

# C/CAG

## CITY/COUNTY ASSOCIATION OF GOVERNMENTS OF SAN MATEO COUNTY

*Atherton • Belmont • Brisbane • Burlingame • Colma • Daly City • East Palo Alto • Foster City • Half Moon Bay • Hillsborough • Menlo Park  
Millbrae • Pacifica • Portola Valley • Redwood City • San Bruno • San Carlos • San Mateo • San Mateo County • South San Francisco • Woodside*

**2:30 PM, Thursday, March 16, 2017**  
**San Mateo County Transit District Office<sup>1</sup>**  
**1250 San Carlos Avenue, 2<sup>nd</sup> Floor Auditorium**  
**San Carlos, California**

### STORMWATER (NPDES) COMMITTEE AGENDA

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------------|
| 1. Public comment on items not on the Agenda (presentations limited to three minutes).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Breault              | No materials               |
| 2. Stormwater Issues from C/CAG Board meetings: <ul style="list-style-type: none"><li>February –Appointments of Marty Hanneman, Atherton City Engineer, and Denice Hutten, Half Moon Bay Associate Engineer, to Stormwater Committee (Approved)</li><li>February – Review and approval of Resolution 17-04 adopting the San Mateo County Stormwater Resource Plan (Approved)</li><li>March –Resolution 17-02, authorizing a two-year agreement with the Bay Area Stormwater Management Agencies Association in an amount not to exceed \$282,426 for implementing regional stormwater projects (Approved)</li><li>March –Appointment of John Fuller, Daly City Public Works Director, to Stormwater Committee (Approved)</li><li>March - Presentation on progress toward trash load reduction requirements (Information)</li></ul> | Fabry                | No materials               |
| 3. ACTION – Review and approve January 19 Stormwater Committee meeting minutes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Fabry                | Pages 1-6                  |
| 4. INFORMATION – Announcements on stormwater issues <ul style="list-style-type: none"><li>CNRA Urban Greening Grant</li><li>Water Board Trash Informational Item</li><li>Upcoming Duly Authorized Representative Approvals Needed</li><li>April 5 Stormwater Finance Forum</li><li>Other</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Fabry                | Verbal                     |
| 5. INFORMATION – Receive presentation on PCBs monitoring and preliminary load reduction quantification for MRP 2.0 permit term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Fabry/<br>Konnan     | Page 7 and<br>presentation |
| 6. ACTION – Review and approve modeling assumptions for stormwater management features for Reasonable Assurance Analysis modeling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Fabry                | Pages 8-18                 |
| 7. DISCUSSION – Receive information from County Environmental Health staff regarding business inspection program budget/resource shortfall                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Env. Health<br>staff | Verbal                     |
| 8. ACTION – Review and approve response letter to Regional Water Board regarding business inspection concerns                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Fabry                | Handouts                   |
| 9. Regional Board Report                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Mumley               | No Materials               |
| 10. Executive Director’s Report                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Wong                 | No Materials               |
| 11. Member Reports                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | All                  | No Materials               |

<sup>1</sup> For public transit access use SamTrans Bus lines 390, 391, 292, KX, PX, RX, or take CalTrain to the San Carlos Station and walk two blocks up San Carlos Avenue. Driving directions: From Route 101 take the Holly Street (west) exit. Two blocks past El Camino Real go left on Walnut. The entrance to the parking lot is at the end of the block on the left, immediately before the ramp that goes under the building. Enter the parking lot by driving between the buildings and making a left into the elevated lot. Follow the signs up to the levels for public parking. Persons with disabilities who require auxiliary aids or services in attending and participating in this meeting should contact Mima Guilles at 650 599-1406, five working days prior to the meeting date.

## **C/CAG AGENDA REPORT**

Date: March 16, 2017  
To: Stormwater Committee  
From: Matthew Fabry, Program Manager  
Subject: Review and approve January 19, 2017 Stormwater Committee meeting minutes

(For further information or questions contact Matthew Fabry at 650 599-1419)

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### **RECOMMENDATION**

Review and approve January 19, 2017 Stormwater Committee meeting minutes, as drafted.

### **ATTACHMENTS**

1. Draft January 19, 2017 Minutes

**STORMWATER COMMITTEE**  
**Regular Meeting**  
**Thursday, January 19, 2017**  
**2:30 p.m.**

**DRAFT Meeting Minutes**

The Stormwater Committee met in the SamTrans Offices, 1250 San Carlos Avenue, San Carlos, CA, 2<sup>nd</sup> floor auditorium. Attendance at the meeting is shown on the attached roster. In addition to the Committee members, also in attendance were Sandy Wong (C/CAG Executive Director), Matt Fabry (C/CAG Program Manager), Reid Bogert (C/CAG Stormwater Program Specialist), Jon Konnan (EOA, Inc.), Steve Carter (Paradigm Consultants), Azalea Mitch (Menlo Park), Phil Erickson (CD+A), John Fuller (Daly City), Dale Bowyer (Regional Water Board), Sandy Mathews (LWA), Steve Machida (San Mateo), Ahmad Haya (Redwood City) and Richard Chiu (Daly City). Chair Breault called the meeting to order at 2:35 p.m.

1. Public comment: None

2. C/CAG staff Matt Fabry provided an update on issues relevant to the Committee from the previous C/CAG Board meetings:

- November – The Board approved the appointment of Ray Towne, Interim Public Works Director, to represent the City of South San Francisco on the Stormwater Committee.
- December – The Board approved the draft Countywide Stormwater Resource Plan and authorized C/CAG’s Executive Director to release it for public review and comment.

3. ACTION – The draft minutes from the August 18 and November 17 2016 Stormwater Committee meetings were unanimously approved as drafted (motion: Oskoui, second: Walter).

4. INFORMATION – Fabry provided announcements on the following stormwater issues:

- Proposition 1 stormwater grant award recommendations – the City of Redwood City and the City of San Mateo worked with C/CAG to submit individual applications, each with multiple projects. These projects are included in the countywide Stormwater Resource Plan. Daly City also separately submitted a Proposition 1 application. The following was awarded:
  - City of Redwood City – Redwood City Sustainable Streets - \$608,099
  - City of San Mateo – City of San Mateo Sustainable Streets and Parking Lot - \$630,031
  - City of Daly City – Vista Grande Drainage Basin Improvement Project - \$10,000,000
- The California State Coastal Conservancy has Bay Area-specific Proposition 1 funding for a competitive grant program for urban greening. Matching funds are not required but would strengthen an application. Proposed stormwater capture projects need to be part of a Stormwater Resource Plan.
- Unfunded mandate test claims on Municipal Regional Permit (MRP) requirements – staff provided a brief update on the current status of the unfunded mandate test claims pending action by the State Commission on Mandates
- Caltrans trash Notice of Violation – the Regional Water Board issued a Notice of Violation to Caltrans for failure to achieve adequate progress on addressing trash issues in the Bay Area as required under the Caltrans statewide stormwater permit.

- A free two day “Watershed University” will be held on March 14 and 15 in Oakland and provide opportunities to learn about current challenges in water, flood, and emergency management. A flyer was available as a handout.

5. ACTION – Fabry and Steve Carter (Paradigm Environmental) provided a presentation on the status of the Countywide Stormwater Resource Plan (SRP). The goal was obtain approval from the Committee for the approach to responding to comments on the draft SRP. C/CAG contracted with Paradigm Environmental (via subcontract to Larry Walker Associates) to develop the SRP in accordance with requirements promulgated in SB 985 and guidance from the State Water Board. SRPs are now required in order to compete for voter-approved bond funds for stormwater or dry weather capture projects. On October 17, C/CAG released an administrative draft of the SRP to its member agencies for review, with comments due November 11. C/CAG staff has presented various pieces of the SRP to the Stormwater Committee during previous meetings, including at the November 2016 Committee meeting at which the Committee voted to recommend to the C/CAG Board approval of the revised Administrative Draft as a public review draft. The C/CAG Board acted on the Stormwater Committee’s recommendation at its December 8 meeting, approving the draft SRP for release for public review and comment through January 13. Given that several Proposition 1 stormwater grant proposals from San Mateo municipalities were recommended for funding by the State Water Board in early December, staff needs to address comments from the public, finalize the SRP, and submit it to the State Water Board by March 1 to ensure those proposals remain eligible for funding.

Fabry and Carter provided an overview of the three public workshops held in early January on the draft SRP and the comments received during the public comment period. The workshops were held in Menlo Park, Millbrae, and Pacifica. Public participants were generally educated and engaged. Fifty-three comments were received from 23 individuals or agencies. The most substantial comment was from the San Mateo County Resource Conservation District, which requested that the green infrastructure screening be expanded to include private parcels in addition to public parcels, since they would like to encourage green infrastructure on private parcels. Staff’s proposed response is to not expand the screening at this time, but to add a discussion of the benefits of doing so in the text of the SRP. Next steps include:

- Revise the document consistent with the approved approach and prepare a response to comments.
- Bring to C/CAG’s Congestion Management and Environmental Quality Committee on January 30.
- Bring the final draft SRP to the C/CAG Board February 9 with a recommendation for approval.
- Submit to Bay Area IRWMP.
- Submit to State Water Board by March 1.

Committee member Jim Porter noted that maintenance of green infrastructure facilities is problematic due to a lack of funding and this committee should discuss in the future how to develop funding. Fabry noted that the SRP states project will be built as funding becomes available and that approval of the SRP does not obligate agencies to move forward with any projects. However, the local agency green infrastructure plans required by the MRP will have targets that will drive projects. A paragraph about funding issues will be added to the draft SRP.

The Committee unanimously approved staff's approach to responding to the comments on the draft SRP (motion: Oskoui, second: Porter).

6. INFORMATION – Carter provided a presentation on the status of Reasonable Assurance Analysis (RAA), including associated watershed and pollutant modeling efforts (PCBs and mercury). C/CAG contracted with Paradigm Environmental to perform a RAA in accordance with MRP requirements to demonstrate local agency Green Infrastructure Plans will achieve mandated load reductions in mercury and PCBs within prescribed timelines. Paradigm Environmental is developing models to support the RAA and green infrastructure planning. Carter reviewed the modeling approaches including development of hydrologic and pollutant loading and stormwater capture models for San Mateo County, progress made to-date to calibrate the models, and preliminary modeling results. Carter noted the models will eventually be used for green infrastructure optimization but separate RAA work will be needed to address other types of controls (e.g., source controls such as managing PCBs in building materials during demolition). Carter will continue to work with C/CAG staff and the Committee to vet the modeling assumptions as the models are further developed and calibrated. Other next steps include:

- Complete PCB load reduction analysis.
- Separate loads from MS4-permitted urban areas from open space and other NPDES permitted areas.
- Project phased load reduction associated with green infrastructure based on new loading estimates.
- Initiate SUSTAIN modeling of LID (C.3) and green infrastructure.
- Identify modeling scenarios to support C/CAG key decisions.

Committee members noted that the TMDL allocations are Bay-wide and asked about RAA results from other Bay Area counties. Fabry noted San Mateo County is out ahead and other counties have not started yet.

7. INFORMATION – Fabry and Phil Erickson (Community Design + Architecture) provided a presentation on initial assumptions and preliminary results for projecting future new and redevelopment acreage in San Mateo County. As part of the MRP requirements to achieve specified load reductions in mercury and PCBs by the end of the permit term and 2040 via green infrastructure, it is important to understand how much green infrastructure is anticipated to occur on private lands via new and redevelopment in accordance with Provision C.3 requirements in the MRP. C/CAG contracted with Community Design + Architecture (CD+A) to support member agencies in developing Green Infrastructure Plans, and part of that support is to develop projections for the amount of new and redevelopment likely to occur during these timeframes.

Erickson summarized the initial assumptions used to develop these projections. The approach includes using data related to both supply of and demand for lands areas for new and redevelopment. It utilizes demographic data for new households and jobs from the Countywide Transportation Plan. These data are distributed to more than 350 Traffic Analysis Zones (TAZs) and are already reviewed and approved by local agency staff. Erickson then summarized the preliminary projection results.

Underlying assumptions for these projections are important and C/CAG staff wants to ensure municipal buy-in before finalizing the approach. As such, staff plans to distribute the assumptions to all member

agencies for review and comment, including discussion at the January 25 meeting of SMCWPPP's Green Infrastructure Committee and seeking formal Stormwater Committee approval at a future meeting. The data will then be provided to Paradigm Consultants for use in the RAA.

8. INFORMATION – Fabry and Carter provided a presentation on modeling assumptions for stormwater management features for RAA modeling. The MRP requires Permittees to develop RAAs demonstrating Green Infrastructure Plans will achieve specified mercury and PCBs load reductions by the end of the permit term and 2040. To do this, C/CAG's consultant, Paradigm Environmental, will be modeling numerous green infrastructure implementation scenarios to establish the most cost-effective combination of controls that will achieve San Mateo County's share of the mandated load reduction. This requires informed decisions regarding the specific design features and cost functions of the types of stormwater controls being modeled.

Paradigm Environmental staff developed a memorandum (attached to the agenda package for today's meeting) describing the proposed assumptions that will be used to represent BMP simulation processes in the RAA model representing San Mateo County watersheds. Carter provided a brief overview of the memorandum. C/CAG staff wants to ensure municipal buy-in before finalizing the modeling approach. As such, staff will distribute the memorandum to all member agencies for review and comment, and seek formal Stormwater Committee approval at a future meeting.

9. Regional Board Report: Dale Bowyer noted that Regional Water Board staff appreciates that C/CAG is getting out ahead in the Bay Area on RAA efforts and he believes other Bay Area counties will hasten to follow.

10. Executive Director's Report: NONE.

11. Member Reports: NONE.

Chair Breault adjourned the meeting at 4:11 p.m.

2017 Stormwater Committee Roster			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Agency	Representative	Position												
Atherton	Vacant	Vacant												
Belmont	Afshin Oskoui	Public Works Director	X											
Brisbane	Randy Breault	Public Works Director/City Engineer	X											
Burlingame	Syed Murtuza	Public Works Director	X											
Colma	Brad Donohue	Director of Public Works and Planning	X											
Daly City	Patrick Sweetland	Director of Water & Wastewater	O											
East Palo Alto	Kamal Fallaha	City Engineer												
Foster City	Jeff Moneda	Public Works Director	X											
Half Moon Bay	Vacant	Vacant												
Hillsborough	Paul Willis	Public Works Director	X											
Menlo Park	Justin Murphy	Public Works Director	X											
Millbrae	Ray Chan	Public Works Director												
Pacifica	Van Ocampo	Public Works Director/City Engineer												
Portola Valley	Howard Young	Public Works Director												
Redwood City	Saber Sarwary	Supervising Civil Engineer	X											
San Bruno	Jimmy Tan	City Engineer												
San Carlos	Jay Walter	Public Works Director	X											
San Mateo	Brad Underwood	Public Works Director												
South San Francisco	Ray Towne	Public Works Director	X											
Woodside	Sean Rose	Public Works Director	X											
San Mateo County	Jim Porter	Public Works Director	X											
Regional Water Quality Control Board	Tom Mumley	Assistant Executive Officer	O											

"X" - Committee Member Attended  
 "O" - Other Jurisdictional Representative Attended

## **C/CAG AGENDA REPORT**

Date: March 16, 2017  
To: Stormwater Committee  
From: Matthew Fabry, Program Manager  
Subject: Receive presentation on PCBs monitoring and preliminary load reduction quantification for MRP 2.0 permit term

(For further information or questions contact Matthew Fabry at 650 599-1419)

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### **RECOMMENDATION**

Receive presentation on PCBs monitoring and preliminary load reduction quantification for MRP 2.0 permit term

### **BACKGROUND**

The Municipal Regional Permit (MRP) requires specific reductions in mercury and PCBs (polychlorinated biphenyls) by the end of the permit term (2020) and at an interim point (June 30, 2018), and further specifies a portion of the required load reductions be achieved via green infrastructure. The MRP anticipated use of an Interim Accounting Methodology during this permit term in advance of permittees developing more robust load reduction accounting and tracking methodologies during the permit term as part of the required Reasonable Assurance Analyses. EOA has been working with C/CAG member agencies to account for all green infrastructure implemented in San Mateo County to-date and the associated load reductions using the Interim Accounting Methodology. In addition, EOA has been working to identify other potential load reduction opportunities, including identification of potential source properties that could be referred for cleanup to appropriate regulatory agencies.

EOA has also been doing monitoring to help identify watersheds of interest with regard to reducing mercury and PCBs. EOA staff will provide a presentation on the latest information with regard to monitoring efforts and the preliminary results of load reductions via the Interim Accounting Methodology.

### **ATTACHMENTS**

None

## **C/CAG AGENDA REPORT**

Date: March 16, 2017

To: Stormwater Committee

From: Matthew Fabry, Program Manager

Subject: Review and approve modeling assumptions for stormwater management features for Reasonable Assurance Analysis modeling.

(For further information or questions contact Matthew Fabry at 650 599-1419)

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### **RECOMMENDATION**

Review and approve modeling assumptions for stormwater management features for Reasonable Assurance Analysis modeling.

### **BACKGROUND**

The Municipal Regional Permit (MRP) requires permittees to develop Reasonable Assurance Analyses demonstrating Green Infrastructure Plans will achieve specified load reductions in mercury and PCBs (polychlorinated biphenyls) by the end of the permit term and 2040. To do this, C/CAG's consultant, Paradigm Environmental, will be modeling numerous green infrastructure implementation scenarios to establish the most cost-effective combination of controls that will achieve San Mateo County's share of the mandated load reduction. This requires informed decisions regarding the specific design features and cost functions of the types of stormwater controls being modeled.

Paradigm Environmental staff developed a memorandum describing proposed assumptions for these items and provided an overview at the January Stormwater Committee meeting. C/CAG staff distributed the memorandum electronically to all member agencies on January 31 with comments requested by February 10. In response to comments, Paradigm revised the memorandum (Attachment 1).

Comments and associated responses are in Attachment 2. Staff recommends the Committee approve the revised memorandum to enable Paradigm to move forward with modeling various green infrastructure implementation scenarios.

### **ATTACHMENTS**

1. February 15, 2017 Paradigm Environmental revised memorandum, "Green Infrastructure Modeling Assumptions for the Reasonable Assurance Analysis"
2. Comment/Response Table

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To: Matt Fabry, PE, San Mateo Countywide Water Pollution Prevention Program  
From: Stephen Carter, PE, Paradigm Environmental  
cc: Sandy Mathews, Larry Walker Associates  
Date: 2/15/2017  
Re: Green Infrastructure Modeling Assumptions for the Reasonable Assurance Analysis

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The following technical memorandum outlines proposed modeling assumptions which will be used to represent green infrastructure (GI) simulation processes in the Reasonable Assurance Analysis (RAA) model representing San Mateo County watersheds. The RAA model will be used to establish relationships between the overall amount of GI implementation and the quantity of runoff volume and the overall amount of GI needed to achieve incremental reductions of mercury and PCBs loadings through stormwater capture, infiltration, and/or treatment. The RAA will establish a robust quantitative linkage between runoff volumes managed with GI and mercury and PCBs loads to demonstrate phased reductions to meet TMDL wasteload allocations. The Countywide Stormwater Resource Plan (SRP) developed by C/CAG identified suitable locations for three types of stormwater capture projects through a desktop analysis using screening criteria to identify project opportunity. That assessment of spatial opportunity will be used in conjunction with the physical and process parameters proposed in the following sections to represent regional stormwater capture projects, green street, and low impact development (LID) in the RAA model.

## 1 MODELING ASSUMPTIONS

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Due to the requirements outlined by the Municipal Regional Stormwater Permit (MRP) that affect the design of LID for new and redevelopment (Provision C.3), the modeling assumptions used in the RAA will reflect the minimum requirements of the permit. The MRP outlines several methods for sizing of stormwater treatment projects that will be used in the RAA. The San Mateo County Water Pollution Prevention Program (SMCWPPP) has also developed a technical guidance document tailored for San Mateo County that aids developers of stormwater projects to address Provision C.3 requirements. This guidance document specifies preferred methods and design criteria for stormwater treatment systems that fulfill permit requirements while addressing local standards. The methods suggested by the SMCWPPP technical guidance document are proposed as the basis for modeling assumptions that will be used in development of the RAA.

Modeling assumptions are organized into the subsequent sections according to the three project types identified in the SRP:

- Regional Stormwater Capture Projects
- Green Streets (bioretention, permeable pavement)
- Low Impact Development

### 1.1 Regional Stormwater Capture Projects

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Regional stormwater capture projects are assumed to be subsurface infiltration systems. These types of projects are typically implemented on publicly-owned parcels below parks, open space and/or recreational facilities. Depending on specific site constraints, these facilities can capture stormwater

diverted from adjacent channels or storm drains which often results in increased captured drainage area. These situations require inclusion of a diversion structure and may require pumping at additional cost. Modeling assumptions regarding diversion will be determined on a case-by-case basis for each regional project. Based on the SMCWPPP technical guidance, these facilities will be represented using a storage depth that facilitates a 72-hour drain-down time. The modeling assumptions for regional projects are listed below in Table 1.

**Table 1. Regional Projects on Public Parcels Modeling Assumptions**

Groups	Item Description	Value	Units	Source <sup>[1]</sup> <sup>[2]</sup>
Storage	Design Drainage Area	<i>Sized for capture of 80% of the annual runoff volume</i>		[1] C.3.d.i.(1).(b) pg.22
	Structure Footprint			
	Storage Depth	3	ft	[2] Section 6.11 pg.6-55
	Minimum Infiltration	0.5	in/hr	[2] Section 6.11 pg.6-55
Diversion	<i>Diversion assumptions will be made on a case-by-case basis for each regional project</i>			

[1] Municipal Regional Stormwater Permit Order No. R2-2015-0049

[2] SMCWPPP C.3 Stormwater Technical Guidance

## 1.2 Green Streets

Green streets are implemented in the public right-of-way and typically capture runoff contributed from the street and adjacent parcels. Suitable green street locations were identified through a screening process during the development of the SRP. Green streets will be represented using a combination of bioretention and permeable pavement. Conceptually these two components are implemented in unison, although permeable pavement can be limited or removed in areas where implementation is not feasible. The modeling assumptions for both the bioretention and permeable pavement components of green streets are listed in Table 2.

Both bioretention and permeable pavement consist of three components: surface layer, media layer, and underdrain layer. The surface layer consists of captured runoff that is allowed to pond above the treatment surface and is treated as storage. The media layer is the primary component of treatment and storage. The media layer must be a minimum of 18 inches for bioretention (SMCWPPP 2016). For permeable pavement, the media layer depth is dependent on expected traffic load, runoff depth, and soil conditions (Caltrans 2014). According to design guidance in San Francisco, a minimum depth between 18 and 28 inches is required for the media layer, depending on soil conditions and expected traffic load (SFPUC 2016). A depth of 2 feet will be used for permeable pavement as an intermediate assumption to account for a variety of street usage and expected runoff depths. The media infiltration rate should not be a limiting factor for permeable pavement and a rate of 10 inches per hour will be assumed, compared to the minimum of 5 inches per hour specified by the MRP. Underdrains are typically required for either component when the underlying soils have low infiltration below a specific threshold. In most of San Mateo County, underdrains will generally be required unless exempted by the local jurisdiction on a case-by-case basis depending on soil permeability (SMCWPPP 2016). According to several regional design resources across the United States, underdrains should be included when underlying soils have an infiltration rate below 0.5 inches per hour (DOEE 2013; Virginia DEQ 2011; SF DPW Order No. 178,493) and will be used in the model to determine which projects include underdrains. For bioretention, the underdrain layer can be a minimum of 12 inches (SMCWPPP 2016; SFPUC 2016). For permeable pavement, an

underdrain can have a diameter of at least 4 inches with a minimum 4 inches of aggregate on all sides (SMCWPPP 2016), resulting in an underdrain layer of 12 inches. Underdrains in permeable pavements are typically placed above the media layer (the primary component of storage) to maximize infiltration (BASMAA 2015; SMCWPPP 2016). Pollutant removal estimates for pollutants of concern, PCBs and Mercury, are from influent and underdrain concentration statistics reported by BASMAA.

**Table 2. Green Street Modeling Assumptions**

Groups	Item Description	Value	Units	Source <sup>[1] [2] [3]</sup>
<b>Bioretention</b>				
Surface	Design Drainage Area	<i>Sized for runoff from 0.2 inches per hour intensity rainfall event</i>		[1] C.3.d.i.(2).(c) pg.22
	Project Footprint	<i>4% of drainage area</i>		[2] Section 5.1 pg.5-6
	Ponding Depth	6	in	[2] Section 6.1 pg.6-4
Media	Depth	1.5	ft	[2] Section 6.1 pg.6-5
	Soil Porosity	0.35	-	[3] Appendix A
	Soil Infiltration Rate	5	in/hr	[1] C.3.c.i.(2).(c).(ii) pg.20
Underdrain	Use if soil infiltration rate is less than	0.5	in/hr	
	Depth	1	ft	[2] Section 6.1 pg.6-5, [3]
	Media Porosity	0.4	-	[3] Appendix A
	Pollutant Filtration	<i>98% PCBs / 45% Hg Reductions</i>		[4] Table 4-2, pg.36
	Background Infiltration	<i>Match underlying soils</i>		
<b>Permeable Pavement</b>				
Surface	Design Drainage Area	<i>Sized for capture of 80% of the annual runoff volume</i>		[1] C.3.d.i.(1).(b) pg.22
	Project Footprint	<i>1/3 of the drainage area</i>		[2] Section 6.6 pg.6-33
	Ponding Depth	0.12	in	
Underdrain	Use if soil infiltration rate is less than	0.5	in/hr	
	Depth	1	ft	[2] Section 6.6 pg.6-33
	Media Porosity	0.4	-	[3] Appendix A
	Pollutant Filtration	<i>No significant filtration through underdrain</i>		
Media	Depth	2	ft	[5] Appendix B
	Media Porosity	0.4	-	[3] Appendix A
	Media Infiltration Rate	10	in/hr	[1] C.3.c.i.(2).(c).(ii) pg.20
	Background Infiltration	<i>Match underlying soils</i>		

[1] Municipal Regional Stormwater Permit Order No. R2-2015-0049

[2] SMCWPPP C.3 Stormwater Technical Guidance

[3] Upper Los Angeles River EWMP

[4] BASMAA "White Paper" on Provision C.3 in MRP 2.0

[5] SFPUC San Francisco Stormwater Management Requirements and Design Guidelines

## 1.3 Low Impact Development

Assumptions for LID will be incorporated in the model and linked to future projections of new and re-development to represent implementation of Provision C.3. LID may also be considered on public parcels, as identified in the SRP. LID typically treats runoff generated onsite. This means that the drainage area for LID is typically no larger than the parcel size. In the RAA model, these features will be represented as bioretention, though implementation will vary with individual site constraints. The components for bioretention are discussed in Section 1.2. The modeling assumptions for LID are listed in Table 3. Underdrains are typically required for bioretention when the underlying soils have low infiltration below a specific threshold. According to several regional design resources across the United States, underdrains should be included when underlying soils have an infiltration rate below 0.5 inches per hour (DOEE 2013; Virginia DEQ 2011; SF DPW Order No. 178,493) and will be used in the model to determine which projects include underdrains. Pollutant removal estimates for pollutants of concern, PCBs and Mercury, are from influent and underdrain concentration statistics reported by BASMAA.

Table 3. Low Impact Development Modeling Assumptions

Groups	Item Description	Value	Units	Source <sup>[1][2]</sup>
Bioretention				
Surface	Design Drainage Area	<i>Sized for runoff from 0.2 inches per hour intensity rainfall event</i>		[1] C.3.d.i.(2).(c) pg.22
	Project Footprint	<i>4% of drainage area</i>		[2] Section 5.1 pg.5-6
	Ponding Depth	6	in	[2] Section 6.1 pg.6-4
Media	Depth	1.5	ft	[2] Section 6.1 pg.6-5
	Soil Porosity	0.35	-	[3] Appendix A
	Soil Infiltration Rate	5	in/hr	[1] C.3.c.i.(2).(c).(ii) pg.20
Underdrain	Use if soil infiltration rate is less than	0.5	in/hr	
	Depth	1	ft	[2] Section 6.1 pg.6-5
	Media Porosity	0.4	-	[3] Appendix A
	Pollutant Filtration	<i>98% PCBs / 45% Hg Reductions</i>		[4] Table 4-2, pg.36
	Background Infiltration	<i>Match underlying soils</i>		

[1] Municipal Regional Stormwater Permit Order No. R2-2015-0049

[2] SMCWPPP C.3 Stormwater Technical Guidance

[3] Upper Los Angeles River EWMP

[4] BASMAA "White Paper" on Provision C.3 in MRP 2.0

## 2 COST ASSUMPTIONS

Due to limited cost data in San Mateo County, cost functions developed from an inventory of projects in the Los Angeles region will be used. The functions were determined for the Upper Los Angeles River Enhanced Watershed Management Program by estimating costs of all project components for each project. There will be some uncertainty regarding the true costs pertaining to San Mateo County, but the relative costs between project types is well represented for the

optimization of project types in the RAA. In other words, although it would not be recommended to use these cost functions for projections of county-wide or city-wide implementation costs, these functions will be sufficient for comparison of alternative implementation scenarios for selection of the most cost-effective strategy and combination of GI, LID, and regional stormwater capture projects to meet necessary pollutant reductions. The cost functions are listed in Table 4.

**Table 4. Project Cost Functions**

Project Type	Project Subtype	Cost Estimate Formula	User inputs
<b>Regional Project</b>	Infiltration basin w/o pump station	$\$10.01 (A_f) + 100,013.76 (S) + 2.8 (V_m)$	<ul style="list-style-type: none"> <li>Capacity (S)</li> <li>Footprint area (<math>A_f</math>)</li> <li>Media volume (<math>V_m</math>)</li> </ul>
	Infiltration basin w/ pump station	$\$10.01 (A_f) + 100,013.76 (S) + 2.8 (V_m) + 56,227 (P) + 1,207,736$	<ul style="list-style-type: none"> <li>Footprint area (<math>A_f</math>)</li> <li>Capacity (S)</li> <li>Pumping rate in cfs (P)</li> <li>Media volume (<math>V_m</math>)</li> </ul>
<b>Green Streets</b>	Bioretention and permeable pavement w/ underdrain	$\$17.688 (A_f) + 94,307.4 (S) + 2.64 (V_m) + 25.344 (A_p) + 10.367 (R)^2 (U)$	<ul style="list-style-type: none"> <li>Bioretention capacity (S)</li> <li>Bioretention area (<math>A_f</math>)</li> <li>Media volume (<math>V_m</math>)</li> <li>Pavement area (<math>A_p</math>)</li> <li>Underdrain radius (R)</li> <li>Underdrain length (U)</li> </ul>
	Bioretention and permeable pavement w/o underdrain	$\$9.438 (A_f) + 94,307.4 (S) + 2.64 (V_m) + 25.344 (A_p)$	<ul style="list-style-type: none"> <li>Bioretention capacity (S)</li> <li>Bioretention area (<math>A_f</math>)</li> <li>Media volume (<math>V_m</math>)</li> <li>Pavement area (<math>A_p</math>)</li> </ul>
<b>Low Impact Development</b>	Bioretention retrofit w/ underdrain	$\$17.688 (A_f) + 94,307.4 (S) + 2.64 (V_m) + 10.367 (R)^2 (U)$	<ul style="list-style-type: none"> <li>Bioretention capacity (S)</li> <li>Bioretention area (<math>A_f</math>)</li> <li>Media volume (<math>V_m</math>)</li> <li>Underdrain radius (R)</li> <li>Underdrain length (U)</li> </ul>
	Bioretention retrofit w/o underdrain	$\$9.438 (A_f) + 94,307.4 (S) + 2.64 (V_m)$	<ul style="list-style-type: none"> <li>Bioretention capacity (S)</li> <li>Bioretention area (<math>A_f</math>)</li> <li>Media volume (<math>V_m</math>)</li> </ul>

**Units:** S [ac-ft],  $V_m$  [ft<sup>3</sup>],  $A_f$  [ft<sup>2</sup>],  $A_p$  [ft<sup>2</sup>], P [cfs], R [ft], U [ft]

### 3 REFERENCES

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- Bay Area Stormwater Management Agencies Association (BASMAA). February 2015. *“White Paper” on Provision C.3 in MRP 2.0.*
- California Department of Transportation (Caltrans). August 2014. *Caltrans Pervious Pavement Design Guidance.* <[dot.ca.gov](http://dot.ca.gov)>
- District of Columbia Department of Energy and Environment (DOEE). 2013. *District of Columbia Stormwater Management Guidebook.* <[doee.dc.gov](http://doee.dc.gov)>
- San Francisco Bay RWQCB. November 2015. *Order No. R2-2015-0049, NPDES Permit No. CAS612008, Municipal Regional Stormwater Permit.* <[waterboards.ca.gov](http://waterboards.ca.gov)>
- San Francisco Department of Public Works. *DPW Order 178,493, Approving the Use of Permeable Paving Systems.* <[sfpublicworks.org](http://sfpublicworks.org)>
- San Francisco Public Utilities Commission (SFPUC). May 2016. *San Francisco Stormwater Management Requirements and Design Guidelines.* <[sfwater.org](http://sfwater.org)>
- San Mateo County Water Pollution Prevention Program (SMCWPPP). June 2016. *C.3 Stormwater Technical Guidance, version 5.* <[flowstobay.org](http://flowstobay.org)>
- Upper Los Angeles River Watershed Management Group. January 2016. *Enhanced Watershed Management Program for the Upper Los Angeles River Watershed.* <[waterboards.ca.gov](http://waterboards.ca.gov)>
- Virginia Department of Environmental Quality (Virginia DEQ). March 2011. *Virginia DEQ Stormwater Design Specification No. 7, Permeable Pavement: version 1.8.*

Name	Affiliation	Section	Comment	Response
Martin Quan	Burlingame	Section 2 Table 4	We reviewed the document and link provided. The memo by Paradigm for GI modeling assumptions is acceptable for Burlingame as they reflect the requirements of the MRP. Is the cost assumptions table necessary? The memo states that it would not be recommended for use as cost projections, other than for relative comparison between different subtype projects.	Although the cost assumptions are not recommended for cost projections, the relative comparison between project types is a necessary component of the RAA modeling. The modeling process will result in alternative scenarios that can be used in the selection of the most cost effective strategy and combination of green streets, LID, regional projects even though the projected costs may differ. Since these cost functions will be used in this analysis, they are documented for review.
Brian Dong	Belmont	Section 1.2	Is the infiltration rate of Permeable Pavement not a limited design factor because they should be well drained as with a catch basin? Therefore shouldn't be limited by 5in/hr, but for sake of calculations the rate is doubled to 10in/hr?	Correct. 5 in/hr is the minimum value prescribed by the MRP but permeable pavement is often designed with much higher infiltration rates through the aggregate layer. However, a value must be provided for the model so 10 in/hr was selected for the sake of calculations.
Brian Dong	Belmont	Section 1.2	Did you mean to say that underdrains are generally required unless exempted by local jurisdictions on a case by case basis?	Yes, the text was updated to make this statement clearer.
Brian Dong	Belmont	Section 1.3 Table 3	It's my understanding that using 4% is a conservative number. For special projects, such as in PDA or downtown areas, would the footprint percentage be lowered?	For evaluation on a countywide scale, the 4% assumption was selected because it is recommended in the C.3 Technical Guidance to address the sizing methods prescribed by the MRP. This assumption does provide a conservative estimate. In reality, special projects as you mentioned can be designed with smaller footprints in areas where space is limited, as long as they meet one of the three MRP sizing requirements for flow-based measures.

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Mark Lander	Half Moon Bay	Section 1.2	<p>A media filter rate of 10 inches per hour is assumed, as opposed to the 5 inches per hour specific in the MRP (C.3.d.iii(2)(a)). Is there reason to believe that the Board will allow an increase in the infiltration rate beyond what is specifically called out in the permit? And if allowed for non-regulated GI projects, are we creating a separate set of design criteria for GI projects vs. regulated projects? This seems like potential for confusion and/ or error in choosing the correct design criteria.</p>	<p>That section of the MRP is relevant to infiltration devices and is to ensure that adequate pollutant removal occurs before injected runoff reaches the groundwater aquifer; it applies to projects that intend to bypass surficial soils (dry wells, injection wells, infiltration trenches, etc.). However, the assumption of 10 in/hr is not the rate that water will be injected in the ground (this is still limited by the infiltration rate of background soils). Rather, 10 in/hr is how quickly the water will move through the media layer. The MRP specifies 5 in/hr as the <i>minimum</i> rate through the media layer for bioretention (C.3.c.i.(2).(c).(ii)). The permit does not prescribe a minimum for permeable pavement since flow through the media layer should not be a limiting factor and pavements are often designed with rates of 10-25 in/hr or sometimes even higher.</p>
Mark Lander	Half Moon Bay	Section 1.2 Table 2	<p>Under the Bioretention criteria, 5" per hour is shown for the soil infiltration rate. This is consistent with current design criteria, but in conflict with the intent stated in the text suggesting a rate of 10" per hour. Which is the intent?</p>	<p>The statement in the text is intended for permeable pavements only. See answer above for the reason behind the increased value for pavements only. The text has been updated to make this clearer.</p>
Mark Lander	Half Moon Bay	Section 1.2 Table 2	<p>Under the Permeable Pavement criteria, under "pollutant infiltration", there is the statement "no significant filtration through underdrain". Is this suggesting that permeable pavement is ineffective in removing pollutants? And if so, why would be install permeable pavement in a non-regulated GI project. Not sure what the intent of the statement is.</p>	<p>This is only to state that no significant filtration occurs through the aggregate base, and therefore, runoff that leaves through the underdrain will have similar pollutant concentration as the inflow. The primary mechanism for pollutant removal in pavements is through infiltration into background soils, which will still be represented in the model. That assumption only affects runoff that leaves through the underdrain.</p>

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Mark Lander	Half Moon Bay	Section 2 Table 4	Calculation of the full measure cost requires user input on a number of factors, some of which require extensive design work to determine the input quantities. While this may be helpful for projects that are into the design phase, the formulas are not easily used for initial planning efforts (for example, the underdrain radius and length are details that won't be known until the design is almost complete). For this, suggest that the formulas be flushed out to costs per acre of land being treated, with maybe a range of costs for different acreages. This would allow some quick comparisons of treatment scenarios without spending design funds on measures that may not be chosen.	The cost functions are not intended for users to estimate cost projections. Instead, these functions will be used in the RAA model to determine relative costs of alternative implementation scenarios representing combinations of project types to achieve required load reductions. This will assist in selection of cost-effective implementation scenarios for the GI plan and TMDL implementation. Default values derived from the C.3 Technical Guidance will be used for this analysis. No design details will be required from the jurisdictions for this analysis.
Mark Lander	Half Moon Bay	General	I recall seeing studies that have been done that show hydrodynamic separator (HDS) units may be effective in removing 20-50% of PCBs and mercury (the portion in sediment). There are a number of HDS units in place that were installed in pre-LID days, and there may be more going in to help meet C.10 requirements. Suggest adding a pollutant filtration rate for HDS units for agencies who may want to look at the contribution of existing or proposed units toward overall pollutant reductions.	Thank you for the suggestion. The memo only addresses the assumptions that are necessary for the RAA model, which will consider the three project types: regional, bioretention, and permeable pavements. While HDS may be considered for pretreatment or as a standalone treatment device during the actual design phase, the model will not consider HDS.
Rob Lecel	South San Francisco	Section 1.3	In section 1.3 of the GI modeling assumptions the underdrain recommendation is when infiltration is below 0.5 inches per hour. The technical guidance for San Mateo County was when soil types couldn't infiltrate at least 1.5 inches per hour. Will this document be changing the area wide recommendation to using underdrains when the infiltration rate is below 0.5 inches per hour?	The C.3 Technical Guidance does not specify a minimum infiltration rate for which an underdrain must be included. Instead, the Guidance states that an underdrain will generally be required unless the design engineer/local jurisdiction makes an exception. Since there is no source specific to the County, the 0.5 in/hr assumption was referenced from several sources around the country.
Jill Bicknell	EOA, Inc.	Section 1	I'm not sure how bioretention systems with underdrains will be represented in the model, i.e., whether it is assumed that there is no infiltration or some infiltration with these systems. Also, it is unclear in the Modeling Assumptions memo whether the 0.5 in/hr infiltration rate is being used in the model to determine whether a bioretention facility at a particular location will have an underdrain or not. If it is a modeling parameter, it should be listed in Tables 2 and 3.	The model will still consider infiltration for systems that include underdrains (practically speaking, the model will consider unlined systems only). The 0.5 in/hr will be used to determine inclusion of an underdrain. The tables and text have been updated to clarify this.