3.8 HYDROLOGY AND WATER QUALITY

FIGURES

3.8 HYDROLOGY AND WATER QUALITY

This section of the EIR addresses the potential impacts on hydrology and water quality from the development of the proposed ECI Project. It includes an assessment of the effects of the project on on-site and off-site groundwater resources, surface water resources, campus drainage patterns, erosion and sedimentation. Information was obtained primarily from the following geologic, hydrogeologic and drainage plans and studies of the project site, the UC Santa Cruz campus and nearby areas:

- Aley and Weber & Associates, 1994. Results of a Groundwater Tracing Study – UC Santa Cruz
- Bowman & Williams, 1995. Pogonip Storm Drainage Study for City of Santa Cruz, County of Santa Cruz and University of California, Santa Cruz
- Johnson and Weber & Associates, 1989. Evaluation of Groundwater Resources at UCSC
- Kennedy/Jenks Associates 2004. UC Santa Cruz Storm Water and Drainage Master Plan
- H.T. Harvey 2008. Wildlife Surveys and Waters of the U.S. Assessment. U.C. Santa Cruz East Campus Infill Housing, Chinquapin Road Parking Lot, and Chinquapin Road Widening Projects
- Kennedy/Jenks Associates, 2009. UCSC ECI-Project Site Stormwater Calculations (included in Appendix E of this EIR)
- Nolan Associates, 2000. Geologic, Hydrologic and Groundwater Resource Assessment for the North Campus Planning Area – Santa Cruz Campus

This section provides project-level analysis and additional detail regarding hydrology and water quality and, pursuant to Section 15152 of the CEQA Guidelines, supplements and augments the analysis provided in Section 4.8, Volume II of UC Santa Cruz' 2005 LRDP EIR.

Public comments related to hydrology and water quality received during the scoping period of this EIR requested that the EIR address the following issues:

- Impacts on streams and creeks on and below the east side of campus.
- Impacts on surface and groundwater quality and availability.
- Drainage and flood control
- Campus compliance with federal and state regulations for management of wastewater and runoff
- Increased runoff and potential for increased erosion on- and off-campus from increase in impermeable surfaces (roofs, walkways, roadways)
- Potential for construction during the rainy season to create soil erosion
- Consistency of project storm water management with new standards called for in UC Santa Cruz Draft Storm Water Management Plan
- Cumulative effects on degradation of water quality and watersheds through increased volume or intensity of storm water runoff

All of these issues are addressed in the analysis in this section.

3.8.1 Setting

See 2005 LRDP EIR Section 4.8.1 for a comprehensive discussion of the hydrology and water quality setting of the entire campus. The hydrology and water quality setting for the proposed ECI Project is described below.

3.8.1.1 Regulatory Context

Water quality objectives for all California waters are established under the Federal Clean Water Act (CWA) and California's Porter-Cologne Water Quality Control Act. Discharges to surface or groundwater are also covered by regional basin plans. These regulations are described below.

Clean Water Act

The CWA (United States Code, Title 33) requires the EPA to establish effluent limitations for municipal sewage plant and industrial facility discharges. The CWA provides for two types of pollution control limits:

- Limits to the quantity of pollutants discharged from a point source such as pipe, ditch, or tunnel into a navigable body of water. These limits are established through a nationwide assessment of what is technologically and economically feasible with respect to pollution control for a particular industry.
- Ambient water quality standards for navigable waters of the United States that are based on beneficial uses and require more stringent control of discharge if necessary to achieve water quality objectives. For example, the EPA sets water quality limits to control pollution discharged to waters designated by the states for beneficial uses including drinking, fishing, or recreation.

In addition to these point source and ambient water quality control limits, Section 319 of the CWA provides direction for state regulation of nonpoint source discharges. Nonpoint source pollution comes from diffuse sources such as urban runoff, agricultural runoff, or construction site runoff. This section requires each state to submit a report that identifies: navigable waters that are expected to achieve applicable water quality standards or goals; categories of nonpoint or specific sources that add significant pollution to contribute to non-attainment of water quality standards or goals; and a process to develop best management practices (BMPs) and measures to control each category of nonpoint or specific sources. Each state is then required to develop a management program that proposes to implement the nonpoint source control program.

Section 303(d) of the CWA requires states to identify waters that are not expected to meet water quality standards after effluent limitations for point sources are implemented, develop a priority ranking to determine the order in which Total Maximum Daily Load (TMDL) should be developed for these impaired water bodies, and determine the TMDLs of specific pollutants that may be discharged into the water body. TMDLs are developed as part of a program to examine water quality problems, identify sources of pollutants, and specify actions that create solutions.

The primary method by which the CWA imposes pollutant control limits is the National Pollutant Discharge Elimination System (NPDES) permit program established under Section 402 of the act. Under the NPDES program, any point source discharge of a pollutant or pollutants into any waters of the United States is subject to a permit. In California, the state's Regional Water Quality Control Boards (RWQCBs) are responsible for administering the NPDES program. The NPDES program was initially established to regulate the quality of effluent discharge from wastewater treatment plants. Through the NPDES Waste

Discharge Requirements, the RWQCB sets limits on the levels of pollutants that may be discharged into navigable waters of the United States. The limits are designed to meet the water quality objectives established in the Basin Plan.

The 1972 amendments to the CWA prohibit the discharge of pollutants to navigable waters from a point source unless the discharge is authorized by an NPDES permit. In 1987, in recognition that diffuse, or nonpoint, sources were significantly impairing surface water quality Congress amended the CWA to address nonpoint-source storm water runoff pollution in a phased program requiring NPDES permits for operators of municipal separate storm sewer systems (MS4s), construction projects and industrial facilities. Phase I, promulgated in 1990, required permits for facilities of these types generally serving populations over 100,000, construction permits for projects disturbing 5 acres or more of land, and industrial permits for certain industries. UC Santa Cruz construction projects that disturb more than 5 acres are regulated under the Phase I NPDES rule.

The Phase II NPDES program, which was promulgated in 1999, expands on the Phase I program by requiring operators of small MS4s in urbanized areas and operators of small construction sites, through the use of NPDES permits, to implement programs and practices to control polluted storm water runoff. Under Phase II, the State Water Resources Control Board (SWRCB) has issued three general permits: (1) Municipal permits – required for operators of small MS4s, including universities, (2) Construction permits – required for projects involving one acre or more of construction activity, and (3) Industrial permits. The municipal permit requires development and implementation of a Storm Water Management Program (SWMP). The purpose of the SWMP is: (1) to identify pollutant sources potentially affecting the quality and quantity of storm water discharges; (2) to provide Best Management Practices (BMPs) for municipal and small construction activities; and (3) to provide measurable goals for the implementation of the SWMP to reduce the discharge of the identified pollutants into the storm drain system and associated water ways. The goal of the SWMP is to reduce the discharge of pollutants to the Maximum Extent Practicable (MEP), as defined by the EPA. "Minimum Control Measures" (MCMs) is the term used by the EPA for the six MS4 program elements aimed at achieving improved water quality through NPDES Phase II requirements.

The SWRCB's general permit for construction activities requires that for projects that disturb more than one acre of soil, a Storm Water Pollution Prevention Plan (SWPPP) be developed and implemented. The SWPPP must identify potential sources of pollution and describe runoff controls that will be implemented both during construction and after the building is complete.

Porter Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act of 1969 authorized the SWRCB to provide comprehensive protection for California's waters through water allocation and water quality protection. The SWRCB implements the requirement of CWA Section 303 that water quality standards be set for certain waters by adopting water quality control plans under the Porter-Cologne Act. In addition, the Porter-Cologne Act established the responsibilities and authorities of the nine RWQCBs, which include preparing water quality plans for areas within the region (Basin Plans), identifying water quality objectives, and issuing NPDES permits and Waste Discharge Requirements (WDRs). Water quality objectives are defined as limits or levels of water quality constituents and characteristics established for reasonable protection of beneficial uses or prevention of nuisance. NPDES permits, issued by RWQCBs pursuant to the CWA, also serve as WDRs issued pursuant to the Porter-Cologne Act. WDRs are also issued for discharges that are exempt from the

CWA NPDES permitting program, discharges that may affect waters of the state that are not waters of the United States (i.e., groundwater), and/or wastes that may be discharged in a diffused manner. WDRs are established and implemented to achieve the water quality objectives (WQOs) for receiving waters as established in the Basin Plans, as described below. Sometimes they are combined WDRs/NPDES permits.

In 2006, the SWRCB issued Order No. 2006-0003-DWQ, State General Waste Discharge Requirements for Sanitary Sewer Systems. This Order prohibits sanitary sewer overflows that result in discharge of untreated or partially treated wastewater to waters of the U.S. and discharges of untreated or partially treated wastewater that create a nuisance. All sanitary sewer overflows must be reported to the RWQCB. All public agencies that own or operate a sanitary sewer system that is comprised of more than one mile of pipes or sewer lines which conveys wastewater to a publicly owned treatment facility must apply for coverage under the Sanitary Sewer Order. Each of these public agencies must develop and implement a Sewer System Master Plans (SSMP) that includes provisions for proper and efficient management, operation and maintenance of sanitary sewer systems to reduce and prevent sanitary sewer overflows, and a spill response plan. UC Santa Cruz owns and operates more than one mile of sewer pipeline and therefore is subject to this requirement.

Central Coast Regional Water Quality Control Plan

The UC Santa Cruz campus is within the jurisdiction of the Central Coast (CC) RWQCB (Region 3). The CCRWQCB has the authority to implement water quality protection standards through the issuance of permits for discharges to waters located within its jurisdiction. Beneficial uses of inland surface waters and water quality objectives for the region are specified in *The Water Quality Control Plan for the Central Coast Basin* ("Basin Plan") prepared by the CCRWQCB in compliance with the federal CWA and the State Porter-Cologne Water Quality Control Act. The objective of the Basin Plan is to show how the quality of the surface and ground waters in the Central Coast Region should be managed to provide the highest water quality reasonably possible. The RWQCB implements the Basin Plan by issuing and enforcing waste discharge requirements to individuals, communities, or businesses whose waste discharges can affect water quality. These requirements can be either State WDRs for discharges to land, or federally delegated permits for discharges to surface water. The CCRWQCB has issued TMDLs for nitrate and sediment in the San Lorenzo River watershed in order to restore beneficial uses within the watershed.

City of Santa Cruz Wastewater Discharge Permit

The Campus discharges wastewater to the City's sewer system under a waste discharge permit issued by the City. The permit specifies effluent limitations that apply to all dischargers and as well as certain specific limitations for the campus. It also requires that the Campus collect and analyze samples for prescribed components on a quarterly basis. Over the course of its monitoring history, the Campus has generally been in compliance with the effluent limits. There have been a few exceedances in the past 15 years: one for silver in 1991, and two exceedances for oil and grease in 1995 and 2002. All exceedances were promptly remedied and the Campus has not had an exceedance since 2002 (Blunk 2009).

Campus Storm Water Management Program

Under the Phase II NPDES storm water program, UC Santa Cruz is required to prepare and implement a SWMP. In April 2004, the Campus submitted a first draft of its SWMP to the CCRWQCB. In September 2008, after several rounds of review and revision, the Campus submitted a Final Draft SWMP, which was posted by the CCRWQCB for public review from November 4, 2008 to January 5, 2009. The Campus anticipates the SWMP will be approved in March 2009.

In addition to the six Minimum Control Measures (MCMs) mandated by EPA, the UC Santa Cruz Final Draft SWMP includes an MCM that identifies measures specific to UC Santa Cruz. The BMPs in MCM #7 include but are not limited to the proposed storm water infrastructure improvements, measures to encourage alternative transportation, and storm water-related research. Because a portion of the eastern side of the campus drains to the San Lorenzo watershed, and the San Lorenzo River has been designated under the Clean Water Act as an impaired water body for sediment and pathogens, the SWMP includes restrictions intended to improve water quality in the San Lorenzo. These restrictions apply to activities throughout the campus, regardless of watershed.

The BMPs included in the SWMP are to be implemented by UC Santa Cruz staff and construction contractors and, to a lesser extent, by students, faculty and other members of the UC Santa Cruz community. Whenever UC Santa Cruz staff or contractors perform work at UC Santa Cruz, steps outlined in each relevant BMP, or other proven techniques that reach the same goal, must be used in order to ensure compliance with storm water management regulations. UC Santa Cruz has already initiated many of the listed BMPs. However, full development and implementation of BMPs will be completed following approval of the final SWMP through a 5-year implementation plan that will be included in the SWMP.

For campus construction projects, the Campus Standards Handbook is the equivalent of municipal building codes and ordinances. The University has an extensive plan review process to ensure that project design conforms to the Campus Standards. Construction contract administration procedures and on-site University inspectors ensure that construction conforms to the approved plans and specifications.

Primary control of construction sites belongs to the contractor during construction; UC Santa Cruz uses the construction contract document package, which is a legally binding document between the contractor and UC Santa Cruz, to ensure that adequate storm water controls are in place. Language in the standard campus contract specifications requires contractors to control erosion and sediment and construction site waste is incorporated into the SWMP and the construction contract. The University has an extensive plan review process to ensure that project design conforms to the Campus Standards. Construction contract administration procedures and on-site University inspectors ensure that construction conforms to the approved plans.

The Final Draft SWMP commits the Campus to adopting, in the first year after the SWMP is approved, specific design standards to provide source control for potential contaminants such as sediment, oil and grease, and bacteria that area typically found in urban runoff. Under the SWMP, the Campus will be required to develop design criteria for storm water management systems for new development to control hydromodification[1] and protect the biological and physical integrity of the University's individual watersheds. In addition, new development projects will be required to maximize infiltration on-site and approximate natural infiltration levels to the maximum extent practicable and to implement applicable low-impact development (LID) strategies. LID is an approach to storm water management that manages storm

[1] Hydromodification is defined as any activity that increases the velocity, volume or timing of runoff. Such activities include urbanization or other land use changes that result in increased stream flows and changes in sediment transport, as well as alteration of stream and river channels, installation of dams and water impoundments, and excessive stream bank and shoreline erosion.

water at the source rather than conveying if off site, by integrating site hydrologic and environmental functions into the development design. By minimizing directly connected impervious area and promoting infiltration, LID features such as vegetated roofs, bioswales, and bioretention areas, and pervious pavement, mimic natural hydrologic conditions to counteract the hydrologic effects of development. For example, LID strategies focus on disconnecting roofs and paved areas from traditional drainage infrastructure and instead conveying runoff to bioretention areas, swales, and vegetated open spaces. LID also strives to prevent the generation of runoff by reducing the impervious footprint of a site, thereby reducing the amount of water that flows off site, and that requires treatment to remove pollutants. The end hydrological results are a reduction in runoff volume, an increased time of concentration, reduced duration and peak rate of flows, and improved water quality. Because more water is retained on-site and in distributed facilities, the rate of discharge is less critical for LID facilities, since different facilities will discharge into the stream system at different times.

Campus Sanitary Sewer Master Plan

UC Santa Cruz is developing and implementing a Sewer System Management Plan (SSMP) pursuant to State Water Resources Control Board Order 2006-0003, Statewide General Waste Discharge Requirements for Sanitary Sewer Systems. The goal of the UCSC SSMP is to provide a plan and schedule to properly manage, operate, and maintain all parts of the sanitary sewer system. This will help reduce and prevent sanitary sewer overflows (SSOs), as well as mitigate potential impacts of any SSOs that do occur. The development process began in summer 2007 and the SSMP is expected to be complete by August 2009. Since May 2007, UC Santa Cruz has reported SSO's electronically to the California Integrated Water Quality System (CIWQS).

3.8.1.2 Local and Regional Context

Physiography and Climate

The campus is located within the Big Basin Hydrologic Unit, as defined by the RWQCB. The UC Santa Cruz campus slopes upward in a series of marine terraces from an elevation of 300 feet at its southern boundary on High Street to an elevation of about 1,200 feet at its northwestern boundary. The average north-south gradient is slightly more than 5 percent. Along the eastern and western flanks of the campus and along the numerous stream drainages that cross the campus, gradients generally range from about 25 to about 70 percent.

Rainfall levels vary considerably on campus with elevation; the lower campus receives an average of 30 inches of rainfall annually, while the upper campus receives 40 to 45 inches or more (Johnson and Weber & Associates 1989). Average evapotranspiration[2] is estimated to be 19.7 inches per year (Johnson and Weber & Associates 1989).

Surface Water Drainage

The campus is drained through both surface and subsurface drainages that originate within the campus boundaries. The assignment of surface water runoff to a particular watershed is based on topographic

[2] Evapotranspiration refers to the loss of water by evaporation from soil and transpiration from plants.

features of the campus; however, flows captured by the karst aquifer or by the campus storm water drainage system may be transferred from one watershed to another.

The geology of the northern one-third of the campus consists of weathered schist and granitic rocks, which are overlain in some areas by thin (5- to 30-feet thick) remnants of Santa Margarita sandstone and marine terrace deposits. The topographic surfaces in most of this portion of the campus are broad and gently sloping. Surface drainage from these areas occurs as overland flow and rills. Drainage divides are poorly defined, but surface flow eventually collects in a few well-defined drainages along the margins of the flats. The dispersed surface flow encourages percolation of rainwater, recharging a shallow groundwater system which in turn feeds springs and seeps located along the southern and eastern edge of the north campus.

The hydrologic system of the upper and north campus is dominated by broad, gently sloping topographic surfaces where surface drainage occurs as overland flow and rills. Drainage divides are poorly defined, but surface flow eventually collects in a few well-defined drainages along the margins of the flats. The dispersion of surface flow encourages infiltration of rainwater, recharging the shallow groundwater system, which in turn feeds springs and seeps located throughout the area. Many forest springs are perennial (i.e., flow throughout the year) during years of average rainfall. Surface runoff toward the south and west eventually enters the karst (marble) aquifer system of the central and lower campus via Cave Gulch, Moore Creek and Jordan Gulch. Surface flow toward the east enters tributary drainages of the San Lorenzo River system.

The southern two-thirds of the campus is underlain by marble and schist bedrock overlain by deposits of residual soils and colluvium. Karst topography has developed in these areas as a result of the dissolution of marble along faults and fractures. Sinkholes, sinks, closed depressions and swallow holes caused by subsidence or collapse of subsurface solution cavities in karst terrain are collectively known as dolines, which are a fundamental feature of karst topography (Bloom 1978). Karst topography is characterized by: (1) a relative absence of surface streams and drainage channels, with most precipitation discharging to the subsurface through fractures, and (2) the presence of sinkholes, closed depressions, and swallow holes (i.e., the location in karst limestone at which a surface stream goes underground [Sweeting 1973]).

Very little storm water from the central and lower campus is conveyed by surface streams to channels downstream of the campus. Instead, storm water is captured by the karst aquifer, stored and transmitted via solution channels, and discharged in springs at lower elevations to the east, south and west of the campus. The marble area on campus contains more than 50 sinkholes which appear to capture as much as 40 percent of campus runoff.

Three watersheds, Cave Gulch, Moore Creek and Jordan Gulch, drain approximately 1,100 acres in the central portion of the campus. All three stream channels are aligned north-south and are controlled by the major geologic fracture systems on the campus. Cave Gulch, which drains most of the northwestern portions of the campus, joins Wilder Creek immediately west of the campus. Moore Creek, which drains the central portions of the campus, discharges into Antonelli Pond near the coast. Jordan Gulch drains the central and eastern portions of the campus (Figure 3.8-1). Most of the flow in Moore Creek and Jordan Gulch is captured by swallow holes in the lower campus, even during extreme storm events.

Areas of the campus not drained by the three major watersheds are drained by a number of creeks and gullies that originate along the campus boundary. Much of the western boundary of the campus, including portions of the upper and north campus, is drained by Wilder Creek. Runoff from the southern campus flows into four small drainages: a western tributary of Moore Creek that joins to Moore Creek downstream from the UC Santa Cruz campus boundary; Arroyo Seco; the City storm water drainage system on High Street; and Kalkar Quarry Pond (a spring-fed pond occupying a former marble quarry). The eastern boundary of the campus is in the San Lorenzo River watershed; the southeastern portion of the campus drains to a series of hillslope drainages within the San Lorenzo River watershed, designated as gullies A through H.

Natural drainages are the primary means used to manage storm water runoff on the campus. Within the developed portions of the campus, storm drains have been installed to capture and convey storm water. These are generally small systems that locally capture runoff and convey it to detention basins from which the water is then discharged into the nearest drainage through culverts of lined ditches. Since 1989, new construction has included detention and sediment filtration facilities to detain excess runoff and slowly release runoff at predevelopment rates in order to avoid increasing peak flows and to remove suspended sediment. In some areas with older development, the collected water is discharged without detention.

Groundwater Conditions

Regional

The UC Santa Cruz campus is roughly divided into two hydrogeologic systems: upper/north campus system and central/lower campus system. These two hydrogeologic systems are closely associated with campus geology (i.e., rock types, faults and fracture zones). Each of these systems is discussed below.

Upper/North Campus

The upper/north campus hydrogeologic system (generally north of McLaughlin Drive) includes shallow water-bearing zones of moderate permeability consisting of Santa Margarita sandstone and weathered schist and quartz diorite (a granitic rock), which overlie relatively impermeable unweathered schist and granitic rocks. Depth to groundwater throughout most of the north campus ranges from about 2 to 16 feet below ground surface (bgs) (Nolan Associates 2000). The shallow groundwater system is recharged through the infiltration of rainfall into the permeable sandstone and weathered schist and granitic rocks. The springs and seeps bordering the north campus at higher elevations originate from shallow aquifers within thin layers of Santa Margarita sandstone and the schist and granitic basement rocks, which intersect steep slopes along the San Lorenzo River drainages.

Central/Lower Campus

An extensive underground drainage network of subterranean caverns and channels has formed in the central and lower campus through the dissolution of marble by groundwater. The locations of the subsurface channels are predominantly governed by bedrock fractures that provide zones where water can penetrate, weather and dissolve the rock, eventually widening the fractures. Dissolution of the marble can only take place where water can flow. Nonfractured, crystalline marble will not be readily weathered or dissolved, because unlike sandstone, for example, it does not have space between grains (inter-granular porosity) that would allow water penetration in any appreciable amounts. Much of the marble on campus is dense and has no inter-granular porosity or permeability. Nonfractured areas in between areas of fractured limestone are typically dry (Johnson and Weber & Associates 1989).

The two main underground channels on the campus lie beneath Jordan Gulch and Moore Creek, where they coincide with two north-south trending fault/fracture systems. In addition, there are several east-west fractures in the central and southern portions of the campus (Johnson and Weber & Associates 1989; Weber and Associates 1994). Underground channels are inferred to be present along the alignments of these fractures. Groundwater from the campus discharges to surface water in the surrounding areas by way of numerous springs and seeps feeding drainages in the San Lorenzo River watershed to the north and east of the campus; the Cave Gulch and Wilder Creek watersheds to the west of the campus; and the Moore Creek, Arroyo Seco, and Jordan Gulch/Neary Lagoon watersheds south to southwest of the campus.

Water in the karst aquifer is of excellent quality and has the potential to supply a portion of the campus' water demand (URS 2008; Weber Hayes & Associates 2007). However, groundwater is not extracted on the campus for any purpose at this time and the Campus depends on the City's domestic water supply for both domestic and irrigation water. Surface streams fed by some of the springs are used by owners of neighboring properties for recreation and landscape irrigation (Johnson and Weber & Associates 1989). A clubhouse in the Pogonip City Park, which has not been in use in more than 15 years, historically had used springs in the Pogonip as a water supply.

Surface Water and Groundwater Quality

Since 1989, water quality monitoring has been conducted annually at one groundwater well, four spring and surface water locations, and three parking lots (including the Crown/Merrill parking lot). The samples are analyzed for general mineral, physical and inorganic constituents; parking lot samples are also analyzed for petroleum hydrocarbons. The analytical results are compared against performance criteria (e.g., water quality standards, guidelines, and benchmarks) and the beneficial uses identified for the surface water bodies on and near the campus. As discussed in the 2005 LRDP EIR (Section 4.8.1.8) the historical water quality data does not indicate an increase in urban runoff pollutants over time in the waters that are sampled.

3.8.1.3 Site Characteristics

Existing Surface Water Drainage Patterns

With the exception of the 0.64 acre area at the western edge of the site, which drains to Jordan Gulch, the project site is within the San Lorenzo watershed, in the San Lorenzo-Pogonip sub-watershed. Surface runoff from the larger portion of the project site, which is in the San Lorenzo watershed, drains to Gully H, one of several drainage swales that originate on the campus and carry flows into the Pogonip City Park. The San Lorenzo River, which discharges to Monterey Bay, lies approximately 2.2 miles southeast of the campus. As discussed in the 2005 LRDP EIR (Section 4.8.1.3), the San Lorenzo watershed encompasses an area of approximately 87,000 acres, of which approximately 510 acres are on the UC Santa Cruz campus.

The San Lorenzo – Pogonip sub-watershed drains most of the eastern portion of the campus east of Hagar Drive, from north of the Crown/Merrill Apartments south to the southern boundary of the campus. The sub-watershed is divided into eight sub-areas, each associated with one of the gullies (gullies A through H) that drain to the east. The southernmost sub-area, which includes the East Remote parking lot and the East Field area, is drained by sinkholes. Some of the runoff in the other sub-areas, including Gully H, percolates into permeable hillslopes along the boundary between the campus and the Pogonip.

Runoff that drains to the subsurface via sinkholes on campus contributes to several springs located south and east of the campus. The two surface streams in the Pogonip, Redwood Creek and Pogonip Creek, are fed by springs that discharge groundwater derived at least in part from campus runoff. Gully H is in the surface watershed of Redwood Creek, which flows to the San Lorenzo River (Johnson and Weber & Associates 1989). However, as shown by a dye tracing study conducted by the campus in 1992, runoff on campus can travel by way of subsurface flow from one surface watershed to another. For example, dye injected into the East Remote sinkhole, which receives runoff from Gully B, was detected in several springs to the south of campus (in the Moore Creek, Jordan Gulch, High Street and Kalkar Quarry watersheds) (Aley 1994).

Gully H has a tributary area of approximately 40 acres (Kennedy/Jenks 2004). UC Santa Cruz development in the Gully H watershed consists of Crown/Merrill Apartments and portions of Merrill and Crown Colleges, including Parking Lot 111 and portions of the fire station. The uppermost portion of Gully H is a well-defined, steeply sloping channel. Near the Lime Kiln Trail that runs near the eastern boundary of the UC Santa Cruz property, Gully H is a very small swale with no clearly defined bank. There is no culvert beneath this trail/access road, which suggests that surface flows in Gully H at this location are minimal (H.T. Harvey 2008). East of the UC Santa Cruz property boundary line, in Pogonip Park, Gully H becomes a continuous and well defined channel known as Redwood Creek, which is fed by springs as well as surface runoff. Redwood Creek drains into the San Lorenzo River approximately one mile east of and several hundred vertical feet below the campus boundary. Although some of the flow in Gully H percolates to the subsurface before reaching Redwood Creek, in large storm events surface runoff from the campus may flow overland to the creek (Johnson and Weber & Associates 1989).

Runoff from the three terraces of Parking Lot 111 is discharged by way of a series of subsurface storm water pipes and asphalt and concrete swales to an outfall at the head of Gully H**.** In addition to the runoff from these parking lots, runoff from a portion of Crown/Merrill Apartments, two of the three parking lots north of Crown/Merrill Apartments, and the northeast portion of Crown College (including the Dining Commons) are also piped and channeled to this outfall (Figure 3.8-2). Runoff from rooftops and pavement in the northern portion of Merrill College (to the south of Gully H) and the remainder of the runoff from Crown/Merrill Apartments and the parking lots to the north discharge to the banks of Gully H at a series of smaller outfalls along the northern and southern slopes of the drainage.

An area of 0.64 acres at the southwest corner of the project site, including the Crown College Preceptors' Apartment, drains toward Chinquapin Road. A portion of this runoff is captured in a drainage inlet in Chinquapin Road and discharges to the east fork of Jordan Gulch. The remainder of the runoff flows overland down Chinquapin, partly on the road surface and partly in a shallow ditch along the east side of the road, to storm drain inlets on McLaughlin that discharge to the main stem of Jordan Gulch below Quarry Plaza.

The east fork of Jordan Gulch, which is fed by springs north of Colleges Nine and Ten, flows toward the south between Crown College and College Nine west of Chinquapin Road, and terminates in the McLaughlin sinkhole immediately above McLaughlin Drive. The drainage area of the east fork is approximately 30 acres. The McLaughlin sinkhole appears to have a very low infiltration capacity as a result of fine-grained sediments that appear to have been deposited in the sinkhole as a result of historic land uses associated with the lime industry (Kennedy/Jenks 2004). During winter storms, water ponds in the sinkholes. In large storm events the level of the ponded water can exceed the level of the inlet to the culvert beneath McLaughlin Drive and the water can spill into the main stem of Jordan Gulch.

Erosion Potential

As discussed in detail in the 2005 LRDP EIR (Section 4.8.1.3), the potential for erosion by storm water runoff is generally high in the central campus as a result of steep gradients and the presence of fractured rocks, and soils that are highly susceptible to erosion. Historical uses, including logging, quarrying, and grazing that occurred prior to development of the UC Santa Cruz campus, disturbed the natural vegetation and landscape, thereby increasing erosion and sedimentation rates within the campus watersheds. The potential for erosion on the central and lower campus has been exacerbated by the addition of impervious surface as the central campus has developed over the years.

Since 1989, the construction of detention systems as part of new development on campus has helped to reduce slope erosion and the rates at which runoff flows to off-campus areas; however, detention systems do not address runoff from development constructed before 1989. Unprotected trunk channels have been adversely affected by erosion and sedimentation.

All of the existing development within the Gully H sub-watershed was constructed before 1989, and the storm water drainage systems in this area, therefore, do not include any detention. Channel conditions in the San Lorenzo–Pogonip watershed, including the campus portion of the watershed, vary from location to location but are in general fair to poor. The campus's Storm Water and Drainage Master Plan (Kennedy/Jenks 2004) identified two areas with existing erosion conditions in Gully H. The first area (GH-A) was approximately 200 feet downstream of the easternmost existing parking lot on the project site and was characterized by several active knickpoints[3] between 1 and 2 feet in height. The second area (GH-B), approximately 200 feet downstream of GH-A, was characterized as a steep, actively eroding gully on the valley slope, caused by concentrated runoff from a residence hall and parking area within Merrill College. The Storm Water and Drainage Master Plan recommended two improvements to address these erosion conditions: 1) installation of a detention vault in the lower terrace of Parking Lot 111 to reduce peak flows to Gully H; and 2) extension of the culvert that discharges runoff onto the slope above Gully H from the Merrill College residence halls, and installation of an energy dissipation apron at the end of the culvert.

There are existing erosion problems in the main stem of Jordan Gulch between Quarry Plaza and the junction with the Middle Fork of Jordan Gulch, approximately 1,300 feet downstream; below that junction, the main stem is in good condition (Kennedy/Jenks 2004). This outfall receives a mix of detained and undetained runoff from the Jordan Gulch watershed, including portions of McLaughlin Drive, Chinquapin Road, Crown College, and Quarry Plaza. As recommended by the 2004 Campus Storm Water Drainage and Master Plan (Kennedy/Jenks 2004), the campus is beginning to implement the suggested projects in Jordan Gulch as part of the previously-approved Infrastructure Improvements Project (IIP) Phase 1. A portion of the runoff (up to approximately 13 cubic feet per second [cfs] in a 2-year storm) that currently discharges to the outfall south of Quarry Plaza will be diverted to the Upper Quarry sinkhole. A second improvement project would divert approximately 5 cfs from the Middle Fork of Jordan Gulch to the Upper Quarry sinkhole. The campus Storm Water and Drainage Master Plan identified the Upper Quarry sinkhole as one location with capacity for infiltration of additional runoff, and recommended the diversion. The IIP Phase 1 was approved in February 2007. Construction of the Phase 1 storm water drainage improvements, including the Middle Fork and Upper Quarry diversions, is scheduled for construction in summer 2009.

[3] A knickpoint is an abrupt discontinuity in the slope of a channel bed.

3.8.2 Relevant Project Characteristics

Development of the proposed project would increase the impervious surface area (pavement or buildings with traditional roofs) on the 3.1-acre ECI Project site, from 0.88 acre to 1.63 acres. The remainder of the site surfaces would be pervious, including 0.26 acre of pervious concrete, and 0.13 acre of green/living rooftop, in addition to traditional landscaping, bioswales, and bioretention areas. The storm water management system for the proposed project includes a series of detention and bioretention features that would reduce the volume and rate of runoff leaving the site while improving the water quality through biofiltration. To avoid concentration of runoff ~~to the filled doline beneath the existing parking lot, which could potentially result in reactivation of this feature,~~ adjacent to the buildings, the proposed storm water management features would be lined with impermeable barriers; the other retention areas would not be lined ~~(Pacific Crest Engineering 2008b)~~. These features are illustrated in Figures 3.8-3 and 3.8.4 and described below.

The 0.13-acre (5,750-sf) green/living roof would be located on the eastern portion of Building B. The vegetated roof would consist of a waterproof membrane, an "egg-crate" water retention layer, a root barrier, a growing medium consisting of an engineered blend of inorganic and organic contents, and highly drought-resistant ground cover plants. The depth of the soil profile is limited to 8 inches to minimize the impact on the structural system of the building. The green roof would slow down the concentration of storm water flows from the rooftop. The evapotranspiration of some of the water retained in the soil profile would reduce the total volume of runoff from the roof, and the soil and vegetation would absorb pollutants. In large storm events, when the rainfall on the vegetated roof exceeds the capacity of the soil and vegetation to hold water, the excess flows would overflow down roof leaders and be directed to the bioretention/bioswales and rain gardens adjacent to the building and in the plaza.

Bioretention bioswales and rain gardens adjacent to Building B and in the plaza would consist of an impervious liner, a 6-inch layer of drain rock, and 18 inches of engineered soil. These features would provide initial storm water quality treatment for runoff from the traditional, impervious roofs on Building A and a portion of Building B. These would also provide some reduction in runoff volume through evapotranspiration. In large storms, the excess runoff to these features would be collected in perforated piping within the drain rock, and piped to the ~~bioretention~~ landscaped area east of Building B or to underground detention vaults.

Pervious paving in the plaza adjacent to Building B would be a mixture of porous concrete and open-jointed pavers. The porous concrete would consist of 8 inches of porous concrete underlain by 6 inches of drain rock, and an underdrain system. ~~The pervious pavement system would be lined with an impervious liner to prevent saturation of the subgrade soils.~~ The underdrain system would drain the overflow storm water via pipe to the bioretention area northeast of the plaza.

The Campus is considering two options for management of runoff ~~that reaches the bioretention area northeast of the plaza~~ discharged to Gully H. Under Option 1, a passive irrigation system would be installed beneath a ~~landscaped open space~~ bioretention area east of Building B. In this system, storm water runoff would infiltrate through the landscaping and would be stored in a sand profile underlain by an impervious liner. As the surface soil dries, water retained in the sand layer would be drawn into the root zone through capillary action. In the 2-year, 5-year and 10-year design storms, excess storm water would be stored in underground tanks below the bioretention area. The tanks would be designed to hold the volume of runoff in excess of the estimated runoff volume for these design storms under pre-development (i.e., pre-UC Santa Cruz development) conditions. The water stored in these tanks would be discharged to the culverts that run beneath the two lower terraces of Parking Lot 111 to the existing outfall at the head of Gully H. However, this system could also be designed to circulate a portion of the water back into the bioretention area as the sand dries out, where it would be available to the plants.

Under Option 2, the ~~bioretention area~~ landscaped area east of Building B would consist of conventional landscaping and would not include a passive irrigation system. Instead, runoff ~~filtered through the bioretention area~~ would be stored in underground tanks that would discharge to two 5,000-gallon cisterns. The cisterns would store runoff for use in landscape irrigation, which would offset a small portion of the project's irrigation water demand. The underground tanks would be sized to contain the excess runoff from the 2-year, 5-year and 10-year storms. Overflow in excess of the 10-year design storm beyond the capacity of the cisterns would discharge to Gully H through the culverts beneath the lower parking lot terraces.

Under both options, the rate of runoff discharged to the culvert would not exceed 10 percent of the estimated flow for the 2-year design storm under pre-development (i.e., pre-UC Santa Cruz) conditions. The rationale for selecting this discharge rate is discussed in Section 3.8.3.3, in the discussion of ECI Impact HYD-2. The size of the underground tanks would depend on which option is selected and on details of the design of the bioretention area but would be approximately 10,000 to 13, 000 gallons.

In addition to the storm water management system for the proposed project, the project would implement two improvements to address the existing erosion conditions in Gully H identified in the 2004 Campus Storm Water and Drainage Master Plan. As discussed in Section 3.8.1.3, above, the 2004 Storm Water Master Plan recommended two improvements in the Gully H watershed: 1) installation of a detention vault in the lower parking lot to reduce peak flows to Gully H; and 2) extension of the culvert discharging runoff onto the slope above Gully H from the Merrill College residence halls, with an energy dissipation apron at the end. To implement the first of these recommendations, the proposed project would construct detention tanks on the project site (rather than in the lower parking lot) to reduce peak flows from existing development in the Gully H watershed. The detention tanks would discharge to the proposed bioretention area, which would provide treatment to remove pollutants from this runoff. The Campus has determined that the second of the two recommendations is no longer required, as erosion is no longer evident at the outfall from the residence halls.

3.8.2.1 Applicable LRDP Mitigation Measures

The following, previously adopted, 2005 LRDP EIR mitigation measures are applicable to and incorporated into the proposed project:

HYD-2B: No grading shall be conducted on hillsides (sites with slopes greater than 10 percent) during the wet season (October 1 through May 31) unless controls that prevent sediment from leaving the site are implemented. Erosion control measures, such as erosion control blankets, seeding, or other stabilizing mechanisms shall be incorporated into the project erosion control plan or SWPPP and applied to graded hillsides prior to predicted storm events.

HYD-3A: The Campus shall install additional signs and expand the public education program to inform and educate the campus population about the importance of staying on paved roads and approved paths to prevent vegetation disturbance and soil erosion.

HYD-3C: Each new capital project proposed under the 2005 LRDP that creates new impervious surface shall include design measures to ensure that post-development peak flows from 2-, 5- and 10-year storms do not exceed the 2-, 5-, and 10-year pre-development peak flows and that post-development peak flows from a 25-year storm do not exceed the pre-development peak flow from a 10-year storm.

As described below in Section 3.8.3.3, in the discussion of ECI Impact HYD-2, the new ECI Mitigation HYD-2 will be implemented in lieu of LRDP Mitigation HYD-3C, to provide a more effective and applicable performance standard.

HYD-3D: The Campus shall require each new capital project to include design measures to minimize, to the maximum extent practicable, the increase in the volume of storm water runoff discharged from the project site to sinkholes or natural drainages. These design measures shall include features that maximize infiltration and dissipation of runoff, preferably near the area where new runoff is generated, and may include, but will not be limited to: vegetated swales, bioretention areas, infiltration trenches and basins, level spreaders, permeable pavement, minimizing directly connected impervious surfaces, storage and re-use of roof runoff, and green roofs. Within one year following approval of the 2005 LRDP, the Campus shall provide a protocol for design consultants to use in demonstrating that measures to reduce runoff are included in the project design to the maximum extent practicable.

HYD-5B: For projects involving construction on karst, if: (a) groundwater is encountered beneath the building site during the geotechnical investigation, and (b) the proposed foundation type would require pressure grouting, the Campus will follow the procedures outlined below:

- Perform a dye tracing study to determine if there is a potential for pressure grouting to affect water quality in springs and seeps around the UC Santa Cruz campus. If a potential impact is indicated, alternative building foundation plans will be considered.
- As an alternative, the Campus may conduct a preliminary hydrogeological study to evaluate whether the groundwater zone encountered during the geotechnical investigation is hydraulically connected to the karst aquifer. If the hydrogeological study indicates that the groundwater zone is hydraulically independent of the karst aquifer, such that there is no potential for grout injected during construction to affect karst water quality, a dye tracing study need not be performed. If results of the hydrogeological study indicate hydraulic connectivity between the groundwater encountered beneath the site and the karst aquifer, the Campus shall conduct a dye tracing study as described above.

3.8.3 Impacts and Mitigation Measures

3.8.3.1 Standards of Significance

The following standards of significance are based on Appendix G of the CEQA Guidelines. For the purposes of this EIR, hydrology and water quality impacts would be considered significant if the proposed project would:

- Violate any water quality standards or waste discharge requirements
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on site or off site
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on site or off site
- Create or contribute runoff water that would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff
- Otherwise substantially degrade water quality

No areas proposed for development under the 2005 LRDP, including the proposed project site, are within a 100-year flood hazard area, or an area subject to inundation as a result of dam failure, seiche, tsunami or mudflow. The following CEQA checklist items identified in Appendix G of the CEQA Guidelines were not analyzed in the 2005 LRDP EIR and are not analyzed in the discussion below because the proposed project would not:

- Place housing within a 100- year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map
- Place within a 100-year flood hazard area structures that would impede or redirect flood flows
- Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam, or inundation by seiche, tsunami or mudflow

3.8.3.2 Analytical Method

Surface Water

The effects of the increase in impervious surface that would result from redevelopment of the project site were analyzed by: 1) comparing hydrographs for runoff from the project site under existing conditions and after project construction is completed; 2) calculating the total effective impervious area for the project site after construction; and 3) comparing the time of concentration for project site runoff under existing conditions and after project construction is completed. Each of these procedures is described below.

Hydrographs show the rate of storm water discharge during a storm event of a given intensity and duration. Individual points on the hydrograph represent the rate of storm water discharge at a given time. The area under the curve, in the hydrograph, is the total volume of storm water discharged during the storm event.

Hydrographs were prepared for the project site for 1-, 2-, 5-, and 10-year events, each of 10 minutes duration. Peak flows were estimated using the Modified Rational Unit Hydrograph Method and the time of concentration was estimated by using the overland velocity guidelines found in SCS Technical Report 55 (USDA, SCS 1975). The rainfall intensity for each of the model storms was derived from an intensity-duration-frequency curve obtained from rainfall data from rain gauges in the city of Santa Cruz and Skyline Ridge in San Mateo County.

Effective impervious area is that portion of the impervious area that drains directly to a receiving surface water body via a hardened storm drain conveyance without first draining to a pervious area. Impervious area that collects and drains the water directly to a stream or wetland system via pipes or sheet flow is considered "effective impervious area." Impervious area that drains to landscaping, swales or other impervious areas is not considered "effective" because the water is allowed to infiltrate through the soil, without a direct connection to the stream or wetland. Effective impervious area can be reduced through project design features that disconnect impervious surfaces such as sidewalks, rooftops, parking areas, and streets, from the drainage system so that runoff does not flow directly to streams. Disconnecting the storm water system allows the watersheds' hydrologic cycle to respond in a manner that more closely reflects pre-development conditions.

The time of concentration is generally defined as the time required for a drop of water to travel from the most hydrologically remote point in the drainage area to the point of collection. It represents the time to reach the maximum discharge rate. In a natural setting, the initial rainfall is absorbed by soil and vegetation. Runoff occurs only after the soil is saturated. The time of concentration typically is shorter after a site is developed, because impervious surfaces such as buildings and pavement do not allow rainfall to infiltrate. This can increase the potential for flooding.

3.8.3.3 Project Impacts and Mitigation Measures

Wastewater Discharge Requirements

Wastewater from the proposed project would be discharged to the campus sewer conveyance system. Campus wastewater is discharged to the City of Santa Cruz sewer system and is treated at the City's wastewater treatment plant. The UC Santa Cruz campus does not discharge wastewater directly to any receiving water bodies but must comply with the effluent limitations specified in the waste discharge permit issued by the City. As explained in Section 3.8.1.1, above, the Campus is also subject to the State General Waste Discharge Requirements for Sanitary Sewer Systems, which prohibit sanitary sewer overflows that result in discharge of untreated or partially treated wastewater to waters of the U.S. and discharges of untreated or partially treated wastewater that create a nuisance. To comply with these requirements, the Campus is in the process of developing a SSMP, which will include a plan and schedule for management, operation, and maintenance of the Campus' sanitary sewer system.

The 2005 LRDP EIR analyzed the potential for campus wastewater discharge to cause a violation of the waste discharge requirements of the City's wastewater treatment plant. Although the amount of wastewater discharged by the campus would increase, the types of activities and uses on the campus would remain unchanged; therefore, the quality of wastewater that is discharged to the sewer system would not change. Therefore, the LRDP EIR concluded that the impact with respect to wastewater discharge requirements would be less than significant. The proposed project is within the development program analyzed in the LRDP EIR and would not change the conclusion of the LRDP EIR that the impact would be less than significant.

The 2005 LRDP EIR did not discuss the State General Waste Discharge Requirements for Sanitary Sewer Systems, as these were not in effect at the time the EIR was prepared. As discussed in Section 3.16, *Utilities* *and Service Systems*, the campus sanitary sewer system has adequate capacity to handle the wastewater flow from the proposed ECI projects. Therefore, construction and operation of the proposed project would not increase the potential for a sanitary sewer overflow which would violate the general waste discharge requirements. The project impact would be less than significant.

Construction Storm Water Quality

ECI Impact HYD-1:	The proposed project could result in storm water runoff during construction, which could substantially degrade water quality.
Applicable LRDP EIR Mitigation:	HYD-2B
Significance with LRDP EIR Mitigation:	Less than significant
Project Mitigation:	Mitigation not required

Project construction activities, including grading and excavation for utilities and building foundations, could cause erosion during storm events that would discharge sediment into Gully H or Jordan Gulch. Other pollutants such as fuels, paints, and solvents, could be accidentally released and could affect the quality of surface flow in these drainages. Surface flow in both Gully H and Jordan Gulch is ephemeral and generally infiltrates into the ground before reaching downstream receiving waters. However, in an extreme storm event surface flow in Gully H may reach Redwood Creek, which is a tributary to the San Lorenzo River. Thus, pollutants could affect water quality and other beneficial uses of the San Lorenzo River and Monterey Bay. In addition, pollutants in storm water runoff from the project site could reach groundwater in the karst aquifer via dissolution features in the karst system. These pollutants, if soluble, could be discharged to surface water by way of springs fed by the karst aquifer.

The 2005 LRDP EIR identified the potential for construction activities under the 2005 LRDP to degrade water quality as a potentially significant impact that would be reduced to a less-than-significant level by mitigation. Because the Campus is required by law to implement SWPPPs for all construction sites that disturb one acre or more, the potential for construction activities to cause erosion and other water quality impacts is low. However, construction on steep slopes and/or on erosive soils, and numerous small projects that would not be subject to the SWPPP requirement, could result in a significant impact. LRDP Mitigation HYD-2B, which specifies requirements for construction on steep slopes, is applicable to and is incorporated into the proposed project. The proposed project is within the building program analyzed in the 2005 LRDP EIR. Therefore, the project impact would be less than significant.

Surface Water Quality

ECI Impact HYD-2:	The proposed project would increase impervious surface, which would result in an increase in the volume and peak flow rates of storm water runoff, which could exacerbate existing erosion conditions in Gully H, and would increase the amount of urban pollutants in storm water runoff, which could affect water quality.
Applicable LRDP EIR Mitigations	HYD-3A; HYD-3C; HYD-3D. For this project, ECI Mitigation HYD-2 will be implemented in lieu of LRDP Mitigation HYD-3C.
Significance with LRDP: EIR Mitigation:	Potentially significant
ECI Mitigation HYD-2:	The storm water management system for the project shall be designed to release runoff to Gully H from the project site at the following rate: Runoff in excess of the estimated pre-development flow for the 2-, 5- and 10-year design storms shall not exceed 10 percent of the peak flow rate for the 2-year, pre-development design storm.
Residual Significance:	Less than significant

Impacts from Increased Impervious Surface

The proposed project would increase the impervious surface on the project site by 32,113 sf, including 8,998 sf in the Jordan Gulch watershed and 23,115 sf in the Gully H watershed. This would increase the volume of storm water runoff, which, if not properly managed, could cause erosion and sedimentation in Jordan Gulch and/or Gully H.

Consistent with LRDP Mitigation HYD-3D, the project includes several LID features. Runoff from the new parking spaces and pathways, the building roofs, and most of the new roadways created by the project would drain through the vegetated roof, pervious pavement, bioswales and/or bioretention areas before being discharged to Gully H or Jordan Gulch. This would reduce the effective impervious surface to 5,870 sf, which is less than five percent of the total project area of 136,230 sf. The pervious pavement, vegetated roof, bioswales and bioretention areas would increase the time of concentration and flow rates of runoff from the site. In addition, some of the runoff flowing to the vegetated roof and bioretention areas would be retained in the soil and then lost to evapotranspiration, and some would be stored for later use in landscape irrigation. However, there would still be a net increase in the volume of runoff from the project site for the 2-, 5- and 10-year design storms.

The proposed project includes two design options for storm water management. As described in Section 3.8.2, above, the Campus is considering two options for management of runoff~~ that reaches the bioretention area northeast of the plaza ~~discharged to Gully H. Under Option 1, a passive irrigation system would be installed beneath ~~the~~a bioretention area east of Building B. In this system, storm water runoff that infiltrated through the landscaping in this area would be stored in a sand profile underlain by an impervious liner. As the surface soil dried, water retained in the sand layer would be drawn into the root zone through capillary action. Under Option 2,~~ bioretention area~~ landscaped area east of Building B would consist of conventional landscaping and would not include a passive irrigation system. Instead, runoff ~~filtered through the bioretention area~~ would be stored in underground tanks that would discharge to two 5,000-gallon cisterns. The cisterns would store runoff for use in landscape irrigation, which would offset a small portion of the project’s irrigation water demand. The underground tanks would be sized to contain the excess runoff from the 2-year, 5-year and 10-year storms. Overflow in excess of the 10-year design storm beyond the capacity of the cisterns would discharge to Gully H through the culverts beneath the lower parking lot terraces. Under either option, the system would be designed to release the stored runoff to the culvert underneath the two lower parking lots that discharges to Gully H at a rate of no more than 0.099 cfs, which is 10 percent of the estimated 2-year flow from the project site to Gully H before UC Santa Cruz development.

The project would increase the peak rate of runoff flow from the project site to the east fork of Jordan Gulch by up to approximately 1 cfs, in the 10-year design storm. As described in Section 3.8.1.3, above, the Campus is preparing, under a previously approved project, to address existing erosion conditions in Jordan Gulch by diverting up to approximately 13.2 cfs of runoff from the East Fork and the Middle Fork of Jordan Gulch. This is one of the storm water drainage improvements recommended by the Campus’ 2004 Storm Water and Drainage Master Plan. The increased runoff from the proposed ECI Project would not significantly reduce the effectiveness of this diversion.

The 2005 LRDP EIR estimated that, under the 2005 LRDP, 58 acres would be added to the existing impervious surfaces in the San Lorenzo-Pogonip watershed, for a total of 100 acres (2005 LRDP EIR, Section 4.8.2.4, LRDP Impact HYD-3). The LRDP EIR concluded that implementation of LRDP Mitigations HYD-3A through HYD-3E would reduce the impact to a less-than-significant level if they could be implemented for all future development projects under all conditions. However, the LRDP EIR concludes that the impact would be significant and unavoidable, despite implementation of these mitigation measures because it cannot be determined that, for all future projects, design measures will be available that would decrease the volume of flow to the extent needed to avoid all increases in erosion.

The Campus proposes to implement ECI Mitigation HYD-2 in lieu of LRDP Mitigation HYD-3C to identify more effective and applicable performance standards for storm water management for the proposed project. The requirements for limiting peak flow embodied in LRDP Mitigation HYD-3C are standards the Campus adopted in the late 1980s, consistent with standard engineering practices developed to avoid flooding. Conventional flood control detention basins are designed to control peak flows for large events to pre-project levels and to meter the excess runoff out over a longer period. This approach can increase the duration of small but still erosive flows and can cause extensive channel erosion.

In recent years, storm water standards for new development have focused increasingly on the prevention of hydrograph modification, or hydromodification, by avoiding increases in the rate and duration of storm water flows. Hydromodification refers to changes in the magnitude and frequency of stream flows as a result of urbanization, and the resulting impacts on the receiving channels in terms of erosion, sedimentation and degradation of instream habitat. The degree to which a channel will erode is a function of the increase in driving forces (shear stress), the resistance of the channel (critical shear stress), the change in sediment delivery, and the geomorphic condition of the channel. Critical shear stress is the stress threshold above which erosion occurs. Only those flows that are large enough to generate shear stress in excess of the critical shear stress of the bank and bed materials cause erosion. This increases the shear stress exerted on the channel by stream flows and can trigger erosion in the form of incision (channel downcutting) or widening (bank erosion) or both. Increases in flow below critical shear stress levels have little or no effect on the channel.

The stream flows that are most important for erosion are those that are both large enough to move an appreciable amount of sediment and frequent enough to have a significant cumulative impact, generally around the 1- to 5-year recurrence interval. Much of the impact of hydrograph modification is an increase in the frequency of geomorphically effective flows.

One way to manage hydrograph modification is to control site runoff to levels that are equal to or less than pre-project runoff. There is a general consensus that both the frequency and duration of flows must be controlled. It is also generally accepted that events smaller than those with a 10-year recurrence level are the most critical for hydrograph modification management. Hydrograph modification plans (HMPs) developed by counties and cities in the San Francisco Bay Area and other parts of California take varied approaches. For example, the Contra Costa HMP strongly emphasizes the use of LID for hydrograph modification management, while the Santa Clara Valley Urban Runoff Pollution Prevention Program focuses on the use of detention basins for hydrograph modification management and requires that post-project runoff not exceed estimated pre-project rates and durations within a critical range.

Within one year after the campus' SWMP takes effect, the campus will be required to develop its own interim hydromodification standards for new development. These hydromodification criteria will identify a range of runoff flow rates and durations for post-project runoff that will not result in off-site erosion or other significant adverse impacts to beneficial uses. In Gully H, the primary concern for storm water management is hydromodification, as flooding is not a problem in this drainage. Until the SWMP has been approved and the campus has developed its interim hydromodification criteria, project-by-project hydromodification criteria will be used. The critical shear stress level, and, therefore, the minimum flow that can cause or exacerbate erosion, varies by drainage. Data on the critical shear stress for Gully H is not available. Therefore, for the ECI Project, the campus is proposing to set a performance standard that requires that runoff from the project site be released at a rate that is low enough to be below the erosive threshold, based on the lowest flows for which HMPs developed by other agencies in the region require controls.

The Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) HMP defines its lower flow control limit as the minimum flow that could initiate erosion in the channel bed and banks; in technical terms, this is the storm that generates the critical shear stress on a channel (Qc). Based on an estimate of bed and bank material shear resistance at selected cross sections in two creeks, SCVURPPP estimated Qc to be ten percent of the flow that would recur, on average, every two years (represented as Q2), (Santa Clara Urban Runoff Pollution Prevention Program, 2005). As a result of the SCVURPPP study, both the Santa Clara and Alameda HMPs adopted ten percent of Q2 as the lower limit for flow control regulation. Recently, the San Francisco Bay Regional Water Quality Control Board issued an order to the San Francisco Public Utilities Commission for their controlled release operations in which threshold of flow that would cause excessive erosion was defined as 20 percent of Q2 (Order No. <R2-2008-XXX>).

Consistent with the findings of these agencies, ECI Mitigation HYD-2 requires that runoff from the project site be released at a rate that does not exceed 10 percent of the pre-development peak flow for the 2-year design storm. Although the duration of storm water flows would increase (to a maximum of about 5 hours for the 10-year storm) under ECI Project conditions, the flows would be released at rates that would not cause channel erosion.

Impacts from Increased Human Activity

The proposed project would result in increased human activity and vehicle traffic in the project area, which would generate urban pollutants that could be discharged into storm water runoff, including petroleum products and heavy metals from parking lots and loading/unloading areas, and phosphates and nitrates from landscape maintenance activities. Although the proposed project would reduce the total number of parking spaces on the project site, the additional population associated with the project could result in an increase in the number of vehicle trips to the site, including trips by residents as well as delivery, garbage and other service vehicles. All of the new parking spaces and all of the service drives that would be constructed on the project site, except the loading dock for the café, would drain to the bioretention area. According to U.S. EPA standards for the sizing of bioretention areas, the project would require 3,028 sf of bioretention area to provide adequate treatment of the storm water runoff from the site (U.S. EPA 1999). Under Option 1, the proposed project would include 19,638 sf of bioretention area; Option 2, the size of the bioretention area would be 6,558 sf, which would be more than adequate to treat the runoff generated on the site.

The LRDP EIR discussed the potential for increased use of undesignated trails in the central and lower campus by pedestrians and bicyclists to result in disturbance of vegetative cover and consequently in erosion and sedimentation. Some of these trails are close to creeks and streams. One such informal trail runs from Crown/Merrill Apartments to Colleges Nine and Ten across the east fork of Jordan Gulch. Campus Site Stewardship program has done some erosion repair along that informal trail. Currently, the formal pedestrian route requires traveling south and east through Crown College to McLaughlin Drive, then proceeding west on McLaughlin Drive, and two crossings of McLaughlin Drive. The previously approved Chinquapin Sidewalk Project, planned for construction in the spring and summer of 2009, will construct a sidewalk on the west side of Chinquapin Road between the fire station and McLaughlin. This will provide a safe, formal pedestrian route from the project site, as well as from Crown/Merrill Apartments, to Colleges Nine and Ten. Consistent with LRDP Mitigation HYD-3A, the campus will also provide signage at entrances to the informal pathway, and educate residents of new and existing buildings in the area about the importance of staying on formal pathways.

In conclusion, the proposed project would result in increased storm water flows to Gully H, but the runoff would be released at non-erosive rates by means of the storm water management features included in the project. The project would include low-impact development measures that would minimize the effective impervious surface, increase the time of concentration, and remove pollutants from runoff. The increase in runoff to Jordan Gulch would not exacerbate the existing erosion conditions in that drainage. Therefore, the project would not contribute to the significant and unavoidable impact on water quality identified in the 2005 LRDP EIR.

Flooding

The proposed project would increase the impervious surface area on the project site. However, flooding is not a concern in Gully H, where most runoff infiltrates into the ground surface before leaving the campus; only in very large storms is there surface flow from Gully H into Redwood Creek. Storm water flows from the project site to Gully H would be released at a very slow rate. In addition, the proposed project would provide detention for runoff from other developed areas in the Gully H watershed. These measures would reduce the frequency of high flows in Gully H.

The proposed project would slightly increase runoff to the east fork of Jordan Gulch. As discussed in the 2005 LRDP (Section 4.18-8), the sinkhole close to the project site, in this drainage, is one of several campus sinkholes that are showing signs of having limited remaining capacity. This sinkhole has been observed to overflow into downstream reaches of Jordan Gulch. The proposed project would discharge runoff downstream of this sinkhole and therefore would not contribute to the potential for the sinkhole to overtop.

Groundwater

The proposed project would not involve or result in withdrawal of groundwater from a local aquifer. The project would increase impervious surface area on the project site, which could potentially result in a decrease in groundwater recharge on the site. Most of the runoff in the Gully H watershed, including the project site, infiltrates into the karst aquifer, which feeds off-campus springs south, southeast and southwest of the campus, including those in the Pogonip. Under the proposed project, runoff from the project site would be released at very slow rates, which would still allow most of the runoff to infiltrate into the ground surface. Similarly, the additional runoff from the project site to Jordan Gulch would infiltrate into the karst aquifer, either at the Upper Quarry sinkhole, or in sinkholes in the main stem of Jordan Gulch. Therefore, the proposed project would not reduce groundwater recharge from the project site.

Zones of soft soil within doline fill were encountered in exploratory borings for the project geotechnical study. Pressure grouting is frequently used in construction on campus to densify and stabilize such soft soils. The geotechnical report for the proposed project recommends that the building foundation consist of drilled, cast-in-place concrete piers founded in marble bedrock, in conjunction with reinforced concrete grade beams and a structural slab (Pacific Crest Engineering 2008b). This type of foundation does not require pressure grouting of the soft soils. However, if the final project design includes a structural mat foundation for one or more of the site structures, it is possible that pressure grouting would be required.

The 2005 LRDP EIR analyzed the potential that pressure grouting for building foundations in areas of karst could affect groundwater quality. The LRDP EIR concluded that pressure grouting could potentially affect water quality if grout were to be injected where groundwater is present but that this impact would be reduced to a less-than-significant level by implementation of LRDP Mitigation HYD-3A. This mitigation requires that the Campus conduct a dye tracing study or hydrogeological analysis if groundwater is encountered in the geotechnical borings for the project to evaluate hydraulic connectivity with the karst aquifer and associated springs. Groundwater was not encountered in any of the 43 borings conducted at the project site. Therefore, even if pressure grouting were used for the building foundations at the site, further investigation is not required.

3.8.3.4 Cumulative Impacts and Mitigations

The potential hydrology and water quality impacts of the proposed project would generally be limited to Gully H except that, in extreme storm events, runoff from the project site could flow overland to Redwood Creek and thus affect water quality in the San Lorenzo River and Monterey Bay. There are no other currently planned (reasonably foreseeable) projects on the portion of the campus that is in the Pogonip/San Lorenzo watershed. There are three projects under construction in the Harvey West area of the city of Santa Cruz, which are in the Pogonip/San Lorenzo watershed: the Tannery Arts Center, which includes 100 residential units and a 120,000-sf arts center; a new, 5,376-sf industrial building at 229 Encinal Street; and the MetroBase project, which consists of construction of bus maintenance and fueling facilities for Santa Cruz Metropolitan Transit District.

As discussed in Section 3.8.3.4, above, the proposed project would not result in increased erosion in Gully H. The 2005 LRDP EIR identified cumulative impacts to water quality in the San Lorenzo watershed related primarily to the increase in discharge of urban pollutants as the population, level of development and urban activities in the area increase. Because the City of Santa Cruz and the Campus would implement storm water management plans to control nonpoint source pollution and to comply with NPDES Phase II regulations and the TMDL for sediment and nitrates in the San Lorenzo River watershed, the quality of runoff from the watershed should improve over current conditions. However, because of the existing water quality problems in the San Lorenzo River, the cumulative impact of development on water quality in the watershed would be significant. The 58 acres on campus that could be developed under the 2005 LRDP would be a very small portion of the of the 74,000 acre watershed. Furthermore, the Campus would implement LRDP Mitigation HYD-2A and 2B, and LRDP Mitigation HYD-3A through HYD-3D to minimize water quality impacts. Therefore, the contribution of development under the 2005 LRDP to this cumulative impact would not be cumulatively considerable. The proposed project site, which is 3.1 acres in size, is well within the development analyzed in the 2005 LRDP EIR and, furthermore, would project would implement all applicable LRDP EIR mitigation measures. Therefore, the proposed project would not make a cumulatively considerable contribution to cumulative impacts on the San Lorenzo watershed.

The project would result in increased flows to Jordan Gulch. Other projects contributing runoff to Jordan Gulch are the Cowell Student Health Center Expansion and Renovation Project (CSHC Project), which is currently under construction, and the Chinquapin Sidewalk Project, which is planned for construction in the spring and summer of 2009. The Chinquapin Sidewalk Project could result in increased storm water runoff in the east fork of Jordan Gulch watershed. However, the additional runoff from the Chinquapin Sidewalk Project will be dissipated by level spreaders in relatively level areas above the channel, which would allow the runoff to infiltrate into the ground. The CSHC Project will result in an increase in the volume of runoff to a storm drain pipe that discharges to the main stem of Jordan Gulch below Quarry Plaza. However, that project also will provide detention for runoff from a portion of the existing health center building, and this will result in a net decrease in peak flows to Jordan Gulch. In addition, a portion of the storm water flow from the CSHC storm drain pipe will be diverted to the Upper Quarry sinkhole as part of the previously-approved Infrastructure Improvements Projects Phase 1. Therefore, the Chinquapin Sidewalk and CSHC projects would not result in increased flows in Jordan Gulch and the cumulative impact would be less than significant.

3.8.4 References

Aley, T., and Weber & Associates. 1994. Results of a Groundwater Tracing Study – UC Santa Cruz. January 21.

Bloom, Arthur L. 1978. Geomorphology – A Systemic Analysis of Late Cenozoic Landforms, published by Prentice-Hall, Inc., Inglewood Cliffs, New Jersey.

Blunk, D., UC Santa Cruz Environmental Health and Safety. 2009. Personal communication with Alisa Klaus, UC Santa Cruz Physical Planning and Construction. February 6.

Bowman & Williams, 1995. Pogonip Storm Drainage Study for City of Santa Cruz, County of Santa Cruz and University of California, Santa Cruz. November 21.

H. T. Harvey & Associates. 2008. Wildlife Surveys and Waters of the U.S. Assessment. U.C. Santa Cruz East Campus Infill Housing, Chinquapin Road Parking Lot, and Chinquapin Road Widening Projects. On file, UC Santa Cruz Physical Planning and Construction. December.

Johnson, N.M., Weber & Associates, Evaluation of Groundwater Resources at UCSC, Parts I and II, March 1989.

Kennedy/Jenks Consultants. 2004. *Stormwater & Drainage Master Plan.* September.

Pacific Crest Engineering, Inc., 2008a. Preliminary Geotechnical and Geologic Feasibility Study for Crown/Merrill Apartments, University of California Santa Cruz. July.

Pacific Crest Engineering, Inc., 2008b. Geotechnical Investigation for East Campus Infill Housing. November.

Santa Clara Urban Runoff Pollution Prevention Program. 2005. Hydromodification Plan, Final Report.

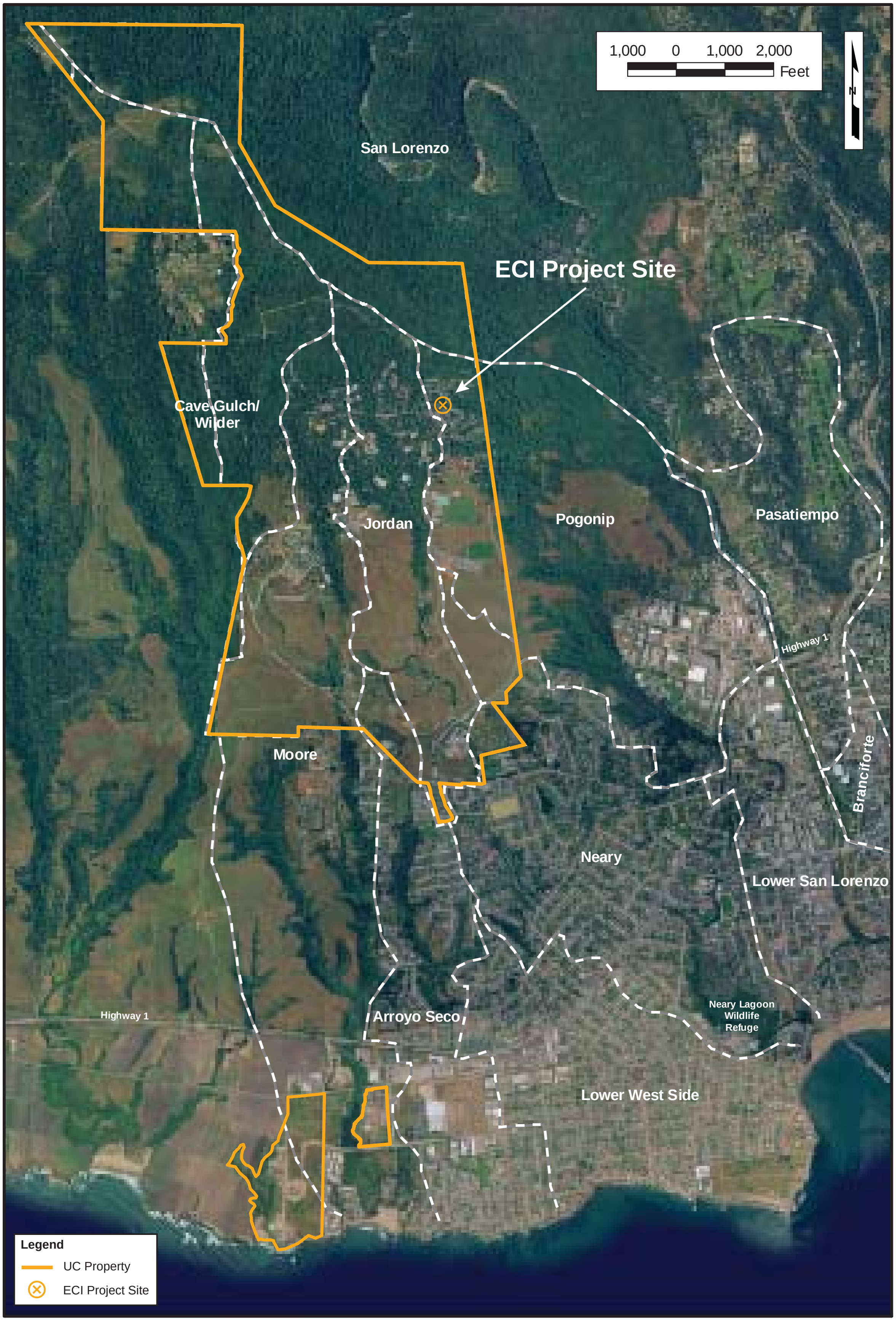
UC Santa Cruz 2008. Final Draft Storm Water Management Plan.

URS Corporation. 2008. Summary of Hydrogeologic Water Balance and the Influence of Projected Groundwater Pumping at the University of California, Santa Cruz Campus. March.

USDA Soil Conservation Service (SCS; now Natural Resources Conservation Service). 1975. Technical report 55: *Urban Hydrology for Small Watersheds.*

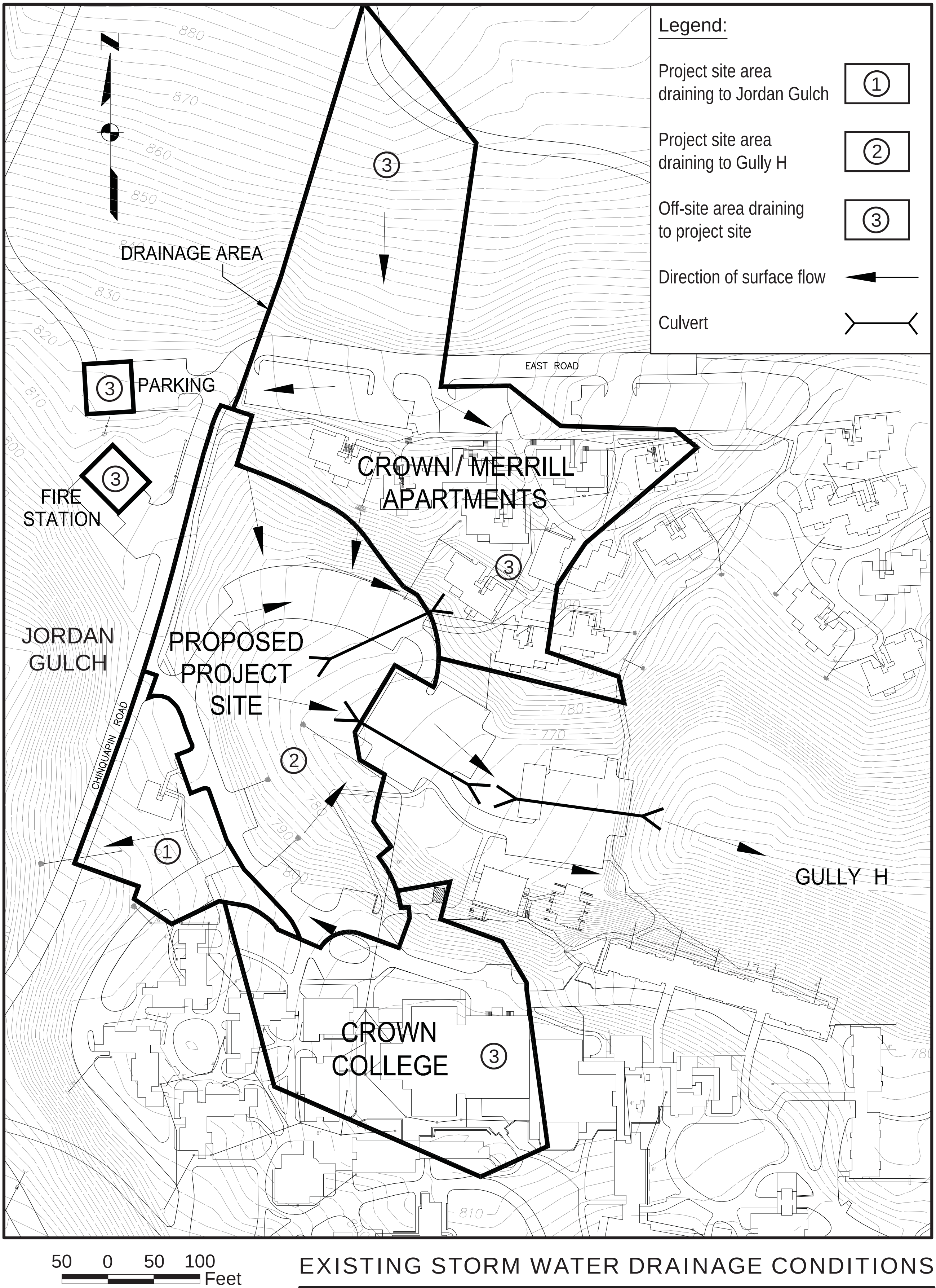
U.S. EPA. 1999. Storm Water Technology Fact Sheet, Bioretention. EPA 832-F-99-012.

Weber Hayes & Associates. 2007. 72-Hour Constant-Rate Well Pumping and Aquifer Recovery Test and Pumping Impact Assessment for UCSC Well #1 (WSW#1). December 7.



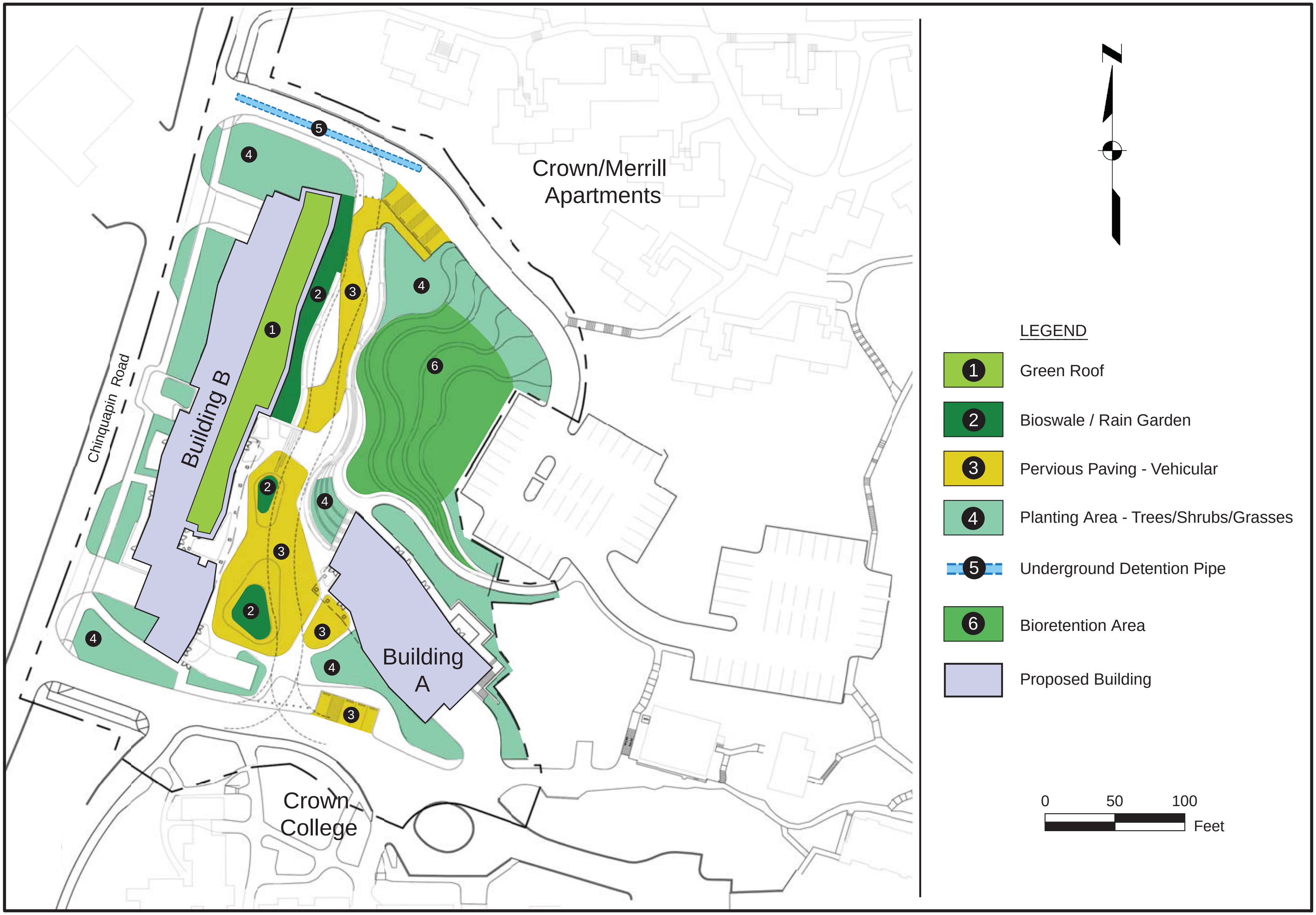
WATERSHEDS IN THE GREATER VICINITY OF THE UC SANTA CRUZ CAMPUS

FIGURE 3.8-1



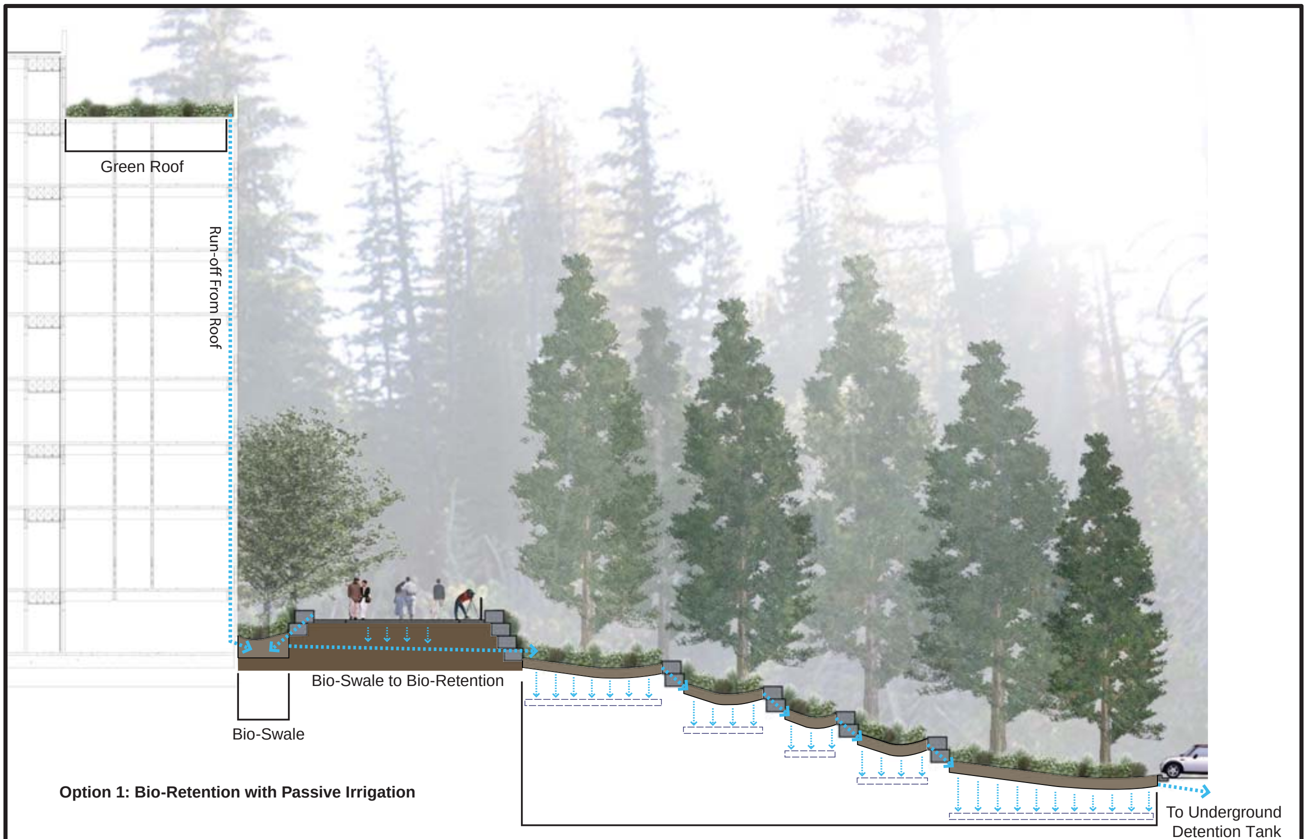
EXISTING STORM WATER DRAINAGE CONDITIONS

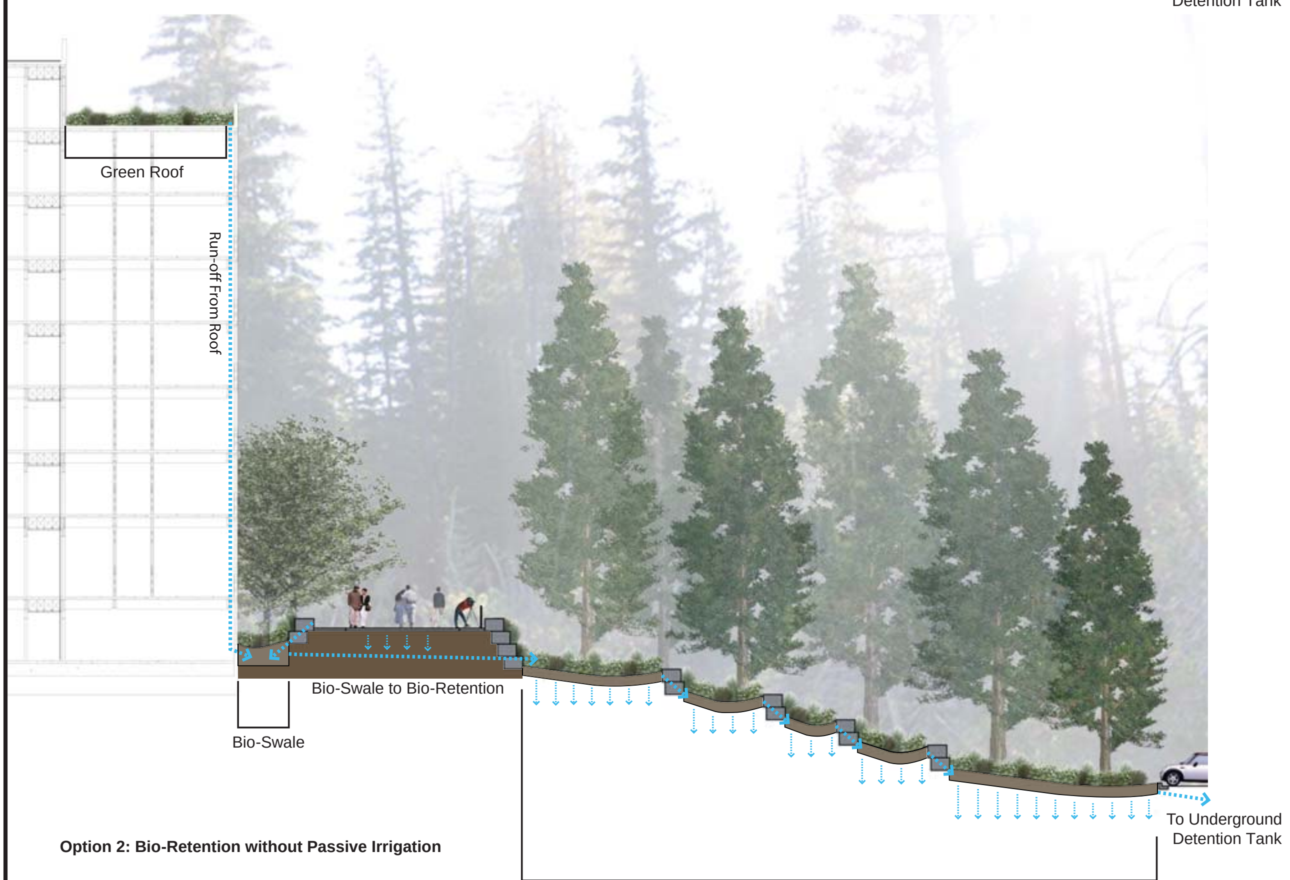
FIGURE 3.8-2



PROPOSED STORM WATER MANAGEMENT FEATURES

FIGURE 3.8-3





PROPOSED STORM WATER SYSTEM, SECTIONS

UC Santa Cruz — East Campus Infill Housing Project EIR, Santa Cruz, California — March 2009

FIGURE 3.8-4