Executive Summary

Introduction

In 2004, the City of Santa Barbara's Creeks Restoration and Water Quality Improvement Division (Creeks Division) initiated the development of watershed action plans for the Arroyo Burro, Mission Creek, Sycamore Creek, and Laguna Creek watersheds, as part of the Creeks Restoration/Water Quality Improvement Program for Santa Barbara. As one of the initial steps in developing watershed action plans for these four watersheds, this Existing Conditions Study involves research of environmental conditions based on available documentation and field surveys, provides a detailed characterization of each watershed, and reviews relevant federal, state, and local regulations. Each section includes statements of findings and conclusions on issues that should be addressed in the subsequent formulation of detailed watershed action plans.

Watershed Action Plans

Many single-purpose water resource-related plans are prepared that address, for instance, only flood control, water quality, or habitat protection. More often a plan only covers a single jurisdiction (such as within the city limits), an official sphere of influence, or a specific river corridor or stream segment. A ***watershed action plan*** is multi-objective and may cross jurisdictional boundaries, as it covers all water-related issues and resources, including flooding, bank stability, groundwater, creek restoration, fisheries and stream habitat enhancement, and water quality. A watershed action plan comprehensively looks at contributing factors and cause-and-effect relationships on a watershed-wide scale. It identifies and coordinates program and individual project development needs, aimed at solving identified problems (stressors), with the agencies in the best position to implement them.

Purpose of Existing Conditions Report

This Existing Conditions Study is the first step in the development of a comprehensive watershed action plan to work towards an environmentally and economically healthy watershed. The study reflects existing information on characteristics of each watershed, including geology and geomorphology, vegetation/habitat types, fisheries, land use, infrastructure, cultural resources, hydrologic processes, and water quality. The study also identifies potential watershed stressors and creek management constraints and opportunities, information gaps, and recommendations for areas of additional study.

Coordination with Santa Barbara County Water Resources Division (WRD)

Although WRD staff has not yet reviewed and commented on a draft of this report, County staff has provided input and information to the study team and participated in an informal workshop where some of the preliminary ideas on hydrology and geomorphology were discussed.

Coordination with General Plan Update Process

The information and findings of the work that went into preparation of this Existing Conditions Report has been shared with General Plan Update preparation staff; likewise, trends and other analyses that have been developed as part of the General Plan Update have been provided to the study team. It is very important that various elements of the General Plan Update continue to be coordinated with the preparation of the watershed action plans, both for plan effectiveness and for efficiency in effort and expenditures. Coordinated with the concurrent General Plan Update process, the Existing Conditions Study can help provide a framework for future watershed policy development. Both planning processes will include extensive stakeholder and public outreach efforts.

Other Uses of the Existing Conditions Report

This Existing Conditions Report is comprehensive and can potentially be used as a resource to supplement the City Master Environmental Assessment (MEA), now more than 25 years old, for use in CEQA review of development proposals and City and County public works projects. It can also provide information useful to the preparation of the EIR on the updated General Plan. This report can be referred to and incorporated by reference.

Setting

The City of Santa Barbara is located along the Southern California coast, approximately 100 miles north of Los Angeles, and about 100 miles south of San Luis Obispo. Santa Barbara enjoys a Mediterranean climate that is generally mild and sunny most of the year, with relatively stable temperatures.

Santa Barbara's watersheds are contained within the Santa Barbara Coastal hydrologic unit. This unit consists of the south face of the Santa Ynez Mountains, which trends east to west, at an elevation of about 3,000 feet above mean sea level (MSL). From the crest of the mountains to the ocean is the approximately 7- to 10-mile-wide band that contains more than half the county's population, and all of the City of Santa Barbara. Although the Santa Barbara Coastal hydrologic unit is often classified as a single watershed, it consists of 50 to 60 individual stream systems, including the study area streams. The creeks flow south from their headwaters in the mountains to the Santa Barbara Channel. Each of the four study area watersheds is relatively small, ranging from approximately 2,000 acres to 7,400 acres, with total stream lengths rarely exceeding 10 miles. The physical geography of the watersheds ranges from steep canyons running from the ridgeline of the Santa Ynez Mountains to the mostly urbanized coastal mesas and coastal plains. Each of the study area watersheds (except Laguna) begins in the Santa Ynez Mountains, draining steep, brushy hillsides and wooded canyons. The profiles of Mission, Arroyo Burro, and Sycamore Creeks consist of: 1) a high-gradient segment in the steep mountain slopes and foothills, 2) moderate-gradient alluvial fans, mesas, and debris flows on the front and toe slope portions of the mountains (where streams are incised), and 3) low-gradient coastal plains, marine terraces, and alluvial floodplains that terminate at the Santa Barbara Channel.

Santa Barbara's Creeks

Within Santa Barbara there are seven major creeks and primary tributaries. This Study focuses on four watersheds and associated sub-watersheds within Santa Barbara:

- Arroyo Burro Creek, which includes the main stem from Hendry's Beach parallel to Las Positas Road, and primary tributaries including Las Positas Creek, San Roque Creek, and Barger Canyon Creek. The Cliff Drive tributary, also known as Mesa Creek, is a minor creek located in the lower Arroyo Burro Drainage.

- Mission Creek, which includes both Old Mission and Mission Creeks. These creeks and primary tributaries include Rattlesnake Creek, Las Canoas Creek and West Mountain Drive drainage in the upper watershed, downstream, parallel to Highway 101, to West Beach. The Foothill Tributary is located east of middle Mission Creek, near Foothill Blvd. Old Mission Creek tributary is west of Highway 101.

- Sycamore Creek, which includes the main stem from East Beach, as well as tributaries in the upper watershed area including Coyote Creek, Parma Park Creek, Westmont Creek, and Westmont Drive tributary.

- Laguna Creek, which is a created channel that extends from the East Beach Stearns Wharf area to Highway 101. The former intermittent creeks above the new channel are now contained in an underground storm drainage system.

Each of the watersheds (except Laguna Creek) has been divided into ***sub-watersheds*** to facilitate analysis and discussion. The sub-watersheds represent the subdivision of each watershed into units based on drainage area,

considering both surface topography and the developed storm drain system, which in some cases reroutes surface flow out of one topographically defined drainage area into another drainage system.

The four study area creeks have also been divided into management *reaches* (lengths of creek with roughly similar biology, geomorphology, hydrology, land use, or habitat conditions), based on the creek segments identified in the URS's 2000 Creek Inventory and Assessment Study GIS and the research conducted as part of this Existing Conditions Study. The segments were characterized based on their occurrence within five major landform groups (Canyons, Coastal Plain, Flood Plain, Estuary, and Mesa). This reach division also distinguishes between creeks with differing stream gradients, incision, bank conditions, connection with a floodplain, and/or management needs. For instance, long creek segments next to commercial, high-density residential, parks and open space, or largely undeveloped parcels were separated. The reaches can be used for delineation of future development of management strategies and needs.

Creek and Watershed Policies and Programs

There is an extensive amount of sometimes overlapping laws, rules, and regulations that govern or control land use and land development affecting creeks, watersheds, water resources and quality, and biological resources. Section 2.0 provides a detailed review of existing local creek and watershed policies and programs, background reports and plans reviewed in preparing this report, local, state, and federal agencies and related watershed programs, and educational resources.

One of the findings of this review is that there currently is not a comprehensive storm drainage or flood control design manual or drainage master plan that can be used to guide the design of environmentally sensitive and comprehensive or site-specific drainage structures, including bank repair structures.

Development of recommendations for use of lands and development guidelines adjacent to creeks was not within the scope of this project, and may be completed as part of the General Plan Update process, with adequate public input.

Land Use, Cultural Resources, and Infrastructure

Section 3.0 provides information on jurisdiction, land ownership, land use/land cover, cultural resources, and infrastructure.

Jurisdiction and Land Ownership

About half of the study area watersheds' more than 17,600 acres are under the jurisdiction of the City of Santa Barbara, with 36% under Los Padres National Forest jurisdiction, and 13% under County of Santa Barbara jurisdiction.

Most of the land in the lower portions of each of the watersheds is privately owned, while the U.S. government owns a substantial amount of land in the upper portions of each watershed, primarily within the Los Padres National Forest. The City and County have substantial holdings in public facilities, public buildings, parks, beaches, and open space areas. The State of California owns a small amount of land at state historic parks. Public schools and a community college also control small but significant areas.

Land Use/Land Cover

Land use/land cover information was obtained from the NOAA Coastal Change Assessment Program (C-CAP), while the impervious surface information was obtained from an analysis completed by AbTech Industries. Both of these GIS maps were prepared from interpretation of multi-spectral satellite imagery.

Land use patterns in the watersheds are highly dependent on topography. The relatively flat to gently sloping coastal plain of each watershed is highly urbanized, with densities decreasing towards the foothills. All of the Laguna Creek watershed and much of the Sycamore Creek watershed lay on the coastal plain and lower foothills. Urban development, primarily low- to medium-density residential, and orchard agriculture (within Arroyo Burro) extends through the foothill portions of the Arroyo Burro, Mission Creek, and Sycamore Canyon Creek watersheds. However, only the Arroyo Burro and Mission Creek watersheds include extensive steep montane regions that extend well into the Los Padres National Forest to the crest of the Santa Ynez Mountains. The montane portions of these watersheds support mostly open space and natural vegetation.

Santa Barbara is generally urbanized, with the highest percentage of urban/commercial development within Laguna Creek Watershed and the lowest in Arroyo Burro. The lower and middle portions of the Mission Creek and Sycamore Creek Watersheds are urbanized, while the upper reaches of the watersheds are largely rural residential or undeveloped Forest Service lands.

Impervious Surface Areas

Although all four of the watersheds can be considered "urbanized," actual impervious surface coverage (paved areas and roofs, but not landscaped areas) computed on a watershed-wide basis ranges from only about 9% in the Arroyo Burro Watershed, 13% in the Mission Creek Watershed, and 8% in Sycamore Creek Watershed, to 39 % in the Laguna Creek Watershed.

Most researchers have found that many creek systems begin to experience problems, including water quality impairments and increased bank instability, when impervious surface area exceeds 15%, with more significant problems commonly occurring where total impervious surface area exceeds 30%.

While the Laguna Creek Watershed is almost all urbanized, roughly half of the Arroyo Burro, Mission Creek, and Sycamore Creek watersheds are in unincorporated open space lands, with about 25% to 45% within Los Padres National Forest. If the percentage of impervious surface area is recomputed to only include the lower or urban portions of these watersheds, impervious coverage increases to 19% in Arroyo Burro, 26% in Mission Creek, and almost 30% in the more urbanized area of Sycamore Creek.

Allowable Land Use & Development Potential

Most of the four watersheds are considered nearly "built out", with new potential development consisting largely of infill of existing vacant lots, redevelopment, densification, or additions to existing buildings, increasing square footage. There is some development potential in the City and County unincorporated areas near and above Foothill Boulevard in each of the watersheds, with the most large, undeveloped parcels in the Veronica Meadows area of lower Arroyo Burro.

Considering the degree of existing build-out and the land available for development, it is unlikely that new development/redevelopment will substantially impact or increase surface runoff rates and volumes in the four watersheds over existing conditions. However, any increased runoff is a concern in areas that are flood-prone or have existing channel instabilities.

Solutions to better manage increased runoff include use of permeable paving and on-site detention, sometimes in underground basins. Storm water quality treatment using filtering devices and bioswales is also sometimes recommended for water quality reasons. Use of these technologies can increase the costs of development, which is an issue in an area of already high housing and land development costs; this issue warrants further review and discussion in the watershed action plans. Focus areas for coordination with the General Plan Update and policy review could include the development of Best Management Practices (BMPs) guidelines for the above, indicating where and when BMPs are best implemented. These will be included in the City's final Storm Water Management Plan (SWMP).

Infrastructure

Much of the information on infrastructure was obtained from the City of Santa Barbara Community Development Department's 2004 General Plan Update 2030 Conditions, Trends and Issues reports which are available online.

The infrastructure discussion in the Existing Conditions Report provides an overview of the following:

- Parks, open space, and recreational resources. City, County, and State parks, as well as the Los Padres National Forest land, are inventoried and discussed. These areas are important as they provide sites for creek restoration and water quality treatment, as well as demonstration areas for implementation of BMPs. Management objectives identified for Los Padres National Forest include reducing conflicts between recreational users, private landowners, and sensitive habitat, improving defensible space and community protection from fire and floods, and enhancing recreation opportunities while protecting special-status species and overall ecological health.
- Water supply. The City's water resources are currently administered under the 1994 Long-Term Water Supply Program (LTWSP). Very little watershed-originated surface water is diverted, stored, and used locally within the study area. On average, the Cachuma Reservoir provides about half of the study area's water supply, Gibraltar Reservoir about 35%, and groundwater about 8 to 12%, mainly as a reserve for use during period of drought. Reclaimed water use is about 4 to 5%. Critical-period planning models for water supply indicate that the target demand of 18,200 acre-feet per year (AFY), including a 10% safety margin, can be met for each year, with use of the desalination facility and groundwater only necessary for extreme drought conditions or other contingencies.
- Utilities and storm drainage infrastructure. The creek system and storm drainage infrastructure has been significantly altered along the coastal plain. Many smaller creek tributaries have been placed in underground storm drains and larger creeks have more or less been straightened to conform to street layout, with their banks somewhat haphazardly altered by placement of fill, concrete blocks, rock riprap, and other forms of bank armoring. There are 76 pipeline crossings of creeks within the study area; of the study area creeks, Sycamore Creek has the highest relative frequency of crossings. The City's existing Draft SWMP will be an important element to coordinate with the watershed action plans.
- Wastewater and solid waste. Wastewater systems are discussed, including the City's sewer system and private septic systems. Water quality sampling as part of the County's Septic Study did not find septic systems to be a significant contributor to water quality problems. The need for additional onsite wastewater management planning should be further investigated, in coordination with County Environmental Health, especially in lower Arroyo Burro Creek. Watershed action plans should also include coordination with the City's proposed Sewer Lateral Inspection Program. The wastewater treatment plant needs to be rehabilitated to meet NPDES requirements, protect the environment, and anticipate future regulatory requirements that could significantly alter the level of treatment required. There are apparently no major sources of groundwater contamination from solid waste that are impacting creek resources and water quality. Existing local and state programs adequately address leaking underground fuel tank (LUFT) and site mitigation unit (SMU) sites.

- Transportation and access roads. Draft City and County storm water management programs address streets and roads, but control of runoff from existing large, paved areas (e.g., parking lots) should be reviewed in the watershed action plans for prioritization of BMP implementation, along with further evaluation of the problem of sediment originating along dirt roads and utility access roads in upper watershed areas.
- Fire protection and emergency services. A well thought-out Fire Management Plan is in place for the study area watersheds, although it does not fully address post-fire watershed treatment and erosion control along fire breaks and temporary access roads. These needs are currently dealt with through development of post-fire watershed rehabilitation planning.

The watershed action plans will need to continue to coordinate with the City's General Plan update process and with any advanced planning activities conducted by the County and the Forest Service. Focus areas for coordination and policy review with the General Plan Update and City and County Storm Water and Water Quality Management Programs could include the development of BMP guidelines for maintenance of important groundwater recharge areas, as well as minimization of runoff increases through selective use of porous pavement, onsite detention, and storm water treatment structures, such as bioswales.

Historic and Cultural Resources

Much of the information on cultural resources was obtained from the existing City MEA and from University of California, Santa Barbara (UCSB).

The recorded history of the study area can be divided into three broad periods: the Spanish Period (1769-1822), the Mexican Period (1822-1848), and the American Period (1848-present). Prehistoric Native American archeological sites in the study area are found throughout the coastal plains and foothills of the Santa Ynez Mountains. The archaeological artifacts are the result of over 9,000 years of Chumash (especially the Barbareño group) habitation and consist of ornaments, tools, middens, petroglyphs, and pictographs. The most sensitive areas in the City are coastal bluffs, drainages, and the margins of estuaries. With a few exceptions, prehistoric archaeological sites in the City are primarily located within 300 feet of drainages, bluffs, and estuaries; consequently, they may be impacted by watershed planning activities. However, City, County, State, and Federal policies and regulations on identification and protection of cultural resources are fairly complete and need not be a major focus area of the watershed action plans.

Citywide Watershed Conditions

Section 4.0 of the report reviews citywide physical and biological watershed conditions, focused on common resource problems and management needs. Sections 5.0 through 8.0 discuss the existing conditions of each of the four study area watersheds separately.

Geology and Soils

The Santa Ynez Mountains are the western extension of the Transverse Ranges, a geomorphic unit characterized by east-west trending faults, folds, mountain ranges, and valleys. The coastal plain is composed of uplifted and dissected marine terraces, hills, and valleys, some of which form estuaries and lagoons. Soils on the coastal terraces and the southern portions of the foothills in the study area tend to be deep, heavy clays derived from shales overlain in many places by alluvial deposits. Along the south slope of the Santa Ynez Mountains, these heavy soils contact a broad east-west trending band of marine and alluvial terrace deposits derived from marine sandstones. The Santa Barbara Formation extends as an east-west exposure along the lower portions of the Mission Creek and Arroyo Burro watersheds, and results in the distribution of plant communities that favor sandy soils and droughty conditions. The foothill and montane sandstone outcrops are a conspicuous feature of most of the south-facing

range and are tilted nearly vertically. Soils from these sandstone formations vary from thin, poorly developed sandy loams to deep loamy sands and may contain embedded calcareous material, alternating with shales, especially in the lower foothills. The foothills rise steeply to the crest of the range north of this geologic contact. Because of geologic and topographic controls on local watershed development and vegetation, seasonal and perennial drainages in the study area and throughout the south-facing slope of the range tend to form deep, parallel canyons that readily transport eroded material from the mountain slopes to the ocean during periodic, large storm events.

Geologic and landslide maps obtained from the U.S. Geological Survey and the California Geological Survey are included in Section 4.0, along with a soils map derived from the USDA Soil Survey of the Santa Barbara area. The Santa Barbara Area is a seismically active area, where uplift of the Santa Ynez Mountains is concentrated along folds and faults of the Santa Barbara fold and thrust belt. As a result of the active geology there is a constant adjustment between uplift and erosion expressed by periodic debris flows and landsliding, which over a long period has accumulated to form the large fanglomerate and debris flow deposits found at the base of the mountain front. Slope failure, alluviation of valleys, erosion and incision of stream channels is also related to short- and long-term climate patterns in the region, and particularly the periodic occurrence of El Niño. The landscape within each of the study area watersheds reflects the balance between uplift and erosion acting upon the different geologic units in each watershed.

Bedrock in the study area is dominated by a sequence of Tertiary-age Marine Sedimentary Rock Units. In a typical sequence starting from the south, outcropping units are the Santa Barbara, Monterey, Rincon, Vaqueros, Sespe, Alegria, Gaviota, Sacate, Cozy Dell, Matilija, Jalama, Espada and Franciscan Formations. The resistance to erosion of these units varies considerably. Certain sandstone members of the Sespe Formation and of undifferentiated units in the upper watershed areas are relatively resistant to erosion. These units tend to form cliffs and steep slopes. Other units are more susceptible to erosion and slope failure, particularly units composed of siliceous shale and mudstone. This includes units of the Monterey Formation and especially the Rincon Shale. The Rincon shale is particularly susceptible to landsliding. Landslides in the Hope Ranch area of lower Arroyo Burro and the Conejo Road Landslide complex in upper Sycamore Creek may be largely attributed to slope instability due to the underlying rock composition.

In the Santa Barbara area, thick fanglomerate and debris flow deposits may be found abutting against older bedrock in the foothills of the Santa Ynez Mountains. Over a long period of time, these deposits have accumulated to form the overlapping alluvial fans upon which the City sits. These coarse-grained deposits of older alluvium composed of sand, gravel, cobbles, and boulders typically become finer grained toward the ocean. More recent alluvium eroded from these deposits is concentrated in the stream valleys of the study watersheds; along the coastal plain, finer-grained alluvium has been re-deposited as floodplain deposits.

The two most important geologic hazards are landsliding and faulting. In the upper watershed, slope instability is dominated by smaller rockslides and debris flows, while larger complexes are found in the foothills and in the Hope Ranch Uplands. This includes the group of landslides at Hope Ranch and the Conejo Road Complex, where development has been restricted as a result of active landslides. Slope instability in these areas may be directly related to incision by Arroyo Burro and Sycamore Creeks, since the resulting steep slopes are the most susceptible to slope failure. Landslides along these creeks likely supply a large component of the overall sediment load transported by these creeks. While no faults zoned as active by the State of California Geological Survey cross through the City, several are located nearby. These include the Ventura fault 18 miles to the southeast, the Red Mountain fault approximately 17 miles to the east, and the Los Alamos fault about 30 miles to the northwest. Potentially active faults such as the Mission Ridge fault, the Mesa-Rincon Creek fault, and the More Ranch fault pass through the City and are related to the active folding and thrust faulting that underlie the City and Coastal Plain. The area is subject to periodic strong seismic shaking. Major earthquakes occurred in 1812 in the Santa Barbara Channel, while the 1927 magnitude (M) 7.5 Lompoc earthquake occurred some 130 km offshore and west of Santa Barbara. The 1850 M 8.0 Fort Tejon Earthquake is the largest historic earthquake reported in the region, and while strongly felt it did only minor damage. In addition to these major earthquakes, four strong earthquakes between

M 5.9 and M 6.8 were reported in 1925, 1941, 1973, and 1978 (Kamerling, 2000). Although not considered major earthquakes, the 1925 and 1978 earthquakes did considerable damage, some of which is recorded in the Catalog of Santa Barbara Earthquakes.

Landslides and large bank failures along creeks attributable to geologic causes are best dealt with on a reach-wide or neighborhood basis, and not necessarily on a parcel-specific basis. Incorporating appropriate community input, the watershed action plans should investigate the feasibility of the establishment of a Geologic Hazard Abatement District (GHAD) for planning and implementation of geologic-related management actions.

Geomorphology and Channel Stability

The Santa Barbara area can be divided into five general geomorphic units or landforms for creek management purposes. These are canyons, the coastal plain, coastal mesa areas, lower floodplains, and estuaries.

A majority of the western and northern parts of the City are located on an elevated coastal plain dissected by several of the principal creeks in the study area, while the southeastern area is primarily located on the low-lying coastal floodplains of lower Mission and lower Sycamore Creeks. Small tidal lagoons or estuaries occur where Sycamore, Laguna, Lower Mission, and Arroyo Burro Creeks discharge into the Santa Barbara Channel.

All of the creeks have a dendritic drainage pattern and a generally elongated watershed shape, flowing generally south to enter the east-west trending coastline at several coastal beaches. Mission Creek is unique in that it first heads southwest out of the Santa Ynez, and then makes a sweeping turn back to the southeast. Recent geologic investigations indicate that the drainage patterns are structurally controlled by folding and faulting that has formed elevated ridges such as Mission Ridge that direct the location of the channels.

In the mountains above the City, the creeks flow through narrow canyons with steep slopes composed largely of exposed bedrock, large boulders, and generally thin topsoil. Creek scouring action creates a typical sequence of riffles, falls and pools of varying depths within the creek channel in the upland portions of the watersheds. The creeks can be best characterized as short drainages, generally intermittent in their middle reaches originating in the mountains and dropping steeply, a thousand feet or more, in a distance of 6 to 10 miles. The steepness of their upper watersheds often results in torrential flows of sediment-laden water in the drainage ways during periods of flooding, especially following wildfires or intense storms. As the gradient drops through the foothills and coastal plain areas, the creeks become increasingly entrenched, and the shear stress and flow velocity decrease, causing deposition and sedimentation, decreased channel capacity, and small stream course changes through progressive lateral bank erosion. The creeks have deposited cobble, gravel, and finer sediments that have created flat, wide floodplains that were once covered with dense riparian forests and oak woodlands, but are now mostly urbanized. During flood events, boulders up to 10 feet in diameter, larger trees, and other debris have been carried from the mountains onto the alluvial fan and lower floodplains, resulting in significant damage. The County has constructed a number of debris basins generally located just above the City limits in the lower foothills.

Santa Barbara creeks are geomorphically diverse. The deposit of debris from flash flood events, resulting from a combination of steep and unstable slopes from active fault uplift, high-intensity winter storms, and fire, can quickly reshape channel banks through vertical and lateral erosion and is a significant factor in forming the stream patterns in the watersheds of this region. Creek management in these watersheds must consider sediment transport and the need to manage sediment and debris as much as flood flow management.

Ongoing creek adjustment to flow changes and sediment transport is called ***dynamic equilibrium***. Common adjustments to increased total flow volumes and peak flows following urbanization are channel widening through bank erosion (toe undermining and collapse of tall, steep bank slopes) and channel deepening, or stream incision. Both adjustment processes to watershed urbanization are occurring within the creeks of Santa Barbara. Bank failure is exacerbated in some areas by deep-seated geologic failure, as discussed previously, making bank stabilization

design especially challenging. Another type of stream adjustment occurs in the upper canyons, where debris basins have been constructed that have removed sediment from the system; incision is far more likely to occur below these basins.

In certain cases a stream may have reached equilibrium in an urban setting as a result of land use change. *Urban equilibrium* is the term used to describe a channel that has changed from its natural or original shape, but has finished adjusting to urban influences so that it is relatively stable in its planform and meander, and has achieved a new balance in its bankfull width and depth. A channel in urban equilibrium is neither excessively eroding nor depositing sediment and has a healthy riparian growth, although it may not consist entirely of native plants. It is not currently known if all of the creeks in Santa Barbara have achieved urban equilibrium. The response of streams may be measured directly and also modeled in terms of the channel form, bankfull discharge, longitudinal profile, bed mobility, and bank erosion. In order to predict future channel behavior and to model the watersheds, each of these factors must be considered.

For example, the two-year or channel-forming flow is typically considered to be most subject to alteration following urbanization. Urbanization reduces rainfall infiltration, increases runoff, and lessens sediment delivery to streams. Increases in the bankfull flow can create channel instability by causing increased bed mobility and subsequent bank erosion. Larger flood flows are often less affected by urbanization in watershed areas of clayey soils or steep, rocky slopes with naturally high runoff rates, because a rainfall event that causes larger flows typically occurs on watersheds that are already saturated from prior rainstorm events, lessening the relative increase in runoff between saturated soils, steep slopes, and urban areas.

Modeling using data from the Creek Inventory and Assessment Study was completed for this Existing Conditions Study to determine bankfull flow, with some hydrologic transect data, including channel widths and depths for bankfull flow, channel slope, and Manning's *n* values, used to determine bankfull discharge. By comparing critical velocities to calculated velocities in each reach, bed mobility potential was predicted as either high, medium, or low.

Results of desktop hydraulic analysis indicate variable bed mobility, and that consequent bank erosion problems are widespread and apparently associated with a number of causes: channel bed degradation due to watershed urbanization and channel narrowing, creek realignment that has steepened reaches, construction of concrete channels that increase velocities downstream, and a mix of bank repair structures causing local erosion.

Hard bank protection is widespread along the creeks, ranging from 15% to 30% for Arroyo Burro, Sycamore, and Mission Creeks. Some of the bank repair structures were not well engineered, or are approaching the end of their design life. The watershed action plans should consider the need to comprehensively evaluate bank erosion and repair of aging and failing bank structures on a neighborhood-wide basis. Because of the potential for deep-seated geologic bank failure, tall, steep bank slopes, and high stream velocities, the use of biotechnical bank repair structures must be assessed cautiously, on a site-by-site basis. As indicated in the Land Use discussion, development of design guidelines, including biological, geotechnical, geomorphic, and hydraulic analysis for bank stabilization design should be considered as an element of the watershed action plans.

New institutional methods for planning and financing bank repair on private lands on a reach-wide basis should also be considered in the watershed action plans. Although floodplain connectivity and the natural hydraulic and sediment transport functioning of the creeks in Santa Barbara cannot be restored to predevelopment conditions, substantial improvements can be made, including repair of existing structures or construction of new structures that improve channel stability, while maintaining and improving habitat.

Hydrology, Drainage, and Flood Control

Rainfall is concentrated in the winter months, ranging from about 18 inches on the coastal plain to as much as 32 inches in the upper watershed areas of the Santa Ynez Mountains above the City. In Santa Barbara, typical short-

duration, intense rainfall patterns are common and result in water flowing quickly through the system, yielding high peak flows that often drop quickly back to winter base flow levels once intense rainfall ceases. The City's high-energy, incised creek systems (with low sinuosity and dropping about 3,000 feet in less than 7 or 8 miles) have little to no floodwater storage capacity within their channel and urbanized floodplains. Therefore, over-bank flooding is relatively frequent, especially where gradients flatten and channel bank tops are relatively low. Many of the channels and bridges within the City have flood conveyance capacities of less than the 25-year flood event; flooding can occur at these structures and is exacerbated by debris blockage problems. As discussed under Geomorphology, urbanization of the coastal plain also likely contributes to flooding and bank instability problems by further sharpening the already pronounced peak storm hydrographs, particularly for the low recurrent or bankfull flows. One of the main hydrologic impacts of urbanization in the study area appears to be its effect on increasing the two-year or channel-forming flow, and resultant channel instability. Loss of riparian habitat and water quality deterioration are also significant concerns.

The upper watershed areas are also highly susceptible to wildfires, especially during prolonged dry periods. Flooding following wildfires deposits sedimentation and debris, including boulders, brush, and trees, increasing flood heights. Additional sources of flooding include bridge openings and culverts clogged with debris and other stream obstructions, such as vegetation overhanging the creeks.

There is a long history of flooding in the Santa Barbara area, with floods recurring about every 5 to 15 years. The exception is the period of the 1940s and 1950s. Damaging floods have occurred in 1862, 1909, 1914, 1927, 1938, 1962, 1964, 1967, 1969, 1973, 1978, 1980, 1983, 1991, 1993, 1995, 1998, and 2005. Even so, relatively few structural flood control projects have been implemented.

Flooding is most common along lower Mission and Sycamore Creeks, and above the Laguna channel. Recent devastating flooding occurred in 1995 as a result of two quite different storm systems. More recent rainstorms in early January of 2005 brought a series of landslides and floods that severed vital transportation arteries and flooded many city streets and intersections in Santa Barbara County. Minor flooding occurred along Mission Creek. Torrential rains caused flooding and mudslides in several locations east of Santa Barbara that covered Highway 101 in up to seven feet of mud. The only access in or out of southern Santa Barbara County was on Highway 101 through Gaviota, the northbound section of which was closed by mudslides the last week of December.

Channelization, including straightening of creek meanders and realignment for street and road construction has been common within the watershed. The straightened, hardened and deepened creeks result in flows with high stream velocities and high shearing or tractive forces. Such flows can erode the toe of bank slopes, causing steep, often undercut banks that are subject to collapse. The realigned creeks have likely incised into the channel bed several feet (3 to 6 feet or more, based on observations at bridge abutments) over time. The haphazard placement of various bank protection structures has also created local instabilities. Long segments of many of the creeks have been undergrounded in culverts and placed in storm drains. This is especially apparent in the Laguna watershed (between Sycamore and Mission Creeks), where flow from a historic network of small creeks apparently has been placed in an underground storm drain before discharging into the manmade Laguna Channel.

Flow levels in the creeks are highly variable, largely because of the seasonal pattern of rainfall that occurs throughout the region and the large fluctuations in annual rainfall from one year to the next. Significant flows are generally only common during winter and spring months. Base flow sustaining water in pools in the canyons is provided by water stored in the bedrock fractures and released slowly throughout the year. The small summer flow and pools of water in portions of the middle and lower reaches of all the study area creeks is dependent upon the inflow of shallow perched groundwater, and sometimes upon runoff from landscape irrigation and other urban water uses.

It is common for some small creeks and tributaries not to flow during drought years, and for dry washes to persist into the early winter even in normal years. Some flow is typically maintained in pools in many upper creek tributary areas, fed by shallow surface flow and intergravel flow. These pools are critically important to fish, aquatic organisms, and

wildlife, making the canyon creeks especially sensitive to disturbance. Arroyo Burro Creek often has year-round flow in the upper San Roque tributary, along portions of the creek north of Highway 101, and in the Las Positas Valley. Mission and Sycamore creeks also have year-round water in the foothills. However, there are a few locations along the lower Sycamore Creek that have perennial flows. Old Mission Creek contains year-round flows from bank seepage, as does lower Mission Creek, below Canon Perdido Street.

Because of creek encroachment by housing and commercial development, and the generally shallow nature of flooding that does not create damage extensive enough to financially warrant flood control projects, solutions to flooding problems in Santa Barbara are challenging. Even non-structural flood control projects, such as building elevation, have not had positive cost-benefit ratios. The watershed action plans should consider a more proactive non-structural flood control approach, including providing neighborhood flood-proofing workshops, provision of technical assistance in retrofit flood-proofing, and an incentives-based program with matching funds, possibly linked to implementation of water quality BMPs and creek restoration and enhancement.

Water Quality

While the upper reaches of the four watersheds generally have good water quality, water quality downstream worsens as a result of surface runoff from the urban areas, and very likely from inflow of poor-quality shallow groundwater. Primary pollutants are suspended sediments, nutrients, and bacteria. The loss of riparian vegetation has increased water temperatures in some reaches, in turn reducing dissolved oxygen saturation levels in the water. Elevated water temperatures affect species that are sensitive to changes in dissolved oxygen levels, such as southern steelhead.

Since 2001, the City has managed a creek and ocean water quality monitoring program in order to identify potential types and sources of pollutants. The County has also sampled several of the creeks in unincorporated areas, contributing to the understanding of water quality problems. This has included storm event sampling of storm drains, creeks, lagoons, and ocean water, while dry weather efforts have focused on bacteria as an indicator of pollution, and physical parameters such as temperature, turbidity and pH. Based on these results, it has been determined that water quality near storm drain outlets is most likely to be impaired. The problem is complex and not fully understood. Some water quality degradation may be due to inflow of shallow, contaminated groundwater. The City is researching this issue in conjunction with UCSB and the US Geological Survey.

To date, other than indicator bacteria, only total phosphorous and total suspended sediment have exceeded benchmark water quality values. The City has two water bodies on the impaired water bodies (303(d)) list for pathogens (indicator bacteria) within the study area: Arroyo Burro and Mission Creek.

These pollutants are to be targeted with implementation of BMPs identified in the SWMP. Although there is no clear indication that other potential storm water pollutants are present in detectable amounts, the City continually revises and improves its monitoring efforts in order to determine the presence and sources of other storm water pollutants. As a result, the SWMP also identifies a range of BMPs that should reduce the discharge of other such pollutants into the storm drain system. Coordination with the City's Water Quality Monitoring Program and the County's Clean Water Program will be emphasis areas of the watershed action plans.

Groundwater

The primary sources of groundwater information were the Santa Barbara County Groundwater Reports for the water years 2000, 2001, 2003, and 2004. Information on groundwater levels was also obtained from monitoring of municipal wells by City and County staff, as well as from an electronic database covering shallow-zone monitoring wells installed as part of work on leaking underground fuel tank (LUFT) sites maintained by the State Water Resources Control Board Geotracker Program.

The City lies in the South County Groundwater Basin, seaward of the Santa Ynez Mountains. In the Santa Barbara area, this basin has been subdivided into several smaller sub-basins for management purposes. Overall recharge to underlying groundwater basins is directly related to the precipitation pattern within the study area watersheds. The frequency and length of droughts are particularly important, since over a period of several years a water deficit can be demonstrated to significantly lower water levels in the primary groundwater basins. Records indicate drought periods of several years or more have occurred two to four times per century over the last 460 years.

In the study area, the South County Groundwater Basin is divided into three smaller groundwater basins. These are the Foothill Basin, Santa Barbara Groundwater Basin, and the Montecito Basin. The Foothill Basin is located north of the Mission Ridge Fault, while the Santa Barbara Basin includes most of the urban area south of the fault. A small area of the westernmost portion of the Montecito Basin is also included since it underlies part of the Sycamore Creek Watershed, in a definable aquifer. Basin divides do not include the upland areas of the watersheds since these are not areas where groundwater accumulates.

Runoff has percolated through these deposits to replenish the underlying aquifers. ***Aquifers*** are horizontally extensive, water-bearing strata, which when combined, contribute water to the larger basin. Groundwater has also percolated through underlying rocks to form deeper aquifers, especially through fractures and faults. Throughout much of the city, urban development, particularly along floodplains of the major creeks, has limited recharge due to impervious surfaces. Therefore, recharge occurs principally in undeveloped upland areas with permeable soils, and most importantly, along creek channels.

Approximately 8 to 10 percent of the total water demand of the City of Santa Barbara, or about 1,500 AFY, is supplied from groundwater. During periodic droughts the groundwater supply becomes particularly critical. This is a small fraction of the available storage supply within the three groundwater basins, which together have an estimated rough yield of more than 29,000 AFY. However, since these basins have been set aside for contingency storage rather than routine supply, the estimated safe yields from these basins are only a small fraction of the total estimated yield. The safe yields for the Santa Barbara, Foothill, and Montecito Groundwater Basins are estimated at 847 AFY, 953 AFY, and 1,350 AFY, respectively. Groundwater pumping within the Santa Barbara Groundwater Basin has been drastically reduced since 1991. Conservation management and reduction in pumping, with implementation of groundwater injection programs, have restored water levels from overdraft conditions occurring prior to active management beginning in the 1980s. This has also restored a positive gradient or flow of fresh groundwater toward the ocean, thereby reversing the earlier trend of seawater intrusion.

Groundwater occurs in three characteristic zones within the basins: a shallow zone, a moderately deep zone, and a deep zone. Shallow groundwater flow conditions are complex underneath the Santa Barbara Coastal Plain, especially due to lateral discontinuities from backfilled “paleochannels”, undergrounding of streams into culverts, and various fill and deep foundation conditions as a result of development. In some areas the shallow groundwater zone may be discontinuous. The moderately deep and deep zones are partially confined, while the shallow zone is more subject to contamination from land uses such as underground tanks, and from contaminated surface water infiltration. The shallow zone groundwater is also in more direct hydrologic contact with the creeks than are the deeper zones, especially during the summer months when it forms an important component of the base flow in lower stream reaches of all of the creeks. Where present, the shallow groundwater zone therefore more significantly influences creek flow and creek water quality. Shallow zone groundwater can occur from 4 to 6 feet below ground surface during the winter months along the low-lying beachfront areas of the watershed, to as deep as 70 to 80 feet or more on the upper areas of the Coastal Plain. Seasonal water level fluctuations of the shallow zone can be more than 10 feet, with some areas drying up entirely.

Although the deeper groundwater basins are very actively monitored and managed by the City and County Water Agency, voluntary AB 3030-defined groundwater management plans have not yet been prepared and submitted to the California Department of Water Resources. These are not needed for management of the deep aquifers.

However, the watershed action plans could include a shallow zone groundwater management element, incorporating AB 3030 guidelines, which could potentially further facilitate grant funding for addressing water quality issues.

Biology

An extensive amount of information is presented on the biology of the watershed study area, drawn from the previous 2000 URS Creek Inventory and Assessment Study and compiled from other sources of information. The biological resources discussion is separated into Terrestrial Biology (Section 4.6) and Fisheries (Section 4.7). The fisheries section includes information from the Conception Coast Project, as well as new fieldwork completed by the study team in Sycamore Creek. The new biological information presented in this report can be used to supplement the City's MEA and possibly as part of the Existing Conditions section of the General Plan Update EIR.

The middle and lower reaches of most streams have a pronounced urban character. The forest lands of the upper watersheds contain a continuous overstory of riparian woodland along the creeks, and a dense understory of shrubs, herbs, and grasses. The steep slopes of the canyons typically have an oak woodland on their north- or east-facing slopes, while the drier south and west slopes, ridge, and mountain-front slopes, are mostly covered by chaparral vegetation. A thin riparian corridor, bordered by oak woodland, occurs along the canyon bottom and lower canyon slopes. In many areas of the foothills, however, large sections of canopy cover have been removed to accommodate development; downstream, urban development has eliminated much of the pre-development natural vegetation and paved large areas of the lower watershed.

The riparian areas of these upper watersheds provide significant wildlife corridors for sensitive species, including Cooper's hawks, white-tailed kites, and southwestern pond turtles. The south-facing slopes and foothills of the Santa Ynez Mountains and the coastal plain are highly dissected by drainage features. Consequently, differences in aspect and degree of slope create a variety of microclimates, often within a small area, which, along with spatial variation in soil and bedrock features, controls the distribution of native vegetation types and ultimately, the distribution of wildlife species in this area.

As reported in the URS Creek Inventory and Assessment Study, the City's creek system is highly fragmented and altered, with the riparian corridor degraded in many areas, and with relatively few intact areas of native riparian plant assemblages. In most areas, the native riparian plant community has been disconnected from adjacent upland natural areas, which lessens the biological value of the corridor and these areas. The remaining open space lands in the urban areas are especially valuable. The riparian corridor has also been invaded by non-native landscape plants and weedy species, including by invasive exotic species (e.g., the giant reed, or *Arundo donax*) in some areas, such as lower Arroyo Burro.

Protection of remaining high-value riparian areas and enhancement of the riparian corridor, especially along parks and public lands in the watershed, should be a focus of the watershed action plans, along with control of invasive species. This element of the watershed action plans should be coordinated with the Santa Barbara County Weed Management Area and other interested stakeholders.

In addition to presenting overall information on the vegetation and wildlife habitat of the greater watershed study area, the report also provides a summary of the Sensitive Plant and Animal Species that occur in the watershed, including protected rare, threatened, and endangered species. The protection of these species will need to be considered in the design of all projects along streams and in sensitive areas. Although the watershed action plans are not currently envisioned to constitute a formal Habitat Conservation Plan (HCP) for any sensitive species, the watershed action plans can help protect these species by noting especially sensitive and valuable habitat, and feasible restoration and enhancement sites. In addition, the watershed action plans can help streamline the permitting process by including, where appropriate, background information on the occurrence of the species, and typical permit conditions and BMPs for habitat protection, enhancement, and mitigation that can be built into project designs.

Section 4.7 - Fisheries provides an overview of fish habitat and fish passage barriers, with more detailed information on each watershed presented in Sections 5.0 through 8.0. The study area watersheds provide critical habitat for Southern California Ecologically Significant Unit (ESU) anadromous steelhead trout, a federally endangered species, which spawn in the middle and upper reaches of Mission Creek, perhaps Arroyo Burro, and their major tributaries. Steelhead populations have declined due to human activity impacts, such as loss of native vegetation, influx of aggressive exotic species, increased creek/stream scouring, streamflow and groundwater diversion, increases in impervious surfaces and runoff, and degraded water quality because of thermal pollution and potential nutrient, sediment, and other polluted runoff from urban development. Culverts, concrete channels, low-flow crossings, or other structures have created fish passage barriers to important upstream habitat.

The federally protected tidewater goby occurs in the tidal lagoon of Arroyo Burro, and in the lower Mission Creek and Laguna Creek areas. Other fish species in the study area include arrow goby, mudsucker, topsmelt, tidewater goby, staghorn sculpin, California killifish, prickly sculpin, and stickleback.

Section 4.7 - Fisheries discusses the occurrence of suitable steelhead habitat in all of the creeks, (except Laguna Creek), and notes that steelhead have been observed in Arroyo Burro and Mission Creeks in recent years, but have not been observed in Sycamore Creek in many years. Study team members have provided general recommendations on each barrier identified; however, this information is not included in the Existing Conditions report and will be deferred for inclusion in the watershed action plans. Further recommendations regarding potential removal of the barriers, some of which consist of important grade control structures for stream stability or flood control debris basins, will need to be carefully reviewed by and coordinated with City and County Public Works Departments during the preparation of the watershed action plans. Removal of all of the barriers is likely prohibitively expensive, and will require grant funding assistance. The City and County are currently participating in the Tri-County FISH Team fish passage barrier removal ranking and prioritization study for Santa Barbara, San Luis Obispo, and Ventura Counties. This, along with the Conception Coast Project document, which addresses fish passage barriers in the South County area, will help guide the fisheries elements of the watershed action plans. The Tri-County FISH Team is also developing BMPs for stream and fisheries habitat protection, as well as a Permit Streamlining Program, focused initially on restoration and enhancement projects, then ultimately on channel maintenance and management.

Arroyo Burro Watershed

Section 5.0 focuses on existing conditions in the Arroyo Burro Watershed. Arroyo Burro Creek is the westernmost watershed of the study area, flowing about 7 miles south from its headwaters in the Santa Ynez Mountains, at an elevation of 3,800 feet mean sea level (MSL), until it discharges into a small tidal estuary at Arroyo Burro Beach County Park (Hendry's Beach). Tributaries to Arroyo Burro Creek include Las Positas Creek, Barger Creek, San Roque Creek, and Lauro Canyon Creek. A small, tidally influenced lagoon is present at the end of the creek at Arroyo Burro Beach. The upper portions of the creek traverse rural estates and orchards, while the middle portions of the creek pass through dense residential and commercial development between Foothill Road and Highway 101. Downstream of Highway 101, the creek traverses a mixture of residential areas and open space. The watershed drains approximately 5,600 acres of land.

Two main tributaries to Arroyo Burro Creek in the upper watershed include San Roque Creek, which forms an east branch, and Barger Creek, located in Barger Canyon to the west of the main stem. Barger Creek constitutes about 15% of the overall watershed, while San Roque Creek constitutes about 48% of the overall watershed. Upper reaches of the watershed are dominated by mixed chaparral open space, while the middle watershed runs through low-density residential areas. Most reaches have moderately vegetated banks, cobble and sand substrate, while portions of Arroyo Burro have been channelized north of Highway 101.

South of Highway 101, Arroyo Burro drains a medium-density residential area, as well as several hundred acres of undeveloped land and the privately operated Elings Park. This reach is characterized by native and non-native vegetation, including extensive eucalyptus plantings.

Nine management reaches are identified: AB-1 - Lower Arroyo Burro, AB-2 - Hidden Valley Park, AB-3 - Arroyo Burro Commercial Area, AB-4 - Arroyo Burro Foothill Area, LP-1 - Las Positas Creek, SR-1 - San Roque Creek Commercial Area, SR-2 - San Roque Creek Middle Area, and SR-3 - San Roque Creek Upper Area.

Jurisdiction over the urban sections of the watershed is divided between the City and County. Current restoration and water quality projects include the Wetlands Recovery Project, a program to eradicate giant reed (*Arundo donax*) along sections of the creek downstream of State Street by the Santa Barbara County Weed Management Area of the Agricultural Commissioner's Office, and development of a "visioning statement" by the Friends of Arroyo Burro, a local watershed non-profit group. Community interest in the creek has been renewed with the opening of the South Coast Watershed Resource Center next to the Arroyo Burro estuary. City projects include a 1.5-acre restoration project to daylight Mesa Creek and expand the estuary, storm water diversion and storm water detention facilities for water quality treatment. The City also owns six acres of upstream riparian property that it is in the process of restoring.

There are several significant areas of open space, including the Shoreline Beach Area, Arroyo Burro County Park, the Douglas Family Preserve, and Elings Park.

A summary of specific geologic, soils, groundwater, hydrological, and biological issues is not included in the Arroyo Burro summary, as they are similar to those described previously under Citywide watershed conditions. Detailed discussion of these issues for the watershed is provided in Section 5.0.

Significant water quality problems occur in lower Arroyo Burro Creek, which the City is currently investigating and addressing in several pilot treatment programs. Restoration and enhancement of the creeks (including fish barriers), especially where they flow through public lands, will need to be addressed in the watershed action plans.

Bank instability is a significant problem in middle and lower Arroyo Burro, especially in the Hidden Valley area. Based on review of existing channel geomorphic conditions, general observations and recommendations to be reviewed further in the watershed action plans are: (1) sediment aggradation in the upper Arroyo Burro watershed may be associated with lack of conveyance in downstream creek culverts and major culvert crossings; these should be field-checked for debris dams or other blockages; (2) due to the presence of potentially unstable geologic formations, Arroyo Burro reaches are susceptible to bank failure by hydraulic toe scour and undercutting of over-steepened banks, as well as more deep-seated geotechnical causes, requiring an integrated approach; (3) low fish-friendly grade control structures and flow deflectors should be considered to selectively manage the tendency for creeks to incise as they reestablish equilibrium following high flows and sediment loads; (4) high velocities and bank shear stresses may not allow purely biotechnical bank stabilization methods to be applied in Arroyo Burro; these need to be investigated on a case-by case basis; (5) the existing bank erosion sites occurring throughout Arroyo Burro and San Roque Creeks may indicate that isolated installations of hard channel revetment have had upstream and downstream impacts on other channel segments.

Mission Creek Watershed

Section 6.0 focuses on existing conditions in the Mission Creek Watershed. The Mission Creek Watershed extends approximately 7.5 miles from the Santa Ynez Mountains to the ocean and covers approximately 7,400 acres. The Los Padres National Forest encompasses 47 percent of the overall watershed. The two main tributaries of Mission Creek are Las Canoas Creek and Rattlesnake Creek, which converge near Foothill Road. Rattlesnake Creek forms

27 percent of the watershed. Mission Creek winds its way through highly urbanized areas until it reaches the ocean east of Stearns Wharf.

The upper portion of the watershed, upstream of State Street, is low-density residential. Upper Mission, Rattlesnake, and Las Canoas Creeks flow through rural residential areas and open space lands. Above the Botanic Garden in Mission Canyon there are few residences, mostly on medium to large lots along Mission Canyon Road. Bank failure problems are common in the canyons, and many of these erosion problems have not been addressed, as the URS Creek Inventory and Assessment Study does not indicate extensive bank protection.

The middle reach of Mission Creek traverses downtown Santa Barbara, with medium-density residential and commercial land uses. Land use within the urbanized portion of the watershed includes 31% residential and 17% commercial uses. Middle Mission Creek occurs on a Coastal Plain landform and has a generally moderate creek gradient. The creek traverses areas of cobble boulder fan and debris deposits, and older alluvial terraces, as well as some areas where it has created an alluvial floodplain. The lower reaches of Mission Creek include one mile of creek between the Canon Perdido Street Bridge, at the upstream end, and Cabrillo Boulevard Bridge, near the outlet to the ocean. The lower reaches pass through medium- to high-density residential areas, and the confluence with the ocean is estuarine. Old Mission Creek is a remnant of the original creek alignment that meandered west of the highway, and has both dense native vegetation and a channelized section. The lower portions of Mission Creek in downtown Santa Barbara have been highly altered for development many years ago, requiring channel maintenance to provide flood protection.

Nine management reaches are defined for the watershed: M-1 - Mission Creek Lower Area, M-2A - Mission Creek Concrete Segment, M-2B - Old Mission Creek, M-3 - Mission Creek – Middle Area, M-4 - Mission Creek - Museum Reach, M-5 - Mission Creek – Upper Area, M-6 - Foothill, R-1 - Rattlesnake, and LC-1 - Las Canoas Creek.

Current restoration and water quality projects include work on a portion of the middle reach of Mission Creek that is channelized, adjacent to Highway 101. This reach of Mission Creek (owned by CalTrans) is being investigated by the Environmental Defense Council (EDC) for possible restoration and naturalization. The City completed a riparian restoration and storm water quality management project using bioswales and riparian plantings at Bohnett Park on Old Mission Creek in 2004. The US Army Corps of Engineers (Los Angeles District) is in the design phase of a flood control project on Lower Mission Creek. This project is the result of an almost 30-year planning effort by the Corps and local agencies. The Mission Creek Restoration Partnership (MCRP) has expressed interest in developing a watershed management plan for the middle reach of the creek—the area upstream from State Street to the Santa Barbara Botanic Garden. MCRP is initially focusing its efforts on the middle and upper portions of Mission Creek and its tributaries, Rattlesnake and Los Canoas Creeks. As part of this effort, MCRP and the Community Environmental Center (CEC) have been working with the Santa Barbara Museum of Natural History on a demonstration bank stabilization, riparian and oak woodland restoration, and storm water management project.

The Santa Barbara chapter of the Urban Creeks Council (UCC) has also been active in creek restoration and management issues in Santa Barbara. They developed a vision statement for Mission Creek that advocates for removal of fish passage barriers, naturalization of concrete channel reaches, riparian restoration, storm water quality improvements, and non-structural flood control and floodplain management. Mission Creek is also considered a restoration priority by several regional restoration initiatives, such as the Southern California Wetlands Recovery Project.

A summary of specific geologic, soils, groundwater, hydrological, and biological issues is not included in the Mission Creek summary, as they are similar to those described previously under Citywide watershed conditions. Detailed discussion of these issues for the watershed is provided in Section 6.0.

Channel stability and bank erosion are significant issues in the Mission Creek Watershed, along with water quality issues and opportunities to restore the native steelhead fishery through fish passage barrier removal. These will be focus areas of the watershed action plans.

Based on review of existing channel geomorphic conditions, general observations and recommendations are: (1) Sediment aggradation does not presently appear to be a significant problem in the Mission Creek watershed; (2) on an average annualized basis, there was virtually no net scour or deposition occurring in the upper reaches of Lower Mission Creek; (3) local bank erosion may be a significant source of sediment deposition in the upper reaches of Mission Creek due to the large percentages of active and failed banks; (4) high channel velocities and bank shear do not allow widespread use of purely biotechnical bank stabilization methods in the upper reaches of Mission Creek. In general, a combination of hard bank toe support up to half the channel height with biotechnical methods on the upper bank slope may be the optimal solution for bank stabilization. However, there are opportunities for biotechnical bank stabilization, and all bank stabilization designs will need to be based on site-specific hydraulic and geomorphic analysis.

Sycamore Creek Watershed

Section 7.0 focuses on existing conditions in the Sycamore Creek Watershed. The Sycamore Creek Watershed is relatively short compared to the other study creeks. Originating in the chaparral of Los Padres National Forest, it contains five major tributaries in the foothills: the main stem, beginning near Sheffield Reservoir, Parma Park tributaries, Coyote Creek, Westmont Creek, and Chelham Creek, a tributary east of Westmont Drive. These tributaries all converge near the intersection of Sycamore Canyon Road and Stanwood Drive in a deep canyon with landslide-prone hills. The creek follows a narrow canyon to Alameda Padre Serra, where the grade decreases and traverses a medium-density residential and commercial area. This middle and lower reach floodplain area is approximately 90% developed, with areas of significant flooding problems. The creek empties into the ocean at East Beach, where a sandbar forms a small lagoon.

Eight management reaches are defined for the watershed: S-1 - Sycamore Creek Lower Area, S-2 - Sycamore Upper Flats, S-3 - Sycamore Creek Canyon, S-4, S-5 - Sycamore Creek, Upper Canyon Area/Parma Park, S-6, S-7, S-8 - Coyote, Westmont, and Chelham Creeks.

A summary of specific geologic, soils, groundwater, hydrological, and biological issues is not included in the Sycamore Creek summary, as they are similar to those described previously under Citywide watershed conditions. Detailed discussion of these issues for the watershed is provided in Section 7.0.

Flooding and channel stability are significant management issues, both in the upper and lower areas of the watershed, that will need to be addressed in the watershed action plans. In addition, there is some opportunity for fish habitat improvement and barrier removal that should be further explored.

Based on review of existing channel geomorphic conditions, general conclusions are: (1) sedimentation does not presently appear to be a problem in the Sycamore Creek watershed; (2) comparison of historical and present longitudinal profiles show only small reaches of scour and deposition; (3) local bank erosion may be a significant source of sediment deposition in the upper reaches of Sycamore Creek due to the large percentages of active and failed banks, and high bed mobility; (4) the middle reach shows the largest total lengths of active and failed bank erosion sites; This reach may benefit the most from a comprehensive bank stabilization plan; (5) high channel velocities and bank shear stresses do not appear to allow widespread use of purely biotechnical bank stabilization methods to be applied in the upper reaches of Sycamore Creek; a combination of hard bank toe support up to half the channel height with biotechnical methods on the upper bank slope may be the optimal solution for many bank stabilization projects. Estimates of bank shear stresses vary from site to site, and each site will require detailed geomorphic and hydraulic design analysis.

Laguna Watershed

Section 8.0 focuses on existing conditions in the Laguna Creek Watershed. The Laguna Creek Watershed is comprised of approximately 2,020 acres of almost entirely urban land on the southeast side of Santa Barbara. The watershed is bounded on the north by the foothills, on the east by Quarantina Street, on the west by State Street, and on the south by the Santa Barbara Channel. Near the foothills is a small upland area with oak woodland and chaparral vegetation; the rest of the watershed is residential, or nearest Laguna Channel and just above and below Highway 101, commercial. The watershed is sometimes referred to as the Central Drainage Area, as it is located between the main watershed areas of Mission Creek and Sycamore Creek. Flooding is a major concern in this watershed, in part from flood flows that break out of lower Mission Creek.

Laguna Channel is a remnant of a large estuarine area that was originally located on the east side of downtown. The channel and contains both earthen and fully lined concrete reaches. There is a tide gate at the mouth of the channel to prevent tidal influx. The creek empties at the beach across from Chase Palm Park. Most of the runoff from the highly developed east side of the City is conveyed to Laguna Channel through underground storm drains. The channel has a very low gradient and the upstream areas are prone to flooding. The area upstream of the park, behind the water treatment plant, is mixed-use commercial and industrial. The remainder of the creek upstream of this area (within the central portion of the City) is culverted or underground, limiting restoration values; only the lower 3,100 feet of the Laguna Channel remains open, although this channel has been substantially altered and straightened. There are also several secondary tributary channels south of Alameda Padre Serra that feed into the Laguna drainage system.

Due to the small watershed size, the Laguna Channel has not been subdivided into management reaches. A summary of specific geologic, soils, groundwater, hydrological, and biological issues is not included in the Laguna Creek summary, as they are similar to those described previously under Citywide watershed conditions. Detailed discussion of these issues for the watershed is provided in Section 8.0.

Based on review of existing channel geomorphic conditions, general conclusions are: (1) sedimentation in Laguna Channel currently requires dredging every 3-5 years; (2) bank erosion is not a significant problem in the reach.

Watershed Stressors and Creek Management Needs

Section 9.0 of the report summarizes identified watershed problems, stressors, and preliminary management needs to provide a means of focus for the subsequent development of watershed action plans.

Land Use related parameters selected to provide an overview characterization of stressors in the four study area watersheds and sub-watersheds included the following:

- Impervious surface areas
- Population density
- Road density
- Dirt roads
- On-site wastewater disposal
- Leaking sewer lines
- Permeable soils/ important recharge areas
- Shallow groundwater occurrence
- Steep slopes/highly erosive soils
- Unstable geologic formations

Individual creek management reaches within each watershed were ranked in terms of severity of the following problem areas of concern:

- Flooding
- Bank erosion
- Revetments
- Channel bed erosion
- Sedimentation
- Water quality
- Aquatic habitat
- Exotic vegetation (or areas invaded by aggressive weedy non-native species).
- Riparian canopy

The above watershed stressors and creek management needs were summarized in tables and provide a means of focusing and prioritizing the subsequent watershed action plans for each watershed and creek reach.

Section 9.0 also includes general information to guide the development of creek restoration and enhancement elements of the watershed action plans, including fisheries enhancement. The City currently has an inventory of potential restoration sites and projects, mainly prepared as part of the URS Creek Inventory and Assessment Study and further water quality planning work by the Creeks Division. This inventory will need to be updated as part of watershed action plan preparation.

A recommended focus will be on removing fish passage barriers on Mission Creek, and to a lesser extent, Arroyo Burro and Sycamore Creeks. As some of the barriers are important grade control structures for stream stability or flood control debris basins, considerable coordination and feasibility review with the City and County Public Works Departments and CalTrans will be needed. The barriers also vary in their severity and importance for removal, and as previously mentioned, the Tri-County FISH Team is currently in the process of ranking and prioritizing these fish

passage barriers. The Conception Coast Project, which addresses fish passage barriers in the South County area, has also ranked the barriers for removal priority.