

¹ Population is obtained from 2000 Census

² City size is obtained from city's web site

Table 2 Incorporated Cities in San Bernardino County

City	Population	City Size (Square Miles)
Adelanto	18,130	53.54
Apple Valley	67,507	73.62
Barstow	21,119	33.59
Big Bear Lake	5,438	6.5
Chino	69,732	21.1
Chino Hills	80,897	44.9
Colton	47,662	15.7
Fontana	181,640	41.5
Grand Terrace	11,626	3.5
Hesperia	62,582	67.4
Highland	44,605	13.8
Loma Linda	18, 681	7.3
Montclair	33,049	5.10
Needles	4,830	30.2
Ontario	172,701	49.9
Rancho Cucamonga	144,958	37.46
Redlands	63,591	37.46
Rialto	93,284	21.88
San Bernardino	205,010	78.5
Twentynine Palms	14,764	54.8
Upland	70,493	15.1
Victorville	102,538	73.3
Yucaipa	41,207	27.8
Yucca Valley	16,865	40

The ongoing land development in the Inland Empire area has also resulted in long-commute travels for high-paid work and businesses in Orange and Los Angeles Counties. Such long-commute travels have created lots of problems including traffic congestion and air quality degradation. The solutions to these problems are not simple. Coordinated and well organized efforts are needed to help all the cities and communities to find feasible solutions to address these problems in their general plans and capital improvement programs.

General plan is the statement of a city's future vision. It acts as the most important long-term policy and planning document to address issues and problems in a city. It provides goals, objectives, zoning plans, and development/redevelopment activities that every department in the city should work for. It contains policies for every aspect of the city: land use, housing, open space and conservation, circulation (or traffic), noise, air quality, and health and safety.

California State law (Government Code Section 63500) requires each city and county shall prepare and adopt "...a comprehensive, long-term general plan for the physical development of the county or city, and any land outside its boundaries which ...bears relation to its planning." The general plan must address seven required elements: land use, housing, open space and conservation, circulation, public safety, and noise. It may also include optional elements (such as park and recreation) specific to the city.

Capital improvements program is one of the multi-year programs established to implement the general plan of a city. It aims at upgrading and expanding city facilities, buildings, grounds, streets, parks, roads, and sewers. It serves as a guide to build new facilities to meet the increasing demand for capital improvements throughout the city, as well as to upgrade or replace outdated facilities.

As shown in Tables 1 and 2, there are 48 cities within the Inland Empire region. General Plans and Capital Improvements Programs of these cities have been assessed in this research project. GIS use in supporting the general plan and CIP development processes has also been investigated. Appendices A and B show the detailed description of the assessment.

Findings from this assessment are as follows:

1) General Plan Development

Of 48 cities in the Inland Empire region, 46 cities have provided information about their general plan on web sites (see Appendices A and B). These cities have already developed the general plan for their cities and met the requirements of California State law. A few cities are currently in the process of revising or updating the general plan since the general plan is a living document and needs to be updated at a regular time based on the condition changes in the cities. The California State law requires each city update the housing element every five years.

In preparation for a new general plan or update on an existing general plan, almost all the Inland Empire cities have organized a General Plan Advisory Committee (GPAC) and a General Plan Steering Committee (GPSC) (or the GPAC/GPSC-like committees) to help the cities shape the future (see Figure 2).

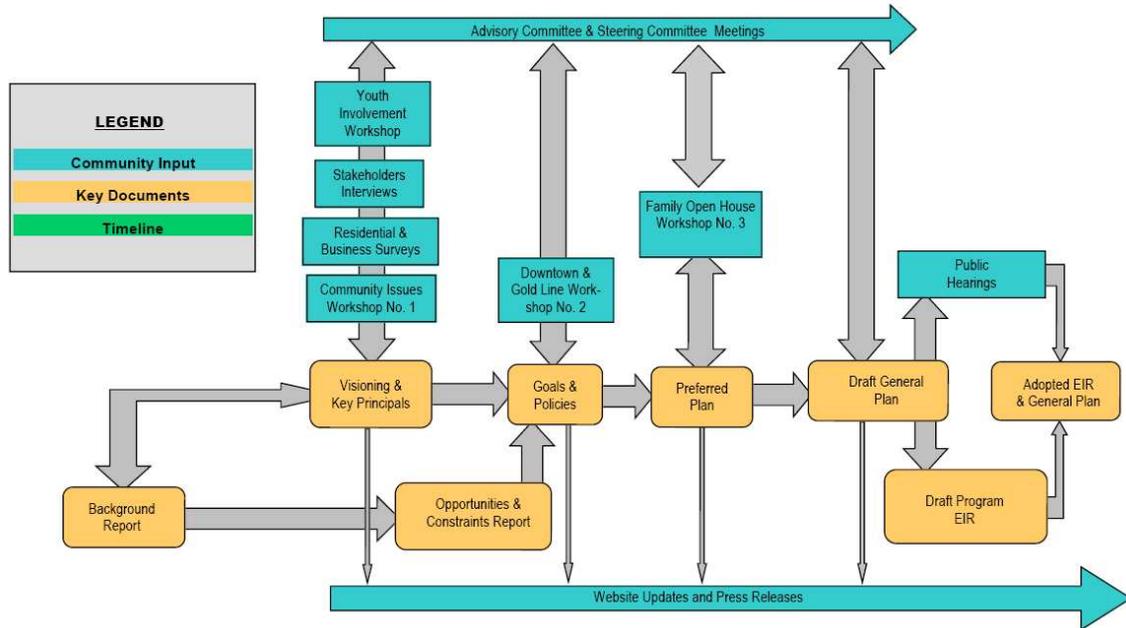


Figure 2 General Plan Development Process

Adopted from <http://www.accessduarte.com/Generalplan/documents/Introduction.pdf>

The GPAC, composed of City Commission representatives and a cross-section of residents and business stakeholders, serves in a technical support capacity to the General Plan Steering Committee. The GPAC members are in charge of helping the city define and formulate the goals and policies for the general plan. GPAC duties include 1) developing a background report for a new general plan or updating the background report of the existing general plan, 2) updating each element in the existing general plan, 3) reviewing drafts of each element in the general plan, and 4) transmitting draft elements to the relevant City Commissions and GPSC for review.

The Planning and/or Community Development departments in a city normally lead the general plan update efforts, because they, by California State law, are the primary review body for the general plan. They are responsible for making background report, opportunity/constraint report, and draft general plan to GPAC, GPSC, and City Council.

Consultant(s) may be hired to provide specific expertise in public outreach and education, conduct a variety of technical analyses, and prepare the draft general plan.

Environmental Impact Report (EIR) typically is developed along with the general plan. It evaluates the environmental changes or impacts due to the updates of existing general plan. It includes thresholds and baseline information for evaluating future development projects. It provides an environmental study of all data (such as air quality, noise, transportation, geology, etc) for future projects.

Public participation is a key component of the general plan update process. The cities in the Inland Empire have used a number of methods to get residents and business stakeholders to be involved in the general plan development/update process. The methods include questionnaire/telephone surveys, workshops, and numerous council and commission meetings or workshops. They also use special web sites and newsletters to inform information about the general plan development process to residents. Also they use GIS technologies to represent background and existing conditions (including land use, housing, and circulation elements) in geographical format.

Different cities have different focuses and policies for land use, community development, street improvements, and others when they develop or update their general plans. For example, the City of Big Bear Lake has placed more attentions to fire protection when they update their general plan. Cathedral City, Lake Elsinore, Palm Desert, and Desert Hot Springs have conducted a systematic and comprehensive transportation modeling analysis for their general plan. The analysis helped the cities 1) identify the location and extent of existing and proposed streets and roadways, 2) outline feasible intersection improvements, and 3) program budgets for upgrading public transit facilities, railroads, transportation terminals, and other transportation facilities.

All the cities periodically amend the general plans as new information becomes available and as community needs and values change. Policies and procedures for general plan amendments have been developed in many cities and can be found on their web sites.

Figure 3 shows the detailed process for the general plan update in the City of Ontario. Similar to the general plan development process as shown in Figure 2, the City of Ontario's process consists of seven steps: Project Initiation, Community Outreach, Technical Studies, Develop Preferred Land Use Plan (LUP), General Plan Preparation, Environmental Analysis, and Plan Adoption & EIR Certification. These seven steps are being used by the City for the ongoing general plan update. More discussions on this process are provided in later section.

THE **ONTARIO PLAN**
A FRAMEWORK FOR THE FUTURE

*A model heritage
A dynamic present
A sustainable, world-class future*

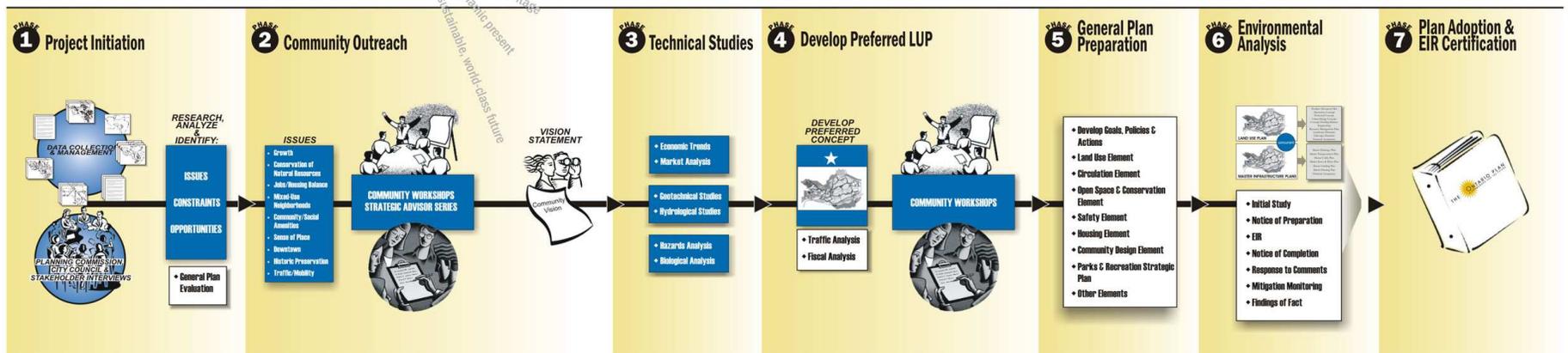


Figure 3 General Plan Update Process of the City of Ontario

Source: <http://www.ontarioplan.org/images/processdiagram.jpg>

The City of Corona has used ten steps for its general plan updates. These ten steps are as follows³:

*Step 1: A **Vision** for the City's future was defined as the overarching framework for the formulation of updated Plan policies. This addresses the intended functional role, character, and quality of the built City and its natural environment. The vision was crafted to reflect the collective input of Corona's residents that chose to participate in the visioning process.*

*Step 2: **Guiding Principles** that define a framework of expected outcomes of the General Plan's updated policies were formulated. These articulate specific measures for the attainment of the Corona Vision.*

*Step 3: **Background data** regarding the existing conditions, trends, and projected future conditions for the City's physical, economic, social, and environmental resources were compiled and analyzed. This data serves three purposes:*

- *As the basis for the articulation of planning issues to be addressed by Plan policy, incorporating all studies required by state law;*
- *As measures to test the impacts of alternative growth and development scenarios; and*
- *As the statutory "Existing Setting" section of the General Plan Environmental Impact Report (EIR).*

As the data base contains extensive written narrative, tables, and in excess of 70 maps, it is physically incorporated into a separate volume that legally is a component of the General Plan and EIR. An overview of pertinent baseline and projected conditions is contained in the relevant sections of the General Plan.

*Step 4: **Alternative growth and land use development scenarios** were identified for the City. As the City is approaching its build out, the alternatives focused on development opportunities for the remaining vacant sites that are not currently committed for preservation as open space and for re-use and improvement of economically obsolete and physically declining commercial and industrial districts and, to a very limited extent, residential neighborhoods.*

The alternatives were evaluated for their comparative traffic and fiscal impacts. The latter estimated the costs of public services to support the candidate use and expected revenues. Cumulative effects on the fiscal balance of the City were assessed.

³ Adopted directly from the City of Corona's General Plan document.

- Step 5: A **preferred growth and land use plan** was selected in consideration of their comparative impacts, as well as consistency with the Vision, Guiding Principles, and objectives defined by Corona's residents.
- Step 6: **Plan policies and implementation actions** were updated based on the review of existing policies for their consistency with the Vision, Guiding Principles, and selected growth and land use plan, reflection of current issues and community needs, understandability, effectiveness in previous applications, practicality and feasibility, embodiment of state-of-the-art planning practices, consistency with current legislation and court decisions, and reflection of community values and City Council policy decisions.
- Step 7: The **Draft Updated General Plan** was published incorporating an overview of background data and projections, the Vision, Guiding Principles, and goals, policies, and implementing actions. The Draft General Plan is made available for public review and comment in writing or oral testimony at Planning Commission and City Council hearings.
- Step 8: A **Draft EIR** was prepared in accordance with the substantive and procedural requirements of the California Environmental Quality Act (CEQA). From the date of publication, the DEIR is circulated for a 45-day period for public review and comment. Responses to all comments are prepared and incorporated into the Final EIR. The Final EIR is then reviewed and certified by the City Council.
- Step 9: The Planning Commission and City Council will conduct **public hearings** on the Draft General Plan and EIR. In consideration of the public input, the Commission will make recommendations to the City Council regarding the Plan's content and certification of the Final EIR. The City Council will consider the Commission's input and conduct additional public hearings. Based on these, the Council makes its final recommendations and adopts the General Plan with changes, if necessary, and certifies the Final EIR.
- Step 10: The **adopted Corona General Plan** is published and implemented.

2) CIP Development

Capital improvements program is a critical instrument to a city to achieve the goals and objectives described in the general plan. It serves as a planning and financial tool to identify a city's capital needs and project priorities. It relates the capital needs to the financial sources and allocates or funds to projects.

A capital improvements program is normally composed of two parts -- a capital budget and a capital program. The capital budget is the upcoming year's spending plan for capital projects or capital purchase. The capital program is a five-year implementation plan that

describes capital expenditures to be funded by the capital budget. The CIP is updated annually.

Development of a CIP in a city is a process by which capital projects are identified, prioritized, selected, and incorporated into the long range fiscal and strategic planning of the city. It requires effective leadership and the involvement and cooperation of all departments of the city.

Many cities in the Inland Empire region have provided information about their capital improvements program (CIP) on web sites (see Appendices A and B). The information includes CIP benefits, CIP development processes, and budgets for CIP projects. For example, the City of Moreno Valley lists approximately 650 projects that are approved by the City Council for five-year (2007-2012) and proposes \$1.4 billion for these projects in order to improve and maintain the City's infrastructure.

All the available CIP budgets and programs of Inland Empire cities have been reviewed and compared in this research. From the review, it is found that the development of a CIP in a city is an extensive annual process that requires the following ten steps⁴:

Step 1: Adopt a CIP bylaw and establish a CIP Committee

Many Inland Empire cities, including the City of Montclair, have established a CIP policy or bylaw to create and empower a CIP Committee for the CIP development. The CIP Committee normally is composed of members of City Council and representatives from different departments. The Committee is chaired by the Director of Engineering/Public Works department, the Director of Community Development, or the Director of Finance Department. Due to the unique nature of CIP development, more than 30 Inland Empire cities have appointed the Director of Public Works to lead the CIP Committee.

One of the first tasks of the CIP Committee is to define the criteria for CIP project scoping and equipment purchase and to prepare a timetable and a working plan for completing the CIP.

Step 2: Prepare an Inventory of Existing Facilities

A complete inventory of all city properties and assets is prepared in this step. The inventory normally includes information about the year the existing public facilities were built or acquired, the date of last improvement, the conditions of the facilities, etc.

⁴ The ten steps were originally developed by the Division of Local Services' Municipal Data Management and Technical Assistance Bureau (<http://www.mass.gov/Ador/docs/dls/publ/misc/cip.pdf>).

Extensive work has been conducted by many cities to collect data for the inventory. Data collection methods include road condition surveys, traffic volume surveys, etc. A number of cities, including the Cities of Palm Springs, Ontario, Rancho Cucamonga, and Hemet, have used GIS-based pavement management systems to assess the pavement conditions of city streets.

Engineering consulting services are often contracted out for the preparation of the inventory.

Step 3: Evaluate Previously Approved, Unimplemented or Incomplete CIP Projects

Many cities have identified and assessed the status of previously approved CIP projects before they develop new CIP projects. For example, the Cities of Corona and Temecula have monthly activity reports that describe the progress of CIP projects and monitor previously approved, unimplemented, or incomplete CIP projects regularly. In doing so, the cities can have a better understanding of the status and needs for infrastructure improvements.

Representatives from departments of Budget, Engineering/Public Works, Community Development, members of the CIP Committee normally gather together to update the implementation progress of CIP projects that are approved in prior years. The results of this update help the city to determine if new CIP projects are needed in the coming fiscal year.

Step 4: Assess Financial Capacity

The CIP Committee works with the people in the Finance department to assess the ability of the city to afford CIP projects. This financial analysis is often regarded by many cities as a required step for CIP development. The analysis examines recent and anticipated trends in city reserves, revenues, and expenditures. It helps the CIP Committee find funding sources for CIP projects and allocate the available budget to the CIP projects for the coming fiscal year.

Both the qualitative and quantitative methods, including trend analysis, economic indicators, and professional judgment, have been used in many cities for financial analysis. Multiple funding sources have been identified for CIP projects. For example the City of Palm Springs has the following primary funding sources:

- *Operating Funds – They combine the General Fund and the Community Promotion Fund. The General Fund accounts for all the general revenue of the City except those specifically required to be levied or collected for other City funds. The Community Promotion Fund accounts for revenues related to the*

promotional efforts of the City with regards to tourism and related activities. The top three operational fund revenues for the City of Palm Springs are property tax, sale tax, and transient occupancy tax.

- *Special Revenue Funds – These funds are used to account for specific revenues that are legally restricted to expenditures for particular purposes.*
- *Enterprise Funds – These funds are used to account for operations that are financed and operated in a manner similar to private business enterprises. The intent of the governing body is that the costs of providing goods or services to the general public be financed or recovered primarily through user charges.*
- *Internal Service Funds – These funds are used to account for the financing of goods or services provided by one department or agency of the City to other departments or agencies on a cost reimbursement basis.*
- *Debt Service Funds – These funds are used to account for the accumulation of resources for, and the payment of, general long-term debt principal and interest.*

Step 5: Solicit, Compile and Evaluate New CIP Project Requests

The CIP Committee solicits new CIP potential projects from various departments including Engineering/Public Works, Community Development, Parks and Recreation, etc. Many cities have used request forms for solicitation. The forms contain a clear statement of the need and justification for the proposed project, costs, impacts on budget, and a proposed implementation schedule. Some cities also receive proposed CIP projects through a series of workshops with residents and business stakeholders.

The CIP Committee is responsible for reviewing all proposed capital projects for timing and cost considerations and preparing a preliminary capital improvement plan recommendation for further review by the Department Directors and City Council.

Step 6: Prioritize Projects

The CIP projects listed in Step 5 are ranked in priority as objectively as possible. Normally the CIP Committee first establishes criteria for project prioritization. For example, the City of Fontana defines four levels of priorities for CIP projects. The criteria used to determine the priorities of CIP projects are as follows:

- Priority 1:** CIP projects are **essential** and should be started within the year.
- Priority 2:** CIP projects are **necessary** and should be started within 1 to 3 years.
- Priority 3:** CIP projects are **desirable** and should be started within 3 to 5 years.
- Priority 4:** CIP projects are **deferrable** due to lacking funding or other reasons and are scheduled to start within 5 to 10 years.

There are many methods available for prioritizing proposed CIP projects. These methods include goal achievement, numerical ratings, consensus building, priority indexes, programming evaluation matrices, and multi-objective systems analysis techniques. The methods commonly used by the Inland Empire cities are numerical ranking and consensus building methods.

When the numerical ranking method is used, each proposed CIP project is evaluated and scored based upon a number of factors. A relative weight is then assigned, largely by the City's policy makers or the members of the CIP Committee, to each factor in the ranking system. The ranking of a CIP project normally is determined based on the total weights of the factors that are associated with the CIP project. It is noted that both the relative weight placed on a CIP project and financial limitation are important elements to the CIP project prioritization process.

Step 7: Develop a Financing Plan

The CIP Committee in this step develops a CIP financing plan based on the financial capabilities identified in Step 4 and CIP project priorities determined in Step 6. The financing plan describes the allocation of available budget to CIP projects.

Many Inland Empire cities select the “Pay-As-You-Go” method or “no debt” method to provide funding for CIP projects.

Step 8: Adopt a Capital Improvements Program

The capital budget and the capital program developed by the CIP Committee are submitted in this step to the City Council for review and approval. The Council then holds a series of public hearings 1) to inform the residents, business stakeholders, and the general public of the ongoing needs for capital expenditures in the city, and 2) to receive comments on the city’s CIP budget plan and program.

The CIP Committee then re-evaluate and revise the CIP budget and program based on the comments and recommendations received from the public hearings. The revised CIP budget and program are in effect after they are approved by the City Council for the coming fiscal year.

Step 9: Implement Approved CIP Projects

Once the City Council has adopted the capital budget/program and the fiscal year begins, departments are authorized to start implementing CIP projects. All departments are required to monitor and manage their CIP budgets and spend only amounts allocated by the City Council. When unforeseen costs arise to the level that they cannot be covered by the original adopted budget, the City Manager may recommend budget modifications to the City Council. The City Council may approve budget modification resolutions for the necessary changes.

The CIP Committee monitors and manages the city-wide CIP efforts and informs various departments and the public of the implementing progress of CIP projects through newsletters and monthly reports.

Step 10: Update and Archive Existing/Ongoing CIP Projects

The CIP Committee may prepare revisions of the CIP budget/program when the CIP needs are changed. The revisions provide necessary information for the following's year CIP project development. When CIP projects are completed, the CIP Committee needs to achieve all the data generated from the CIP projects.

It is noted that the above ten-step process is the general CIP development process derived from all the Inland Empire cities. The individual CIP development process in a city may differ from the above described process.

3. GIS USE IN GENERAL PLAN AND CIP DEVELOPMENT PROCESS

Geographical Information System (GIS) is a system that captures, stores, analyzes, manages and presents data and associated attributes which are spatially referenced to locations on earth. GIS technologies are useful tools for cities since many properties and facilities managed by cities are location-oriented.

Inland Empire cities have adopted GIS technologies for producing maps and managing city-wide geo-spatial data. Their GIS use provides numerous benefits to various departments. One of the benefits is to help improve the management of city data and work flow procedures. GIS can link spatial data sets together to a common geo-reference system. It thus helps departments share their data. One department can benefit from the work of another. GIS data collected once can be used many times.

Another benefit is to help decision-makers make better decisions. GIS is a tool to query, analyze, and map data in support of the decision making process. With the information presented succinctly and clearly in maps, decision makers can focus more on the issues and problems which may not be readily apparent in tables.

3.1 GIS Use in Inland Empire Cities

This research has investigated all the Inland Empire cities from the view of GIS use in support of businesses in various departments. From this investigation, it is found that GIS use varies from city to city and can be grouped in three levels: City-side, Department-wide, and Ad hoc.

GIS use in the cities of Ontario, Riverside, Beaumont, Montclair, Moreno Valley, and Murrieta can be considered at the city-wide level. GIS data, tools and applications in these cities are developed and operated in an enterprise GIS environment. Interactive GIS web sites have been available in these cities for displaying and querying land use, parcel information, CIP projects, and others.

In order to administer the enterprise GIS environment, GIS people normally work under the Information Service or System department in these cities. They are better equipped to provide recommendations on City policy, service improvements, and future community developments. They are responsible for administering, creating, maintaining, and operating the city's GIS databases and applications for parcels, subdivisions, easements, legal lots, addresses, public and private right-of-ways, as well as the city's infrastructure assets (water, sewer, storm water, and other City-owned properties). They provide GIS services for data capture and conversion, business process analysis, training and support of GIS technicians, and support/upgrade of enterprise GIS software.

GIS use at the department level includes the City of Palm Springs. GIS people in this level normally work under the Planning or Community Development Department. Their daily GIS services may include 1) creating customized maps for various departments, 2) performing data capture/conversion from existing GIS data, or data collection using Global Positioning System (GPS) technologies, and 3) providing city-wide hardcopy maps or digital maps (in PDF format) to the public.

GIS use at the ad hoc level indicates that the cities normally lack GIS resources and expertise. When the cities need ad hoc GIS services, they often hire GIS consultants for help.

3.2 GIS Use for General Plan and CIP Development

This research has investigated all the Inland Empire cities from the view of GIS use in support of general plan and CIP development process. It is found that the GIS technologies have been widely employed to create maps for general plan, zoning, specific plan and new developments/redevelopments. However, the GIS use in support of CIP development process can be observed only in a few cities. Most Inland Empire cities have used EXCEL, ACCESS and other spreadsheet-like Windows applications for the CIP development. CIP projects are often represented in tables.

The City of Moreno Valley is one of the few cities that use GIS for CIP development. The city has about 650 capital projects in its proposed five-year CIP (2007-2012). Each of these projects is described by a project detail sheet. The purpose of the detail sheet is to provide a comprehensive view of the project in the CIP including an extensive project description, justification, expenditure, revenue, and GIS map display of project location among other detailed information. Figure 4 shows an example of the detail sheet.

The City's CIP document is published annually to include the completion and addition of new capital projects adopted each fiscal year. With each revision, the carryover CIP projects will remain as part of the document from previous years until the project or phase is complete. All new CIP projects that are not previously on the list are added, and all completed CIP projects are removed from the project list.

The Cities of La Quinta and Palm Desert have used GIS tools to summarize their CIP projects in GIS maps (see Figures 5 and 6).

The City of Colton also provides each CIP project with a project detail sheet. However the sheet only shows funding sources and project location by street addresses and a photo snap of the project site (see Figure 7). The City of Fontana has used Google Map as a tool to layout the location of CIP projects (see Figure 8). Although the two cities have not used GIS technologies for CIP development, however their way of using graphic images for CIP development is simple but effective.

CITY OF MORENO VALLEY
Capital Improvement Project Details
FY 2007-2012

Project Title: DAY STREET / ALESSANDRO BLVD - COTTONWOOD STREET IMPROVEMENTS	<input type="checkbox"/> New <input checked="" type="checkbox"/> In Progress <input type="checkbox"/> Delayed	Project Status <input type="checkbox"/> Completed <input type="checkbox"/> On Hold <input type="checkbox"/> Deleted
Funding/Acct Number: 892 66920		
Department/Division: Economic Development/RDA Capital Projects		
Project Description: Design and Construction of Day Street from 1) Alessandro Boulevard to Cottonwood Avenue, 2) Sherman Avenue from Day Street and Noize Place, 3) Bay Avenue from Day Street to Noize Place. The first design phase included deliverable of the Project Report and 35% design. The final phase is to include final, environmental, and right-of-way. (Includes 280.68625)	<input type="checkbox"/> Bridges <input type="checkbox"/> Buildings <input type="checkbox"/> Drainage <input type="checkbox"/> Elec Utility <input type="checkbox"/> Equipment <input type="checkbox"/> Landscaping	CIP Category <input type="checkbox"/> Parks <input type="checkbox"/> Special Projects <input checked="" type="checkbox"/> Street Improvements <input type="checkbox"/> Traffic Signals <input type="checkbox"/> Underground Utilities <input type="checkbox"/> Land Acquisition
Justification or Significance of Improvement:	Project Priority in CIP Category <input checked="" type="checkbox"/> Essential (start within 1 yr) <input type="checkbox"/> Necessary (start within 1 to 3 yrs) <input type="checkbox"/> Desirable (start within 3 to 5 yrs) <input type="checkbox"/> Deferrable (start within 5 to 10 yrs)	

COST	Carry Over	07/08	08/09	09/10	10/11	11/12-Beyond	Total
Prelim Eng/Environ							0
Design							0
Right-of-Way							0
Construction							0
Other	900,767	3,510,000					4,410,767
TOTALS	900,767	3,510,000	0	0	0	0	4,410,767

REVENUE	Carry Over	07/08	08/09	09/10	10/11	11/12-Beyond	Total
RDA (892)	527,767	2,604,000					3,131,767
CDBG (05-08)	373,000	906,000					1,279,000
							0
							0
							0
TOTALS	900,767	3,510,000	0	0	0	0	4,410,767

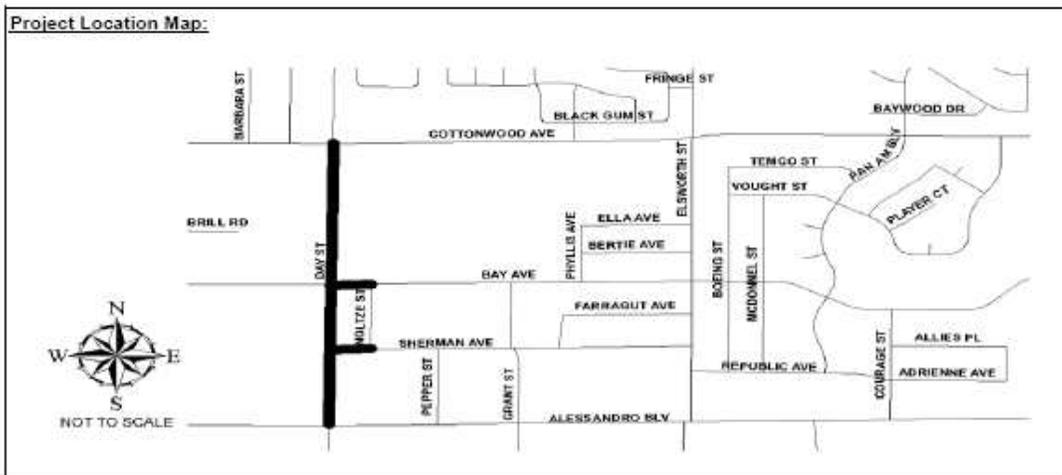


Figure 4 GIS Use for CIP in the City of Moreno Valley
 Source: http://www.moreno-valley.ca.us/city_hall/financial/07-08_MV-CIP.pdf

**City of La Quinta
Capital Improvement Plan (CIP)
Fiscal Years 2007/08 – 2011/12**

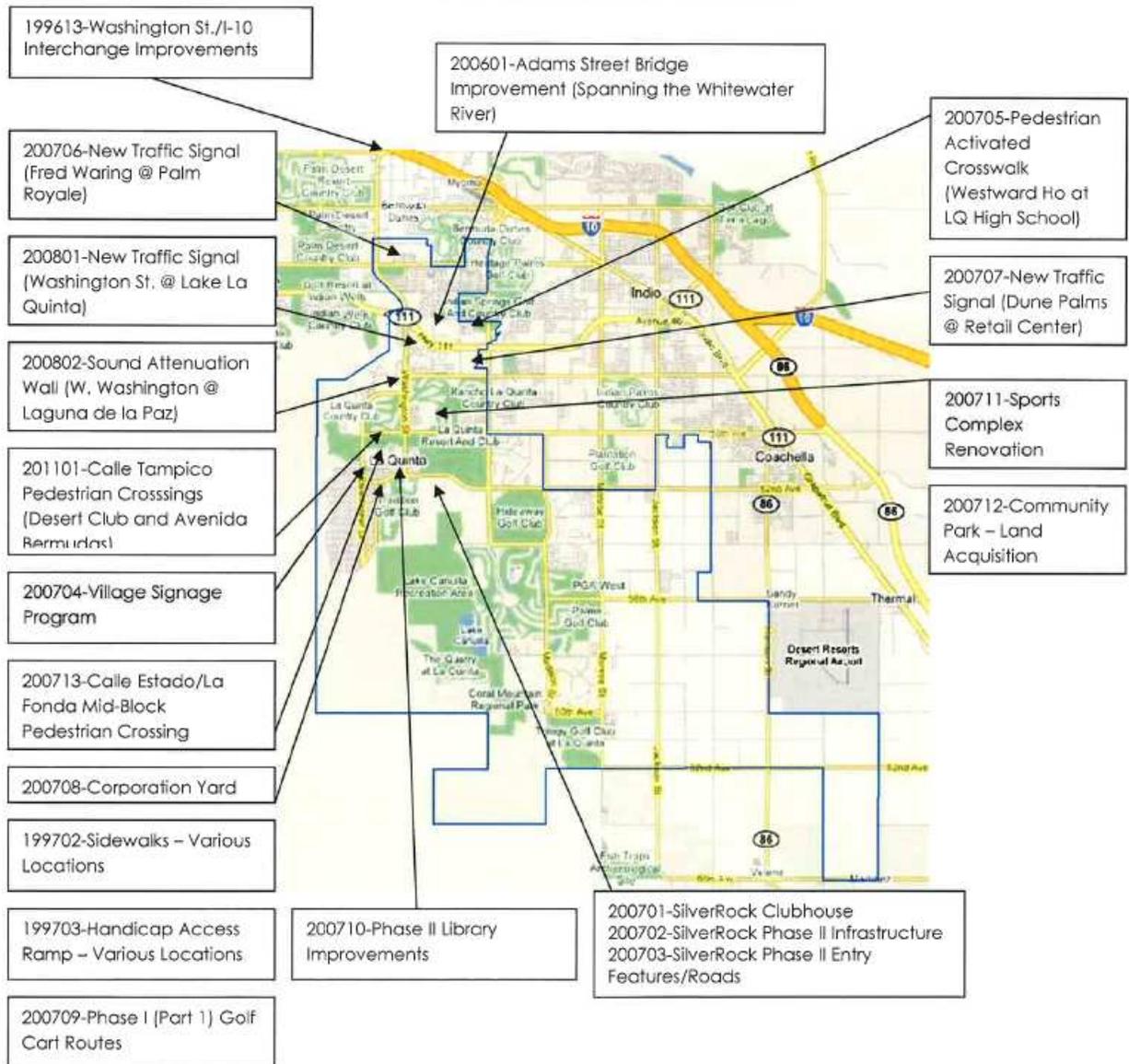


Figure 5 GIS Use for CIP in the City of La Quinta

Source: <http://www.la-quinta.org/Modules/ShowDocument.aspx?documentid=2879>



CITY OF PALM DESERT CAPITAL IMPROVEMENT PROGRAM STREET, TRAFFIC SIGNAL, AND DRAINAGE PROJECTS 5-YEAR SCHEDULE 2008-2012

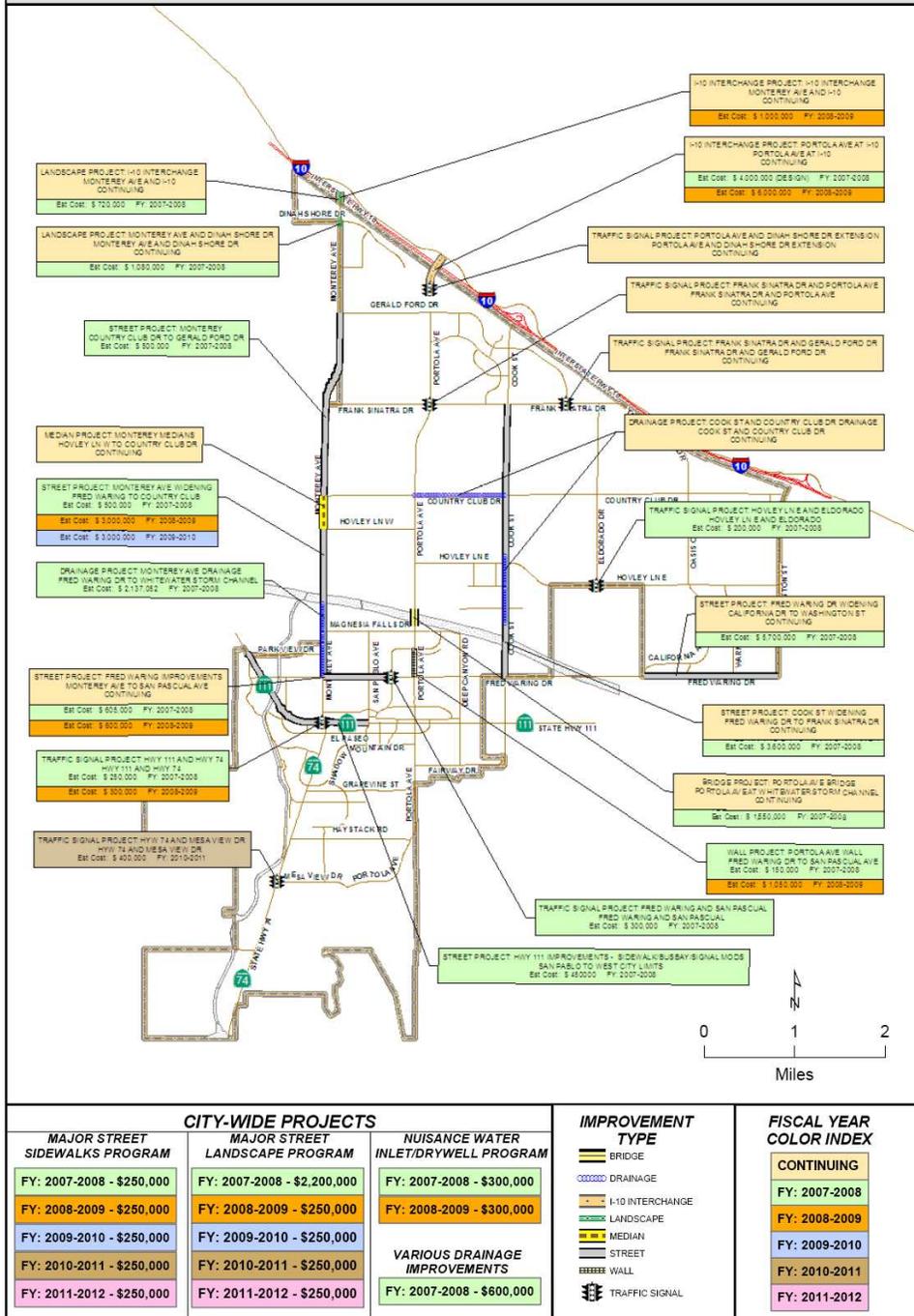


Figure 6 GIS Use for CIP in the City of Palm Desert

Source: <http://www.cityofpalmdesert.org/Index.aspx?page=249>

	<p style="text-align: center;"><i>NEW CONSTRUCTION</i></p> <p style="text-align: center;">Washington Street Widening</p> <p>Project Location: Washington Street between Reche Canyon and Hunts Lane.</p> <p>Agenda Dates: 7-Jun-05 Budgeted</p> <p>Funding Sources: State CMAQ Funds \$ 400,000.00 Measure I \$ 100,000.00</p> <p>Budget: \$ 500,000.00</p> <p>Account: 450-0543-6983-3890 450-0543-6970-3890</p>
<p>Scope: Modify existing traffic lanes and reconstruct median in order to eliminate the bottleneck transition along this arterial street. Remove, dispose or relocate some existing right of way improvements. Install match-up and new asphalt pavement over base and re-stripe all impacted areas.</p>	

Figure 7 CIP Detail Sheet of the City of Colton

Source: <http://www.ci.colton.ca.us/Documents/PW/Binder1.pdf>

CITY OF FONTANA

Department of Engineering
Design Section
8353 Sierra Avenue
Fontana, California 92335

Citrus - Valley to Foothill (Interconnect)



Project Location Map

PROJECT DESCRIPTION:

Install HDPE conduit for future fiber connecting the traffic signals along Citrus between Valley and Foothill to the City's Automated Traffic Management System (ATMS).

TOTAL COST: \$879,593

START OF CONSTRUCTION: May 2007

PROJECT COMPLETION: March 2008

PROJECT STATUS: Construction

For further information you may contact the Department of Engineering at (909) 350 - 7610

Last Updated on - 10/2008
PJD: 244

Figure 8 CIP Detail Sheet in the City of Fontana

Source: City of Fontana

4. CASE STUDY: CITY OF ONTARIO

After reviewing all the available general plans, CIP documents, and GIS services and applications of the Inland Empire cities, this research team has selected the City of Ontario as the case study city for further assessment. The reasons of choosing Ontario are as follows:

- 1) The City has recently embarked on a two-year planning program to update the general plan for the entire Ontario community and its public enterprises for the next several decades. The Ontario General Plan Update embraces all of the City's functions of governance and provides guidance for various investment and development activities.
- 2) The City has a strong enterprise GIS environment in which geographical data acts as a foundation for many business applications used by various departments. Further, geographical data have been integrated with the tabular data of multiple business processes. The enterprise GIS environment indicates extensive GIS use for applications in Police, Building, Planning, Fire, Business License, Code Enforcement, Public Works and Housing.
- 3) The City has an official web site that provides sufficient information about the general plan, capital improvements programs, and GIS applications. The web site makes the research team believe the City must have had GIS applications and services that facilitate the transportation project development process.

The research team has reviewed the City's general plan and various available CIP documents. Further, the research team members have interviewed the City's engineers and planners who are responsible for the development of capital improvements programs.

Below are the observations of the City's development process for the General Plan Update and CIP, as well as the status of GIS use in the City:

- 1) The City has a systematic process for updating the General Plan (see Figure 3). This process, similar to the ten-step General Plan Update process of the City of Corona, evaluates the City's existing conditions in its Project Initiation phase. GIS technologies, as indicated by the City's engineers and planner (being interviewed), have been widely used to produce maps for the evaluation of existing conditions.

With the GIS maps presented to the Planning Commissions, City Councils, and stakeholders, the City has identified various issues, constraints, and opportunities that should be addressed in the General Plan Update. The issues are related to city growth, conservation of natural resources, job/housing balance, mixed-use neighborhoods, community and social amenities, sense of place, downtown development, historical preservation, and traffic/mobility.

Three community workshops have been conducted to get the communities to be involved in the General Plan Update process. A website (<http://www.ontarioplan.org>) has been launched to inform the public of the General Plan updates. A series of strategic advisory meetings has been conducted to develop the City's visions that are shared by all the communities.

Technical studies including economic trends prediction, market analysis, geotechnical studies, hydrological studies, hazard analysis, and biological analysis have been conducted to get inputs for future land use planning. GIS technologies have been used in these technical studies.

The City has further conducted traffic and fiscal analyses and developed a preferred land use plan (LUP). Currently the City is conducting a series of community workshops to get the inputs and comments from the public on the new land use plan. GIS technologies have been used in these technical studies.

With the preferred land use plan as inputs, the City, according to the General Plan Update process as shown in Figure 3, will develop goals, policies and actions for the updated General Plan. The updated General Plan will contain the revised land use element, circulation element, open space & conservation element, safety element, housing element, community design element, parks & recreation strategic plans and other elements.

The City will conduct environmental analyses for the programs described in the General Plan. The analyses will include identifying CEQA⁵ requirements, determining potential environmental impacts, and developing mitigation measures.

Through a number of Planning Commission and City Council public hearings, the City will adopt the General Plan Update. The environmental Impact Report (EIR) document will be certified. The updated General Plan will be the living document to guide the City for the future.

- 2) The City has developed its Five-Year (2003-2008) Capital Improvement Program (CIP) consistent with the goals and objectives established by the City Council in the General Plan. CIP Projects are selected based on an assessment of needs and available funding. Projects with funding limitations are considered on an individual basis, while those without such funding limitations are considered relative to the overall needs of the City.

The Engineering Department, as indicated by the City's engineers and planners, is responsible for programming, planning, designing & administering construction of the annual capital improvement program. Following the similar ten-step CIP

⁵ CEQA – California Environmental Quality Act

development process as described in the previous section, the Engineering Department leads a CIP Committee to prepare an inventory of existing facilities and administer CIP projects. Working with the people from the Administrative and other departments, the CIP Committee develops and updates annual CIP budget based on the needs of the City. In summary, the City uses the CIP as a planning tool to 1) systematically identify capital improvement needs and 2) coordinate the financing and timing of those needs in a manner that assures the CIP projects use the City's limited resources most responsibly and efficiently.

The City has a limited GIS use for the support of the CIP development process. All the CIP projects are represented normally in table format. No detail sheets are developed for CIP projects.

5. GIS-BASED CIP DEVELOPMENT FRAMEWORK

Considering the limited GIS use in the Inland Empire cities for the CIP development, this research has developed a GIS-Based CIP conceptual framework. The purpose of this framework is to help the Inland Empire cities identify and prioritize CIP projects and develop CIP budgets effectively.

As shown in Figure 9, the conceptual framework consists of the following components:

- CIP Committee
- Inventory of Existing Facilities
- Requests of Projects
- Existing CIP Projects
- Web-Based GIS Services
- GIS Databases
- Funding Sources
- Financial Analysis
- Project Prioritization
- Capital Projects/Capital Budget
- CIP Implementation

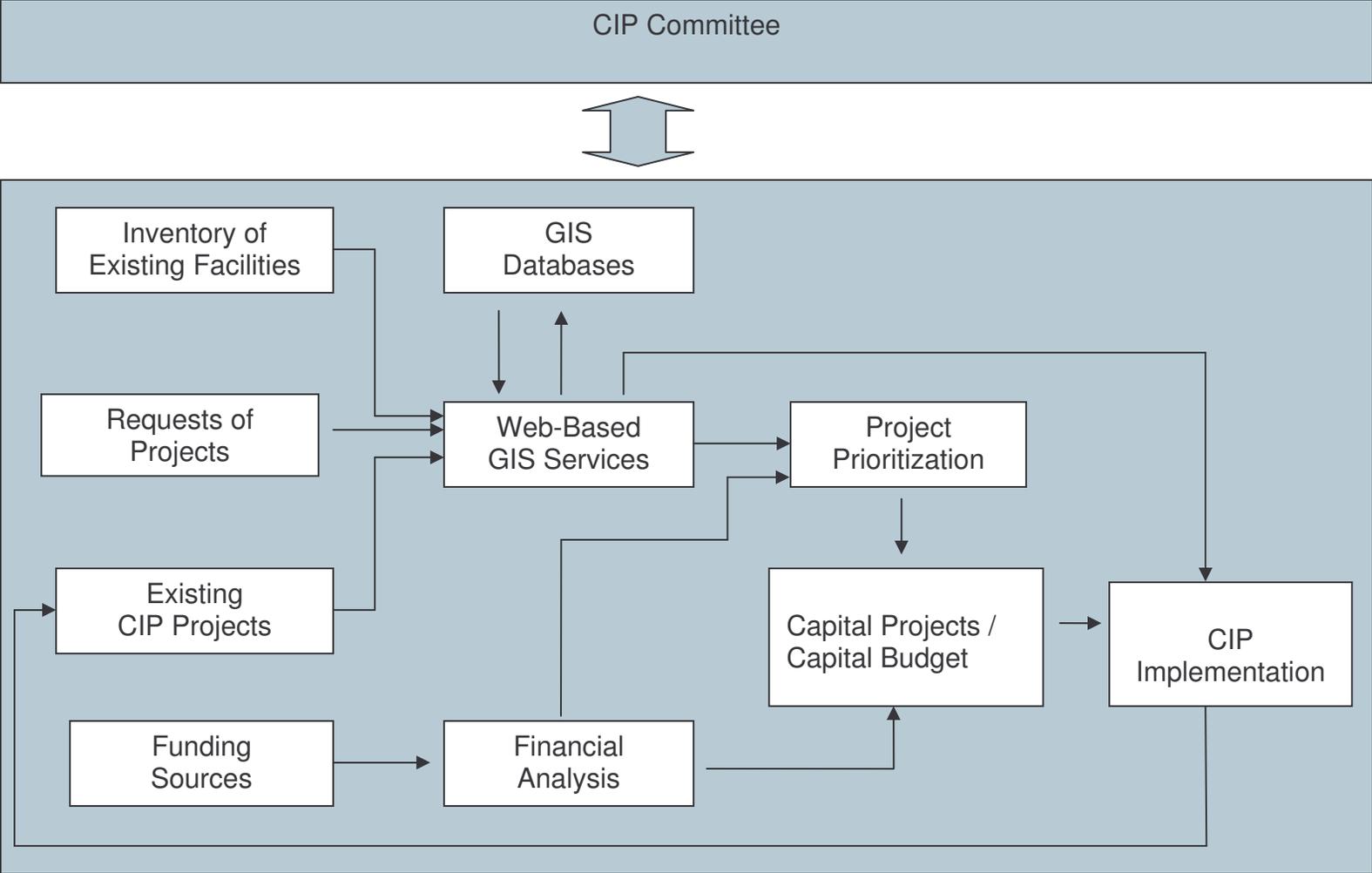


Figure 9 GIS-Based CIP Conceptual Framework

CIP Committee is an administrative component in the framework. Members of the CIP Committee are in charge of implementing all the components described in the conceptual framework.

GIS technologies are incorporated into the ten-step CIP development process as discussed in the previous section. The Web-based GIS services acts as a core component that should have the following functions:

- 1) Web Services for Existing Facilities. The Web services allow existing facilities to be stored geographically to the GIS Databases component. When existing facilities are already collected and represented in GIS format (such as in ESRI⁶'s Shapefiles or Geodatabases), the interfaces can place them into the GIS Databases component directly. The interfaces may also have editing capabilities that help CIP users geocode existing facilities (point, linear, or polygon features) and store them in the GIS Databases component.
- 2) Web Services for Project Request. The Web services provide a working environment in which CIP users can get project requests from various city departments and enter them into the GIS Databases component through in a standardized project detail sheet. An example standardized detail sheet could be derived from those of the City of Moreno Valley (see Figure 4). CIP users can define the scope of a potential CIP project geographically.
- 3) Web Service for Existing CIP Projects. The Web services keep track of all the previously approved, unimplemented or incomplete CIP Projects. They provide interfaces to update these CIP projects in the GIS Databases component when the projects are complete or the funding situations are changed for the projects.
- 4) Web Service for Project Prioritization. The Web services have query capabilities to retrieve potential CIP projects from the GIS Databases. The detail sheets of the retrieved projects should be provided to the CIP Committee members for prioritization. In addition, this component may also provide an EXCE-like ranking Web service with which the CIP Committee members can make effective rankings for potential CIP projects. When other prioritization methods are used, the component should be flexible enough to include the methods in the Web services.
- 5) Web Services for CIP Implementation. The Web services keep track of all the approved CIP projects under implementation. It provides progress reports for the CIP projects.

⁶ ESRI – Environmental Systems Research Institute

The Financial Analysis component is also a core element with which the budget for supporting CIP projects can be planned. This component along with the Funding Sources component produces financial information for CIP project prioritization.

There have been a number of capital project management systems that can be found nation-wide to implement fully or partially the above conceptual framework. For example, the City of Davis, California has developed a simple Web-based interactive mapping system for capital improvements project (see Figure 10). Users can select a CIP category (Drainage, Facilities, Signal, Transportation, Wastewater, Water, Miscellaneous, or all) and display all the CIP projects geographically of the selected category. This mapping system displays all the CIP projects in dots. It does not have Web services to help prepare the initiation of CIP projects.

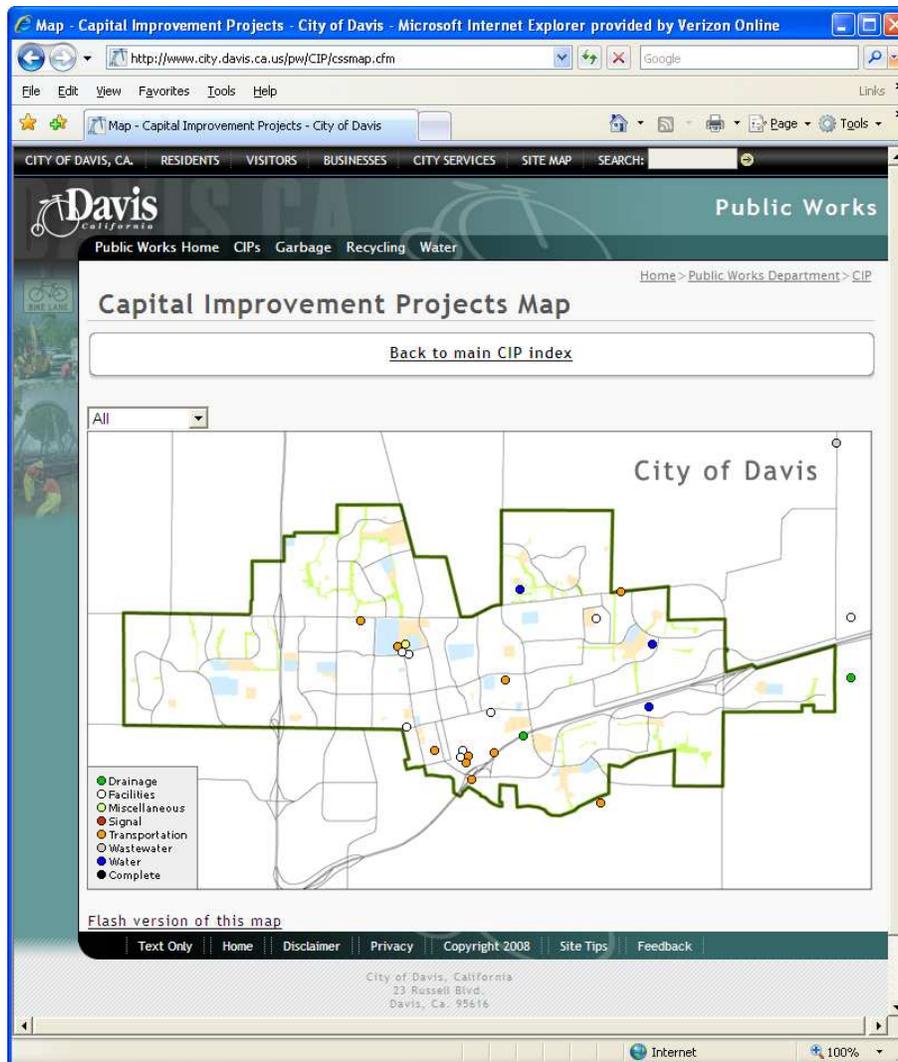


Figure 10 Web-Based CIP Map in the City of Davis

Source: <http://www.city.davis.ca.us/pw/CIP/cssmap.cfm>

The City of San Jose has developed a comprehensive system for capital project management (see Figure 11). This system enables users to select and display CIP projects that are in pre-construction, construction, or completion. When a specific CIP is selected, the progress report related to the CIP project is presented to the users. This system also has a search mechanism to allow users to query CIP projects based on certain criteria.

This system, similar to the system shown in Figure 10, is also a mapping display system. It does not have other Web services that can help the CIP users to prepare an inventory of existing facilities, identify potential CIP projects, prioritize CIP projects, and monitor and update approved CIP projects.

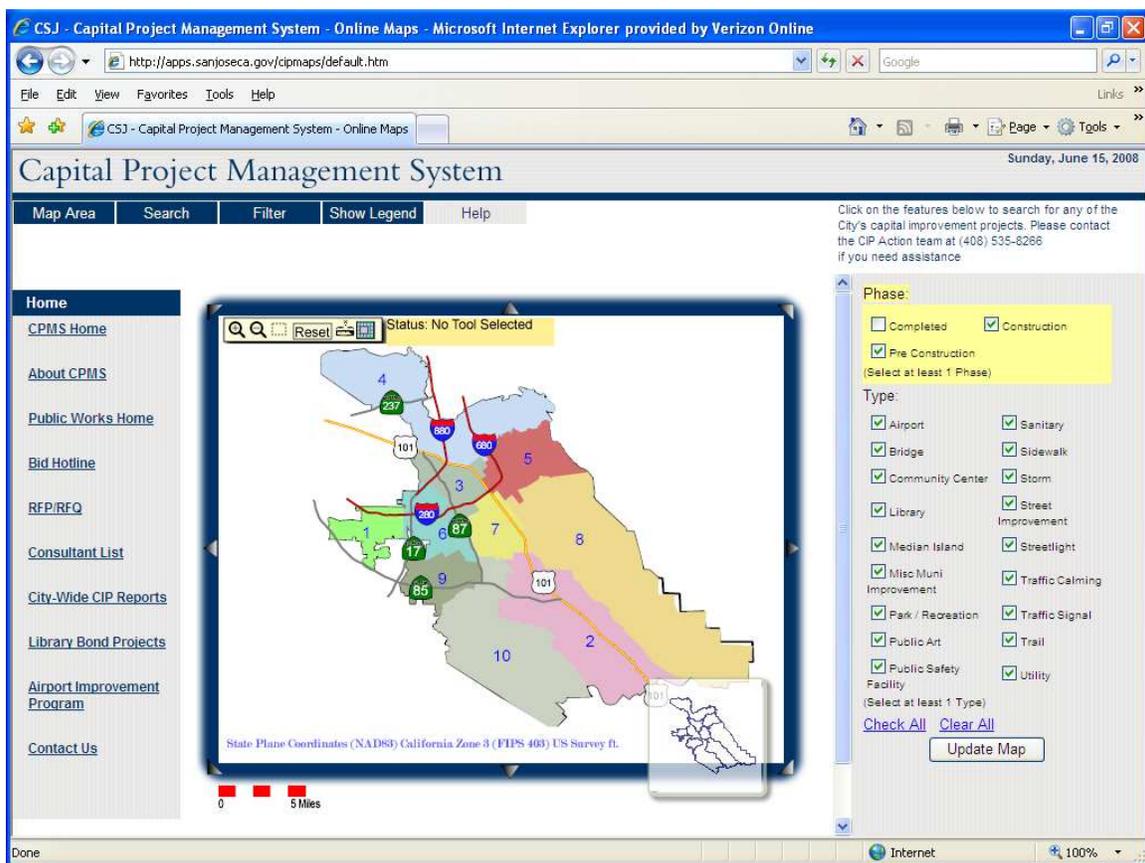


Figure 11 Capital Project Management System in the City of San Jose

6. PROPOSED FUTURE WORK PLAN

CIP is a dynamic document that is continuously updated as the City moves through a new fiscal year. CIP projects may change or be re-prioritized when construction cost estimates are changed, grant opportunities are available, or new Council directions are enforced.

The GIS-based conceptual framework considers the above dynamic characteristic of the CIP development process. In order to implement this framework and promote the GIS use in Inland Empire cities, this research has proposed a future work plan. The work plan has the following tasks:

- 1) Develop a Manual for CIP development. A Manual that documents the best practices for CIP development is needed in the Inland Empire cities since the CIP development varies from city to city. The Manual will further elaborate the ten-step CIP process with more examples and case studies. It is anticipated that the Manual will be a good guidebook for Inland Empire cities.
- 2) Develop a Web-based capital project management system that fully implements the conceptual framework described in the previous section. A city which has strong GIS use for city businesses could be selected for this task. The City of Ontario or the City of Moreno Valley could be a good candidate for the management system.

The capital project management system will be considered as a model for other cities. It should be designed to be scalable and transferable. Once the system is developed and used by a city, it should be easily applied to other cities with minor changes of code.

- 3) Provide CIP workshops to Inland Empire cities. The purposes of having the CIP workshops are to train city engineers and planners on how to use the Web-based capital project management system. It is accepted that the workshops will be held after the capital project management system is developed and fully operated in a city. Also the workshops will provide a working environment to allow people to share experiences in CIP development.

7. CONCLUSIONS

General plans and capital improvement programs (CIPs) are the documents that shape the future of a city. Many cities in the Inland Empire region have been using GIS technologies for General Plan updates and CIP development. This research has conducted an assessment of all the Inland Empire cities on their General Plan and CIP development processes. The assessment is limited to the review of all the General Plans and CIP documents that can be found on city's web site, as well as the investigation of GIS data and services used in the cities for various programs.

Through the assessment, this research has found the following findings:

- 1) Of 48 cities in the Inland Empire region, 46 cities have provided information about their general plan on web sites. In responses to requirements of California State law, these cities have developed or updated the general plan for their cities.

Different cities have different focuses and policies for land use, community development, street improvements, and others when they develop or update their general plans.

GIS technologies have been widely used in the Inland Empire cities for the development of general plans. Example uses are 1) GIS maps that display city streets, parcels, land use polices, zoning plans, and existing conditions of city facilities, 2) GIS tools/services to help the cities provide information for the preparation of various elements including land use, housing, open space and conservation, circulation (or traffic), noise, air quality, and health and safety.

The General Plan Update processes described by the Cities of Corona and Ontario are the example processes that show the methods and procedures used for the general plan updates.

- 2) The CIP development process within the Inland Empire cities involves ten steps. The most important of the process is to establish a CIP Committee that is led by the Director of Engineering/Public Works, Director of Finance Department, or the Director of the Community Development.

There are many methods available for prioritizing proposed CIP projects. These methods include goal achievement, numerical ratings, consensus building, priority indexes, programming evaluation matrices, and multi-objective systems analysis techniques. The methods commonly used by the Inland Empire cities are numerical ranking and consensus building methods.

All the Inland Empire cities have been investigated from the view of GIS use in support of CIP development process. It is found that the GIS technologies have

been widely employed to create maps for general plan, zoning, specific plan and new developments/redevelopments. However, the GIS use in support of CIP development process can be observed only in a few cities. Most Inland Empire cities have used EXCEL, ACCESS and other spreadsheet-like Windows applications for the CIP development. CIP projects are often represented in tables.

3. The GIS-based conceptual framework considers the above dynamic characteristic of the ten-step CIP development process. In order to implement this framework and promote the GIS use in Inland Empire cities, this research has proposed a future work plan whose purpose is to implement a capital project management system in an Inland Empire city.

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