Post Construction Stormwater Management Requirements for Development Projects and Recommendations for the City of Monterey

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Executive summary

This study was conducted using previous data from state and government agencies. The primary objectives of this study were to research and review the previous data for local groundwater for post construction stormwater management requirements for development projects within the City of Monterey, California, 2) provide mapping of all monitoring wells with depth to water data within the City limits, 3) conduct a Geographic Information Systems (GIS) analysis to delineate slope, hydrologic soil groups, watershed management zones, infiltration and runoff potential 4) quantify the characteristics of those watershed management zones, and 5) provide recommendations for post construction stormwater management requirements for development projects in the joint Effort permit in the City of Monterey California.

Urbanized areas alter natural hydrology through building coverage and other impervious surface coverage. Impervious surfaces harbor pollutants including toxic metals, chemicals from vehicles, animal feces, and trash; this waste gets into the storm drains when it rains and runs off into receiving waterways. Polluted runoff in areas with high impervious cover poses a danger to not only the flora and fauna that inhabit the receiving waterways, but also to humans that recreate in those waterways. The City of Monterey (City) stormwater runoff drains into local creeks, lakes, ponds, and eventually the Monterey Bay National Marine Sanctuary (MBNMS). The United States Environmental Protection Agency (EPA) and the State Water Resources Control Board (SWRCB) regulate municipal and other stormwater discharges into receiving waters. Monterey is currently exploring mitigation measures to improve stormwater quality and decrease stormwater runoff with the Phase 2 permit and joint effort.

To help the City site and select appropriate Best Management Practices (BMP’s) this study provides maps of the watersheds with respect to slope, Hydrologic Soil Groups, local geology, percent impervious coverage, and discrete groundwater data.

This study is a first attempt at analyzing data from the Regional Board. The data retrieved for all physical characteristics studied here in Monterey are at a large scale and may not accurately represent physical land characteristics within the City. Further refinements will need to be done by the city so the data fits the reality of local knowledge. At the site development scale, site-specific engineering evaluations are necessary for any development project proposed.
Acronyms

BMPs – Best Management Practices
CCRWQCB – Central Coast Regional Water Quality Control Board
CWA – Clean Water Act
DEM – Digital Elevation Model
DTSC- Department of Toxic Substances Control
EPA – Environmental Protection Agency

“First Flush” – commonly used term in municipal planning that refers to a season’s first rainstorm event that produces enough runoff to transport pollutants that have accumulated over several months. In Monterey County, this event usually occurs in the fall.

GIS – Geographic Information Systems
HSG- Hydrologic Soil Group
LID – Low Impact Development/Design
MBNMS – Monterey Bay National Marine Sanctuary
MRSWMP - Monterey Regional Storm Water Management Program
MS4s – Municipal Separate Storm Sewer Systems
NRCS-Natural Resources Conservation Service
NPDES – National Pollutant Discharge Elimination System
PLZ- Physical Landscape Zone
SWRCB – State Water Resources Control Board
USDA – United States Department of Agriculture Forest Service
USGS – United States Geologic Survey
WMZ- Watershed Management Zone

*Definitions are on pg 26
1 Introduction/ Background

There is a lack of comprehensive understanding of the groundwater and land characteristics in the City of Monterey (City). Knowledge of the monitoring well locations, slope, hydrologic soil groups, local geology, and percent impervious coverage, would enable the City to further assess the efficacy of potential mitigation measures as presented in the Joint Effort, designed to reduce the potential for polluted urban runoff. This report describes a brief study with the following two goals: 1) to examine the applicability of new LID regulations to the city of Monterey and its physical landscape, 2) to Investigation of groundwater data and depth to groundwater levels in city to aid new LID program.

Due to the temperate weather, and proximity to the Monterey Bay National Marine Sanctuary (MBNMS), the City has historically been an attractive location for urban development. As a result of urbanization and local population growth, impervious surface areas continue to increase with structures such as roads, parking lots, and buildings. In fact, the city is almost fully built out. As a result, the management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of future development on water quality. Impervious surfaces such as rooftops, roads, parking lots, and sidewalks due to land development can have a detrimental effect on local water quality and aquatic systems. Runoff from impervious areas can contain a variety of pollutants that are detrimental to water quality, including sediment, nutrients, toxic metals, pathogenic bacteria, and petroleum hydrocarbons. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

This study is a first attempt at analyzing data from the Regional Board. The data retrieved for all physical characteristics studied here in Monterey are at a large scale and may not accurately represent physical land characteristics within the City. Further refinements will need to be done by the city so the data fits the reality of local knowledge. At the site development scale, site-specific engineering evaluations are necessary for any development project proposed.

1.1 Clean Water Act

As noted by the Environmental Protection Agency (EPA), “The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters”(epa.gov). Originally the law was enacted in 1948 and called the “Federal Water Pollution Control Act”; however, in 1972 the act was reorganized and renamed the “Clean Water Act”. The CWA made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit was obtained.

1.2 National Pollutant Discharge Elimination System

In order to control point source discharges the EPA created its National Pollutant Discharge Elimination System (NDES) permit program. Most individual homes do not need a NPDES permit; the sources that must obtain the permits are industrial, municipal, and other industries that have discharges that go directly into the surface water. In California, the EPA delegates regulatory authority to the State Water Resources Control Board (SWRCB), which includes the responsibility for issuing and enforcing NPDES permits. In 1987 amendments to the CWA included a two-phase plan to address stormwater runoff from municipal separate storm sewer systems (MS4s). MS4s are defined as a publically owned stormwater
conveyance system that is not combined with a sanitary sewer collection and treatment system sewer. Phase I of the NPDES permit required municipalities with a population over 100,000 people to follow the permit program. Later, Phase II became effective and required smaller municipalities like the City of Monterey, to gain permit coverage and enforce water quality regulations locally. The Phase II permit also includes “non-traditional” permitees such as military bases, public campuses, and prison and hospital complexes to follow the NPDES permit program. In the early 2000’s the SWRCB required Monterey to apply for a NPDES permit to minimize runoff pollutants to the maximum extent possible.

1.3 Monterey Regional Storm Water Management Program
The City of Monterey along with other local partner agencies developed a regional storm water management plan as part of their NPDES permits. That plan is called the M.R.S.W.M.P. (MRSWMP). The purpose of the MRSWMP is to apply and enforce a series of storm water best management practices (BMPs) in each jurisdiction to protect water quality. These BMPs are designed to reduce the discharge of pollutants from the MS4’s to the “maximum extent practicable,” and to satisfy the appropriate water quality requirements of the CWA. The BMPs are grouped under the following six “Minimum Control Measures”, which are required under the Phase II rule regulations:

1. Public Education and Outreach
2. Public Participation/Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Runoff Control
6. Pollution Prevention/Good Housekeeping for Municipal Operations

The MRSWMP describes the organizational framework under which the participating groups work together to accomplish the objectives of the Program. The MRSWMP also describes how the BMPs and Measurable Goals will be applied and enforced within the jurisdictional boundaries of each of the participating groups. Using the very broad list of recommended BMPs and Measurable Goals promulgated by the EPA, the MRSWMP list contains those BMPs and Measurable Goals that the participants believe will be most useful and effective in reducing the discharge of pollutants from storm sewer systems within the particular geographic area covered by this permit.

1.4 Joint Effort
The Central Coast Regional Water Quality Control Board (Water Board) is offering municipalities the option of forming and participating in a Joint Effort, led by a consultant team, to develop hydromodification control criteria to meet the Water Board's stormwater regulations for new and redevelopment for post construction runoff control. Hydromodification is alteration of the natural flow of the water through a landscape. The Joint Effort for Hydromodification Control is an effort to create a method for developing hydromodification control criteria, derive criteria by applying the methodology, and support implementation of the resulting criteria for new and redevelopment projects. The effort includes oversight by the Water Board; a team of subject area experts to execute the scope of work; and participating municipalities. The Water Board is using this work to create a process to achieve healthy
watersheds, similar to the State Board’s goals for statewide healthy watersheds. Compared to the Phase I communities, many Phase II communities are small, have fewer resources, and possess less internal expertise to develop and execute hydromodification controls. By participating in a Joint Effort led by subject area experts, municipalities will be supported toward optimal water quality protection. Municipalities can then propose these resulting hydromodification control criteria to the Water Board to meet the requirements of their NPDES Municipal Stormwater Permit. The Joint Effort is a strategic, cost-efficient way for municipalities to integrate hydromodification control principles into the post-construction runoff control sections of their stormwater programs.

Through implementation of the Post-Construction Requirements, municipalities will ensure that the new and redevelopment projects they approve integrate measures into their design and construction to protect, or to the extent feasible, restore the processes supporting healthy aquatic systems throughout the life of the project. The urbanized portions of the Central Coast Region are categorized into 10 Watershed Management Zones (WMZs). In the terminology of the Joint Effort, every WMZ has two attributes: its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. These combine to define the “Watershed Management Zones,” of which there are 90 unique combinations (reflecting 15 Physical Landscape Zones and 6 receiving water types). Designated Groundwater Basins of the Central Coast Region underlie some but not all WMZs in urbanized portions of the Central Coast Region. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Requirements to address the impacts of development on those watershed processes and beneficial uses. The primary objective of these Post-Construction Stormwater Management Requirements (Post-Construction Requirements) is to ensure that the Permittee is reducing pollutant discharges to the Maximum Extent Practicable and preventing stormwater discharges from causing or contributing to a violation of receiving water quality standards in all applicable development projects that require approvals and/or permits issued under the Permittee’s planning, building, or other comparable authority. Maintenance and restoration of watershed processes impacted by stormwater management is necessary to protect water quality and beneficial uses.

The reason for implementing this research is to develop an understanding of ground water characteristics and how they impact the City of Monterey’s Low Impact Development Program. LID is defined by the Central Coast Regional Water Board (Regional Board) as “minimizing or eliminating pollutants in storm water through natural processes and maintaining pre-development hydrologic characteristics, such as flow patterns, surface retention, and recharge rates”. By initiating the characterization of groundwater characteristics (gradients, elevations, and quality) within the city, the City can use these characteristics to support groundwater understanding, regulatory requirements and decision-making processes for the Low Impact Development Program. Currently the City of Monterey has approximately 15 urban watersheds that contribute urban storm water to local streams, lakes, and Monterey Bay National Marine Sanctuary. Most watersheds expand beyond the City jurisdictional boundary and include a groundwater component. The City is currently in the development of a new LID program that requires development projects to be managed on a “Watershed Management Zone” (WMZ) basis. Although the Regional Board plans to provide the WMZs to the City, the one key informational item missing from the program will be the groundwater component. Groundwater is an important component when considering the design/construction of permanent LID measures; therefore, research of local groundwater characteristics is necessary.
2 Methods

Examination of current and past literature was necessary to develop a solid understanding of current regulations and how various government agencies and laws work within the city of Monterey. It was necessary to have an understanding of the CWA, NPDES, MRSWMP, and responsibilities the CCWQCB. Depth to water date was needed for this study because this data is a limiting factor for different BMP’s of Low impact development and the Joint Effort. Research was done through the internet on government websites and by contacting different local agencies that could potentially have depth to water data.

After the data collection process, the data was analyzed through Geographic Information Systems (GIS). In order to use GIS, an online course was taken through esri.com. After the basics were learned and with the help of other engineering staff within the City of Monterey, maps displaying different attributes were completed. Fourteen (14) different maps were created using pervious layers and shape files from the City of Monterey, California State University Monterey Bay, Central Coast Regional Water board, esri.com, and NRCS’s Soil Data Mart. Through the maps created and by reading many different permits and permit drafts, the study could identify some gaps and errors in the draft regulations needing clarification to better implement stormwater management approaches in the Joint Effort. Lastly, all of the information regarding the existing data, created maps, and errors were written in this final report.
3 Results

3.1 Slope of Monterey

The slope classification was created from using GIS to calculate on a digital elevation model image from the USGS. Different BMP’s call for different slope grades in order for them to be successful. The lower the slope is more favorable for groundwater recharge (i.e. less than 10%). According to the Joint Effort low slope is <10%, a medium slope is 10 %< x<40%, and a high slope is 40% slope or greater. The areas with a lower percent slope are around downtown Monterey, Del Monte Ave, and lake El Estero. The areas of the west side of the City around New Monterey, and the Community Hospital of the Monterey Peninsula have a much higher slope.

The City has 3612.8 acres at slope of 3% or less. The City has 1886.6 acres at a slope of above 3%. Therefore, 66% of the city has a slope of ≤3%. Additionally 93% of City is at a hill slope of ≤10%.

![City of Monterey Slope Classification](image)

Figure 1. Slope Classification of Monterey. Elevation source: USGS- DEM (elevation, hillshade, contours): 1/9 arc second (~3m)
3.2 Geology of Monterey

There are three different geology classifications Igneous, metamorphic, and Sedimentary. Volcanic rocks are formed from liquid magma that has solidified. Sedimentary rock is formed by sediment deposits pushing down on one another with high amounts of force. The volcanic igneous rocks are found on the western edge of the city. Most of the City is covered with sedimentary rocks from both the Tertiary and Quaternary times in the geologic history.

The City has 4974 acres that are sedimentary which is 90% of the city. Much of the Quaternary sedimentary deposits have impervious surfaces, not ideal for infiltration and water management practices (Figure 12).

3.3 Lithology of Monterey

The City of Monterey is made up of several different types of rock types (Lithology). The lithology types have different ways of formation and properties. The deposits are favorable for infiltration compared to Granodiorite which has a low infiltration potential. Geologic Faults also exist within the city limits. The west side of the City is made up of Granodiorite an igneous rock. The central and southern portion of the City consists of shale a lithotype made up of trillions of marine organisms layered on top of one another. The man made deposits exist in areas of low slope and near water bodies such as lake El Estero.
3.4 Physical Landscape Zone

In the Joint Effort Physical Landscape Zones (PLZ) were classified from two different attributes, hill slope and geologic material. This Graphic has six different PLZ’s. They consist of both sedimentary and crystalline rock with low (<10%) and medium (10 %< X<40%) slopes. By looking at Figure 3 the Pre-Quaternary crystalline rocks are Granodiorite, and the Early to Mid-Tertiary sedimentary rocks are shale. The areas near the Ocean are made of Quaternary sedimentary deposits; those are also the areas of lower slope (Figure 1).
3.5 Infiltration Potential

Within the Watershed Characterization Document on the CCRWQB website there is a chart that has the infiltration potentials of geologic material with its slope. This map is representation of the infiltration column for the Monterey area. Nearly half of the City of Monterey has High Infiltration potential. The areas of lower infiltration are on the west side of the city. The areas of low infiltration potential are made from crystalline rock which has a not pervious. The areas of higher infiltration potential are consisting of sedimentary rocks and deposits.

The City has 4280.6 acres of land (77.5%) with the ranking of high infiltration potential. The City has 806.1 acres of land (14%) with the ranking of medium infiltration potential. The City has 435 acres of land (8.5%) with the ranking of low infiltration potential. In areas around Lighthouse Ave and Pacific Street there exist high amounts of impervious surface and Hydrologic Soil Group D (Figure 10, Figure 12).
Figure 5. Infiltration potential of Physical Landscape Zone (slope and geologic material)

<table>
<thead>
<tr>
<th>Slope class</th>
<th>Geologic unit</th>
<th>Overland flow (incl. sheetwash)</th>
<th>Infiltration</th>
<th>Interflow</th>
<th>Groundwater recharge</th>
<th>Creep</th>
<th>Erosion and gullying</th>
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<tr>
<td>0–10%</td>
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<td>&gt;40%</td>
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Table. 1 Rating from low too high for different land and soil characteristics based off of geologic material and slope. Retrieved from page 23 of:
3.6 Receiving Water Type

During rains stormwater moves to a receiving water body. These can be a stream, a lake, a wetland, or the ocean. Watershed Management Zones (WMZ) all have a specific receiving water type. WMZ are further discussed on in the next Figure 7 and Attachment A. The areas in the southwestern part of the city drain to local streams. The central part of the city where lake El Estero is located drains to the surrounding wetland. New Monterey along with parts of downtown and along the beach drains to the Ocean.

![Watershed Management Zone with Receiving Water Type](image)

Figure 6. Receiving Water Type with Watershed Management Zones. WMZ and receiving water type shapefile from Water Board.

3.7 Watershed Management Zones

The Regional Water Quality Control Board has divided the city into multiple Watershed Management Zones (WMZs). Each WMZ was delineated using two attributes its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. Each WMZ and, where present, groundwater basin, is aligned with specific Post Construction Stormwater Management Design Requirements for new and redevelopment projects to address the impacts of urbanization on the watershed processes and beneficial uses. The WMZ 1 exists near the airport and fairgrounds on the eastern side of the City and extends to potions of downtown. New Monterey is made
up of WMZ 4 and only a small portion of the City has WMZ 3. More information of specific WMZs in Attachment A and B.

![Watershed Management Zone within the City of Monterey](image)

**Figure 7. Watershed Management Zones of Monterey. WMZ data from Water Board.**

### 3.8 Groundwater Basin

There is an underlying groundwater basin under a portion of the City of Monterey. The management approach according to the Joint Effort is infiltration for WMZs that overlie a groundwater basin. For the City of Monterey the only WMZs that have special management strategies and requirements is WMZ 4*, which is made up of the same geologic material as 4, but 4* overlies a groundwater basin. The Seaside groundwater basin underlies half of the City, specifically the Eastern edge of Monterey.
Figure 8. Watershed Management Zones with underlying groundwater basin. Groundwater basin data from Water Board.

Figure 9. World map showing the City of Monterey and surrounding areas that have an underlying groundwater basin.
3.9 hydrologic Soil Groups

Hydrologic Soil Groups (HSGs) indicate the transmission rate at which the water moves through the soil. There are four different HSGs labeled A through D. HSG A is normally composed of a sand and has a high infiltration rate and low run off rate. HSG D is a soil with more clay, giving it a low infiltration rate and a high runoff potential. The western sides of the City, including New Monterey and downtown have the HSG D. The eastern sides of the city have the HSGs A and B.

The City has 39.5% of HSG D in the city (2186 acres). The City has 10.5% of HSG C the city (580 acres). The City has 29% of HSG B in the city (1606 acres). Lastly, the City has 17% of HSG A in the city (941 acres). The location of HSG A is also generally impervious (Figure 12).

Figure 10. Hydrologic Soil Groups in Monterey with infiltration rates and runoff potential. HSG data from Water Board

This Figure shows which HSGs exist in different areas of the city. This map also shows what HSG exist in different WMZs. This information can help determine if infiltration is possible for WMZs and their specific management approaches.
3.10 Percent land Imperviousness

Impervious surface is produced by material that is impenetrable. The increase of impervious surfaces is caused by further land development such as rooftops, roads, parking lots, and sidewalks. Urbanized areas alter natural hydrology through building coverage and other impervious surface coverage. The areas with a high percent of impervious coverage are in downtown Monterey and along the coast near Del Monte Ave. Another, area of high imperviousness is near the seaside bordered on the eastern side of the City. The areas that are pervious are areas that generally have a high slope ad less development. These pervious areas are in the southwestern part of the City.

Areas with a percent of land imperviousness of 0-25% within the City are 54.4%. Areas with a percent of land imperviousness of 25-50% within the city are 19.2%. Areas with a percent of land imperviousness of 50-75% within the city are 19.3%. Areas with a percent of land imperviousness of 75-100% within the city are 7.1%. In the locations of low imperviousness (0-50%) where infiltration is favorable there exist large areas of HSG D and C, and higher slopes (Figure 10, Figure 1).
Figure 12. Percent land imperviousness of the City of Monterey and surrounding area. Impervious data from: USGS National Map Viewer

### 3.11 Pervious Area Infiltration Potential

In this study pervious areas were classified by less than 50% coverage of impervious surfaces. This map only shows the areas that are pervious (<50% coverage). Infiltration is only realistic in pervious areas where the water can soak into the ground. This map also shows HSGs to further see the Infiltration potential of certain locations. The land area which HSG A covers is only in the eastern side of the City. The southwestern portion of the City with the most pervious area has HSGs B, C, and D.

HSG A exists in 13% of the pervious areas in Monterey. HSG B exists in 34% of the pervious areas in Monterey. HSG C exists in 13% of the pervious areas in Monterey. And with the highest coverage HSG D exists in 37% of Monterey.
Figure 13. The infiltration potential of pervious areas (pervious- less than 50% impervious coverage) using Hydrologic Soil Groups in Monterey. White areas are impervious. Impervious data from: USGS National Map Viewer

3.12 Depth to Water

With data from the Department of Toxic Substances Control’s database “Envirostor” from each monitoring well with depth to water data the historic high was recorded and displayed on the map. The wells exist in clusters near previous and past gas stations. This map shows the location of the well and the historic depth to groundwater height for that well. Many of the wells depth to water are very close to the surface closer than half a foot.

There are 62 (20%) wells with a depth to water of ≤ 2ft. There are 130 (42%) wells with a depth to water ≤4ft. There are 64 (20.5%) wells with a depth of at least 10ft deep.
4 Discussion:

A majority the City has a slope of 3% or less (Figure 1). Many BMPs and management approaches only work with low slopes, many as low as 1%. However a few BMPs will work at slopes up to 10% hillslope (BMP Guidance Manual). Overall the City has 93% of its area with less than 10% slope, yet LID is not completely applicable because much of the areas with lower slopes have HSGs (Figure 10) that limit infiltration and are covered with impervious surfaces (Figure 12).

The Geology of the city is 90% sedimentary deposits from different times in the geologic history. Sedimentary deposits are favorable for infiltration, Quaternary more than Tertiary. On the west side of the City there are patches of Igneous and Metamorphic rock that are crystalline and thus have poor infiltration rates. There are many different lithologic types within the city: sand, deposits, shale, and more. With the knowledge of lithologic types it is possible to have a better understanding of how infiltration can be implemented.

Even though the Joint Effort identifies 15 different PLZs only 6 PLZs exist within the city. According to the Table 1 and the map created (Figure 5) there is a high Infiltration potential throughout the city based on the areas geologic makeup and slope. There is an area of concern on the west side of the city were infiltration potential is low as a result of the crystalline rock. In addition, many of those areas that would have a high infiltration potential in fact do not, because impervious surfaces cover 26% of the City (Figure 12). And land area with HSGs D and C exist in 50% of the pervious surfaces (Figure 13). Both The HSGs and the impervious surfaces will impair the City’s applicably for the LID program.
This study helped identify what specific receiving water types exist within the City. It is necessary to understand what water body the water drains to so the appropriate management approaches can be completed. With the receiving water type and PLZs, the CCRWCB was able to divide the city into different WMZs. There are 7 MMZs within the City of Monterey: 1, 2, 3, 4, 4*, 9, and 10. More information about each WMZ can be found in Attachment A.

Understanding the HSGs is also going to be vital when looking at the application of LID in Monterey. The HSGs indicate the transmission rate at which water moves through the soil. The City has all four HSGs and some locations that are denoted as “N/A”. The City has a high proportion (39.5%) of land area with HSG D, which consists of clay soils and 10.5% of land area with HSG C (figure 10). Having soils C and D are not ideal for infiltration. The water cannot move through the soil well and therefore has a high runoff rate. Land area with HSG D is also found in 37% of pervious areas where there is less that 50% impervious coverage. Ideally for LID the pervious area would have HSGs A and B for the best Infiltration. Currently land area which is HSG A exists in 13% and land area which is HSG B exists in 34% of the city (Figure 13). Therefore, there is some infiltration potential for the City even though half of the pervious areas have HSG C and D.

Groundwater data was very difficult to find for this study. After communicating with numerous local and government agencies depth to water data within the city is diminutive. The only sources of available data were from the Natural Resources Conservation Service’s (NRCS) Web Soil Survey and DTSC’s Envirostor. The NRCS soil data was based off of soil dampness and only accurate for the first few feet. Therefore, the data used in this study came from the DTSC’s database “Envirostor”. The data consisted of monitoring wells that had depth to groundwater measurement. The historic high for each of those wells were mapped with its location. Even with 80% of the wells with a depth to water value of at least 2ft (Figure 14), according to the EPA and a few other publications, most BMPs only work with a minimum depth of at least 2-4ft deep (SWRQB). A minimum depth to water table of 10 ft would provide a good infiltration potential and largest amount of BMPs to be applicable in the City (BMP Guidance Manual). Within the City and surrounding area there are 64 wells (20.5%) that have a depth to water value of at least 4ft. Overall the water table is very high in the downtown and wharf locations with only 1 of those wells at 10ft (Figure 14). Locations just outside the city boundaries on Prescott Ave, near Roberts Lake, and within the City limits by Del Monte Shopping center have wells with depths ideal for LID.

With these WMZs the CCRWCB aligned specific stormwater requirements for new and redevelopment projects to address the impacts of urbanization. The CCWQCB published the “Draft Technical Support Document” (Tech doc.) with the requirements, but there are items that are inconsistent with other documents. Attached to the Tech doc. is a flowchart to simplify the requirements for the redevelopment projects. However, on Figure 1D of the Attachment C on the Tech doc. the detached single home size and performance requirements are not consistent with “Draft Post-Construction Stormwater Management Requirements for Development Projects in the Central Coast Region” (Draft Requirements doc.) requirements for single detached homes.

Other issues occur for WMZs that are not specifically addressed. An example would be the Performance Requirement no. 3 Runoff Retention. The Runoff Retention Requirement only mentions WMZs 1, 4*, 2, and 9 for the City. The question is, are WMZs 3, 4, and 10, not applicable or do they have their own requirements not addressed? This question is similar for Performance Requirement no. 4 peak management. Do the non discussed WMZs have their own requirements?
Every WMZ has management strategies that need to be implemented. Some of the strategies include promoting infiltration while others need to minimize overland flow and runoff. Both WMZ 4 and 10 do not have a specific management strategies listed.

5 Recommendations

There is a lack of constancy of the Performance Requirements for the post construction documents. The City should contact members of the CCWQCB to discuss the requirements of detached family home projects to clarify the project size with its mandatory requirements. The next explanation that needs to be settled is the WMZs not mentioned in Performance Requirements 3 and 4. It is suggested that the city also communicate with the CCWQCB to gain clarity for this non-specified information. Another recommendation would be to discuss what the best management strategies would be for WMZs 4 and 10.

There is still information missing from the groundwater component for the city. The groundwater is an important component when considering the design and construction of LID measures. The City of Monterey should hire an appropriate professionals and organizations to get more depth to water data. There are not enough well locations and much of the monitoring has stopped and there can be new highs and changes in the water table with water use and climate change. The City should also find out the HSG of the denoted “N.A.” locations in Monterey. The City should also obtain ground toxicity data to see if infiltration would lead to more polluted water. Lastly, the city needs refinements on data presented by the Regional Board, along with site-specific engineering evaluations.

- Discuss detached family home requirements with Water Board
- Get specific management strategies for WMZ 4 and 10
- Hire groundwater professional to obtain more depth to water data within the City
- Create more monitoring wells for future depth to water data collection
- Get more information on “N.A.” denoted areas on Figure 10
- Acquire data of toxic ground plumes within the City
- Further refinements will need to be done by the city so the land characteristics data fits the reality of local area
- At the site development scale, site-specific engineering evaluations are necessary for any development project proposed

6 Conclusion

There is still a lack of full comprehensive understanding of the groundwater and land characteristics in the City of Monterey. However, there is a better knowledge of the monitoring well locations, slope, hydrologic soil groups, local geology, and percent impervious coverage that would enable the city to further assess the efficacy of potential mitigation measures as presented in the Joint Effort, designed to reduce the potential for polluted urban runoff. There are many different factors that need to be
examined for LID regulations. Areas of Monterey have a potential for LID to be applicable, but future investigation of groundwater data is necessary to aid the new LID program.
References

- DEM (elevation, hillshade, contours): 1/9 arc second (~3m). Downloaded from the United States Geologic Survey (USGS) National Map Viewer on 07/03/2012
- Impervious Cover: NLCD 2006 Percent Developed Imperviousness Map. Downloaded from the USGS National Map Viewer on 07/03/2012.
- Soil data and shapefile. Downloaded from USDA, Natural Resources Conservation Service on 7/14/2012.
Definitions

**Best Management practices (BMP)** - Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants to waters of the United States. BMPs also include treatment requirements, operating procedures, and practice to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

**Groundwater Basins** – Groundwater basin areas defined by the California Department of Water Resources (DWR) and used in the Central Coast Water Board Joint Effort for Hydromodification Control to identify groundwater receiving-water issues and areas where recharge is a key watershed process. DWR based identification of the groundwater basins on the presence and areal extent of unconsolidated alluvial soils identified on a 1:250,000 scale from geologic maps provided by the California Department of Conservation, Division of Mines and Geology. DWR then further evaluated identified groundwater basin areas through review of relevant geologic and hydrogeologic reports, well completion reports, court-determined adjudicated basin boundaries, and contact with local agencies to refine the basin boundaries.

**Hydrology** – Hydrology is the study of the movement, distribution, and quality of water on Earth and other planets, including the hydrologic cycle, water resources and environmental watershed sustainability.

**Impervious Surface** – A hard, non-vegetated surface area that prevents or significantly limits the entry of water into the soil mantle, as would occur under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for purposes of determining whether the thresholds for application of Performance Requirements are exceeded. However, for modeling purposes, open, uncovered facilities that retain/detain water (e.g., retention ponds, pools) shall be considered impervious surfaces.

**Low Impact Development (LID)** – A stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation, and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.

**Net impervious area** – The sum of new and replaced impervious areas, minus any new pervious area created by elimination or demolition of existing on-site impervious surfaces: Net Impervious Area = (New and Replaced Impervious Area) – (New Pervious Area)

**New Development** – Land disturbing activities that include the construction or installation of buildings, roads, driveways and other impervious surfaces. Development projects with pre-existing impervious surfaces are not considered New Development.

**Percentile Rainfall Event** (e.g., 85th and 95th) – A percentile rainfall event represents a rainfall amount which a certain percent of all rainfall events for the period of record do not exceed. For example, the 95th percentile rainfall event is defined as the measured rainfall depth accumulated over a 24-hour period, for the period of record, which ranks as the 95th percentile rainfall depth based on the range of all daily event occurrences during this period.

**Permeable or Pervious Surface** – A surface that allows varying amounts of stormwater to infiltrate into the ground. Examples include pasture, native vegetation areas, landscape areas, and permeable pavements designed to infiltrate.
**Project Site** – The area defined by the legal boundaries of a parcel or parcels of land within which the new development or redevelopment takes place and is subject to these Post-Construction Stormwater Management Requirements.

**Receiving Waters** – Bodies of water, surface water systems or groundwater that receive surface water runoff through a point source, sheet flow or infiltration.

**Redevelopment** – On a site that has already been developed, construction or installation of a building or other structure subject to the Permittee’s planning and building authority including: 1) the creation or addition of impervious surfaces; 2) the expansion of a building footprint or addition or replacement of a structure; or 3) structural development including construction, installation or expansion of a building or other structure. It does not include routine road maintenance, nor does it include emergency construction activities required to immediately protect public health and safety.

**Replaced Impervious Surface** – The removal of existing impervious surfaces down to bare soil or base course, and replacement with new impervious surface. Replacement of impervious surfaces that are part of routine road maintenance activities are not considered replaced impervious surfaces.

**Single-Family Residence** – The building of one single new house or the addition and/or replacement of impervious surface associated with one single existing house, which is not part of a larger plan of development.
Attachment A

Attachment B

Attachment C
Attachment A
Watershed Management Zones of the City of Monterey

Background: The management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of development on water quality. Impervious surfaces as a result of land development such as rooftops, roads, parking lots, and sidewalks can have a detrimental effect on local water quality and aquatic systems. Runoff from impervious areas can contain a variety of pollutants that are detrimental to water quality, including sediment, nutrients, heavy metals, pathogenic bacteria, and petroleum hydrocarbons. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

Through implementation of these Post-Construction Requirements by project applicants, municipalities will ensure that the new and redevelopment projects approved locally integrate measures into their project designs to protect, or to the extent feasible restore, the processes supporting healthy aquatic systems throughout the life of the project. The urbanized portions of the Central Coast Region are categorized into 10 Watershed Management Zones (WMZs). In the terminology of the Joint Effort, every WMZ location on the landscape has two attributes: its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. These combine to define the “Watershed Management Zones,” of which there are 90 unique combinations (reflecting 15 Physical Landscape Zones and 6 receiving water types). Designated Groundwater Basins of the Central Coast Region underlie some but not all WMZs in urbanized portions of the Central Coast Region. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Requirements to address the impacts of development on those watershed processes and beneficial uses. The primary objective of these Post-Construction Stormwater Management Requirements (hereinafter, Post-Construction Requirements) is to ensure that the Permittee is reducing pollutant discharges to the Maximum Extent Practicable and preventing stormwater discharges from causing or contributing to a violation of receiving water quality standards in all applicable development projects that require approvals and/or permits issued under the Permittee’s planning, building, or other comparable authority. Maintenance and restoration of watershed processes impacted by stormwater management is necessary to protect water quality and beneficial uses.

WMZ 1: Characteristics: Drains to stream or to wetland. Underlain by: Quaternary and Late Tertiary deposits, slope 0-40%; Early to Mid-Tertiary sediments, slope 0-10%. It is defined by low-gradient deposits (Quaternary and Tertiary in age) together with the moderately sloped areas of these younger deposits that drain to a stream or wetland. The dominant watershed processes in this setting are infiltration into shallow and deeper soil layers; conversely, overland flow is localized and rare. Management strategies should minimize overland flow and promote infiltration, particularly into deeper aquifers if overlying a groundwater basin in its recharge area.

WMZ 2: Characteristics: Drains to stream or to wetland. Underlain by Early to Mid-Tertiary sediments, slope 10-40%. Attributes and Management Approach: This WMZ is similar to WMZ 1 in both materials and watershed processes, but groundwater recharge is anticipated to be a less critical watershed process in most areas. Management strategies need to minimize overland flow as with WMZ 1; they need not emphasize groundwater recharge as the chosen approach to the same degree.
WMZ 3: Characteristics: Drains to stream or to wetland. Underlain by Franciscan mélangé and Pre-Quaternary crystalline, slope 0-10%. Attributes and Management Approach: This WMZ includes those few flat areas of the Central Coast Region underlain by old, generally impervious rocks with minimal deep infiltration (and intersecting with no mapped groundwater basins). Overland flow is still uncommon over the surface soil; and chemical and biological remediation of runoff, reflecting the slow movement of infiltrated water within the flat soil layer, are the dominant watershed processes. Management strategies should promote treatment of runoff through infiltration, filtration, and by minimizing overland flow.

WMZ 4 and 4*: (* Overlie designated groundwater basin). Characteristics: Drains to lake, large river, or marine near shore. Underlain by all geologic types, slope 0–10%, and Quaternary and Late Tertiary deposits, slope 10-40%. Attributes and Management Approach: This WMZ covers those areas geologically equivalent to WMZ’s 1 and 3, but draining to one of the receiving water types that are not sensitive to changes in flow rates. The dominant watershed processes in this low-gradient terrain are those providing chemical and biological remediation of runoff, but a specific focus on infiltration management strategies is only necessary for those parts of this WMZ that overlie a groundwater basin (4*).

WMZ 9: Characteristics: Drains to wetland. Underlain by Franciscan mélangé and Pre-Quaternary crystalline, slope >10%; or drains to stream or wetland, and underlain by Franciscan mélangé and Pre-Quaternary crystalline, slope 10–40%. Attributes and Management Approach: These moderately sloping, older rocks that drain to either a stream or wetland are neither extremely sensitive to changes in infiltrative processes (because the underlying rock types are typically impervious), nor key sources of sediment delivery (because slopes are only moderate in gradient). Overland flow is still uncommon over the surface soil, and so management strategies should apply reasonable care to avoid gross changes in the distribution of runoff between surface and subsurface flow paths.

WMZ 10: Characteristics: Drains to lake, large river, or marine near shore. Underlain by Franciscan mélangé, Pre-Quaternary crystalline, Early to Mid-Tertiary sediments, slope 10-40%; or, drains to lake and underlain by all geologic types, slope >40%. Attributes and Management Approach: This WMZ drains into those receiving waters insensitive to changes in runoff rates. It includes the moderately sloped areas that are anticipated not to be key sediment delivery sources (by virtue of hillslope gradient) or that drain into lakes (which generally do not require natural rates of sediment delivery for their continued health). Management strategies not specified for WMZ 10.
### Stormwater management requirements by WMZ

**Performance Requirement No. 1: Site Design and Runoff Protection**

**Site Design** Measures shall be applied throughout the Regulated Project site.

Regulated Projects that create and/or replace > 2,500 square feet of impervious surface, including detached single-family home projects, to utilize the following site design and runoff reduction measures, where feasible:

- i) Prevent disturbance of creeks and natural drainage features
- ii) Minimize compaction of native soils
- iii) Limit clearing and grading of native vegetation at the site to the minimum area needed to build the project, allow access, and provide fire protection
- iv) Minimize impervious surfaces by concentrating improvements on the least sensitive portions of the site, while leaving the remaining land in a natural undisturbed state
- v) Direct roof runoff into cisterns or rain barrels for reuse
- vi) Direct roof runoff onto vegetated areas
- vii) Direct runoff from sidewalks, walkways, and/or patios onto vegetated areas
- viii) Direct runoff from driveways and/or uncovered parking lots onto vegetated areas
ix) Construct bike lanes, driveways, uncovered parking lots, sidewalks, walkways, and patios with permeable surfaces

The Permittee shall confirm that projects comply with Site Design and Runoff Reduction Performance Requirements by means of appropriate documentation (e.g., check lists) accompanying applications for project approval.

Performance Requirement No. 2: Water Quality Treatment

Site Design

Measures shall be applied throughout the Regulated Project site.

Water Quality Treatment shall apply to runoff generated from new and replaced impervious surfaces on the Regulated Project site. Regulated Projects that create and/or replace > 5,000 square feet of net impervious surface area, and detached single-family homes that create and/or replace > 15,000 square feet of impervious surface, to treat stormwater runoff as required in the Water Quality Treatment Performance requirement.

Regulated Project subject to Water Quality Treatment Performance Requirements (listed in the order of preference (highest to lowest)): (look at B.3.b for more information)

i) Low Impact Development (LID) Treatment Systems

(1) Hydraulic Sizing Criteria for LID Treatment Systems

ii) Biofiltration Treatment Systems

(1) Maximum surface loading rate appropriate to prevent erosion, scour and channeling within the biofiltration treatment system itself and equal to 5 inches per hour, based on the flow of runoff produced from a rain event equal to or at least

(a) 0.2 inches per hour intensity; or
(b) Two times the 85th percentile hourly rainfall intensity for the applicable area, based on historical records of hourly rainfall depth

(2) Minimum surface reservoir volume equal to surface area times a depth of 6 inches

(3) Minimum planting medium depth of 24 inches

(4) Proper plant selection

(5) Subsurface drainage/storage (gravel) layer with an area equal to the surface area and having a minimum depth of 12 inches

(6) Under drain with discharge elevation at top of gravel layer

(7) No compaction of soils beneath the facility (ripping/loosening of soils required if compacted)

(8) No liners or other barriers interfering with infiltration

iii) Non-Retention Based Treatment Systems

(1) Hydraulic Sizing Criteria for Non-Retention Based Treatment Systems:
(a) Volume Hydraulic Design Basis
(b) Flow Hydraulic Design Basis

Reporting Requirements – For each Regulated Project subject to Water Quality Treatment, the Permittee shall require the Project Applicant to provide the below information in a Stormwater Control Plan.

Required Hydrologic Analysis: The hydrologic analysis requirements for post-construction new development and redevelopment are as follows:

1) For Regulated Projects between 5,000 square feet and 22,500 square feet, single-event based analyses may be used

**Performance Requirement No. 3: Runoff Retention**

**Site Design** Measures shall be applied throughout the Regulated Project site and has to meet **Water quality Treatment** and **Runoff Retention** Performance requirements.

Runoff Retention Performance Requirements shall apply to runoff generated from new and replaced impervious surfaces on the Regulated Project site. Regulated Projects that create and/or replace >15,000 square feet of impervious surface in WMZs 1, 2, 4*, and 9 to meet the Runoff Retention Performance Requirements in using the LID Development Standards for optimal management of watershed processes.

**WMZ- 1, 4***

1) Retain 95th Percentile Rainfall Event – Prevent offsite discharge from events up to the 95th percentile 24-hour rainfall event as determined from local rainfall data

2) Compliance must be achieved via infiltration

**WMZ- 2**

1) Retain 95th Percentile Rainfall Event – Prevent offsite discharge from events up to the 95th percentile 24-hour rainfall event as determined from local rainfall data

2) Compliance must be achieved via storage, rainwater harvesting, infiltration, and/or evapotranspiration

**WMZ-9**

1) Retain 85th Percentile Rainfall Event – Prevent offsite discharge from events up to the 85th percentile 24-hour rainfall event as determined from local rainfall data

2) Compliance must be achieved via storage, rainwater harvesting, infiltration, and/or evapotranspiration

**Adjustments to the Runoff Retention Performance Requirements for Redevelopment** – Where the Regulated Project includes replaced impervious surface, the following adjustments apply:
i) Outside an approved Urban Sustainability Area, as described in Section C.3. – The total amount of replaced impervious surface, subject to Runoff Retention Performance Requirements, shall be multiplied by 0.5 when calculating the volume of runoff to be retained.

ii) Within an approved Urban Sustainability Area (Section C.3.) – The total amount of new and replaced impervious surface, subject to Runoff Retention Performance Requirements, shall be multiplied by 0.5 when calculating the volume of runoff to be retained.

Reporting Requirements – For each Regulated Project subject to the Runoff Retention Performance Requirement, the Permittee shall require the Project Applicant to provide the below information in a Stormwater Control Plan.

LID Standards – The Permittee shall require Regulated Projects, subject to Runoff Retention Performance Requirements, to meet Runoff Retention Performance Requirements (Section 4.c.i.-iv.) using the following LID (B.4.e.i –v. for requirements).

Where LID Stormwater Control Measures and/or BMPs are not feasible, the Permittee may allow Regulated Projects to use conventional designs to meet the Runoff Retention Performance Requirement (Section B.4.c.) including:

i) Infiltration (Retention) Basins

ii) Infiltration Trenches

iii) Dry Wells

iv) Constructed Wetlands

v) Wet Ponds

Required Hydrologic Analysis: The hydrologic analysis requirements for post-construction new development and redevelopment are as follows:

1) For Regulated Projects between 5,000 square feet and 22,500 square feet, single-event based analyses may be used.

Performance Requirement No. 4: Peak Management

Site Design Measures shall be applied throughout the Regulated Project site.

Peak Management Performance Requirements shall apply only to the additional runoff generated by increased impervious surfaces on the Regulated Project site.

Regulated Projects that create and/or replace >22,500 square feet of impervious surface in Watershed Management Zones 1, 2, 3, and 9 to manage peak stormwater runoff as required to meet Water Quality Treatment and Runoff Retention Performance Requirements.

   i) Post-development peak flows, discharged from the site, shall not exceed pre-project peak flows for the 2- through 100-year storm events.
Reporting Requirements – For each Regulated Project subject to the Peak Management Performance Requirement, the Permittee shall require the Project Applicant to provide the below information in a Stormwater Control Plan.

Approved Urban Sustainability Area -The Permittee may allow Regulated Projects located within an approved Urban Sustainability Area to pursue Alternative Compliance for numeric Runoff Retention and Peak Management Performance Requirements without demonstrating technical infeasibility. (Look at C.3. for more info)

Required Hydrologic Analysis: The hydrologic analysis requirements for post-construction new development and redevelopment are as follows:

a) For Regulated Projects between 5,000 square feet and 22,500 square feet, single-event based analyses may be used

b) For Regulated Projects >22,500 square feet a calibrated continuous simulation hydrologic model to select stormwater control measures must be used

Performance Requirement No. 5: Special Circumstances

Special Circumstances based on certain site and/or receiving water conditions: The Special Circumstances designation exempts a Regulated Project from Runoff Retention and/or Peak Management Performance Requirements where those Performance Requirements would be ineffective to maintain or restore beneficial uses of receiving waters.

Special Circumstances must still comply with the Water Quality Treatment Performance Requirements.

Special Circumstances include:

i) Highly Altered Channel Special Circumstance:

   (1) Project runoff discharges into stream channels that are concrete-lined or otherwise continuously armored from the discharge point to the channel’s confluence with a lake, large river (>200-square mile drainage area)

   (2) Project runoff discharges to a continuous underground storm drain system that discharges directly to a lake, large river (>200-square mile drainage area), or marine near shore waters

   (3) Under no circumstance described in 6.a.i. can runoff from the Regulated Project result in adverse impacts to downstream receiving waters

ii) Intermediate Flow Control Facility Special Circumstance:

   (1) The Permittee may designate Regulated Projects as subject to Special Circumstances for Intermediate Flow Control Facilities if the project runoff discharges to an existing flow control facility that regulates flow volumes and durations to levels that have been demonstrated to be protective of beneficial uses of the receiving water downstream of the facility
(2) The flow control facility must have the capacity to accept the Regulated Project’s runoff

(3) Demonstration of facility capacity to accept runoff and to regulate flow volumes and durations must include quantitative analysis based on numeric, hydraulic modeling of facility performance

(4) Under no circumstance described in 6.a.ii. can runoff from the Regulated Project result in adverse impacts to downstream receiving waters

iii) Historic Lake and Wetland Special Circumstance:

(a) Project is located where there was once a historic lake or wetland where pre-development hydrologic processes included filtration and storage but no significant infiltration to support downstream receiving water

(b) The Special Circumstance has been established based on a delineation of the historic lake or wetland approved by the Central Coast Water Board Executive Officer

Historic Lake and Wetland Special Circumstance – Prior to granting a Regulated Project Special Circumstances, the Permittee shall submit a proposal to the Central Coast Water Board Executive Officer for review and approval. The proposal shall include, at a minimum:

(1) Delineation of historic lakes and wetlands and any supporting technical information to substantiate the requested Special Circumstances designation

(2) Documentation that the proposal was completed by a registered professional engineer, geologist, architect, and/or landscape architect

Performance Requirements for **Highly Altered Channel** and/or **Intermediate Flow Control Facility** Special Circumstances

i) For Regulated Projects that create and/or replace >22,500 square feet of impervious surface, are located in WMZs 1, 2 and those portions WMZs 4*

   (1) **Water Quality Treatment** (Performance Requirement No. 2)

   (2) **Runoff Retention** (Performance Requirement No. 3)

ii) For Regulated Projects that create and/or replace >22,500 square feet of impervious surface; and 2) are located in WMZs 3, and 9, and those portions of WMZs 4, and 10 that do not overlie a designated Groundwater Basin:

   (1) **Water Quality Treatment** (Performance Requirement No. 2)

Performance Requirements for **Historic Lake and Wetland** Special Circumstances

i) For Regulated Projects that create and/or replace >15,000 and < 22,500 square feet of impervious surface and meet the Historic Lake and Wetland Special Circumstance:

   (1) **Water Quality Treatment**
(2) Detention: Detain runoff such that the post-project peak discharge rate does not exceed the pre-project rate for all runoff up to the 95th percentile 24-hr rainfall event, or a more protective rate consistent with the Permittee's own development requirements

ii) For Regulated Projects that create and/or replace >22,500 square feet of impervious surface and meet the Historic Lake and Wetland Special Circumstance:

(1) **Water Quality Treatment**

(2) **Peak Management**: Detain runoff such that the post-project peak discharge rate does not exceed the pre-project rate for the 95th percentile 24-hr rainfall event and the 2- through 100-yr storm events or a more protective rate consistent with the Permittee's own development requirements.

Documentation and Approval of Special Circumstances – The Permittee shall provide reasonable documentation to justify that a Regulated Project is more appropriately categorized under the Special Circumstances category.
Attachment B
Watershed Management Zone 1

**Background:** The management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of development on stream flow and water quality. Impervious surfaces such as rooftops, roads, parking lots, and sidewalks have a detrimental effect on local water quality and aquatic systems. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

The Regional Water Quality Control Board has divided the city into multiple Watershed Management Zones (WMZs). Each WMZ was delineated using adverse attributes its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Design Requirements for new and redevelopment projects to address the impacts of urbanization on the watershed processes and beneficial uses.

**Characteristics:**

- Drains to stream or to wetland
- Underlain by: Quaternary and Late Tertiary deposits, slope 0-40%; Early to Mid-Tertiary sediments, slope 0-10%
- Defined by low-gradient deposits (Quaternary and Tertiary in age) together with the moderately sloped areas of these younger deposits that drain to a stream or wetland
- The dominant watershed processes in this setting are infiltration into shallow and deeper soil layers; conversely, overland flow is localized and rare

**Management Approach:** Should minimize overland flow and promote infiltration, particularly into deeper aquifers if overlying a groundwater basin in its recharge area.

**Development Design Requirements:** The following are changes to Joint Effort Performance Requirements for WMZ 1.

- **Performance Requirement No. 1:** Site Design and Runoff Reduction – no changes
- **Performance Requirement No. 2:** Water Quality Treatment – no changes
- **Performance Requirement No. 3:** Runoff Retention:
  - Retain 95th Percentile Rainfall Event – Prevent offsite discharge from events up to the 95th percentile 24-hour rainfall event as determined from local rainfall data.
  - Compliance must be achieved via infiltration
- **Performance Requirement No. 4:** Peak Management:
  - Post-development peak flows, discharged from the site, shall not exceed pre-project peak flows for the 2- through 100-year storm events.
- **Performance Requirement No. 5:** Special Circumstances:
  - If Highly Altered Channel or Intermediate Flow Control Facility with a Regulated Project > 22,500 ft\(^2\) - Comply with Water Quality Treatment and Runoff Retention Performance Requirements
  - Historic lake or wetland- no changes
Watershed Management Zone 2

**Background:** The management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of development on stream flow and water quality. Impervious surfaces such as rooftops, roads, parking lots, and sidewalks have a detrimental effect on local water quality and aquatic systems. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

The Regional Water Quality Control Board has divided the city into multiple Watershed Management Zones (WMZs). Each WMZ was delineates using adverse attributes its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Design Requirements for new and redevelopment projects to address the impacts of urbanization on the watershed processes and beneficial uses.

**Characteristics:**

- Drains to stream or to wetland
- Underlain by Early to Mid-Tertiary sediments, slope 10-40%
- Defined by low-gradient deposits with the moderately sloped areas of these younger deposits that drain to a stream or wetland
- Similar to WMZ 1 in both materials and watershed processes, but groundwater recharge is anticipated to be a less critical watershed process in most areas of WMZ 2

**Management Approach:** Minimize overland flow; need not emphasize groundwater recharge as the chosen approach to the same degree as WMZ 1.

**Development Design Requirements:** The following are changes to Joint Effort Performance Requirements for WMZ 2.

- **Performance Requirement No. 1:** Site Design and Runoff Reduction – no changes
- **Performance Requirement No. 2:** Water Quality Treatment – no changes
- **Performance Requirement No. 3:** Runoff Retention:
  - Retain 95th Percentile Rainfall Event – Prevent offsite discharge from events up to the 95th percentile 24-hour rainfall event as determined from local rainfall data.
  - Compliance must be achieved via storage, rainwater harvesting, infiltration, and/or evapotranspiration.
- **Performance Requirement No. 4:** Peak Management:
  - Post-development peak flows, discharged from the site, shall not exceed pre-project peak flows for the 2- through 100-year storm events.
- **Performance Requirement No. 5:** Special Circumstances:
  - If Highly Altered Channel or Intermediate Flow Control Facility with a Regulated Project > 22,500 ft² - Comply with Water Quality Treatment and Runoff Retention Performance Requirements
  - Historic lake or wetland - no changes
Watershed Management Zone 3

**Background:** The management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of development on stream flow and water quality. Impervious surfaces such as rooftops, roads, parking lots, and sidewalks have a detrimental effect on local water quality and aquatic systems. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

The Regional Water Quality Control Board has divided the city into multiple Watershed Management Zones (WMZs). Each WMZ was delineates using adverse attributes its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Design Requirements for new and redevelopment projects to address the impacts of urbanization on the watershed processes and beneficial uses.

**Characteristics:**
- Drains to stream or to wetland
- Underlain by Franciscan mélange and Pre-Quaternary crystalline, slope 0-10%
- Includes few flat areas of the Central Coast Region underlain by old, generally impervious rocks with minimal deep infiltration
- Overland flow is still uncommon over the surface soil; and chemical and biological remediation of runoff, reflecting the slow movement of infiltrated water within the flat soil layer, are the dominant watershed processes

**Management Approach:** Should promote treatment of runoff through infiltration, filtration, and by minimizing overland flow.

**Development Design Requirements:** The following are changes to Joint Effort Performance Requirements for WMZ 3.

- Performance Requirement No. 1: Site Design and Runoff Reduction – no changes
- Performance Requirement No. 2: Water Quality Treatment – no changes
- Performance Requirement No. 3: Runoff Retention- not applicable
- Performance Requirement No. 4: Peak Management:
  - Post-development peak flows, discharged from the site, shall not exceed pre-project peak flows for the 2- through 100-year storm events.
- Performance Requirement No. 5: Special Circumstances:
  - If Highly Altered Channel or Intermediate Flow Control Facility with a Regulated Project > 22,500 ft²- Comply with Water Quality Treatment Performance Requirements
  - Historic lake or wetland- no changes
Watershed Management Zone 4

**Background:** The management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of development on stream flow and water quality. Impervious surfaces such as rooftops, roads, parking lots, and sidewalks have a detrimental effect on local water quality and aquatic systems. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

The Regional Water Quality Control Board has divided the city into multiple Watershed Management Zones (WMZs). Each WMZ was delineates using adverse attributes its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Design Requirements for new and redevelopment projects to address the impacts of urbanization on the watershed processes and beneficial uses.

**Characteristics:**
- Drains to lake, large river, or marine near shore
- Underlain by all geologic types, slope 0–10%, and Quaternary and Late Tertiary deposits, slope 10-40%
- Covers those areas geologically equivalent to WMZ’s 1 and 3, but draining to one of the receiving water types that are not sensitive to changes in flow rates
- Dominant watershed processes in this low-gradient terrain are those providing chemical and biological remediation of runoff

**Management Approach:** Not specified

**Development Design Requirements:** The following are changes to Joint Effort Performance Requirements for WMZ 4.

- Performance Requirement No. 1: Site Design and Runoff Reduction - no changes
- Performance Requirement No. 2: Water Quality Treatment - no changes
- Performance Requirement No. 3: Runoff Retention - not applicable
- Performance Requirement No. 4: Peak Management - not applicable
- Performance Requirement No. 5: Special Circumstances:
  - If Highly Altered Channel or Intermediate Flow Control Facility with a Regulated Project > 22,500 ft² - Comply with Water Quality Treatment Performance Requirements
  - Historic lake or wetland- no changes
Watershed Management Zone 4*  

**Background:** The management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of development on stream flow and water quality. Impervious surfaces such as rooftops, roads, parking lots, and sidewalks have a detrimental effect on local water quality and aquatic systems. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

The Regional Water Quality Control Board has divided the city into multiple Watershed Management Zones (WMZs). Each WMZ was delineates using adverse attributes its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Design Requirements for new and redevelopment projects to address the impacts of urbanization on the watershed processes and beneficial uses.

**Characteristics:**
- * Overlie designated groundwater basin
- Drains to lake, large river, or marine near shore
- Underlain by all geologic types, slope 0–10%, and Quaternary and Late Tertiary deposits, slope 10-40%
- The dominant watershed processes in this low-gradient terrain are those providing chemical and biological remediation of runoff

**Management Approach:** Focus on infiltration management strategies because 4 * overlies a groundwater basin.

**Development Design Requirements:** The following are changes to Joint Effort Performance Requirements for WMZ 4*.

- Performance Requirement No. 1: Site Design and Runoff Reduction - no changes
- Performance Requirement No. 2: Water Quality Treatment - no changes
- Performance Requirement No. 3: Runoff Retention
  - Retain 95th Percentile Rainfall Event – Prevent offsite discharge from events up to the 95th percentile 24-hour rainfall event as determined from local rainfall data.
  - Compliance must be achieved via infiltration
- Performance Requirement No. 4: Peak Management - not applicable
- Performance Requirement No. 5: Special Circumstances:
  - If Highly Altered Channel or Intermediate Flow Control Facility with a Regulated Project > 22,500 ft² - Comply with Water Quality Treatment and Runoff Retention Performance Requirements
  - Historic lake or wetland - no changes
Background: The management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of development on stream flow and water quality. Impervious surfaces such as rooftops, roads, parking lots, and sidewalks have a detrimental effect on local water quality and aquatic systems. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

The Regional Water Quality Control Board has divided the city into multiple Watershed Management Zones (WMZs). Each WMZ was delineates using adverse attributes its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Design Requirements for new and redevelopment projects to address the impacts of urbanization on the watershed processes and beneficial uses.

Characteristics:
- Drains to wetland
- Underlain by Franciscan mélange and Pre-Quaternary crystalline, slope >10%; or drains to stream or wetland, and underlain by Franciscan mélange and Pre-Quaternary crystalline, slope 10–40%
- Moderately sloping, older rocks that drain to either a stream or wetland are neither extremely sensitive to changes in infiltrative processes (because the underlying rock types are typically impervious), nor key sources of sediment delivery (because slopes are only moderate in gradient)
- Overland flow is still uncommon over the surface soil

Management Approach: Apply reasonable care to avoid gross changes in the distribution of runoff between surface and subsurface paths.

Development Design Requirements: The following are changes to Joint Effort Performance Requirements for WMZ 9.

- Performance Requirement No. 1: Site Design and Runoff Reduction – no changes
- Performance Requirement No. 2: Water Quality Treatment – no changes
- Performance Requirement No. 3: Runoff Retention
  - Retain 85th Percentile Rainfall Event – Prevent offsite discharge from events up to the 85th percentile 24-hour rainfall event as determined from local rainfall data.
  - Compliance must be achieved via storage, rainwater harvesting, infiltration, and/or evapotranspiration.
- Performance Requirement No. 4: Peak Management:
  - Post-development peak flows, discharged from the site, shall not exceed pre-project peak flows for the 2- through 100-year storm events.
- Performance Requirement No. 5: Special Circumstances:
  - If Highly Altered Channel or Intermediate Flow Control Facility with a Regulated Project > 22,500 ft²- Comply with Water Quality Treatment Performance Requirements
  - Historic lake or wetland- no changes
Watershed Management Zone 10

Background: The management of stormwater runoff from new or redeveloped properties is vital to controlling the impacts of development on stream flow and water quality. Impervious surfaces such as rooftops, roads, parking lots, and sidewalks have a detrimental effect on local water quality and aquatic systems. Therefore, the main goal of post-construction stormwater management is to prevent or limit these adverse effects.

The Regional Water Quality Control Board has divided the city into multiple Watershed Management Zones (WMZs). Each WMZ was delineates using adverse attributes its Physical Landscape Zone, determined by the underlying geology and the local hillslope gradient, and its direct receiving water type. Each WMZ and, where present, Groundwater Basin, is aligned with specific Post Construction Stormwater Management Design Requirements for new and redevelopment projects to address the impacts of urbanization on the watershed processes and beneficial uses.

Characteristics:
- Drains to lake, large river, or marine near shore
- Underlain by Franciscan mélangé, Pre-Quaternary crystalline, Early to Mid-Tertiary sediments, slope 10-40%; or, drains to lake and underlain by all geologic types, slope >40%
- Drains into those receiving waters insensitive to changes in runoff rates
- Includes the moderately sloped areas that are anticipated not to be key sediment delivery sources (by virtue of hillslope gradient) or that drain into lakes (which generally do not require natural rates of sediment delivery for their continued health)

Management Approach: Not specified

Development Design Requirements: The following are changes to Joint Effort Performance Requirements for WMZ 10.

- Performance Requirement No. 1: Site Design and Runoff Reduction – no changes
- Performance Requirement No. 2: Water Quality Treatment – no changes
- Performance Requirement No. 3: Runoff Retention – not applicable
- Performance Requirement No. 4: Peak Management – not applicable
- Performance Requirement No. 5: Special Circumstances:
  - If Highly Altered Channel or Intermediate Flow Control Facility with a Regulated Project > 22,500 ft² - Comply with Water Quality Treatment Requirements
  - Historic lake or wetland- no changes
Attachment C
Post Construction Stormwater Management Plan Requirements

- **RP > 2,500 SF, SFH > 2,500 SF**
  - Site Design and Runoff Reduction
  - Water quality Treatment
  - Report in SWCP

- **RP > 5,000 SF, SFH > 15,000 SF**
  - Site Design and Runoff Reduction
  - Water quality Treatment
  - Run off retention
    - WMZ 1, 4*
      - *Retain 95th% Rainfall Event
      - *By infiltration
    - WMZ 2
      - *Retain 95th% Rainfall Event
      - *By storage, rainwater harvesting, infiltration, and/or, evapotranspiration
    - WMZ 9
      - *Retain 85th% Rainfall Event
      - *By storage, rainwater harvesting, infiltration, and/or, evapotranspiration

- **RP > 15,000 SF**
  - Site Design and Runoff Reduction
  - Water quality Treatment
  - Run off retention
    - WMZ 3, 4, 10 N.A.

- **RP > 22,500 SF**
  - Site Design and Runoff Reduction
  - Follow chart of: Water quality Treatment
  - Follow complete chart of: Run off retention
    - WMZ 1, 2, 3, 9
    - WMZ 4, 4*, 10 N.A.

- **LID feasible B.4.e.**
  - Report in SWCP
  - Within Urban Sustainability Area - B.4.d.
  - Outside Urban Sustainability Area - B.4.d.

- **LID Not feasible B.4.f**
  - Report in SWCP

- **Hydrologic Analysis - single event based**
  - If in Urban Sustainability Area C.3.
  - Report in SWCP
  - Post development peak flows, 2-100 yr. storm events

- **Key**
  - RP - Regulated Project
  - SF - Square Feet
  - SFH - Single Family Home
  - SWCP - Stormwater Control plan

- **Special Circumstance**
  - Go to next page
  - High altered channel
  - Flow Control facility
  - Historic: Lake/Wetland

- **Hydrologic Analysis**
  - Single event based
  - Calibrated continuous simulation
Special Circumstance

Provide documentation to justify Circumstance Category

- High altered channel
- Intermediate flow control facility
- Historic lake or wetland N.A. < 15,000 SF

RP ≥ 22,500 SF
N.A. if RP < 22,500 SF

- WMZ 1,2,4*
- Water Quality Treatment
- Runoff Retention

15,000 SF ≤ RP < 22,500 SF

- WMZ 3,9,4,10
- Water Quality Treatment
- Detention

RP > 22,500 SF

- Water Quality Treatment
- Peak Management
  - Detain runoff post – project peak discharge rate not exceed 95th%, 2-100 yr. storm