ATTACHMENT "A"

Draft Executive Summary

Storm Drainage Master Plan

Prepared for

City of Oakland
Public Works Agency
Engineering Design Department

April 2004

CH2MHILL

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Acronyms and Abbreviations

°F	degrees Fahrenheit
A – F Grades	scorning convention assumes A is best and F is worst.
ACCWP	Alameda Countywide Clean Water Program
ACFC	Alameda County Flood Control and Water Conservation District
ACI	Asset Condition Index
BMP	Best Management Practice
Caltrans	California Department of Transportation
CCTV	closed-circuit television
CEDA	Community and Economic Development Agency
CIP	Capital Improvement Program
City	City of Oakland
CMP	corrugated metal pipe
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
GIS	Geographic Information System
HDPE	high density polyethylene
MOUSE	Model for Urban Sewers
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PVC	polyvinyl chloride
RWQCB	Regional Water Quality Control Board
SDMS	storm drainage management system
sq. mi.	square mile
SRF	State Revolving Fund
SWQMP	Storm Water Quality Management Plan
SWRCB	State Water Resources Control Board
VCP	vitrified clay pipe

Storm Drainage Master Plan Executive Summary

The City of Oakland (City) is responsible for the management of storm drainage within the City. Portions of the system interface with the Cities of Berkeley and San Leandro. The City system totally captures drainage from the City of Piedmont. The City encompasses 60 square miles (sq. mi.) of land area as shown in **Figure ES-1.** It is bordered on the west by the San Francisco Bay, on the north by the City of Berkeley, on the east by the City of Moraga and unincorporated portions of Alameda and Contra Costa Counties, and on the south by the City of San Leandro. . The city rises from sea level at the Bay to approximately 1,750 foot elevation in the Hills. The City has a temperate climate, with an annual average temperature of 59 degrees Fahrenheit (°F) (range from 52 to 67 °F) and an average annual precipitation of 23 inches (monthly range from 0 to 15.1 inches).

The entire city storm drainage system interfaces downstream with the Alameda County Flood Control and Water Conservation District (ACFC) system. ACFC has constructed several infrastructure projects over the last four decades, including pump stations and deeper or wider concrete channels to increase the flow carrying capacity of watercourses in the downstream portions of the storm drainage system. The City's construction projects did not keep pace with those of the ACFC. Through the 1990s, the City experienced increasing complaints about storm drainage, erosion, and roadway damage in the hills and flooding in the downstream portions of the system below I-580. Stormwater runoff accumulates rapidly and the pipe system doesn't have sufficient capacity to contain the runoff as it accumulates.

Over the years, the City has experienced many storm events where flooding was noted. Following these events, citizens filed a number of complaints with the City staff and City Council. After a Storm Drainage Task Force, appointed by the City Council, gathered much information about these problems and Oakland's limited resources available to deal with them, the City Council elected to complete a storm drainage master plan. The storm drainage master plan project conducted extensive field investigations and compiled comprehensive information on storm drainage issues. An overview of the problems in the system include:

1. **Incomplete Database.** The inventory of the storm drainage system within the City is incomplete. The City's records on the drainage system are incomplete or not field verified. There are several sources of data and no single database contains all existing information.

2. **Complaints.** The City received numerous complaints from residents regarding drainage and erosion problems during storm events.

3. **Erosion, Debris, and Landslides.** Over the years, erosion and landslides led to debris buildup in hydraulic channels. This problem is particularly evident in the Hills, but will continue to wash downstream over time. Debris buildup restricts the hydraulic

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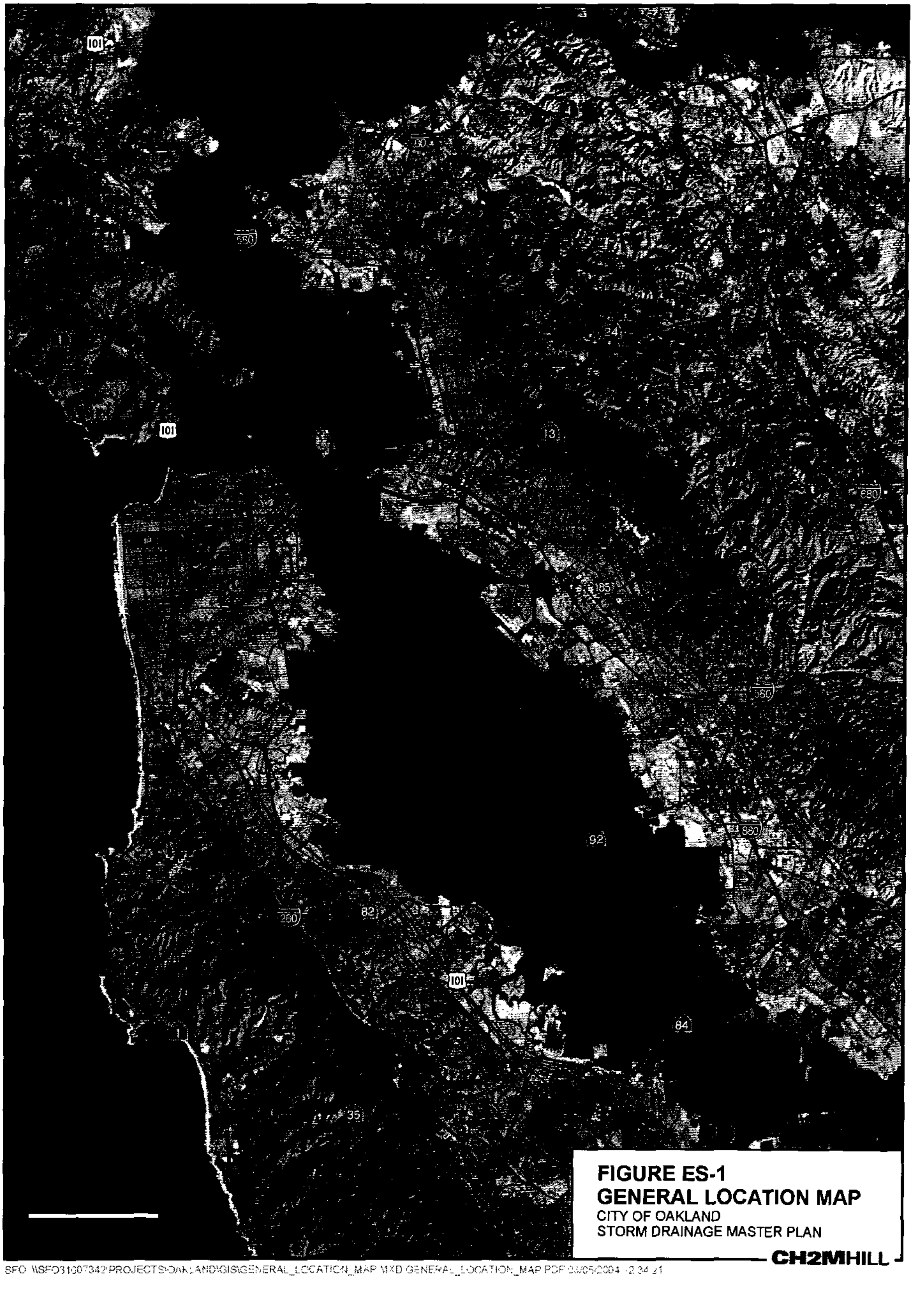

FIGURE ES-1
GENERAL LOCATION MAP
CITY OF OAKLAND
STORM DRAINAGE MASTER PLAN

CH2MHILL

capacities of channels downstream and can cause flooding problems upstream of debris dams.

4. **Inadequate Hydraulic Capacity.** The drainage system is unable to carry the entire volume of storm flows, causing flooding problems in many areas of Oakland.
5. **Significant Private Drainage.** Drainage from one resident's property can significantly impact their downslope neighbors, particularly in the hilly areas of the City. Access to these lines has become more and more difficult as development continues. Storm drains in backyard easements are also more susceptible to root intrusion, requiring ongoing maintenance and greatly shortening their service life.
6. **Need for Better Inspection and Maintenance.** Residents are concerned that the limited resources available for the Maintenance (O&M) program doesn't adequately address the needs of the system.
7. **Flow Augmentation and Watershed Development.** As the City develops and re-develops through infill, the amount of impervious areas within the City will increase. As a result, runoff or storm flows will increase. Problems may be associated with smaller and smaller storms.
8. **Condition.** Many parts of the system are deteriorated and in danger of structural failure. Such failure can cause street cave-ins, damage to public and private property, and create liability for the City.

The City contracted with CH2M HILL to complete a Storm Drainage Master Plan. The project was completed over the last two years in five major tasks as shown in **Figure ES-2**.

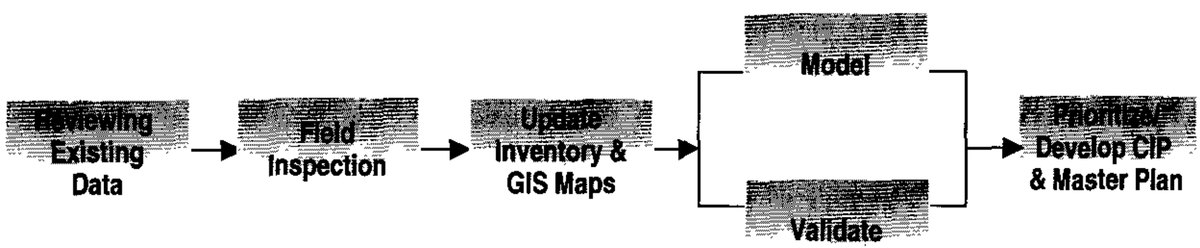

FIGURE ES-2
Project Approach

Industry Drivers

Storm drainage infrastructure is a significant public investment. Initial construction costs are just a fraction of the replacement costs for most systems. The City's storm drainage infrastructure, including pipelines and pump stations, was constructed 60 to 70 years ago. Since that time, very little upgrading of the system has taken place. Much of the system is now nearing the end of its useful life. In 2004, the replacement value of the same infrastructure exceeded $1.1 billion. Pipelines represent the largest capital investment made by most cities; however, the condition of these underground assets is largely unknown.

Policy and Regulation

Table ES-1 shows the applicable regulations and policies that govern storm drainage within the City of Oakland. The table also identifies the administering agency for each. Of these agencies, the state Regional Water Quality Control Board has the most significant compliance role through the NPDES Permit that impacts the City of Oakland storm drainage management.

TABLE ES-1
Regulations and Policies Applicable to Storm Water Management for the City of Oakland

Regulations and Policies	Administering Agency
Clean Water Act (CWA)	EPA
National Pollutant Discharge Elimination System (NPDES) Municipal Storm Water Permit for the Alameda Countywide Clean Water Program	California Regional Water Quality Control Board (RWQCB)
Beneficial Use Designations per CWA and State Resolutions and Basin Plans	RWQCB and State Water Resources Control Board (SWRCB)
Storm Water Quality Management Plan Fiscal Years 2001/02 through 2007/08	Alameda County Clean Water Program (ACCWP)
Creek Protection, Storm Water Management, and Discharge Control. Ordinance No. 12024 C.M.S., effective December 16, 1997	City of Oakland, California

The RWQCB recognizes that storm water discharge points and pollutant sources are diffuse. Numerical effluent limitations are not deemed feasible at the current time. Nonetheless, best management practices (BMPs) are expected to reduce pollutant discharges that may violate water quality objectives. The RWQCB monitors BMP compliance.

The RWQCB approach to urban runoff within Oakland emphasizes reduction of pollutants transported through storm drainage systems into surface waters. In the City, the most important aspect is control of debris and trash within the storm drainage system. The burden of this BMP rests primarily with the City's Maintenance Department.

The Alameda Countywide Clean Water Program (ACCWP) is comprised of local cities, county agencies, and flood control districts that discharge storm water to the San Francisco Bay. The City of Oakland is a participant of the ACCWP. The ACCWP submitted a Storm Water Quality Management Plan (SWQMP) for Fiscal Year 2001/2002 – 2007/2008 as the basis of the storm water discharge permit from the California State Water Quality Control Board (RWQCB). The SWQMP is designed to enable the ACCWP to meet the requirements identified in the NPDES permit and the City's NPDES permits. The SWQMP essentially identifies a series of BMPs to protect the watershed.

Best Management Practices for Maintenance

The Sewer Maintenance and Utility Inspection Division is tasked with preventing flooding, identifying needs for repair and replacement of storm drain system components, cleanliness of Lake Merritt and surrounding areas, and other miscellaneous tasks. All of the existing Best Management Practice (BMP) tasks under the responsibility of the Sewer Maintenance and Utility Inspection Division are summarized in **Table ES-2.**

Efforts to maintain storm drains in proper conditions are particularly difficult at certain locations. Inlets located near liquor stores are often clogged by debris, and require cleaning more frequently than other inlets. Many inlets near Lake Merritt are clogged with fast food and drink containers. A number of cross culverts in the City do not allow gravity flow as designed due to repeated re-paving of road surfaces at intersection. The re-paving effort did not appear to have accounted for drainage concerns.

Maintenance crews are called frequently to address flooding issues throughout the City due to year round standing water at cross culverts. Standing water promotes breeding habitats for vectors that may carry disease. Debris and sediment accumulate under altered drainage conditions. Flooding damages and prevents access to private property and public spaces. The condition may be alleviated only temporarily by the maintenance crew and repeated visits are made to these cross culverts to keep them free of debris and flowing properly.

Tributaries to the Bay near the Oakland Coliseum require cleaning due to collection of debris, trash, and sediment. These are natural drainage ways that include easements deeded to the City to maintain. Cleaning can only be performed between July and October. The City doesn't own the proper equipment to clean these water ways, so these tributaries are manually cleaned. When downstream stretches owned by the ACFC or the State are not maintained, cleaning by the City's crew becomes less effective in preventing flooding in the surrounding neighborhood areas.

Data Gathering

An understanding of the City system, resources and practices was developed through an extensive data gathering effort using various tools:

- Review of current City documents, procedures, practices, standards, and organizational charts
- Interviews with key staff in Maintenance and Operations (O&M) and Public Works Agency, Community and Economic Development (CEDA), and the Port of Oakland.
- Industry experiences
- Series of field investigations
  - Structure Inspection
  - Closed Circuit Television Inspection
  - Field Survey

TABLE ES-2
Best Management Practices Currently in Place

Job Category	Task	Frequency & Season	Notes on Priority, Structural Issues, etc.
Preventive Maintenance – Debris Removal	Clean trash racks on weirs (hill area)	As needed/ Winter months	Located in natural drainage ways.
	Hydroflushing	When addressing inlet complaints	Pipe flushing + use of power router at times
	Creek maintenance	As needed to avoid flooding	Vegetation removal, etc.
	Inlet Cleaning	Strive for once/yr., (only 60% cleaned)	Street sweeping can put debris in between bars in inlet grate.
Public Relations & Response	Field complaints	Daily/ Year Round	
	Replace inlets with bicycle-safe grates	As identified, ASAP/ Year Round, more frequent in Jul-Sept	Priority. Old grates have gaps that are too wide. Litigation driven; 60% to be replaced.
	Respond to complaints	On call/ Year Round, esp. in rainy season	Priority. Year Round issue. Repaving does not allow gravity flow. Trip to clear flooding storm drains.
	Make sand bags & deliver to fire stations, seniors, and disabled	For storms in winter months	Priority.
Repair and Replacement	Pipe, inlet, & manhole repairs	As needed	
Preventive Maintenance – Other Measures	Erosion control	As needed	For construction jobs.
	TV inspections	As needed	City owns equipment.
Special Projects	Lake Merritt, Grand Ave. Inlet and Outlet Cleaning	Weekly/ Year Round	Priority. 60 portals into Lake Merritt. Businesses along Grand and Lakeshore affected by flooding.
	Lake Merritt Harvester	7 days a week between April & Sept. Schedule around summer activities and annual rowing competition.	Priority. More aerators and fountains may be installed to reduce algae growth. Lake Merritt depth is 12 ft at low tide, 16 ft at high tide. Machine submerged 10 ft.
	Maintain stormwater treatment units (Staten & Bellevue, Euclid & Grand)	Check monthly, vacuum and dispose debris/ Year Round, esp. winter months	Priority in winter. CDS is tied to multiple inlets. Still needs to clean individual inlets and pull up grates to clean underneath. More units are scheduled to be installed.

Note: Table developed through interviews with City staff.

- Series of Data Capture and Modeling Tools
  - Storm Drainage Management System (SDMS Database)
  - Hydraulic Model (MOdel for Urban SEwers – MOUSE)
  - Preliminary Rehabilitation Costing Model
  - Updated Geographic Information System (GIS)

City Infrastructure Assets

City storm drainage assets encompass a range of conveyance strategies. In undeveloped areas, water drains through a system of natural swales, ditches and streams. The major surface drainages in the City follow the drainage channels of the creeks: Temescal, Glen Echo, Trestle Glen, Sausal, Peralta, Courtland, Seminary, Lion, Arroyo Viejo, Elmhurst, Stonehurst, and San Leandro. Creeks generally flow in a southwesterly direction from their headwaters in the Oakland/Berkeley Hills, following steep natural channels segmented by many short culverts until they reach flatter, more developed areas. As the City was developed, portions of this system were replaced with culverts, concrete lined channels and buried pipes. Most creeks within the City flow through underground channels until their point of discharge. Runoff from Temescal Creek drains thorough Emeryville and empties directly into San Francisco Bay. Runoff from Glen Echo and Trestle Glen creeks drain into Lake Merritt before entering the Oakland Estuary, while runoff from the other creeks drain first through the Oakland Estuary and then into the Bay.

The ACFC is a unit of the Alameda County Public Works Agency responsible for construction, operation and maintenance of major storm drainage facilities. The City of Oakland system drains to ACFC structures throughout the City. Throughout this project, the City and ACFC have cooperated in developing a modeling approach that will be used throughout the City by both entities.

The system is comprised of 15 creeks with 30 tributaries and approximately 370 miles of storm drain pipes ranging from 6 inches to 72 inches in diameter as shown in **Table ES-3**. Approximately 80 percent of the system is concrete pipe. The remaining pipes are corrugated metal (CMP), vitrified clay (VCP), polyvinyl chloride (PVC), high density polyethylene (HDPE) and several other types.

The City manages many storm drainage assets including pipes, pump stations, manholes, inlets, culverts, trash racks, weirs, etc. within the storm drainage system. Approximately 60 percent of the structures are inlets (7,305), 25 percent are manholes (3,152), and the remainder are cross culverts (457), creeks or natural channels (11), or pump stations (6). Other structures are outlets or those that could not be accessed during field investigations.

TABLE ES-3
City Wide Diameter Distribution

Diameter	Pipe Count	Total Length (Feet)	Total Length (Miles)	% of Total
12 inches and less	5,318	433,316	82.1	22%
12 to 18 inches	4,462	586,437	111.1	30%
18 to 24 inches	2,140	327,977	62.1	17%
24 to 36 inches	1,533	247,881	46.9	13%
36 to 48 inches	555	117,482	22.3	6%
>48 inches	985	261,887	49.6	13%
Total[1]	*14,992*	*1,974,979*	*374*	100%

(1) In the future, recommend the City field verify diameters that are presently flagged in the inventory.

Mapping

The purpose of mapping the storm drainage system was to collate a current inventory of the existing system on an overall City geographic information system (GIS) map. A grid was developed for field work that corresponds to the City's sewer sheet grid. Structures were inspected during field work. Once the field work was complete, a visual reasonableness check was completed by comparing field maps with the City's sewer sheets to find and resolve discrepancies. Structures previously reflected on the sewer sheets were confirmed. New structures identified during field investigation were added to the database using AutoCAD, scanned images, data gathered in the field, or field geocoding to 'connect the dots' from known to newly identified structure locations. To designate ownership, three areal overlays were used for the City's Port, Caltrans, and ACFC. Each network and sub-network was traced to determine the flow direction based on topology within the City. All slope discrepancies were resolved with either best judgment or field verification.

The base map developed for the storm drainage master plan was shared with the consultant responsible for creek mapping within the City. A pilot area was identified within the City where they field verified the creeks on the base map and digitized the results of their investigations onto the storm drain base map. This pilot area map is shown in **Figure ES-3**. As shown in the figure, the lines shown in blue are the creeks. The storm drain lines shown in black dovetail with the creeks. Once the two projects are complete, the combined creek and storm drainage mapping will provide one overall map of the City's drainage system.

Condition Assessment

As the system ages, there is an increased likelihood of structural failure. Almost 12,500 structures were inspected to determine their condition. Qualitative data from the

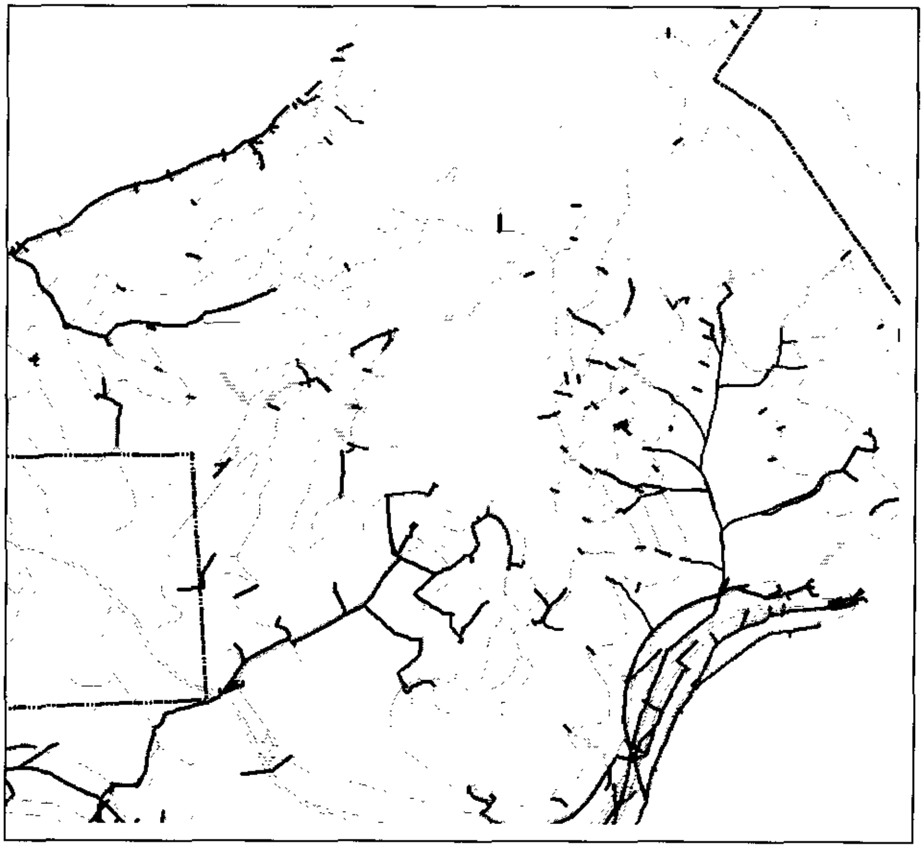

FIGURE ES-3
Creek Pilot Area Map

inspections were converted to numerical scores. This scoring produces five grades of structures (A, B, C, D, and F). The grade convention assumes A is best and F is worst.

Table ES-4 summarizes the individual structure inspections, letter grades, maintenance and capital requirements. Approximately 83 percent of the structures are condition grade A or B or sound condition, requiring only inspection, limited spot repairs or ordinary maintenance. This pipe category will require further investigation over time to determine appropriate levels of inspection and spot repair. Approximately 4.5 percent of structures are in condition Grade C, D or F. These areas will require maintenance, design and construction efforts in the coming years. **Figure ES-4** shows the relative percentages of structures within the C, D and F condition grade based on the inspection results.

The Table also shows that approximately 12 percent of structures could not be accessed or located during field investigations. These structures, along with those not previously identified or investigate by the City should be targeted for future investigation to determine appropriate levels of maintenance, inspection and/or repair.

A portion of the structures located within the City of Oakland, 556, interface with either Caltrans or ACFC pipelines. These structures should be discussed with the other agencies and an appropriate definition of ownership and maintenance responsibility should be identified for the future.

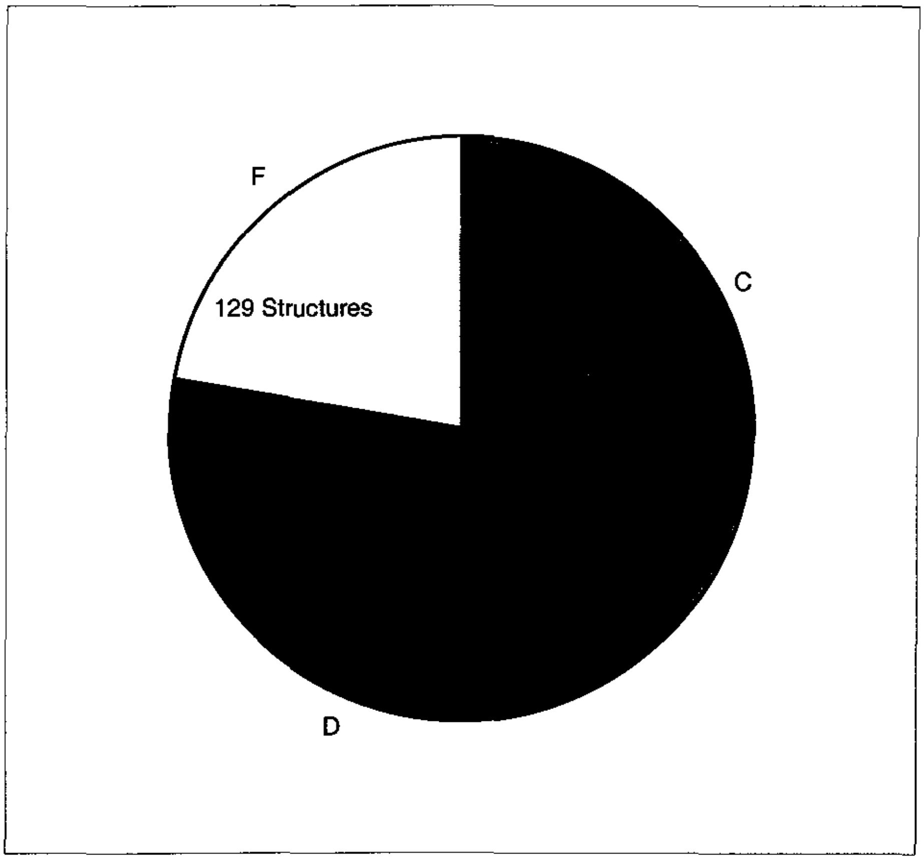

FIGURE ES-4
Current Inspected Structure Condition

Detailed closed-circuit television (CCTV) inspection was conducted on a portion of the system distributed throughout the City. These pipes are shown in **Figure ES-5**. Qualitative data from the CCTV were converted to numerical scores. A model was developed to relate the "known" attributes of selected pipes to the "scored" condition of the same pipes. The resulting relationship was used to predict the condition of the entire system. Similar to the structure grading, the model produced five grades of pipe (A, B, C, D, and F). **Table ES-4** shows the grades and the corresponding description of appropriate rehabilitation and maintenance requirements for the structures. Five general workload categories are generated, inspection, maintenance, structure and pipe repair. The vast majority of predicted conditions are anticipated to drive the maintenance workload. CCTV inspection shows a significant quantity of debris within the storm drainage system. If pipes are not rehabilitated, then the situation only worsens. Significant debris contained within the pipelines can cause flooding. Poor structures will continue to degrade until they eventually fail.

TABLE ES-4
Overall Condition-Related Maintenance and Rehabilitation Workload

Structure or Pipe Condition Grade [1]	Description	Structures Inspected (City) [2]	Structures Inspected (interface with Caltrans or ACFC) [2]	Structures Identified for Maintenance	Structures Identified for Rehabilitation	Pipe Identified for Rehabilitation (feet) [3]
A	Structure in sound condition. Inspect within several years. Install leaf or gravel collector. Perform routine cleaning.	9,361	111	6,981		
B	Structure is generally good condition. Perform routine inspection and cleaning.	1,032	22	2,795		
C [4]	Point repairs, installation of leaf/gravel collectors or increased maintenance should be carried out to extend structure life and reduce likelihood of problems. Perform routine maintenance.	196	23	951	211	20,625
D [4]	Major repairs necessary to maintain service in damaged structures. Replacement or repair should be considered. Enhanced maintenance required until repairs are made.	236	3	390	241	4,019
F [4]	Imminent failure. Replace or rehabilitate structure ASAP in order to maintain service. Extraordinary maintenance required until repairs are made.	123	3	256	129	2,909
CNA / CNL / CNO	Other structures that could not be accessed, opened or located during field investigation	1,525	394			
Total Inspections		12,473	556	11,373	581	27,553
Future Confirmation[5]	Other structure inspections recommended to confirm location and type. These include additional manholes, inlets, culverts, channels, weirs, trash racks, outlets, etc. that were not previously field located.	7,011	1,713			

(1) Grade convention assumes A is best and F is worst.
(2) Totals include structures previously inspected by the City and structures inspected through this project.
(3) Pipe length is an estimate based on structure condition. CCTV will verify length.
(4) Some structures in Grade C, D and F are assumed to require maintenance as well as repair. Some structures may be double counted as appropriate.
(5) As part of the routine activities, a percentage of these structures should be located and confirmed annually or removed as appropriate.

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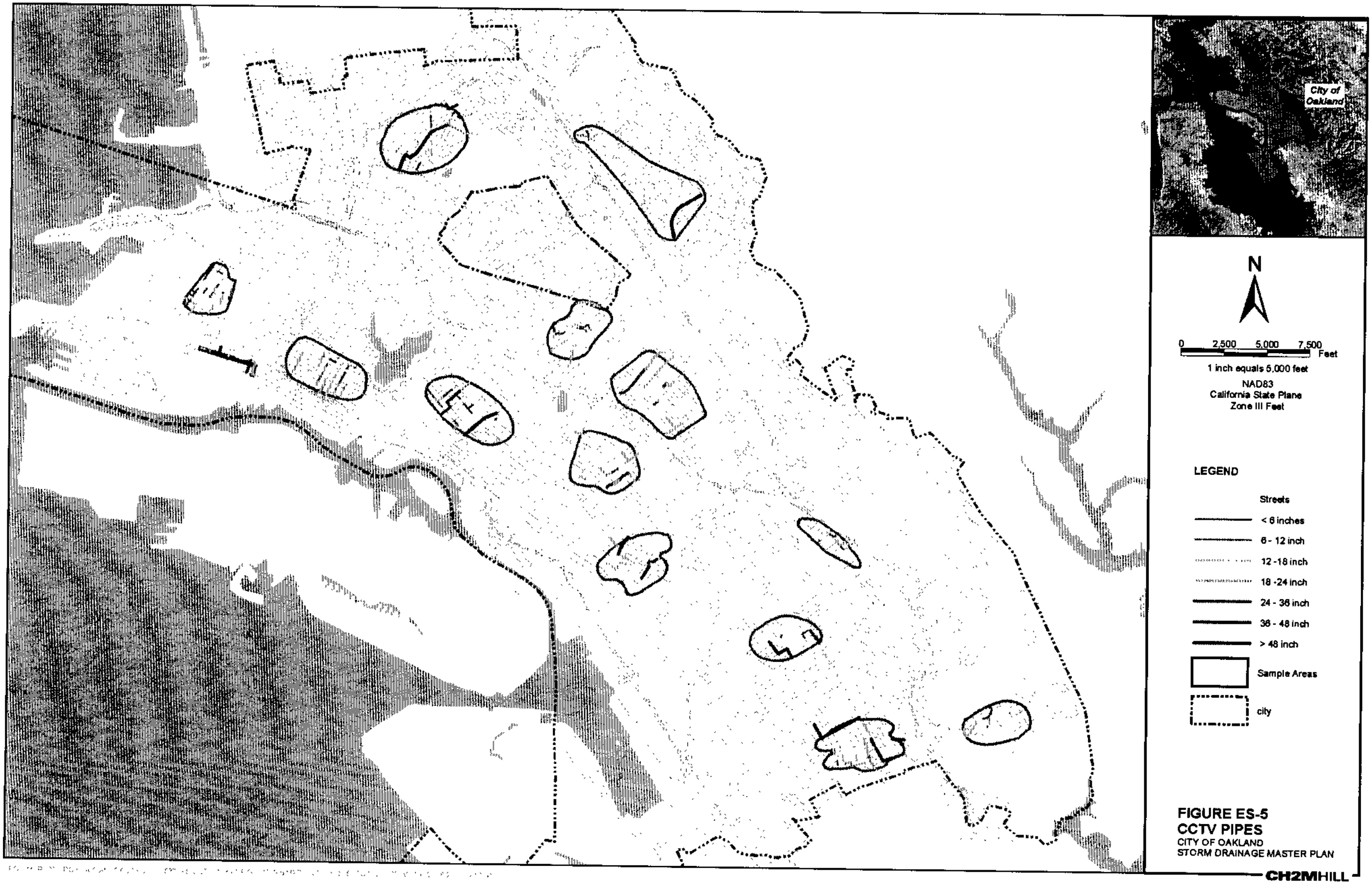
City of Oakland
N
0 2,500 5,000 7,500 Feet
1 inch equals 5,000 feet
NAD83
California State Plane
Zone III Feet
LEGEND
Streets
< 6 inches
6 - 12 inch
12 -18 inch
18 -24 inch
24 - 36 inch
36 - 48 inch
> 48 inch
Sample Areas
city
FIGURE ES-5
CCTV PIPES
CITY OF OAKLAND
STORM DRAINAGE MASTER PLAN
CH2MHILL

Capacity Constraints

A hydraulic model was developed for the City by simplifying the system to all pipes greater than 18 inches in diameter. The model included the portions of the Caltrans system within the City and the ACFC System downstream of the City's system. The City system was divided into 15 watersheds using the stream catchments as major conveyance corridors. Each basin was then subdivided into smaller catchment or subcatchment areas that contribute to local points of concentration within the hydraulic model.

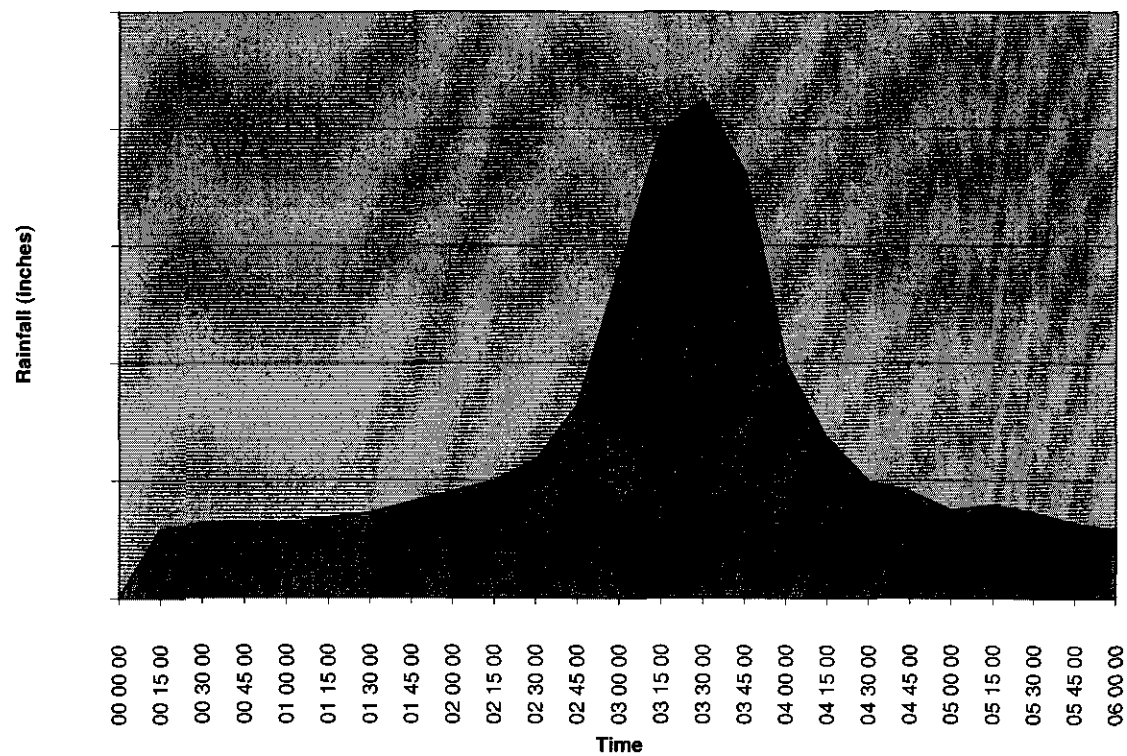

FIGURE ES-6
Synthetic Design Storm

A synthetic design storm was developed assuming a 6-hour, 15-year return frequency (**Figure ES- 6**). For the City, the volume of the storm can range from 1.6 to 3.9 inches in 6 hours. The probability that a 15-year event may occur in any given year is 7 percent. Parameters utilized in the model were developed based on the ACFC's *Draft Hydrology and Hydraulics Manual* (June 2003). The synthetic storm was utilized to evaluate the capability of the existing storm drainage system to carry the stormwater runoff. The storm was routed through the model and evaluated for capacity constraints.

An evaluation of the City's system shows that the existing storm drainage network will carry approximately a 2.5 to 3 year storm. The 15-year storm event is approximately 8 times that volume. Generally, the system is undersized and needs capital investment to reduce flooding and carry more storm runoff volume.

A series of criteria are used to evaluate the system capacity. First, the maximum hydraulic grade line was compared with ground surface elevation. If the hydraulic grade line was within 1.25 feet of the surface or if flooding was predicted, then these locations were flagged. Additional criteria were developed where the modeled flow volume exceeded the flow volume used to design the pipelines. Based on model results, a series of projects are recommended to eliminate flow restrictions and flooding. There are 186 projects throughout the City recommended for capacity improvements.

Stakeholder Ranking

Once all of the capital improvement projects are identified, it is necessary determine which projects should be constructed first. A prioritization process was developed that included a stakeholder group from a variety of city offices and the ACFC to provide input to the evaluation process. The evaluation scale was developed primarily from stakeholder meetings, and knowledge of the local system and impacts. During a series of meetings in 2003, stakeholders identified and prioritized evaluation criteria. Initial categories included:

- System performance
- Regulatory
- Health and Safety
- Cost
- Public Involvement/Acceptance
- Operations and Maintenance
- Order of Construction
- Local Factors

Specific evaluation criteria and the resulting prioritization of scores are listed in the evaluation matrix shown in **Figure ES-7**. A detailed alternatives evaluation model was developed, in which CH2M HILL converted the criteria to a quantifiable basis for comparing the capital improvement projects. The detailed prioritization list includes all of the appropriate factors for each project. Where necessary, the evaluation scale was determined by industry-standard information. **Figure ES-8** maps all of the prioritization criteria throughout the City. To calculate the scores for each project, the mapped criteria were overlain on the projects and a total score was calculated. Generally speaking, the higher the score, the higher the project priority. Where necessary to prevent potential downstream flooding impacts, a downstream project was sequenced prior to the upstream project even though the priority of the downstream project may be lower.

Infrastructure	Score	[illegible]	Score	[illegible]	[illegible]
Public System	4	Actual Flooding	6	Essential Public Buildings Including Schools (within 200 feet)	5
Natural Creek	3	Imminent Infrastructure (including roadways) Failure	5	Streets	4
No Existing System (natural Water Courses or sheet-flows)	2	Erosion (within 200 feet)	4	Landslide Area	3
Private System	1	Predicted Flooding	3	Residential	2
		Hydrograph consideration (construct downstream prior to upstream, evaluate time of concentration, velocity, etc.)	2	Unimproved Private Property and Parks	1
		Potential Infrastructure Failure	1		

FIGURE ES-7
Prioritization Matrix

Costing Model

Unit cost estimates were developed based on input from the City and Bid Tabulation Data collected from a variety of sources. The unit costs are based on various replacement or rehabilitation methods available to the City. A costing model was developed to electronically integrate the results from the predictive modeling equations and unit-cost estimates and generate an order of magnitude estimate for each construction project. The cost model uses current bid tabulation data from the local area to provide realistic program estimates. All hard and soft costs were included in the program level estimates. The current rehabilitation costing program uses a 15 percent contingency (instead of the usual 25 percent to 30 percent used in program-level planning because actual bid tabulations were used) and 30 percent engineering, inspection and administration estimate. For order of magnitude estimates, the range is assumed to be +50 percent/-30 percent when using the American Consulting Engineers Council guidelines.

Capital Improvements

The results of the Storm Drainage Master Plan provides a road map for future capital investment. Overall, needs are estimated at $195 million for new facilities, improved capacity to prevent flooding, and rehabilitation of aging infrastructure. This represents a little over 18 percent of the replacement value of the system. **Table ES-5** and **Figure ES-9** summarize the overall capital improvement needs for the City. **Table ES-5** identified the

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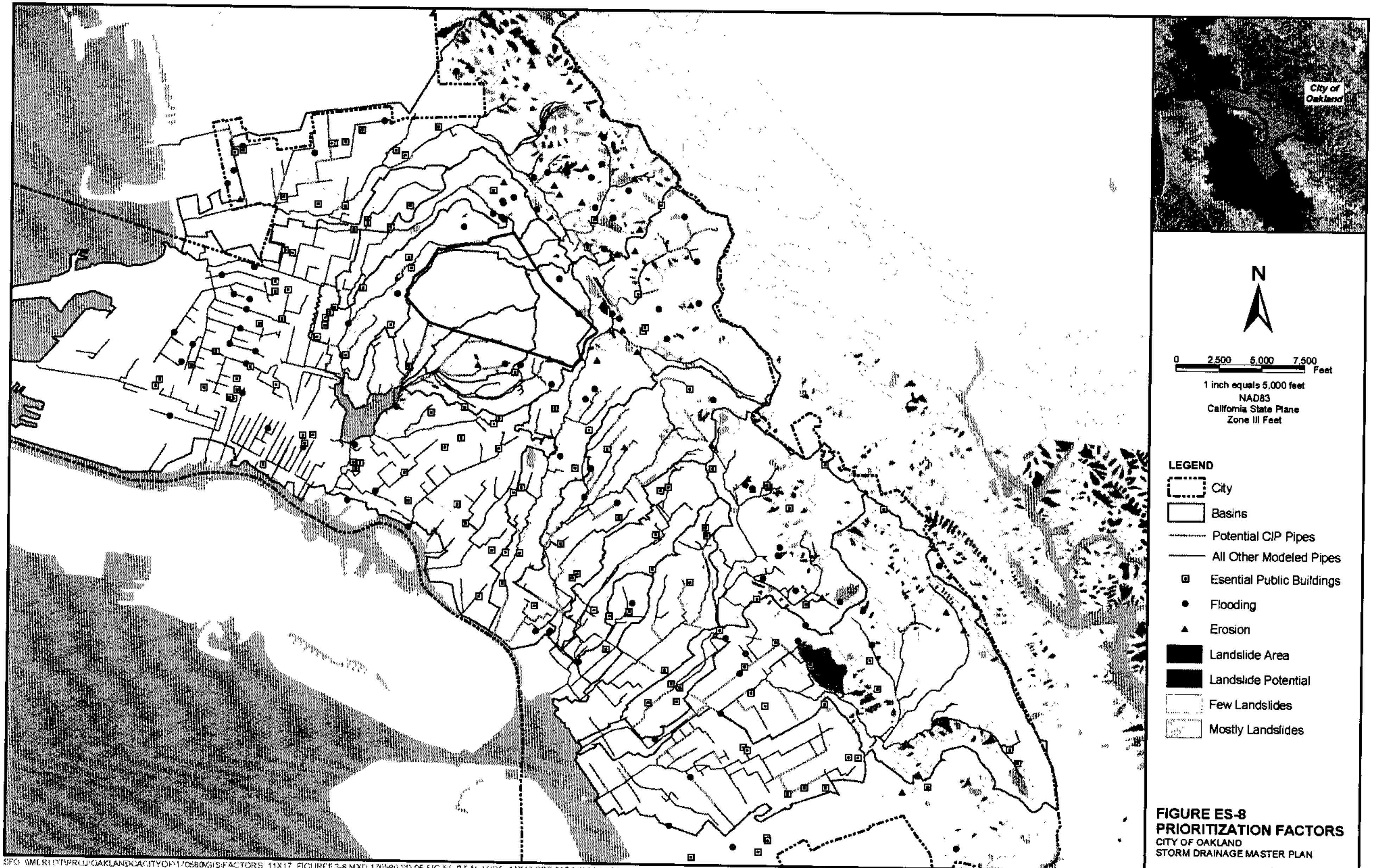

FIGURE ES-8
PRIORITIZATION FACTORS
CITY OF OAKLAND
STORM DRAINAGE MASTER PLAN

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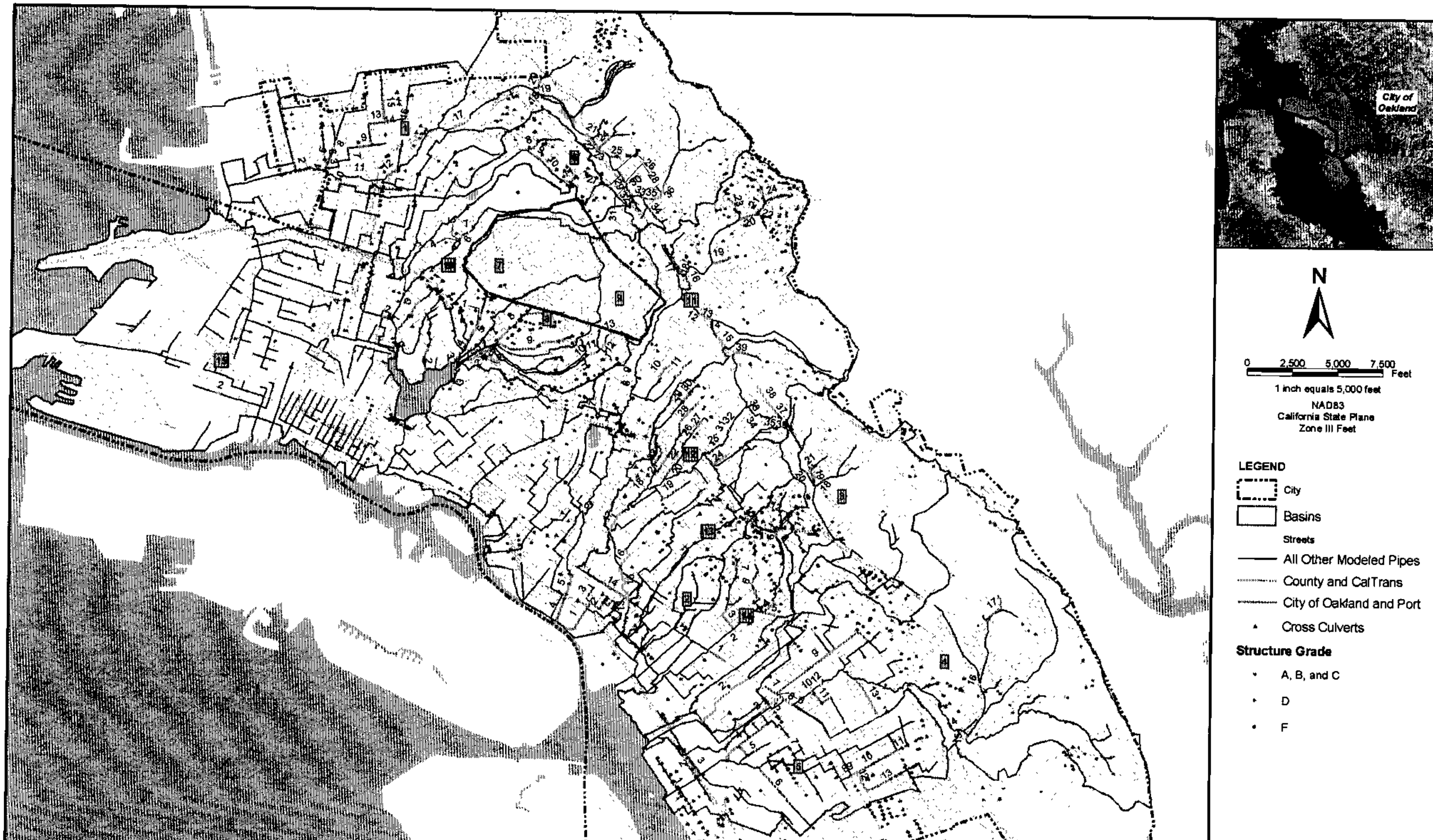

FIGURE ES-9
POTENTIAL CIP PIPES
CITY OF OAKLAND
STORM DRAINAGE MASTER PLAN

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individual basin needs by project type. A separate **Table ES-7** was also prepared that lists individual reaches in priority order for each basin and for the City as whole.

TABLE ES-5
Summary of Modeled Watershed Needs

Creek Drainage	Basin	Council District	System Expansion ($M)	Rehab Needs ($M)	Capacity Needs ($M)	Drainage Subtotal ($)
Temescal Creek	01	1 & 4		2.0	30.2	32.2
64th Ave. Creek, Peralta Creek, Courtland Creek, & Seminary Creek	02,12-14	4, 5, 6, & 7		2.3	22.5	24.8
Lion Creek & Arroyo Viejo Creek	03,04	4, 6 & 7	10.7	3.6	24	38.3 [2]
Elmhurst Creek	05	6 & 7		1.9	24.2	26.1
Rockridge Creek & Glen Echo Creek	06,10	1, 2, 3, & 4		7.2	8.2	15.4
Pleasant Valley Creek	07	1, 2 & 3		0.2	1.8	2
Wildwood Creek & Trestle Glen Creek	08, 09	2, 3, 4, & 5		0.9	13.2	14.1
Sausal Creek	11	4 & 5		5.1	22.4	27.5
14th Ave. Creek, San Antonio Slough, & Damon Slough	15	1, 2, 3, 4 & 5		1.2	5.9	7.1
San Leandro Creek	99	7		1.8	0.03	1.83
		Total	10.7	31.4 [1]	152.4	194.5 [1]

(1) An additional 5.2M is identified by the City for Creek Revitalization (included in the total).
(2) An additional 4.6M will be necessary when Basins 3 & 4 are developed.

One of the industry tools used to evaluate the "health" of the system is the Asset Condition Index (ACI). It is a simple but powerful tracking tool. ACI is calculated as a ratio of the cost to rehabilitate or fix the system divided by the total replacement cost of the system. It is expressed as a percentage. ACI index values fall into three rating groups. Theses groupings are used as guideline by asset managers in response to regulations provided in GASB 34. Assets range from water and sewer utility systems to buildings and other fixed assets.

- ACI < 5% Good
- ACI = 5-10% Fair
- ACI > 10% Poor

Table ES-6 summarizes the overall Capital Improvement needs in the storm drainage system. The City's storm drainage asset condition falls within the "poor" category. The objectives of the capital investment are to maintain the existing infrastructure and provide an improved level of service for the City. Estimated rehabilitation program costs for predicted poor condition or hydraulically constrained pipes were developed using the costing model.

TABLE ES-6
Capital Improvement Needs

Need	Length	Portion of System By Length	CIP Need	Portion of System By Value
New Facilities (length is estimate)	10,000	1%	11.0	1.0%
Increased Capacity	100,000	5%	152.4	13.8%
Rehabilitation (length is an estimate)	30,000	2%	31.4	2.9%
Total *	110,000	6%	194.5	18.0%

* - line items may not total exactly due to rounding.

Investment At Risk

While much of the City's system is sound, critical parts of the system are failing. Many structures are nearing the end of their useful life. Spending the capital now for the City's storm drainage system helps preserve the more than $1 billion investment in the assets already in place. Infrastructure has a limited life span. With proper maintenance and routine repair or replacement of portions of the system, that useful life span can be extended to serve the City's needs.

This study shows that much of the system is undersized and requires larger pipes to be constructed throughout the City. The consequence of not implementing this capital program is that flooding will continue and will worsen as the system ages. Flooding can impact individual homes, businesses, and can impact the City through claims and lawsuits. Implementing the capital program will avoid these serious costly consequences. The consequence of not improving the system is an increased burden placed on the already overloaded Maintenance staff. The required capital investment will only increase as time passes.

Funding

In 2001, the City Council established the Storm Drainage Finance Committee to review all potential sources of funding the storm drainage program. Their evaluation process showed that the City did not have an available source to fund the capital or maintenance needs of the storm drainage system. The lack of a dedicated source of funding limits the City's capability to adequately maintain and improve the system. A new funding source is needed to fund the program identified throughout the master planning process.

Other cities are investing in their storm drainage network. The range of maintenance investment for local Bay Area cities is from $0 per foot to $9.41 per foot. The City's investment is on the low side at approximately $0.80 per foot. This level of maintenance is not sufficient to prevent debris build up within the storm drainage system. Additional funding is required to provide the maintenance staff the capability to clear the debris from the system and comply with the City's National Pollutant Discharge Elimination System (NPDES) permit.

Optimization Opportunities

The City, like other municipalities, is balancing the trade off between maintenance and design. As a public agency, the ratepayers support all of these activities. Without a rate increase, the staff and workload will be static unless work practices are modified to achieve more work with the same resources. **Figure ES-10** illustrates the tradeoffs realized by adjusting design and O&M activities. There are two solid lines on the chart, Maintenance and typical capital investment activities. Planning includes everything from first planning projects through, design, engineering, and administration. These two activities have an inverse relationship. If the City plans to a very high level, then the corresponding maintenance requirement will be low. The costs will be high for planning and low for maintenance. At the other end of the spectrum, if the City does very little planning, then the corresponding maintenance needs will be very high. Comparisons and recommendations for optimization need to be grounded in what can be accomplished. The City needs to plan to the right level so that maintenance activities provide the appropriate level of service within the system. The desired or optimum level is such that the combined activities approach the low point of the total cost curve.

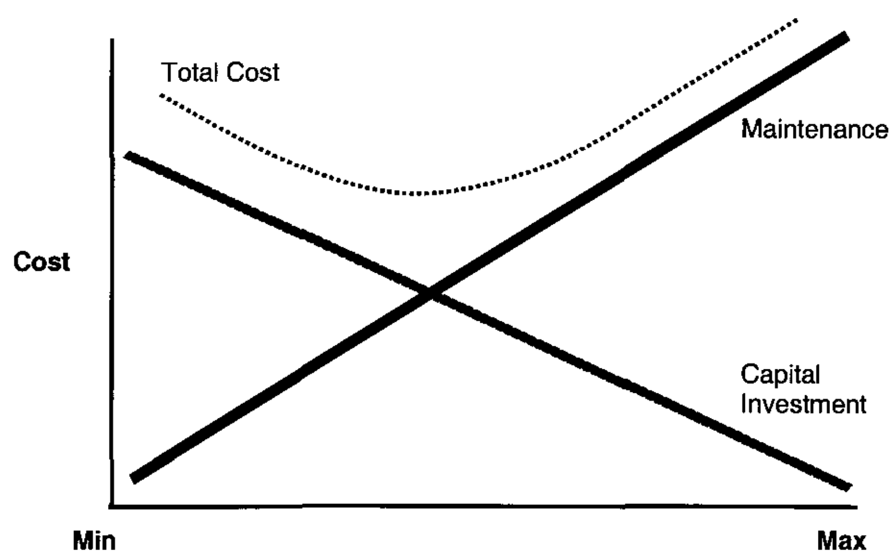

FIGURE ES-10
Optimization Model

Optimization is defined as the most efficient use of processes, systems, and section resources (people, technology, tools, and budget) for effective asset management. A few of the most important optimization opportunities are:

1. Utilize an organizational approach to manage existing assets that targets tools such as GIS, storm drainage management system (SDMS) database, scheduling and cost tracking.

2. Utilize appropriate tools, practices and technologies for O&M to identify and schedule cleaning and inspection activities, and document the work within the SDMS database.
3. Implement standardized data collection and identification procedures for maintenance staff, evaluating rehabilitation needs and focusing on future decision making practices.
4. Continue to update the electronic resources developed during this project, including maps, database and inventory tools.

Key Recommendations

Based on the results of the master planning process, we recommend the following actions be taken by the City:

1. Dedicate a funding source for maintenance and capital needs for the storm drainage system.
2. Develop a strategy to clean the debris from the storm drainage system on an annual basis. The cleaning process should be scheduled utilizing the SDMS to document process and target hot spots. In this manner, the City can document the locations cleaned and formulate a strategy to remove and control debris within the storm drainage system.
3. The types of debris and trash, leaves, branches, fast food containers, etc., identified in the storm drainage system indicate that public education currently in process by the City should continue to help reduce the level of debris and complement the BMPs currently in place.
4. Construct capital improvement projects to improve hydraulic carrying capacity within the City. These projects should be implemented from the downstream portion to the upstream portion in each/all watersheds. Improving these structures will help alleviate the maintenance workload.
5. Construct capital improvement projects to repair the poor condition structures within the system. Improving these structures will help alleviate the maintenance workload.
6. Construct capital improvement projects to capture debris upstream, prior to where it enters the closed pipe system. Items such as gravel and leaf collectors are good options. Improving these structures will help alleviate the maintenance workload.
7. Continue updating and improving the inventory tools (GIS map and SDMS database). During routine activities, document and incorporate data from the current projects into the database.
8. Continue inspection of structures and pipe lines to determine the specific needs for repair and replacement within the storm drainage system. Timing for inspections should be determined over the next several years of experience within the City.

9. Only a portion of the storm drainage system was televised during this project. The City should continue televising the storm drainage system to document the condition. Most utilities work to televise the entire system on a 5-10 year cycle.

10. During this project, flow monitoring was not conducted. Flow monitoring is recommended in each basin to further refine the hydraulic model for both planning and design in the future.

(Note: Table ES-7 is bound in a separate document.)