ARCHAEOLOGICAL SURVEY OF 1121 MOANA DRIVE, SAN DIEGO, CALIFORNIA

March 23, 2017

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Certification

The information provided in this report is the result of Legacy 106, Inc,'s research and our authorship is correct to the best of our knowledge. We prepared this report in accordance with the California Environmental Quality Act and the *Archaeological Resource Management Reports (ARMR): Recommended Contents and Forma, February 1990.*

_______________________________ Date March 30, 2017

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NATIONAL ARCHAEOLOGICAL DATABASE INFORMATION

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Prepared for:

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U.S.G.S. Quadrangle: San Diego

Address of Site: 1121 Moana Drive, San Diego, CA 92107

Acreage: 0.1435 (6,250 sq. ft.)

Keywords: San Diego, Archaeology Survey

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APPENDIX b Confidential Appendix. Loveless & Linton Report. This information is to be provided to the City of San Diego, but is exempt from the Public Information Act and cannot be accessed for public viewing.

LIST OF ACRONYMS

APE Area of Potential Effect

ARMR Archaeological Resource Management Reports

CEQA California Environmental Quality Act

CHRIS California Historical Resources Information System

DPR Department of Parks and Recreation

SHPO State Historic Preservation Office

USGS United States Geological Survey

EXECUTIVE SUMMARY

Benjamin Dahlin retained Ronald V. May, RPA, Legacy 106, Inc. to conduct an archaeological survey of 1121 Moana Drive, San Diego, CA 92107. The objective of this survey was to determine if any archaeological resources are present on the project site and to report on said resources following the ARMR format. Dahlin also retained Loveless & Linton to conduct research into Sacred Lands Issues.

Limited historical research revealed this property is a 0.1435 (6,250 sq. ft.) lot in Rosecrans Park, which the County of San Diego recorded on October 6, 1911. Preliminary research did not reveal uses for this lot prior to the present and no Sanborn Fire Insurance Maps were created for Rosecrans Park, so no record could be found at this time to determine if a house once existed on the property.

The field survey found the ground to be uneven with a shallow depression near the center and a broad scatter of broken cement, wall plaster, English standard brick fragments, and a pink bath tile suggestive of either on-site building demolition or illegal dumpage of demolition debris. One heavy cast steel manhole cover might also be waste dumpage or the lid to an old cistern or cesspool. Automotive oil soaked soil near the concrete alley and automotive parts debris suggests parking of automobiles long ago. A scatter of saw-cut rib bones along the north boundary suggests neighbors discarded BBQ waste along that fence line.

Although no prehistoric archaeological soil, artifacts, or associated marine shell were observed, fossil rootlets and *Ostrea* fragments in association with natural limonite balls could be found on exposed natural soil along the south property line. Examination of the depressed areas suggests old excavation, which also did not reveal prehistoric archaeological soil. The proximity of the fossil rootlets to the *Ostrea* fragments supports the hypothesis that these shells are ancient marine fossils, as would be found in the Bay Point and Rosario Formation natural soils.

In conclusion, the surface debris may indicate a house once stood and was later demolished on the property. Depending on the age of said resource, buried historic archaeological features might be under the existing surface (artifact deposits, privy fill, old foundations, cisterns, etc.) Similar historic deposits have been found buried at a number of addresses within the nearby Riviera Shores and other neighborhoods (Santa Barbara Drive, for example), as discussed elsewhere in this report. For these reasons, earth disturbance monitoring is recommended for grading or other earth disturbance activities, and historical research conducted to assist in evaluating discovered resources for scientific value.

Loveless & Linton conducted Sacred Lands research with the Native American Heritage Commission and all relevant Native American representatives. No issues were identified in this study and the results have been conveyed to Myra Herrmannn, Senior Planner, CEQA Division, Development Services Department, City of San Diego.

1.0 **INTRODUCTION**

1.1 Project Location

The project is located at 1121 Moana Drive in the Point Loma area of San Diego. The legal description is Lot 15, Block 2, Map 1378, Rosecrans Park. The County of San Diego approved the subdivision of Pueblo Lot 191 on October 6, 1911. This subdivision created Point Loma Avenue, Moana Drive, La Paloma, Varona, and Renaud Street. The Tax Assessor Map records the lot as 530-10-00.

1.2 Project Description

There is no proposed project at this time. However, the likely outcome of this study will be to satisfy a City of San Diego building permit review and that will lead to earth disturbance grading to level the lot in preparation for geo-soils testing, trenching for foundation stemwalls, building pads, walkways, vehicular access, undergrounding of utilities, and excavation for yard landscaping. Other possible earth disturbance might include recreational pool excavation.

1.3 Existing Conditions

1.3.1 Environmental Setting

There is no natural landscape, as the surface has been disrupted by various 20th century earth disturbing activities. In the not so distant past, trees and other ornamental vegetation had been removed. Prior to 1911, and based on what exists south of Point Loma Nazarene College, Coastal Sage Scrub habitat grew in the native Bay Point and Rosario Formation soils. These soils remain on the property.

Cultural Setting. The project is within one mile of recorded Archaic prehistoric sites, historic buildings, and buried historic deposits. No known prehistoric sites have been reported along the high elevations within this one mile Area of Potential Effect (APE). There are no water resources (springs, drainages, ponds) to support a prehistoric population, although walking trails and temporary camps might be expected in the higher elevations. All the recorded prehistoric camps were found on lower elevations closer to the Pacific Ocean or San Diego Bay.

Over the past 12,000 years, the ocean level has risen at least 400-feet in elevation and this has destroyed inundated archaeology sites. This sea level rise has caused massive land sliding around Point Loma, creating the nearly vertical bluffs now named Sunset Cliffs. What then served as inland archaeology sites between 12,000 and 5,000 years ago are now found on the remnant coastline, exposed by landslides and massive erosion.

Point Loma lacks sufficient natural springs to support large residential communities, but small horticultural and coastal complexes developed along the natural drainages inside San Diego Bay as early as 1796, when the Spanish Army erected "Fort Guijarros" to defend the harbor from pirates, smugglers and foreign incursions. One ship to shore cannon engagement in 1803 between American smugglers and the Spanish Army justified the fort construction down on Ballast Point. A ship to shore battle between other American smugglers and the Mexican Army in 1830 reinforced the need for a military presence. Along San Diego Bay were small clusters of fishing families, whale hunters, and merchants engaged in commercial enterprises, especially after Mexico opened San Diego to foreign trade in 1822.

Sometime in the 1840s, agriculturalists began removing Coastal Sage Scrub habitat from the uplands of Point Loma and planting rain dependent crops. Although next to nothing is known of these operations, the closest likely market for their products would have been the Mexican Customs port community of La Playa (located down near Rosecrans Street and the Navy gate). Early diaries and unofficial records document dry farming where Catalina, Canon, Jennings, and Silvergate are located today. No historic archaeological bottles, ceramics, or other datable artifacts from the pre-1850 time period have yet to be found (or reported) in the upper highlands of Point Loma.

Following the Mexican War of 1846-1848, the United States ratified California as a State in the Union in 1850 and began dividing the land around the official San Diego Pueblo in that year. Several private citizens presented the federal Lands Commission with a map documenting about fifty square miles of land they declared to be the "Pueblo of San Diego." The Lands Commission adopted a version of the map, but sent a Lands Commission out to investigate the more spurious claims to most of the un-mapped lands beyond the alleged pueblo. The State of California assigned a "Common Council" to create a land subdivision system for selling off the former Mexican lands to create a revenue stream to operate state and local governments. The Common Council hired land surveyors to create enormous tracts of land for the land auctions. Pueblo Land auctions became the primary amusement for the small Charter City from 1850 through the end of the 19th century. Much of Point Loma shifted from U.S. Patent Lands to private ownership during that time frame. The larger Pueblo Lots were then subdivided by auction buyers and the smaller pieces later re-subdivided for housing projects. Little record exists for who owned or used those upland properties in the decades leading up to 1910.

Land speculators acquired the large Pueblo Lot tracts during the Land Boom of 1885 through 1887. Subdivisions such as "Irontown" (near Canon and Rosecrans) and various Rosecrans additions were created on paper, but never saw the breaking of ground for streets or public utilities. One such small subdivision of a portion of Pueblo Lot 191 created Tract 1378, Rosecrans Park on October 6, 1911. That map recorded two blocks of twenty-four lots, bounded by Paloma on the north, Moana on the west, Point Loma Avenue on the east, and Varona Street on the south. No explanation is offered for the naming of the streets. The Union Title and Trust Company is the only listed owner. The Tax Assessor's real estate records are silent on what existed on the property before 1971 and further research would require deep historical research into title records, City Directory, and Property Tax records.

1.3.2 Background Research

As a Phase 1 survey, the only background research required for this project is to learn what exists at the South Coast Information Center (SCIC) and use that information to evaluate the potential for archaeological findings on this property. The scientific methodology of using other researchers work for this purpose has only been developed after 1945.

As scientific inquiry improved following World War 2, refinements in mapping, recovery, and statistical analysis of evidence changed dramatically. Systematized record keeping systems were developed by the University of California that are now used state-wide with the local center at San Diego State University. Cooperative research among scientists include formal publication of books and articles to help advance research questions among scholars. State of the art storage and research facilities enable scientists to examine older collections to understand their findings. But the first step is always to conduct an intuitional record search of all that is known in an area in order to predict what might be found and to know what is important and what is not.

Previous Research. The earliest archaeology scholar to pass through the Point Loma area was a University of California, Berkeley student in the early years following 1900 and he only recorded large shell mounds around the edge of San Diego Bay. The first true scientific archaeologist, Malcolm J. Rogers, arrived as engineering geologist and accepted a post with the San Diego Museum of Man to record a broader range of prehistoric archaeology sites on various landforms throughout Southern California, southern Arizona, and northern Baja California (1936). Few other scholars contributed to the body of knowledge in the area until after 1945, when the University of California, Los Angeles sent graduate students down to visit deep trenches Rogers opened at the C.W. Harris Site on the San Dieguito River. Based on Rogers' artifact samples, examination of the geology, and their own testing, those students published a series of key articles that refined scientific understanding. Carl Hubbs, Ph.D., ichthyologist from Scripps Institute of Oceanography and geographers began studying lines of evidence for widespread rainfall, temperature, landscape, and coastal marine resource changes over the past 5,000 years. The University of California, San Diego provided a radiocarbon dating laboratory at Scripps that enabled huge changes of thinking about those temporal and geographic changes, which undoubtedly affected land use decisions of prehistoric people. To understand what might be found at 1121 Moana, one must understand what these scientists, as well as scholars following their work, learned.

Rogers (1936) noted the appearance of deep dark ashy soil mixed with broken rocks, marine shell, bone tools, carved shell and stone beads, and rare fragments of charred basket textiles along the edge of coastal cliffs and estuarine terraces. These ashy soil deposits were often buried by erosive soils washed down from disturbed ancient marine soils between occupational episodes, some as deep as five meters. Marine scientists at Scripps used various techniques to determine the Pacific Ocean has risen approximately 400 feet in elevation over the past 5,000 years, flooding over and causing massive erosion of the ever retreating shoreline. We now know the shoreline when the first humans arrived is at least two miles off shore from Point Loma of today. Most of those archaeological resources were destroyed by pounding surf, erosion, and the movement of coastal sediments, leaving only the heaviest artifacts to be found by modern divers today.

As the ocean rose and undermined what had been coastal foothills, landslides created very steep bluffs in locations like La Jolla, Torrey Pines, Del Mar, Solana Beach, and Encinitas. Contemporary archaeologists in the 1960s through 2000s have attempted to study some of those sites before housing development, freeway expansion, and other earth disturbing projects eliminated scientific study. Those contributions are now documented in reports curated at the South Coast Information Center, San Diego State University. Samples recovered by archaeologists, such as stone artifacts, food shell and food bones, plant phytoliths, pollens, blood residue, proteins, stone tools, and historic artifacts were recovered for other scientists and scholars to study now that most of the prehistoric sites are gone forever. Today, most of those collections are curated at the San Diego Archaeological Center at San Pasqual.

The purpose of these collections is for the artifacts to be examined as elements in developing a scientific research context to measure levels of importance. For this study, those collections would be used to meaningfully understand how much in quantity of artifacts, food remains, and other materials would be necessary for a new discovery to contribute to an important on-going research problem.

The following is a review of the SCIC record search for cultural records within the one mile radius of the Area of Potential Effect (APE):

CA-SDI-50. Update. Robert Case evaluated an historic deposit at 390 San Antonio Avenue. Report P37-0000050.

CA-SDI-51. Update. Andrew Pigniolo evaluated a trench through 992 Scott Street and recovered marine shell, fire affected rock, and one core tool.

CA-SDI-10531H. Sue Wade evaluated a portion of the 1897-1942 Universal Brotherhood and Theosophical Society historic deposit.

CA-SDI-P-37-0011784. Isabella Cordova and Annabelle Cox examined a 1942-1945 era historic deposit from the United States Army camp at the Theosophical Society campus.

CA-SDI-11912H. Andrew Pigniolo and Steven H. Briggs examined a small prehistoric campsite exposed by landslide erosion of the cliffs at Sunset and Osprey Street. Also associated were concrete footings from the 1916 Albert Spaulding Sunset Cliffs Park.

CA-SDI-11913H. Andrew Pigniolo and Steven H. Briggs examined a cobblestone and concrete footing that survived from the 1916 Albert Spaulding Sunset Cliffs Park.

CA-SDI-1191H (report P37-011914). Andrew Pigniolo and Steven H. Briggs recorded one isolated prehistoric stone tool.

CA-SDI-11915H. Andrew Pigniolo and Steven H. Briggs examined one historic archaeological deposit.

CA-SDI-11915. Andrew Pigniolo and Steven H. Briggs examined prehistoric fire cooking pits exposed by a collapsed cliff face.

CA-P-37-0011917. Isabella Cordova and Annamarie Cox recorded a prehistoric campsite.

CA-P-37-011918. Isabella Cordova and Annamarie Cox recorded a prehistoric flaked stone workshop.

CA-SDI-11919. Jillian L. Hahnlen recorded a buried historic deposit with artifacts spanning 1921 to 1964 in age.

CA-SDI-11920. Andrew Pigniolo and Steven H. Briggs examined a cluster of prehistoric fire hearth features.

CA-SDI-11921. Andrew Pigniolo and Steven H. Briggs examined a prehistoric camp with fire affected rock hearths, flaked stone, flaked cores, and burned food bone.

CA-P-37-011922. Isabella Cordova and Annamarie Cox re-examined a Craftsman style house first recorded in 2003 and again by them in 2014. This building contributed to understanding the Universal Brotherhood and Theosophical Society campus.

CA-SDI-13075H. Ruth D. Schultz and Mary Robbins-Wade monitored the demolition of the 1917 student building at the Universal Brotherhood and Theosophical Society campus.

CA-P-37-015104. Andrew Pigniolo examined and recorded a single stone flake.

CA-P-37-016217. Carolyn S. Kyle, Roxanne Phillips, and Dennis Gallegos reported a prehistoric shell feature.

CA-P-37-016218. Carolyn S. Kyle and Dennis Gallegos recorded a prehistoric shell feature.

CA-P-37-016549. No authors were recorded for a record of 4519 Bermuda Avenue.

CA-P-37-016660. No authors were recorded for a record of two houses at 924 Scott Street.

CA-P-37-017161. No authors were recorded for a record of a house at 3765 Pio Pico Street.

CA-P-37-017161. No authors were recorded for a record of a house at 4733 Pescadero Street.

CA-P-37-023864. No authors were listed for a record of a 1920s historic archaeology deposit at 4714 Bermuda in Point Loma.

CA-P-37-023874. No authors were listed for a record of a 1890-1910 historic archaeology deposit in a trench.

CA-P-37-024617 (CA-SDI-16301). No authors were recorded for a record of a prehistoric campsite in Sunset Cliffs City Park.

CA-P-37-024618. Isabel Cordova recorded a historic deposit associated with the Universal Brotherhood and Theosophical Society.

CA-P-37-024859 (CA-SDI-16,774). Robert Case recorded an historic deposit with no geographical or other reference information.

CA-P-37-025283 (CA-SDI-16775). Robert Case recorded a prehistoric fire hearth that radiocarbon dated at 3,010 years before present along Novara Street, between Piedmont and Devonshire.

CA-P-37-025284 (CA-SDI-17395). George Carter recorded this site as SDM-W-3410 and later J.J. Mitchell re-recorded the site as a prehistoric campsite with flaked stone tools associated with a fire hearth.

CA-P-37-027683 (CA-SDI-17978). Ron Self and R. Smith recorded this prehistoric shell deposit at 821 Rosecrans Street.

CA-SDI-P-37-027750 (CA-SDI-018013). Andrew Pigniolo recorded a prehistoric shell deposit associated with fire hearths at 1023 Cordova Street.

CA-P-37-029025. An unknown author reported the "OB beach cottages" (Ocean Beach) as dating between 1887 and 1931.

CA-P-37-030580. Scott Moomjian reported Master Architect Wayne McAllister designed 2069 Santa Barbara Drive.

CA-P-37-031093 (CA-SDI-19719). Liz Davidson recorded a buried historic archaeology deposit at 965 Cordova (4485 Hill Street).

CA-P-37-031094 (CA-SDI-19720). Liz Davidson recorded a buried prehistoric archaeology camp at 1007 Cordova.

CA-P-37-031808. Jennifer Kraft and Brian Smith recorded a buried 1915 to 1950s historic deposit in a utility trench at Osprey and Alexandria.

CA-P-37-031809. Jennifer Kraft recorded a buried 1880s to 1920s historic deposit in a utility trench at Calaveras Drive.

CA-P-37-032117 (CA-SDI-20351). Jennifer Kraft reported a circa 1900 to 1950s historic deposit buried underneath a demolished concrete garage deck at 4512 Monaco Street in Azure Vista (south of Hill Street).

CA-P-37-032124 (CA-SDI-20356). An unidentified practitioner reported a buried circa 1914 to 1945 historic deposit in a utility trench extending from 3445 Garrison Street to 1141 Clove Street.

CA-P-37-032125 (CA-SDI-20357/ SDMM-W-3410). Carol Serr and Dimitra Salavaris-Chase reported a circa 1945 historic deposit in front of 1402 Willow Street and a buried prehistoric campsite in a trench in front of Ladera and Cornish Streets.

Reports in the APE.

Bonner, Wayne H., Marnie Aislin-Kay, Sarah A. Williams, 2007, Cultural Resource Record Search and Site Visit Results for T-Mobile Facility Candidate SDO7496A, Narragansett ROV, Intersection of North Catalina, San Diego, San Diego County, SD-11908. (sixty-four historic properties within one mile of the project site).

Bouden-Renna, Cheryl, 2010, Letter Report: eTS 20882-Cultural Resource Monitoring for Boring and Trenching for Cathodic Station No. 366, Monaco Street, Sunset Cliffs, San Diego County, California. SD-14171. (negative survey)

Brandes, Raymond and Scott Moomjian, 1998, 739 Golden Park Avenue, SD-11345.

Caterino, David, 2005, The Cemeteries and Gravestones of San Diego County: An Archaeological Study. MA Thesis: San Diego State University. SD-09516.

Courtney, Michelle G. and Tracey A. Stropes, 2014, Cultural Resource Monitoring Report for the Water Group 914 Project No. 233447. SD-14977. (negative survey)

Crawford, Kathleen A., 2012, DPR 523, Edward and Aldena Silva Residence, Sim Bruce Richards Residence, 560 San Gorgonio, San Diego. SD-13920. (singe residence study)

Giletti, Andrew and Mary Robbins-Wade, 2008, Archaeological Resource Inventory: Lerner and Gruber Residences, Point Loma, San Diego, Project No. 140246. SD-11697 (east Catalina, south Talbot, north Jennings, east of Loma Valley).

Furlonger, Jaye E., 2009, Nomination for the State of California, Register of Historical Resources, The Robert O. Peterson-Russell Forester Residence, 567 Gage Lane, San Diego, CA. SD 12280. (single residence study).

Hector, Susan, 2003, Historical Resources Impact Assessment for Sunset Cliffs Natural Park.

Kyle, Carolyn, Roxanne Phillips, and Dennis Gallegos, 1998, Cultural Resource Constraint Study for the North Bay Redevelopment Project, City of San Diego, SD-03461 (1,500 acres in the Midway/Pacific Highway, Old Town, Peninsula, Clairemont Mesa, Uptown, and Linda Vista area). This study recorded twelve significant and eighty-seven potentially significant historic or prehistoric properties.

May, Ronald V., Dale Ballou May, and Kiley Wallace, 2011, Historical Nomination of the Malin Burnham House, 535 San Gorgonio Street, Point Loma Neighborhood. SD-13861. (single residence study).

May, Ronald V., Dale Ballou May, and Kiley Wallace, 2011, Historical Nomination of the Ben and Freida Kaplan House, 1226 Concord Street, Point Loma, San Diego, CA 92106. SD-13621. (single residence study)

May, Ronald V. and Kiley Wallace, 2013, Historical Nomination of the Lewis H. and Annie B. Dodge Speculation House, 4545 Alhambra Street, Sunset Cliffs Neighborhood, San Diego, California. (single residence study).

May, Vonn Marie, 2012, The Frank Hope, Jr. House, Circa 1967, 3430 Bangor Place, San Diego, CA, 92106. SD-13939. (single residence study).

May, Vonn Marie, 2011, The Edmund and Elise Herman, Russell Forester House. SD-13364. (single residence study).

McGeorge, Heather and Brian F. Smith, 2012, Archaeological Monitoring Report for the Babicky Residence Project, Ocean Beach, CA, LDR#40-0614. SD-14121 (negative survey).

Moomjian, Scott, 2006, Department of Parks and Recreation 523 Form, Sim Bruce Richards and Janet Hopkins Richards House, 3360 Harbor View Drive. SD-12515 (single residence study).

Moomjian, Scott, 2007, Historic Assessment of the Harry and Meta Pollack/I.M. Laddon/Wayne McAllister House, 1068 Santa Barbara Street. SD-12173. (historical designation of this address).

Moomjian, Scott, 2008, Historic Assessment of the Doris Helen Torvea House, 1010 Leroy Street, San Diego, CA 92106. SD-12712. (single residence study).

Moomjian, Scott, 2009, Historical Assessment of the John Steven McGroaty, Harry and Edna Collins House, 1004 Devonshire Drive, San Diego, CA 92106. SD-13937. (single residence study).

Moomjian, Scott, 2012, Historical Resources Report for the W. Wesley and Hazel Hummon House, 1031 Alexandria Drive, San Diego, CA 92107. SD-13937. (single residence study)

Moomjian, Scott, 2013, Historic Resources Research Report for the David and Beverly Reed House, 1541 Gunnison Place. SD-14371. (historical designation for this address)

Moomjian, Scott, 2013, Historic Resources Technical Report for the 4515 Ladera Street Residence, San Diego, CA 92107. SD-14494. (historical designation for this address)

Reddy, Seetha, 2007, A Programmatic Approach for National Register Eligibility Determinations of Prehistoric Sites within the Southern Coast Archaeology Region, California. Department of Defense Legacy Resource Management Program. SD-11460 (Naval Base Point Loma)

Shannon, Loftus, 2012, Cultural Resource Record Search and Site Survey for AT&T Site SD0615, All Souls Church, LTE, 1455 Catalina. SD-14436. (historical eligibility study for this address)

Steigler, Ione, 2013, Revised Single Discipline Preliminary Review and Potential Historical Resource Review for 579 San Elijo Street. SD-14222. (single address study)

Wade, Susan, Steve Van Wormer, Dayle Cheever, 1998, Historic Resource Inventory for North City Water Reclamation Facilities, Clean Water Program for Greater San Diego, SD-08852. (140 acres and 27.5 miles of utility line site studies in the area north of Highway 52. This survey recorded fifteen prehistoric sites, nine historic sites, one historic "area," and concluded there would be no impacts to thirteen of those sites.)

In summary, archaeologists recorded twenty prehistoric archaeology sites and thirteen historic archaeology sites within one mile of the project site. Another ten historical buildings were recorded and evaluated for architectural significance.

The significant prehistoric archaeology sites/features were primarily located in lower elevations around Sunset Cliffs City Park, Cordova Street and Sunset Cliffs Boulevard, or along Rosecrans (bay side of Point Loma). House construction covered or obliterated most of the prehistoric archaeology sites in the upper elevations.

However, between 1887 and 1964, residents in Point Loma buried historic deposits of artifacts that later proved to yield scientifically significant data as contributors to understanding important periods of San Diego history. These deposits most likely happened before the City of San Diego established vehicular trash truck pickups to be deposited in the City Dump over near the San Diego River and Midway area in the 1920s. However, hard economic times during the Great Depression of the 1930s reduced or eliminated public trash pickup in Point Loma, causing local people to deposit historical debris in canyons or in buried pits. During that period, people were encouraged to erect fire pits to burn organic waste and then bury the remains. These latter waste disposal behaviors account for the trash and bottle deposits recorded by archaeologists monitoring utility trenching machine routes along Alexandria and Santa Barbara Drive in recent years.

These nearest historic deposits mostly date to the 1930s-1940s, based on bottle and ceramic analysis. The presence of buried historic deposits in the neighborhood suggests people along Moana Street might have taken advantage of a vacant lot to bury or disperse their historic refuse materials. This would account for the construction waste, saw-cut food bone, automobile parts, and bottle glass observed on the surface of the lot at 1121 Moana.

1.4 Applicable Regulations.

City of San Diego Significance Determination Thresholds. The City of San Diego created threshold criteria to define what is or is not significant. The APE was evaluated under the guidelines defined in the City of San Diego Significance Determination Thresholds and Historical Resources Guidelines in sections 1.4 (Applicable Regulations) and 2.0(Guidelines for Determining Significance).

The field survey did not find any buried archaeology or surface features and the surface artifacts lack distinguishing characteristics that can be dated. There is no record of archaeology on this property. And Loveless and Linton did not find evidence for surface or buried archaeology. This report fulfills the requirements of the City of San Diego Municipal Code and California Environmental Quality Act for the City of San Diego review of building and underground permits at 1121 Moana.

Loveless & Linton conducted the requisite research with the Native American Heritage Commission, which informed them of the contacts for the designated tribal representatives in this area of California. These entities were contacted and no sensitive issues or Sacred Lands were identified, but several stated the potential for buried materials is sufficient they request a Native American Observer be present to monitor earth disturbing activities. They also explained their findings to the City of San Diego.

2.0 GUIDELINES FOR DETERMINING SIGNIFICANCE

Section 16064 of the California Public Resources Code explains in detail how archaeological resources are determined significant or not significant through testing the data created by measuring the site contents against one or more scientific questions. At the most basic level of testing, the site must contain enough artifacts to constitute a feature that "tells a story." This could be a cluster of artifacts that help understand site function, a concentration of marine shell or animal bone that can be used to study prehistoric eating practices, a pattern of artifacts that contribute to understanding human culture, or artifacts that contain microscopic plant pollens, proteins, or other materials from the prehistoric time in which artifacts were used on the site. The challenge is to envision how those items can be used to further scientific research.

3.0 ANALYSIS OF PROJECT EFFECTS

3.1 Methods

The field strategy involved walking and inspecting exposed natural earth around the property edge and then zig-zagging across the lot. Although some objects were lifted for examination, all were dropped back on the lot and nothing was dug out or removed from embedded locations.

3.2 Results

The field surveyor first examined the property edges to determine the presence or absence of human occupation or historic modification of the lot. The landform has been heavily disturbed with depressions that appear approximately twenty-five feet back from the sidewalk along Moana and about ten feet away from the north and south property boundaries with developed neighboring lots.

The surface of the lot is uneven. The fragments of construction debris associated with the depression might indicate a demolished building site. Closer to the concrete alley at the eastern rear of the lot are patches of dark oily soil associated with broken automotive parts that suggest parked automobiles. Various ornamental trees have been removed and some cut logs remain around the property. Weed-whipped vegetation and leaf mold obscures view of most of the surface soil.

Small elevated natural soil mounds close to the south property boundary reveal a yellowish-red ferrous-stained, poorly sorted, marine sediment mixed with natural, irregular shaped, limonite concretions, root fossil fragments, and scraps of fossilized *Ostrea* marine shell. Careful examination of this soil exposure revealed twelve tiny scraps of fossil shell mixed with plaster and concrete fragments. Geologist Michael Kennedy describes this soil as a mix of Bay Point Formation and Rosario Formation marine fossiliferous sandstone (1975). These materials occur naturally along the high points of Point Loma. The depressions on the lot expose more of the light gray, fine, evenly sorted, sandstone and mudstone. Roy H. Bowman also described these natural soils in the 1973 *Soil Survey, San Diego Area, Part I*, United States Department of Agriculture reports.

As noted, the center of the lot is characterized by a 12"-18" deep depression that gently rises upward to the south and north property edges. Construction debris includes one broken pink-glazed bath tile that lacks adhesive and may have been a construction discard. Nearby is a partly buried cement waste pour that has been covered by erosive soils. Between the depression and the Moana Street sidewalk is a partly buried cast steel manhole plate that was not explored to determine if it is attached to a cistern or other construction. Along the north edge of the property are saw-cut domestic animal rib bones that litter the surface, none of which were buried and some lay on top of leaf litter.

Datable objects that were observed, but not recovered, include the side of an emerald green bottle wall, automobile parts, the pink glazed tile, and construction debris. All these objects suggest a post 1930 time-frame.

4.0 INTERPRETATION OF IMPORTANCE AND IMPACT IDENTIFICATION

No archaeological features or isolate resources were observed on the surface of the lot at 1121 Moana. No testing was performed within the APE and is not recommended. The lack of findings prohibits this initial study to evaluate for significance to anything on or within this property or say with confidence that the APE is void of any and all “Important archaeological sites” as defined in the San Diego Municipal Code Chapter 11: Land Development Procedures Article 3 Division 1, page 11. However, depressions on the lot suggest either a building once existed or some large objects have been removed that created pits, which rainwater softened over time. A large cast steel manhole cover might conceal the opening to a cistern, water well, or could be refuse dumped on the lot. Also, reports at the South Coast Information Center indicate a potential for buried, non Native American,1930s-1940s historic archaeology deposits on the lot. At this point in time, insufficient data exists on the surface of the lot to determine if there are buried archaeological deposits on the property.

5.0 MANAGEMENT CONSIDERATIONS

Although no prehistoric or historic archaeological features were observed and the project does not exceed the City of San Diego Development Services Department’s Significance Threshold, the close proximity of the APE to known cultural and historical resources and the evidence of prior development mentioned in section 4.0 above, suggests that there remains a possibility for buried historical deposits dating from the 1930s-1940s and Native American resources. In order to reduce potential negative impacts to any and all unknown resources to remain at a level of less than significant, monitoring is recommended, Three Native American representatives from IIpay Nation of Santa Ysabel, Jamul Indian Village, and the San Pasqual Band of Mission Indians requested Native American monitoring of earth disturbing activities. We recommend construction monitoring by an archaeologist and a Native American observer as a condition of the earth disturbing activities. Should something be observed during monitoring, the City of San Diego would be notified to develop a plan for scientific recovery, evaluation, curation of significant materials, and a report to mitigate the impacts to archaeology to below a level of significance or negotiated with the Native American representatives.

6.0 AGENCIES AND INDIVIDUALS CONSULTED

South Coast Information Center, San Diego State University

7.0 PERSONNEL

Ronald V. May, RPA Project Director, Principal Investigator

Ronald V. May, RPA is President and co-founder of Legacy 106 Inc. During the past 47 years, Ronald V. May, RPA has been involved in a broad spectrum of historic, archaeological, and general environmental studies in California and northern Baja California, Mexico. This experience includes two years as staff with the Department of Anthropology, San Diego State University; three years part-time as District Liaison Archaeologist with California Division of Highways; two years part-time as Senior Archaeologist with David D. Smith & Associates; several short-term historic and archaeology studies with the United States Army Corps of Engineers, United States Department of Agriculture, State of California Department of Parks and Recreation; 24 years as Environmental Management Specialist, County of San Diego, general environmental and staff archaeologist/ historian, and manager of the National Park Service, Certified Local Government, County Historic Sites Board; two years with the United States Navy as Environmental Protection Specialist, as manager of natural-cultural, Environmental Office, Naval Submarine Base (1998-1999) and staff architectural historian for Naval Base Point Loma (1999-2000); President of Legacy 106, Inc. since 2000. He is author of over 70 publications on history, historic and prehistoric archaeology, government policy, and Spanish historic ceramics. , in 1989, King Juan Carlos of Spain awarded him Knight's Officer, Orden del Civil Merito for the archaeological discovery and publication on an 18th century Spanish Army fort in San Diego. The Society for California Archaeology awarded him the Mark Raymond Harrington Conservation Archaeology Award in 1987. The San Diego Archaeological Center awarded him the Golden Trowel Lifetime Achievement Award in 2012.

8.0 REFERENCES

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FIGURE 1

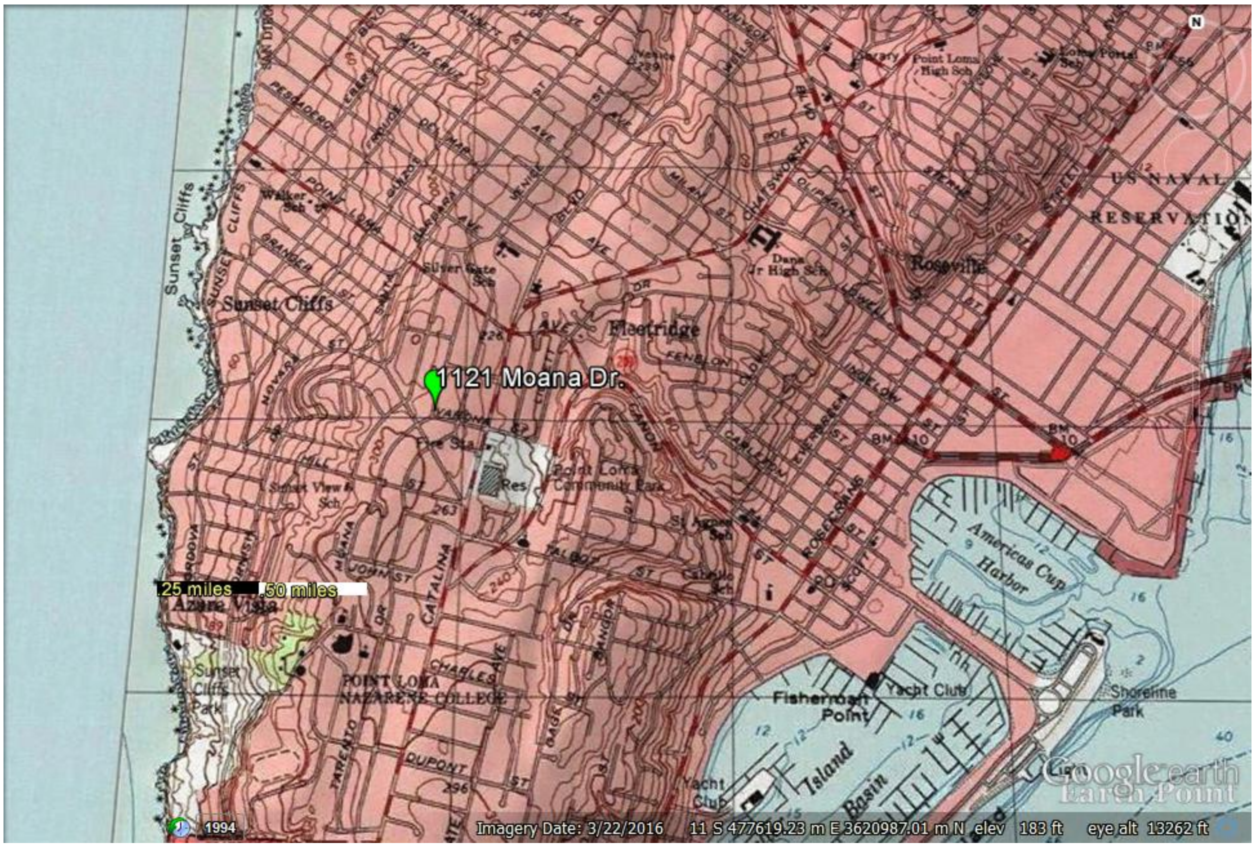
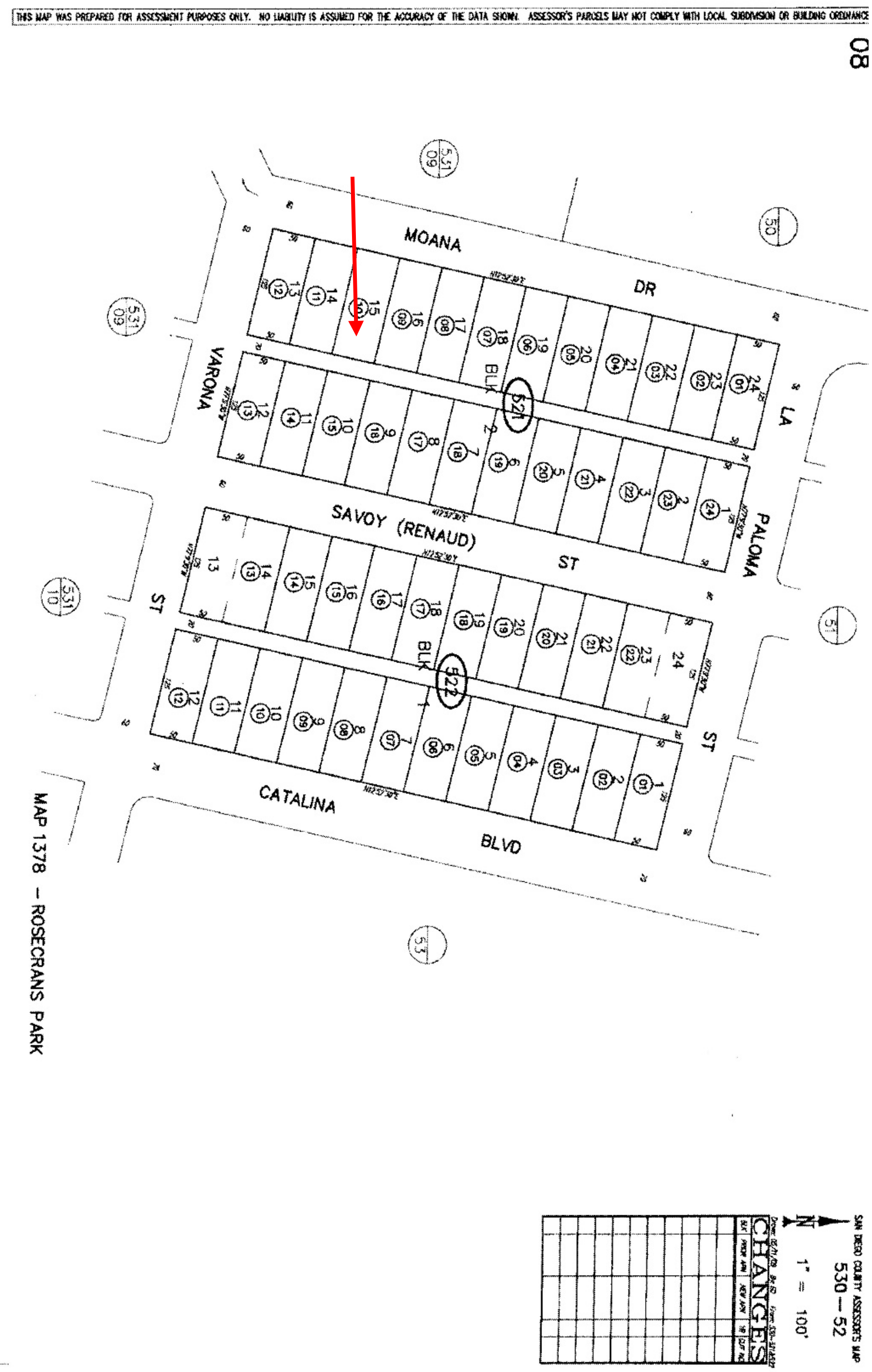
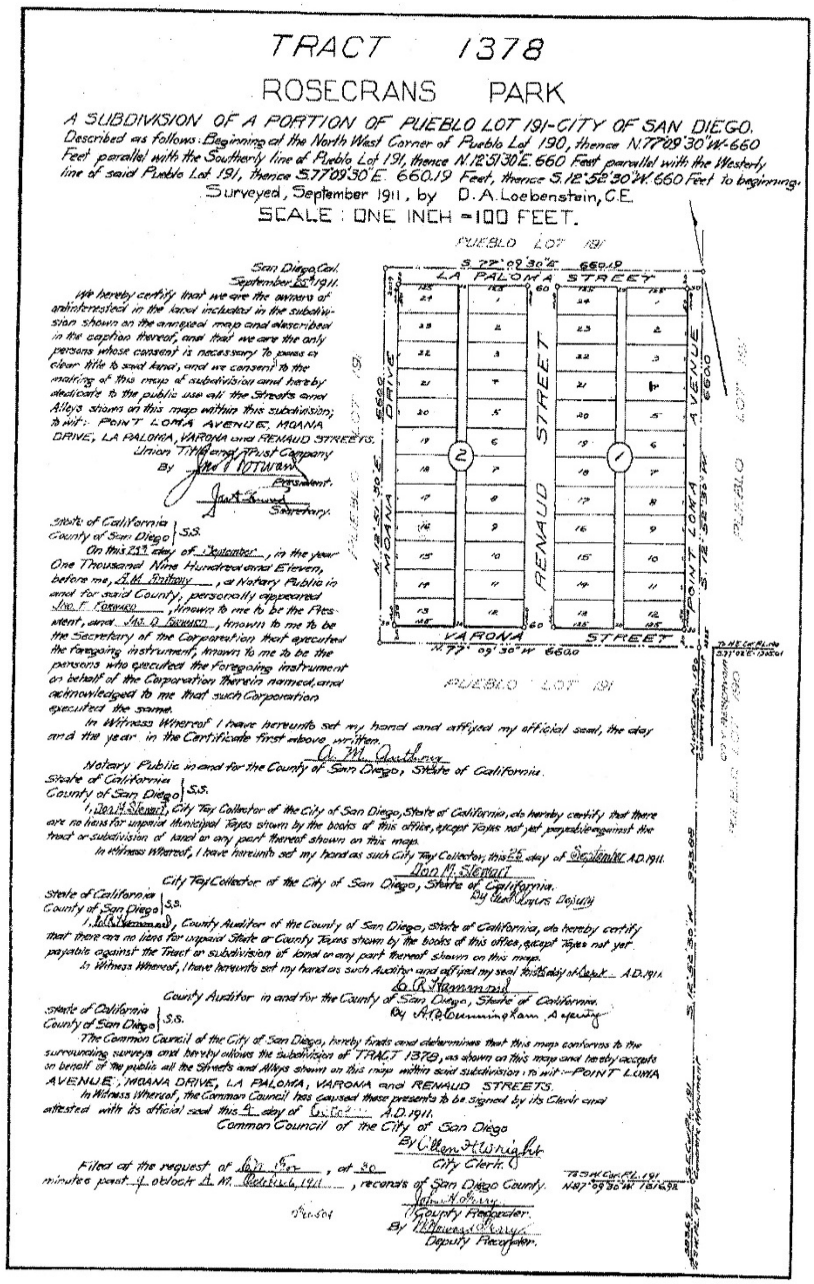

1121 Moana Dr.
25 miles
.50 miles
Sunset Cliffs
Sunset Cliffs
Fleetridge
Roseville
US NAVAL
Point Loma Community Park
POINT LOMA NAZARENE COLLEGE
Americas Cup Harbor
Fisherman Point
Yacht Club
Shoreline Park
1994
Imagery Date: 3/22/2016
11 S 477619.23 m E 3620987.01 m N elev 183 ft eye alt 13262 ft

FIGURE 2


THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSES ONLY. NO LIABILITY IS ASSUMED FOR THE ACCURACY OF THE DATA SHOWN. ASSESSOR'S PARCELS MAY NOT COMPLY WITH LOCAL SUBDIVISION OR BUILDING ORDINANCE
08
MOANA DR
VARONA ST
SAVOY (RENAUD) ST
LA PALOMA ST
CATALINA BLVD
BLK 2
BLK 1
521
522
MAP 1378 – ROSECRANS PARK
SAN DIEGO COUNTY ASSESSOR'S MAP
530 – 52
1" = 100'
CHANGES



TRACT 1378

ROSECRANS PARK

A SUBDIVISION OF A PORTION OF PUEBLO LOT 191-CITY OF SAN DIEGO.

Described as follows: Beginning at the North West Corner of Pueblo Lot 190, thence N.77°09'30"W.-660 Feet parallel with the Southerly line of Pueblo Lot 191, thence N.12°51'30"E. 660 Feet parallel with the Westerly line of said Pueblo Lot 191, thence S.77°09'30"E. 660.19 Feet, thence S.12°52'30"W. 660 Feet to beginning.

Surveyed, September 1911, by D.A. Loebenstein, C.E.

SCALE: ONE INCH = 100 FEET.

San Diego, Cal.
September 25th 1911.

We hereby certify that we are the owners of and interested in the land included in the subdivision shown on the annexed map and described in the caption thereof, and that we are the only persons whose consent is necessary to pass a clear title to said land, and we consent to the making of this map of subdivision and hereby dedicate to the public use all the Streets and Alleys shown on this map within this subdivision; to wit: POINT LOMA AVENUE, MOANA DRIVE, LA PALOMA, VARONA and RENAUD STREETS.

Union Title and Trust Company
By [signature] President.
[signature] Secretary.

State of California
County of San Diego } S.S.

On this 25th day of September, in the year One Thousand Nine Hundred and Eleven, before me, A.M. Anthony, a Notary Public in and for said County, personally appeared Jno. F. Forward, known to me to be the President, and Jas. O. Brown, known to me to be the Secretary of the Corporation that executed the foregoing instrument, known to me to be the persons who executed the foregoing instrument on behalf of the Corporation therein named, and acknowledged to me that such Corporation executed the same.

In Witness Whereof I have hereunto set my hand and affixed my official seal, the day and the year in the Certificate first above written.

A. M. Anthony
Notary Public in and for the County of San Diego, State of California.

State of California
County of San Diego } S.S.

I, Don M. Stewart, City Tax Collector of the City of San Diego, State of California, do hereby certify that there are no liens for unpaid Municipal Taxes shown by the books of this office, except Taxes not yet payable against the tract or subdivision of land or any part thereof shown on this map.

In Witness Whereof, I have hereunto set my hand as such City Tax Collector, this 25 day of September A.D. 1911.

Don M. Stewart
City Tax Collector of the City of San Diego, State of California.
By [signature] Deputy

State of California
County of San Diego } S.S.

I, [signature], County Auditor of the County of San Diego, State of California, do hereby certify that there are no liens for unpaid State or County Taxes shown by the books of this office, except Taxes not yet payable against the Tract or subdivision of land or any part thereof shown on this map.

In Witness Whereof, I have hereunto set my hand as such Auditor and affixed my seal this 25 day of Sept. A.D. 1911.

[signature]
County Auditor in and for the County of San Diego, State of California.
By A.P. Cunningham, Deputy

State of California
County of San Diego } S.S.

The Common Council of the City of San Diego, hereby finds and determines that this map conforms to the surrounding surveys and hereby allows the subdivision of TRACT 1378, as shown on this map and hereby accepts on behalf of the public all the Streets and Alleys shown on this map within said subdivision, to wit:—POINT LOMA AVENUE, MOANA DRIVE, LA PALOMA, VARONA and RENAUD STREETS.

In Witness Whereof, the Common Council has caused these presents to be signed by its Clerk and attested with its official seal this 4 day of October A.D. 1911.

Common Council of the City of San Diego
By Allen H. Wright
City Clerk.

Filed at the request of [illegible], at 30 minutes past 4 o'clock A.M. October 1911, records of San Diego County.

[signature]
County Recorder.
By [signature]
Deputy Recorder.

FIGURE 3

March 01, 2017

Memo

RE: Sacred Lands Files Search for 1121 Moana Dr. San Diego, CA 92107.

Ron May,

The purpose of this memo is to inform you that the Sacred Lands Files search for 1121 Moana Dr. San Diego, CA 92107 has been completed. Below is a summary of the methods used by Loveless & Linton Consulting (Loveless & Linton) to accomplish the task and the results.

Methods

- January 13, 2017 a letter was sent to the Native American Heritage Commission (**NAHC**) requesting a Sacred Lands Files search for the above address. Please see attached copy of sent letter.
- January 19, 2017 a response was returned by Gail Totton of the NAHC. Search resulted in negative findings. However, a list of contacts was supplied and suggested that efforts be made to contact everyone on the given list. Please see attached copy of response.
- February 01, 2017 a letter was sent out to each contact on the list given to Loveless & Linton by the NAHC. Letters were replicas of the original letter sent to NAHC and included map.
- Two additional attempts to contact individuals who did not respond. Please see attached communication log.

Results

- February 13, 2017 Clinton Linton, IIpay Nation of Sant Ysabel, responded with a phone call. He stated that there have been small hearths located within the general area and monitoring of ground disturbance should be performed by archaeologist and Native American monitors.
- February 27, 2017 Lisa Cumper, Jamul Indian Village, responded via email. She stated that Jamul Indian Village would like to be involved in the project and formally consulted with.
- February 27, 2017 Tribal Office Inaja Band of Mission Indians, responded to phone call. Representative stated that due to location, Inaja Tribe has no questions, comments or interests in this project.
- February 28, 2017 Dave Tolar, San Pasqual Band of Mission Indians, responded by phone call. He stated that they do not have any additional information, however, that does not mean that there are no cultural resources there. There could be resources in the area that have not been documented due to lack of monitoring in the past. Much of the development in San Diego took place before current environmental laws and monitoring practices. Monitoring by qualified Native American monitor should be implemented in this project

In conclusion, the majority of responsive parties recommend monitoring of ground disturbing activities.

If you have any questions, please contact me at the contacts provided below.

Regards,

Rebekah Loveless
Principal Archaeologist
Loveless & Linton Consulting
rebekah@loveless-linton.com
(619) 922.0718

HYDROLOGY AND DRAINAGE STUDY

DEVELOPMENT OF AN EXISTING PARCEL
SINGLE FAMILY HOME
LOT 15, BLOCK 2 OF MAP 1378
____ MOANA DRIVE

CITY OF SAN DIEGO, CALIFORNIA

PTS# 482858

Signed & sealed by RCE: ____________________
F. Dan Rinehart, RCE 28204
Registration expires 3-31-2018

REGISTERED PROFESSIONAL ENGINEER
F. D. RINEHART
No. 28204
Exp. ________
CIVIL
STATE OF CALIFORNIA

RINEHART ENGINEERING
6431 Cleeve Way
San Diego, California 92117-4246
(858) 268-8401

Rev. 8/20/2016
March 25, 2016
16201H01.doc

HYDROLOGY AND DRAINAGE STUDY

DEVELOPMENT OF AN EXISTING PARCEL
SINGLE FAMILY HOME
LOT 15, BLOCK 2 OF MAP 1378
____ MOANA DRIVE

CITY OF SAN DIEGO, CALIFORNIA

Site Description

The existing site was previously subdivided and graded vacant lot. The lot is located in the Rosecrans Park Subdivision in Point Loma. The area of the existing lot is 0.144 acres. The proposed project will construct a new home.

Drainage from the Existing Site

The existing storm runoff sheet flows both east and west. The front approximately quarter of the lot flows westerly and into Moana Drive. The easterly three-quarters of the existing lot flows easterly to the existing paved alley.

Area B1 – Flow to the Street

The existing storm drainage sheet flows across the lot from east to west and into the existing street. The peak 10 year flow from the 0.022 Ac area is calculated to be 0.026 cfs. The peak 100 year flow is calculated to be 0.038 cfs.

Area B2 – Flow to the Alley

The existing storm drainage sheet flows across the lot from west to east and into the existing paved alley. The peak 10 year flow from the 0.121 Ac area is calculated to be 0.143 cfs. The peak 100 year flow is calculated to be 0.211 cfs.

Drainage after Addition to the existing Single Family Home

The project will construct a new home on the site. The project will add a total of 3,548 sqft of impermeable surface. The building will not significantly change the drainage patterns from the old development.

Area A1 – Flow to the Street

The westerly area is 0.044 acres. 0.024 acres is impervious surface and 0.020 acres is landscape and permeable. The storm drainage flows across the lot from east to west and into the Moana Drive. The peak 10 year flow is calculated to be 0.109 cfs. The peak 100 year flow is calculated to be 0.161 cfs.

Area A2 – Flow to the Alley
The easterly area is 0.100 acres. 0.058 acres is impervious surface and 0.042 acres is landscape and permeable. The storm drainage flows across the lot from west to east and into the Alley. The peak 10 year flow is calculated to be 0.257 cfs. The peak 100 year flow is calculated to be 0.377 cfs.

The calculated total 100 year peak flow from the project area is approximately 0.538 cfs, an increase of 0.29 cfs.

Conclusion
Development of the parcel will not change the flow patterns and will increase the total peak 100 year flow. The calculated total 100 year peak flow from the proposed project area is approximately 0.538 cfs, an increase of 0.29 cfs more than the existing vacant lot. No adverse impacts will occur due to the very small increase in flow from the development.

The parcel sits near the top of the ridge and slightly on the bay side, so the easterly slope would take any runoff from the property toward the bay. There are several storm drain pipes between the property and the bay. Based on slopes and street locations, the storm run-off will flow northerly in Moana Drive to La Paloma. The storm runoff to the alley will also flow north and parallel with Moana Drive to La Paloma. Then, runoff will either flow along Catalina Blvd to a low point storm drain near the intersection of Catalina and Chatsworth, or, it would cross Catalina and go down Point Loma Ave, where there is a storm drain at the intersection of Canon and Point Loma Ave. The storm drains take the runoff directly into the bay.

There are no dredge or fill operations in a wetlands area and no discharge into navigable waters and therefore not required to obtain approval from the Regional Water Quality Control Board under the Federal Clean Water Act section 401 or 404.

APPENDIX

RINEHART ENGINEERING
F. Dan Rinehart, R.C.E.
6431 Cleeve Way
SAN DIEGO, CALIFORNIA 92117-4246
(858) 268-8401

JOB 16201
SHEET NO. 1 OF
CALCULATED BY FDR DATE 3/24/16
CHECKED BY DATE
SCALE

HYDRO BEFORE DEVELOPMENT

AREA B1

$A_T = 0.022$ AC
$A_{IMP} = 0$ AC

$C = .3$

$I < 5$ MIN
$I_{10} = 3.95$
$I_{100} = 5.8$

$Q_{10} = CIA = .3(3.95)\,0.022 = 0.026$ CFS
$Q_{100} = .3(5.8)\,0.022 \quad 0.038$ CFS

AREA B2

$A_T = 0.121$ AC
$A_{IMP} = 0$ AC

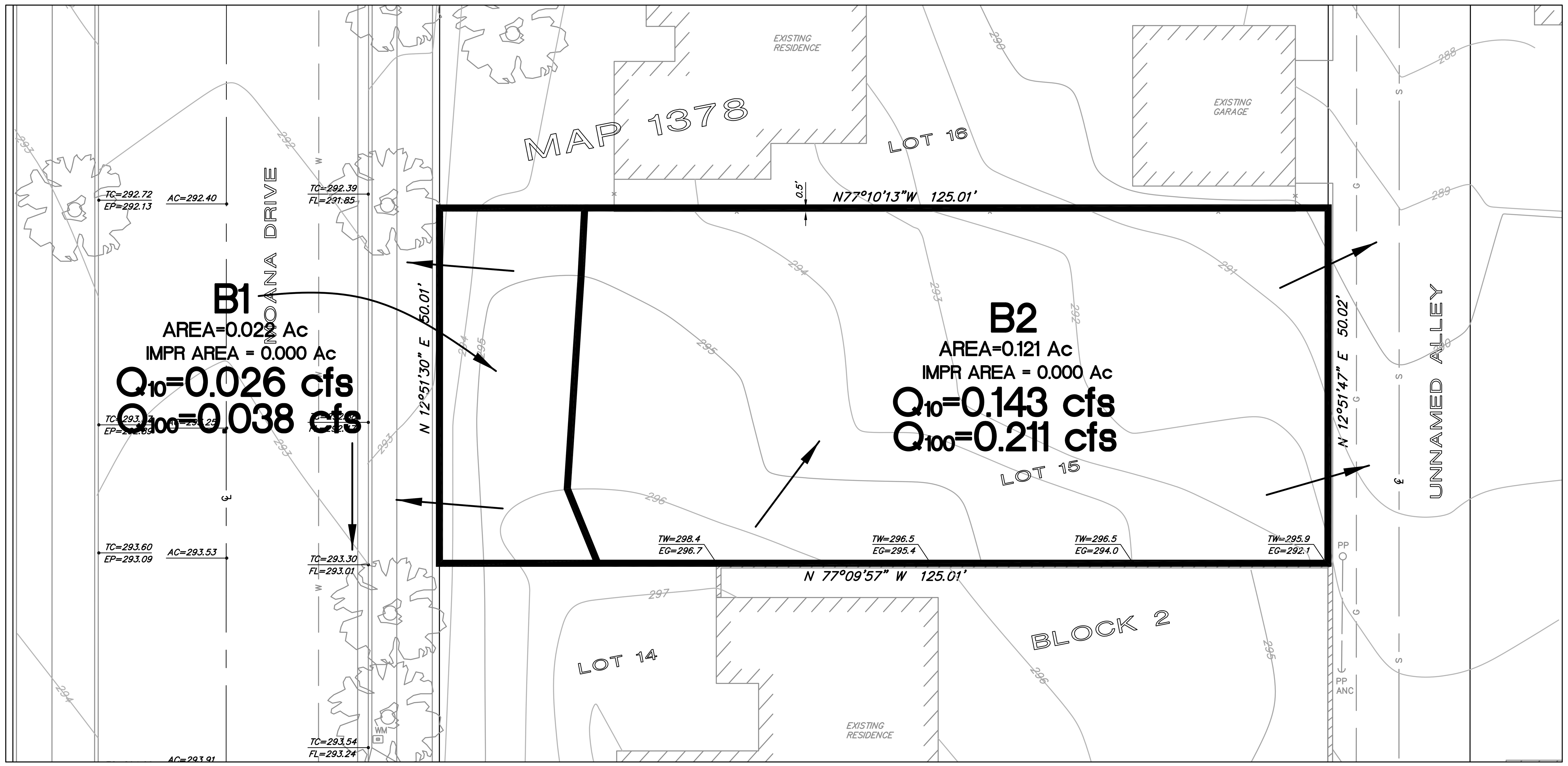
$C = .3$

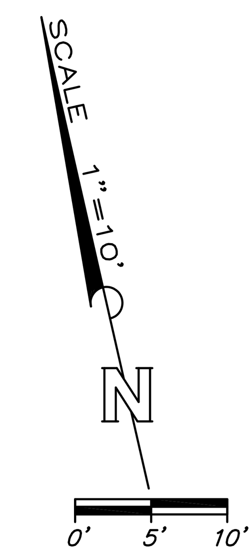
$Q_{10} = CIA = .3(3.95)\,0.121 = 0.143$ CFS
$Q_{100} = .3(5.8)\,0.121 = 0.211$ CFS

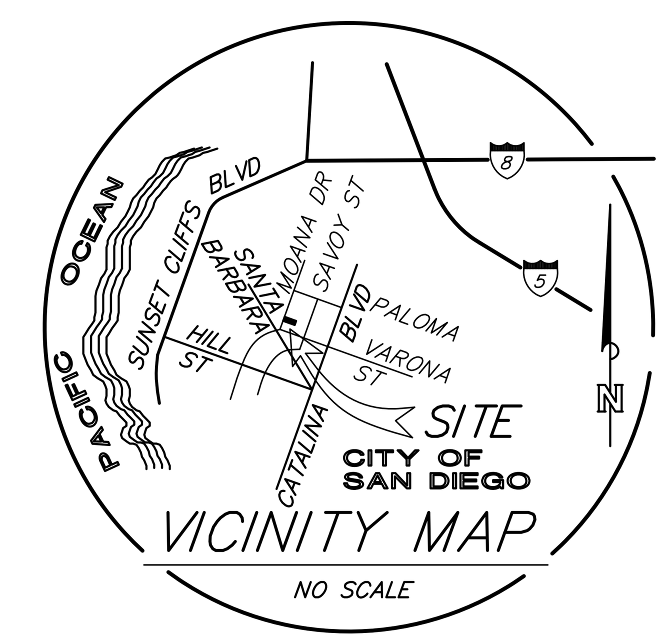
HYDROLOGY STUDY - BEFORE DEVELOPMENT

LEGEND - STORM DRAINAGE

IMPERMEABLE SURFACE	IMPERMEABLE
IMPERMEABLE SURFACE	SEMI-IMPERMEABLE
FLOW DIRECTION	







RINEHART ENGINEERING
6431 CLEEVE WAY SAN DIEGO, CA 92117
FDR@RINEHART-ENGINEERING.COM
(858) 268-8401

DRAINAGE STUDY
BEFORE DEVELOPMENT
LOT 15, BLOCK 2
MAP 1378
____ MOANA DRIVE

REGISTERED PROFESSIONAL ENGINEER F. RINEHART No. 28204 Exp. 3/31/2018 CIVIL STATE OF CALIFORNIA

DATE:	03/14/2016
ENGINEER:	F. DAN RINEHART
DRAWN BY:	FDR
SCALE:	1"=10'
JOB NUMBER:	16201GOD.DWG
SHEET	1 OF 2

BENCH MARK	
DESCRIPTION:	BRASS PLUG TOP OF CURB
LOCATION:	SOUTH CORNER OF MOANA DRIVE AND SANTA BARBARA STREET
RECORD FROM:	CITY OF SAN DIEGO VERTICAL CONTROL
ELEVATION:	289.721 DATUM: SAN DIEGO MEAN SEA LEVEL

RINEHART ENGINEERING
F. Dan Rinehart, R.C.E.
6431 Cleeve Way
SAN DIEGO, CALIFORNIA 92117-4246
(858) 268-8401

JOB
SHEET NO. 2 OF
CALCULATED BY FDR DATE 3/24/16
CHECKED BY DATE
SCALE

HYDRO AFTER DEVELOPMENT

AREA A1

$A_T = 0.044$ AC
$A_{IMP} = 0.024$
$A_O = 0.020$

$$C = \frac{.9(0.024) + .3(0.020)}{0.044} = 0.63$$

$I_{10} = 3.95$ $I_{100} = 5.8$

$Q_{10} = .63(3.95)0.044 = 0.109$ CFS
Q_{100} $.63(5.8)0.044 = 0.161$ CFS

AREA A2

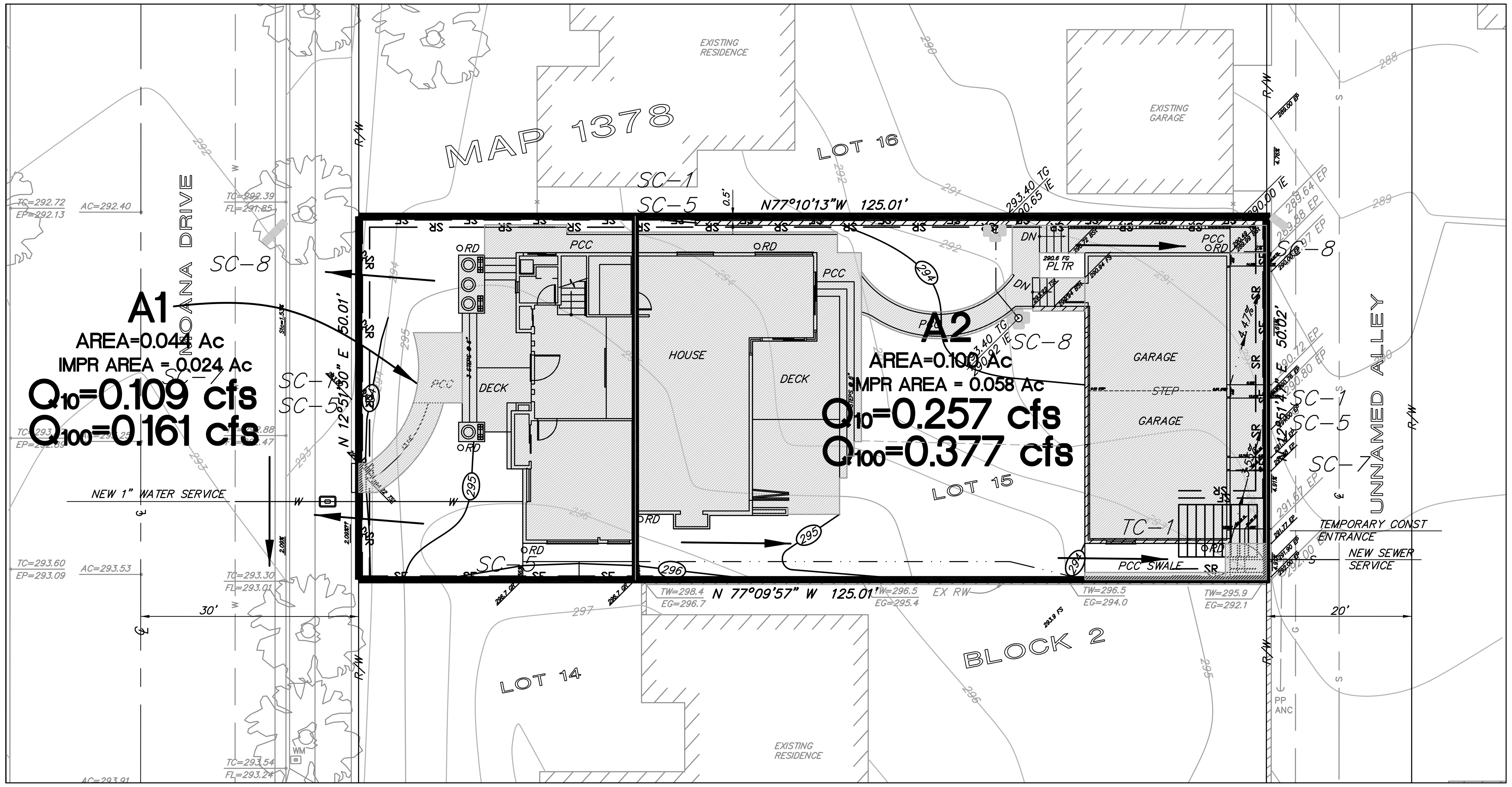
$A_T = 0.100$
$A_I = 0.058$
$A_O = 0.042$

$$C = \frac{.9(0.058) + .3(0.042)}{0.100} = 0.65$$

$Q_{10} = .65(3.95)\ 0.100 = 0.257$ CFS
$Q_{100} = .65(5.8)\ 0.100 = 0.377$ CFS

TOT AREA = 0.144 AC
IMPERVIOUS = 0.082 = 56%

HYDROLOGY STUDY - AFTER RE-DEVELOPMENT

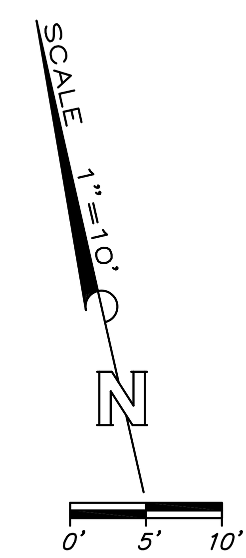


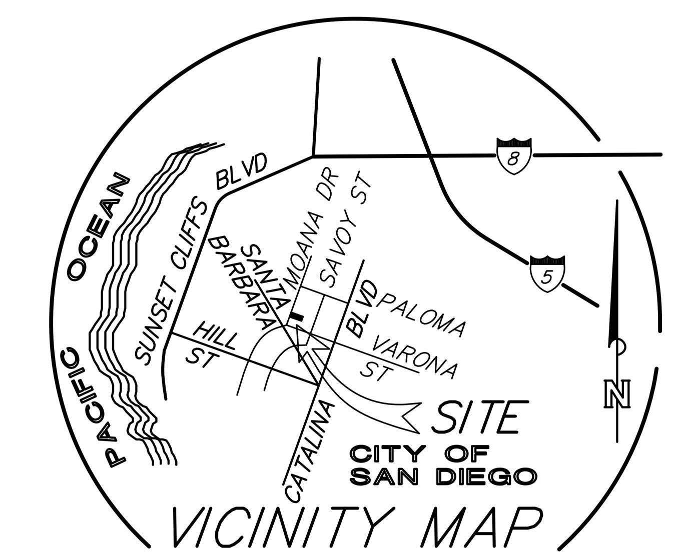
LEGEND - STORM DRAINAGE

IMPERMEABLE SURFACE — IMPERMEABLE

IMPERMEABLE SURFACE — SEMI-IMPERMEABLE

FLOW DIRECTION





VICINITY MAP

NO SCALE

RINEHART ENGINEERING
6431 CLEEVE WAY SAN DIEGO, CA 92117
FDR@RINEHART-ENGINEERING.COM
(858) 268-8401

DRAINAGE STUDY
BEFORE DEVELOPMENT
LOT 15, BLOCK 2
MAP 1378
____ MOANA DRIVE

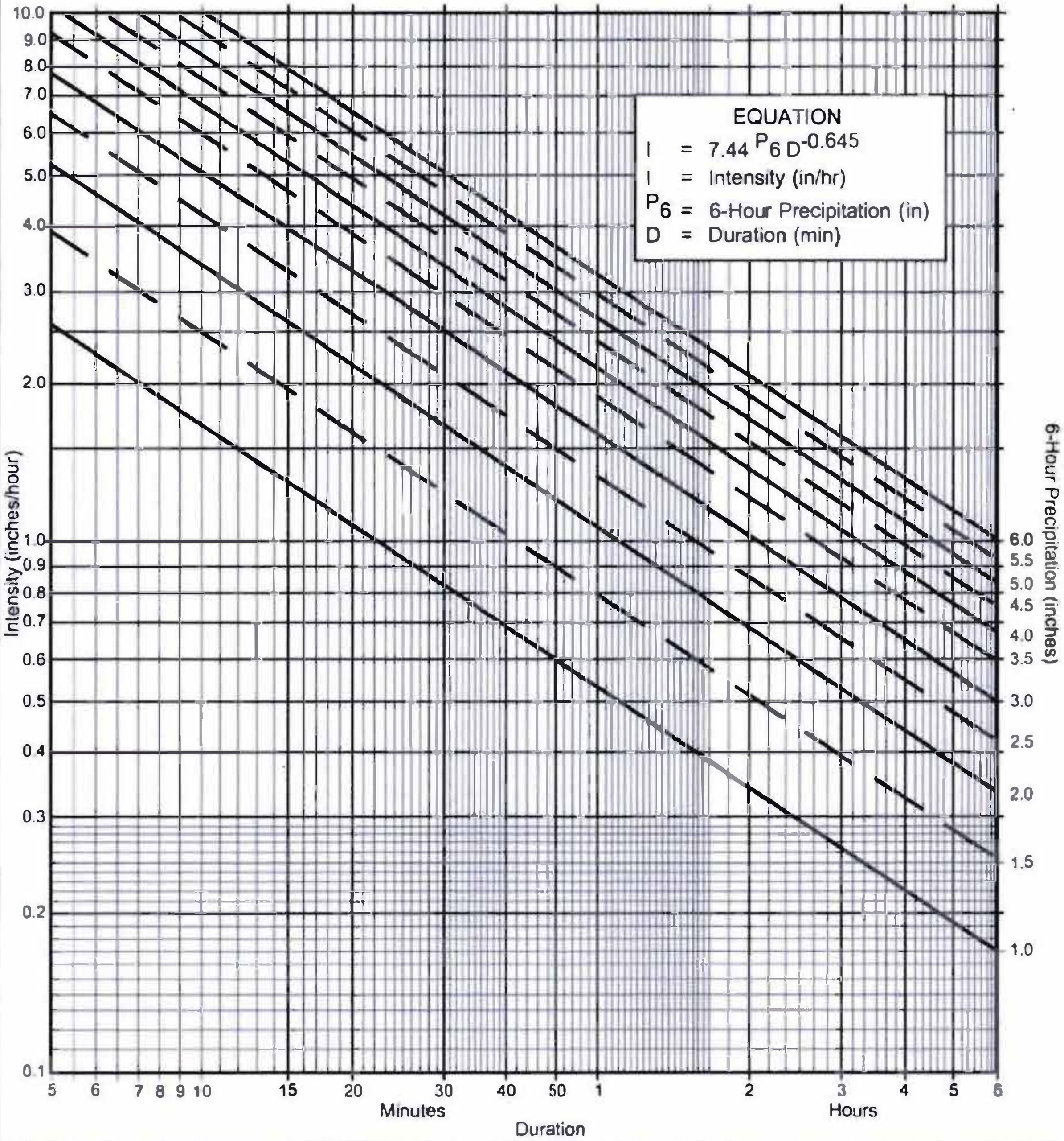
REGISTERED PROFESSIONAL ENGINEER — F. DAN RINEHART — No. 28204 — Exp. 3/31/2018 — CIVIL — STATE OF CALIFORNIA

DATE:	03/14/2016
ENGINEER:	F. DAN RINEHART
DRAWN BY:	FDR
SCALE:	1"=10'
JOB NUMBER:	16201G0D.DWG
SHEET	2 OF 2

BENCH MARK

DESCRIPTION:	BRASS PLUG TOP OF CURB
LOCATION:	SOUTH CORNER OF MOANA DRIVE AND SANTA BARBARA STREET
RECORD FROM:	CITY OF SAN DIEGO VERTICAL CONTROL
ELEVATION:	289.721 DATUM: SAN DIEGO MEAN SEA LEVEL

100 YEAR 5 MIN



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.2 in., P_{24} = 4.0, $\frac{P_6}{P_{24}}$ = 55 %(2)

(c) Adjusted P_6(2) = 2.2 in.

(d) t_x = 5 min.

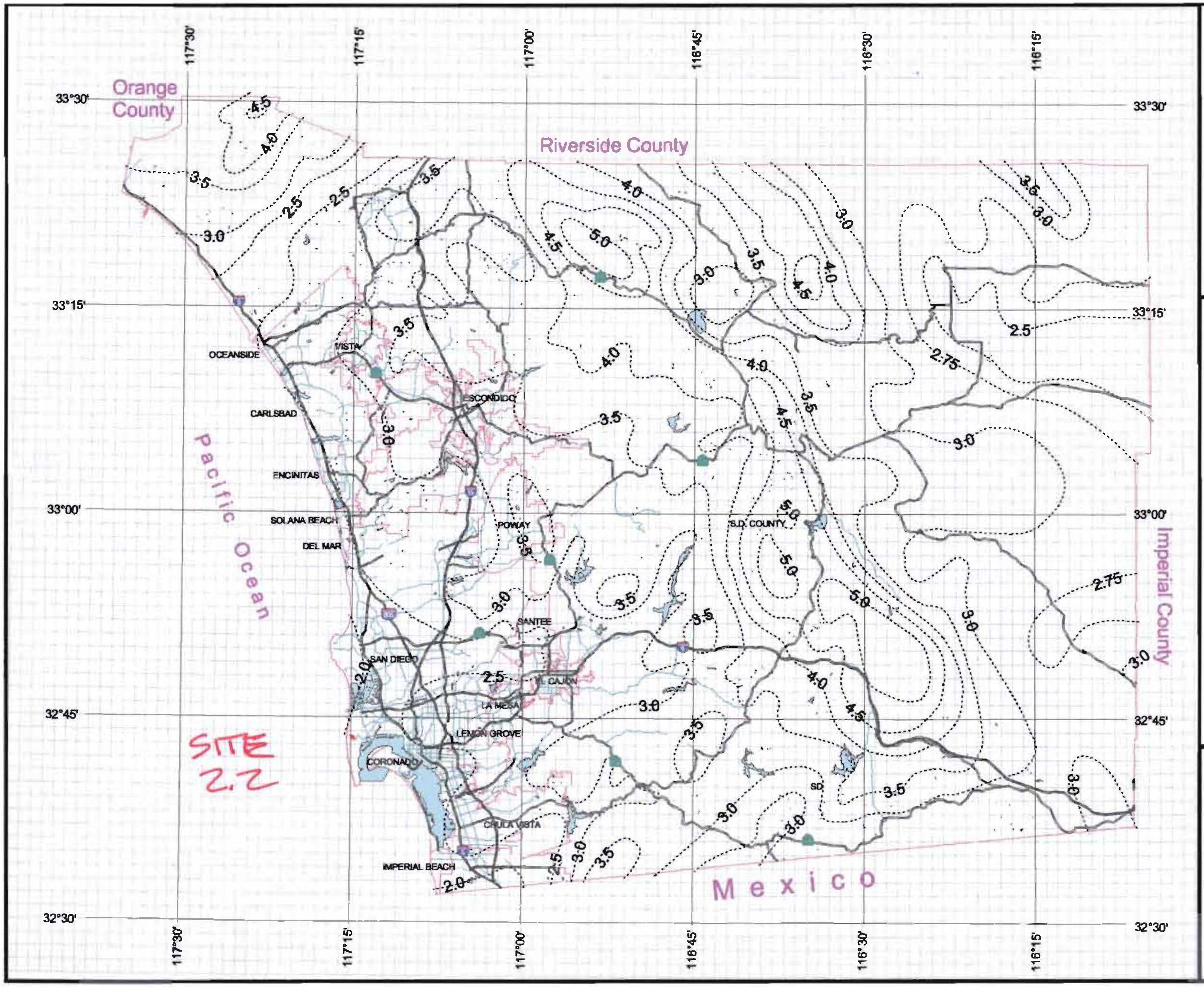
(e) I = 5.8 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE **3-1**



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

....	Isopluvial (inches)

DPW GIS

SanGIS

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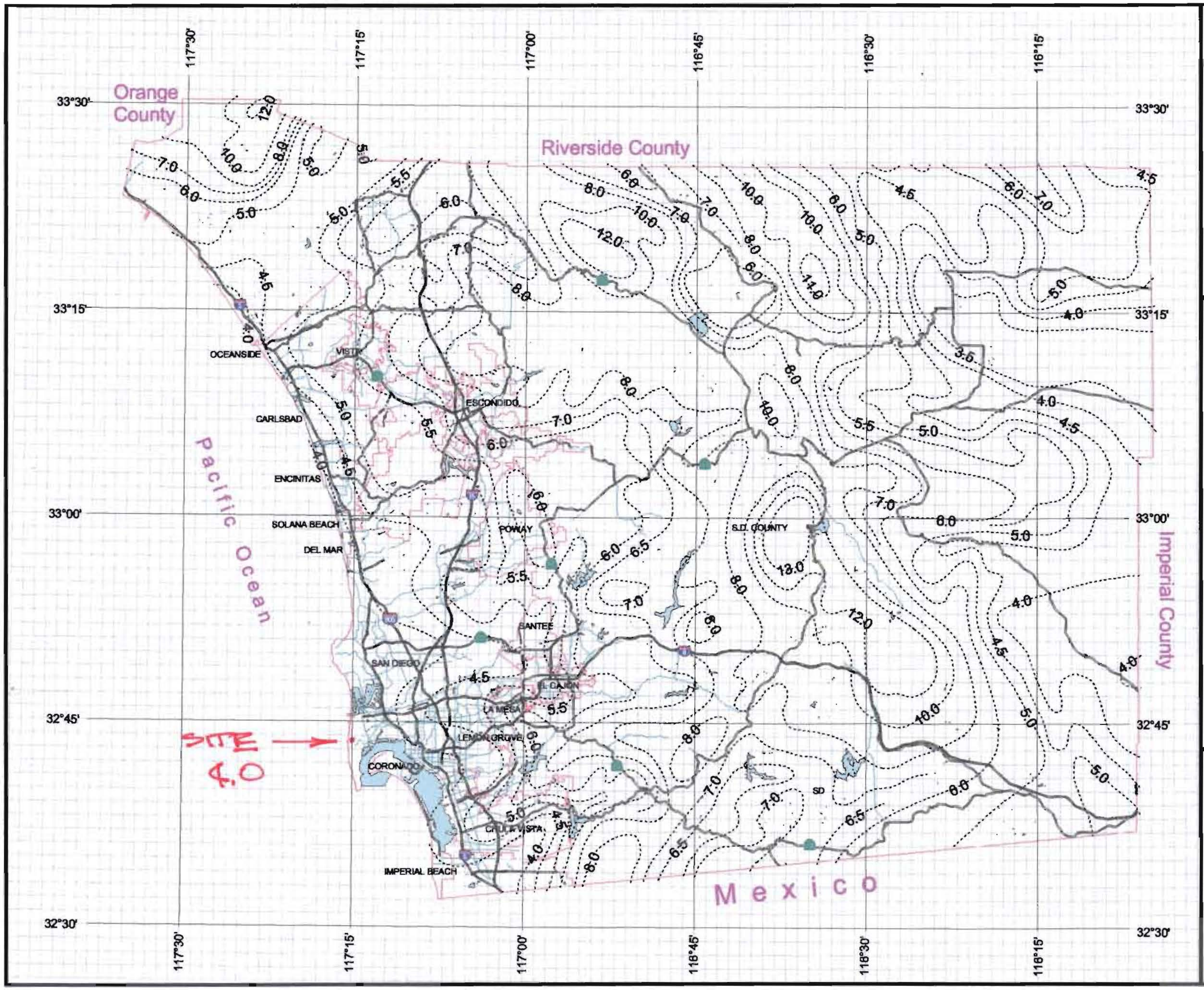

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

....	Isopluvial (inches)

N W E S

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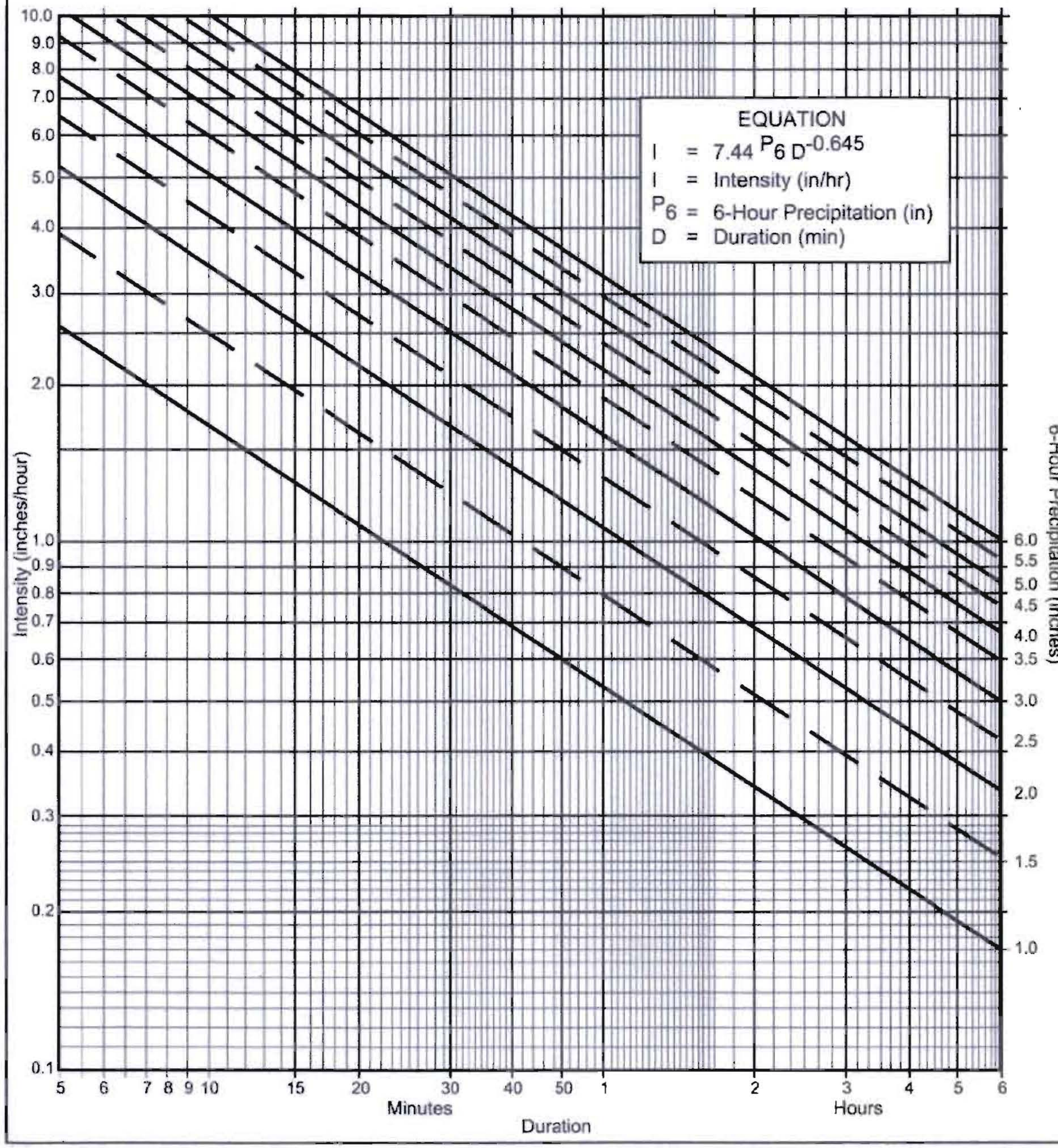
10 YEAR 5 MIN



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 10 year

(b) P_6 = 1.5 in., P_{24} = 2.7, $\frac{P_6}{P_{24}}$ = 55 %[2]

(c) Adjusted P_6[2] = 1.5 in.

(d) t_x = 5 min.

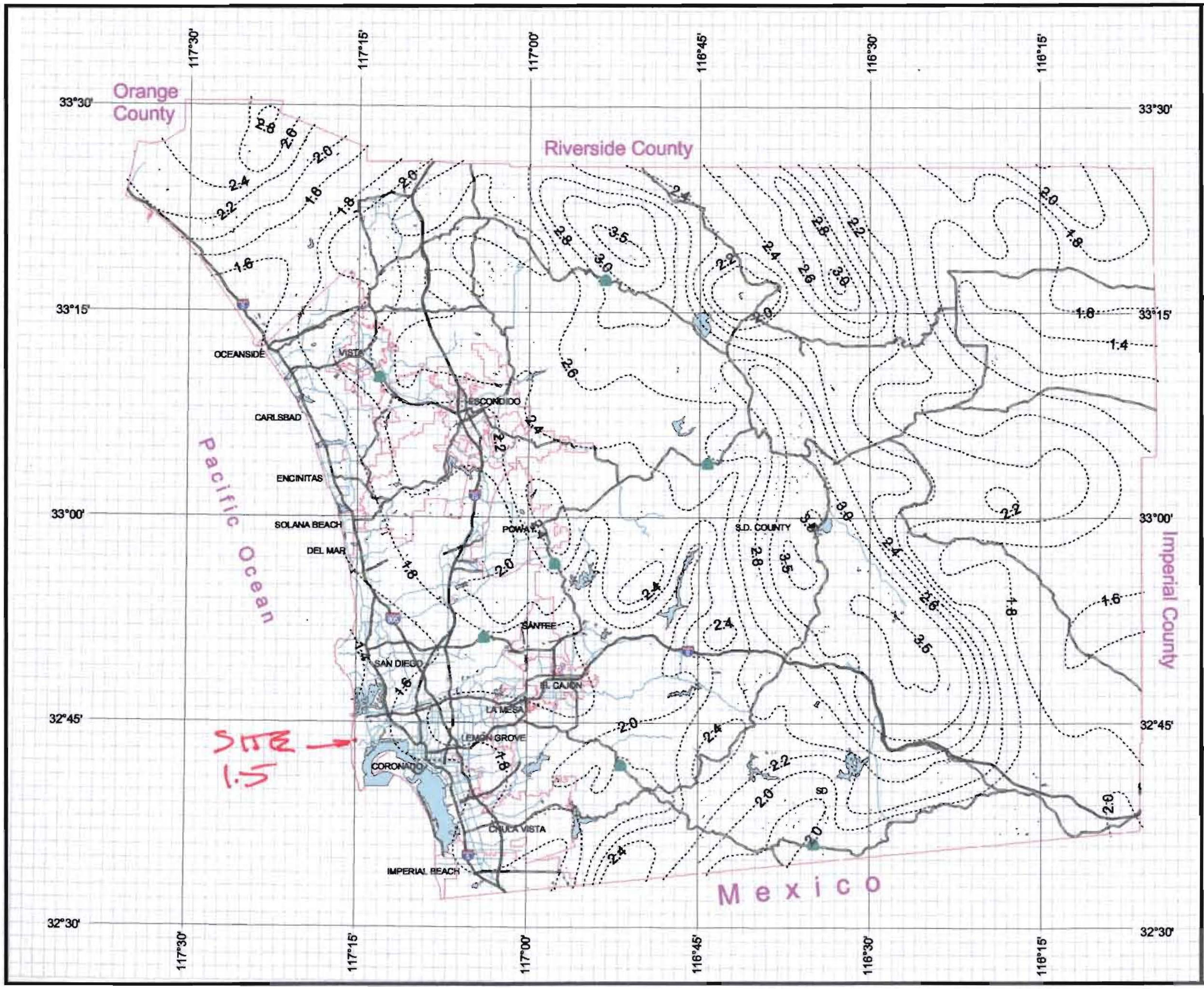
(e) I = 3.95 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 6 Hours

------- Isopluvial (inches)

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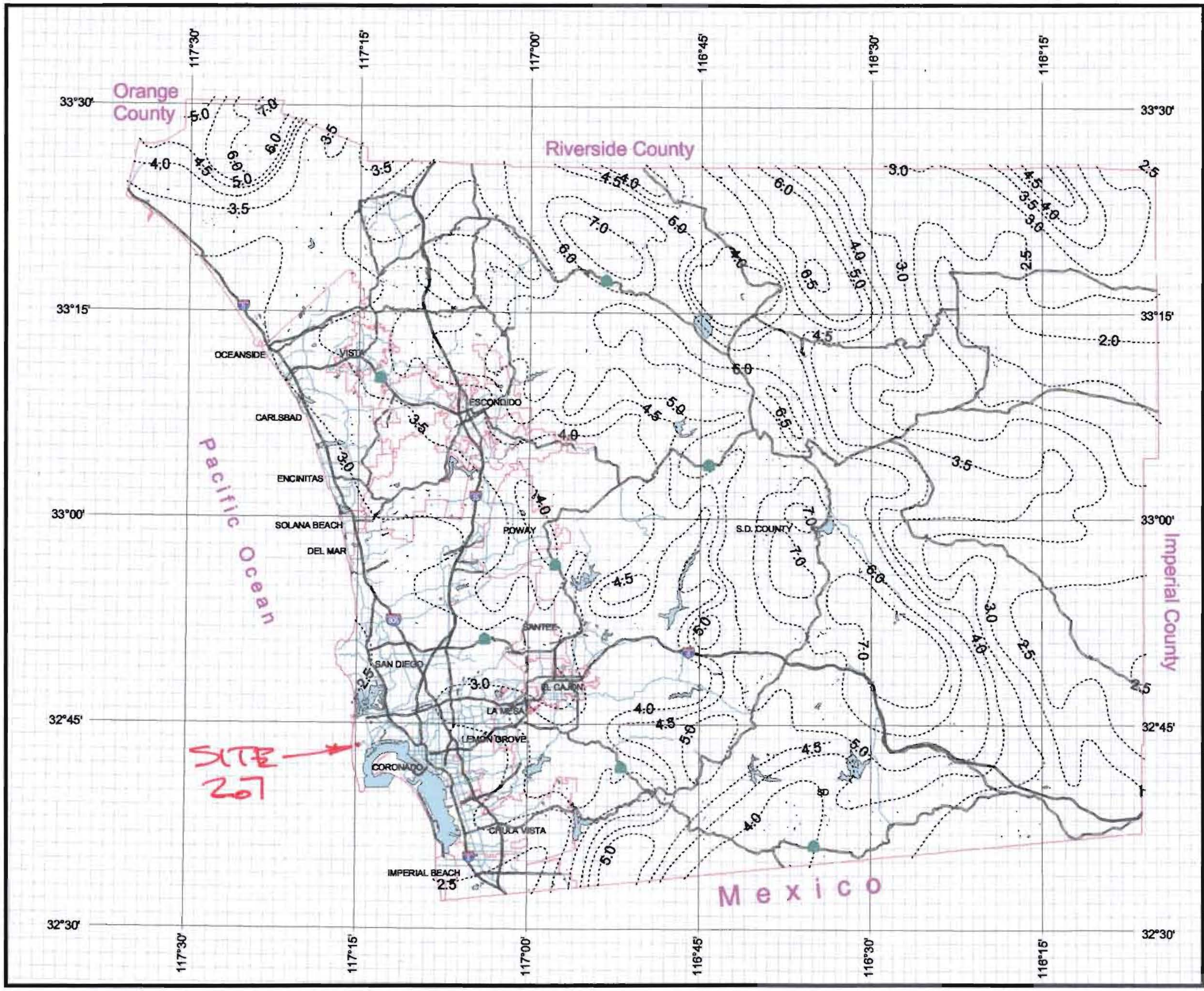
County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 24 Hours

Isopluvial (inches)



SECTION 3
RATIONAL METHOD AND MODIFIED RATIONAL METHOD

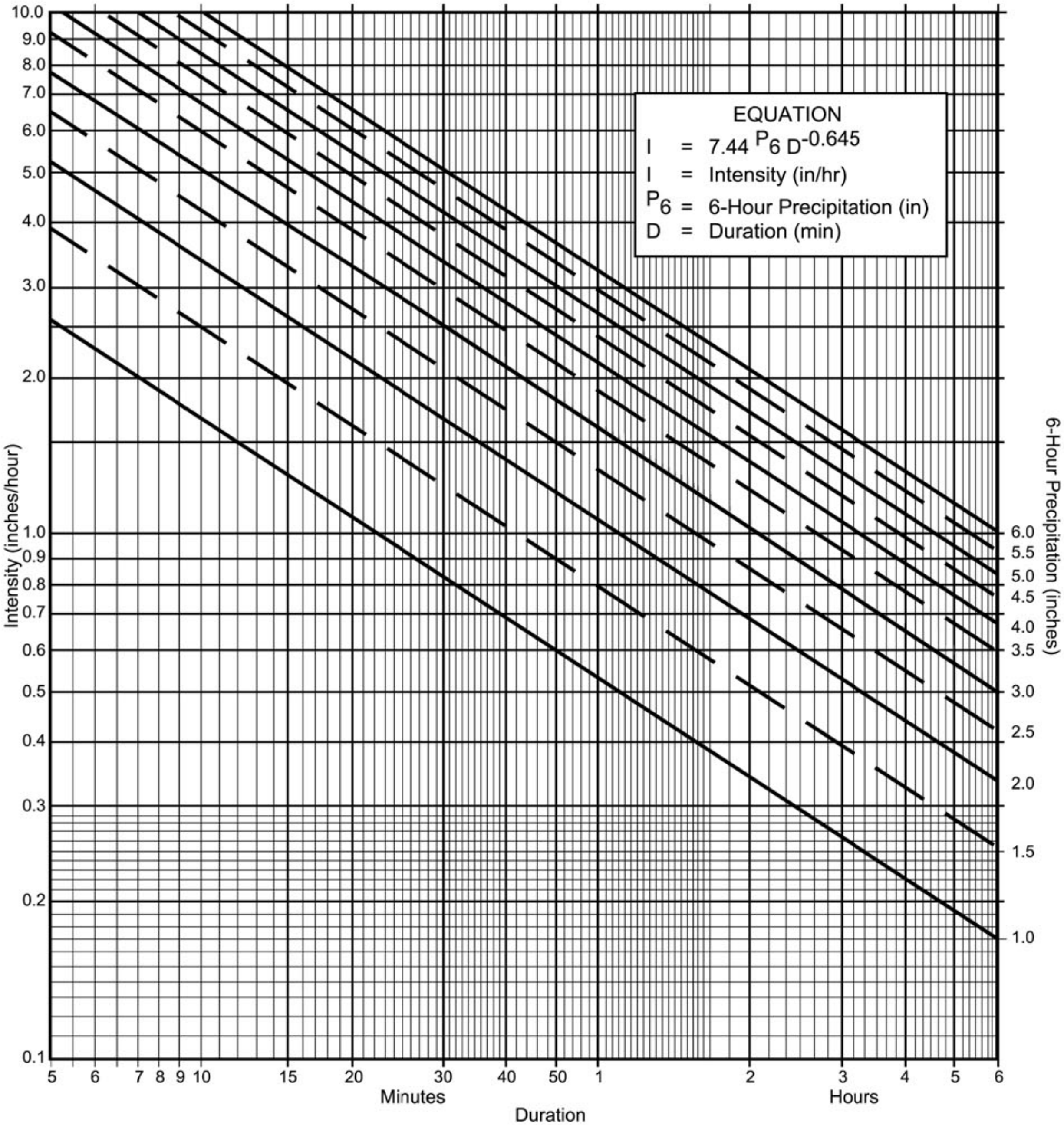
3.1 THE RATIONAL METHOD

The Rational Method (RM) is a mathematical formula used to determine the maximum runoff rate from a given rainfall. It has particular application in urban storm drainage, where it is used to estimate peak runoff rates from small urban and rural watersheds for the design of storm drains and small drainage structures. The RM is recommended for analyzing the runoff response from drainage areas up to approximately 1 square mile in size. It should not be used in instances where there is a junction of independent drainage systems or for drainage areas greater than approximately 1 square mile in size. In these instances, the Modified Rational Method (MRM) should be used for junctions of independent drainage systems in watersheds up to approximately 1 square mile in size (see Section 3.4); or the NRCS Hydrologic Method should be used for watersheds greater than approximately 1 square mile in size (see Section 4).

The RM can be applied using any design storm frequency (e.g., 100-year, 50-year, 10-year, etc.). The local agency determines the design storm frequency that must be used based on the type of project and specific local requirements. A discussion of design storm frequency is provided in Section 2.3 of this manual. A procedure has been developed that converts the 6-hour and 24-hour precipitation isopluvial map data to an Intensity-Duration curve that can be used for the rainfall intensity in the RM formula as shown in Figure 3-1. The RM is applicable to a 6-hour storm duration because the procedure uses Intensity-Duration Design Charts that are based on a 6-hour storm duration.

3.1.1 Rational Method Formula

The RM formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area (A), runoff coefficient (C), and rainfall intensity (I) for a duration equal to the time of concentration (T_c), which is the time required for water to



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency ______ year

(b) P_6 = ______ in., P_{24} = ______, $\frac{P_6}{P_{24}}$ = ______ %(2)

(c) Adjusted $P_6^{(2)}$ = ______ in.

(d) t_x = ______ min.

(e) I = ______ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1

flow from the most remote point of the basin to the location being analyzed. The RM formula is expressed as follows:

$$Q = C\ I\ A$$

Where: Q = peak discharge, in cubic feet per second (cfs)
C = runoff coefficient, proportion of the rainfall that runs off the surface (no units)
I = average rainfall intensity for a duration equal to the T_c for the area, in inches per hour (Note: If the computed T_c is less than 5 minutes, use 5 minutes for computing the peak discharge, Q)
A = drainage area contributing to the design location, in acres

Combining the units for the expression CIA yields:

$$\left(\frac{1\,\text{acre} \times \text{inch}}{\text{hour}}\right)\left(\frac{43{,}560\,\text{ft}^2}{\text{acre}}\right)\left(\frac{1\,\text{foot}}{12\,\text{inches}}\right)\left(\frac{1\,\text{hour}}{3{,}600\,\text{seconds}}\right) \Rightarrow 1.008\,\text{cfs}$$

For practical purposes the unit conversion coefficient difference of 0.8% can be ignored.

The RM formula is based on the assumption that for constant rainfall intensity, the peak discharge rate at a point will occur when the raindrop that falls at the most upstream point in the tributary drainage basin arrives at the point of interest.

Unlike the MRM (discussed in Section 3.4) or the NRCS hydrologic method (discussed in Section 4), the RM does not create hydrographs and therefore does not add separate subarea hydrographs at collection points. Instead, the RM develops peak discharges in the main line by increasing the T_c as flow travels downstream.

Characteristics of, or assumptions inherent to, the RM are listed below:

- The discharge flow rate resulting from any I is maximum when the I lasts as long as or longer than the T_c.

- The storm frequency of peak discharges is the same as that of I for the given T_c.

- The fraction of rainfall that becomes runoff (or the runoff coefficient, C) is independent of I or precipitation zone number (PZN) condition (PZN Condition is discussed in Section 4.1.2.4).

- The peak rate of runoff is the only information produced by using the RM.

3.1.2 Runoff Coefficient

Table 3-1 lists the estimated runoff coefficients for urban areas. The concepts related to the runoff coefficient were evaluated in a report entitled *Evaluation, Rational Method "C" Values* (Hill, 2002) that was reviewed by the Hydrology Manual Committee. The Report is available at San Diego County Department of Public Works, Flood Control Section and on the San Diego County Department of Public Works web page.

The runoff coefficients are based on land use and soil type. Soil type can be determined from the soil type map provided in Appendix A. An appropriate runoff coefficient (C) for each type of land use in the subarea should be selected from this table and multiplied by the percentage of the total area (A) included in that class. The sum of the products for all land uses is the weighted runoff coefficient (Σ[CA]). Good engineering judgment should be used when applying the values presented in Table 3-1, as adjustments to these values may be appropriate based on site-specific characteristics. In any event, the impervious percentage (% Impervious) as given in the table, for any area, shall govern the selected value for C. The runoff coefficient can also be calculated for an area based on soil type and impervious percentage using the following formula:

$$C = 0.90 \times (\%\ \text{Impervious}) + C_p \times (1 - \%\ \text{Impervious})$$

Where: C_p = Pervious Coefficient Runoff Value for the soil type (shown in Table 3-1 as Undisturbed Natural Terrain/Permanent Open Space, 0% Impervious). Soil type can be determined from the soil type map provided in Appendix A.

The values in Table 3-1 are typical for most urban areas. However, if the basin contains rural or agricultural land use, parks, golf courses, or other types of nonurban land use that are expected to be permanent, the appropriate value should be selected based upon the soil and cover and approved by the local agency.

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

3.1.3 Rainfall Intensity

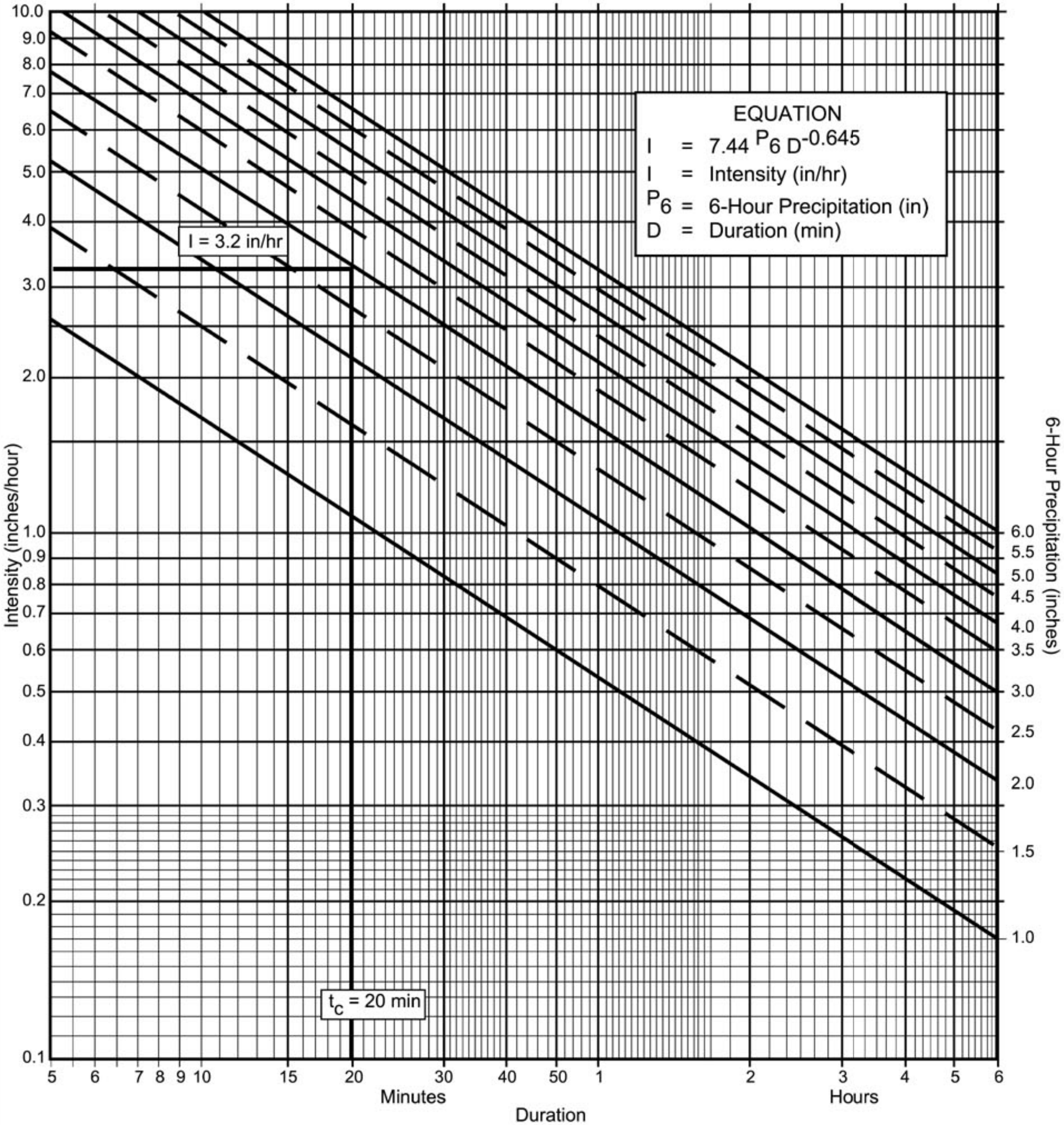
The rainfall intensity (I) is the rainfall in inches per hour (in/hr) for a duration equal to the T_c for a selected storm frequency. Once a particular storm frequency has been selected for design and a T_c calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration Design Chart (Figure 3-1). The 6-hour storm rainfall amount (P_6) and the 24-hour storm rainfall amount (P_{24}) for the selected storm frequency are also needed for calculation of I. P_6 and P_{24} can be read from the isopluvial maps provided in Appendix B. An Intensity-Duration Design Chart applicable to all areas within San Diego County is provided as Figure 3-1. Figure 3-2 provides an example of use of the Intensity-Duration Design Chart. Intensity can also be calculated using the following equation:

$$I = 7.44\ P_6\ D^{-0.645}$$

Where: P_6 = adjusted 6-hour storm rainfall amount (see discussion below)
D = duration in minutes (use T_c)

Note: This equation applies only to the 6-hour storm rainfall amount (i.e., P_6 cannot be changed to P_{24} to calculate a 24-hour intensity using this equation).

The Intensity-Duration Design Chart and the equation are for the 6-hour storm rainfall amount. In general, P_6 for the selected frequency should be between 45% and 65% of P_{24} for the selected frequency. If P_6 is not within 45% to 65% of P_{24}, P_6 should be increased or decreased as necessary to meet this criteria. The isopluvial lines are based on precipitation gauge data. At the time that the isopluvial lines were created, the majority of precipitation gauges in San Diego County were read daily, and these readings yielded 24-hour precipitation data. Some 6-hour data were available from the few recording gauges distributed throughout the County at that time; however, some 6-hour data were extrapolated. Therefore, the 24-hour precipitation data for San Diego County are considered to be more reliable.



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 50 year

(b) P_6 = 3 in., P_{24} = 5.5 , $\frac{P_6}{P_{24}}$ = 54.5 %$^{(2)}$

(c) Adjusted $P_6^{(2)}$ = 3 in.

(d) t_x = 20 min.

(e) I = 3.2 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Example

FIGURE

3-2

3.1.4 Time of Concentration

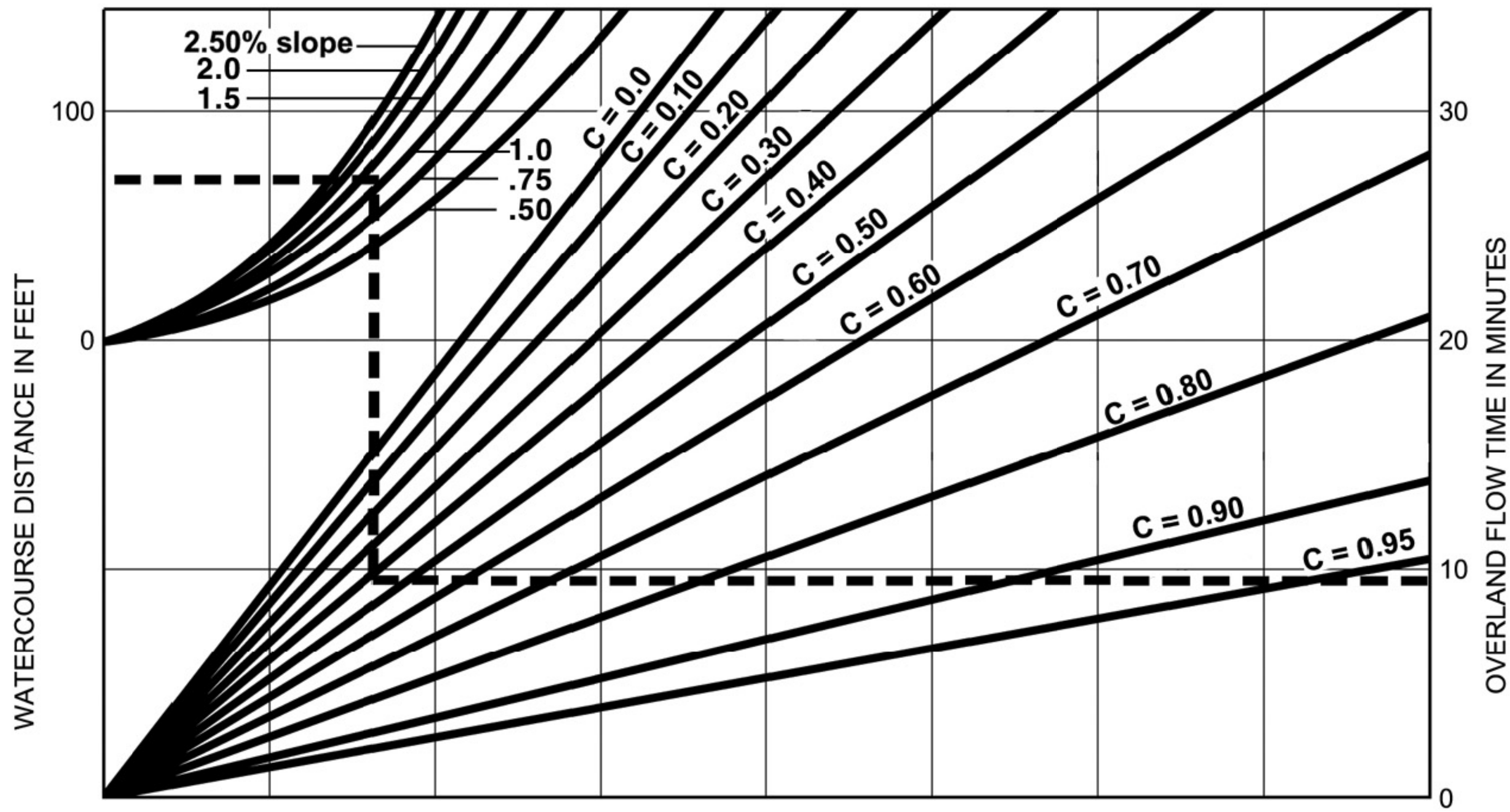
The Time of Concentration (T_c) is the time required for runoff to flow from the most remote part of the drainage area to the point of interest. The T_c is composed of two components: initial time of concentration (T_i) and travel time (T_t). Methods of computation for T_i and T_t are discussed below. The T_i is the time required for runoff to travel across the surface of the most remote subarea in the study, or "initial subarea." Guidelines for designating the initial subarea are provided within the discussion of computation of T_i. The T_t is the time required for the runoff to flow in a watercourse (e.g., swale, channel, gutter, pipe) or series of watercourses from the initial subarea to the point of interest. For the RM, the T_c at any point within the drainage area is given by:

$$T_c = T_i + T_t$$

Methods of calculation differ for natural watersheds (nonurbanized) and for urban drainage systems. When analyzing storm drain systems, the designer must consider the possibility that an existing natural watershed may become urbanized during the useful life of the storm drain system. Future land uses must be used for T_c and runoff calculations, and can be determined from the local Community General Plan.

3.1.4.1 Initial Time of Concentration

The initial time of concentration is typically based on sheet flow at the upstream end of a drainage basin. The Overland Time of Flow (Figure 3-3) is approximated by an equation developed by the Federal Aviation Agency (FAA) for analyzing flow on runaways (FAA, 1970). The usual runway configuration consists of a crown, like most freeways, with sloping pavement that directs flow to either side of the runway. This type of flow is uniform in the direction perpendicular to the velocity and is very shallow. Since these depths are ¼ of an inch (more or less) in magnitude, the relative roughness is high. Some higher relative roughness values for overland flow are presented in Table 3.5 of the *HEC-1 Flood Hydrograph Package User's Manual* (USACE, 1990).



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE **3-3**

Rational Formula - Overland Time of Flow Nomograph

The sheet flow that is predicted by the FAA equation is limited to conditions that are similar to runway topography. Some considerations that limit the extent to which the FAA equation applies are identified below:

- Urban Areas – This "runway type" runoff includes:
  1) Flat roofs, sloping at 1% ±
  2) Parking lots at the extreme upstream drainage basin boundary (at the "ridge" of a catchment area).
     Even a parking lot is limited in the amounts of sheet flow. Parked or moving vehicles would "break-up" the sheet flow, concentrating runoff into streams that are not characteristic of sheet flow.
  3) Driveways are constructed at the upstream end of catchment areas in some developments. However, if flow from a roof is directed to a driveway through a downspout or other conveyance mechanism, flow would be concentrated.
  4) Flat slopes are prone to meandering flow that tends to be disrupted by minor irregularities and obstructions. Maximum Overland Flow lengths are shorter for the flatter slopes (see Table 3-2).

- Rural or Natural Areas - The FAA equation is applicable to these conditions since (.5% to 10%) slopes that are uniform in width of flow have slow velocities consistent with the equation. Irregularities in terrain limit the length of application.
  1) Most hills and ridge lines have a relatively flat area near the drainage divide. However, with flat slopes of .5% ±, minor irregularities would cause flow to concentrate into streams.
  2) Parks, lawns and other vegetated areas would have slow velocities that are consistent with the FAA Equation.

The concepts related to the initial time of concentration were evaluated in a report entitled *Initial Time of Concentration, Analysis of Parameters* (Hill, 2002) that was reviewed by the Hydrology Manual Committee. The Report is available at San Diego County Department of Public Works, Flood Control Section and on the San Diego County Department of Public Works web page.

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

3.1.4.1A Planning Considerations

The purpose of most hydrology studies is to develop flood flow values for areas that are not at the upstream end of the basin. Another example is the Master Plan, which is usually completed before the actual detailed design of lots, streets, etc. are accomplished. In these situations it is necessary that the initial time of concentration be determined without detailed information about flow patterns.

To provide guidance for the initial time of concentration design parameters, Table 3-2 includes the Land Use Elements and other variables related to the Time of Concentration. The table development included a review of the typical "layout" of the different Land Use Elements and related flow patterns and consideration of the extent of the sheet flow regimen, the effect of ponding, the significance to the drainage basin, downstream effects, etc.

3.1.4.1B Computation Criteria

(a) Developed Drainage Areas With Overland Flow - T_i may be obtained directly from the chart, "Rational Formula – Overland Time of Flow Nomograph," shown in Figure 3-3 or from Table 3-2. This chart is based on the Federal Aviation Agency (FAA) equation (FAA, 1970). For the short rain durations (<15 minutes) involved, intensities are high but the depth of flooding is limited and much of the runoff is stored temporarily in the overland flow and in shallow ponded areas. In developed areas, overland flow is limited to lengths given in Table 3-2. Beyond these distances, flow tends to become concentrated into streets, gutters, swales, ditches, etc.

(b) Natural Or Rural Watersheds – These areas usually have an initial subarea at the upstream end with sheet flow. The sheet flow length is limited to 50 to 100 feet as specified in Table 3-2. The Overland Time of Flow Nomograph, Figure 3-3, can be used to obtain T_i. The initial time of concentration can excessively affect the magnitude of flow further downstream in the drainage basin. For instance, variations in the initial time of concentration for an initial subarea of one acre can change the flow further downstream where the area is 400 acres by 100%. Therefore, the initial time of concentration is limited (see Table 3-2).

The Rational Method procedure included in the original Hydrology Manual (1971) and Design and Procedure Manual (1968) included a 10 minute value to be added to the initial time of concentration developed through the Kirpich Formula (see Figure 3-4) for a natural watershed. That procedure is superceded by the procedure above to use Table 3-2 or Figure 3-3 to determine T_i for the appropriate sheet flow length of the initial subarea. The values for natural watersheds given in Table 3-2 vary from 13 to 7 minutes, depending on slope. If the total length of the initial subarea is greater than the maximum length allowable based on Table 3-2, add the travel time based on the Kirpich formula for the remaining length of the initial subarea.

3.1.4.2 Travel Time

The T_t is the time required for the runoff to flow in a watercourse (e.g., swale, channel, gutter, pipe) or series of watercourses from the initial subarea to the point of interest. The T_t is computed by dividing the length of the flow path by the computed flow velocity. Since the velocity normally changes as a result of each change in flow rate or slope, such as at an inlet or grade break, the total T_t must be computed as the sum of the T_t's for each section of the flow path. Use Figure 3-6 to estimate time of travel for street gutter flow. Velocity in a channel can be estimated by using the nomograph shown in Figure 3-7 (Manning's Equation Nomograph).

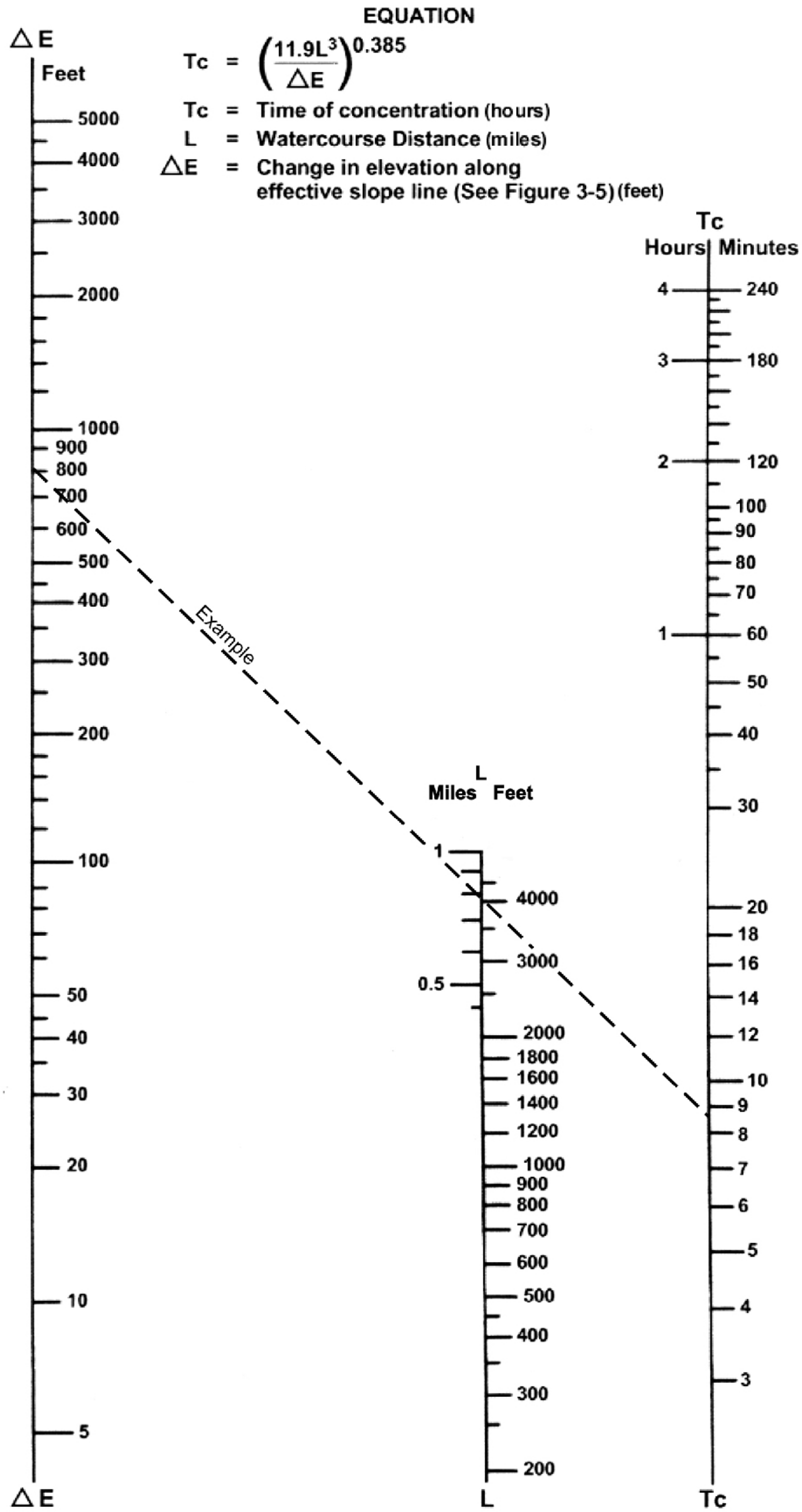
(a) Natural Watersheds – This includes rural, ranch, and agricultural areas with natural channels. Obtain T_t directly from the Kirpich nomograph in Figure 3-4 or from the equation. This nomograph requires values for length and change in elevation along the effective slope line for the subarea. See Figure 3-5 for a representation of the effective slope line.

This nomograph is based on the Kirpich formula, which was developed with data from agricultural watersheds ranging from 1.25 to 112 acres in area, 350 to 4,000 feet in length, and 2.7 to 8.8% slope (Kirpich, 1940). A maximum length of 4,000 feet should be used for the subarea length. Typically, as the flow length increases, the depth of flow will increase, and therefore it is considered a concentration of flow at points beyond lengths listed in Figure 3-2. However, because the Kirpich formula has been shown to be applicable for watersheds up to 4,000 feet in length (Kirpich, 1940), a subarea may be designated with a length up to 4,000 feet provided the topography and slope of the natural channel are generally uniform.

Justification needs to be included with this calculation showing that the watershed will remain natural forever. Examples include areas located in the Multiple Species Conservation Plan (MSCP), areas designated as open space or rural in a community's General Plan, and Cleveland National Forest.

(b) Urban Watersheds - Flow through a closed conduit where no additional flow can enter the system during the travel, length, velocity and T_t are determined using the peak flow in the conduit. In cases where the conduit is not closed and additional flow from a contributing subarea is added to the total flow during travel (e.g., street flow in a gutter), calculation of velocity and T_t is performed using an assumed average flow based on the total area (including upstream subareas) contributing to the point of interest. The Manning equation is usually used to determine velocity. Discharges for small watersheds typically range from 2 to 3 cfs per acre, depending on land use, drainage area, and slope and rainfall intensity.

Note: The MRM should be used to calculate the peak discharge when there is a junction from independent subareas into the drainage system.



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

City of San Diego
2016 STORM WATER STANDARDS
WATER QUALITY STUDY BMP REPORT
RESIDENCE
LOT 15, BLOCK 2 OF MAP 1378
____ MOANA DRIVE
CITY OF SAN DIEGO, CALIFORNIA

F. Dan Rinehart. RCE 28204
July 18, 2016

Prepare a report to identify the required permanent best management practices for Standard Development Project per the City of San Diego's Storm Water Standards.
The City's Storm Water Standards are available online at:
http://www.sandiego.gov/stormwater/pdf/citysdstormwaterstandardsmanualdraft2015.pdf

Potential Pollutants
The potential pollutants identified in this category are Sediments, Nutrients, Trash and Debris, Oxygen Demanding Substances, Oil & Grease, Bacteria and Viruses and Pesticides. All except Oil and Grease are possible pollutants

Your report will identify the 6 Source Control BMP’s and 8 Site Design BMP’s possible for your project. Your report will discuss which of the 14 applies to your project and also discuss why the remaining BMP's are not feasible or applicable to your project.

Required Permanent Best Management Practices for Standard Development Projects

Source Control (SC) BMP Requirements:

How to comply: Projects shall comply with this requirement by implementing source control BMPs listed in this section that are applicable to their project. Applicability shall be determined through consideration of the development project’s features and anticipated pollutant sources. Appendix E provides guidance for identifying source control BMPs applicable to a project. The "Source Control BMP Checklist for All Development Projects" located in Appendix I-4 shall be used to document compliance with source control BMP requirements.

SC-1: Prevent illicit discharges into the MS4

An illicit discharge is any discharge to the MS4 that is not composed entirely of storm water except discharges pursuant to a National Pollutant Discharge Elimination System permit and discharges resulting from firefighting activities. Projects must effectively eliminate discharges of non-storm water into the MS4. This may involve a suite of housekeeping BMPs which could include effective irrigation, dispersion of non-storm water discharges into landscaping for infiltration, and controlling wash water from vehicle washing.

DISCUSSION:

Use Efficient Irrigation Systems & Landscape Design

It is the intent of the design that the system will provide water to plant material in the most efficient and economical manner, incorporating equipment that will be manageable by the maintenance personnel as well as the owner. Sprinklers will be directed away from hardscape and devices will be installed to reduce irrigation after a rain.

Manage Fire Sprinkler System Discharges
All testing discharges from any proposed sprinkler system will be contained and conveyed to the sanitary sewer system

Manage Air Conditioning Condensate
Air conditioning condensate from the house and pool house is minimal if not non-existent and will be directed to landscaped areas.

Manage Vehicle wash water runoff
Any wash water from vehicle washing will be directed into adjacent landscape areas.

SC-2: Identify the storm drain system using stenciling or signage

Storm drain signs and stencils are visible source controls typically placed adjacent to the inlets. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Stenciling shall be provided for all storm water conveyance system inlets and catch basins within the project area. Inlet stenciling may include concrete stamping, concrete painting, placards, or other methods approved by the local municipality. In addition to storm drain stenciling, projects are encouraged to post signs and prohibitive language (with graphical icons) which prohibit illegal dumping at trailheads, parks, building entrances and public access points along channels and creeks within the project area.
Language associated with the stamping (e.g., "No Dumping-Drains to Ocean") must be satisfactory to the City Engineer. Stamping may also be required in Spanish.

DISCUSSION:

Project will not install any public storm drain inlets.

SC-3: Protect outdoor material storage areas from rainfall, run-on, runoff, and wind dispersal

Materials with the potential to pollute storm water runoff shall be stored in a manner that prevents contact with rainfall and storm water runoff. Contaminated runoff shall be managed for treatment incorporate the following structural or pollutant control BMPs for outdoor material storage areas, as applicable and feasible:
Materials with the potential to contaminate storm water shall be:

• Placed in an enclosure such as, but not limited to, a cabinet, or similar structure, or under a roof or awning that prevents contact with rainfall runoff or spillage to the storm water conveyance system; or
• Protected by secondary containment structures such as berms, dikes, or curbs.
• The storage areas shall be paved and sufficiently impervious to contain leaks and spills, where necessary. (continued below)
• The storage area shall be sloped towards a sump or another equivalent measure that is effective to contain spills.
• Runoff from downspouts/roofs shall be directed away from storage areas.

• The storage area shall have a roof or awning that extends beyond the storage area to minimize collection of storm water within the secondary containment area. A manufactured storage shed may be used for small containers.

DISCUSSION:

Design Trash Storage Areas to Reduce Pollution Contribution
Trash will be held within the garage, an interior enclosed area.

SC-4: Protect materials stored in outdoor work areas from rainfall, run-on, runoff, and wind dispersal

Outdoor work areas have an elevated potential for pollutant loading and spills. All development projects shall include the following structural or pollutant control BMPs for any outdoor work areas with potential for pollutant generation, as applicable and feasible:

• Create an impermeable surface such as concrete or asphalt, or a prefabricated metal drip pan, depending on the size needed to protect the materials.
• Cover the area with a roof or other acceptable cover.
• Berm the perimeter of the area to prevent water from adjacent areas from flowing on to the surface of the work area.
• Directly connect runoff to sanitary sewer or other specialized containment system(s), as needed and where feasible. This allows the more highly concentrated pollutants from these areas to receive special treatment that removes particular constituents. Approval for this connection must be obtained from the appropriate sanitary sewer agency.
• Locate the work area away from storm drains or catch basins.

DISCUSSION:

There are no separate material storage areas for this project.

SC-5: Protect trash storage areas from rainfall, run-on, runoff, and wind dispersal

Storm water runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. All development projects shall include the following structural or pollutant control BMPs, as applicable:

• Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This can include berming or grading the waste handling area to prevent run-on of storm water.
• Ensure trash container areas are screened or walled to prevent offsite transport of trash.
• Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
• Locate storm drains away from immediate vicinity of the trash storage area and vice versa.
• Post signs on all dumpsters informing users that hazardous material are not to be disposed.

DISCUSSION:

Design Trash Storage Areas to Reduce Pollution Contribution
Trash will be held within the garage, an interior enclosed area.

SC-6: Use any additional BMPs determined to be necessary by the permittee to minimize pollutant generation at each project site
Appendix E.1 provides guidance on permanent controls and operational BMPs that are applicable at a project site based on potential sources of runoff pollutants at the project site. The project shall implement all applicable and feasible source control BMPs listed in Appendix E.1. In addition to the source control BMPs in Appendix E.1, additional source control requirements apply for the following project types within the City jurisdiction. Guidance for implementing these additional source control requirements are presented in Appendix E.

• **SC-6A: Large Trash Generating Facilities**: Includes but are not limited to restaurants, supermarkets, "big box" retail stores serving food, and pet stores. Refer to Appendix E.20

• **SC-6B: Animal Facilities**: Includes but are not limited to animal shelters, dog daycare centers, veterinary clinics, groomers, pet care stores, and breeding, boarding, and training facilities. Refer to Appendix E.21

• **SC-6C: Plant Nurseries and Garden Centers**: Includes but are not limited to commercial facilities that grow, distribute, sell, or store plants and plant material. Refer to Appendix E.22

• **SC-6D: Automotive-related Uses**: include but are not limited to facilities that perform maintenance or repair of vehicles, vehicle washing facilities, and retail gasoline outlets. Refer to Appendix E.23

DISCUSSION:

Residence, does not apply.

Site Design (SD) BMP Requirements:

How to comply: Projects shall comply with this requirement by using all of the site design BMPs listed in this section that are applicable and practicable to their project type and site conditions. Applicability of a given site design BMP shall be determined based on project type, soil conditions, presence of natural features (e.g. streams), and presence of site features (e.g. parking areas). Explanation shall be provided by the applicant when a certain site design BMP is considered to be not applicable or not practicable/feasible. Site plans shall show site design BMPs and provide adequate details necessary for effective implementation of site design BMPs. The "Site Design BMP Checklist for All Development Projects" located in Appendix I-5 shall be used to document compliance with site design BMP requirements.

SD-1: Maintain natural drainage pathways and hydrologic features
Maintain or restore natural storage reservoirs and drainage corridors (including topographic depressions, areas of permeable soils, natural swales, and ephemeral and intermittent streams)

Buffer zones for natural water bodies (where buffer zones are technically infeasible, require project applicant to include other buffers such as trees, access restrictions, etc.)

During the site assessment, natural drainages must be identified along with their connection to creeks and/or streams, if any. Natural drainages offer a benefit to storm water management as the soils and habitat already function as a natural filtering/infiltrating swale. When determining the development footprint of the site, altering natural drainages should be avoided. By providing a development envelope set back from natural drainages, the drainage can retain some water quality benefits to the watershed. In some situations, site constraints, regulations, economics, or other factors may not allow avoidance of drainages and sensitive areas. Projects proposing to dredge or fill materials in Waters of the U.S. must obtain Clean Water Act Section 401 Water Quality Certification.

Projects proposing to dredge or fill waters of the State must obtain waste discharge requirements. Both the 401 Certification and the Waste Discharge Requirements are administered by the San Diego Water Board. The project applicant shall consult the local jurisdiction for other specific requirements.

Projects can incorporate SD-1 into a project by implementing the following planning and design phase techniques as applicable and practicable:

• Evaluate surface drainage and topography in considering selection of Site Design BMPs that will be most beneficial for a given project site. Where feasible, maintain topographic depressions for infiltration.
• Optimize the site layout and reduce the need for grading. Where possible, conform the site layout along natural landforms, avoid grading and disturbance of vegetation and soils, and replicate the site's natural drainage patterns. Integrating existing drainage patterns into the site plan will help maintain the site's predevelopment hydrologic function.
• Preserve existing drainage paths and depressions, where feasible and applicable, to help
• Structural BMPs cannot be located in buffer zones if a State and/or Federal resource agency (e.g. SDRWQCB, California Department of Fish and Wildlife; U.S. Army Corps of Engineers, etc.) prohibits maintenance or activity in the area.

DISCUSSION:

There are no natural drainage features on or near the site. 401 and 404 do not apply.

SD-2: Conserve natural areas, soils and vegetation

• Conserve natural areas within the project footprint including existing trees, other vegetation, and soils

To enhance a site's ability to support source control and reduce runoff, the conservation and restoration of natural areas must be considered in the site design process. By conserving or restoring the natural drainage features, natural processes are able to intercept storm water, thereby reducing the amount of runoff. The upper soil layers of a natural area contain organic material, soil biota, vegetation, and a configuration favorable for storing and slowly conveying storm water and establishing or restoring vegetation to stabilize the site after construction. The canopy of existing native trees and shrubs also provide a water conservation benefit by intercepting rain water before it hits the ground. By minimizing disturbances in these areas, natural processes are able to intercept storm water, providing a water quality benefit. By keeping the development concentrated to the least environmentally sensitive areas of the site and set back from natural areas, storm water runoff is reduced, water quality can be improved, environmental impacts can be decreased, and many of the site's most attractive native landscape features can be retained. In some situations, site constraints, regulations, economics, and/or other factors may not allow avoidance of all sensitive areas on a project site. Project applicant shall consult the local municipality for jurisdictional specific requirements for mitigation of removal of sensitive areas.

Projects can incorporate SD-2 by implementing the following planning and design phase techniques as applicable and practicable:

• Identify areas most suitable for development and areas that should be left undisturbed. Additionally, reduced disturbance can be accomplished by increasing building density and increasing height, if possible.
• Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
• Avoid areas with thick, undisturbed vegetation. Soils in these areas have a much higher capacity to store and infiltrate runoff than disturbed soils, and reestablishment of a mature vegetative community can take decades.

Vegetative cover can also provide additional volume storage of rainfall by retaining water on the surfaces of leaves, branches, and trunks of trees during and after storm events.
• Preserve trees, especially native trees and shrubs, and identify locations for planting additional native or drought tolerant trees and large shrubs.
• In areas of disturbance, topsoil should be removed before construction and replaced after the project is completed. When handled carefully, such an approach limits the disturbance to native soils and reduces the need for additional (purchased) topsoil during later phases.
• Avoid sensitive areas, such as wetlands, biological open space areas, biological mitigation sites, streams, floodplains, or particular vegetation communities, such as coastal sage scrub and intact forest. Also, avoid areas that are habitat for sensitive plants and animals, particularly those, State or federally listed as endangered, threatened or rare. Development in these areas is often restricted by federal, state and local laws.

DISCUSSION:

There are no natural areas within the site.

SD-3: Minimize impervious area

• Construct streets, sidewalks or parking lots aisles to the minimum widths necessary, provided public safety is not compromised
• Minimize the impervious footprint of the project

One of the principal causes of environmental impacts by development is the creation of impervious surfaces. Imperviousness links urban land development to degradation of aquatic ecosystems in two ways:

• First, the combination of paved surfaces and piped runoff efficiently collects urban pollutants and transports them, in suspended or dissolved form, to surface waters. These pollutants may originate as airborne dust, be washed from the atmosphere during rains, or may be generated by automobiles and outdoor work activities.

• Second, increased peak flows and runoff durations typically cause erosion of stream banks and beds, transport of fine sediments, and disruption of aquatic habitat. Measures taken to control stream erosion, such as hardening banks with riprap or concrete, may permanently eliminate habitat. Impervious cover can be minimized through identification of the smallest possible land area that can be practically impacted or disturbed during site development. Reducing impervious surfaces retains the permeability of the project site, allowing natural processes to filter and reduce sources of pollution.

Projects can incorporate SD-3 by implementing the following planning and design phase techniques as applicable and practicable:

• Decrease building footprint through (the design of compact and taller structures when allowed by local zoning and design standards and provided public safety is not compromised.
• Construct walkways, trails, patios, overflow parking lots, alleys and other low-traffic areas with permeable surfaces.
• Construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and alternative transportation (e.g. pedestrians, bikes) are not compromised.
• Consider the implementation of shared parking lots and driveways where possible.
• Landscaped area in the center of a cul-de-sac can reduce impervious area depending on configuration. Design of a landscaped cul-de-sac must be coordinated with fire department personnel to accommodate turning radii and other operational needs.
• Design smaller parking lots with fewer stalls, smaller stalls, more efficient lanes.
• Design indoor or underground parking.

• Minimize the use of impervious surfaces in the landscape design.

DISCUSSION:

Optimize the Site Layout.
The runoff from the house and the detached will be directed to landscaped area as much as possible to maximize the distance traveled before entering a solid or paved drainage system. The area has been previously landscaped and there are no natural areas and/or vegetation. Significant trees and landscaping will be planted to insure a low impact design.

Minimize Impervious Footprint
Every effort will be made to decrease impervious footprint and increase the separation between impervious areas. The house is a two story structure. The walkway around the house to the street will be constructed by widely separated paving blocks. The minimal runoff will drain into the adjacent pervious areas. Storm water runoff sheet flows along the longest possible the street or alley.

SD-4: Minimize soil compaction

• **Minimize soil compaction in landscaped areas**

The upper soil layers contain organic material, soil biota, and a configuration favorable for storing and slowly conveying storm water down gradient. By protecting native soils and vegetation in appropriate areas during the clearing and grading phase of development the site can retain some of its existing beneficial hydrologic function. Soil compaction resulting from the movement of heavy construction equipment can reduce soil infiltration rates. It is important to recognize that areas adjacent to and under building foundations, roads and manufactured slopes must be compacted with minimum soil density requirements in compliance with local building and grading ordinances.

Projects can incorporate SD-4 by implementing the following planning and design phase techniques as applicable and practicable:

• Avoid disturbance in planned green space and proposed landscaped areas where feasible. These areas that are planned for retaining their beneficial hydrological function should be protected during the grading/construction phase so that vehicles and construction equipment do not intrude and inadvertently compact the area.
• In areas planned for landscaping where compaction could not be avoided, re-till the soil surface to allow for better infiltration capacity. Soil amendments are recommended and may be necessary to increase permeability and organic content. Soil stability, density requirements, and other geotechnical considerations associated with soil compaction must be reviewed by a qualified landscape architect or licensed geotechnical, civil or other professional engineer.

DISCUSSION:

Construction Considerations
Soil compaction will be done for the structures only. Landscaped areas will have minimum grading and wheel compaction only.

SD-5: Disperse impervious areas
Disconnect impervious surfaces through disturbed pervious areas

Design and construct landscaped or other pervious areas to effectively receive and infiltrate, retain and/or treat runoff from impervious areas prior to discharging to the MS4

Impervious area dispersion (dispersion) refers to the practice of essentially disconnecting impervious areas from directly draining to the storm drain system by routing runoff from impervious areas such as rooftops, walkways, and driveways onto the surface of adjacent pervious areas. The intent is to slow runoff discharges, and reduce volumes while achieving incidental treatment. Volume reduction from dispersion is dependent on the infiltration characteristics of the pervious area and the amount of impervious area draining to the pervious area. Treatment is achieved through filtration, shallow sedimentation, sorption, infiltration, evapotranspiration, biochemical processes and plant uptake.

The effects of imperviousness can be mitigated by disconnecting impervious areas from the drainage system and by encouraging detention and retention of runoff near the point where it is generated. Detention and retention of runoff reduces peak flows and volumes and allows pollutants to settle out or adhere to soils before they can be transported downstream. Disconnection practices may be applied in almost any location, but impervious surfaces must discharge into a suitable receiving area for the practices to be effective. Information gathered during the site assessment will help determine appropriate receiving areas.

Project designs should direct runoff from impervious areas to adjacent landscaping areas that have higher potential for infiltration and surface water storage. This will limit the amount of runoff generated, and therefore the size of the mitigation BMPs downstream. The design, including consideration of slopes and soils, must reflect a reasonable expectation that runoff will soak into the soil and produce no runoff of the DCV. On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas that have higher potential for infiltration. Or use low retaining walls to create terraces that can accommodate BMPs.

Projects can incorporate SD-5 by implementing the following planning and design phase techniques as applicable and practicable:

• Implement design criteria and considerations listed in impervious area dispersion fact sheet (SD-5) presented in Appendix E.
• Drain rooftops into adjacent landscape areas.
• Drain impervious parking lots, sidewalks, walkways, trails, and patios into adjacent landscape areas.
• Reduce or eliminate curb and gutters from roadway sections, thus allowing roadway runoff to drain to adjacent pervious areas.
• Replace curbs and gutters with roadside vegetated swales and direct runoff from the paved street or parking areas to adjacent LID facilities. Such an approach for alternative design can reduce the overall capital cost of the site development while improving the storm water quantity and quality issues and the site's aesthetics.
• Plan site layout and grading to allow for runoff from impervious surfaces to be directed into distributed permeable areas such as turf, landscaped or permeable recreational areas, medians, parking islands, planter boxes, etc.
• Detain and retain runoff throughout the site. On flatter sites, landscaped areas can be interspersed among the buildings and pavement areas. On hillside sites, drainage from upper areas may be collected in conventional catch basins and conveyed to landscaped areas in lower areas of the site.
• Pervious area that receives run on from impervious surfaces shall have a minimum width of 10 feet and a maximum slope of 5%.

DISCUSSION:

Disperse Runoff to Adjacent Landscaping

The roof drainage will flow to the surrounding grassed areas and in a few areas onto semi-permeable paved areas.

SD-6: Collect runoff

• Use small collection strategies located at, or as close to as possible to the sources (i.e. the point where storm water initially meets the ground) to minimize the transport of runoff and pollutants to the MS4 and receiving waters

• Use permeable material for projects with low traffic areas and appropriate soil conditions

Distributed control of storm water runoff from the site can be accomplished by applying small collection techniques (e.g. green roofs), or integrated management practices, on small sub-catchments or on residential lots. Small collection techniques foster opportunities to maintain the natural hydrology provide a much greater range of control practices. Integration of storm water management into landscape design and natural features of the site, reduce site development and long-term maintenance costs, and provide redundancy if one technique fails. On flatter sites, it typically works best to intersperse landscaped areas and integrate small scale retention practices among the buildings and paving.

Permeable pavements contain small voids that allow water to pass through to a gravel base. They come in a variety of forms; they may be a modular paving system (concrete pavers, grass-pave, or gravel-pave) or poured in place pavement (porous concrete, permeable asphalt). Project applicants should identify locations where permeable pavements could be substituted for impervious concrete or asphalt paving. The O&M of the site must ensure that permeable pavements will not be sealed in the future. In areas where infiltration is not appropriate, permeable paving systems can be fitted with an under drain to allow filtration, storage, and evaporation, prior to drainage into the storm drain system.

Projects can incorporate SD-6 by implementing the following planning and design phase techniques as applicable and practicable:

• Implementing distributed small collection techniques to collect and retain runoff
• Installing permeable pavements (see SD-6B in Appendix E)

DISCUSSION:
Planters cannot be used on the small site.

SD-7: Landscape with native or drought tolerant species

All development projects are required to select a landscape design and plant palette that minimizes required resources (irrigation, fertilizers and pesticides) and pollutants generated from landscape areas. Native plants require less fertilizers and pesticides because they are already adapted to the rainfall patterns and soils conditions. Plants should be selected to be drought tolerant and not require watering after establishment (2 to 3 years). Watering should only be required during prolonged dry periods after plants are established. Final selection of plant material needs to be made by a landscape architect experienced with LID techniques. Microclimates vary significantly throughout the region and consulting local municipal resources will help to select plant material suitable for a specific geographic location.

Projects can incorporate SD-7 by landscaping with native and drought tolerant species. Recommended plant list is included in Appendix E (Fact Sheet PL).

DISCUSSION:
Drought tolerant species will be used as much as possible.

SD-8: Harvest and use precipitation

Harvest and use BMPs capture and stores storm water runoff for later use. Harvest and use can be applied at smaller scales (Standard Projects) using rain barrels or at larger scales (PDPs) using cisterns. This harvest and use technique has been successful in reducing runoff discharged to the storm drain system conserving potable water and recharging groundwater.

Rain barrels are above ground storage vessels that capture runoff from roof downspouts during rain events and detain that runoff for later reuse for irrigating landscaped areas. The temporary storage of roof runoff reduces the runoff volume from a property and may reduce the peak runoff velocity for small, frequently occurring storms. In addition, by reducing the amount of storm water runoff that flows overland into a storm water conveyance system (storm drain inlets and drain pipes), less pollutants are transported through the conveyance system into local creeks and the ocean. The reuse of the detained water for irrigation purposes leads to the conservation of potable water and the recharge of groundwater. SD-8 fact sheet in Appendix E provides additional detail for designing Harvest and Use BMPs. Projects can incorporate SD-8 by installing rain barrels or cisterns, as applicable.

DISCUSSION:
The small lot area does not lend itself to water storage for later use.