STORM WATER TRAINING
LOW IMPACT DEVELOPMENT (LID)

DECEMBER 11, 2019

INTRODUCTION

REGIONAL LID MANUAL TRAINING

AGENDA

1:00 PM	Introduction	Colleen Hunt
1:15 PM	Regulations	Brendan Thompson
1:30 PM	LID Manual 101	Heaven Moore
2:30 PM	BREAK	
2:45 PM	Example Exercise	Yoash Tilles
3:30 PM	Q&A Panel	Panelist
4:30 PM	END	

RRWA
RUSSIAN RIVER WATERSHED ASSOCIATION

CLOVERDALE · CITY OF COTATI · CITY OF SANTA ROSA · CITY OF UKIAH · TOWN OF WINDSOR · SONOMA WATER

ACRONYMS
&
DEFINITIONS

- **IMPERVIOUS SURFACE:** For the purposes of this Manual, impervious area is defined as areas that have been modified such that storm water percolation into underlying soils is reduced or prohibited. Typical examples of surfaces include concrete, asphalt, and roof tops.
  - *Gravel placed as part of the proposed project is considered to be impervious unless documentation is provided to verify that it is pervious.*
  - *Existing gravel on a project site prior to the proposed project is considered to be pervious unless documentation is provided that demonstrates that it is impervious.*

REGULATORY BACKGROUND

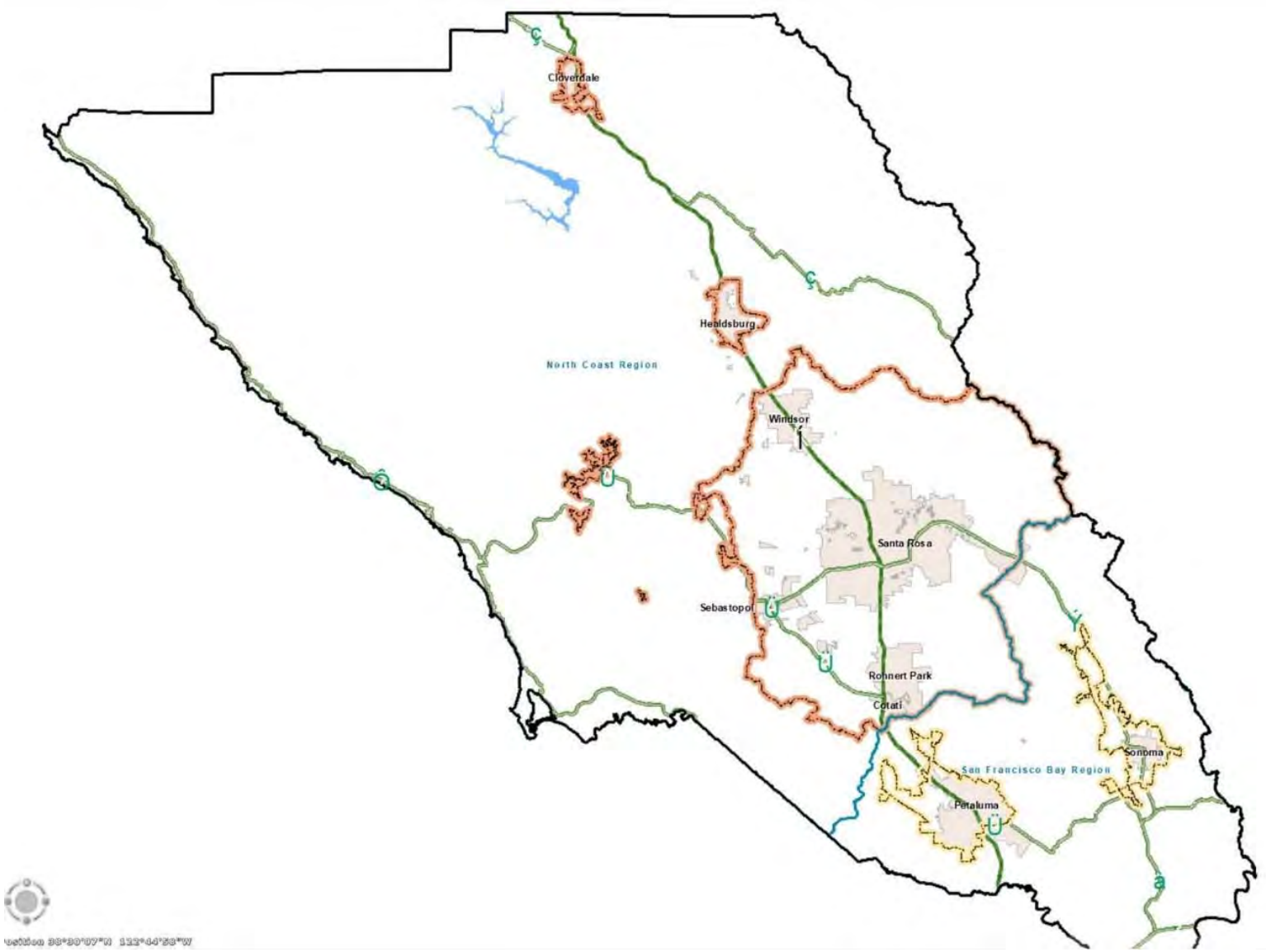
BRENDAN THOMPSON

MS4 Storm Water Permit

- Regulates the discharge of storm water discharged from the municipal separate storm sewer system (MS4) to receiving water
- Requires Permittees to reduce pollution in storm water runoff to the maximum extent practicable
- BMP based permit requiring control measures related to public education and outreach, illicit discharge detection and elimination, municipal operations, construction sites, industrial and commercial facilities, monitoring and post-construction development

Municipal MS4 Storm Water Permit

- Order No. R1-2015-0030, Phase I Permit
- Areas subject to requirements include:
  - Cloverdale
  - Cotati
  - Healdsburg
  - Rohnert Park
  - Santa Rosa
  - Sebastopol
  - Ukiah
  - Windsor
  - Portions of Unincorporated Sonoma County
- Adopted by the North Coast Regional Water Quality Control Board Jan 6, 2016
- Expires January 5, 2021


Cloverdale
Healdsburg
North Coast Region
Windsor
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Sonoma
San Francisco Bay Region
Petaluma

Planning and Land Development

- Permit Requirements:
  - Project triggers that require LID
  - Exemptions
  - Treat all pollutants of concern including: dissolved and particulate metals, pathogens, nutrients, sediment, hydrocarbons, and trash and find sediment sized at 100 microns or larger
  - Sizing criteria
  - BMP selection
  - LID Manual
  - Approval Process
  - Hydromodification
  - Maintenance Declaration
  - Tracking and Inspections

Planning and Land Development

- Projects that trigger LID:
  - All new development and redevelopment projects creating or replacing 10,000 square feet or more of impervious surface
  - Streets, roads, highways, and freeway construction or reconstruction projects creating or replacing a combined total of 10,000 square feet or more of impervious surface

Planning and Land Development

- Projects that are exempt from LID:
  - Routine Maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, and original purpose of the facility, including pothole repairs and square cut patching
  - Emergency activities required to protect public health and safety
  - Projects undertaken solely to install or reinstall public utilities and do not include any additional street or road development or redevelopment activities beyond paving
  - Stand-alone pedestrian pathways, trails, and off-street bicycle lanes

APPLICABILITY

Which version of LID Manual must be used to comply with the LID requirements?

Which LID Manual To Use?

What date did the project receive approval?*

	July 13, 2005 - July 1, 2010	July 1, 2010 - May 3,2017	After May 3, 2017
Manual	Guidelines for the Standard Urban Storm Water Mitigation Plan, Storm Water Best Management Practices, for New Development and Redevelopment (June 3, 2006)	2011 Storm Water Low Impact Development Technical Design Manual (August 2011)	**2017 Storm Water Low Impact Development Technical Design Manual (May 2017)**

*Discretionary approval = Date of discretionary permit issuance

Ministerial approval = Date of ministerial permit issuance

Public projects w/o discretionary approval = CEQA determination date

Other Triggers- note these can change

401 Permit

CALGreen

- May be required for non-residential building permit
- Building Code change
- Effective January 2011
- Clarification Memo on Santa Rosa's website

General Construction Permit

Phase II MS4 Permit

LOW IMPACT DEVELOPMENT MANUAL

HEAVEN MOORE

2017 LID Manual

Designing a Project

- Sizing Requirements
- BMP Selection
- Storm Water Calculator

SIZING REQUIREMENTS

Sizing Criteria

Volume Capture and Treatment

- Treat all of the runoff generated using the modified Rational Method with an intensity of 0.2 inches per hours
- Capture the increase in volume generated by the site due to the increase in impervious surface for a 1.0" 24 hour rain event using the Curve Number method.

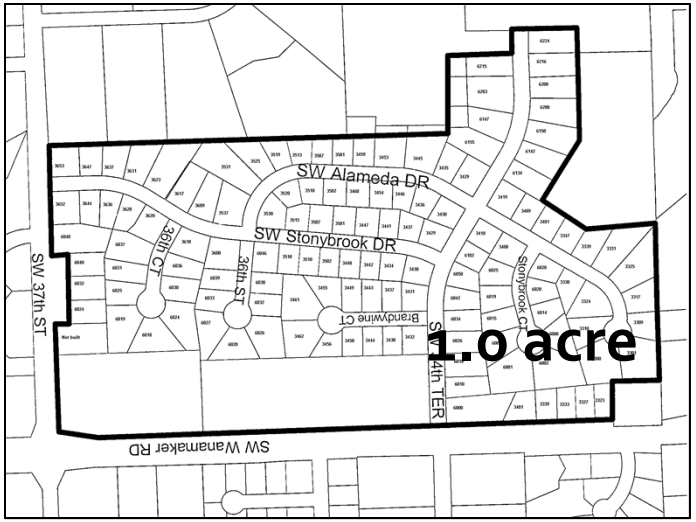
Treatment Only

- If only treatment is required BMPs must be sized and designed to:
  - 1.5 times the design flow rate using the modified Rational Method;
  - Flow rate of runoff produced by 1.0" 24 hour rain event using the Curve Number method.

Hydromodifications

- Project **create or replace a combined total of 1.0 acre or more** of impervious surface

- *Triggers the 100% Volume Capture Hydromodification Control Requirements*



BMP SELECTION

Prioritization of LID BMPs

- Small scale landscaped based infiltration BMPs that treat storm water as close to the source as possible
- BMPs are categorized into seven priorities

Prioritization of LID BMPs

Universal

- Generally not dependent on site constraints
- Should be considered for use at all projects

Examples

- Rain Water Harvesting
- Green Roofs
- Interceptor Trees
- Buffer Strips
- Flow Through Planters


Rain Barrel Cistern

Prioritization of LID BMPs

Priority 1

- Small scale
- Vegetated
- Infiltration based
- No perforated pipe
- No impermeable liners
- Provides infiltration into native soils

Examples

- Bioretention
- Constructed wetland

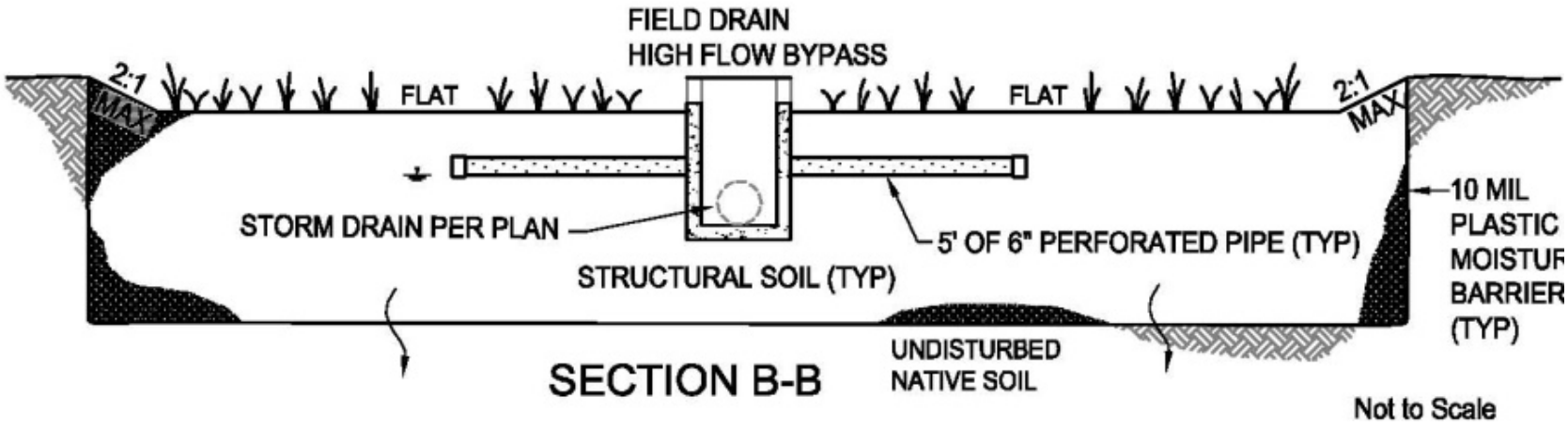
Prioritization of LID BMPs

Priority 2

- Small scale
- Vegetated
- Infiltration based
- **Perforated pipe installed high in the treatment area**
- No impermeable liners
- Use of native soils

Examples

- Bioretention
- Constructed wetland



SECTION B-B

Not to Scale

Prioritization of LID BMPs

Priority 3

- Treatment only
- Installed with subdrains
- Use of impermeable liner
- "Treatment train" or when only treatment is required

Examples

- Bioretention
- Flow through planters
- Vegetated swale

Prioritization of LID BMPs

Priority 4

- May not have vegetation
- "Treatment train"

Examples

- Tree filter units
- Modular wetlands
- Infiltration trench without vegetation

Prioritization of LID BMPs

Priority 5

- Physical structured units
- Treatment only
- No vegetation
- "Treatment train"

Examples

- Chambered separator units
- Centrifugal separator units
- Filter inserts

Prioritization of LID BMPs

Priority 6

- Offset
- Requires Regional Water Approval

Prioritization of LID BMPs

Detention

- May be used of the design meets the design criteria specified for LID

BMP selection

- The proposed design must meet the technical requirements
- The selected BMPs must be LID type BMPs (Universal, Priority level 1 or 2), unless:
  - The project is only required to do treatment or
  - The BMP is use as apart of a "treatment train"

LID features are small scale, infiltration based, landscape features that aim to mimic the undeveloped site.

- The selected BMPs must be LID type BMPs (Universal, Priority level 1 or 2), unless:
  - It is infeasible to infiltrate for <u>one of the following reasons only:</u>
    - High groundwater or deadpan
    - Soil contamination (must be evaluated and confirmed by the Regional Board)
    - Geotechnical hazard
  - Priority level 3, 4, or 5 may be used in these cases- along with offset.

BMP selection

Approval Authority

If these conditions aren't met the municipality doesn't have the authority to approve the project and it must be referred to the Regional Board for review and approval.

A joint meeting will be convened between the applicant, Regional Water Board, and the municipality.

Trash Capture

- Trash capture must be provided for all tributary areas, or in the downstream system, unless it is provided in the BMP by virtue of its design.
  - Trash is defined as material over 100 microns in diameter.
  - Can be part of a treatment train.

Other notes and things to remember…

- BMS must have all three elements (small scale, infiltration based, vegetated) to qualify as LID and be approvable by the municipality.
  - Retention systems such as oversized pipes and chambers are not LID by themselves and must be part of a treatment train.
  - LID features must be 51% vegetated.
  - Permeable pavement is not a BMP, but rather a conveyance method and an impermeable area reduction tool.

Other notes and things to remember…

- All tributary areas must receive treatment and trash capture, however volume capture may be done on a site basis.
  - If one area of the site is not suited for infiltration, that calculated volume may be provided for in a different BMP. The physical water does not need to reach that BMP. This has been referred to as "on-site offset."

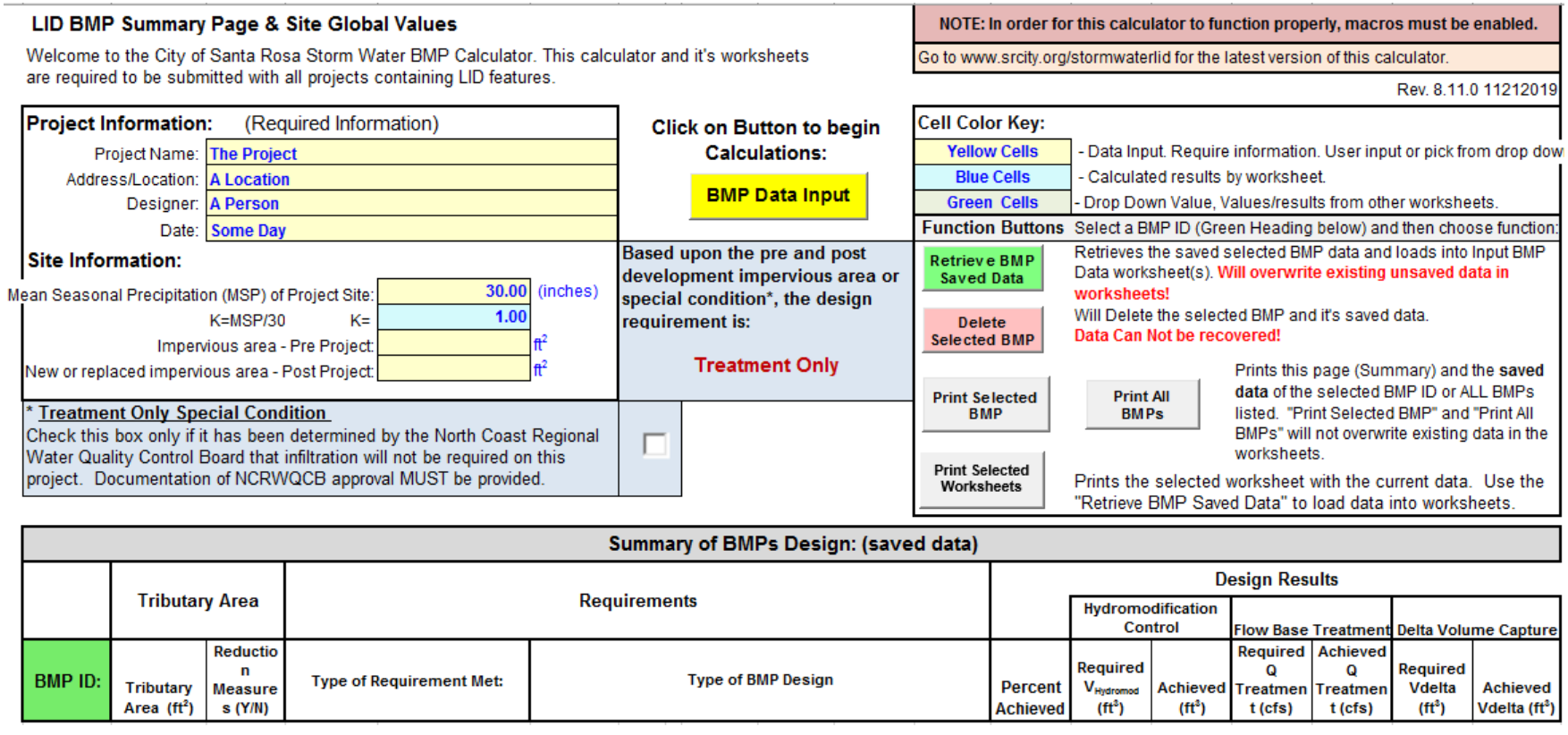
- Offsite improvements need to be considered in the calculations. If it isn't feasible to physically capture the runoff from these improvements, "on-site offset" may be utilized.

Other notes and things to remember…

- Don't forget you high flow bypass! Flood flows still need to be routed to the Storm Drain System.
- Make sure that the BMPs are located so that they can and will be inspected and maintained. BMPs that take up most of a small backyard are very likely to be removed by a homeowner.
- Think about construction sequencing. LID BMPs are designed to handle the level of load coming from the finished project. Construction runoff can foul them requiring them to be replaced before the site is accepted!

STORM WATER CALCULATOR

Calculator available at www.srcity.org/stormwaterLID



LID BMP Summary Page & Site Global Values

Welcome to the City of Santa Rosa Storm Water BMP Calculator. This calculator and it's worksheets are required to be submitted with all projects containing LID features.

NOTE: In order for this calculator to function properly, macros must be enabled.

Go to www.srcity.org/stormwaterlid for the latest version of this calculator.

Rev. 8.11.0 11212019

Project Information: (Required Information)

Project Name:	The Project
Address/Location:	A Location
Designer:	A Person
Date:	Some Day

Site Information:

Mean Seasonal Precipitation (MSP) of Project Site:	30.00	(inches)
K=MSP/30 K=	1.00	
Impervious area - Pre Project:		ft^2
New or replaced impervious area - Post Project:		ft^2

Click on Button to begin Calculations:

BMP Data Input

Based upon the pre and post development impervious area or special condition*, the design requirement is:

Treatment Only

* **Treatment Only Special Condition**

Check this box only if it has been determined by the North Coast Regional Water Quality Control Board that infiltration will not be required on this project. Documentation of NCRWQCB approval MUST be provided.

Cell Color Key:

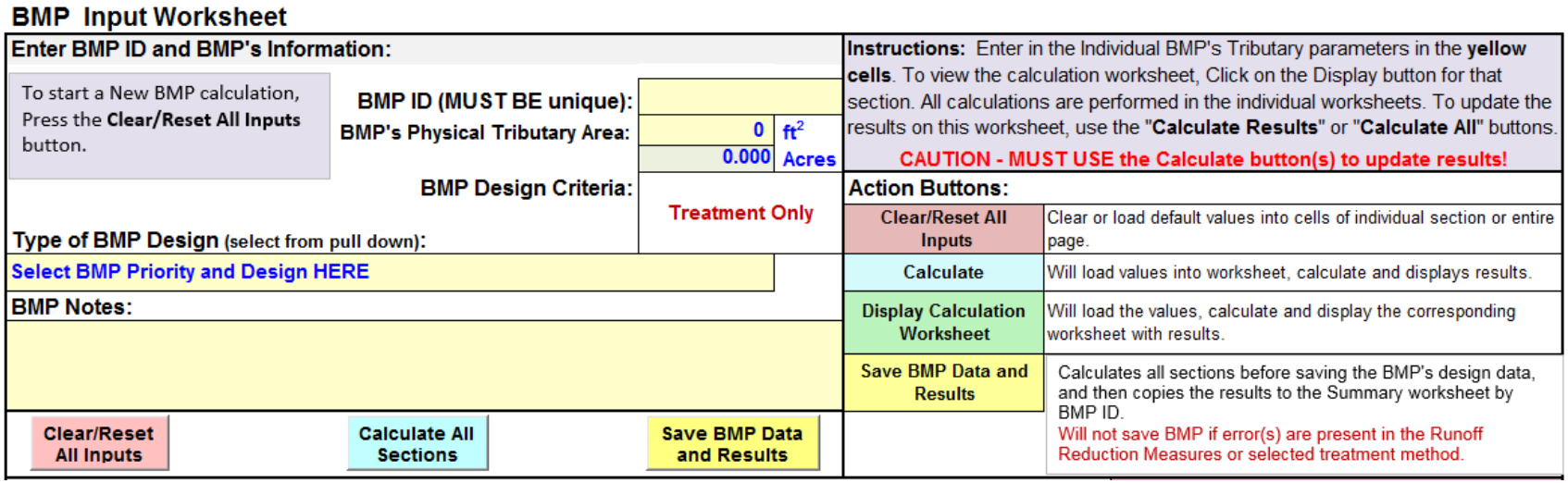
Yellow Cells	- Data Input. Require information. User input or pick from drop dow
Blue Cells	- Calculated results by worksheet.
Green Cells	- Drop Down Value, Values/results from other worksheets.

Function Buttons Select a BMP ID (Green Heading below) and then choose function:

Retrieve BMP Saved Data	Retrieves the saved selected BMP data and loads into Input BMP Data worksheet(s). **Will overwrite existing unsaved data in worksheets!**
Delete Selected BMP	Will Delete the selected BMP and it's saved data. **Data Can Not be recovered!**
Print Selected BMP / Print All BMPs	Prints this page (Summary) and the **saved data** of the selected BMP ID or ALL BMPs listed. "Print Selected BMP" and "Print All BMPs" will not overwrite existing data in the worksheets.
Print Selected Worksheets	Prints the selected worksheet with the current data. Use the "Retrieve BMP Saved Data" to load data into worksheets.

Summary of BMPs Design: (saved data)

	Tributary Area		Requirements		Design Results						
						Hydromodification Control		Flow Base Treatment		Delta Volume Capture	
BMP ID:	Tributary Area (ft^2)	Reduction Measures (Y/N)	Type of Requirement Met:	Type of BMP Design	Percent Achieved	Required $V_{Hydromod}$ (ft^3)	Achieved (ft^3)	Required Q Treatment (cfs)	Achieved Q Treatment (cfs)	Required Vdelta (ft^3)	Achieved Vdelta (ft^3)



BMP Input Worksheet

Enter BMP ID and BMP's Information:

To start a New BMP calculation, Press the **Clear/Reset All Inputs** button.

BMP ID (MUST BE unique):

BMP's Physical Tributary Area: 0 ft^2

0.000 Acres

BMP Design Criteria: Treatment Only

Type of BMP Design (select from pull down):

Select BMP Priority and Design HERE

BMP Notes:

Clear/Reset All Inputs | Calculate All Sections | Save BMP Data and Results

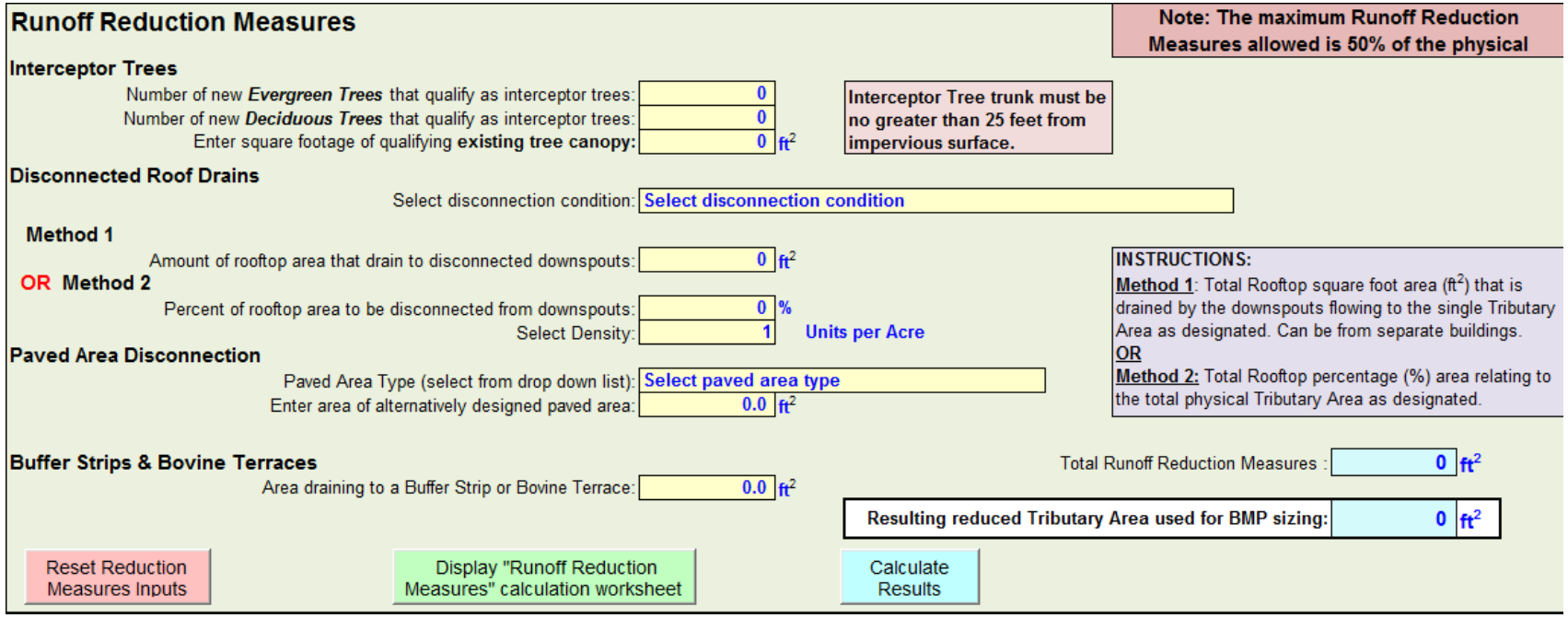
Instructions: Enter in the Individual BMP's Tributary parameters in the **yellow cells**. To view the calculation worksheet, Click on the Display button for that section. All calculations are performed in the individual worksheets. To update the results on this worksheet, use the "**Calculate Results**" or "**Calculate All**" buttons.

CAUTION - MUST USE the Calculate button(s) to update results!

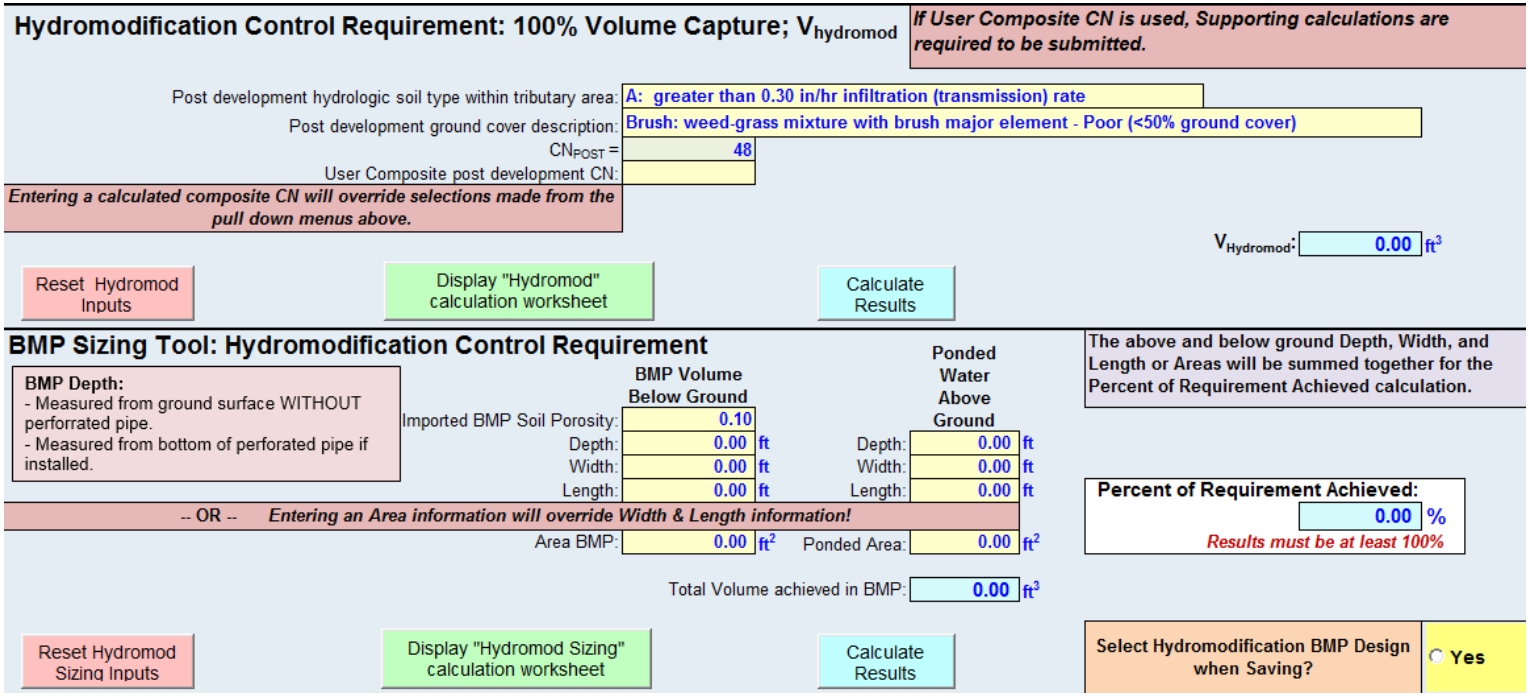
Action Buttons:

Clear/Reset All Inputs	Clear or load default values into cells of individual section or entire page.
Calculate	Will load values into worksheet, calculate and displays results.
Display Calculation Worksheet	Will load the values, calculate and display the corresponding worksheet with results.
Save BMP Data and Results	Calculates all sections before saving the BMP's design data, and then copies the results to the Summary worksheet by BMP ID. Will not save BMP if error(s) are present in the Runoff Reduction Measures or selected treatment method.

BMP INPUT WORKSHEET



RUNOFF REDUCTION MEASURES



Hydromodification Control Requirement: 100% Volume Capture; $V_{hydromod}$

If User Composite CN is used, Supporting calculations are required to be submitted.

Post development hydrologic soil type within tributary area: A: greater than 0.30 in/hr infiltration (transmission) rate

Post development ground cover description: Brush: weed-grass mixture with brush major element - Poor (<50% ground cover)

CN_{POST} = 48

User Composite post development CN:

Entering a calculated composite CN will override selections made from the pull down menus above.

$V_{Hydromod}$: 0.00 ft^3

Reset Hydromod Inputs | Display "Hydromod" calculation worksheet | Calculate Results

BMP Sizing Tool: Hydromodification Control Requirement

BMP Depth:
- Measured from ground surface WITHOUT perforated pipe.
- Measured from bottom of perforated pipe if installed.

	BMP Volume Below Ground		Ponded Water Above Ground	
Imported BMP Soil Porosity:	0.10			
Depth:	0.00	ft	0.00	ft
Width:	0.00	ft	0.00	ft
Length:	0.00	ft	0.00	ft

-- OR -- *Entering an Area information will override Width & Length information!*

Area BMP: 0.00 ft^2 Ponded Area: 0.00 ft^2

Total Volume achieved in BMP: 0.00 ft^3

The above and below ground Depth, Width, and Length or Areas will be summed together for the Percent of Requirement Achieved calculation.

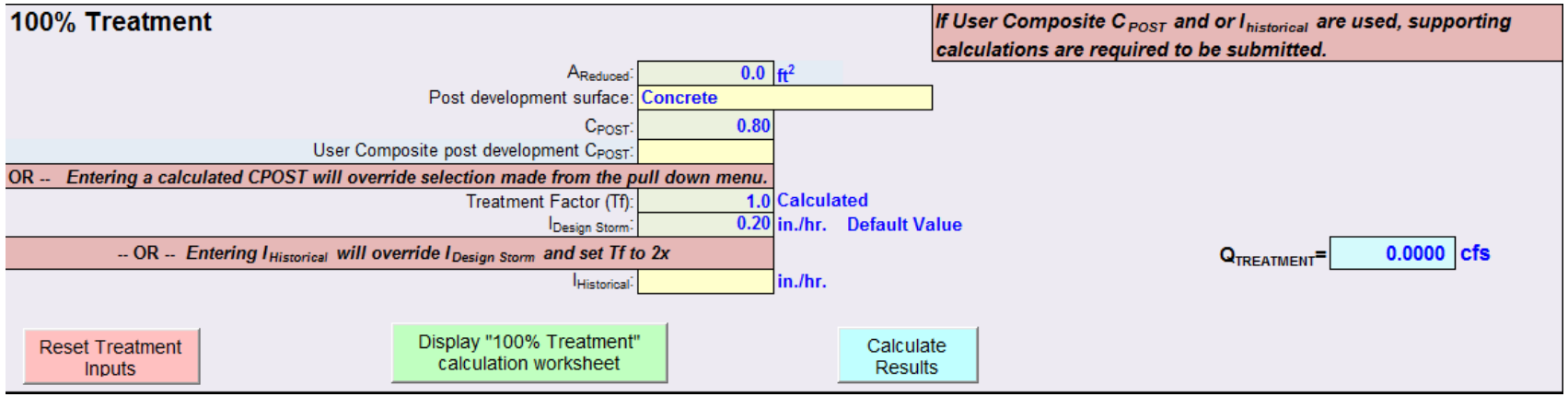
Percent of Requirement Achieved: 0.00 %

Results must be at least 100%

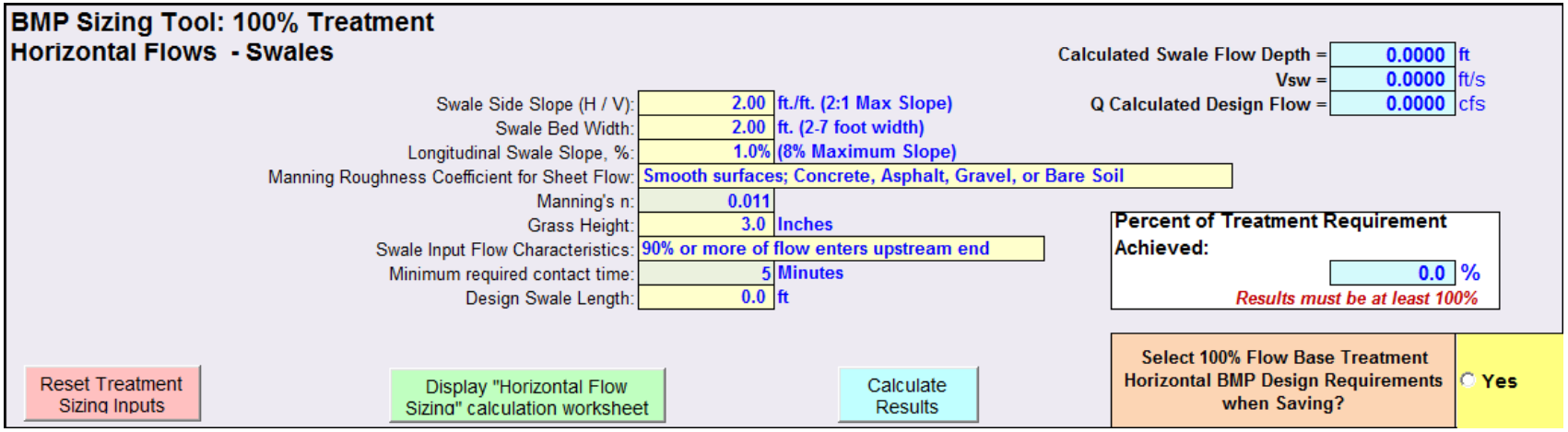
Reset Hydromod Sizing Inputs | Display "Hydromod Sizing" calculation worksheet | Calculate Results

Select Hydromodification BMP Design when Saving? ○ Yes

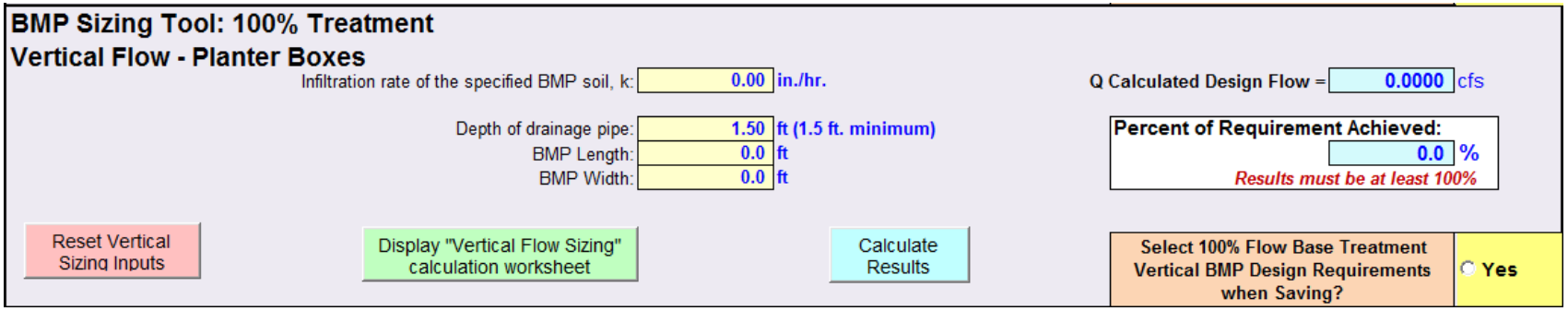
HYDROMODIFICATION CONTROL



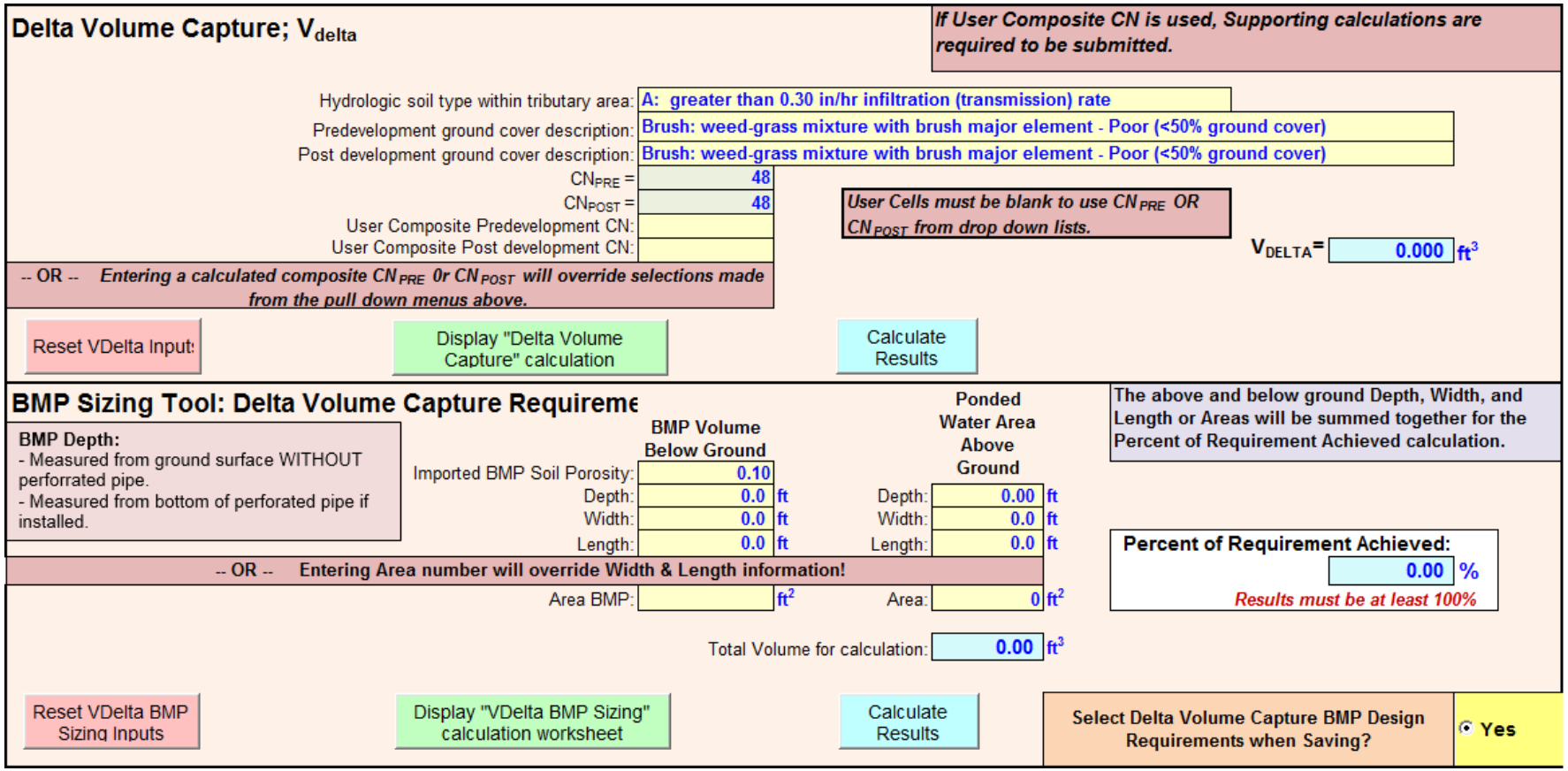
100% TREATMENT



HORIZONTAL FLOWS - SWALES



VERTICAL FLOW – PLANTER BOXES



Delta Volume Capture; V_{delta}

If User Composite CN is used, Supporting calculations are required to be submitted.

Hydrologic soil type within tributary area:	A: greater than 0.30 in/hr infiltration (transmission) rate
Predevelopment ground cover description:	Brush: weed-grass mixture with brush major element - Poor (<50% ground cover)
Post development ground cover description:	Brush: weed-grass mixture with brush major element - Poor (<50% ground cover)
CN_{PRE} =	48
CN_{POST} =	48
User Composite Predevelopment CN:	
User Composite Post development CN:	

User Cells must be blank to use CN_{PRE} OR CN_{POST} from drop down lists.

V_{DELTA}= 0.000 ft^3

-- OR -- ***Entering a calculated composite CN_{PRE} 0r CN_{POST} will override selections made from the pull down menus above.***

Reset VDelta Input | Display "Delta Volume Capture" calculation | Calculate Results

BMP Sizing Tool: Delta Volume Capture Requireme

BMP Depth:
- Measured from ground surface WITHOUT perforated pipe.
- Measured from bottom of perforated pipe if installed.

	BMP Volume Below Ground		Ponded Water Area Above Ground	
Imported BMP Soil Porosity:	0.10			
Depth:	0.0	ft	0.00	ft
Width:	0.0	ft	0.0	ft
Length:	0.0	ft	0.0	ft
-- OR -- Entering Area number will override Width & Length information!				
Area BMP:		ft^2	Area: 0	ft^2

Total Volume for calculation: 0.00 ft^3

The above and below ground Depth, Width, and Length or Areas will be summed together for the Percent of Requirement Achieved calculation.

Percent of Requirement Achieved: 0.00 %

Results must be at least 100%

Reset VDelta BMP Sizing Inputs | Display "VDelta BMP Sizing" calculation worksheet | Calculate Results

Select Delta Volume Capture BMP Design Requirements when Saving? ◉ Yes

DELTA VOLUME CAPTURE

CN Composite Work Sheet

Project:	The Project
Address/Location:	A Location
Designer:	A Person
Date:	Some Day
Inlet Number/Tributary Area/BMP:	0

INSTRUCTIONS: Please refer to the "Urban Hydrology for Small Watersheds" (TR-55 manual).

Click for the PDF of the Runoff curve numbers for urban areas. Check the bottom tool bar for open PDF.

Soil Type (Infiltration Rate)	Cover Description	CN	Area ft²	Product of CN x Area
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
		Totals =	0	0.0

$CN_{COMPOSIT} = \frac{(CN \times Area) + (CN \times Area) + (CN \times Area) + (CN \times Area) \ldots}{\text{Total Tributary Area}}$ = **Use this $CN_{COMPOSIT}$ =** NA

CN COMPOSITE WORK SHEET

C Factor Composite Work Sheet

Project:	The Project
Address/Location:	A Location
Designer:	A Person
Date:	Some Day
Inlet Number/Tributary Area/BMP:	0

INSTRUCTIONS: From "Using Site Design to Meet Development Standards For Storm water Quality" by the Bay Area Storm water Management Agencies Association (BASMAA).

Click for PDF of Table 6-1: C-Factors for Small Storms. Check for open PDF file on bottom tool bar.

Paving Surface	C Number	Area ft²	Product of C x Area
No Entry	-	-	-
No Entry	-	-	-
No Entry	-	-	-
No Entry	-	-	-
No Entry	-	-	-
No Entry	-	-	-
No Entry	-	-	-
No Entry	-	-	-
No Entry	-	-	-
No Entry	-	-	-
	Totals	-	-

$$\text{FACTOR COMPOSIT} = \frac{(C \times \text{Area}) + (C \times \text{Area}) + (C \times \text{Area}) \ldots}{\text{Total Tributary Area}} = C_{\text{FACTOR COMPOSIT}} = \text{NA}$$

C FACTOR COMPOSITE WORK SHEET

SUBMITTING A PROJECT

What needs to be in a SW LID Submittal

Each SUSMP Report needs to be complete.

The version don't need to match each other, but they do need to match the plan set they accompany!

What needs to be in the submittal?

- Completed Submittal Guide (Initial or Final)
- Copy of the completed Determination Worksheet
- Narrative Description
- Exhibits
- Calculation
- BMP details

City of Santa Rosa

APPENDIX D **Preliminary SUSMP Submittal Guide**

Project Information:

Applicant Name (owner or developer)	
Mailing Address	
City/State/Zip	
Phone/Email/Fax	

Project Name	
Site Address	
City/State/Zip	
Permit # (s)	

Engineer Name	
Mailing Address	
City/State/Zip	
Phone/Email/Fax	

Type of Application/Project:

☐ Subdivision ☐ Grading Permit ☐ Building Permit ☐ Design Review ☐ Use Pe

What your Preliminary Plan must include:

Narrative:

Project Description

- ☐ Description of proposed project type, location, and any specific uses or features.
- ☐ Description of any sensitive features (creeks, wetlands, trees, etc) and weather they removed or altered.
- ☐ Description of the existing site.
- ☐ Description of how this project triggers these requirements (impervious area, CALG

Pollution Prevention and Credits

- ☐ Description of all proposed pollution preventio uses, etc).
- ☐ Description of all credits utilized (Interceptor T Design).
- ☐ Summary of tributary area reduction due to cr

Type of BMPs proposed

- ☐ Description of the types of BMPs selected inclu
- ☐ Description of level of treatment and volume c required).

Maintenance

- ☐ Description of maintenance for each type of BM
- ☐ Description of funding mechanism.
- ☐ Designation of Responsible Party.

Exhibits:

Proposed SUSMP Exhibit

- ☐ Exhibit should include: street names, property north arrow.
- ☐ Tributary areas shown for all inlets (including o
- ☐ C value for each tributary area.
- ☐ Soil Type of existing site.
- ☐ New or replaced impervious area.
- ☐ All inlets shown (including identifier).
- ☐ All interceptor trees shown.
- ☐ All proposed BMPs shown.

Existing Condition Exhibit

- ➢ *Not necessary if no impervious area existed on Capture is achieved.*
- ☐ Exhibit should include: street names, property scale, and north arrow.
- ☐ Soil Type of existing site.
- ☐ Proposed tributary areas shown for all propose
- ☐ Existing impervious areas

City of Santa Rosa

APPENDIX D **Preliminary SUSMP Submittal Guide**

BMP Details:

- ☐ Preliminary detail for each type of BMP selected- provide a preliminary 8.5"x11" detail for each BMP type or include on submitted drawings. These can be taken straight from the Fact Sheets if no significant changes are proposed.

On Plans:

- ☐ Show all applicable elements of the selected BMPs on the appropriate sheets.

Calculations:

- ☐ Preliminary calculations; both volume and treatment, using the "storm water calculator" for each inlet.

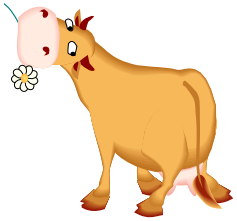
Narrative:

Project Description

- Description of proposed project type, location, and any specific uses or features.
- Description of any sensitive features (creeks, wetlands, trees, etc) and whether they are going to be preserved, removed or altered.
- Description of the existing site.
- Description of how this project triggers these requirements (impervious area, CALGreen, 401 Permit, etc).

Pollution Prevention and Runoff Reduction Measures

- Description of all proposed pollution prevention measures (street sweeping, covered trash enclosures, indoor uses, etc).
- Description of all Runoff Reduction Measures (Interceptor Trees, Impervious Area Disconnection, and/or Alternative Driveway Design).

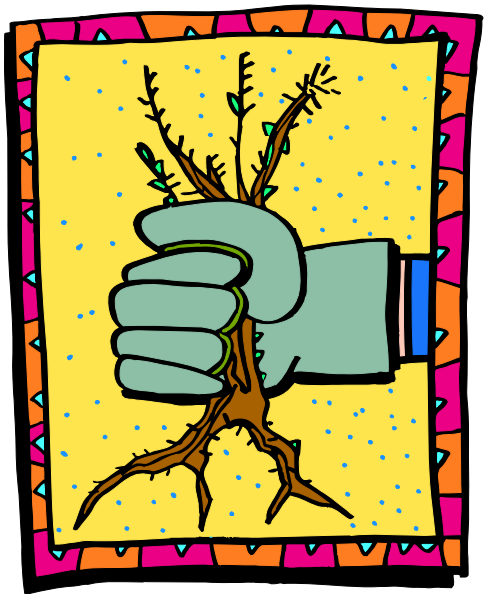


Type of BMPs proposed

- Description of the types of BMPs selected including priority group that each is in.
- Description of level of treatment and volume capture achieved.

Maintenance

- Description of maintenance for each type of BMP.
- Description of funding mechanism.
- Designation of Responsible Party.



PRELIMINARY SUSMP WILD MEADOW COURT September 2, 2011

Project Description:
Wild Meadow Court Subdivision is a 20 lot subdivision located at 168 Wester Ave in Santa Rosa. The site is bounded by existing lots to the west, Willow Ave to the south, the future East Meadow Subdivision to the east, and Santa Rosa Creek to the north. The undeveloped site consists of primarily open space covered with brush as well as an existing home, out building, and gravel driveway. Five oak trees existing on site will be preserved, as well as the vegetation in the creek setback area. The site consists of Type D soil (adobe clay), as identified in the geotechnical report. The developed site will be a residential development project. This project triggers these storm water requirements by creating over 10,000 ft² of new impervious surface. This project will also require a 401 permit for the new outfall to Santa Rosa Creek.

Pollution Prevention Measures:
Downspouts from roof gutters will disconnected from the storm drain system through the use of bubble up emitters that discharge into landscape areas. Interceptor trees will be planted along street frontage and five existing oak trees will be preserved. The total tributary area used for treatment and volume capture calculations has been reduced by taking credit for these measures.

Types of BMPs
Storm water from the streets and lots 1, 5, and 7-20 will be directed through curb cuts to roadside bioretention that will be installed in the planter strip. Runoff from lots 2-4 and 6 will be treated in private raingardens. The bioretention will be installed per detail P2-04 "Priority 2 Roadside Bioretention- Curb Opening" and the raingardens will be installed per detail P1-01 "Priority 1 Rain Garden" as detailed in the Storm Water Low Impact Development Technical Design Manual.

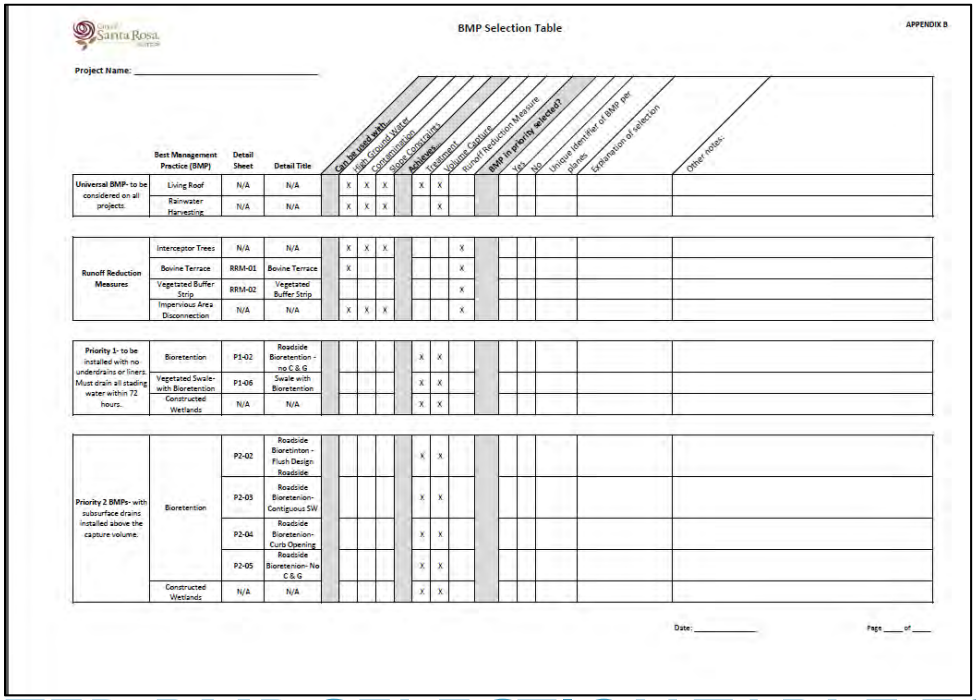
Level of Treatment and Volume Capture
The requirement of 100% Treatment and Delta Volume Capture has been achieved at CB 401. The design goal of 100% Volume Capture has been achieved in all other tributary area.

Maintenance and Funding
BMPs shall be inspected and maintained as described in the "Planter Strip Bioretention Inspection and Maintenance Checklist" and the "Rain Garden Inspection and Maintenance Checklist" provided in Storm Water Low Impact Development Technical Design Manual. All associated cost for the bioretention areas located within the planter strip areas shall be provided by the special tax district created for this purpose and carried out by the City of Santa Rosa. All rain gardens located on private land will be the sole responsibility of the property owner on which they reside. All legal paperwork and agreements will be provided with the Final SUSMP report.

September 2, 2011

ALL OF THIS CAN BE DONE IN JUST A PAGE OR TWO!

EXHIBITS AND ATTACHMENTS



BMP Selection Table

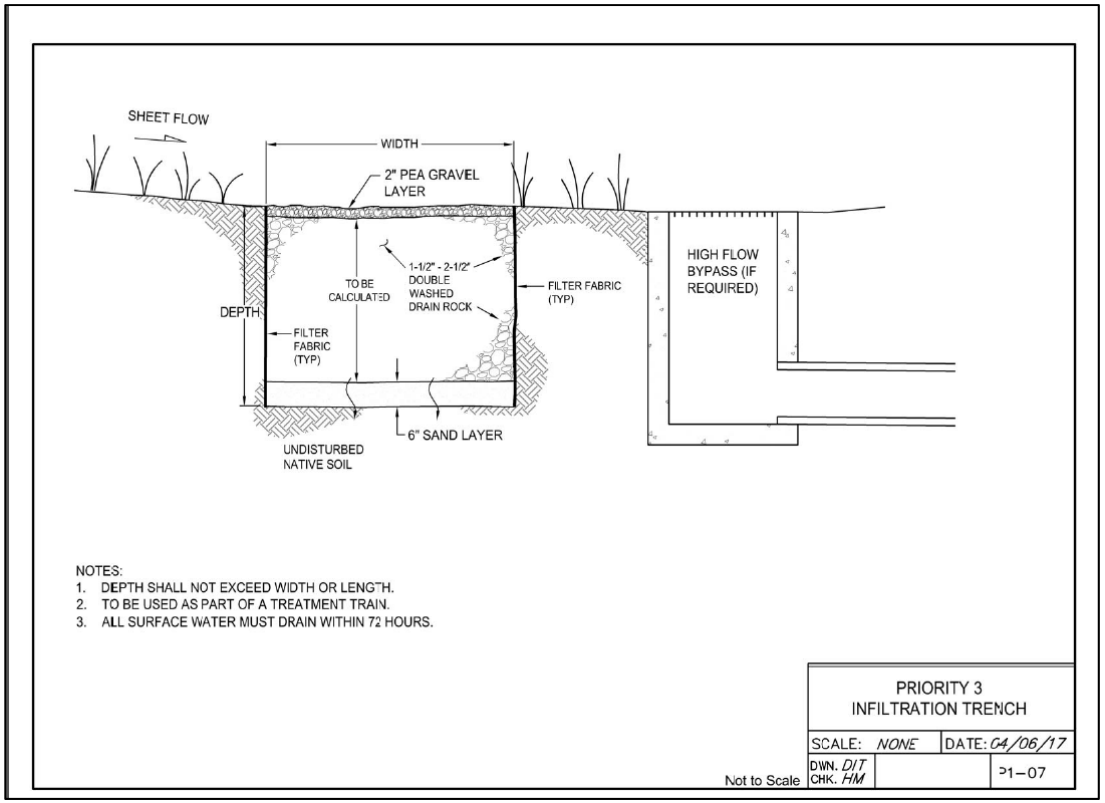
APPENDIX B

Project Name: _____

	Best Management Practice (BMP)	Detail Sheet	Detail Title	Can be used with: High Ground Water	Contamination	Steep Contours	Achieves: Treatment	Volume Capture	Runoff Reduction Measure	BMP in priority selected? Yes	No	Unique identifier of BMP per plans	Explanation of selection	Other notes:
Universal BMP- to be considered on all projects.	Living Roof	N/A	N/A	X	X	X	X	X						
	Rainwater Harvesting	N/A	N/A	X	X	X		X						
Runoff Reduction Measures	Interceptor Trees	N/A	N/A	X	X	X			X					
	Bovine Terrace	RRM-01	Bovine Terrace	X					X					
	Vegetated Buffer Strip	RRM-02	Vegetated Buffer Strip						X					
	Impervious Area Disconnection	N/A	N/A	X	X	X			X					
Priority 1- to be installed with no underdrains or liners. Must drain all standing water within 72 hours.	Bioretention	P1-02	Roadside Bioretention - no C & G				X	X						
	Vegetated Swale- with Bioretention	P1-06	Swale with Bioretention				X	X						
	Constructed Wetlands	N/A	N/A				X	X						
Priority 2 BMPs- with subsurface drains installed above the capture volume.	Bioretention	P2-02	Roadside Bioretintion - Flush Design Roadside				X	X						
		P2-03	Roadside Bioretenion- Contiguous SW				X	X						
		P2-04	Roadside Bioretenion- Curb Opening				X	X						
		P2-05	Roadside Bioretenion- No C & G				X	X						
	Constructed Wetlands	N/A	N/A				X	X						

Date: _____ Page ____ of ____

COMPLETED BMP SELECTION TABLE FOR EACH TRIBUTARY AREA INCLUDING EXPLANATION FOR EACH PRIORITY NOT USED.



PRELIMINARY DETAIL FOR EACH TYPE OF BMP SELECTED

SHOW ALL APPLICABLE ELEMENTS OF THE SELECTED BMPS ON THE APPROPRIATE PLAN SHEETS

CALCULATIONS USING THE “STORM WATER CALCULATOR” FOR EACH INLET.

FACT SHEET- LIVING ROOF

Universal BMP

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the Final SWLID Submittal. The maintenance plan shall include; recommended maintenance practices, identify the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance with provisions for full replacement when necessary, and provide site specific inspection checklist.

At a minimum inspection and maintenance shall include the following:

- Drainage features should be inspected and cleaned as necessary to remove any obstructions.
- Irrigation should be routinely inspected to ensure plant establishment and survival.
- Plants should be pruned, weeds pulled, and dead plants replaced as needed.
- Eroded areas should be repaired as needed

MAINTENANCE CHECKLIST FOR EACH BMP

Existing Condition Exhibit

- Exhibit should include: street names, property lines, proposed storm drainage system, waterways, title block, scale, and north arrow.
- Soil Type of existing site.
- Proposed tributary areas shown for all proposed inlets (including offsite drainage areas).
- Existing impervious area

- *Proposed Condition Exhibit*
- Exhibit should include: street names, property lines, storm drainage system, waterways, title block, scale, and north arrow.
- Tributary areas shown for all inlets (including offsite drainage areas).
- C value for each tributary area.
- Soil Type of existing site.
- New or replaced impervious area.
- All inlets shown (including identifier).
- All interceptor trees shown.
- All proposed BMPs shown.

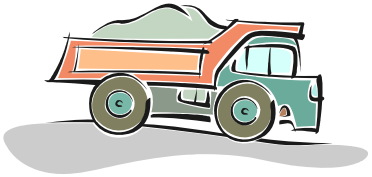
Impervious Area Exhibit

- Exhibit should include: street names, property lines, proposed storm drainage system, waterways, title block, scale, and north arrow.
- Proposed tributary areas shown for all proposed inlets (including offsite drainage areas).
- Proposed impervious area.
- C value used for each area.

MAINTENANCE AND INSPECTIONS

Maintenance Declaration

- Ensure that BMPs remain fully functional and that all areas identified for treatment will discharge to the treatment BMP system
- Verification at a minimum shall include the developer's recorded maintenance declaration accepting responsibility for maintenance until the responsibility is legally transferred to an entity for permanent responsibility



DESIGN EXAMPLE

Yoash Tilles

Documentation of approved project

Conditions of Approval

Date:	December 27, 2017	**File No.:**	ADR17-0117
Applicant:	Ken Taub	**APN:**	058-050-042
Owner:	RMB Real Estate Investments 2, LLC	**Address:**	4440 Old Redwood Hwy

Project Description: Request for Administrative Design Review on a 96 unit residential housing project to replace 70 units lost in the 2017 Sonoma Complex Fire.

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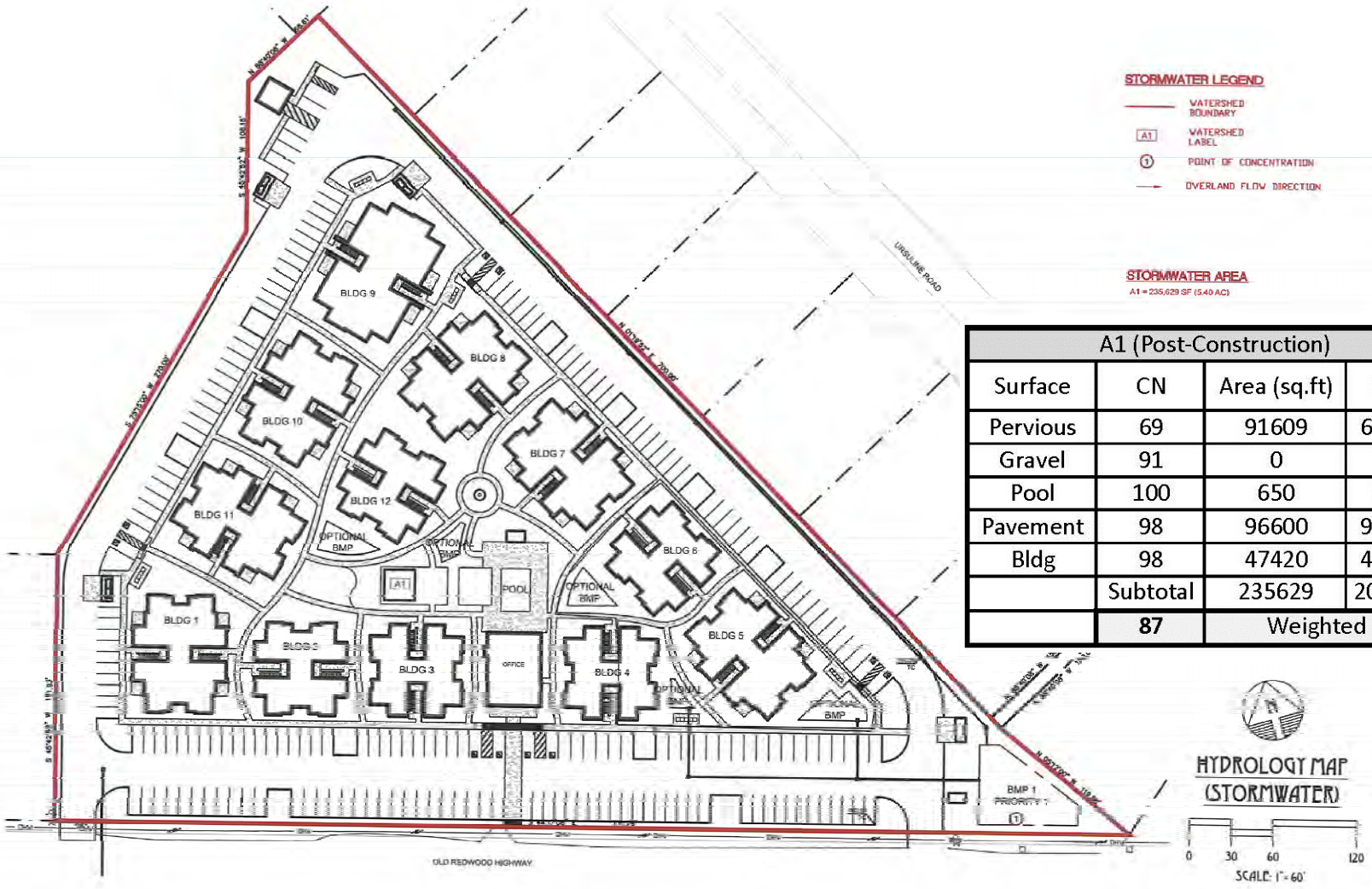
12. A final Storm Water Low Impact Development Submittal (SWLIDS), based upon the approved initial SWLIDS, shall be submitted with the grading and/or building permit application, and be subject to review and approval by the Grading & Storm Water Section of the Permit and Resource Management Department (Permit Sonoma) prior to the issuance of any grading or building permits.

INITIAL STORM WATER CALCULATION WORKSHEET



A1 (Post-Construction)			
Surface	CN	Area (sq.ft)	CN x A
Pervious	69	91609	6321021
Gravel	91	0	0
Pool	100	650	65000
Pavement	98	96600	9466800
Bldg	98	47420	4647160
	Subtotal	235629	20499981
	87	Weighted CN	

Initial Storm Water Calculation Worksheet

BMP Input Worksheet

Enter BMP ID and BMP's Information:

To start a New BMP calculation, Press the **Clear/Reset All Inputs** button.

BMP ID (MUST BE unique):	BMP 1	
BMP's Physical Tributary Area:	235,629	ft^2
	5.409	Acres
BMP Design Criteria:	100% Capture & Treatment	

Type of BMP Design (select from pull down):

Priority 1: P1-06 Swale with Bioretention

BMP Notes:

Clear/Reset All Inputs | Calculate All Sections | Save BMP Data and Results

Instructions: Enter in the Individual BMP's Tributary parameters in the **yellow cells**. To view the calculation worksheet, Click on the Display button for that section. All calculations are performed in the individual worksheets. To update the results on this worksheet, use the "**Calculate Results**" or "**Calculate All**" buttons.

CAUTION - MUST USE the Calculate button(s) to update results!

Action Buttons:

Clear/Reset All Inputs	Clear or load default values into cells of individual section or entire page.
Calculate	Will load values into worksheet, calculate and displays results.
Display Calculation Worksheet	Will load the values, calculate and display the corresponding worksheet with results.
Save BMP Data and Results	Calculates all sections before saving the BMP's design data, and then copies the results to the Summary worksheet by BMP ID. Will not save BMP if error(s) are present in the Runoff Reduction Measures or selected treatment method.

Runoff Reduction Measures

Note: The maximum Runoff Reduction Measures allowed is 50% of the physical tributary area.

Interceptor Trees

Number of new ***Evergreen Trees*** that qualify as interceptor trees:	0	
Number of new ***Deciduous Trees*** that qualify as interceptor trees:	0	
Enter square footage of qualifying **existing tree canopy**:	0	ft^2

Interceptor Tree trunk must be no greater than 25 feet from impervious surface.

Disconnected Roof Drains

Select disconnection condition: Select disconnection condition

Method 1

Amount of rooftop area that drain to disconnected downspouts: 0 ft^2

OR Method 2

Percent of rooftop area to be disconnected from downspouts: 0 %

Select Density: 1 Units per Acre

INSTRUCTIONS:

Method 1: Total Rooftop square foot area (ft^2) that is drained by the downspouts flowing to the single Tributary Area as designated. Can be from separate buildings. **OR**

Method 2: Total Rooftop percentage (%) area relating to the total physical Tributary Area as designated.

Paved Area Disconnection

Paved Area Type (select from drop down list):	Not Directly-connected Paved Area	
Enter area of alternatively designed paved area:	43,700.0	ft^2

Buffer Strips & Bovine Terraces

Area draining to a Buffer Strip or Bovine Terrace: 0.0 ft^2

Total Runoff Reduction Measures : 43,700 ft^2

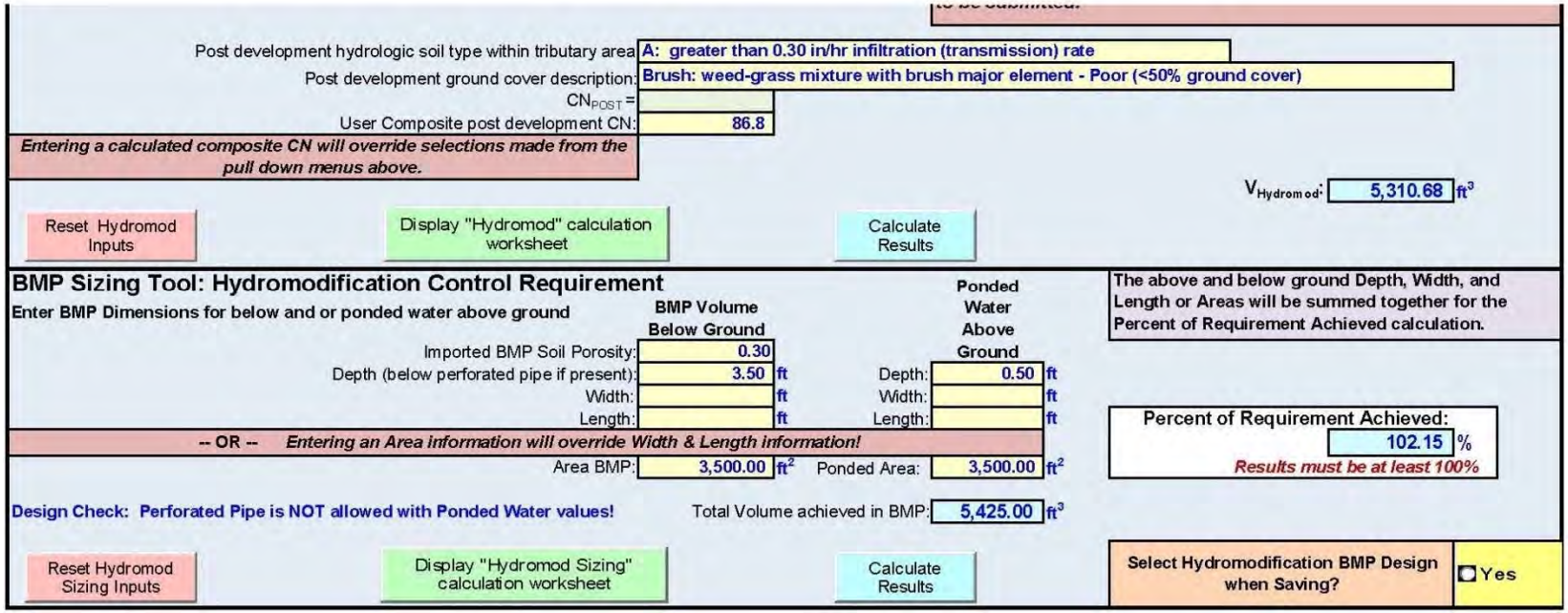
Resulting reduced Tributary Area used for BMP sizing: 191,929 ft^2

Reset Reduction Measures Inputs | Display "Runoff Reduction Measures" calculation worksheet | Calculate Results

Hydromodification Control Requirement: 100% Volume Capture; $V_{hydromod}$

If User Composite CN is used, Supporting calculations are required to be submitted

Initial Storm Water Calculation Worksheet



Post development hydrologic soil type within tributary area: A: greater than 0.30 in/hr infiltration (transmission) rate

Post development ground cover description: Brush: weed-grass mixture with brush major element - Poor (<50% ground cover)

CN_{POST} =

User Composite post development CN: 86.8

Entering a calculated composite CN will override selections made from the pull down menus above.

$V_{Hydromod}$: 5,310.68 ft^3

Reset Hydromod Inputs | Display "Hydromod" calculation worksheet | Calculate Results

BMP Sizing Tool: Hydromodification Control Requirement

Enter BMP Dimensions for below and or ponded water above ground

	BMP Volume Below Ground		Ponded Water Above Ground	
Imported BMP Soil Porosity:	0.30			
Depth (below perforated pipe if present):	3.50	ft	Depth: 0.50	ft
Width:		ft	Width:	ft
Length:		ft	Length:	ft

-- OR -- *Entering an Area information will override Width & Length information!*

Area BMP: 3,500.00 ft^2 Ponded Area: 3,500.00 ft^2

Design Check: Perforated Pipe is NOT allowed with Ponded Water values!

Total Volume achieved in BMP: 5,425.00 ft^3

The above and below ground Depth, Width, and Length or Areas will be summed together for the Percent of Requirement Achieved calculation.

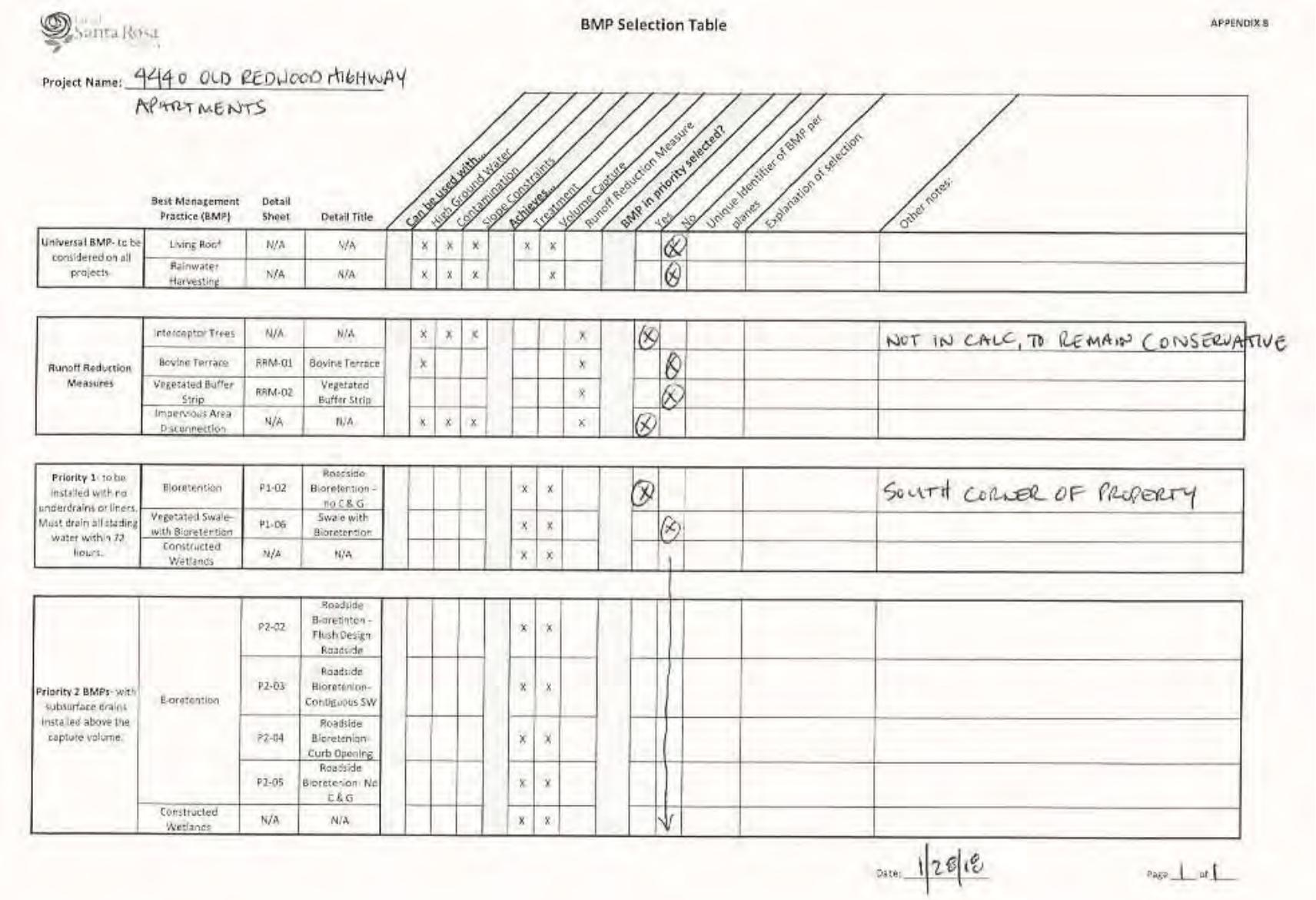
Percent of Requirement Achieved: 102.15 %

Results must be at least 100%

Reset Hydromod Sizing Inputs | Display "Hydromod Sizing" calculation worksheet | Calculate Results

Select Hydromodification BMP Design when Saving? ☐ Yes

Design Elements



BMP Selection Table

APPENDIX B

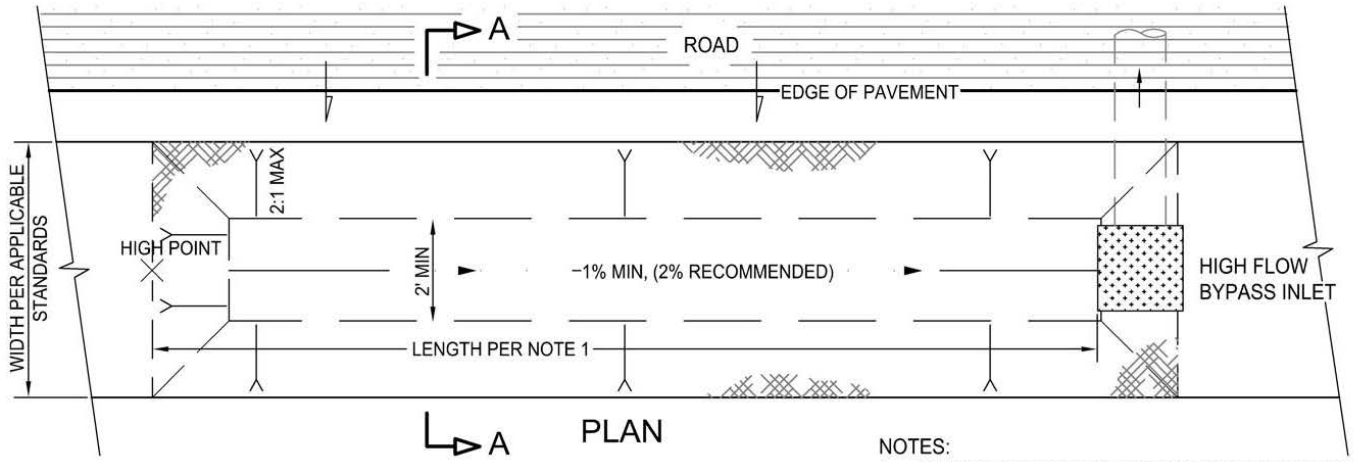
Project Name: 4440 OLD REDWOOD HIGHWAY APARTMENTS

	Best Management Practice (BMP)	Detail Sheet	Detail Title	Can be used with: High Ground Water Contamination	Can be used with: Slope Constraints	Achieves: Treatment	Achieves: Volume Capture	Achieves: Runoff Reduction Measure	BMP in priority selected? Yes	BMP in priority selected? No	Unique Identifier of BMP per planes	Explanation of selection	Other notes:
Universal BMP- to be considered on all projects	Living Roof	N/A	N/A	X X X	X X					⊗			
	Rainwater Harvesting	N/A	N/A	X X X		X				⊗			
Runoff Reduction Measures	Interceptor Trees	N/A	N/A	X X X				X	⊗				NOT IN CALC, TO REMAIN CONSERVATIVE
	Bovine Terrace	RRM-01	Bovine Terrace	X				X		⊗			
	Vegetated Buffer Strip	RRM-02	Vegetated Buffer Strip					X		⊗			
	Impervious Area Disconnection	N/A	N/A	X X X				X	⊗				
Priority 1: to be installed with no underdrains or liners. Must drain all standing water within 72 hours.	Bioretention	P1-02	Roadside Bioretention - no C & G			X X			⊗				SOUTH CORNER OF PROPERTY
	Vegetated Swale with Bioretention	P1-06	Swale with Bioretention			X X				⊗			
	Constructed Wetlands	N/A	N/A			X X							
Priority 2 BMPs- with subsurface drains installed above the capture volume.	Bioretention	P2-02	Roadside Bioretinton - Flush Design Roadside			X X							
		P2-03	Roadside Bioretention- Contiguous SW			X X							
		P2-04	Roadside Bioretenion- Curb Opening			X X							
		P2-05	Roadside Bioretention: No C & G			X X							
	Constructed Wetlands	N/A	N/A			X X				√			

Date: 1/28/19

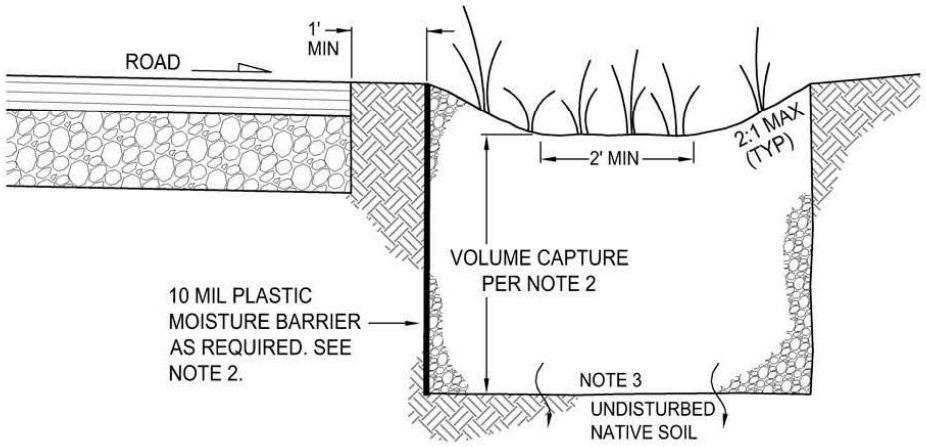
Page 1 of 1

Design Elements



NOTES:

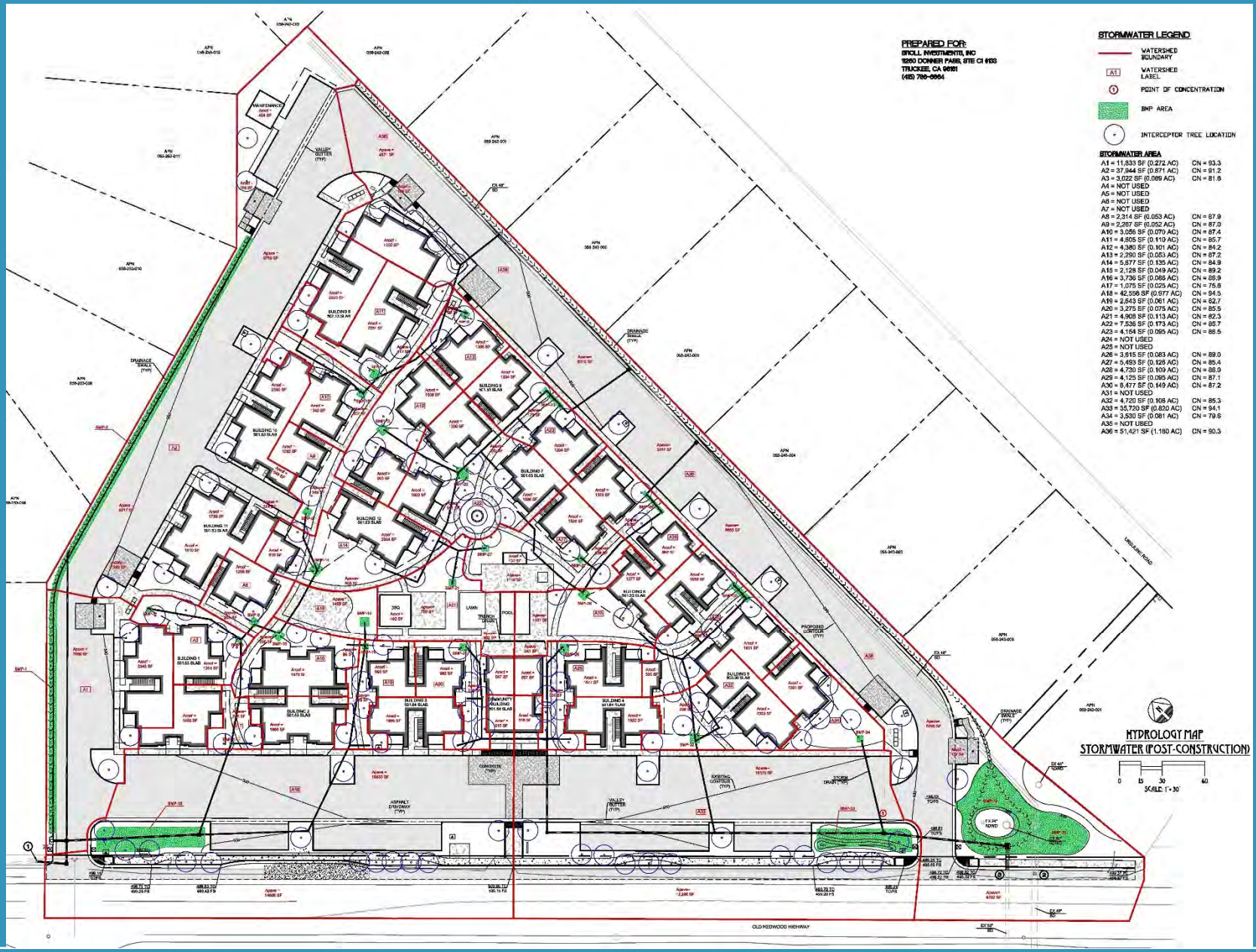
1. IF SWALE PROVIDES TREATMENT, LENGTH SHALL BE DESIGNED TO PROVIDE 12 MINUTES OF CONTACT TIME IF FLOW ENTERS UNIFORMLY ALONG LENGTH. LENGTH SHALL PROVIDE 5 MINUTES OF CONTACT TIME IF 90% OR MORE OF THE FLOW ENTERS AT THE UPSTREAM END.
2. SOIL TO BE SPECIFIED BY DESIGN ENGINEER TO MEET VOLUME CAPTURE AND GOVERNING AGENCY REQUIREMENTS. IF NON-STRUCTURAL SOIL IS SELECTED A CUTOFF WALL IS REQUIRED IN PLACE OF A MOISTURE BARRIER.
3. SWALE MUST CONVEY HIGH FLOWS PER GOVERNING AGENCY DESIGN STANDARDS.



Not to Scale

PRIORITY 1 ROADSIDE BIORETENTION - NO CURB AND GUTTER		
SCALE: *NONE*	DATE: *03/29/17*	
DWN. *DIT* CHK. *HM*		P1–02

FINAL STORM WATER CALCULATION WORKSHEET



Final Storm Water Calculation Worksheet

City of Santa Rosa Water

STORM WATER CALCULATOR

LID BMP Summary Page & Site Global Values

Project Information:

Project Name:	Sonoma Ranch Apartment Homes
Address/Location:	4420, 4440 & 4460 Old Redwood Highway
Designer:	Chad Moll, PE
Date:	8/23/2018

Site Information:

Mean Seasonal Precipitation (MSP) of Project Site:	36.00	(inches)
K=MSP/30 K=	1.20	
Impervious area - pre development:	140,110.0	ft^2
Impervious area - post development:	144,020.0	ft^2

Based upon the pre and post development impervious area, the post construction BMP requirement is:

100% Capture & Treatment

Summary of Saved BMP Results:

		Tributary Area		Requirements		BMP Design Results						
							Hydromodification Control		Flow Base Treatment		Delta Volume Capture	
	BMP ID:	Tributary Area (ft^2.)	Runoff Reduction Measures (Y/N)	Type of Requirement Met	Type of BMP Design	Percent Achieved	Required $V_{Hydromod}$ (ft^3)	Achieved (ft^3)	Required Q Treatment (cfs)	Achieved (ft^3)	Required Vdelta (ft^3)	Achieved (ft^3)
1	A1	11,833	Yes	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	105.5	604.4445	637.5000				
2	A2	37,944	Yes	Hydromod Volume Capture	Priority 2: P2-02 Roadside Bioretention - Flush Design	100.5	1595.91	1604.60				
3	A3	3,022	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	101.5	40.7983	41.4000				
4	A8	2,314	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	101.0	62.0857	62.7000				
5	A9	2,267	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	102.8	51.3767	52.8000				
6	A10	3,056	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	102.3	63.3707	64.8000				
7	A11	4,805	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	101.2	96.0014	97.2000				
8	A12	4,380	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	103.8	83.5402	86.7000				
9	A13	2,290	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	101.0	56.4491	57.0000				
10	A14	5,877	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	102.1	110.2342	112.5000				
11	A15	2,128	No	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	104.0	75.0120	78.0000				
12	A16	3,736	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	102.5	83.7422	85.8000				
13	A17	1,075	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	113.6	4.2245	4.8000				
14	A18	42,558	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	100.5	2423.91	2436.00				
15	A19	2,643	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	103.2	33.4376	34.5000				
16	A20	3,275	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	105.1	54.2168	57.0000				
17	A21	4,908	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	104.9	48.3119	50.7000				
18	A22	7,536	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	104.0	145.6173	151.5000				
19	A23	4,154	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	103.5	121.1378	125.4000				
20	A26	3,615	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	102.0	111.8016	114.0000				
21	A27	5,488	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	104.6	82.0383	85.8000				
22	A28	4,730	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	100.0	85.7747	85.8000				
23	A29	4,125	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	102.5	82.5091	84.6000				
24	A30	6,477	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	101.8	155.0189	157.8000				
25	A32	4,720	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	100.2	92.8026	93.0000				
26	A33	35,720	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	102.0	1940.77	1980.00				
27	A34	3,530	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	107.6	37.9043	40.8000				
28	A36	51,421	Yes	Hydromod Volume Capture	Priority 1: P1-07 Infiltration Trench	101.2	1956.97	1980.00				
29												
30												

Final Storm Water Calculation Worksheet

City of Santa Rosa WATER

STORM WATER CALCULATOR

BMP Tributary Parameters

Project Name: 4440 Old Redwood Highway

BMP ID:	A1
BMP Design Criteria:	100% Capture & Treatment
Type of BMP Design:	Priority 2: P2-02 Roadside Bioretention - Flush Design
BMP's Physical Tributary Area:	11,833.0 ft^2
Description/Notes:	Roadside infiltration planter BMP

Runoff Reduction Measures

Resulting reduced Tributary Area used for BMP sizing = 11,533.0 ft^2

Total Runoff Reduction Measures = 300.0 ft^2

Interceptor Trees

Number of ***new*** interceptor ***Evergreen Trees*** :	0
Number of ***new*** interceptor ***Deciduous Trees*** :	3
Square footage of qualifying **existing tree canopy**:	0.0 ft^2

Total Number of New trees in BMP Tributary Area: 3

Disconnected Roof Drains

Select disconnection condition: Select disconnection condition

Disconnected Roof Drains Method 1

Roof area of disconnected downspouts: 0 ft^2

Disconnected Roof Drains Method 2

Percent of rooftop area: 0 %

Select Density: 1 Units per Acre

Paved Area Disconnection

Paved Area Type:	Select paved area type
Alternatively designed paved area:	0.0 ft^2

Buffer Strips & Bovine Terraces

Area draining to a Buffer Strip or Bovine Terrace: 0.0 ft^2

Hydromodification Requirement: 100% Volume Capture; $V_{HYDROMOD}$

$V_{HYDROMOD}$ = 604.44 ft^3

Post development hydrologic soil type within tributary area:	B: 0.15 - 0.30 in/hr infiltration (transmission) rate
Post development ground cover description:	Brush: weed-grass mixture with brush major element - Poor (<50% ground cover)
CN_{POST}:	
User Composite post development CN:	93.0

BMP Sizing Tool: Hydromodification Requirement

Percent of Goal Achieved = 105.47 %

	BMP Volume Below Ground		Ponded Water Above Ground	
Porosity:	0.30			
Depth below perforated pipe if present:	2.50	ft		
Depth:			0.00	ft
Width:	5.00	ft	0.00	ft
Length:	170.00	ft	0.00	ft
Area:	0.00	ft^2	0.00	ft^2

Final Storm Water Calculation Worksheet

City of Santa Rosa WATER

STORM WATER CALCULATOR

Chad Moll, PE
August 13, 2018

CN Composite Work Sheet

Project:	4440 Old Redwood Highway
Address/Location:	4440 Old Redwood Highway
Designer:	Chad Moll, PE
Date:	August 13, 2018
Inlet Number/Tributary Area/BMP:	A1

INSTRUCTIONS: Please refer to the "Urban Hydrology for Small Watersheds" (TR-55 manual).

Soil Type (Infiltration Rate)	Cover Description	CN	Area ft^2	Product of CN x Area
B: 0.15 - 0.30 in/hr infiltration (transmission) rate	Impervious - Paved Parking, Rooftop, Driveways	98	9928	972,944.0
B: 0.15 - 0.30 in/hr infiltration (transmission) rate	Open Space (lawns, parks, golf courses, cemeteries, etc.) - Fair (50% to 75% grass cover)	69	1905	131,445.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
		Totals =	11833	1,104,389.0

$$CN_{COMPOSIT} = \frac{(CN \times Area) + (CN \times Area) + (CN \times Area) + (CN \times Area) \ldots}{\text{Total Tributary Area}} = \text{Use this } CN_{COMPOSIT} = 93.3$$

Final Storm Water Calculation Worksheet

City of Santa Rosa WATER

STORM WATER CALCULATOR

BMP Tributary Parameters

Project Name: 4440 Old Redwood Highway

BMP ID:	A8
BMP Design Criteria:	100% Capture & Treatment
Type of BMP Design:	Priority 1: P1-07 Infiltration Trench
BMP's Physical Tributary Area:	2,314.0 ft^2
Description/Notes:	Rain Garden Bioretention

Runoff Reduction Measures

Resulting reduced Tributary Area used for BMP sizing = 2,006.0 ft^2

Total Runoff Reduction Measures = 308.0 ft^2

Interceptor Trees

Number of ***new*** interceptor ***Evergreen Trees*** :	0
Number of ***new*** interceptor ***Deciduous Trees*** :	1
Square footage of qualifying **existing tree canopy**:	0.0 ft^2

Total Number of New trees in BMP Tributary Area: 1

Disconnected Roof Drains

Select disconnection condition: Select disconnection condition

Disconnected Roof Drains Method 1

Roof area of disconnected downspouts: 0 ft^2

Disconnected Roof Drains Method 2

Percent of rooftop area: 0 %

Select Density: 1 Units per Acre

Paved Area Disconnection

Paved Area Type:	Not Directly-connected Paved Area
Alternatively designed paved area:	208.0 ft^2

Buffer Strips & Bovine Terraces

Area draining to a Buffer Strip or Bovine Terrace: 0.0 ft^2

Hydromodification Requirement: 100% Volume Capture; $V_{HYDROMOD}$

$V_{HYDROMOD}$ = 62.09 ft^3

Post development hydrologic soil type within tributary area:	B: 0.15 - 0.30 in/hr infiltration (transmission) rate
Post development ground cover description:	Brush: weed-grass mixture with brush major element - Poor (<50% ground cover)
CN_{POST}	
User Composite post development CN:	88.0

BMP Sizing Tool: Hydromodification Requirement

Percent of Goal Achieved = 100.99 %

	BMP Volume Below Ground		Ponded Water Above Ground	
Porosity:	0.60			
Depth below perforated pipe if present:	3.50	ft		
Depth:			0.30	ft
Width:	0.00	ft	0.00	ft
Length:	0.00	ft	0.00	ft
Area:	27.00	ft^2	20.00	ft^2

Final Storm Water Calculation Worksheet

City of Santa Rosa WATER

STORM WATER CALCULATOR

Chad Moll, PE
August 13, 2018

CN Composite Work Sheet

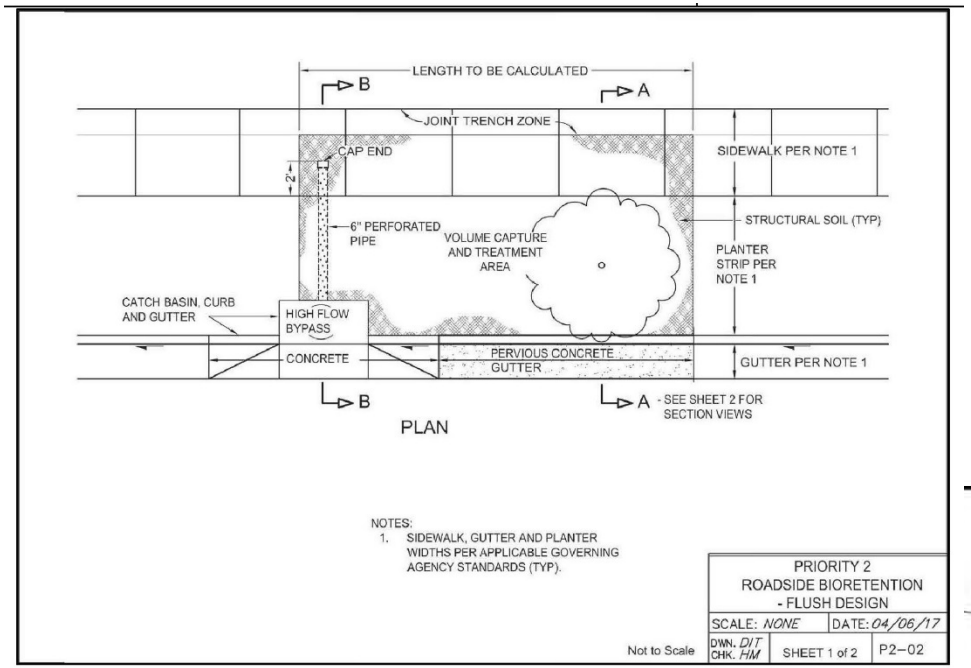
Project:	4440 Old Redwood Highway
Address/Location:	4440 Old Redwood Highway
Designer:	Chad Moll, PE
Date:	August 13, 2018
Inlet Number/Tributary Area/BMP:	A8

INSTRUCTIONS: Please refer to the "Urban Hydrology for Small Watersheds" (TR-55 manual).

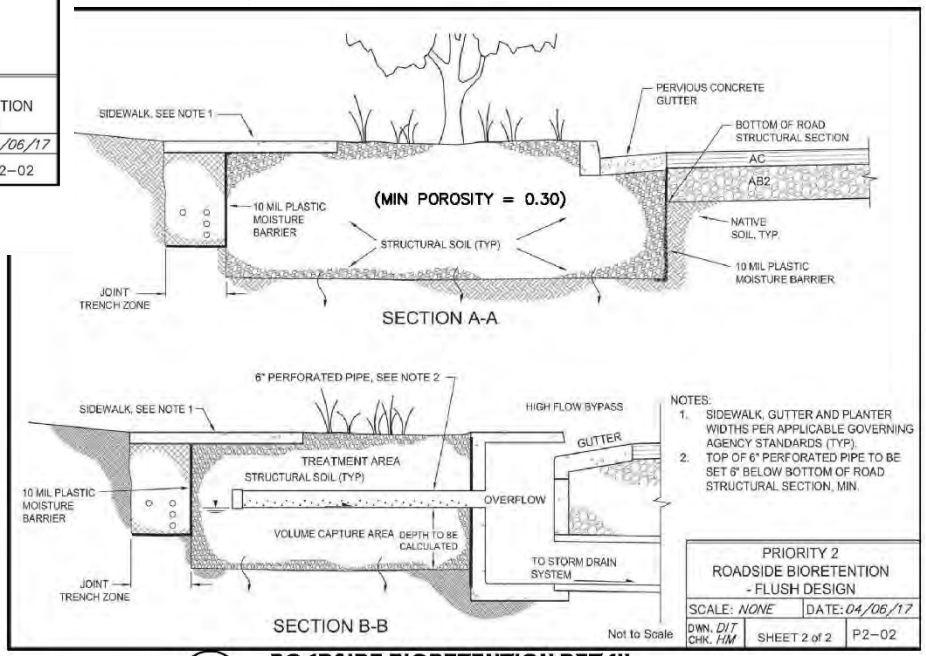
Soil Type (Infiltration Rate)	Cover Description	CN	Area ft^2	Product of CN x Area
B: 0.15 - 0.30 in/hr infiltration (transmission) rate	Impervious - Paved Parking, Rooftop, Driveways	98	1506	147,588.0
B: 0.15 - 0.30 in/hr infiltration (transmission) rate	Open Space (lawns, parks, golf courses, cemeteries, etc.) - Fair (50% to 75% grass cover)	69	808	55,752.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
No Entry	No Entry	0	0	0.0
		Totals =	2314	203,340.0

$$CN_{COMPOSIT} = \frac{(CN \times Area) + (CN \times Area) + (CN \times Area) + (CN \times Area) \ldots}{\text{Total Tributary Area}} = \text{Use this } CN_{COMPOSIT} = 87.9$$

Final Design Elements



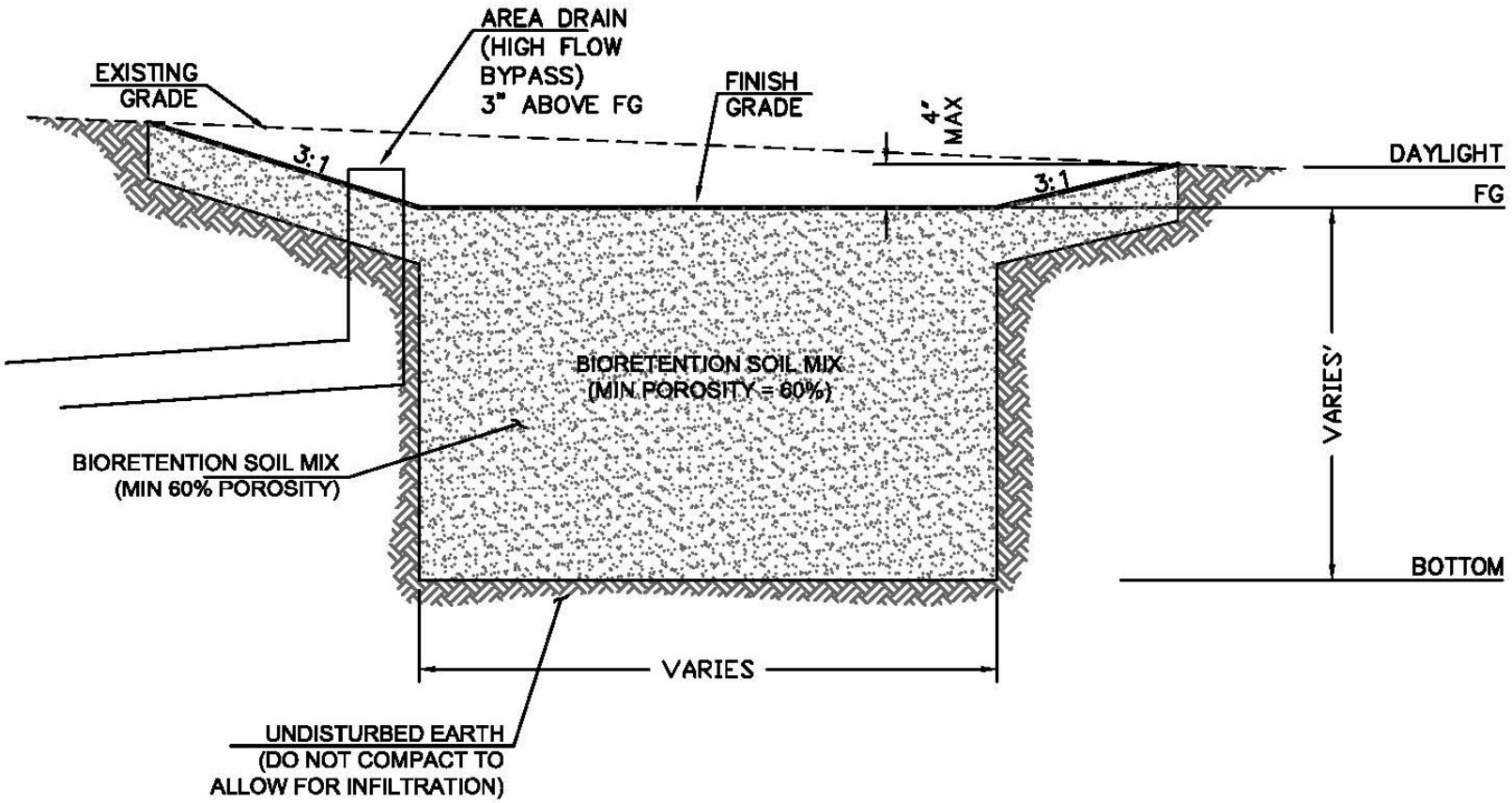
10 ROADSIDE BIORETENTION DETAIL
NOT TO SCALE



11 ROADSIDE BIORETENTION DETAIL
NOT TO SCALE

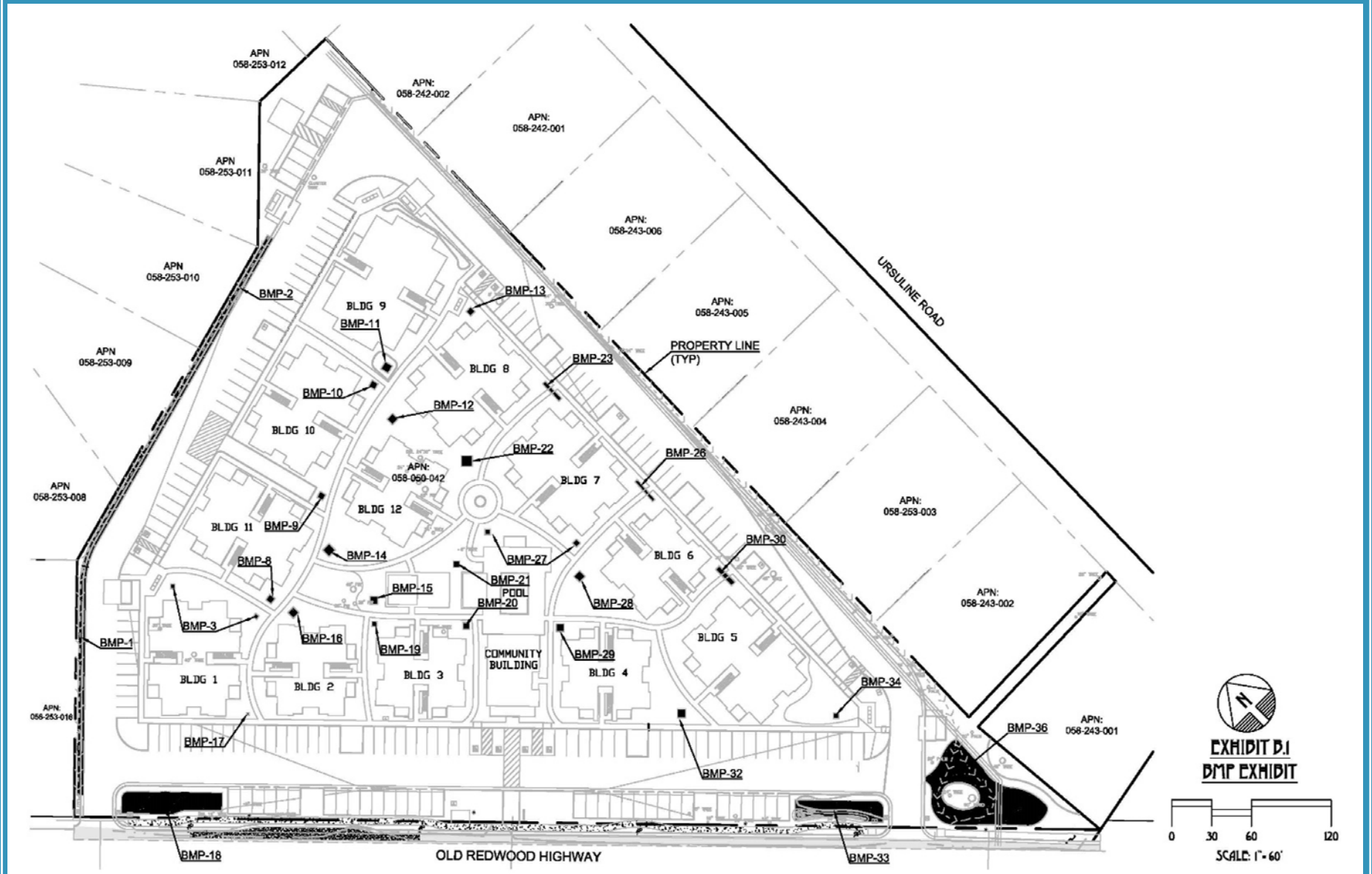
GRD18-0103

Final Design Elements



RAIN GARDEN BIORETENION DETAIL

FINAL STORM WATER CALCULATION WORKSHEET



FINAL STORM WATER CALCULATION WORKSHEET

BMP SCHEDULE

BMP	TYPE	WIDTH (FT)	LENGTH (FT)	AREA (FT^2)	DEPTH (FT)	VOLUME (CY)	MATERIAL	REQUIRED VOLUME CAPTURE (CF)
BMP-1	ROADSIDE BIORETENTION	5.0	170.0	-	2.5	78.7	STRUCTURAL SOIL	604.44
BMP-2	ROADSIDE BIORETENTION	5.0	284.0	-	3.5	184.10	STRUCTURAL SOIL	1595.91
BMP-3	RAIN GARDENS	-	-	23	3.0	2.56	BIORETENTION MIX	40.80
BMP-4	NOT USED	-	-	-	-	-	-	-
BMP-5	NOT USED	-	-	-	-	-	-	-
BMP-6	NOT USED	-	-	-	-	-	-	-
BMP-7	NOT USED	-	-	-	-	-	-	-
BMP-8	RAIN GARDEN	-	-	27	3.5	3.50	BIORETENTION MIX	62.09
BMP-9	RAIN GARDEN	-	-	26	3.0	2.89	BIORETENTION MIX	51.38
BMP-10	RAIN GARDEN	-	-	28	3.5	3.63	BIORETENTION MIX	63.37
BMP-11	RAIN GARDEN	-	-	42	3.5	5.44	BIORETENTION MIX	96.00
BMP-12	RAIN GARDEN	-	-	37	3.5	4.80	BIORETENTION MIX	83.54
BMP-13	RAIN GARDEN	-	-	25	3.5	3.24	BIORETENTION MIX	56.45
BMP-14	RAIN GARDEN	-	-	50	3.5	6.48	BIORETENTION MIX	110.23
BMP-15	RAIN GARDEN	-	-	35	3.5	4.54	BIORETENTION MIX	75.01
BMP-16	RAIN GARDEN	-	-	38	3.5	4.93	BIORETENTION MIX	83.74
BMP-17	RAIN GARDEN	-	-	4	2.0	0.30	BIORETENTION MIX	4.22
BMP-18	RAIN GARDEN	-	-	1160	3.5	150.37	BIORETENTION MIX	2423.91
BMP-19	RAIN GARDEN	-	-	15	3.5	1.94	BIORETENTION MIX	33.44
BMP-20	RAIN GARDEN	-	-	25	3.5	3.24	BIORETENTION MIX	54.22
BMP-21	RAIN GARDEN	-	-	22	3.5	2.85	BIORETENTION MIX	48.31
BMP-22	RAIN GARDEN	-	-	65	3.5	8.43	BIORETENTION MIX	145.62
BMP-23	RAIN GARDEN	-	-	54	3.5	7.00	BIORETENTION MIX	121.14
BMP-24	NOT USED	-	-	-	-	-	-	-
BMP-25	NOT USED	-	-	-	-	-	-	-
BMP-26	RAIN GARDEN	-	-	50	3.5	6.48	BIORETENTION MIX	111.80
BMP-27	RAIN GARDEN	-	-	38	3.5	4.93	BIORETENTION MIX	82.04
BMP-28	RAIN GARDEN	-	-	38	3.5	4.93	BIORETENTION MIX	85.77
BMP-29	RAIN GARDEN	-	-	36	3.5	4.67	BIORETENTION MIX	82.51
BMP-30	RAIN GARDEN	-	-	68	3.5	8.81	BIORETENTION MIX	155.02
BMP-31	NOT USED	-	-	-	-	-	-	-
BMP-32	RAIN GARDEN	-	-	40	3.5	5.19	BIORETENTION MIX	92.80
BMP-33	RAIN GARDEN	-	-	900	3.5	116.67	BIORETENTION MIX	1940.77
BMP-34	RAIN GARDEN	-	-	18	3.5	2.33	BIORETENTION MIX	37.90
BMP-35	NOT USED	-	-	-	-	-	-	-
BMP-36	RAIN GARDEN	-	-	3000	1.1	122.22	BIORETENTION MIX	1956.97

PANEL DISCUSSION

SPECIAL CASES

1. Clarifications Provided- Under 1 AC

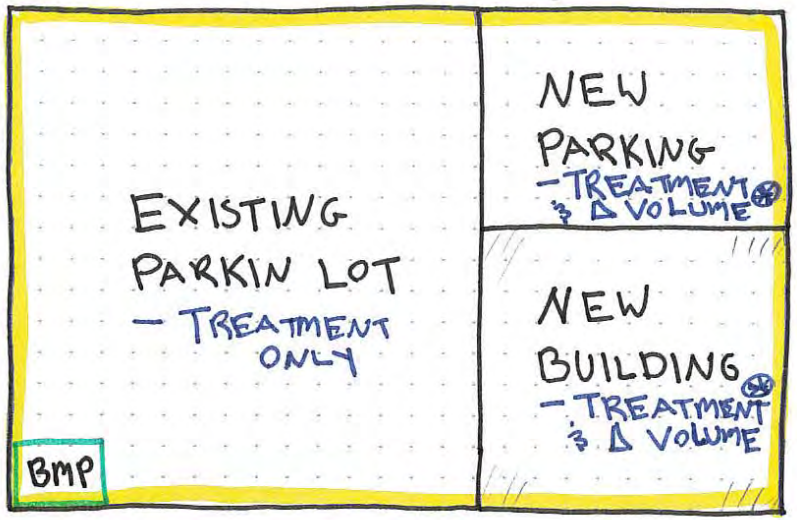
Description of Tributary Area

- Tributary area consists of both existing *and* new and/or replaced impervious area.

Design Requirements

- Existing impervious area: Treatment required.
- New and/or replaced impervious area: 100% Volume Capture or both Delta Volume Capture and Treatment required.
- Trash capture must be met in all tributary areas.

1. TRIBUTARY AREA - BOTH EXISTING AND NEW OR REPLACED IMPERVIOUS AREA.



⊛ CAN ALSO BE MET BY PROVIDING 100% VOLUME CAPTURE

SITE LESS THAN 1.0 ACRE

2. Clarifications Provided- Under 1 AC

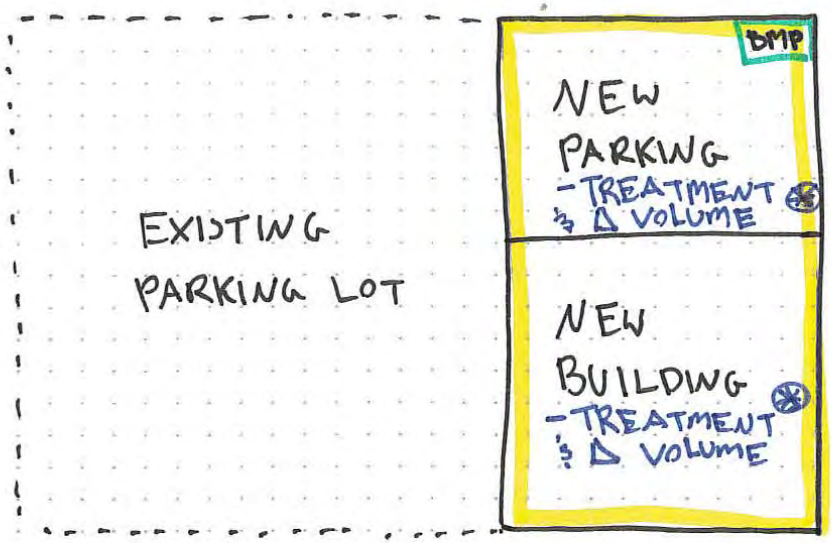
Description of Tributary Area

- Tributary area consists of new and/or replaced impervious area only.

Design Requirements

- 100% Volume Capture or both Delta Volume Capture and Treatment required.
- Trash capture must be met in all tributary areas.

2. TRIBUTARY AREA - NEW OR REPLACED IMPERVIOUS AREA ONLY.



* CAN ALSO BE MET BY PROVIDING 100% VOLUME CAPTURE.

SITE LESS THAN 1.0 ACRE

- IF SITE IS 1.0 ACRE OR GREATER, 100% VOLUME CAPTURE / HYDROMODIFICATION CONTROL IS REQUIRED.

3. Clarifications Provided- Under 1 AC

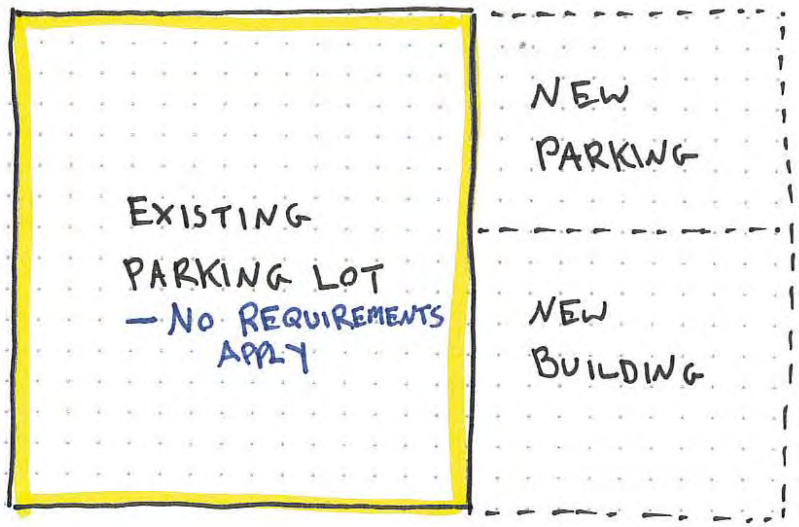
Description of Tributary Area

- Tributary area consists of existing impervious area only.

Design Requirements

- No requirements apply.

3. TRIBUTARY AREA - EXISTING IMPERVIOUS AREA ONLY.



4. Clarifications Provided- Under 1 AC

Description of Tributary Area

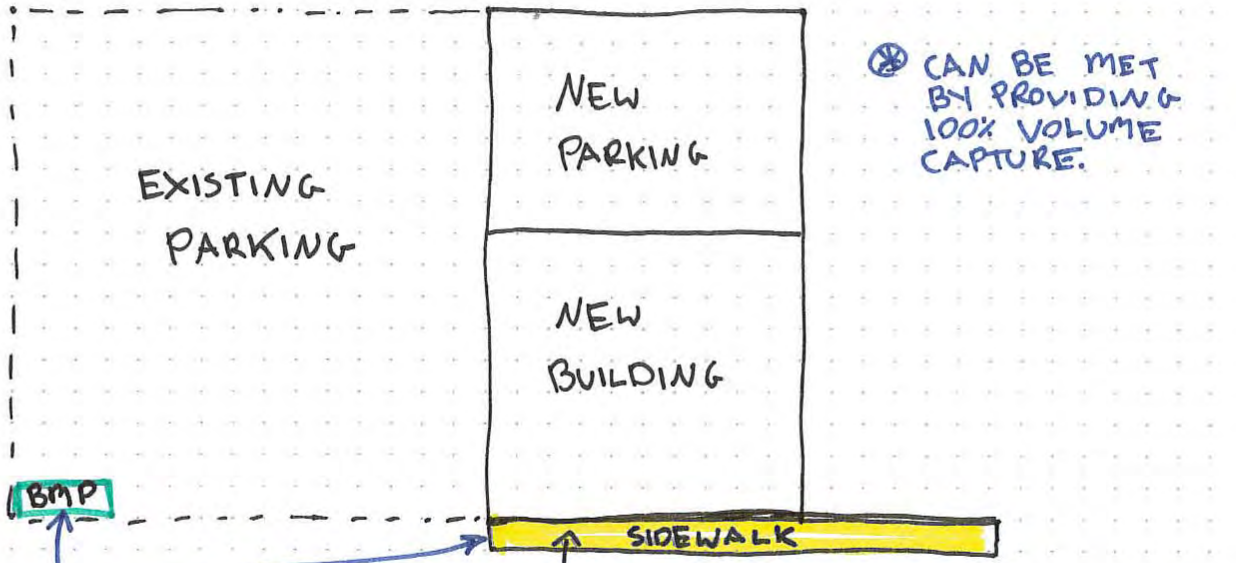
- Tributary area consists of off-site improvements or public improvements only.

Design Requirements

- New and/or replaced impervious area only: 100% Volume Capture or both Delta Volume Capture and Treatment required.

A BMP does not need to be constructed to intercept the physical runoff at this location if not readily feasible. The BMP may be constructed onsite as a "onsite off-set" or the runoff accounted for by oversizing another BMP within the same project, but in another tributary area.

4. TRIBUTARY AREA - OFF-SITE OR PUBLIC IMPROVEMENTS.



⊛ CAN BE MET BY PROVIDING 100% VOLUME CAPTURE.

NOTE:

THE BMP DOES NOT NEEN TO INTERCEPT THE PHYSICAL RUNOFF. IF NOT READILY FEASIBLE. MAY BE CONSTRUCTED AS AN "ONSITE OFFSET"

5. Clarifications Provided- Under 1 AC

Description of Tributary Area

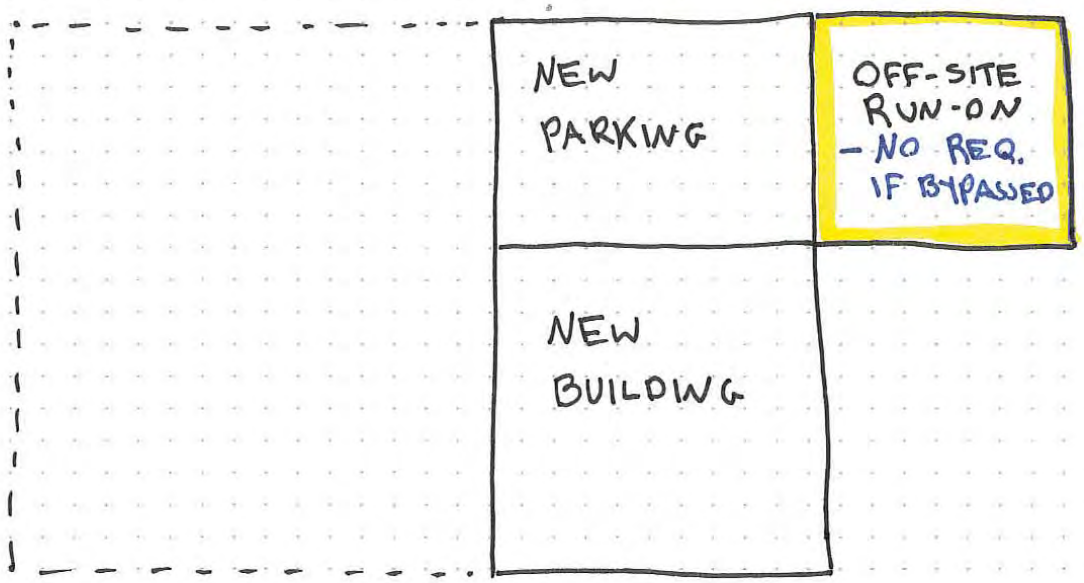
- Run-on from outside the project site.

Design Requirements

- No requirements apply if run-on is bypassed.

If the run-on reaches a BMP it must be either included in the sizing or designed to bypass.

5. TRIBUTARY AREA - RUN-ON FROM OUTSIDE THE PROJECT AREA.



Clarifications Provided- Over 1 AC

Description of Tributary Area

- Tributary area consists of both existing *and* new and/or replaced impervious area.

Design Requirements

- 100% Volume Capture/Hydromodification Control required.
- Trash capture must be met in all tributary areas.

Clarifications Provided- Over 1 AC

Description of Tributary Area

- Tributary area consists of new and/or replaced impervious area only.

Design Requirements

- 100% Volume Capture/Hydromodification Control required.
- Trash capture must be met in all tributary areas.

Clarifications Provided- Over 1 AC

Description of Tributary Area

- Tributary area consists of existing impervious area only.

Design Requirements

- No requirements apply.

Clarifications Provided- Over 1 AC

Description of Tributary Area

- Tributary area consists of off-site improvements or public improvements only.

Design Requirements

- New and/or replaced impervious area only: 100% Volume Capture/ Hydromodification Control or both Delta Volume Capture and Treatment required.

A BMP does not need to be constructed to intercept the physical runoff at this location if not readily feasible. The BMP may be constructed onsite as a "onsite off-set" or the runoff accounted for by oversizing another BMP within the same project, but in another tributary area.

Clarifications Provided- Over 1 AC

Description of Tributary Area

- Run-on from outside the project site.

Design Requirements

- No requirements apply if run-on is bypassed.

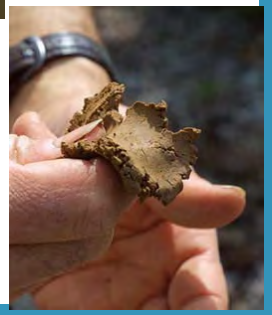
If the run-on reaches a BMP it must be either included in the sizing or designed to bypass.

But we have clay soil!

Clay soil expands when water is introduced. Infiltration is limited.

Infiltration is *very* slow in our native clay soil.

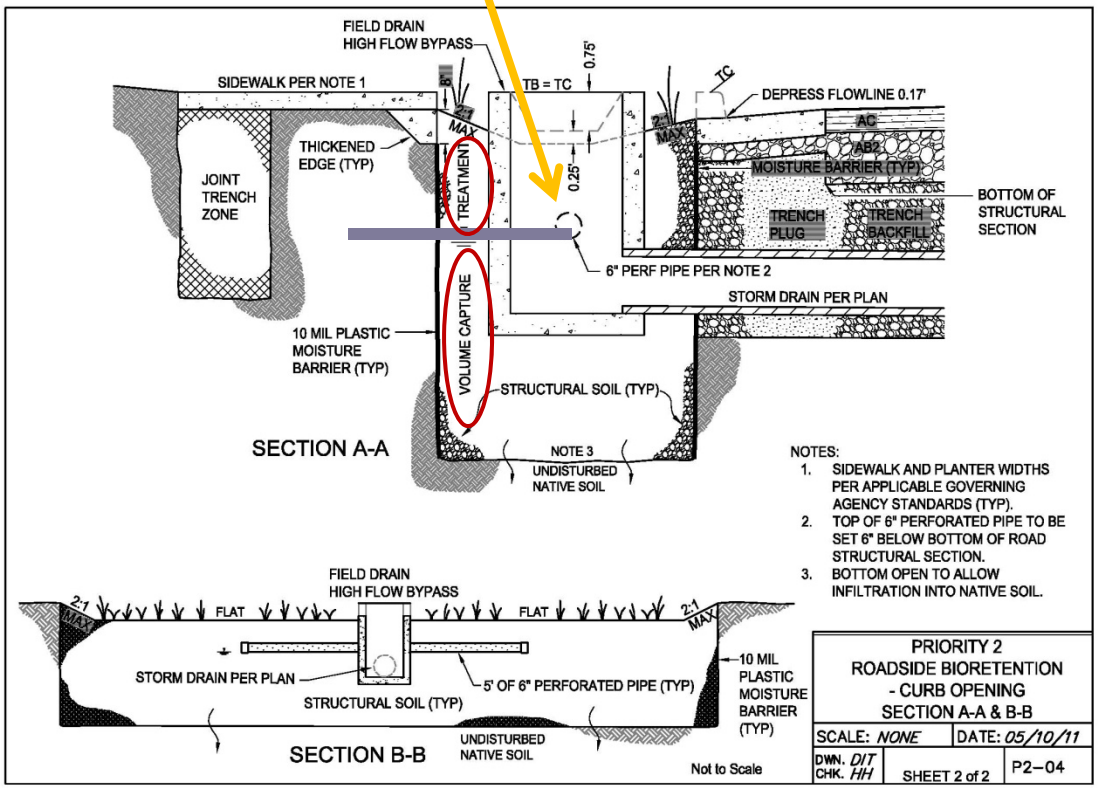
In fact our native soil can be used for pond liners and pottery!



Solution

- A storage volume is provided in the BMP. Therefore, native soil type does not prevent infiltration type BMPS from being used.

Same idea as a french drain, except storage volume is provide below the pipe.



Design Challenges

- But we will have curb overturn, conflicts with utilities and trees, and sidewalk undercutting!

Planting type soil compacts easily.

Utilities and trees were in conflict with space needed for BMPs.

Solution

- Solution : Structural Soil.

Developed in the 1990s for urban tree planting.

Angular rock, organics, and a tackafier.

Is compacted to 95% so that it provides structural support.

Provides 26% porosity when compacted.

Trees love it!

Solution

- Solution : Structural Soil.

Provides a solution to root bound urban trees too.

Trees in structural soil grow bigger and faster.

Structural soil can also used for other load baring needs, such as fire access.

Design Challenge

- We can't have depressions in the planter strip!

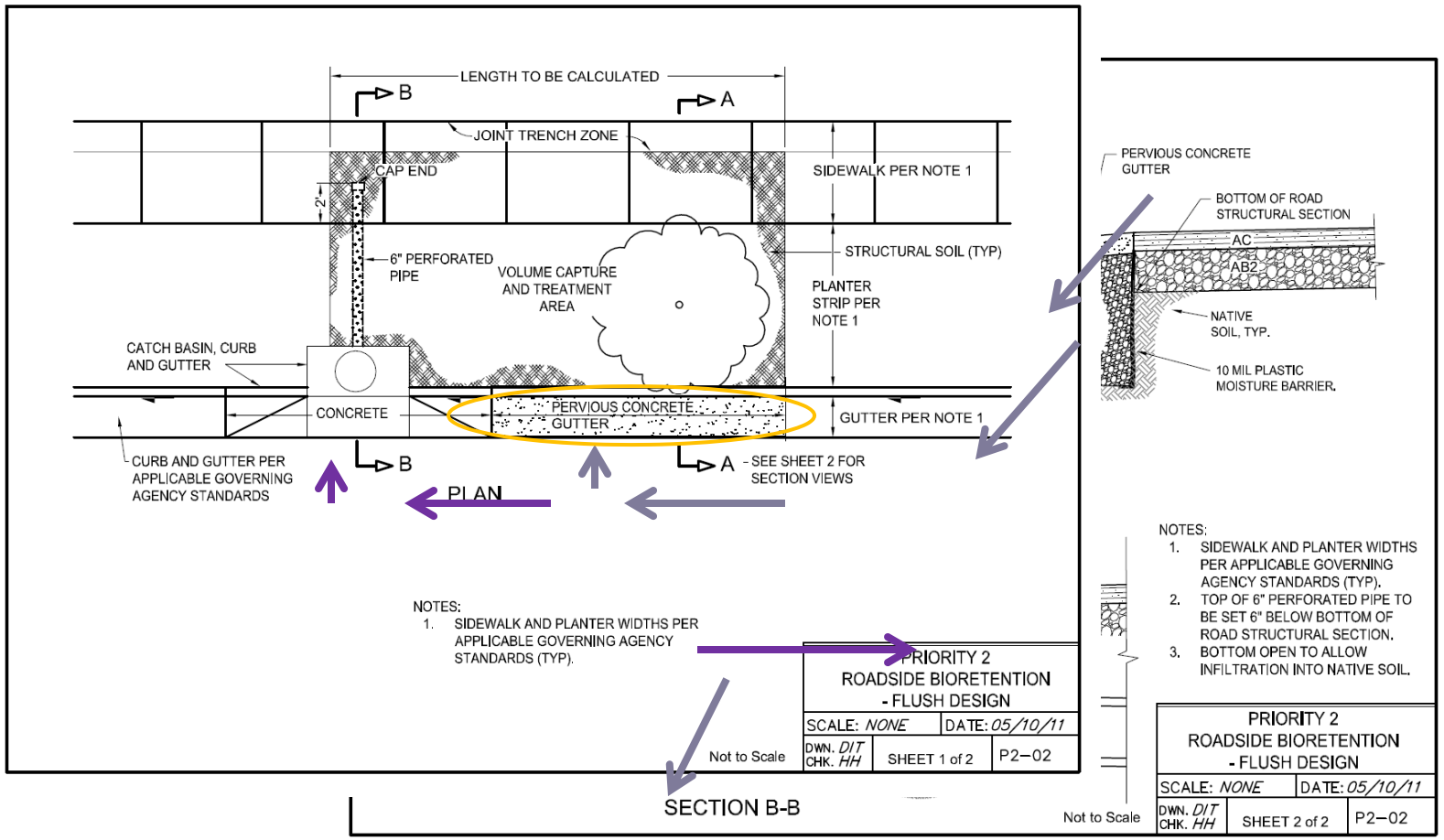
Curb openings to allow storm water from the street.

Grades in planter strips are limited by the sidewalk and street grades.

In some cases, the surface swale in the planter strip can cause a physical barrier to pedestrians and street parking.

Solution

- Solution: Permeable gutter.



Solution

- Solution: Permeable gutter.

Allows for storm water to come in subsurface.

Needs to be placed by a certified contractor.

Doesn't remove larger pollutants like trash.

Design Challenge

- But we can't maintain them!

Fewer swirl chambers and chamber separators.

Plants love bioretention!

Too many plants can block flow.

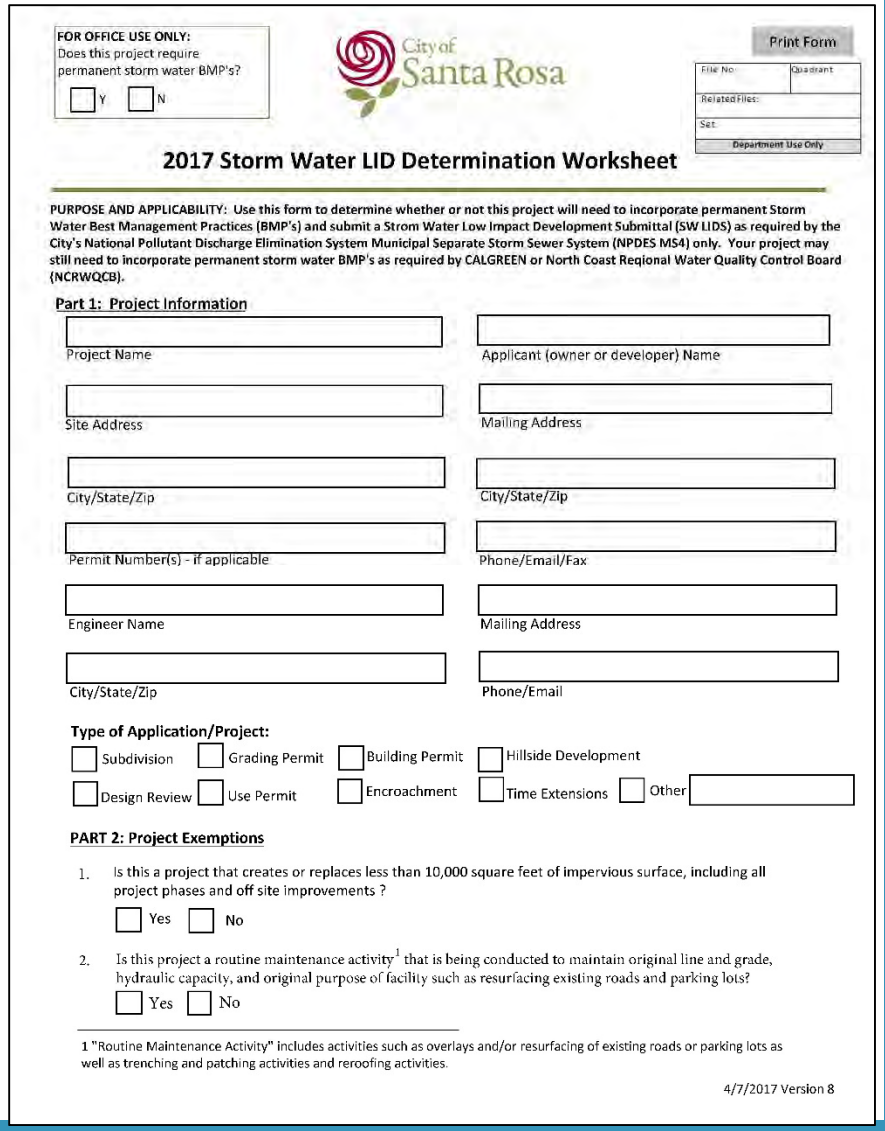
These BMPs need to be weeded, and sediment and trash need to be removed regularly.

Maintenance needs to be considered and a Maintenance Declaration needs to be singed by the Developer and recorded.

Determination Worksheet

Updated-All triggers reflected on the Determination Worksheet

- Required to be submitted with all discretionary and ministerial applications.
  - If the result of the Determination Worksheet is that LID is required, a Initial SWLID Submittal must be submitted as part of the completed application package.



FOR OFFICE USE ONLY:
Does this project require permanent storm water BMP's?
☐ Y ☐ N

City of Santa Rosa

Print Form

File No. | Quadrant
Related Files:
Set:
Department Use Only

2017 Storm Water LID Determination Worksheet

PURPOSE AND APPLICABILITY: Use this form to determine whether or not this project will need to incorporate permanent Storm Water Best Management Practices (BMP's) and submit a Strom Water Low Impact Development Submittal (SW LIDS) as required by the City's National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System (NPDES MS4) only. Your project may still need to incorporate permanent storm water BMP's as required by CALGREEN or North Coast Regional Water Quality Control Board (NCRWQCB).

Part 1: Project Information

Project Name | Applicant (owner or developer) Name
Site Address | Mailing Address
City/State/Zip | City/State/Zip
Permit Number(s) - if applicable | Phone/Email/Fax
Engineer Name | Mailing Address
City/State/Zip | Phone/Email

Type of Application/Project:

☐ Subdivision ☐ Grading Permit ☐ Building Permit ☐ Hillside Development
☐ Design Review ☐ Use Permit ☐ Encroachment ☐ Time Extensions ☐ Other

PART 2: Project Exemptions

1. Is this a project that creates or replaces less than 10,000 square feet of impervious surface, including all project phases and off site improvements ?
   ☐ Yes ☐ No
2. Is this project a routine maintenance activity[1] that is being conducted to maintain original line and grade, hydraulic capacity, and original purpose of facility such as resurfacing existing roads and parking lots?
   ☐ Yes ☐ No

1 "Routine Maintenance Activity" includes activities such as overlays and/or resurfacing of existing roads or parking lots as well as trenching and patching activities and reroofing activities.

4/7/2017 Version 8