LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **1648.93** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **441.00** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **726** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	3.8	ft	Below perforated pipe if present
W =	21.0	ft	
L =	21.0	ft	

Solution:

7

Percent of Goal Achieved = **101.63** % = [(3.8 x 441) / 1,649] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **501.70** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

202

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

*For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #32

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

Physical Tributary Area that drains to Inlet/BMP = **7,361** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(7,361 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(7,361 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

204

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 7,361 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] **=** 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 7,361 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 7,361 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = 98
OR: Composite post development CN [9] = 95

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.57082 in

$$S_{POST} = \frac{1000}{95} - 10$$

205 Q_{POST}= 0.05715 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.57)]^2}{[(1.00 * 1.17)+(0.8 * 0.57)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 420.68 ft^3

$$V_{GOAL} = (0.05715)(7{,}361)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Input:

A_r = 7,361 ft^2 = 0.16899 Acres

C_{POST} [10] = 0.59

K [7] = 1.2

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.02333 cfs

$Q_{TREATMENT}$= (0.2)(0.1690)(0.59)(1.17)

206

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **7,361** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	95

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **66.25** ft^3 — V_{PRE}= (0.00900)(7,361)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.57082** in — $S_{POST} = \frac{1000}{95} - 10$

Q_{POST}= **0.05037** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.57)]^2}{[(0.92*1.17)+(0.8*0.57)]} \times \frac{1ft}{12in}$

V_{POST}= **370.77** ft^3 — V_{POST}= (0.05037)(7,361)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

207

Delta Volume Capture= $(V_{POST}-V_{PRE})$ — Delta Volume Capture= (370.77) - (66.25)

V_{DELTA}= **304.52** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

APPENDIX C
STORM WATER CALCULATOR

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **956.09** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **549.90** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **421** ft^3

Percent of Goal Achieved $= \frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	1.7	ft	Below perforated pipe if present
W =	23.5	ft	
L =	23.5	ft	

Solution:

7

Percent of Goal Achieved = **100.08** % = [(1.7 x 550) / 956] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **304.52** ft^3

Percent of Requirement Achieved $= \frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

208

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #33

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

Physical Tributary Area that drains to Inlet/BMP = **7,412** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(7,412 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

609

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(7,412 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

City of Santa Rosa

APPENDIX C

STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area

Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

210

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 7,412 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 7,412 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 7,412 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 94

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.66098 in

$S_{POST} = \frac{1000}{94} - 10$

211 Q_{POST}= 0.05288 ft

$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.66)]^2}{[(1.00 * 1.17)+(0.8 * 0.66)]} \times \frac{1ft}{12in}$

V_{GOAL}= 391.95 ft^3

V_{GOAL}= (0.05288)(7,412)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

Input:

A_r = **7,412** ft^2 = **0.17016** Acres
C_{POST} [10] = **0.63**
K [7] = **1.2**

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= **0.02508** cfs

$Q_{TREATMENT}$= (0.2)(0.1702)(0.63)(1.17)

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **7,412** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	94

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **66.71** ft^3 — V_{PRE}= (0.00900)(7,412)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.66098** in — $S_{POST} = \frac{1000}{94} - 10$

Q_{POST}= **0.04633** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.66)]^2}{[(0.92*1.17)+(0.8*0.66)]} \times \frac{1ft}{12in}$

V_{POST}= **343.40** ft^3 — V_{POST}= (0.04633)(7,412)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

213

Delta Volume Capture= $(V_{POST}-V_{PRE})$ — Delta Volume Capture= (343.40) - (66.71)

V_{DELTA}= **276.69** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **890.79** ft³

$A_{LID\ GOAL}=(W)(L) =$ **488.41** ft²

Where:
$V_{LID\ GOAL}=$ Required volume of soil in LID BMP.
$A_{LID\ GOAL}=$ Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **392** ft³

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	1.9	ft	Below perforated pipe if present
W =	22.1	ft	
L =	22.1	ft	

Solution:

7

Percent of Goal Achieved = **104.18** % = [(1.9 x 488) / 891] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft³

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft²

Where:
$V_{LID\ DELTA}=$ Required volume of soil in LID BMP
$A_{LID\ DELTA}=$ Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **276.69** ft³

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

214

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #34

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

Physical Tributary Area that drains to Inlet/BMP = **30,425** ft²

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft²

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(30,425 x 0.25 x 0.00) = **0.00** ft² **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(30,425 x 0.25 x 0.00 x 0.19) = **0.00** ft² **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

216

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **30,425** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] **=** **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **30,425** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

***1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.**

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **30,425** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **95**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **0.48218** in

$$S_{POST} = \frac{1000}{95} - 10$$

Q_{POST}= **0.06186** ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.48)]^2}{[(1.00 * 1.17)+(0.8 * 0.48)]} \times \frac{1ft}{12in}$$

V_{GOAL}= **1882.09** ft^3

$$V_{GOAL} = (0.06186)(30,425)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

217

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

Input:

A_r = 30,425 ft^2 = 0.69846 Acres

C_{POST} [10] = 0.61

K [7] = 1.2

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.09970 cfs

$Q_{TREATMENT}$= (0.2)(0.6985)(0.61)(1.17)

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **30,425** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	95

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= **0.00900** ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= **273.83** ft^3

V_{PRE}= (0.00900)(30,425)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.48218** in

$S_{POST} = \frac{1000}{95} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= **0.05485** ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.48)]^2}{[(0.92*1.17)+(0.8*0.48)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= **1668.81** ft^3

V_{POST}= (0.05485)(30,425)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

219

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (1,668.81) - (273.83)

V_{DELTA}= **1394.99** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ 4277.48 ft^3

$A_{LID\ GOAL}=(W)(L) =$ 1544.49 ft^2

Where:
$V_{LID\ GOAL}=$ Required volume of soil in LID BMP.
$A_{LID\ GOAL}=$ Footprint of LID BMP area for a given depth (below perforated pipe if present).

$V_{GOAL} =$ 1,882 ft^3

Percent of Goal Achieved $= \frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	2.8	ft	Below perforated pipe if present
W =	39.3	ft	
L =	39.3	ft	

7

Solution:
Percent of Goal Achieved = 101.10 % = [(2.8 x 1,544) / 4,277] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ #DIV/0! ft^3

$A_{LID\ DELTA}=(W)(L) =$ 0.00 ft^2

Where:
$V_{LID\ DELTA}=$ Required volume of soil in LID BMP
$A_{LID\ DELTA}=$ Footprint of LID BMP area for a given depth (below perforated pipe if present).

$V_{DELTA}=$ 1394.99 ft^3

Percent of Requirement Achieved $= \frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:
220
Percent of Requirement Achieved = #DIV/0! % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #35

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

Physical Tributary Area that drains to Inlet/BMP = **44,444** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(44,444 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(44,444 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

City of Santa Rosa

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

222

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

APPENDIX C
STORM WATER CALCULATOR

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 44,444 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 44,444 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 44,444 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 95

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.54852 in

$$S_{POST} = \frac{1000}{95} - 10$$

Q_{POST}= 0.05816 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.55)]^2}{[(1.00 * 1.17)+(0.8 * 0.55)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 2584.86 ft^3

$$V_{GOAL} = (0.05816)(44,444)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

Input:

A_r = **44,444** ft² = **1.02** Acres

C_{POST} [10] = **0.60**

K [7] = **1.2**

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= **0.14325** cfs

$Q_{TREATMENT}$= (0.2)(1.02)(0.60)(1.17)

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

224

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **44,444** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **95**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= **400.00** ft^3 — V_{PRE}= (0.00900)(44,444)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.54852** in — $S_{POST} = \frac{1000}{95} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= **0.05132** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.55)]^2}{[(0.92*1.17)+(0.8*0.55)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= **2280.87** ft^3 — V_{POST}= (0.05132)(44,444)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

225

Delta Volume Capture= $(V_{POST}-V_{PRE})$ — Delta Volume Capture= (2,280.87) - (400.00)

V_{DELTA}= **1880.87** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \leq C_{PRE}$ or $CN_{POST} \leq CN_{PRE}$)

APPENDIX C
STORM WATER CALCULATOR

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **5874.69** ft³

$A_{LID\ GOAL}=(W)(L)$ = **2787.84** ft²

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **2,585** ft³

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	2.1	ft	Below perforated pipe if present
W =	52.8	ft	
L =	52.8	ft	

Solution:

7

Percent of Goal Achieved = **101.55** % = [(2.1 x 2,788) / 5,875] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft³

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft²

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **1880.87** ft³

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

226

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #36

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

Physical Tributary Area that drains to Inlet/BMP = **45,015** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00**   Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(45,015 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(45,015 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **45,015** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **45,015** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **45,015** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **93**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **0.77586** in

$$S_{POST} = \frac{1000}{93} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

229

Q_{POST}= **0.04776** ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.78)]^2}{[(1.00 * 1.17)+(0.8 * 0.78)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= **2149.92** ft^3

$$V_{GOAL} = (0.04776)(45,015)$$

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

Input:

A_r = 45,015 ft^2 = 1.03 Acres

C_{POST} [10] = 0.53

K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.12816 cfs

$Q_{TREATMENT}$= (0.2)(1.03)(0.53)(1.17)

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **45,015** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **93**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **405.14** ft^3 — V_{PRE}= (0.00900)(45,015)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.77586** in — $S_{POST} = \frac{1000}{93} - 10$

Q_{POST}= **0.04152** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.78)]^2}{[(0.92*1.17)+(0.8*0.78)]} \times \frac{1ft}{12in}$

V_{POST}= **1869.02** ft^3 — V_{POST}= (0.04152)(45,015)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

231

Delta Volume Capture= $(V_{POST}-V_{PRE})$ — Delta Volume Capture= (1,869.02) - (405.14)

V_{DELTA}= **1463.89** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **4886.17** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **2116.00** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **2,150** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.4** as a decimal
D = **2.3** ft Below perforated pipe if present
W = **46.0** ft
L = **46.0** ft

Solution:

7

Percent of Goal Achieved = **101.34** % = [(2.3 x 2,116) / 4,886] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **1463.89** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.0** as a decimal
D = **0.0** ft Below perforated pipe if present
W = **0.0** ft
L = **0.0** ft

Solution:

232

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #37

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

Physical Tributary Area that drains to Inlet/BMP = **24,028** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(24,028 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(24,028 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

[10] *From "Using Site Design to Meet Development Standards For Storm water Quality" by the Bay Area Storm water Management Associations Association (BASMAA).*

33

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

234

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **24,028** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **24,028** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **24,028** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **94**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **0.66098** in

$$S_{POST} = \frac{1000}{94} - 10$$

235

Q_{POST}= **0.05288** ft

$$Q_{POST} = \frac{[(1.00*1.17)-(0.2*0.66)]^2}{[(1.00*1.17)+(0.8*0.66)]} \times \frac{1ft}{12in}$$

V_{GOAL}= **1270.60** ft^3

$$V_{GOAL} = (0.05288)(24{,}028)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

Input:

A_r = 24,028 ft^2 = 0.55161 Acres

C_{POST} [10] = 0.56

K [7] = 1.2

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.07228 cfs

$Q_{TREATMENT}$= (0.2)(0.5516)(0.56)(1.17)

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

236

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **24,028** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **94**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= **0.00900** ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= **216.25** ft^3

V_{PRE}= (0.00900)(24,028)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.66098** in

$S_{POST} = \frac{1000}{94} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= **0.04633** ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.66)]^2}{[(0.92*1.17)+(0.8*0.66)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= **1113.22** ft^3

V_{POST}= (0.04633)(24,028)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

237

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (1,113.22) - (216.25)

V_{DELTA}= **896.97** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **2887.73** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **1099.59** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **1,271** ft^3

$$\text{Percent of Goal Achieved} = \frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.4** as a decimal
D = **2.6** ft Below perforated pipe if present
W = **33.2** ft
L = **33.2** ft

Solution:

7

Percent of Goal Achieved = **100.53** %   = [(2.6 x 1,100) / 2,888] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **896.97** ft^3

$$\text{Percent of Requirement Achieved} = \frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.0** as a decimal
D = **0.0** ft Below perforated pipe if present
W = **0.0** ft
L = **0.0** ft

Solution:

Percent of Requirement Achieved = **#DIV/0!** %   = #DIV/0!

238

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

*For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #38

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

Physical Tributary Area that drains to Inlet/BMP = **22,242** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: **Based on the total rooftop drainage area** - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(22,242 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: **Based on density (units per acre)** - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(22,242 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

639

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

240

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **22,242** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **22,242** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **22,242** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **98**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **0.20408** in

$$S_{POST} = \frac{1000}{98} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= **0.08001** ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.20)]^2}{[(1.00 * 1.17)+(0.8 * 0.20)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= **1779.58** ft^3

V_{GOAL}= (0.08001)(22,242)

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

Input:

A_r = 22,242 ft^2 = 0.51061 Acres

C_{POST} [10] = 0.70

K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.08364 cfs

$Q_{TREATMENT}$= (0.2)(0.5106)(0.70)(1.17)

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

242

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **22,242** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	98

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Where: S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2 * 2.50)]^2}{[(0.92*1.17)+(0.8 * 2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= **200.18** ft^3 — V_{PRE}= (0.00900)(22,242)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.20408** in — $S_{POST} = \frac{1000}{98} - 10$

Where: S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= **0.07240** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2 * 0.20)]^2}{[(0.92*1.17)+(0.8 * 0.20)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= **1610.32** ft^3 — V_{POST}= (0.07240)(22,242)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

243

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (1,610.32) - (200.18)

V_{DELTA}= **1410.14** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \leq C_{PRE}$ or $CN_{POST} \leq CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **4044.51** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **1449.32** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **1,780** ft^3

$$\text{Percent of Goal Achieved} = \frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	2.8	ft	Below perforated pipe if present
W =	38.1	ft	
L =	38.1	ft	

7

Solution:

Percent of Goal Achieved = **100.34** % = [(2.8 x 1,449) / 4,045] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **1410.14** ft^3

$$\text{Percent of Requirement Achieved} = \frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

244

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #39

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

Physical Tributary Area that drains to Inlet/BMP = **6,898** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**
Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2
Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(6,898 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre
Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

245

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(6,898 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 6,898 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 6,898 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 6,898 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = 98
OR: Composite post development CN [9] = 98

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST} = 0.20408 in

$$S_{POST} = \frac{1000}{98} - 10$$

247

Q_{POST} = 0.08001 ft

$$Q_{POST} = \frac{[(1.00*1.17)-(0.2*0.20)]^2}{[(1.00*1.17)+(0.8*0.20)]} \times \frac{1ft}{12in}$$

V_{GOAL} = 551.91 ft^3

$$V_{GOAL} = (0.08001)(6,898)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:
$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

Input:

A_r = 6,898 ft² = 0.15836 Acres
C_{POST} [10] = 0.70
K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.02594 cfs

$Q_{TREATMENT}$= (0.2)(0.1584)(0.70)(1.17)

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

248

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **6,898** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	98

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **62.08** ft^3 — V_{PRE}= (0.00900)(6,898)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.20408** in — $S_{POST} = \frac{1000}{98} - 10$

Q_{POST}= **0.07240** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.20)]^2}{[(0.92*1.17)+(0.8*0.20)]} \times \frac{1ft}{12in}$

V_{POST}= **499.42** ft^3 — V_{POST}= (0.07240)(6,898)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (499.42) - (62.08)

V_{DELTA}= **437.33** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **1254.34** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **540.10** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **552** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	**0.4**		as a decimal
D =	**2.3**	ft	Below perforated pipe if present
W =	**23.2**	ft	
L =	**23.2**	ft	

7

Solution:
Percent of Goal Achieved = **100.76** % = [(2.3 x 540) / 1,254] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **437.33** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	**0.0**		as a decimal
D =	**0.0**	ft	Below perforated pipe if present
W =	**0.0**	ft	
L =	**0.0**	ft	

Solution:
250
Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

STORM WATER CALCULATOR*

*For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #40

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

Physical Tributary Area that drains to Inlet/BMP = **35,086** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: **Based on the total rooftop drainage area** - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(35,086 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: **Based on density (units per acre)** - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(35,086 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **35,086** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] **=** **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **35,086** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **35,086** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **95**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **0.57082** in

$$S_{POST} = \frac{1000}{95} - 10$$

253 Q_{POST}= **0.05715** ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.57)]^2}{[(1.00 * 1.17)+(0.8 * 0.57)]} \times \frac{1ft}{12in}$$

V_{GOAL}= **2005.16** ft^3

$$V_{GOAL} = (0.05715)(35{,}086)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

Input:

A_r = 35,086 ft^2 = 0.80546 Acres

C_{POST} [10] = 0.59

K [7] = 1.2

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.11120 cfs

$Q_{TREATMENT}$= (0.2)(0.8055)(0.59)(1.17)

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 35,086 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 95

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= 0.00900 ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= 315.77 ft^3 — V_{PRE}= (0.00900)(35,086)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.57082 in — $S_{POST} = \frac{1000}{95} - 10$

Q_{POST}= 0.05037 ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.57)]^2}{[(0.92*1.17)+(0.8*0.57)]} \times \frac{1ft}{12in}$

V_{POST}= 1767.28 ft^3 — V_{POST}= (0.05037)(35,086)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

255

Delta Volume Capture= (V_{POST}-V_{PRE}) — Delta Volume Capture= (1,767.28) - (315.77)

V_{DELTA}= 1451.51 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

APPENDIX C
STORM WATER CALCULATOR

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **2864.52** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **528.00** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **2,005** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.7** as a decimal
D = **5.5** ft Below perforated pipe if present
W = **8.0** ft
L = **66.0** ft

Solution:

7

Percent of Goal Achieved = 101.38 % = [(5.5 x 528) / 2,865] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **1451.51** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.0** as a decimal
D = **0.0** ft Below perforated pipe if present
W = **0.0** ft
L = **0.0** ft

Solution:

256 **Percent of Requirement Achieved = #DIV/0! %** = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

*For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #41

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

Physical Tributary Area that drains to Inlet/BMP = **43,274** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(43,274 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(43,274 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 43,274 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 43,274 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 43,274 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 92

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.92896 in

$$S_{POST} = \frac{1000}{92} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

259

Q_{POST}= 0.04216 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.93)]^2}{[(1.00 * 1.17)+(0.8 * 0.93)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= 1824.43 ft^3

$$V_{GOAL} = (0.04216)(43,274)$$

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

Input:

A_r = 43,274 ft^2 = 0.99343 Acres

C_{POST} [10] = 0.60

K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.13948 cfs

$Q_{TREATMENT}$= (0.2)(0.9934)(0.60)(1.17)

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 43,274 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	92

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in — $S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= 0.00900 ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= 389.47 ft^3 — V_{PRE}= (0.00900)(43,274)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.92896 in — $S_{POST} = \frac{1000}{92} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.03629 ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.93)]^2}{[(0.92*1.17)+(0.8*0.93)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= 1570.41 ft^3 — V_{POST}= (0.03629)(43,274)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

Delta Volume Capture= (V_{POST}-V_{PRE})

Delta Volume Capture= (1,570.41) - (389.47)

V_{DELTA}= 1180.95 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **4146.44** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **1672.81** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **1,824** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.4** as a decimal
D = **2.5** ft Below perforated pipe if present
W = **40.9** ft
L = **40.9** ft

Solution:

7

Percent of Goal Achieved = **100.86** % = [(2.5 x 1,673) / 4,146] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **1180.95** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.0** as a decimal
D = **0.0** ft Below perforated pipe if present
W = **0.0** ft
L = **0.0** ft

Solution:

262

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #42

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

Physical Tributary Area that drains to Inlet/BMP = **19,141** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(19,141 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(19,141 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

264

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 19,141 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 19,141 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 19,141 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = 98
OR: Composite post development CN [9] = 78

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 2.87 in

$$S_{POST} = \frac{1000}{78} - 10$$

Q_{POST}= 0.00854 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 2.87)]^2}{[(1.00 * 1.17)+(0.8 * 2.87)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 163.46 ft^3

$$V_{GOAL} = (0.00854)(19{,}141)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:
$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

Input:

A_r = 19,141 ft^2 = 0.43942 Acres
C_{POST} [10] = 0.37
K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.03804 cfs

$Q_{TREATMENT}$= (0.2)(0.4394)(0.37)(1.17)

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

266

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 19,141 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	78

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= 0.00900 ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= 172.27 ft^3

V_{PRE}= (0.00900)(19,141)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 2.87 in

$S_{POST} = \frac{1000}{78} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.00624 ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*2.87)]^2}{[(0.92*1.17)+(0.8*2.87)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= 119.44 ft^3

V_{POST}= (0.00624)(19,141)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

267

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (119.44) - (172.27)

V_{DELTA}= -52.82916 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **371.51** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **670.81** ft^2

Where:
$V_{LID\ GOAL}$ = Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **163** ft^3

Percent of Goal Achieved $= \frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	**0.4**		as a decimal
D =	**1.0**	ft	Below perforated pipe if present
W =	**25.9**	ft	
L =	**25.9**	ft	

Solution:

7

Percent of Goal Achieved = **180.56** % = [(1.0 x 671) / 372] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$ = Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA} = **-52.82916** ft^3

Percent of Requirement Achieved $= \frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	**0.0**		as a decimal
D =	**0.0**	ft	Below perforated pipe if present
W =	**0.0**	ft	
L =	**0.0**	ft	

Solution:

268

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #43

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

Physical Tributary Area that drains to Inlet/BMP = **12,492** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(12,492 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

69

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(12,492 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

270

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 12,492 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 12,492 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

***1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.*

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 12,492 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 91

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.98901 in

$$S_{POST} = \frac{1000}{91} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.04013 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.99)]^2}{[(1.00 * 1.17)+(0.8 * 0.99)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= 501.30 ft^3

$$V_{GOAL} = (0.04013)(12,492)$$

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

271

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Input:

A_r = 12,492 ft^2 = 0.28678 Acres

C_{POST} [10] = 0.59

K [7] = 1.2

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.03959 cfs

$Q_{TREATMENT}$= (0.2)(0.2868)(0.59)(1.17)

272

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 12,492 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 91

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= 0.00900 ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= 112.43 ft^3

V_{PRE}= (0.00900)(12,492)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.98901 in

$S_{POST} = \frac{1000}{91} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.03441 ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.99)]^2}{[(0.92*1.17)+(0.8*0.99)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= 429.85 ft^3

V_{POST}= (0.03441)(12,492)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

273

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (429.85) - (112.43)

V_{DELTA}= 317.42 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \leq C_{PRE}$ or $CN_{POST} \leq CN_{PRE}$)

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **1139.33** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **338.56** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **501** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	3.4	ft	Below perforated pipe if present
W =	18.4	ft	
L =	18.4	ft	

7

Solution:
Percent of Goal Achieved = 101.03 % = [(3.4 x 339) / 1,139] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **317.42** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:
274 **Percent of Requirement Achieved = #DIV/0! %** = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

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

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #44

Physical Tributary Area that drains to Inlet/BMP = **27,597** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(27,597 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(27,597 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft²

Area Reduction = 0.00 ft²

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft² — (200 ft²/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft² — (100 ft²/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft² — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft² = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft²

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft²

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area =	**27,597**	ft^2
Tributary Area Reduction due to Pollution Prevention Measures [4] =	**0.00**	ft^2
Reduced Tributary Area to be used for Calculations =	**27,597**	ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **27,597** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **94**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **0.69519** in

$S_{POST} = \frac{1000}{94} - 10$

Q_{POST}= **0.05110** ft

$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.70)]^2}{[(1.00 * 1.17)+(0.8 * 0.70)]} \times \frac{1ft}{12in}$

V_{GOAL}= **1410.21** ft^3

V_{GOAL}= (0.05110)(27,597)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

Input:

A_r = 27,597 ft^2 = 0.63354 Acres

C_{POST} [10] = 0.59

K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.08747 cfs

$Q_{TREATMENT}$= (0.2)(0.6335)(0.59)(1.17)

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

278

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **27,597** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **94**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **248.37** ft^3 — V_{PRE}= (0.00900)(27,597)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.69519** in — $S_{POST} = \frac{1000}{94} - 10$

Q_{POST}= **0.04465** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.70)]^2}{[(0.92*1.17)+(0.8*0.70)]} \times \frac{1ft}{12in}$

V_{POST}= **1232.21** ft^3 — V_{POST}= (0.04465)(27,597)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

279

Delta Volume Capture= $(V_{POST}-V_{PRE})$ — Delta Volume Capture= (1,232.21) - (248.37)

V_{DELTA}= **983.83** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}$=((V_{GOAL}))/(P) = **2014.58** ft³

$A_{LID\ GOAL}$=(W)(L) = **368.00** ft²

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = 1,410 ft³

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.7** as a decimal
D = **5.5** ft Below perforated pipe if present
W = **8.0** ft
L = **46.0** ft

Solution:

7

Percent of Goal Achieved = 100.47 % = [(5.5 x 368) / 2,015] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}$=((V_{DELTA}))/(P) = **#DIV/0!** ft³

$A_{LID\ DELTA}$=(W)(L) = **0.00** ft²

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= 983.83 ft³

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.0** as a decimal
D = **0.0** ft Below perforated pipe if present
W = **0.0** ft
L = **0.0** ft

Solution:

280 **Percent of Requirement Achieved = #DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #45

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

Physical Tributary Area that drains to Inlet/BMP = **18,988** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(18,988 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

281

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(18,988 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

282

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 18,988 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 18,988 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 18,988 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 92

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.84599 in

$$S_{POST} = \frac{1000}{92} - 10$$

283 Q_{POST}= 0.04505 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.85)]^2}{[(1.00 * 1.17)+(0.8 * 0.85)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 855.41 ft^3

$$V_{GOAL} = (0.04505)(18,988)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

Input:

A_r = 18,988 ft^2 = 0.43590 Acres
C_{POST} [10] = 0.56
K [7] = 1.2

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.05712 cfs

$Q_{TREATMENT}$= (0.2)(0.4359)(0.56)(1.17)

284

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **18,988** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **92**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **170.89** ft^3 — V_{PRE}= (0.00900)(18,988)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.84599** in — $S_{POST} = \frac{1000}{92} - 10$

Q_{POST}= **0.03898** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.85)]^2}{[(0.92*1.17)+(0.8*0.85)]} \times \frac{1ft}{12in}$

V_{POST}= **740.15** ft^3 — V_{POST}= (0.03898)(18,988)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (740.15) - (170.89)

V_{DELTA}= **569.26** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:

If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.

($C_{POST} \leq C_{PRE}$ or $CN_{POST} \leq CN_{PRE}$)

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **1944.11** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **547.56** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **855** ft^3

$$\text{Percent of Goal Achieved} = \frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	3.6	ft	Below perforated pipe if present
W =	23.4	ft	
L =	23.4	ft	

7

Solution:
Percent of Goal Achieved = 101.39 % = [(3.6 x 548) / 1,944] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **569.26** ft^3

$$\text{Percent of Requirement Achieved} = \frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:
286 **Percent of Requirement Achieved = #DIV/0! %** = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #46

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

Physical Tributary Area that drains to Inlet/BMP = **24,447** ft²

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft²

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(24,447 x 0.25 x 0.00) = **0.00** ft² **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(24,447 x 0.25 x 0.00 x 0.19) = **0.00** ft² **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft²

Area Reduction = 0.00 ft²

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft² (200 ft²/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft² (100 ft²/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft² Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft² = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft²

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft²

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

APPENDIX C
STORM WATER CALCULATOR

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 24,447 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 24,447 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 24,447 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 92

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.83424 in

$$S_{POST} = \frac{1000}{92} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

289

Q_{POST}= 0.04580 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.83)]^2}{[(1.00 * 1.17)+(0.8 * 0.83)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= 1119.67 ft^3

$$V_{GOAL} = (0.04580)(24,447)$$

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

Input:

A_r = 24,447 ft^2 = 0.56123 Acres
C_{POST} [10] = 0.61
K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.08011 cfs

$Q_{TREATMENT}$= (0.2)(0.5612)(0.61)(1.17)

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

290

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 24,447 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 92

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= 0.00900 ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= 220.02 ft^3 — V_{PRE}= (0.00900)(24,447)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.83424 in — $S_{POST} = \frac{1000}{92} - 10$

Q_{POST}= 0.03969 ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.83)]^2}{[(0.92*1.17)+(0.8*0.83)]} \times \frac{1ft}{12in}$

V_{POST}= 970.30 ft^3 — V_{POST}= (0.03969)(24,447)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

291

Delta Volume Capture= (V_{POST}-V_{PRE})

Delta Volume Capture= (970.30) - (220.02)

V_{DELTA}= 750.28 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **2544.71** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **696.96** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **1,120** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	3.7	ft	Below perforated pipe if present
W =	26.4	ft	
L =	26.4	ft	

Solution:

7

Percent of Goal Achieved = **101.34** % = [(3.7 x 697) / 2,545] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **750.28** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

292

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #47

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

Physical Tributary Area that drains to Inlet/BMP = **14,334** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(14,334 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(14,334 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

294

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 14,334 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 14,334 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 1.00
K= Seasonal Precipitation Factor [7]

***1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.*

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 14,334 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 86

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 1.68 in

$$S_{POST} = \frac{1000}{86} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

295

Q_{POST}= 0.02306 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 1.68)]^2}{[(1.00 * 1.17)+(0.8 * 1.68)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= 330.54 ft^3

V_{GOAL}= (0.02306)(14,334)

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:
$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

Input:

A_r = 14,334 ft^2 = 0.32906 Acres
C_{POST} [10] = 0.50
K [7] = 1.2

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.03850 cfs

$Q_{TREATMENT}$= (0.2)(0.3291)(0.50)(1.17)

296

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 14,334 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 86

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= 0.00900 ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= 129.01 ft^3 — V_{PRE}= (0.00900)(14,334)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 1.68 in — $S_{POST} = \frac{1000}{86} - 10$

Q_{POST}= 0.01887 ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*1.68)]^2}{[(0.92*1.17)+(0.8*1.68)]} \times \frac{1ft}{12in}$

V_{POST}= 270.48 ft^3 — V_{POST}= (0.01887)(14,334)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

297

Delta Volume Capture= (V_{POST}-V_{PRE})

Delta Volume Capture= (270.48) - (129.01)

V_{DELTA}= 141.48 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \leq C_{PRE}$ or $CN_{POST} \leq CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **751.23** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **249.64** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **331** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	3.0	ft	Below perforated pipe if present
W =	15.8	ft	
L =	15.8	ft	

7

Solution:

Percent of Goal Achieved = 101.02 % = [(3.0 x 250) / 751] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **141.48** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

298

Percent of Requirement Achieved = #DIV/0! % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #48

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

Physical Tributary Area that drains to Inlet/BMP = **19,963** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(19,963 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(19,963 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

699

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area

Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

300

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 19,963 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 19,963 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in) [5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 19,963 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 92

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.84599 in

$$S_{POST} = \frac{1000}{92} - 10$$

301 Q_{POST}= 0.04505 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.85)]^2}{[(1.00 * 1.17)+(0.8 * 0.85)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 899.33 ft^3

$$V_{GOAL} = (0.04505)(19,963)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

Input:

A_r = 19,963 ft² = 0.45829 Acres
C_{POST} [10] = 0.56
K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.06005 cfs

$Q_{TREATMENT}$= (0.2)(0.4583)(0.56)(1.17)

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

302

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 19,963 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 92

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= 0.00900 ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= 179.67 ft^3

V_{PRE}= (0.00900)(19,963)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.84599 in

$S_{POST} = \frac{1000}{92} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.03898 ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.85)]^2}{[(0.92*1.17)+(0.8*0.85)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= 778.16 ft^3

V_{POST}= (0.03898)(19,963)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

303

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (778.16) - (179.67)

V_{DELTA}= 598.49 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ 2043.94 ft^3

$A_{LID\ GOAL}=(W)(L) =$ 718.24 ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = 899 ft^3

Percent of Goal Achieved $= \frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	2.9	ft	Below perforated pipe if present
W =	26.8	ft	
L =	26.8	ft	

7

Solution:
Percent of Goal Achieved = 101.91 %   = [(2.9 x 718) / 2,044] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ #DIV/0! ft^3

$A_{LID\ DELTA}=(W)(L) =$ 0.00 ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= 598.49 ft^3

Percent of Requirement Achieved $= \frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:
304 **Percent of Requirement Achieved =** #DIV/0! %   = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

*For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #49

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

Physical Tributary Area that drains to Inlet/BMP = **4,087** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(4,087 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

105

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(4,087 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

306

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 4,087 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 4,087 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Input: (Pick data from drop down lists or enter calculated values)

A_r = 4,087 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 92

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.84599 in

$$S_{POST} = \frac{1000}{92} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

307 Q_{POST}= 0.04505 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.85)]^2}{[(1.00 * 1.17)+(0.8 * 0.85)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= 184.12 ft^3

$$V_{GOAL} = (0.04505)(4{,}087)$$

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

Input:

A_r = 4,087 ft^2 = 0.09382 Acres
C_{POST} [10] = 0.56
K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.01229 cfs

$Q_{TREATMENT}$= (0.2)(0.0938)(0.56)(1.17)

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **4,087** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **92**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **36.78** ft^3 — V_{PRE}= (0.00900)(4,087)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.84599** in — $S_{POST} = \frac{1000}{92} - 10$

Q_{POST}= **0.03898** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.85)]^2}{[(0.92*1.17)+(0.8*0.85)]} \times \frac{1ft}{12in}$

V_{POST}= **159.31** ft^3 — V_{POST}= (0.03898)(4,087)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

309

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (159.31) - (36.78)

V_{DELTA}= **122.53** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **263.03** ft³

$A_{LID\ GOAL}=(W)(L)$ = **48.00** ft²

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **184** ft³

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.7		as a decimal
D =	5.5	ft	Below perforated pipe if present
W =	4.0	ft	
L =	12.0	ft	

Solution:

7

Percent of Goal Achieved = 100.37 % = [(5.5 x 48) / 263] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft³

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft²

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **122.53** ft³

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

310

Percent of Requirement Achieved = #DIV/0! % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #50

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

Physical Tributary Area that drains to Inlet/BMP = **46,173** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(46,173 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(46,173 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area

Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

312

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 46,173 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 46,173 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:

This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
- S= Potential maximum retention after runoff (in)[5]
- CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
- Q= Runoff depth (ft) [6]
- P= Precipitation (in) = **1.00**
- K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
- V= Volume of Storm Water to be Retained (ft^3)
- A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

NOTE:

If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Input: (Pick data from drop down lists or enter calculated values)

A_r = 46,173 ft^2

K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**

Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = 98

OR: Composite post development CN [9] = 95

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.58201 in

$$S_{POST} = \frac{1000}{95} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

313 **Q_{POST}=** 0.05666 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.58)]^2}{[(1.00 * 1.17)+(0.8 * 0.58)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= 2616.16 ft^3

$$V_{GOAL} = (0.05666)(46,173)$$

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:
$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

Input:

A_r = 46,173 ft^2 = 1.06 Acres
C_{POST} [10] = 0.61
K [7] = 1.2

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.15130 cfs

$Q_{TREATMENT}$= (0.2)(1.06)(0.61)(1.17)

314

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 46,173 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 95

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= 0.00900 ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= 415.56 ft^3 — V_{PRE}= (0.00900)(46,173)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.58201 in — $S_{POST} = \frac{1000}{95} - 10$

Q_{POST}= 0.04990 ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.58)]^2}{[(0.92*1.17)+(0.8*0.58)]} \times \frac{1ft}{12in}$

V_{POST}= 2304.03 ft^3 — V_{POST}= (0.04990)(46,173)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

315

Delta Volume Capture= (V_{POST}-V_{PRE}) — Delta Volume Capture= (2,304.03) - (415.56)

V_{DELTA}= 1888.48 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **3737.37** ft³

$A_{LID\ GOAL}=(W)(L)$ = **680.00** ft²

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **2,616** ft³

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.7		as a decimal
D =	5.5	ft	Below perforated pipe if present
W =	10.0	ft	
L =	68.0	ft	

7

Solution:

Percent of Goal Achieved = **100.07** % = [(5.5 x 680) / 3,737] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement : V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft³

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft²

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **1888.48** ft³

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

316

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #51

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

Physical Tributary Area that drains to Inlet/BMP = **11,547** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(11,547 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(11,547 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft²

Area Reduction = 0.00 ft²

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft² (200 ft²/tree)

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft² (100 ft²/tree)

Enter square footage of qualifying **existing tree canopy** = 0 **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft² Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft² = Sum of areas managed by evergreen + deciduous + existing canopy

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft²

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft²

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

318

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 11,547 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 11,547 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 11,547 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 92

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.85776 in

$S_{POST} = \frac{1000}{92} - 10$

319 Q_{POST}= 0.04467 ft

$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.86)]^2}{[(1.00 * 1.17)+(0.8 * 0.86)]} \times \frac{1ft}{12in}$

V_{GOAL}= 515.80 ft^3

V_{GOAL}= (0.04467)(11,547)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

City of Santa Rosa

APPENDIX C

STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

Input:

A_r = 11,547 ft^2 = 0.26508 Acres

C_{POST} [10] = 0.50

K [7] = 1.2

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.03101 cfs

$Q_{TREATMENT}$= (0.2)(0.2651)(0.50)(1.17)

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 11,547 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	92

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= 0.00900 ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= 103.92 ft^3

V_{PRE}= (0.00900)(11,547)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.85776 in

$S_{POST} = \frac{1000}{92} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.03863 ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.86)]^2}{[(0.92*1.17)+(0.8*0.86)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= 446.06 ft^3

V_{POST}= (0.03863)(11,547)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (446.06) - (103.92)

V_{DELTA}= 342.14 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **1172.28** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **600.25** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **516** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	2.0	ft	Below perforated pipe if present
W =	24.5	ft	
L =	24.5	ft	

7

Solution:
Percent of Goal Achieved = **102.41** % = [(2.0 x 600) / 1,172] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **342.14** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:
Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

322

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #52

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

Physical Tributary Area that drains to Inlet/BMP = **21,864** ft²

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft²

Rooftop Area Factor = **0.00**   Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(21,864 x 0.25 x 0.00) = **0.00** ft²   **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4**   Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

623

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(21,864 x 0.25 x 0.00 x 0.19) = **0.00** ft²   **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

324

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **21,864** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **21,864** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **21,864** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **94**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **0.68376** in

$$S_{POST} = \frac{1000}{94} - 10$$

325

Q_{POST}= **0.05198** ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.68)]^2}{[(1.00 * 1.17)+(0.8 * 0.68)]} \times \frac{1ft}{12in}$$

V_{GOAL}= **1136.49** ft^3

$$V_{GOAL} = (0.05198)(21,864)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

Input:

A_r = 21,864 ft^2 = 0.50193 Acres

C_{POST} [10] = 0.55

K [7] = 1.2

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.06460 cfs

$Q_{TREATMENT}$= (0.2)(0.5019)(0.55)(1.17)

326

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (f^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 21,864 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 94

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in — $S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= 0.00900 ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= 196.78 ft^3 — V_{PRE}= (0.00900)(21,864)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.68376 in — $S_{POST} = \frac{1000}{94} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.04548 ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.68)]^2}{[(0.92*1.17)+(0.8*0.68)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= 994.37 ft^3 — V_{POST}= (0.04548)(21,864)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

327

Delta Volume Capture= (V_{POST}-V_{PRE})

Delta Volume Capture= (994.37) - (196.78)

V_{DELTA}= 797.60 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \leq C_{PRE}$ or $CN_{POST} \leq CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = 2582.93 ft³

$A_{LID\ GOAL}=(W)(L)$ = 750.76 ft²

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = 1,136 ft³

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	3.4	ft	Below perforated pipe if present
W =	27.4	ft	
L =	27.4	ft	

7

Solution:
Percent of Goal Achieved = 99.99 % = [(3.4 x 751) / 2,583] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = #DIV/0! ft³

$A_{LID\ DELTA}=(W)(L)$ = 0.00 ft²

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= 797.60 ft³

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:
328
Percent of Requirement Achieved = #DIV/0! % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

2854.04
Elnoka CCRC
Brelje Race Consulting Engineers
DMA #53

STORM WATER CALCULATOR*

*For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator

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

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #53

Physical Tributary Area that drains to Inlet/BMP = **30,741** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(30,741 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(30,741 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

629

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

330

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **30,741** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **30,741** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **30,741** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **98**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **0.20408** in

$$S_{POST} = \frac{1000}{98} - 10$$

331

Q_{POST}= **0.08001** ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.20)]^2}{[(1.00 * 1.17)+(0.8 * 0.20)]} \times \frac{1ft}{12in}$$

V_{GOAL}= **2459.59** ft^3

$$V_{GOAL} = (0.08001)(30,741)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Input:

A_r = 30,741 ft^2 = 0.70572 Acres

C_{POST} [10] = 0.70

K [7] = 1.2

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.11560 cfs

$Q_{TREATMENT}$= (0.2)(0.7057)(0.70)(1.17)

332

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
$(C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE})$

Input: (Pick data from drop down lists or enter calculated values)

A_r = 30,741 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 98

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= 0.00900 ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= 276.67 ft^3

V_{PRE}= (0.00900)(30,741)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.20408 in

$S_{POST} = \frac{1000}{98} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.07240 ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.20)]^2}{[(0.92*1.17)+(0.8*0.20)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= 2225.65 ft^3

V_{POST}= (0.07240)(30,741)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

333

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (2,225.65) - (276.67)

V_{DELTA}= 1948.98 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **5589.97** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **1398.76** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **2,460** ft^3

Percent of Goal Achieved $= \frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	**0.4**		as a decimal
D =	**4.0**	ft	Below perforated pipe if present
W =	**37.4**	ft	
L =	**37.4**	ft	

Solution:

7

Percent of Goal Achieved = **100.09** % = [(4.0 x 1,399) / 5,590] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **1948.98** ft^3

Percent of Requirement Achieved $= \frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	**0.0**		as a decimal
D =	**0.0**	ft	Below perforated pipe if present
W =	**0.0**	ft	
L =	**0.0**	ft	

Solution:

334

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #54

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

Physical Tributary Area that drains to Inlet/BMP = **17,291** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(17,291 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(17,291 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

336

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 17,291 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 17,291 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 17,291 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 92

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.83424 in

$$S_{POST} = \frac{1000}{92} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

337

Q_{POST}= 0.04580 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.83)]^2}{[(1.00 * 1.17)+(0.8 * 0.83)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{GOAL}= 791.93 ft^3

V_{GOAL}= (0.04580)(17,291)

V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Input:

A_r = 17,291 ft^2 = 0.39695 Acres

C_{POST} [10] = 0.61

K [7] = 1.2

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.05666 cfs

$Q_{TREATMENT}$= (0.2)(0.3969)(0.61)(1.17)

338

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **17,291** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] =	**C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] =	**Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] =	**Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} =	**76**
CN_{POST} =	**90.3**
OR Composite Predevelopment CN [9] =	**80**
Composite Post development CN [9] =	**92**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= **0.00900** ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= **155.62** ft^3

V_{PRE}= (0.00900)(17,291)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.83424** in

$S_{POST} = \frac{1000}{92} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= **0.03969** ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.83)]^2}{[(0.92*1.17)+(0.8*0.83)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= **686.28** ft^3

V_{POST}= (0.03969)(17,291)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

339

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (686.28) - (155.62)

V_{DELTA}= **530.66** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **1799.84** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **739.84** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **792** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	2.4	ft	Below perforated pipe if present
W =	27.2	ft	
L =	27.2	ft	

7

Solution:

Percent of Goal Achieved = **100.30** %   = [(2.4 x 740) / 1,800] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **530.66** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

340 **Percent of Requirement Achieved =** **#DIV/0!** %   = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

*For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #55

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

Physical Tributary Area that drains to Inlet/BMP = **23,221** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: **Based on the total rooftop drainage area** - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(23,221 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: **Based on density (units per acre)** - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(23,221 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

342

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 23,221 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 23,221 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 23,221 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = 98
OR: Composite post development CN [9] = 87

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 1.52 in

$$S_{POST} = \frac{1000}{87} - 10$$

343

Q_{POST}= 0.02619 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 1.52)]^2}{[(1.00 * 1.17)+(0.8 * 1.52)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 608.16 ft^3

$$V_{GOAL} = (0.02619)(23,221)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

Input:

A_r = **23,221** ft² = **0.53308** Acres
C_{POST} [10] = **0.52**
K [7] = **1.2**

Solution:

$Q_{TREATMENT}$= 0.06487 cfs

$Q_{TREATMENT}$= (0.2)(0.5331)(0.52)(1.17)

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 23,221 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] = Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} = 76
CN_{POST} = 90.3
OR Composite Predevelopment CN [9] = 80
Composite Post development CN [9] = 87

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= 0.00900 ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= 208.99 ft^3

V_{PRE}= (0.00900)(23,221)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 1.52 in

$S_{POST} = \frac{1000}{87} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= 0.02169 ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*1.52)]^2}{[(0.92*1.17)+(0.8*1.52)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= 503.66 ft^3

V_{POST}= (0.02169)(23,221)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

345

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (503.66) - (208.99)

V_{DELTA}= 294.67 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **1382.18** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **778.41** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **608** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.4** as a decimal
D = **1.8** ft Below perforated pipe if present
W = **27.9** ft
L = **27.9** ft

Solution:

7

Percent of Goal Achieved = **101.37** % = [(1.8 x 778) / 1,382] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **294.67** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.0** as a decimal
D = **0.0** ft Below perforated pipe if present
W = **0.0** ft
L = **0.0** ft

Solution:

346

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #56

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

Physical Tributary Area that drains to Inlet/BMP = **21,403** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(21,403 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(21,403 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **21,403** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **21,403** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **21,403** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **95**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

349

S_{POST}= 0.49318 in

$$S_{POST} = \frac{1000}{95} - 10$$

Q_{POST}= 0.06131 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.49)]^2}{[(1.00 * 1.17)+(0.8 * 0.49)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 1312.22 ft^3

$$V_{GOAL} = (0.06131)(21,403)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)
C_{POST} = Rational method runoff coefficient for the developed condition[10]
A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)
K = Seasonal Precipitation Factor[7]

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

Input:

A_r = 21,403 ft² = 0.49135 Acres
C_{POST} [10] = 0.66
K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.07588 cfs

$Q_{TREATMENT}$= (0.2)(0.4913)(0.66)(1.17)

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **21,403** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **95**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **192.63** ft^3 — V_{PRE}= (0.00900)(21,403)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.49318** in — $S_{POST} = \frac{1000}{95} - 10$

Q_{POST}= **0.05433** ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.49)]^2}{[(0.92*1.17)+(0.8*0.49)]} \times \frac{1ft}{12in}$

V_{POST}= **1162.82** ft^3 — V_{POST}= (0.05433)(21,403)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (1,162.82) - (192.63)

V_{DELTA}= **970.20** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **2982.31** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **800.89** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **1,312** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	3.7	ft	Below perforated pipe if present
W =	28.3	ft	
L =	28.3	ft	

7

Solution:

Percent of Goal Achieved = **100.44** %   = [(3.7 x 801) / 2,982] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **970.20** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

352

Percent of Requirement Achieved = **#DIV/0!** %   = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

*For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator

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

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #57

Physical Tributary Area that drains to Inlet/BMP = **19,564** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(19,564 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(19,564 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area

Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

354

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = **19,564** ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = **0.00** ft^2

Reduced Tributary Area to be used for Calculations = **19,564** ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input:
(Pick data from drop down lists or enter calculated values)

A_r = **19,564** ft^2
K [7] = **1.17**

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = **98**
OR: Composite post development CN [9] = **89**

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= **1.28** in

$$S_{POST} = \frac{1000}{89} - 10$$

355 Q_{POST}= **0.03173** ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 1.28)]^2}{[(1.00 * 1.17)+(0.8 * 1.28)]} \times \frac{1ft}{12in}$$

V_{GOAL}= **620.77** ft^3

$$V_{GOAL} = (0.03173)(19,564)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Input:

A_r = **19,564** ft^2 = **0.44913** Acres

C_{POST} [10] = **0.47**

K [7] = **1.2**

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= **0.04940** **cfs**

$Q_{TREATMENT}$= (0.2)(0.4491)(0.47)(1.17)

356

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **19,564** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**

OR
Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **89**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in

$$S_{PRE} = \frac{1000}{80} - 10$$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= **0.00900** ft

$$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= **176.08** ft^3

V_{PRE}= (0.00900)(19,564)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **1.27** in

$$S_{POST} = \frac{1000}{89} - 10$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= **0.02694** ft

$$Q_{POST} = \frac{[(0.92*1.17)-(0.2*1.27)]^2}{[(0.92*1.17)+(0.8*1.27)]} \times \frac{1ft}{12in}$$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= **527.05** ft^3

V_{POST}= (0.02694)(19,564)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

357

Delta Volume Capture= (V_{POST}-V_{PRE})

Delta Volume Capture= (527.05) - (176.08)

V_{DELTA}= **350.98** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

APPENDIX C
STORM WATER CALCULATOR

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **1410.83** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **1089.00** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **621** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.4** as a decimal
D = **1.3** ft Below perforated pipe if present
W = **33.0** ft
L = **33.0** ft

Solution:

7

Percent of Goal Achieved = 100.35 % = [(1.3 x 1,089) / 1,411] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the <u>design goal of 100% volume capture of the post development condition.</u> Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement : V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **350.98** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.0** as a decimal
D = **0.0** ft Below perforated pipe if present
W = **0.0** ft
L = **0.0** ft

Solution:

358 **Percent of Requirement Achieved = #DIV/0! %** = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the <u>design requirement of the delta volume capture</u>. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #58

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

Physical Tributary Area that drains to Inlet/BMP = **28,421** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(28,421 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(28,421 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

360

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 28,421 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 28,421 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 28,421 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**

CN_{POST} = 98
OR: Composite post development CN [9] = 94

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.60445 in

$$S_{POST} = \frac{1000}{94} - 10$$

361

Q_{POST}= 0.05568 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.60)]^2}{[(1.00 * 1.17)+(0.8 * 0.60)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 1582.48 ft^3

$$V_{GOAL} = (0.05568)(28,421)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:
The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.
The table of values can be found here
This smaller value should not be used to size the overflow bypass.

Input:

A_r =	28,421	ft^2 =	0.65246	Acres
C_{POST} [10] =	0.61			
K [7] =	1.2			

NOTE:
The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

Solution:

$Q_{TREATMENT}$= 0.09313 cfs

$Q_{TREATMENT}$= (0.2)(0.6525)(0.61)(1.17)

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

362

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \leq C_{PRE}$ or $CN_{POST} \leq CN_{PRE}$)

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **28,421** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **94**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in

$S_{PRE} = \frac{1000}{80} - 10$

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).

Q_{PRE}= **0.00900** ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{PRE}= **255.79** ft^3

V_{PRE}= (0.00900)(28,421)

V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.60445** in

$S_{POST} = \frac{1000}{94} - 10$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).

Q_{POST}= **0.04898** ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.60)]^2}{[(0.92*1.17)+(0.8*0.60)]} \times \frac{1ft}{12in}$

Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

V_{POST}= **1392.06** ft^3

V_{POST}= (0.04898)(28,421)

V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

363

Delta Volume Capture= (V_{POST}-V_{PRE})

Delta Volume Capture= (1,392.06) - (255.79)

V_{DELTA}= **1136.27** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}$=((V_{GOAL}))/(P) = **3596.55** ft^3

$A_{LID\ GOAL}$=(W)(L) = **1075.84** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = 1,582 ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	3.4	ft	Below perforated pipe if present
W =	32.8	ft	
L =	32.8	ft	

Solution:

7

Percent of Goal Achieved = 101.70 %   = [(3.4 x 1,076) / 3,597] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}$=((V_{DELTA}))/(P) = **#DIV/0!** ft^3

$A_{LID\ DELTA}$=(W)(L) = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= 1136.27 ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

364

Percent of Requirement Achieved = #DIV/0! %   = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project:	2854.04
Address/Location:	Elnoka CCRC
Designer:	Brelje & Race Consulting Engineers
Date:	May 19, 2017
Inlet Number/Tributary Area/BMP:	DMA #59

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

Physical Tributary Area that drains to Inlet/BMP = **6,611** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**

Condition Factor = **0.25**

Method 1: **Based on the total rooftop drainage area** - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2

Rooftop Area Factor = **0.00** Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(6,611 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: **Based on density (units per acre)** - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre

Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

165

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(6,611 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.

[5] Per the "Urban Hydrology For Small Watersheds" TR-55 manual.

[6] Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.

[7] From Sonoma County Water Agency Flood Control Design Criteria.

[8] Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.

[9] Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.

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

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area

Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

366

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 6,611 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 6,611 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$$S = \frac{1000}{CN} - 10$$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$$V = (Q)(A_r)$$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 6,611 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 95

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.49318 in

$$S_{POST} = \frac{1000}{95} - 10$$

367

Q_{POST}= 0.06131 ft

$$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.49)]^2}{[(1.00 * 1.17)+(0.8 * 0.49)]} \times \frac{1ft}{12in}$$

V_{GOAL}= 405.32 ft^3

$$V_{GOAL} = (0.06131)(6,611)$$

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

Input:

A_r = 6,611 ft^2 = 0.15177 Acres

C_{POST} [10] = 0.66

K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.02344 cfs

$Q_{TREATMENT}$= (0.2)(0.1518)(0.66)(1.17)

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = 0.92
K= Seasonal Precipitation Factor [7]

0.92 inches in the Santa Rosa area, based on local historical data.

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = **6,611** ft^2
K [7] = **1.2**

Drop down Lists

Select hydrologic soil type within tributary area[8] = **C: 0.05 - 0.15 in/hr infiltration (transmission) rate**
Select predevelopment ground cover description [5] = **Woods (50%), grass (50%) combination (orchard or tree farm) - Fair**
Select post development ground cover description [5] = **Impervious - Paved Parking, Rooftop, Driveways**
CN_{PRE} = **76**
CN_{POST} = **90.3**
OR Composite Predevelopment CN [9] = **80**
Composite Post development CN [9] = **95**

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= **2.50** in

$S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= **0.00900** ft

$Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= **59.50** ft^3

V_{PRE}= (0.00900)(6,611)

Where:
S_{PRE}= Pre development potential maximum retention after runoff (in).
Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= **0.49318** in

$S_{POST} = \frac{1000}{95} - 10$

Q_{POST}= **0.05433** ft

$Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.49)]^2}{[(0.92*1.17)+(0.8*0.49)]} \times \frac{1ft}{12in}$

V_{POST}= **359.18** ft^3

V_{POST}= (0.05433)(6,611)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

369

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (359.18) - (59.50)

V_{DELTA}= **299.68** ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \le C_{PRE}$ or $CN_{POST} \le CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **921.18** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **441.00** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **405** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.4** as a decimal
D = **2.1** ft Below perforated pipe if present
W = **21.0** ft
L = **21.0** ft

Solution:

7

Percent of Goal Achieved = 100.53 % = [(2.1 x 441) / 921] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **299.68** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P = **0.0** as a decimal
D = **0.0** ft Below perforated pipe if present
W = **0.0** ft
L = **0.0** ft

Solution:

370

Percent of Requirement Achieved = #DIV/0! % = #DIV/0!

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

City of Santa Rosa

STORM WATER CALCULATOR*

***For example only, go to www.srcity.org/stormwaterlid for the latest version of the calculator**

Project: 2854.04
Address/Location: Elnoka CCRC
Designer: Brelje & Race Consulting Engineers
Date: May 19, 2017
Inlet Number/Tributary Area/BMP: DMA #60 TYPICAL FOR ALL COTTAGES

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

Physical Tributary Area that drains to Inlet/BMP = **2,700** ft^2

This portion of the Storm water Calculator is designed to account for pollution prevention measures implemented on site. Additional information and description of these measures can be found in the Fact Sheets in Appendix F and in Chapter 4 of the narrative.

Disconnected Roof Drains [1]

Input:

Select disconnection condition: **Runoff is directed across landscape; Width of area: 5' to 9'**
Condition Factor = **0.25**

Method 1: Based on the total rooftop drainage area - to be used if rooftop information is known.

Input:

Enter amount of rooftop area that drain to disconnected downspouts = **0** ft^2
Rooftop Area Factor = **0.00**   Rooftop Area Factor= (Total Rooftop Disconnected Area/Tributary Area)

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Rooftop Area Factor)

(2,700 x 0.25 x 0.00) = **0.00** ft^2 **Rooftop Drainage Area Reduction**

Method 2: Based on density (units per acre) - to be used if rooftop information is unknown.

Input:

Enter percent of rooftop area to be disconnected from downspouts: **0** %

Select Density: **3-4** Units per Acre
Density Reduction Factor= **0.19**

NOTE:
Either Method 1 (rooftop area) or Method 2 (density) can be used. Providing input for both methods will cause an error. If rooftop area information is available, Method 1 should be used.

Solution:

Area reduction = (Physical Tributary Area x Conditional Factor x Percent Disconnected x Density Factor)

(2,700 x 0.25 x 0.00 x 0.19) = **0.00** ft^2 **Density Reduction**

[1] *See "Impervious Area Disconnection" Fact Sheet in Appendix E for further details.*

[2] See "Interceptor Trees" Fact Sheet in Appendix E for further details and see "Plant and Tree List" in Appendix G for approved trees.

[3] See "Vegetated Buffer Strip" and "Bovine Terrace" Fact Sheets in Appendix E for further details.

[4] *Total area reductions due to pollution Prevention Measures cannot exceed 50% of the physical Tributary Area.*

[5] *Per the "Urban Hydrology For Small Watersheds" TR-55 manual.*

[6] *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[7] *From Sonoma County Water Agency Flood Control Design Criteria.*

[8] *Hydrologic soil type based of infiltration rate of native soil as defined by "Urban Hydrology For Small Watersheds" TR-55 Manual.*

[9] *Composite CN calculated per "Worksheet 2 Part 1 of the Urban Hydrology For Small Watersheds" TR-55 manual.*

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

City of Santa Rosa

APPENDIX C
STORM WATER CALCULATOR

Paved Area Disconnection [1]

Paved Area Type (select from drop down list): Not Directly-connected Paved Area
Multiplier = 1

Enter area of alternatively designed paved area: 0 ft^2

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit for driveways designed to minimize runoff. Enter type and area of alternate design.

Interceptor Trees [2]

Number of new ***Evergreen Trees*** that qualify as interceptor trees= 0 — **New Evergreen Trees**

Area Reduction due to new Evergreen Trees= 0 ft^2 — (200 ft^2/tree)

NOTE:
Total Interceptor Area Reduction is limited to 50% of the physical tributary area.

Number of new ***Deciduous Trees*** that qualify as interceptor trees= 0 — **New Deciduous Trees**

Area Reduction due to new Deciduous Trees= 0 ft^2 — (100 ft^2/tree)

Enter square footage of qualifying **existing tree canopy** = 0 — **Existing Tree Canopy**

Allowed reduction credit for existing tree canopy= 0 ft^2 — Allowed credit for existing tree canopy = 50 % of actual canopy square footage

Area Reduction = 0 ft^2 = Sum of areas managed by evergreen + deciduous + existing canopy

INSTRUCTIONS:
Calculates the area reductions credit due to interceptor trees. Includes both new and existing trees. Enter the number of new deciduous and evergreen trees and the canopy area of existing trees.

Buffer Strips & Bovine Terraces [3]

Enter area draining to a Buffer Strip or Bovine Terrace = 0 ft^2

Buffer Factor = 0.7

Solution:

Area Reduction = (Area draining to Buffer Strip or Bovine Terrace) x (Buffer Factor) =

Area Reduction = 0.00 ft^2

INSTRUCTIONS:
Calculates the area reduction credit due to buffer strips and/or bovine terraces. Runoff Must be direct to these features as sheet flow. Enter the area draining to these features.

372

Revised Tributary Area due to Pollution Prevention Measures

Physical Tributary Area = 2,700 ft^2

Tributary Area Reduction due to Pollution Prevention Measures [4] = 0.00 ft^2

Reduced Tributary Area to be used for Calculations = 2,700 ft^2

This worksheet calculates the quantity of storm water that needs to be addressed (captured and/or treated) to comply with the NPDES Storm Water Permit issued to the City of Santa Rosa and County of Sonoma by the North Coast Regional Water Quality Control Board.

Design Goal: 100% Volume Capture

Capture (infiltration and/or reuse) of 100% of the volume of runoff generated by the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
S= Potential maximum retention after runoff (in)[5]
CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12"}$

Where:
Q= Runoff depth (ft) [6]
P= Precipitation (in) = **1.00**
K= Seasonal Precipitation Factor [7]

*****1.00 Per 2016 MS4 *** 0.92 inches in the Santa Rosa area, based on local historical data.***

$V = (Q)(A_r)$

Where:
V= Volume of Storm Water to be Retained (ft^3)
A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 2,700 ft^2
K [7] = 1.17

Drop down Lists

Select post development hydrologic soil type within tributary area[8] = C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select post development ground cover description [5] = Impervious - Paved Parking, Rooftop, Driveways

CN_{POST} = 98
OR: Composite post development CN [9] = 98

NOTE:
Entering a calculated composite CN will override selections made from the pull down menu above. Calculation worksheet should be used for all composite calculations and included with submittal.

Solution:

Volume of storm water - Post Development

S_{POST}= 0.20408 in

$S_{POST} = \frac{1000}{98} - 10$

373 Q_{POST}= 0.08001 ft

$Q_{POST} = \frac{[(1.00 * 1.17)-(0.2 * 0.20)]^2}{[(1.00 * 1.17)+(0.8 * 0.20)]} \times \frac{1ft}{12in}$

V_{GOAL}= 216.03 ft^3

V_{GOAL}= (0.08001)(2,700)

Where:
S_{POST}= Post development potential maximum retention after runoff (in).
Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
V_{GOAL}= Post Development Volume of Storm Water to be Retained (ft^3)

INSTRUCTIONS:
This Design Goal of 100% Capture is the ideal condition and if achieved satisfies all requirements so that no additional treatment is required and pages 4 and 5 of this calculator do not need to be completed.

NOTE:
If the Design Goal of 100% Capture is not achieved, 100% Treatment AND Volume Capture must be achieved and both pages 4 and 5 of this calculator need to be completed.

Requirement 1: 100% Treatment

Treatment of 100% of the flow generated by 85th percentile 24 hour mean annual rain event (0.2 in/hr).

Formula:

$Q_{TREATMENT}$= (0.2 in/hr)(A_r)(C_{POST})(K) cfs

Where:

$Q_{TREATMENT}$= Design flow rate required to be treated (cfs)

C_{POST} = Rational method runoff coefficient for the developed condition[10]

A_r = Reduced Tributary Area including credit for Pollution Prevention Measures (in Acres)

K = Seasonal Precipitation Factor[7]

C value note:

The C value used for this calculation is smaller than the value used for hydraulic Flood Control design.

The table of values can be found here

This smaller value should not be used to size the overflow bypass.

Input:

A_r = 2,700 ft² = 0.06198 Acres

C_{POST} [10] = 0.70

K [7] = 1.2

Solution:

$Q_{TREATMENT}$= 0.01015 cfs

$Q_{TREATMENT}$= (0.2)(0.0620)(0.70)(1.17)

NOTE:

The Flow Rate calculated here should only be used to size the appropriate BMP. All associated overflow inlets and systems should be sized for the Flood Control event.

INSTRUCTIONS:

If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, this page of the calculator, AND Requirement 2- Volume Capture, page 5 of the calculator, **must** be achieved.

374

Requirement 2: Delta Volume Capture

No increase in volume of runoff leaving the site due to development for the 85th percentile 24 hour storm event.

Formulas:

$S = \frac{1000}{CN} - 10$

Where:
- S= Potential maximum retention after runoff (in)[5]
- CN= Curve Number [5]

$Q = \frac{[(P*K)-(0.2*S)]^2}{[(P*K)+(0.8*S)]} \times \frac{1ft}{12in}$

Where:
- Q= Runoff depth (ft) [6]
- P= Precipitation (in) = 0.92 — *0.92 inches in the Santa Rosa area, based on local historical data.*
- K= Seasonal Precipitation Factor [7]

$V = (Q)(A_r)$

Where:
- V= Volume of Storm Water to be Retained (ft^3)
- A_r= Reduced Tributary Area including credit for Pollution Prevention Measures (ft^2)

Input: (Pick data from drop down lists or enter calculated values)

A_r = 2,700 ft^2
K [7] = 1.2

Drop down Lists

Select hydrologic soil type within tributary area[8] =	C: 0.05 - 0.15 in/hr infiltration (transmission) rate
Select predevelopment ground cover description [5] =	Woods (50%), grass (50%) combination (orchard or tree farm) - Fair
Select post development ground cover description [5] =	Impervious - Paved Parking, Rooftop, Driveways
CN_{PRE} =	76
CN_{POST} =	90.3
OR Composite Predevelopment CN [9] =	80
Composite Post development CN [9] =	98

Solution:

Pre Development Storm Water Runoff Volume

S_{PRE}= 2.50 in — $S_{PRE} = \frac{1000}{80} - 10$

Q_{PRE}= 0.00900 ft — $Q_{PRE} = \frac{[(0.92*1.17)-(0.2*2.50)]^2}{[(0.92*1.17)+(0.8*2.50)]} \times \frac{1ft}{12in}$

V_{PRE}= 24.30 ft^3 — V_{PRE}= (0.00900)(2,700)

Where:
- S_{PRE}= Pre development potential maximum retention after runoff (in).
- Q_{PRE}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
- V_{PRE}= Pre Development Volume of Storm Water Generated (ft^3)

Post Development Storm Water Runoff Volume

S_{POST}= 0.20408 in — $S_{POST} = \frac{1000}{98} - 10$

Q_{POST}= 0.07240 ft — $Q_{POST} = \frac{[(0.92*1.17)-(0.2*0.20)]^2}{[(0.92*1.17)+(0.8*0.20)]} \times \frac{1ft}{12in}$

V_{POST}= 195.48 ft^3 — V_{POST}= (0.07240)(2,700)

Where:
- S_{POST}= Post development potential maximum retention after runoff (in).
- Q_{POST}= *Q in feet of depth as defined by the "Urban Hydrology For Small Watersheds" TR-55 Manual.*
- V_{POST}= Post Development Volume of Storm Water Generated (ft^3)

Solution: Volume Capture Requirement

Increase in volume of storm water that must be retained onsite (may be infiltrated or reused).

375

Delta Volume Capture= $(V_{POST}-V_{PRE})$

Delta Volume Capture= (195.48) - (24.30)

V_{DELTA}= 171.18 ft^3

Where:
Delta Volume Capture= The increase in volume of storm water generated by the 85th percentile 24 hour storm event due to development that must be retained onsite (may be infiltrated or reused).

INSTRUCTIONS:
If the Design Goal of 100% Capture on page 3 of this calculator is not achieved; then Requirement 1-100% Treatment, page 4 of the calculator, AND Requirement 2- Volume Capture, this page of the calculator, **must** be achieved.

NOTE:
If the amount of volume generated after development is less than or equal to that generated before development, Requirement 2-Volume Capture is not required.
($C_{POST} \leq C_{PRE}$ or $CN_{POST} \leq CN_{PRE}$)

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P) =$ **490.97** ft^3

$A_{LID\ GOAL}=(W)(L) =$ **100.00** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **216** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	**0.4**		as a decimal
D =	**4.9**	ft	Below perforated pipe if present
W =	**5.0**	ft	
L =	**20.0**	ft	

Solution:

7

Percent of Goal Achieved = **100.62** % = [(4.9 x 100) / 491] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P) =$ **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L) =$ **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **171.18** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}} \times 100$

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	**0.0**		as a decimal
D =	**0.0**	ft	Below perforated pipe if present
W =	**0.0**	ft	
L =	**0.0**	ft	

Solution:

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

376

INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.

LID BMP Sizing Tool: 100% Volume Capture Goal; V_{GOAL}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ GOAL}=((V_{GOAL}))/(P)$ = **2593.46** ft^3

$A_{LID\ GOAL}=(W)(L)$ = **600.25** ft^2

Where:
$V_{LID\ GOAL}$= Required volume of soil in LID BMP.
$A_{LID\ GOAL}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{GOAL} = **1,141** ft^3

Percent of Goal Achieved = $\frac{(D)(A_{LID\ GOAL})}{V_{LID\ GOAL}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

P =	0.4		as a decimal
D =	4.3	ft	Below perforated pipe if present
W =	24.5	ft	
L =	24.5	ft	

Solution:

Percent of Goal Achieved = **100.45** % = [(4.3 x 600) / 2,593] x 100

INSTRUCTIONS:
The 100% volume capture sizing tool helps the designer appropriately size a LID BMP to achieve the design goal of 100% volume capture of the post development condition. Enter the percent porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Goal" equals 100%.

LID BMP Sizing Tool Delta Volume Capture Requirement: V_{DELTA}

NOTE:
LID Sizing Tool only applicable for volume based BMPs. Not required if site requires treatment only.

Formulas:

$V_{LID\ DELTA}=((V_{DELTA}))/(P)$ = **#DIV/0!** ft^3

$A_{LID\ DELTA}=(W)(L)$ = **0.00** ft^2

Where:
$V_{LID\ DELTA}$= Required volume of soil in LID BMP
$A_{LID\ DELTA}$ = Footprint of LID BMP area for a given depth (below perforated pipe if present).

V_{DELTA}= **939.50** ft^3

Percent of Requirement Achieved = $\frac{(D)(A_{LID\ DELTA})}{V_{LID\ DELTA}}$ x 100

Where:
P= Porosity (enter as a decimal)
D= Depth below perforated pipe if present (in decimal feet)
W= Width (in decimal feet)
L= Length (in decimal feet)

Input:

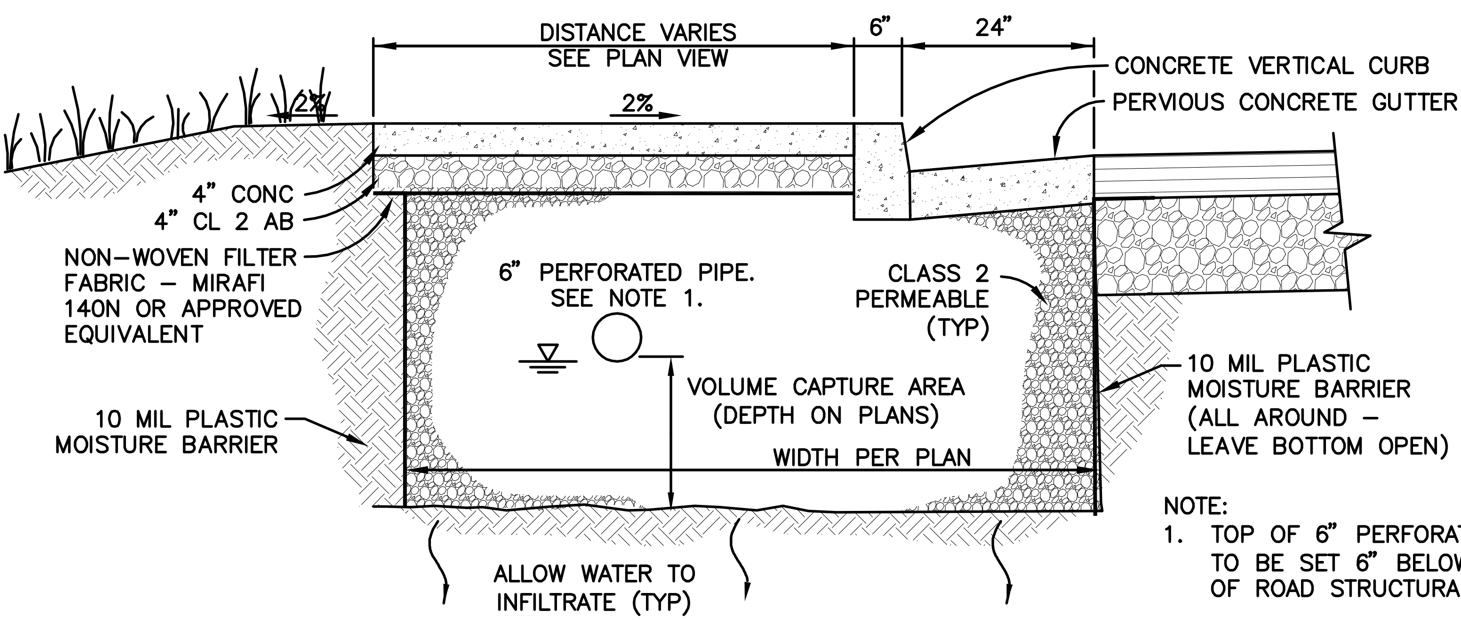
P =	0.0		as a decimal
D =	0.0	ft	Below perforated pipe if present
W =	0.0	ft	
L =	0.0	ft	

Solution:

Percent of Requirement Achieved = **#DIV/0!** % = #DIV/0!

377

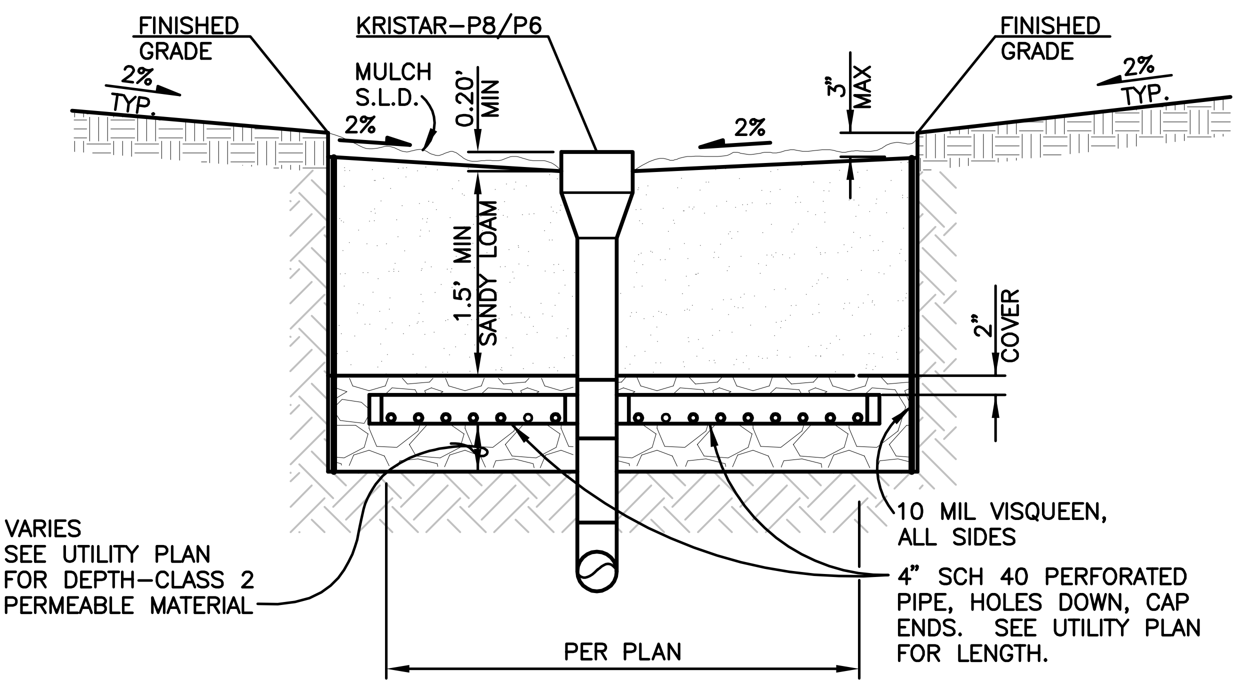
INSTRUCTIONS:
The Delta Volume Capture sizing tool helps the designer appropriately size a LID BMP to achieve the design requirement of the delta volume capture. Enter the percent of porosity of the specified soil and depth below perforated pipe (if present). The width and length entries will need to be interactively adjusted until "Percent of Requirement achieved" reaches 100%.



NOTE:
1. TOP OF 6" PERFORATED PIPE TO BE SET 6" BELOW BOTTOM OF ROAD STRUCTURAL SECTION.

PERVIOUS GUTTER WITH BIORETENTION

NOT TO SCALE

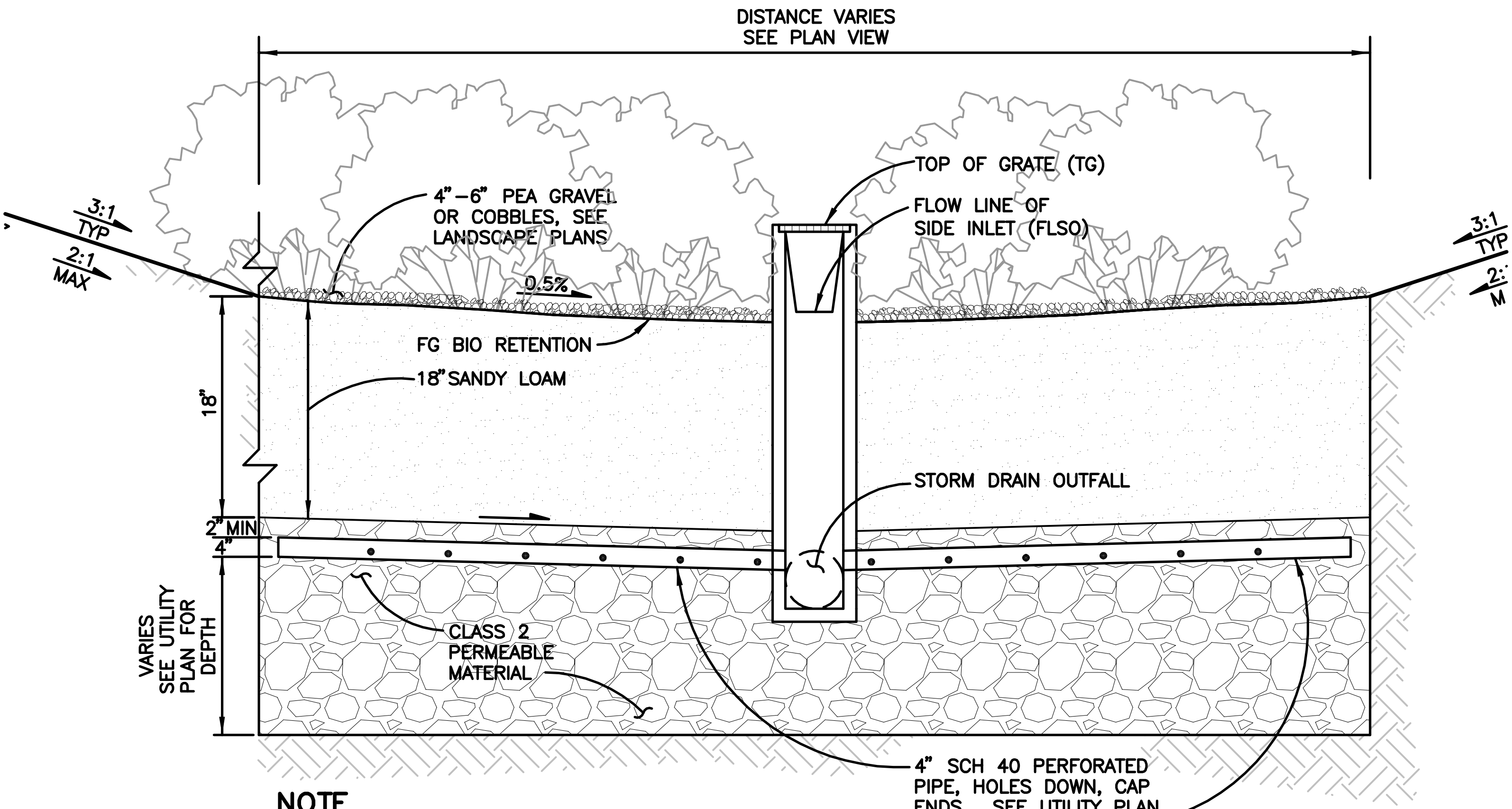


NOTE

SANDY LOAM MIX SHALL HAVE A MINIMUM OF 10"/HOUR INFILTRATION RATE.

BIOINFILTRATION PLANTER TYPE B

NOT TO SCALE



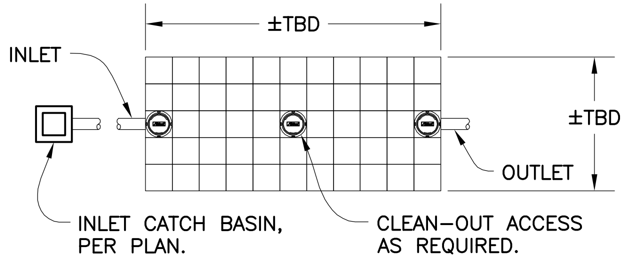
NOTE

SANDY LOAM MIX SHALL HAVE A MINIMUM OF 10"/HOUR INFILTRATION RATE.

BIORETENTION PLANTER TYPE A

NOT TO SCALE

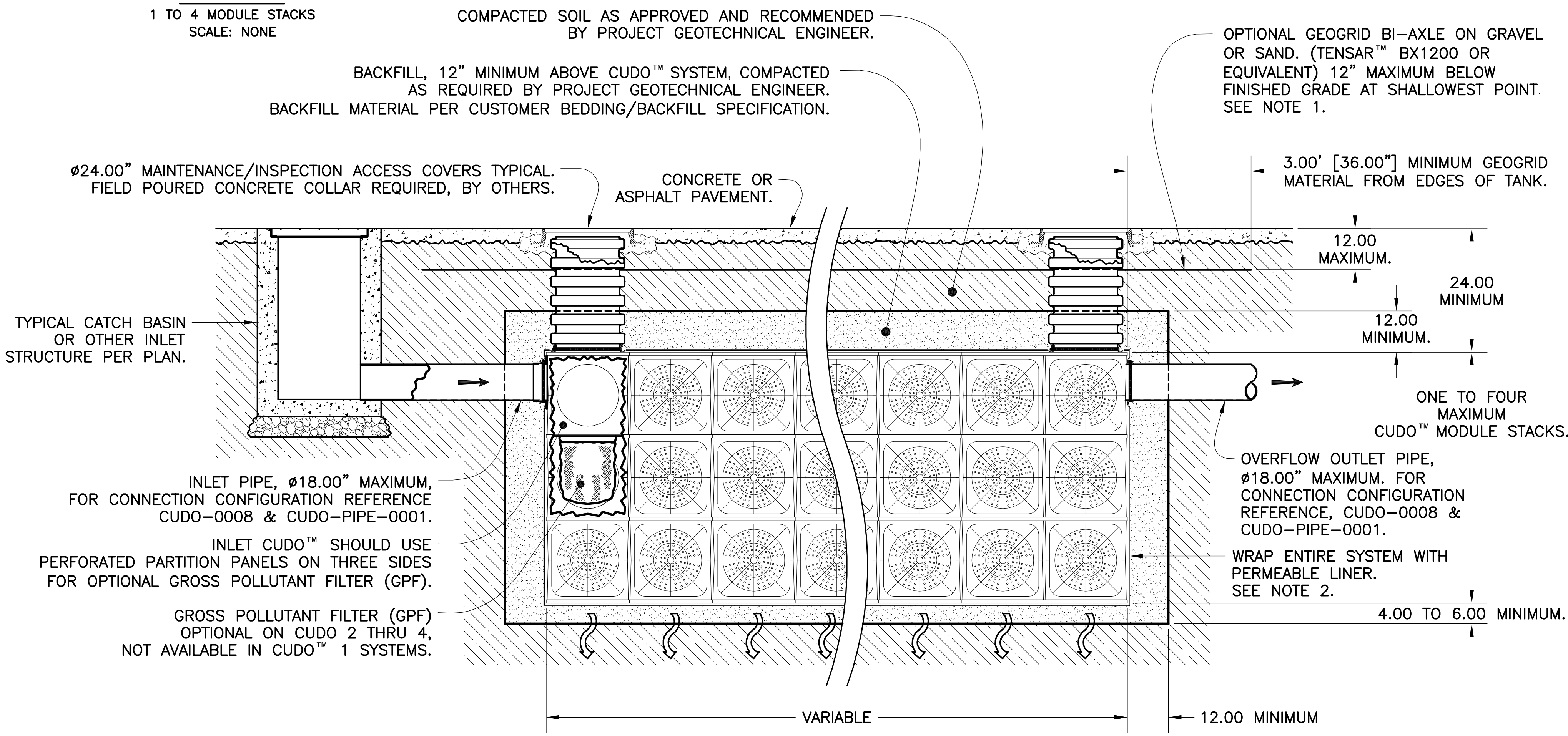
CUDO-IN-0001



PLAN VIEW

1 TO 4 MODULE STACKS

SCALE: NONE



SECTION / CUTAWAY VIEW

SCALE: NONE

NOTES:

1. INSTALL GEOGRID LAYER, (TENSAR™ BX1200 OR EQUIVALENT) IN ACCORDANCE WITH MANUFACTURER RECOMMENDATIONS.

2. SYSTEM ENCASED ENTIRELY WITH NONWOVEN POLYPROPYLENE GEOTEXTILE FILTER FABRIC AS REQUIRED.

3. FIELD POURED CONCRETE COLLAR REQUIRED AROUND ALL ACCESS COVERS & HATCHES, BY OTHERS.

4. ALL EXTERNAL PIPING & ANGLES BY OTHERS. REFER TO PLANS.

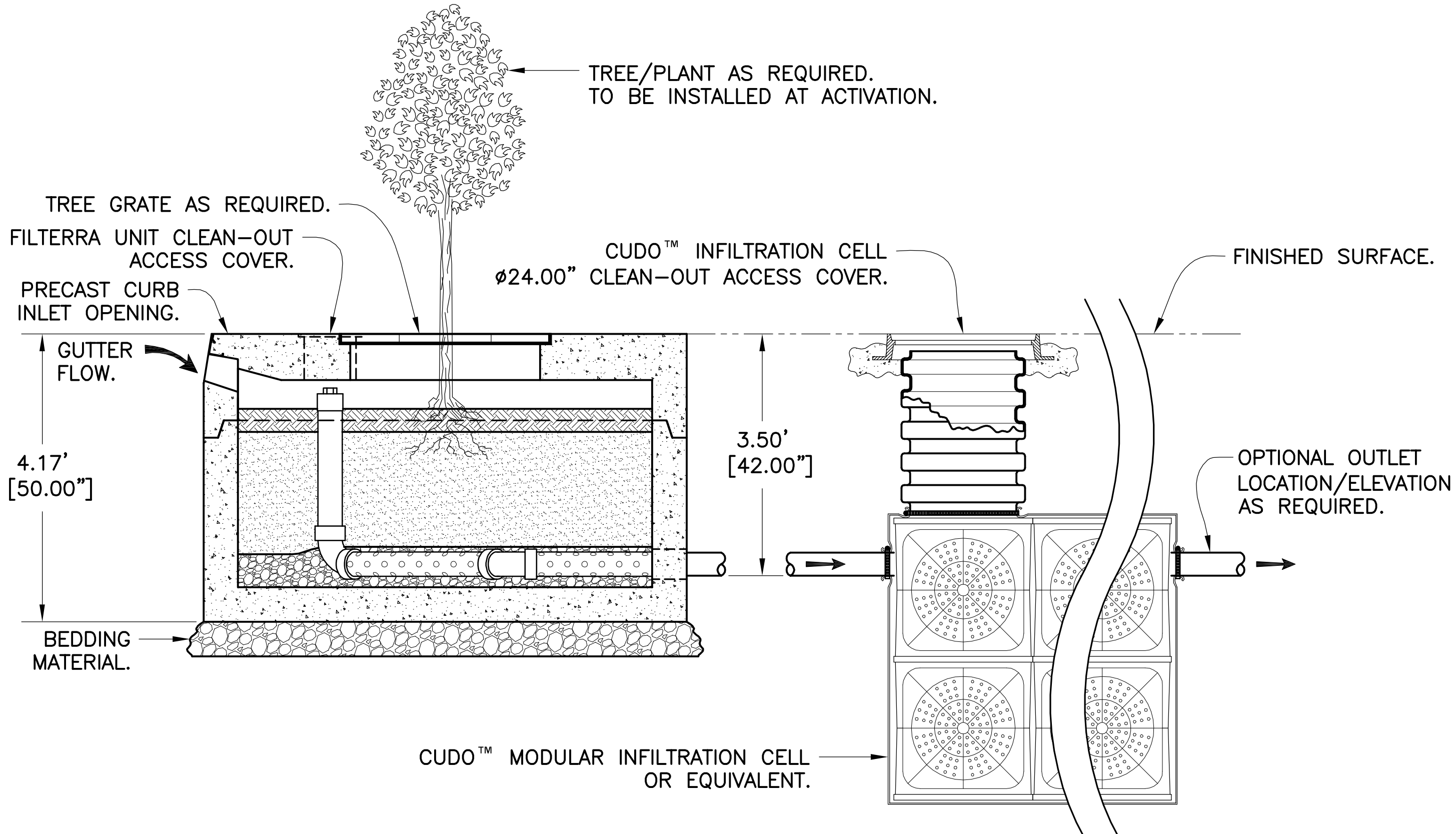
381

KriStar Enterprises, Inc.
360 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

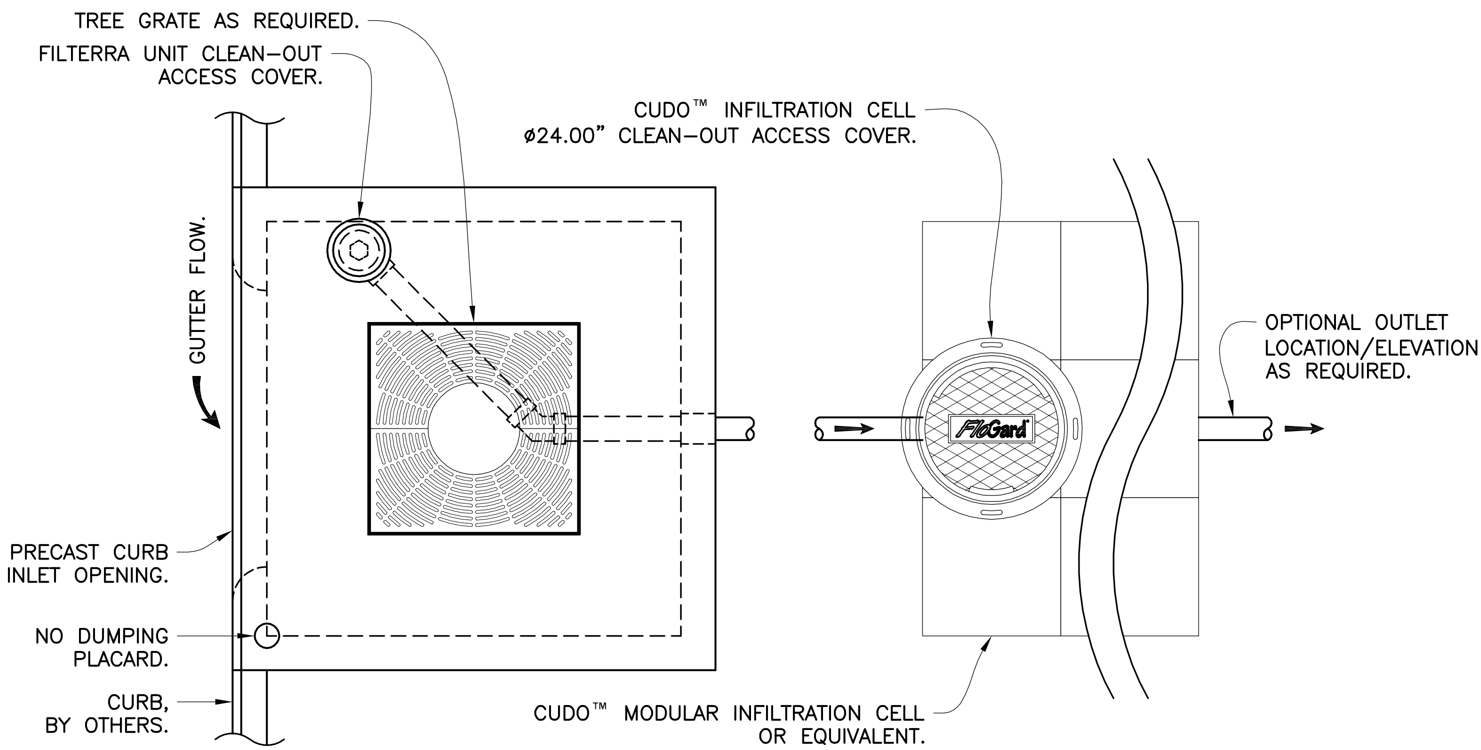
TITLE: CUDO™ Stormwater Infiltration System
Typical Installation Detail
Impermeable Pavement Area

	SCALE:	DRAWN / DATE	CUDO ECO	DRAWING NO.	REV	
DO NOT SCALE DRAWING	NONE	JPR 7/21/08	0005 JPR 3/20/12	CUDO-IN-0001	B	SHEET 1 OF 1

K-FTHYD



SIDE SECTION



PLAN VIEW

MODIFICATION OF DRAWINGS IS PERMITTED ONLY BY WRITTEN AUTHORIZATION FROM KRISTAR ENTERPRISES, INC.

TITLE

Typical Filterra® Hydromodification Configuration

KRISTAR

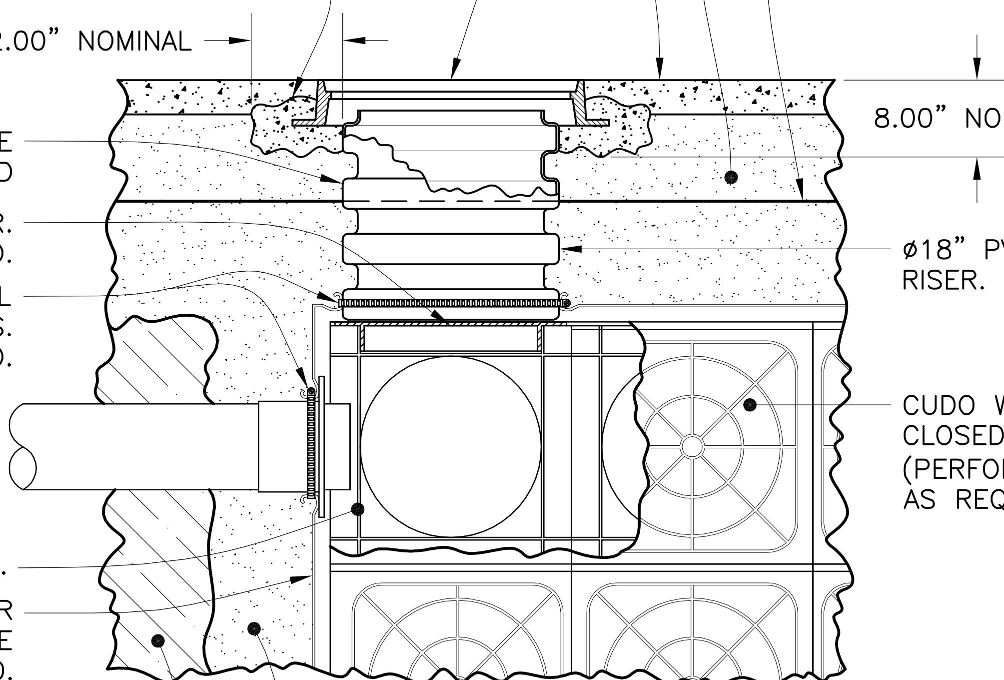
KriStar Enterprises, Inc.

360 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

filterra® US PAT 6,277,274 AND 6,569,321

DRAWING NO.	REV	F-ECO	DATE
K-FTHYD	01	0006 JPR 6/17/11	JPR 6/17/11

CUDO-0008



NOTES:

1. REFER TO CUDO INSTALLATION DETAILS.

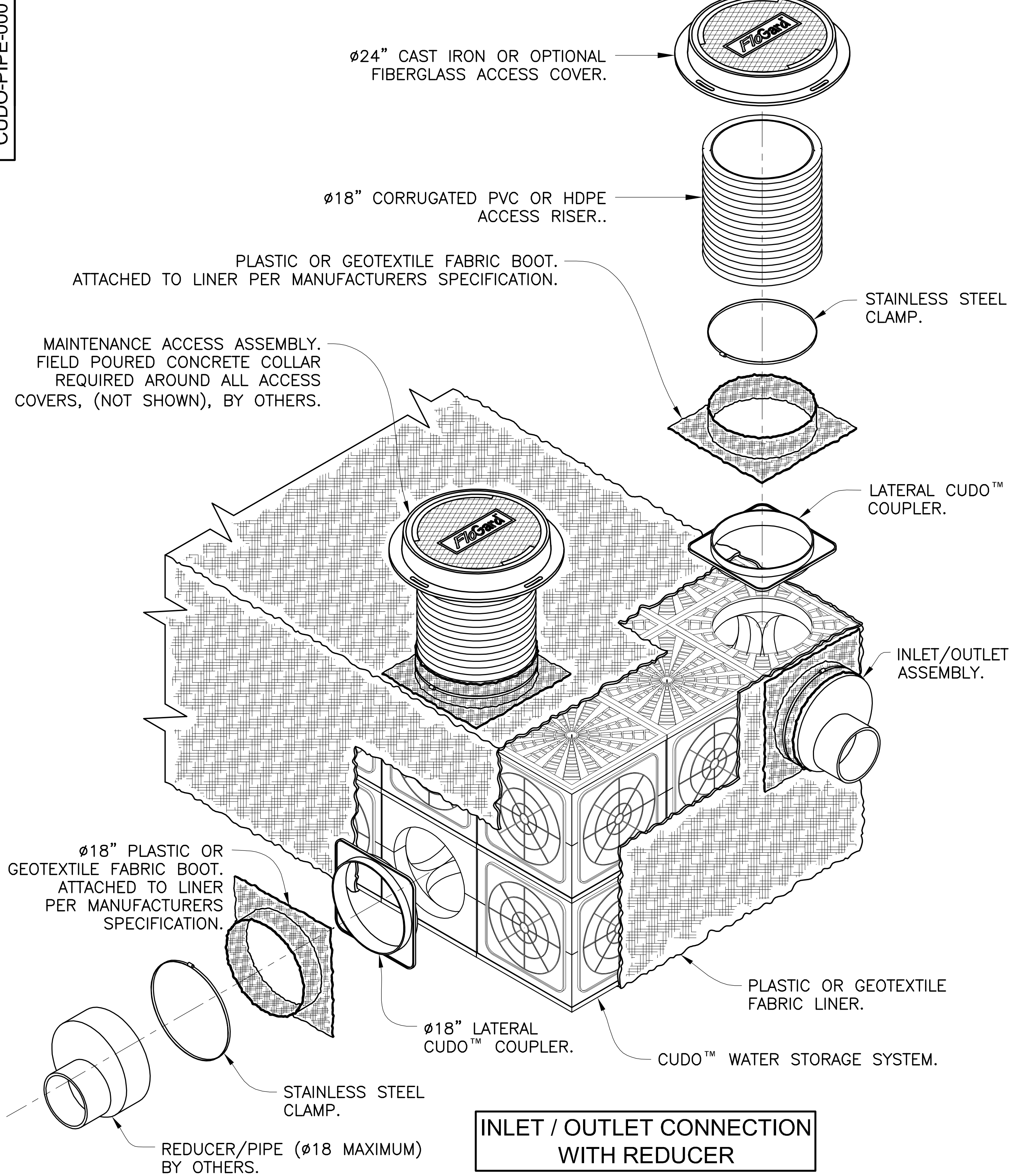
2. INSTALL GEOGRID LAYER, (TENSAR™ BX1200 OR EQUIVALENT) IN ACCORDANCE WITH MANUFACTURER RECOMMENDATIONS IN AREAS SUBJECT TO VEHICLE TRAFFIC,

CUDO™ Water Storage System
TYPICAL MAINTENANCE ACCESS

KriStar Enterprises, Inc.
360 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

DO NOT SCALE DRAWING	SCALE: NONE	DRAWN / DATE JPR 5/2/08	CUDO ECO 0006 JPR 3/26/12	DRAWING NO. CUDO-0008	REV B	SHEET 1 OF 1

CUDO-PIPE-0001



INLET / OUTLET CONNECTION
WITH REDUCER

CUDO™ Water Storage System
Pipe Connection & Maintenance Access
Installation Diagram

KriStar Enterprises, Inc.

360 Sutton Place, Santa Rosa, CA 95407
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

DO NOT SCALE DRAWING	SCALE: NONE	DRAWN / DATE JPR 7/22/09	CUDO ECO 0005 JPR 3/20/12	DRAWING NO. CUDO-PIPE-0001	REV A	384 SHEET 2 OF 2

PLANTER STRIP BIORETENTION- CHECKLIST

Planter Strip Bioretention
Inspection and Maintenance Checklist
(aka: Street Rain Garden, Roadside Bioretention, Bioretention Cell)

Date of Inspection: ____________________________
Inspector(s): ____________________________
BMP ID #:____________________________
Property Owner: ____________________________

Location Description: ____

Type of Inspection: ☐ Pre-rainy Season (PRS) ☐ Rainy Season (RS) ☐ After-rainy Season (ARS)

This Inspection and Maintenance Checklist is to be used in conjunction with its corresponding LID Factsheet and Maintenance Plan. Please review these documents before performing the field inspection.

Inspection Category	When to Inspect	Maintenance Issue	Is the Issue Present?	Require Maintenance	**Comments** (Describe maintenance completed and if needed maintenance was not conducted, note when it will be done)
Drainage	RS	Is there standing or pooling of water in the Bioretention area after 3 days of dry weather? Is water not draining into catch basin from the overflow pipe during a high intensity storm? *		• Check perforated pipe outlet for obstruction or damage. * • Flush perforated pipe to remove obstructions/sediment. * • Remove and replace the first few inches of topsoil. • Remove soil and inspect perforated pipe. Repair or replace perforated pipe, replace with new soil and regrade.	
	PRS RS ARS	Is there sediment visible in the gutter?		• In dry weather, use a mechanical sweeper or a Vactor truck to clean gutter pan.	
	RS	Is there water flowing in the pervious concrete gutter section during a low intensity storm? *		• In wet weather, use a Vactor truck to clean gutter pan.	

* If perforated pipe is present.

PLANTER STRIP BIORETENTION- CHECKLIST

Inspection Category	When to Inspect	Maintenance Issue	Is the Issue Present?	Require Maintenance	**Comments** (Describe maintenance completed and if needed maintenance was not conducted, note when it will be done)
Erosion	RS ARS	Is there under cutting or washouts along the sidewalks and/or curbs abutting the planter strip?		• Fill in eroded areas and regrade.	
	RS ARS	Is there channelization (gully) forming along the length of the planter area?		• Fill in eroded areas and regrade.	
	RS ARS	Is there accumulation of sediment (sand, dirt, mud) in the planter?		• Remove sediment and check the grading. Add replacement soil and/or mulch.	
	PRS RS ARS	Is the mulch unevenly distributed in the planter area?		• Redistribute and add additional mulch if needed. • Regrade planter area.	
	PRS RS ARS	Are there voids or deep holes present? Is there sediment present in the catch basin and in the overflow pipe?		• Check the perforated pipe for damage.*	
	PRS RS ARS	Is there evidence of animal activity such as holes or dirt mounds from digging or borrowing?		• Repair and fill in damage areas. • Rodent control activities must be in accordance with applicable laws and do not affect any protected species.	

* If perforated pipe is present.

PLANTER STRIP BIORETENTION- CHECKLIST

Inspection Category	When to Inspect	Maintenance Issue	Is the Issue Present?	Require Maintenance	**Comments** (Describe maintenance completed and if needed maintenance was not conducted, note when it will be done)
Vegetation	PRS RS ARS	Is the vegetation clogging the inlet flow areas?		• Trim and/or remove the excess vegetation.	
	PRS RS ARS	Is the mulch distributed evenly throughout the planter area?		• Redistribute and add additional mulch if needed. • Regrade planter area.	
	PRS RS ARS	Are there dead or dry plants/weeds? Is the vegetation over grown?		• Remove dead and/or dry vegetation. Replace as needed. • Remove or trim any vegetation that is causing a visual barrier, trip, and or obstruction hazard.	

PLANTER STRIP BIORETENTION- CHECKLIST

Inspection Category	When to Inspect	Maintenance Issue	Is the Issue Present?	Require Maintenance	**Comments** (Describe maintenance completed and if needed maintenance was not conducted, note when it will be done)
BMP General	PRS RS ARS	Is there debris/trash in the planter area?		• Remove all trash and debris.	
	PRS RS ARS	Is graffiti present?		• Remove all graffiti from the area.	
	PRS RS ARS	Are there missing or disturbed aesthetics features?		• Replace and/or reposition aesthetics features to original placement. • Placement should not disrupt flow characteristics/design.	
	PRS RS ARS	Is the vegetation irrigation functional?		• Repaired broken missing spray/drip emitters. • Reposition and/or adjust to eliminate over spray and/or over watering.	
	PRS RS ARS	Are the aesthetic features firmly secured in placed?		• Repair and/or replace loose or damage features.	
	PRS RS ARS	Check for damage sidewalk, curb, gutter, and catch basin including uplift and settling.		• Remove and replace damaged areas.	

388

CUDO^{TM} Stormwater Cube

(Underground Retention / Detention / Infiltration /
Water Reuse Systems)

Operations and Maintenance Manual

Version 1.01 – July 08, 2009

CUDO™ Stormwater Cube – Modular Stormwater Systems

Description / Basic Function
CUDO™ is a modular stormwater system comprised of a grouping of modular polypropylene or concrete cubes that when constructed form an underground storage area for stormwater. This system can be used for infiltration, retention, detention or water reuse. CUDO™ can help achieve runoff detainment and storage to help attenuate the peak flow to pre-construction levels and can help conform to current Low Impact Development requirements.

Infiltration
The purpose of a CUDO™ infiltration system is to capture stormwater runoff, store the runoff, and then allow it to percolate into the ground via the open space area of the cubes and perforations in the side wall. The system is backfilled with a Class I material defined by ASTM D2321 as a cleaned open graded rock or a Class II permeable sand. The rock or sand provide additional storage capacity but also allow for a percolation interface with the native material. The ground water is "recharged" with this type of system.

Detention
The purpose of a CUDO™ detention system is to capture stormwater runoff, store the runoff, and then allow it to be released at a controlled rate through an appropriately sized orifice control. A detention system helps attenuate the peak flow from the site assuring that pre-development runoff flows are not exceeded as a result of the development. A CUDO™ detention requires the cubes to be encapsulated with an impermeable liner for the polypropylene system or the seams of the concrete system to be sealed with a water proof mastic.

Retention
A CUDO™ retention system is a hybrid system. It is a combination of a detention system and an infiltration system. A retention system is utilized to attenuate peak flow as well as promote groundwater re-charge. A retention system is outfitted with an overflow pipe at the top of the system which allows the system to fill for infiltration but also outlet if the ground is saturated.

Water Reuse
The purpose of a water-reuse CUDO™ system is to capture and store water for future use. The system is constructed in a similar fashion to a detention system but instead of a controlled outlet the system is constructed with an emergency overflow. A water reuse system is a LID device that helps attenuate peak flows as well as conserve water. Water may be reused through an active pump system or passive irrigation.

Inspection/Cleanout Ports
Inspection and cleanout ports are 18-inch diameter vertical risers connected to the uppermost polypropylene CUDO™ cubes or up to 30-inch manhole access connected to the concrete CUDO™. They are used for entrance into the system, or for access to place vacuum truck hoses or water-jetting devices or CCTV equipment. Ports are strategically located near inlet and outlet pipes and in other areas or probable deposition in the system. It is recommended to keep surface level access lids sealed and bolted at all times when the system is in service.

Inlet Bay
Some systems are configured so that pretreatment of the stormwater occurs within the CUDO™ system. In this case the CUDO™ system will house an inlet bay. The inlet bay is separated from the rest of the CUDO™ system by sidewall plugs and is intended to separate gross pollutants, trash and debris and floatables from the CUDO™ system and pre-treatment device. The bay contains its own sump area and unique access ports.

Maintenance Overview for CUDO

State and Local regulations require that stormwater storage systems be maintained and serviced on a recurring basis. The purpose of maintaining a clean and obstruction free CUDO™ system is to ensure the system performs the intended function of the primary design. Trash and debris, floatables, gross pollutants and sediment can build up in the CUDO™ leading to clogging of the native soil interface or blockage of the inlet or outlet pipes. This can cause the system to function improperly by limiting storage volume, limiting the design percolation rates or impeding flow in and out of the system. Downstream and upstream, areas could run the risk of flooding and deleterious environmental impact.

Recommended Frequency of Service

It is recommended that the CUDO™ stormwater systems be serviced on a regularly occurring basis. Ultimately the frequency depends on the amount of runoff, pollutant loading, and interference from trash, debris and gross pollutants as well as proper maintenance of upstream pretreatment devices. However, it is recommended that each installation be inspected at least two times per year to assess service needs.

Recommended Timing of Service

Guidelines for the timing of service are as follows:

1. For areas with a definite rainy season the system should be serviced prior to and following the rainy season.
2. For areas subject to year-round rainfall service should occur on a regularly occurring basis. (A minimum of two times per year.)
3. For areas with winter snow and summer rain the system should be serviced prior to and after the snow season.
4. For installed devices that are subject to dry weather flows only (i.e. wash racks, parking garages, etc…) the unit should be serviced on a regularly occurring basis. (A minimum of two times per year.)

Inspection

An inspection should be performed when the system is new. This allows the owner to establish a baseline condition for comparison to future inspections. Sediment build up can typically be monitored without entering the system. (No confined space entry.) Initial and subsequent inspection data should be recorded and filed for reference. Some regulatory agencies require that the results of the inspections be documented and reported. Inspection reports should comply with regulatory requirements and be submitted as required.

Inspection Procedures

1. Locate the inspection, cleanout and access ports. Inspection and cleanout ports are typically 18-inch diameter. Access ports are typically 24-inch or 30-inch diameter. Pictures should be taken to document the location or a site map should be generated to detail the as-built locations of the ports.
2. Unbolt and remove the access port lids.
3. Insert a measuring device into the opening making note of a point of reference to determine the quantity of sediment and other accumulated material. If access is required to measure, ensure only certified confined space entry personnel having appropriate equipment are allowed to enter the system.
4. In addition, for accessible concrete CUDO™ systems personnel should utilize appropriate confined space entry procedures to enter the system and photograph its condition.
5. Inspect inlet and outlet locations for obstructions. Obstructions should be removed at this time.
6. Inspect the structural components of the system.
7. Fill in the CUDO™ Inspection/Maintenance Data Sheet and send a copy to the regulatory agency if necessary.

Disinfection of Water Reuse System

Periodic disinfection of water held for reuse may be required to abate bacteria and algae growth. This may be done using calcium hypochlorite tablets or by the addition of an ozone generator in a small recirculation system.

Maintenance
Cleanout of the CUDO™ system should be considered if there is sediment buildup of two or more inches at over 50% of the inspection ports. Cleaning shall be performed if sediment buildup is two inches or more over 75% of the system floor. In the event of a spill of a foreign substance, cleanout of the system should be considered.

Maintenance Procedures

1. Locate the inspection, cleanout and access ports. Inspection and cleanout ports are typically 18-inch diameter. Access ports are typically 24-inch or 30-inch diameter. Pictures should be taken to document the location or a site map should be generated to detail the as-built locations of the ports.
2. Unbolt and remove the access port lids.
3. Measure the sediment buildup at each port. If access is required to measure ensure only certified confined space entry personnel having appropriate equipment are allowed to enter the system.
4. A thorough cleaning of the system (inlets, outlets, ports, and inlet bays) shall be performed by either a vacuum truck or by manual methods.
5. Inspect inlet and outlet locations for obstructions. Obstructions should be removed at this time.
6. Inspect the structural components of the system.
7. Fill in the CUDO™ Inspection/Maintenance Data Sheet and send a copy to the regulatory agency if necessary.

Inspection / Maintenance Requirements
Listed below are some recommendations for equipment and training for personnel to inspect and maintain a CUDO™ system.

Personnel – OSHA Confined Space Entry Training is a prerequisite for entrance into a system. In the state of California personnel should be CalOSHA certified.

Equipment – Record Taking (pen, paper, voice recorder)
Proper Clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
Flashlight
Tape Measure
Measuring Stick
Pry Bar
Traffic Control (Flagging, barricades, signage, cones, etc.)
First aid materials
Debris and Contaminant collectors
Debris and Contaminant containers
Vacuum Truck

Disposal of Gross Pollutants, Hydrocarbons, and Sediment
The collected gross pollutants, hydrocarbons, and sediment shall be offloaded from the vacuum truck into DOT approved containers for disposal. Once in the container the maintenance contractor has possession and is responsible for disposal in accordance with local, state and federal agency requirements.

Note: As the generator, the landowner is ultimately responsible for the proper disposal of the collected materials. Because the material likely contains petroleum hydrocarbons, heavy metals, and other harmful pollutants, the materials must be treated as EPA class 2 Hazardous Waste. Proper disposal is required.

Cudo Stormwater Products, Inc.
P.O. Box 497
Occidental, California 95465-0497
Phone: (877) 876-3345
www.cudocube.com

Hydrologic Soil Group—Sonoma County, California

Map Scale: 1:5,980 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 250, 500, 1000, 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sonoma County, California
Survey Area Data: Version 10, Sep 27, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 29, 2015—Jun 3, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Sonoma County, California (CA097)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GlE	Goulding cobbly clay loam, 15 to 30 percent slopes	D	0.2	0.3%
MbC	Manzanita gravelly silt loam, 0 to 9 percent slopes	C	4.7	6.7%
PeC	Pleasanton loam, 2 to 9 percent slopes, MLRA 14	C	8.9	12.9%
PhB	Pleasanton clay loam, 2 to 5 percent slopes	C	11.0	15.8%
RnA	Riverwash		12.1	17.5%
TuE	Tuscan cobbly clay loam, 9 to 30 percent slopes	D	32.4	46.8%
Totals for Area of Interest			**69.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

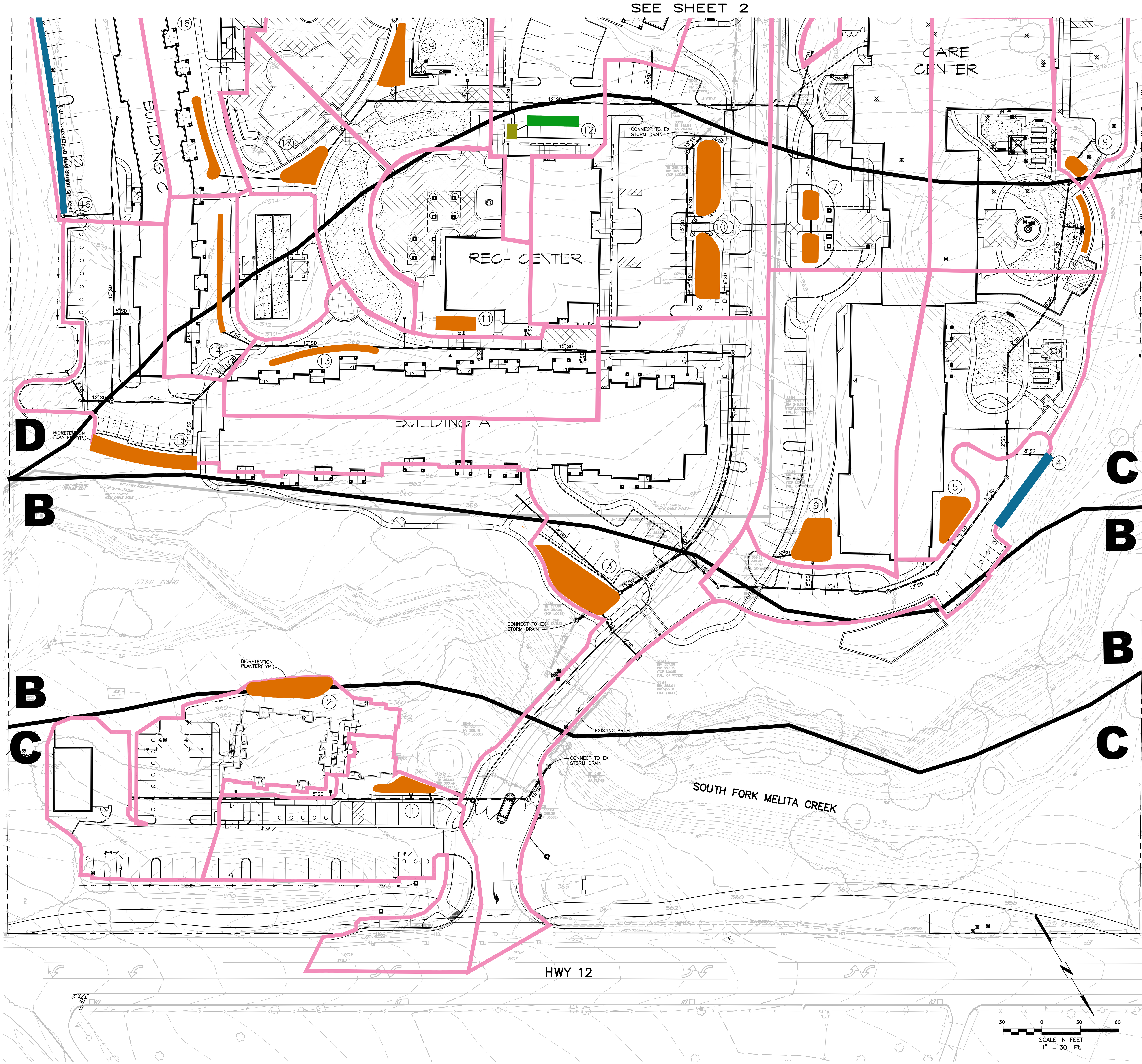
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



DMA AREA #	TOTAL AREA (sf)	CN POST	C POST	PROPOSED BMP TYPE	PROPOSED BMP SIZE
1	20,850	94.2	0.60	BIORETENTION TYPE A	600 SF OF SURFACE AREA, 4.3' BELOW SUBDRAIN
2	24,049	93.7	0.59	BIORETENTION TYPE A	900 SF OF SURFACE AREA, 3.2' BELOW SUBDRAIN
3	48,548	93.6	0.59	BIORETENTION TYPE A	1,555 SF OF SURFACE AREA, 3.7' BELOW SUBDRAIN
4	12,728	96.3	0.66	PERVIOUS GUTTER WITH BIORETENTION	485 SF OF SURFACE AREA, 4.0' BELOW SUBDRAIN
5	22,393	85.1	0.38	BIORETENTION TYPE A	595 SF OF SURFACE AREA, 1.9' BELOW SUBDRAIN
6	25,625	90.4	0.51	BIORETENTION TYPE A	880 SF OF SURFACE AREA, 2.5' BELOW SUBDRAIN
7	25,490	93.1	0.58	BIORETENTION TYPE A	625 SF OF SURFACE AREA, 4.4' BELOW SUBDRAIN
8	21,834	88.7	0.47	BIORETENTION TYPE A	324 SF OF SURFACE AREA, 5.0' BELOW SUBDRAIN
9	8,414	92.1	0.50	BIORETENTION TYPE A	205 SF OF SURFACE AREA, 4.2' BELOW SUBDRAIN
10	39,220	91.5	0.54	BIORETENTION TYPE A	1,913 SF OF SURFACE AREA, 2.0' BELOW SUBDRAIN
11	14,350	90.8	0.52	BIORETENTION TYPE A	340 SF OF SURFACE AREA, 3.8' BELOW SUBDRAIN
12	26,208	91.9	0.55	TREEPOD WITH UNDERGROUND RETENTION	8'X40'X5.5' DEEP UNDERGROUND RETENTION
13	19,862	91.5	0.54	BIORETENTION TYPE A	451 SF OF SURFACE AREA, 4.2' BELOW SUBDRAIN
14	8,121	87.4	0.43	BIORETENTION TYPE A	370 SF OF SURFACE AREA, 1.4' BELOW SUBDRAIN
15	24,620	93.6	0.59	BIORETENTION TYPE A	950 SF OF SURFACE AREA, 3.1' BELOW SUBDRAIN
16	24,684	92.8	0.53	PERVIOUS GUTTER WITH BIORETENTION	745 SF OF SURFACE AREA, 3.6' BELOW SUBDRAIN
17	13,521	88.4	0.38	BIORETENTION TYPE A	620 SF OF SURFACE AREA, 1.5' BELOW SUBDRAIN
18	12,302	90.8	0.46	BIORETENTION TYPE A	420 SF OF SURFACE AREA, 2.6' BELOW SUBDRAIN
19	20,821	87.8	0.36	BIORETENTION TYPE A	650 SF OF SURFACE AREA, 2.1' BELOW SUBDRAIN
20	15,006	90.8	0.46	BIORETENTION TYPE A	27.4 SF OF SURFACE AREA, 1.8' BELOW SUBDRAIN
21	7,804	98	0.70	PERVIOUS GUTTER WITH BIORETENTION	590 SF OF SURFACE AREA, 2.4' BELOW SUBDRAIN
22	43,427	87.3	0.34	BIORETENTION TYPE A	1,273 SF OF SURFACE AREA, 2.2' BELOW SUBDRAIN
23	23,920	95.6	0.62	PERVIOUS GUTTER WITH BIORETENTION	1,128 SF OF SURFACE AREA, 3.1 BELOW SUBDRAIN
24	34,991	92.9	0.53	PERVIOUS GUTTER WITH BIORETENTION	1,370 SF OF SURFACE AREA, 2.8 BELOW SUBDRAIN
25	33,215	90.6	0.45	BIORETENTION TYPE A	700 SF OF SURFACE AREA, 4.1 BELOW SUBDRAIN
26	51,446	92.0	0.50	BIORETENTION TYPE A	1,035 SF OF SURFACE AREA, 5.0 BELOW SUBDRAIN
27	39,558	90.5	0.45	BIORETENTION TYPE A	970 SF OF SURFACE AREA, 3.5 BELOW SUBDRAIN
28	33,681	89.3	0.41	BIORETENTION TYPE A	650 SF OF SURFACE AREA, 4.0 BELOW SUBDRAIN
29	22,085	96.0	0.63	BIORETENTION TYPE A	750 SF OF SURFACE AREA, 4.4 BELOW SUBDRAIN
30	25,456	93.6	0.55	BIORETENTION TYPE A	761 SF OF SURFACE AREA, 4.0 BELOW SUBDRAIN
31	14,563	93.2	0.54	PERVIOUS GUTTER WITH BIORETENTION	440 SF OF SURFACE AREA, 3.8 BELOW SUBDRAIN
32	7,361	94.6	0.59	BIORETENTION TYPE A	550 SF OF SURFACE AREA, 1.7 BELOW SUBDRAIN
33	7,412	93.8	0.63	PERVIOUS GUTTER WITH BIORETENTION	488 SF OF SURFACE AREA, 1.9 BELOW SUBDRAIN
34	30,425	95.4	0.61	PERVIOUS GUTTER WITH BIORETENTION	1,540 SF OF SURFACE AREA, 2.8 BELOW SUBDRAIN
35	44,444	94.8	0.60	PERVIOUS GUTTER WITH BIORETENTION	2,786 SF OF SURFACE AREA, 2.1 BELOW SUBDRAIN
36	45,025	92.8	0.53	PERVIOUS GUTTER WITH BIORETENTION	2,117 SF OF SURFACE AREA, 2.1 BELOW SUBDRAIN
37	24,028	93.8	0.56	PERVIOUS GUTTER WITH BIORETENTION	1,105 SF OF SURFACE AREA, 2.6 BELOW SUBDRAIN
38	22,242	98	0.70	PERVIOUS GUTTER WITH BIORETENTION	1,450 SF OF SURFACE AREA, 2.8 BELOW SUBDRAIN
39	6,898	98	0.70	PERVIOUS GUTTER WITH BIORETENTION	540 SF OF SURFACE AREA, 2.3 BELOW SUBDRAIN
40	35,086	94.6	0.59	TREEPOD WITH UNDERGROUND RETENTION	8'X66'X5.5' DEEP UNDERGROUND RETENTION
41	43,274	91.5	0.60	PERVIOUS GUTTER WITH BIORETENTION	1,670 SF OF SURFACE AREA, 2.5 BELOW SUBDRAIN
42	19,141	77.70	0.37	BIORETENTION TYPE A	670 SF OF SURFACE AREA, 1.0 BELOW SUBDRAIN
43	12,492	91.0	0.59	BIORETENTION TYPE A	340 SF OF SURFACE AREA, 3.4' BELOW SUBDRAIN
44	27,597	93.5	0.59	TREEPOD WITH UNDERGROUND RETENTION	8'X46'X5.5' DEEP UNDERGROUND RETENTION
45	18,988	92.2	0.56	PERVIOUS GUTTER WITH BIORETENTION	550 SF OF SURFACE AREA, 3.6' BELOW SUBDRAIN
46	24,447	92.3	0.61	BIORETENTION TYPE A	695 SF OF SURFACE AREA, 3.7' BELOW SUBDRAIN
47	14,334	85.6	0.50	BIORETENTION TYPE A	250 SF OF SURFACE AREA, 3.0' BELOW SUBDRAIN
48	19,963	92.2	0.56	PERVIOUS GUTTER WITH BIORETENTION	720 SF OF SURFACE AREA, 2.9' BELOW SUBDRAIN
49	4,087	92.2	0.56	TREEPOD WITH UNDERGROUND RETENTION	4'X12'X5.5' DEEP UNDERGROUND RETENTION
50	46,173	94.5	0.61	TREEPOD WITH UNDERGROUND RETENTION	10'X68'X5.5' DEEP UNDERGROUND RETENTION
51	11,547	92.1	0.50	PERVIOUS GUTTER WITH BIORETENTION	600 SF OF SURFACE AREA, 2.0' BELOW SUBDRAIN
52	21,864	93.6	0.55	PERVIOUS GUTTER WITH BIORETENTION	750 SF OF SURFACE AREA, 3.4' BELOW SUBDRAIN
53	30,741	98.0	0.50	PERVIOUS GUTTER WITH BIORETENTION	1,400 SF OF SURFACE AREA, 4.0' BELOW SUBDRAIN
54	17,291	92.3	0.61	PERVIOUS GUTTER WITH BIORETENTION	740 SF OF SURFACE AREA, 2.4' BELOW SUBDRAIN
55	23,221	86.8	0.52	BIORETENTION TYPE A	780 SF OF SURFACE AREA, 1.8' BELOW SUBDRAIN
56	21,403	95.3	0.66	BIORETENTION TYPE A/PERVIOUS GUTTER WITH BIORETENTION	800 SF OF SURFACE AREA, 3.7' BELOW SUBDRAIN
57	19,564	88.7	0.47	BIORETENTION TYPE A	1,090 SF OF SURFACE AREA, 1.3' BELOW SUBDRAIN
58	28,421	94.3	0.61	PERVIOUS GUTTER WITH BIORETENTION	1,074 SF OF SURFACE AREA, 3.4' BELOW SUBDRAIN
59	6,611	95.3	0.66	PERVIOUS GUTTER WITH BIORETENTION	441 SF OF SURFACE AREA, 2.1' BELOW SUBDRAIN
60	2700	98.0	0.70	BIORETENTION TYPE B	100 SF OF SURFACE AREA, 4.9' BELOW SUBDRAIN

Brelje & Race
CONSULTING ENGINEERS
475 Aviation Boulevard, Suite 120
Santa Rosa, CA 95403
v: 707-576-1322
f: 707-576-0469
www.brce.com

ELNOKA CCRC
DESIGN REVIEW

251 ELNOKA LANE
SANTA ROSA, CALIFORNIA

LEGEND

- DMA BOUNDARY
- PERVIOUS GUTTER WITH BIORETENTION
- BIORETENTION PLANTER TYPE A
- BIORETENTION PLANTER TYPE B
- TREEPOD BIORETENTION STRUCTURE
- UNDEGROUND STORMWATER RETENTION STRUCTURE
- APPROXIMATE SOIL TYPE BOUNDARY
- C SOIL TYPE REFERENCE
- 4 DMA AREA LABEL

DATE

REVISIONS

NO.	DATE	DESCRIPTION

ON A FULL-SCALE DRAWING, LENGTH OF BAR BELOW IS 1-INCH. IF BAR MEASURES LESS THAN 1-INCH, THIS SHEET WAS PLOTTED AT A REDUCED SCALE, WHICH MAY REQUIRE ADJUSTMENT OF SCALE(S) SHOWN ON DRAWING.

PROJECT	DATE
–	–
DRAWN BY	CHECKED BY
PIT	–

LID PLAN
AND
DETAILS

SHEET NO.
1 OF 6

Brelje & Race
CONSULTING ENGINEERS
475 Aviation Boulevard, Suite 120
Santa Rosa, CA 95403
v: 707-576-1322
f: 707-576-0469
www.brce.com

ELNOKA CCRC DESIGN REVIEW

251 ELNOKA LANE
SANTA ROSA, CALIFORNIA

LEGEND

- DMA BOUNDARY
- PERVIOUS GUTTER WITH BIORETENTION
- BIORETENTION PLANTER TYPE A
- BIORETENTION PLANTER TYPE B
- TREEPOD BIORETENTION STRUCTURE
- UNDEGROUND STORMWATER RETENTION STRUCTURE
- APPROXIMATE SOIL TYPE BOUNDARY
- C SOIL TYPE REFERENCE
- 4 DMA AREA LABEL

DATE

REVISIONS

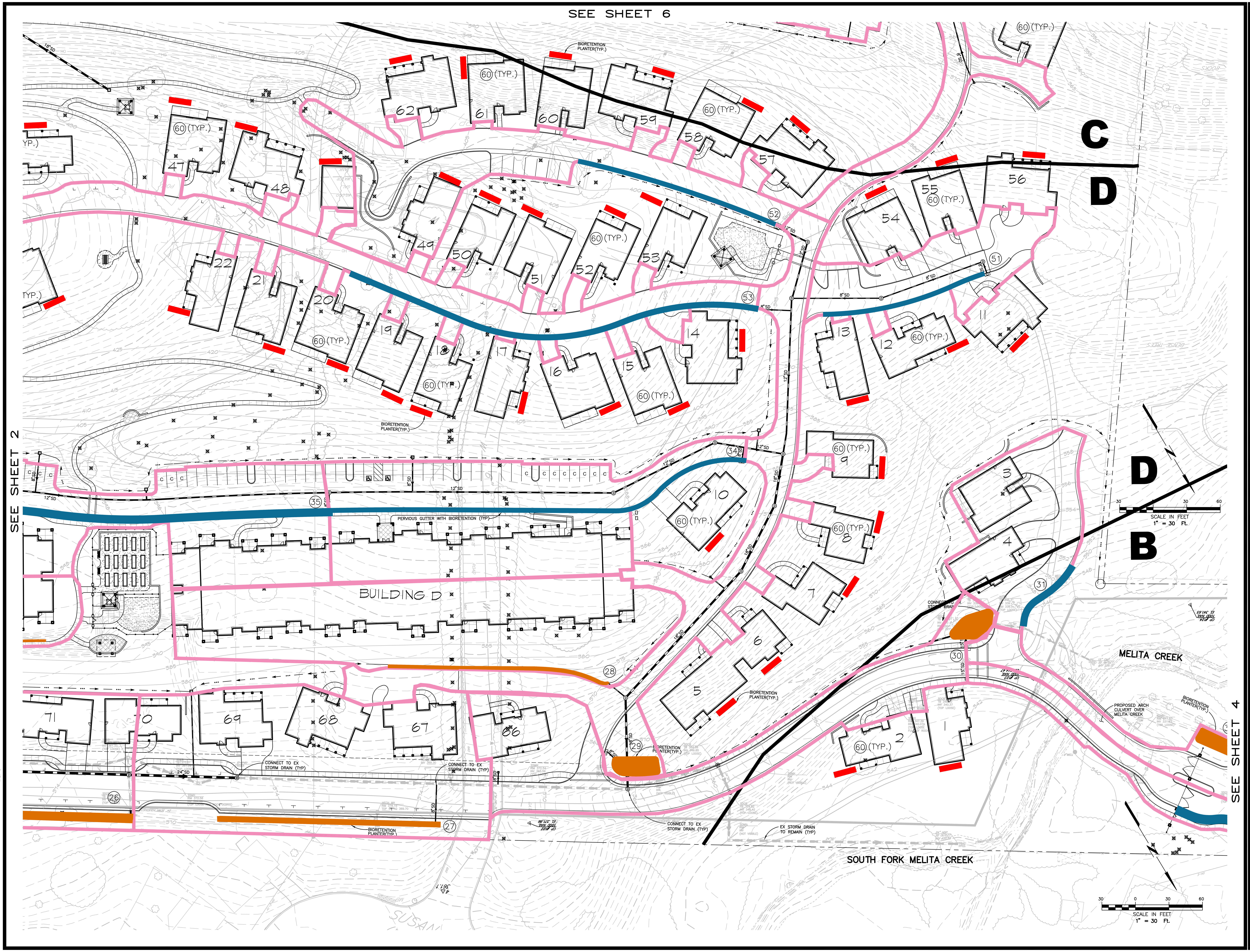
NO.	DATE	DESCRIPTION

ON A FULL-SCALE DRAWING, LENGTH OF BAR BELOW IS 1-INCH. IF BAR MEASURES LESS THAN 1-INCH, THIS SHEET WAS PLOTTED AT A REDUCED SCALE, WHICH MAY REQUIRE ADJUSTMENT OF SCALE(S) SHOWN ON DRAWING.

PROJECT	DATE
–	–
DRAWN BY	CHECKED BY
PIT	–

LID PLAN

SHEET NO.
2 OF 6



Brelje & Race
CONSULTING ENGINEERS
475 Aviation Boulevard, Suite 120
Santa Rosa, CA 95403
v: 707-576-1322
f: 707-576-0469
www.brce.com

ELNOKA CCRC
DESIGN REVIEW

251 ELNOKA LANE
SANTA ROSA, CALIFORNIA

LEGEND

- DMA BOUNDARY
- PERVIOUS GUTTER WITH BIORETENTION
- BIORETENTION PLANTER TYPE A
- BIORETENTION PLANTER TYPE B
- TREEPOD BIORETENTION STRUCTURE
- UNDERGROUND STORMWATER RETENTION STRUCTURE
- APPROXIMATE SOIL TYPE BOUNDARY
- C SOIL TYPE REFERENCE
- 4 DMA AREA LABEL

DATE

REVISIONS

NO.	DATE	DESCRIPTION

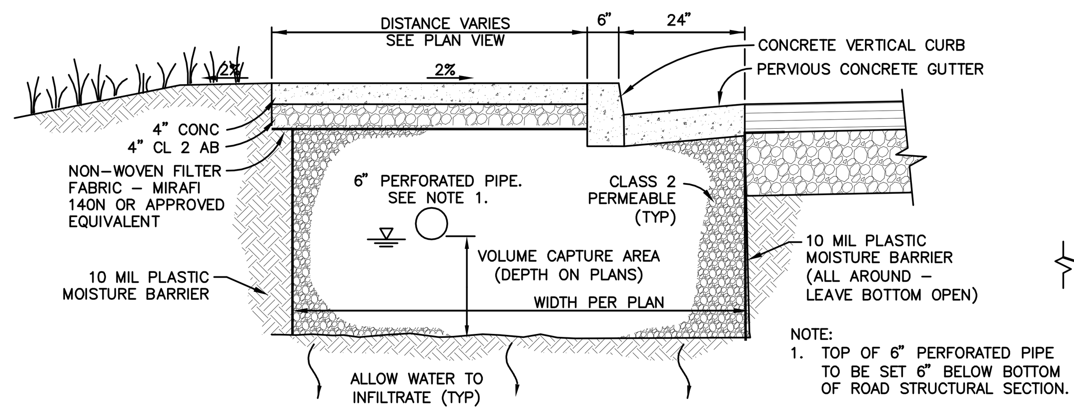
ON A FULL-SCALE DRAWING, LENGTH OF BAR BELOW IS 1-INCH. IF BAR MEASURES LESS THAN 1-INCH, THIS SHEET WAS PLOTTED AT A REDUCED SCALE, WHICH MAY REQUIRE ADJUSTMENT OF SCALE(S) SHOWN ON DRAWING.

PROJECT	DATE
–	–
DRAWN BY	CHECKED BY
PIT	–

LID PLAN

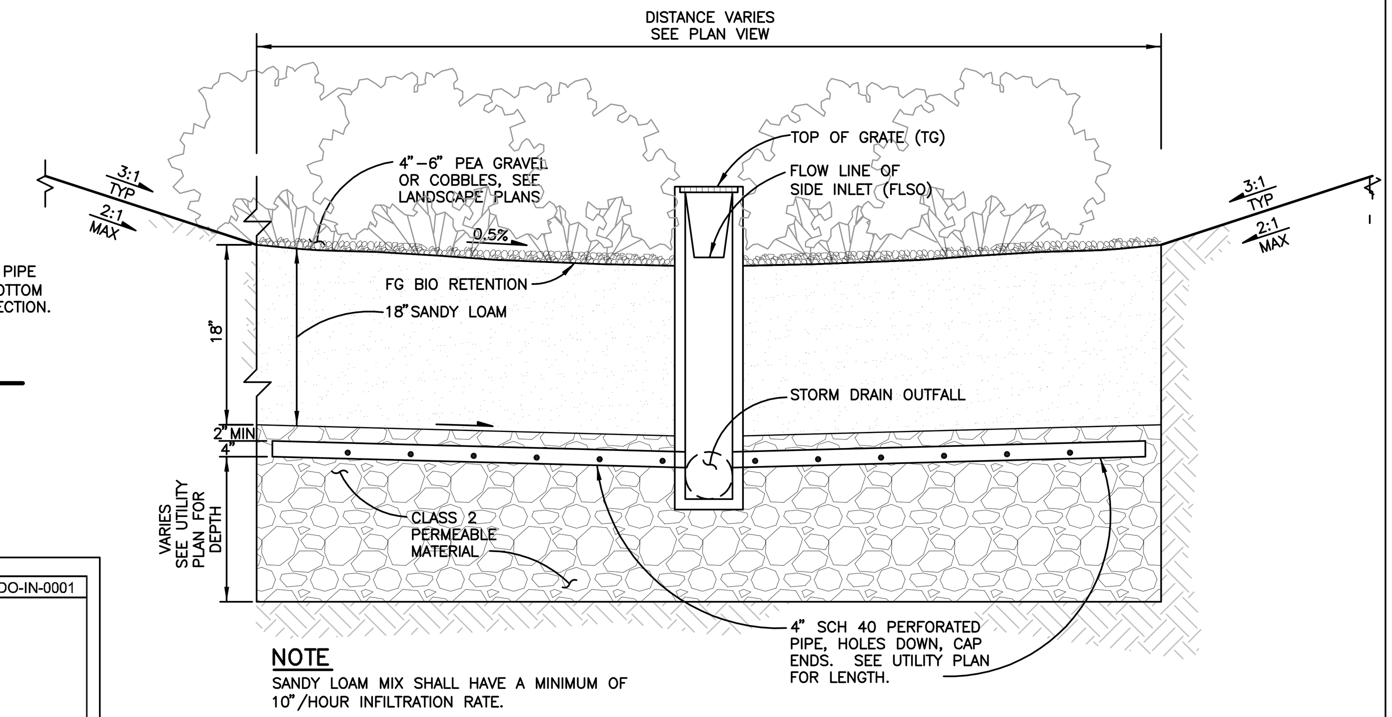
SHEET NO.
3 OF 6

DMA AREA #	TOTAL AREA (sf)	CN POST	C POST	PROPOSED BMP TYPE	PROPOSED BMP SIZE
1	20,850	94.2	0.60	BIORETENTION TYPE A	600 SF OF SURFACE AREA, 4.3' BELOW SUBDRAIN
2	24,049	93.7	0.59	BIORETENTION TYPE A	900 SF OF SURFACE AREA, 3.2' BELOW SUBDRAIN
3	48,548	93.6	0.59	BIORETENTION TYPE A	1,555 SF OF SURFACE AREA, 3.7' BELOW SUBDRAIN
4	12,728	96.3	0.66	PERVIOUS GUTTER WITH BIORETENTION	485 SF OF SURFACE AREA, 4.0' BELOW SUBDRAIN
5	22,393	85.1	0.38	BIORETENTION TYPE A	595 SF OF SURFACE AREA, 1.9' BELOW SUBDRAIN
6	25,625	90.4	0.51	BIORETENTION TYPE A	880 SF OF SURFACE AREA, 2.5' BELOW SUBDRAIN
7	25,490	93.1	0.58	BIORETENTION TYPE A	625 SF OF SURFACE AREA, 4.4' BELOW SUBDRAIN
8	21,834	88.7	0.47	BIORETENTION TYPE A	324 SF OF SURFACE AREA, 5.0' BELOW SUBDRAIN
9	8,414	92.1	0.50	BIORETENTION TYPE A	205 SF OF SURFACE AREA, 4.2' BELOW SUBDRAIN
10	39,220	91.5	0.54	BIORETENTION TYPE A	1,913 SF OF SURFACE AREA, 2.0' BELOW SUBDRAIN
11	14,350	90.8	0.52	BIORETENTION TYPE A	340 SF OF SURFACE AREA, 3.8' BELOW SUBDRAIN
12	26,208	91.9	0.55	TREEPOD WITH UNDERGROUND RETENTION	8'X40'X5.5' DEEP UNDERGROUND RETENTION
13	19,862	91.5	0.54	BIORETENTION TYPE A	451 SF OF SURFACE AREA, 4.2' BELOW SUBDRAIN
14	8,121	87.4	0.43	BIORETENTION TYPE A	370 SF OF SURFACE AREA, 1.4' BELOW SUBDRAIN
15	24,620	93.6	0.59	BIORETENTION TYPE A	950 SF OF SURFACE AREA, 3.1' BELOW SUBDRAIN
16	24,684	92.8	0.53	PERVIOUS GUTTER WITH BIORETENTION	745 SF OF SURFACE AREA, 3.6' BELOW SUBDRAIN
17	13,521	88.4	0.38	BIORETENTION TYPE A	620 SF OF SURFACE AREA, 1.5' BELOW SUBDRAIN
18	12,302	90.8	0.46	BIORETENTION TYPE A	420 SF OF SURFACE AREA, 2.6' BELOW SUBDRAIN
19	20,821	87.8	0.36	BIORETENTION TYPE A	650 SF OF SURFACE AREA, 2.1' BELOW SUBDRAIN
20	15,006	90.8	0.46	BIORETENTION TYPE A	27.4 SF OF SURFACE AREA, 1.8' BELOW SUBDRAIN
21	7,804	98	0.70	PERVIOUS GUTTER WITH BIORETENTION	590 SF OF SURFACE AREA, 2.4' BELOW SUBDRAIN
22	43,427	87.3	0.34	BIORETENTION TYPE A	1,273 SF OF SURFACE AREA, 2.2' BELOW SUBDRAIN
23	23,920	95.6	0.62	PERVIOUS GUTTER WITH BIORETENTION	1,128 SF OF SURFACE AREA, 3.1 BELOW SUBDRAIN
24	34,991	92.9	0.53	PERVIOUS GUTTER WITH BIORETENTION	1,370 SF OF SURFACE AREA, 2.8 BELOW SUBDRAIN
25	33,215	90.6	0.45	BIORETENTION TYPE A	700 SF OF SURFACE AREA, 4.1 BELOW SUBDRAIN
26	51,446	92.0	0.50	BIORETENTION TYPE A	1,035 SF OF SURFACE AREA, 5.0 BELOW SUBDRAIN
27	39,558	90.5	0.45	BIORETENTION TYPE A	970 SF OF SURFACE AREA, 3.5 BELOW SUBDRAIN
28	33,681	89.3	0.41	BIORETENTION TYPE A	650 SF OF SURFACE AREA, 4.0 BELOW SUBDRAIN
29	22,085	96.0	0.63	BIORETENTION TYPE A	750 SF OF SURFACE AREA, 4.4 BELOW SUBDRAIN
30	25,456	93.6	0.55	BIORETENTION TYPE A	761 SF OF SURFACE AREA, 4.0 BELOW SUBDRAIN
31	14,563	93.2	0.54	PERVIOUS GUTTER WITH BIORETENTION	440 SF OF SURFACE AREA, 3.8 BELOW SUBDRAIN
32	7,361	94.6	0.59	BIORETENTION TYPE A	550 SF OF SURFACE AREA, 1.7 BELOW SUBDRAIN
33	7,412	93.8	0.63	PERVIOUS GUTTER WITH BIORETENTION	488 SF OF SURFACE AREA, 1.9 BELOW SUBDRAIN
34	30,425	95.4	0.61	PERVIOUS GUTTER WITH BIORETENTION	1,540 SF OF SURFACE AREA, 2.8 BELOW SUBDRAIN
35	44,444	94.8	0.60	PERVIOUS GUTTER WITH BIORETENTION	2,786 SF OF SURFACE AREA, 2.1 BELOW SUBDRAIN
36	45,025	92.8	0.53	PERVIOUS GUTTER WITH BIORETENTION	2,117 SF OF SURFACE AREA, 2.1 BELOW SUBDRAIN
37	24,028	93.8	0.56	PERVIOUS GUTTER WITH BIORETENTION	1,105 SF OF SURFACE AREA, 2.6 BELOW SUBDRAIN
38	22,242	98	0.70	PERVIOUS GUTTER WITH BIORETENTION	1,450 SF OF SURFACE AREA, 2.8 BELOW SUBDRAIN
39	6,898	98	0.70	PERVIOUS GUTTER WITH BIORETENTION	540 SF OF SURFACE AREA, 2.3 BELOW SUBDRAIN
40	35,086	94.6	0.59	TREEPOD WITH UNDERGROUND RETENTION	8'X66'X5.5' DEEP UNDERGROUND RETENTION
41	43,274	91.5	0.60	PERVIOUS GUTTER WITH BIORETENTION	1,670 SF OF SURFACE AREA, 2.5 BELOW SUBDRAIN
42	19,141	77.70	0.37	BIORETENTION TYPE A	670 SF OF SURFACE AREA, 1.0 BELOW SUBDRAIN
43	12,492	91.0	0.59	BIORETENTION TYPE A	340 SF OF SURFACE AREA, 3.4' BELOW SUBDRAIN
44	27,597	93.5	0.59	TREEPOD WITH UNDERGROUND RETENTION	8'X46'X5.5' DEEP UNDERGROUND RETENTION
45	18,988	92.2	0.56	PERVIOUS GUTTER WITH BIORETENTION	550 SF OF SURFACE AREA, 3.6' BELOW SUBDRAIN
46	24,447	92.3	0.61	BIORETENTION TYPE A	695 SF OF SURFACE AREA, 3.7' BELOW SUBDRAIN
47	14,334	85.6	0.50	BIORETENTION TYPE A	250 SF OF SURFACE AREA, 3.0' BELOW SUBDRAIN
48	19,963	92.2	0.56	PERVIOUS GUTTER WITH BIORETENTION	720 SF OF SURFACE AREA, 2.9' BELOW SUBDRAIN
49	4,087	92.2	0.56	TREEPOD WITH UNDERGROUND RETENTION	4'X12'X5.5' DEEP UNDERGROUND RETENTION
50	46,173	94.5	0.61	TREEPOD WITH UNDERGROUND RETENTION	10'X68'X5.5' DEEP UNDERGROUND RETENTION
51	11,547	92.1	0.50	PERVIOUS GUTTER WITH BIORETENTION	600 SF OF SURFACE AREA, 2.0' BELOW SUBDRAIN
52	21,864	93.6	0.55	PERVIOUS GUTTER WITH BIORETENTION	750 SF OF SURFACE AREA, 3.4' BELOW SUBDRAIN
53	30,741	98.0	0.50	PERVIOUS GUTTER WITH BIORETENTION	1,400 SF OF SURFACE AREA, 4.0' BELOW SUBDRAIN
54	17,291	92.3	0.61	PERVIOUS GUTTER WITH BIORETENTION	740 SF OF SURFACE AREA, 2.4' BELOW SUBDRAIN
55	23,221	86.8	0.52	BIORETENTION TYPE A	780 SF OF SURFACE AREA, 1.8' BELOW SUBDRAIN
56	21,403	95.3	0.66	BIORETENTION TYPE A/PERVIOUS GUTTER WITH BIORETENTION	800 SF OF SURFACE AREA, 3.7' BELOW SUBDRAIN
57	19,564	88.7	0.47	BIORETENTION TYPE A	1,090 SF OF SURFACE AREA, 1.3' BELOW SUBDRAIN
58	28,421	94.3	0.61	PERVIOUS GUTTER WITH BIORETENTION	1,074 SF OF SURFACE AREA, 3.4' BELOW SUBDRAIN
59	6,611	95.3	0.66	PERVIOUS GUTTER WITH BIORETENTION	441 SF OF SURFACE AREA, 2.1' BELOW SUBDRAIN
60	2700	98.0	0.70	BIORETENTION TYPE B	100 SF OF SURFACE AREA, 4.9' BELOW SUBDRAIN



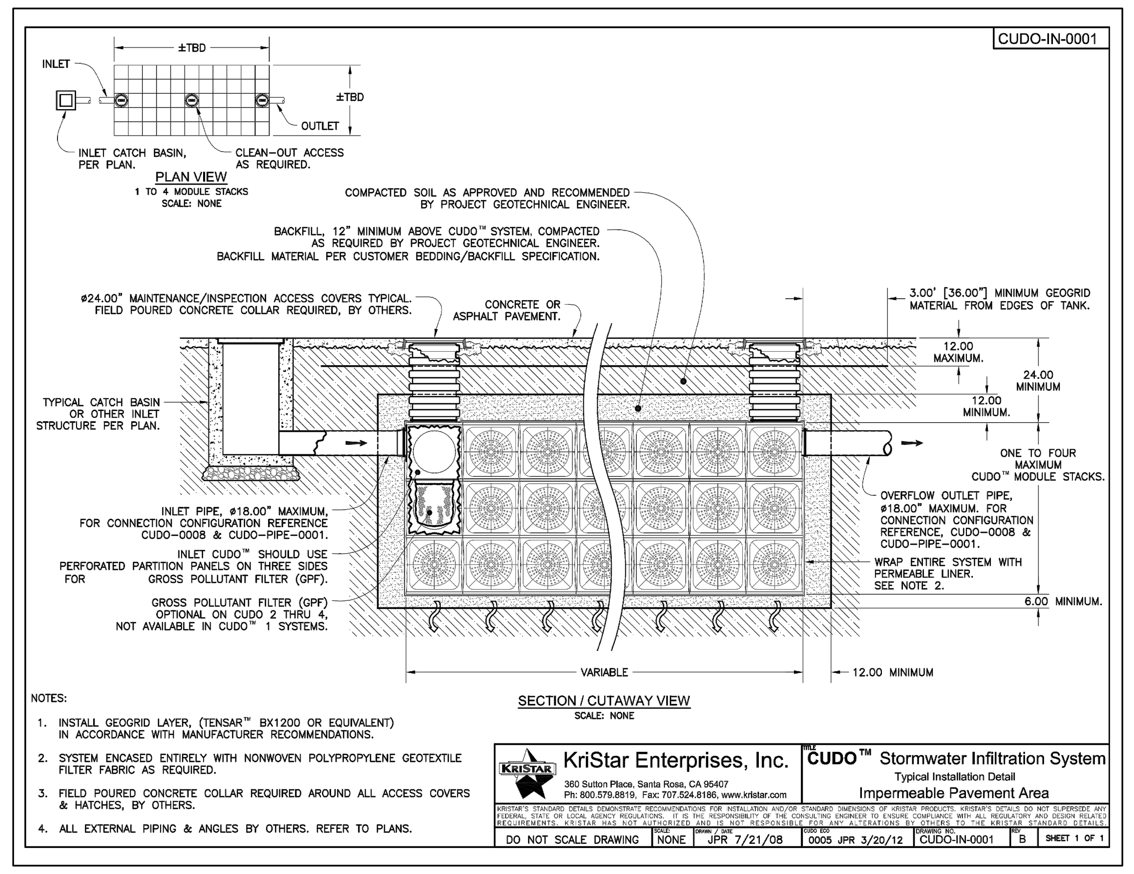
PERVIOUS GUTTER WITH BIORETENTION

NOT TO SCALE



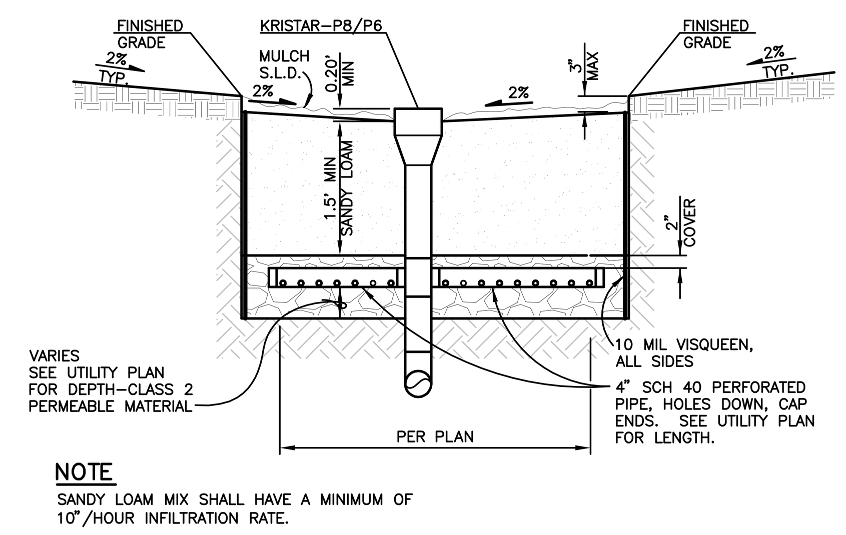
BIORETENTION PLANTER TYPE A

NOT TO SCALE



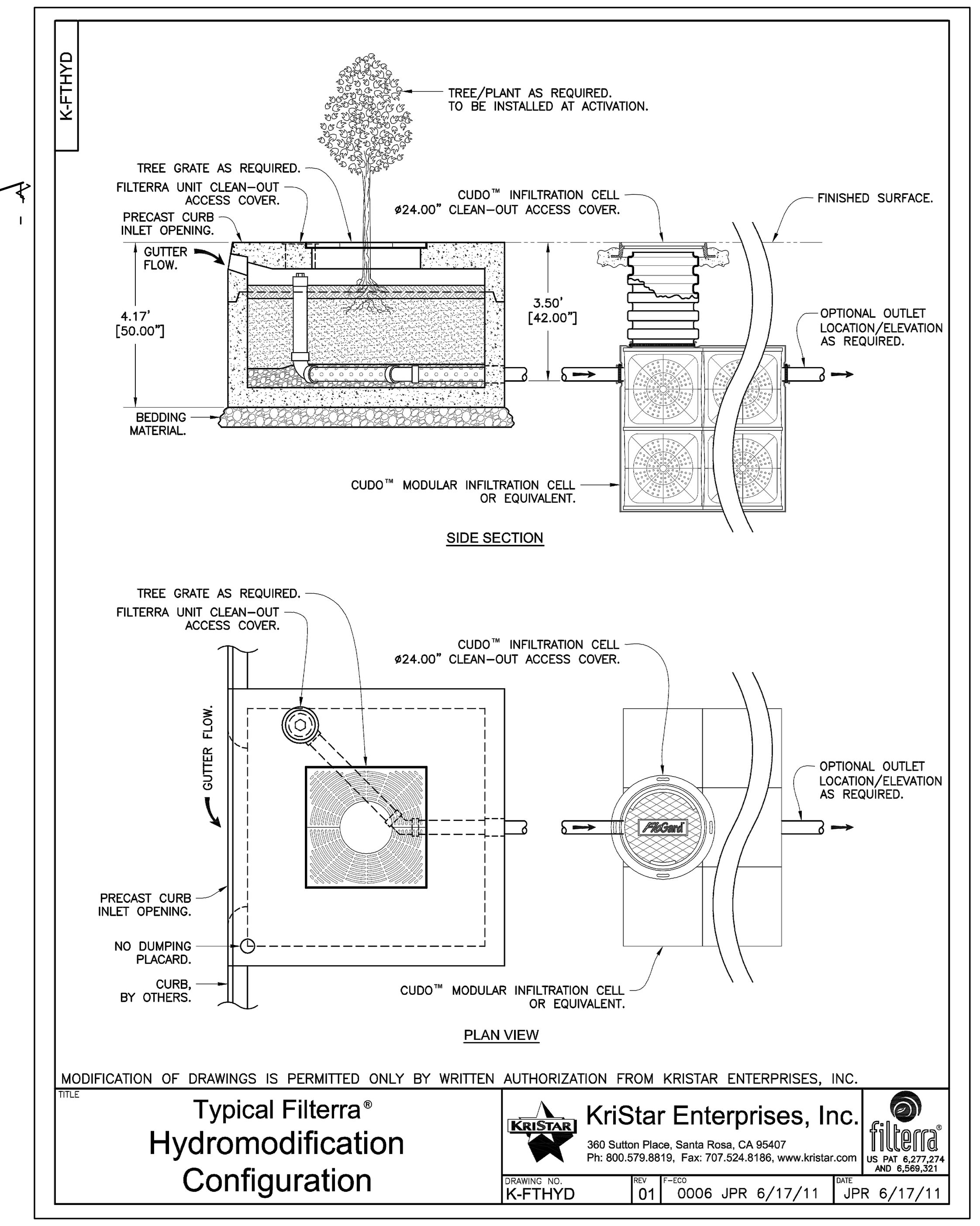
CUDO STORMWATER INFILTRATION SYSTEM

NOT TO SCALE



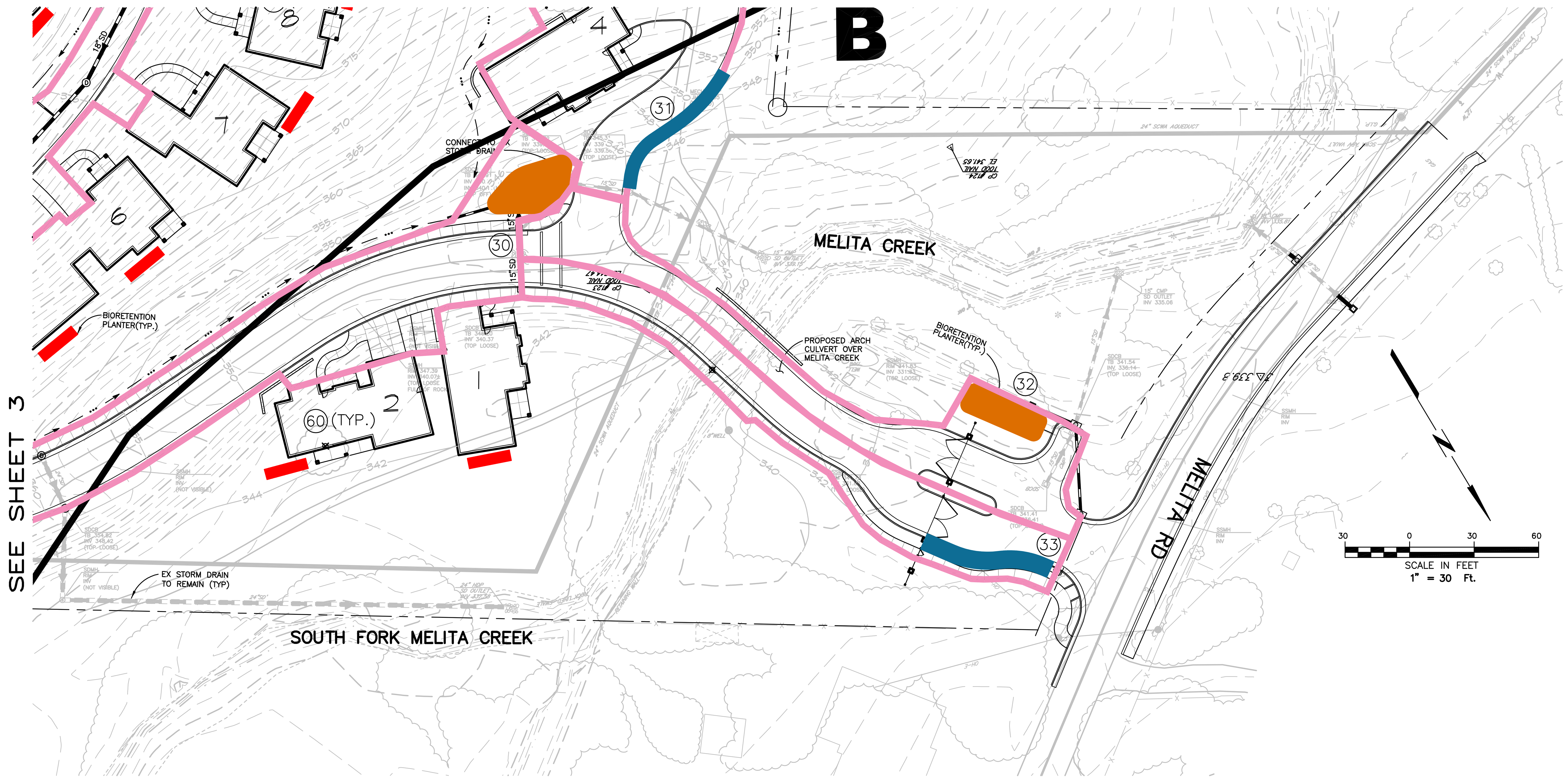
BIOINFILTRATION PLANTER TYPE B

NOT TO SCALE



TREEPOD BIORETENTION STRUCTURE

NOT TO SCALE



Brelje & Race
CONSULTING ENGINEERS
475 Aviation Boulevard, Suite 120
Santa Rosa, CA 95403
v: 707-576-1322
f: 707-576-0469
www.brce.com

ELNOKA CCRC
DESIGN REVIEW

251 ELNOKA LANE
SANTA ROSA, CALIFORNIA

LEGEND

- DMA BOUNDARY
- PERVIOUS GUTTER WITH BIORETENTION
- BIORETENTION PLANTER TYPE A
- BIORETENTION PLANTER TYPE B
- TREEPOD BIORETENTION STRUCTURE
- UNDEGROUND STORMWATER RETENTION STRUCTURE
- APPROXIMATE SOIL TYPE BOUNDARY
- C SOIL TYPE REFERENCE
- 4 DMA AREA LABEL

DATE

REVISIONS

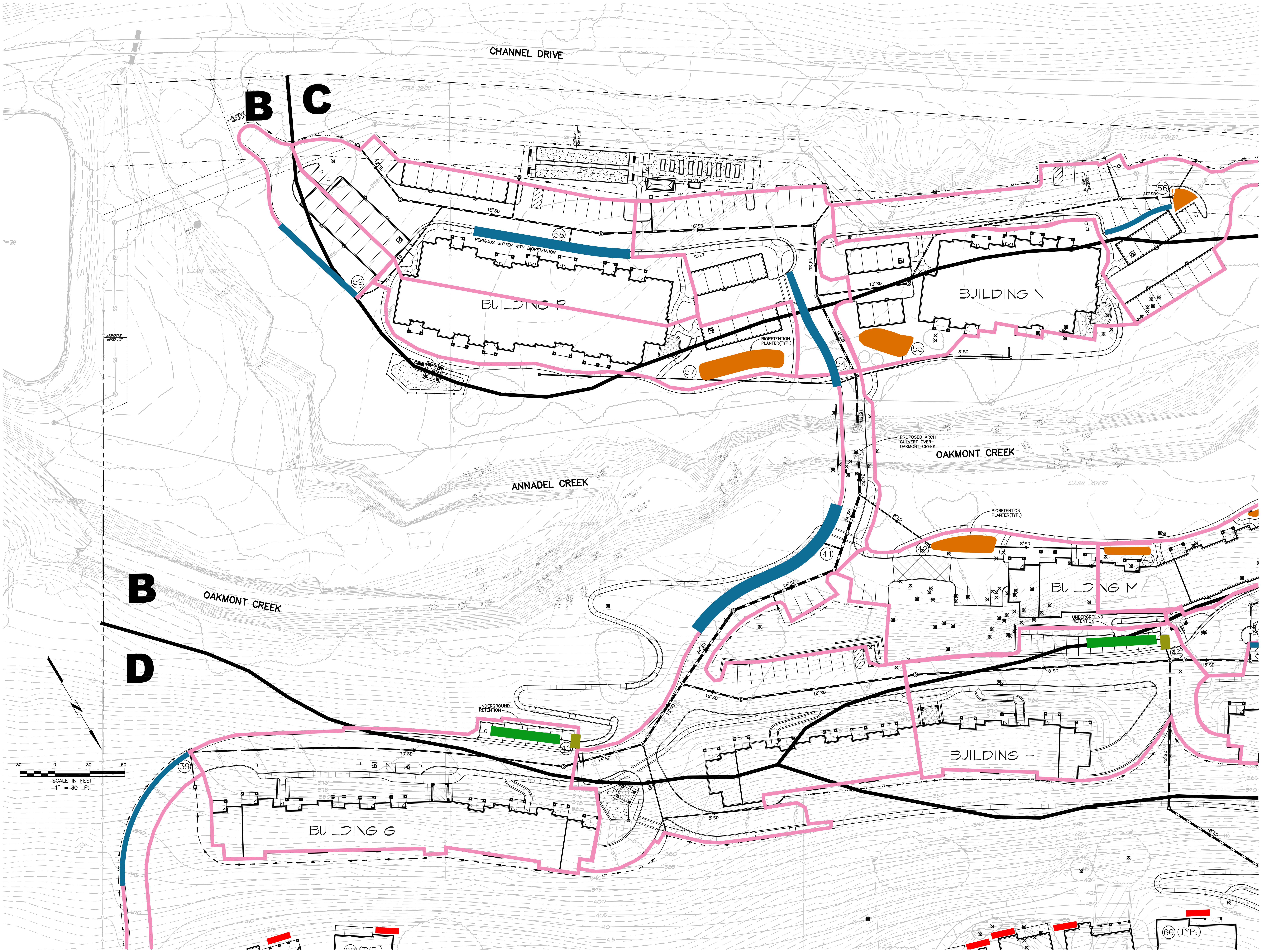
NO.	DATE	DESCRIPTION

ON A FULL-SCALE DRAWING, LENGTH OF BAR BELOW IS 1-INCH. IF BAR MEASURES LESS THAN 1-INCH, THIS SHEET WAS PLOTTED AT A REDUCED SCALE, WHICH MAY REQUIRE ADJUSTMENT OF SCALE(S) SHOWN ON DRAWING.

PROJECT	DATE
–	–
DRAWN BY	CHECKED BY
PJT	–

LID PLAN
AND
DETAILS

SHEET NO.
4 OF 6



SEE SHEET 6

SEE SHEET 2

Brelje & Race
CONSULTING ENGINEERS
475 Aviation Boulevard, Suite 120
Santa Rosa, CA 95403
v: 707-576-1322
f: 707-576-0469
www.brce.com

ELNOKA CCRC DESIGN REVIEW

251 ELNOKA LANE
SANTA ROSA, CALIFORNIA

LEGEND

- DMA BOUNDARY
- PERVIOUS GUTTER WITH BIORETENTION
- BIORETENTION PLANTER TYPE A
- BIORETENTION PLANTER TYPE B
- TREEPOD BIORETENTION STRUCTURE
- UNDEGROUND STORMWATER RETENTION STRUCTURE
- APPROXIMATE SOIL TYPE BOUNDARY
- C SOIL TYPE REFERENCE
- 4 DMA AREA LABEL

DATE

REVISIONS

NO.	DATE	DESCRIPTION

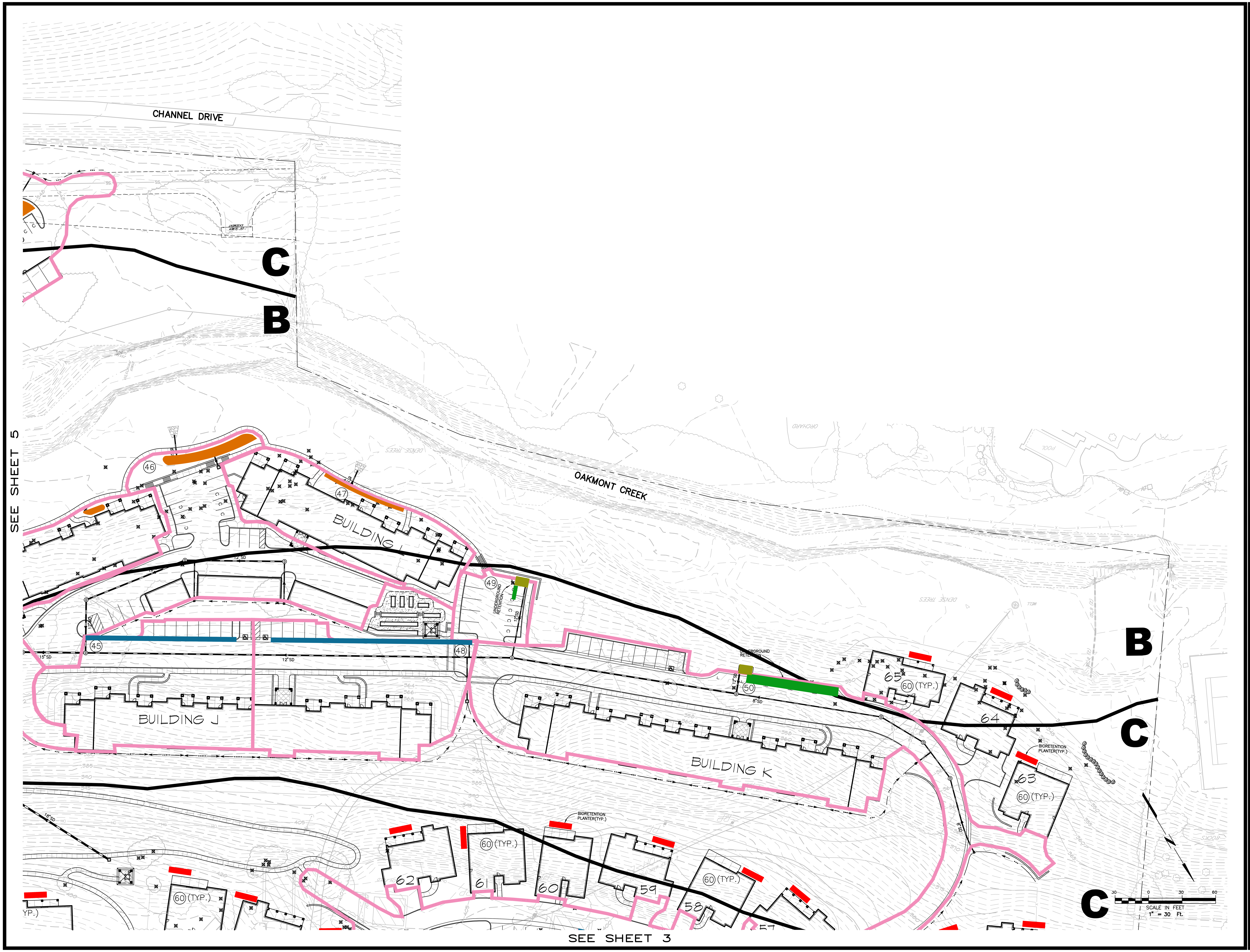
ON A FULL-SCALE DRAWING, LENGTH OF BAR BELOW IS 1-INCH. IF BAR MEASURES LESS THAN 1-INCH, THIS SHEET WAS PLOTTED AT A REDUCED SCALE, WHICH MAY REQUIRE ADJUSTMENT OF SCALE(S) SHOWN ON DRAWING.

PROJECT	DATE
–	–
DRAWN BY PIT	CHECKED BY –

LID PLAN

SHEET NO.
5 OF 6

401



Brelje & Race
CONSULTING ENGINEERS
475 Aviation Boulevard, Suite 120
Santa Rosa, CA 95403
v: 707-576-1322
f: 707-576-0469
www.brce.com

ELNOKA CCRC DESIGN REVIEW

251 ELNOKA LANE
SANTA ROSA, CALIFORNIA

LEGEND

- DMA BOUNDARY
- PERVIOUS GUTTER WITH BIORETENTION
- BIORETENTION PLANTER TYPE A
- BIORETENTION PLANTER TYPE B
- TREEPOD BIORETENTION STRUCTURE
- UNDEGROUND STORMWATER RETENTION STRUCTURE
- APPROXIMATE SOIL TYPE BOUNDARY
- C — SOIL TYPE REFERENCE
- 4 — DMA AREA LABEL

DATE

REVISIONS

NO.	DATE	DESCRIPTION

ON A FULL-SCALE DRAWING, LENGTH OF BAR BELOW IS 1-INCH. IF BAR MEASURES LESS THAN 1-INCH, THIS SHEET WAS PLOTTED AT A REDUCED SCALE, WHICH MAY REQUIRE ADJUSTMENT OF SCALE(S) SHOWN ON DRAWING.

PROJECT	DATE
–	–
DRAWN BY	CHECKED BY
	–

LID PLAN

SHEET NO.
6 OF 6