SDHM 3.0
User Workshop
Morning Session

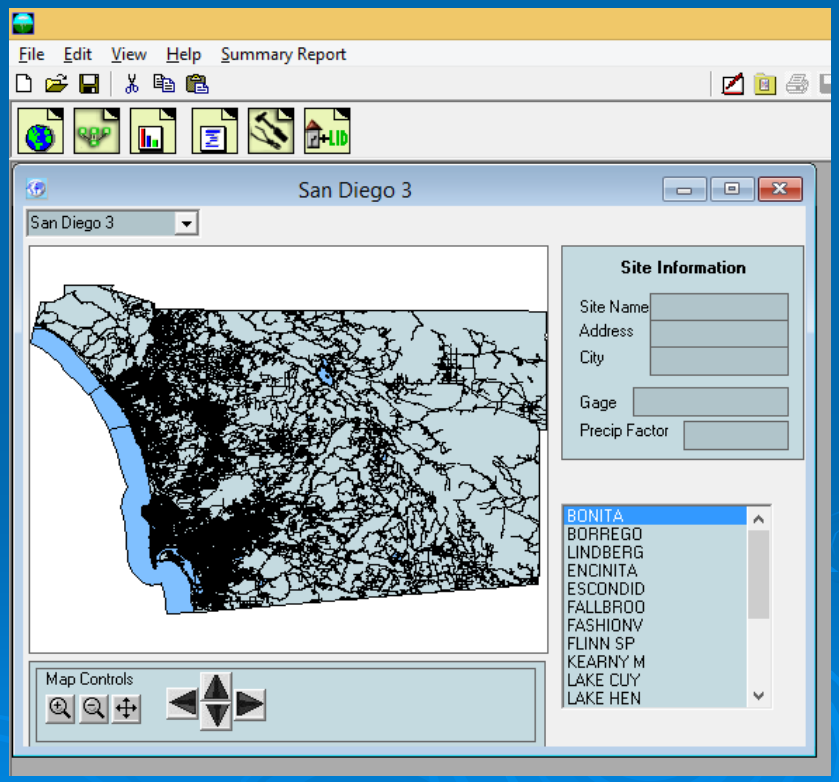
Instructor: Doug Beyerlein, P.E., P.H., D.WRE
Clear Creek Solutions, Inc.
www.clearcreeksolutions.com

CLEAR CREEK SOLUTIONS

SDHM 3.0:
San Diego Hydrology Model

Developed for:

- San Diego County and cities



Replaces SDHM 2011 and 2015.

CLEAR CREEK SOLUTIONS

SDHM 3.0 Changes from SDHM 2015

Final Version

- Revised, updated rainfall data (1984-2014).
- Revised, updated potential evapotranspiration (PET) data.
- SDHM 3.0 automatically selects rainfall record and multiplication factor based project site location on map.
- Rainfall and runoff data changed from hourly to 15-minute time step.
- SDHM 3.0 flow durations percent limit is 110% for 100% of the flow duration levels.
- New SDHM 3.0 land covers: natural vegetation (NatVeg), dirt, rock.
- New SDHM 3.0 urban landscape without irrigation (UrbNoIrr).
- New SDHM 3.0 HSPF parameter values.
- Flow frequency method changed from Cunnane to Weibull.

CLEAR CREEK SOLUTIONS

SDHM 3.0 Changes from SDHM 2015

Interim Version

- ~~Revised, updated rainfall data (1984-2014).~~
- ~~Revised, updated potential evapotranspiration (PET) data.~~
- ~~SDHM 3.0 automatically selects rainfall record and multiplication factor based project site location on map.~~
- ~~Rainfall and runoff data changed from hourly to 15-minute time step~~.
- SDHM 3.0 flow durations percent limit is 110% for 100% of the flow duration levels.
- New SDHM 3.0 land covers: natural vegetation (NatVeg), dirt, rock.
- New SDHM 3.0 urban landscape without irrigation (UrbNoIrr).
- ~~New SDHM 3.0 HSPF parameter values.~~
- Flow frequency method changed from Cunnane to Weibull.

CLEAR CREEK SOLUTIONS

SDHM 3.0 Changes from SDHM 2015

Note: Because of the above listed changes, projects that have been created in SDHM2015 (and earlier SDHM2011) will not work in SDHM 3.0.

To convert these older projects to SDHM 3.0 the user needs to manually re-input the project information into a new SDHM 3.0 project file.

The project results will change and the hydromod mitigation facility may need to be re-sized.

CLEAR CREEK SOLUTIONS

Presentation

- Introduction
- SDHM Background and Theory
- SDHM and HSPF
- SDHM Application
- SDHM Demo
- Questions & Answers

CLEAR CREEK SOLUTIONS

Introduction

SDHM 3.0 software platform is part of WWHM, which was originally developed for the State of Washington Department of Ecology.

Now used in California, Oregon, Washington, and Texas.

CLEAR CREEK SOLUTIONS

Introduction

SDHM 3.0 is available free from the Clear Creek Solutions, Inc., web site.

www.clearcreeksolutions.com

Go to Free Software Downloads.

CLEAR CREEK SOLUTIONS

SDHM Background and Theory

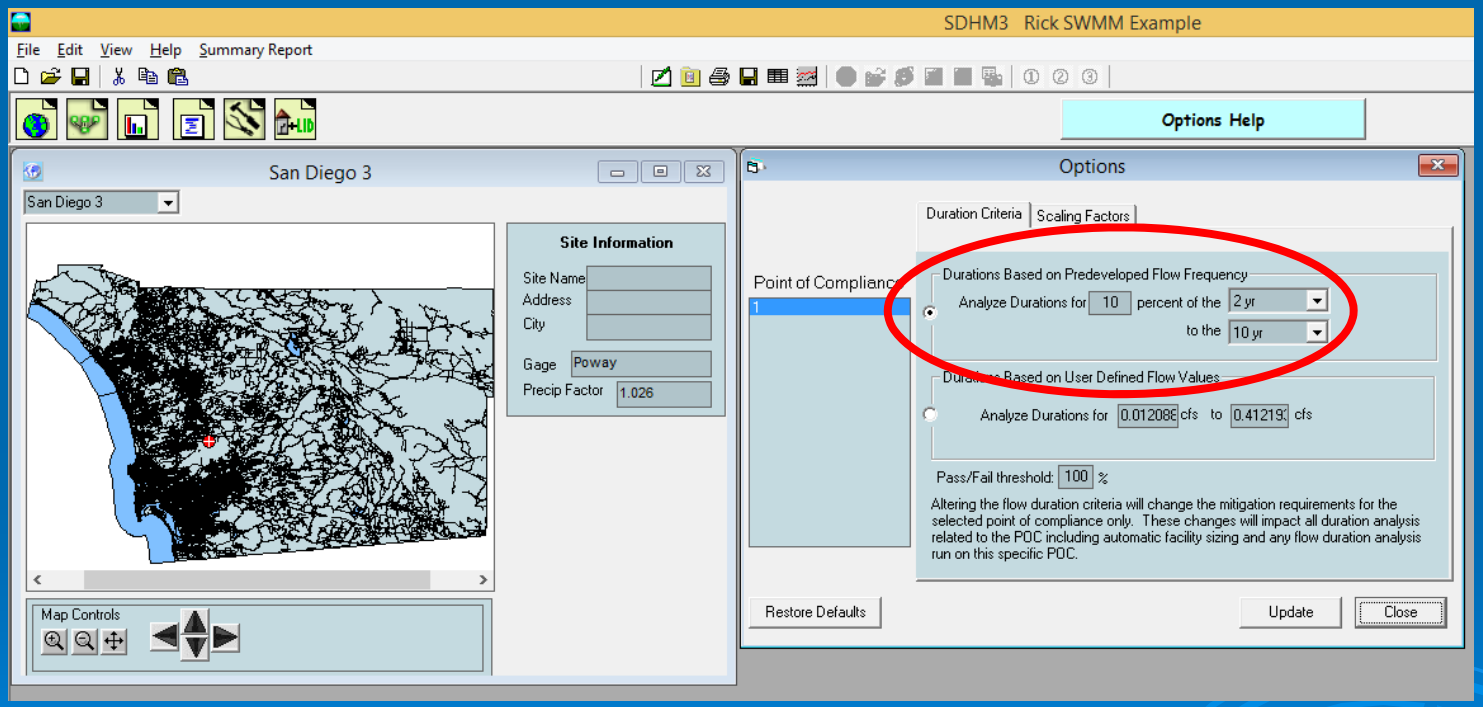
Flow duration threshold requirements:
based on erosive flows.

Erosive flow range: varies by location
(percent of 2-yr flow to 10-yr flow)

CLEAR CREEK SOLUTIONS

SDHM Background and Theory

Flow duration threshold requirements:

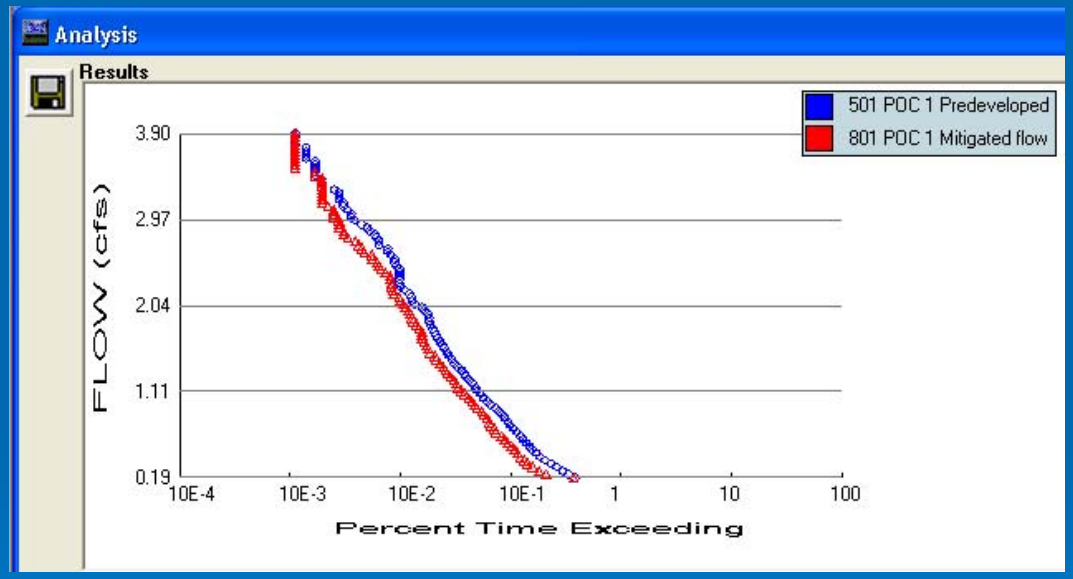


Default range: 10% of 2-yr flow to 10-yr flow

CLEAR CREEK SOLUTIONS

SDHM Background

Flow Duration Analysis: Percent of time the flow exceeds a specific value.



Requires continuous simulation hydrology to compute flow duration.

CLEAR CREEK SOLUTIONS

SDHM Background

Single event modeling doesn't work because:

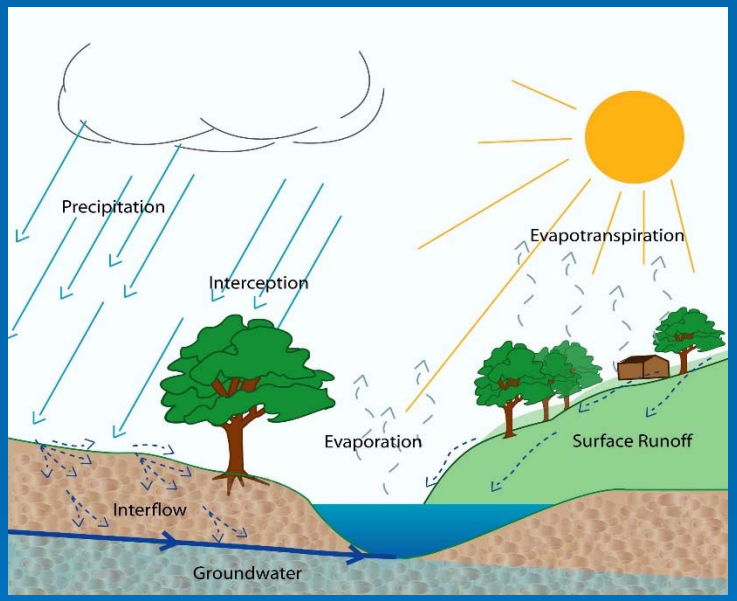
- Single-event flow frequency standards are based on inappropriate assumptions.

- Single-event modeling cannot compute flow durations (percent of time flows exceed a specific value).

CLEAR CREEK SOLUTIONS

SDHM Background

Continuous simulation hydrology models the entire hydrologic cycle for multiple years.

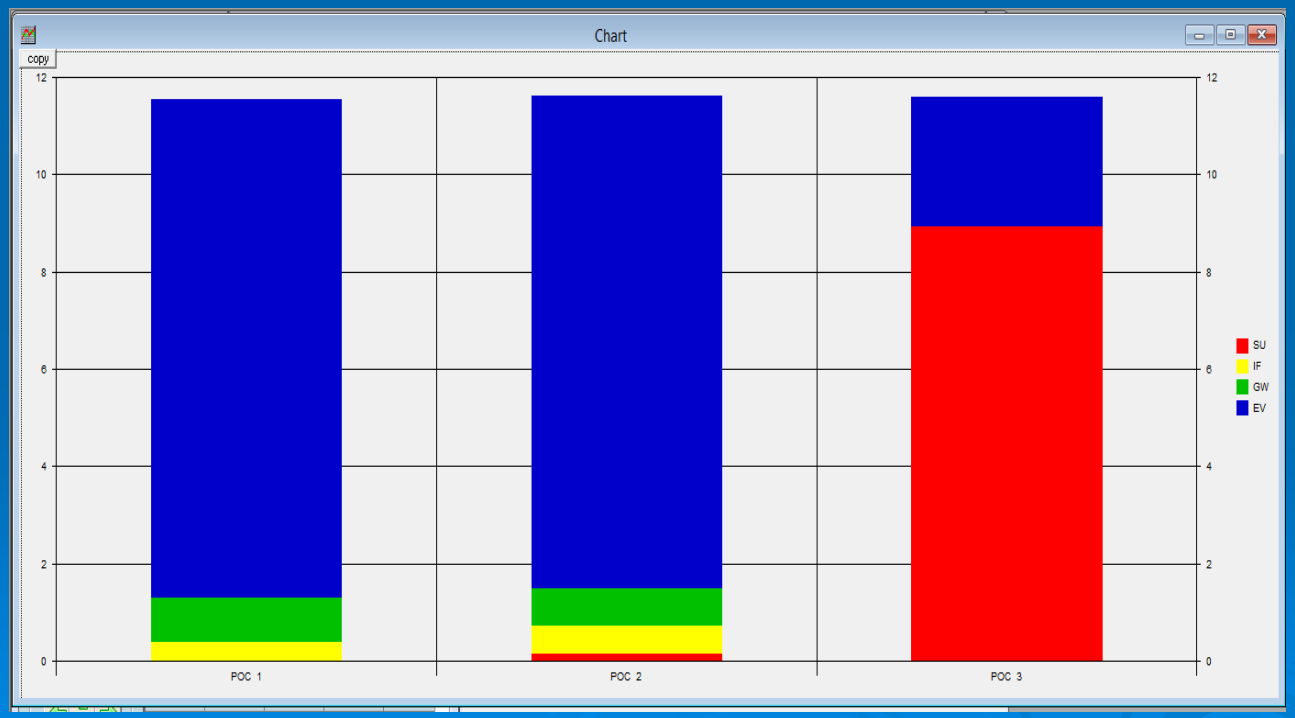


Stormwater runoff = surface runoff + interflow.

CLEAR CREEK SOLUTIONS

SDHM Background

Distribution of San Diego annual rainfall and runoff:



Blue: Evapotranspiration

Green: Groundwater

Yellow: Interflow

Red: Surface Runoff

A Soil **C Soil** **Impervious**

CLEAR CREEK SOLUTIONS

SDHM Capabilities

SDHM 3.0 uses HSPF continuous simulation hydrology to compute stormwater runoff for both pre-project and post-development conditions.

Pre-project

Developed

CLEAR CREEK SOLUTIONS

SDHM Capabilities

- SDHM 3.0 continuous simulation computations from HSPF (included in software).
- HSPF runs in the background with local parameter values and local meteorological data.
- HSPF sponsored and funded by EPA and USGS.

CLEAR CREEK SOLUTIONS

How HSPF works

- Drainage areas are divided into pervious land segments based on soil, vegetation, and land slope and impervious land segments.

- Pervious and impervious segments are linked to conveyance pathways (pipes, ditches, ponds, streams, rivers, lakes, etc.)

- Historic rainfall and evaporation are used as input.

CLEAR CREEK SOLUTIONS

How HSPF works

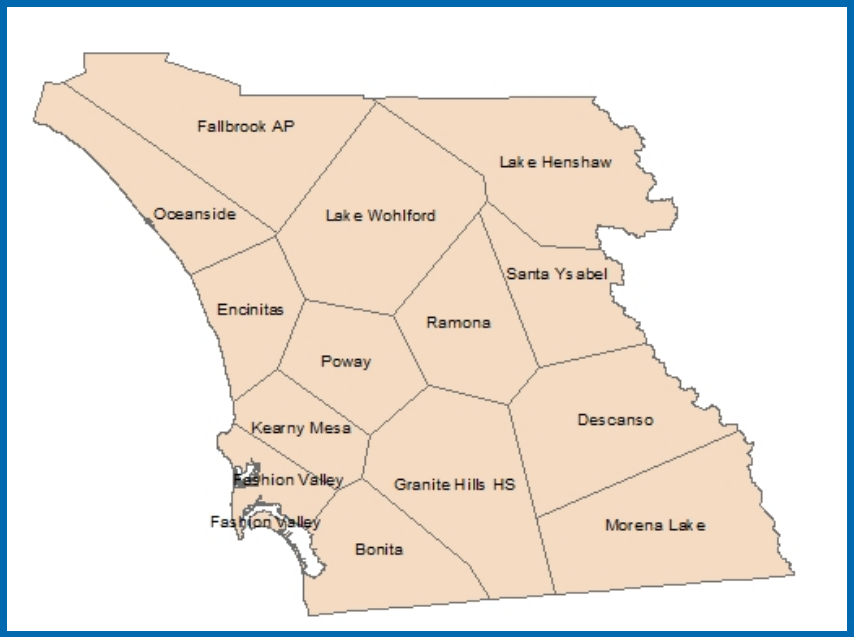
- The entire water cycle is modeled on a 15-minute time step for multiple years.

- The model computes changes in soil moisture, evapotranspiration, and runoff every time step.

- Three types of runoff:
  - surface runoff
  - interflow
  - groundwater/base flow

CLEAR CREEK SOLUTIONS

SDHM 3.0 (Final Version)



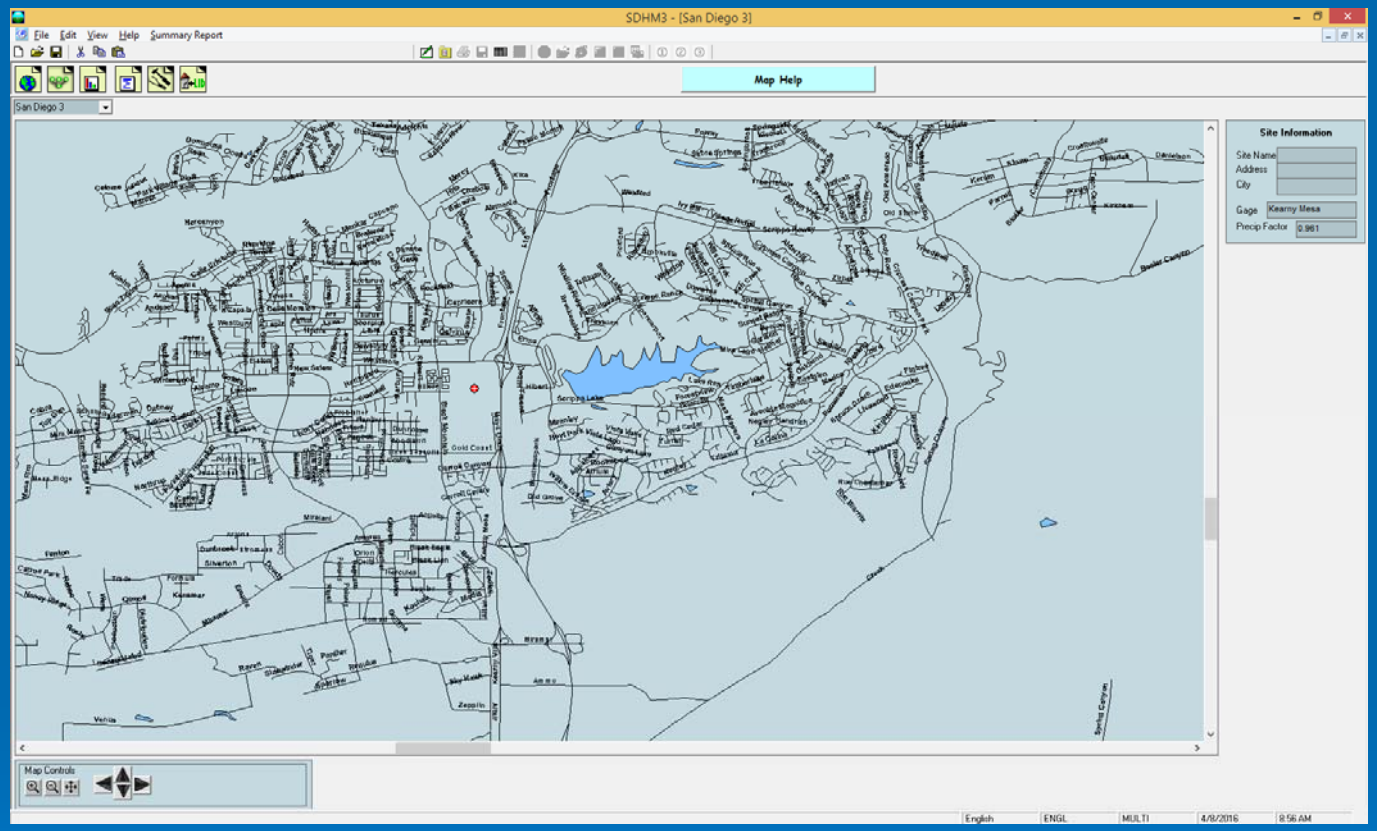
SDHM 3.0 includes 14 rainfall stations in San Diego County.

<u>San Diego County's rainfall stations:</u>

- Bonita
- Descanso
- Encinitas
- Fallbrook
- Fashion Valley
- Granite Hills
- Kearny Mesa
- Lake Henshaw
- Lake Wolford
- Morena Lake
- Oceanside
- Poway
- Ramona
- Santa Ysabel

CLEAR CREEK SOLUTIONS

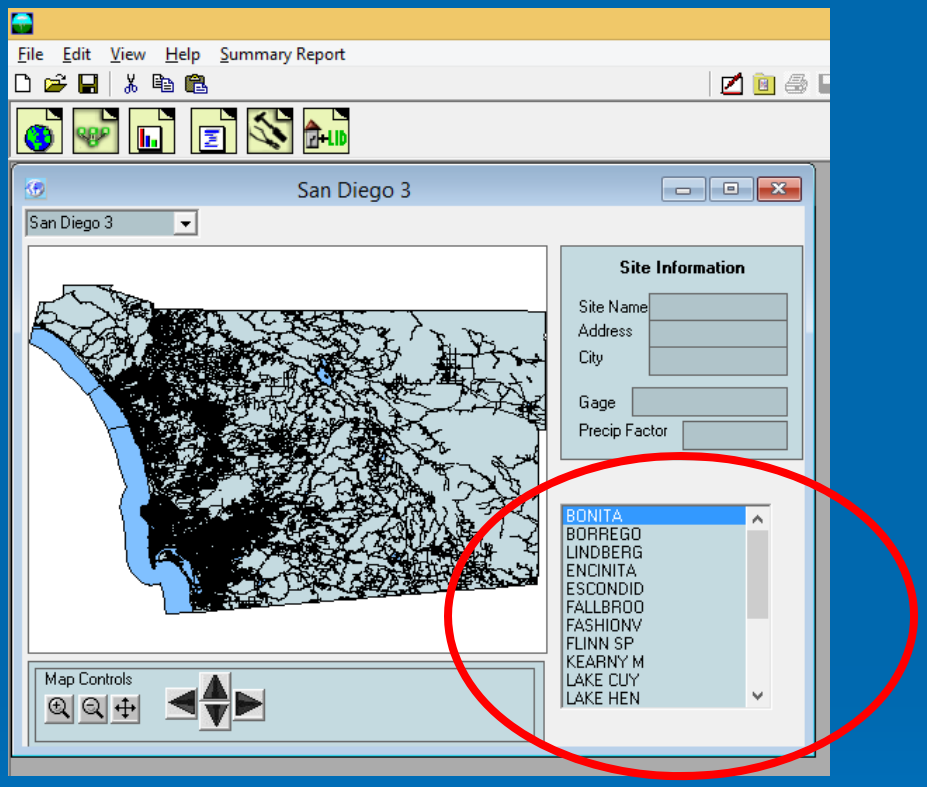
SDHM 3.0 (Final Version)



The user can zoom in on the map to find the project site. SDHM 3.0 then automatically assigns the appropriate rainfall station and precipitation multiplication factor.

CLEAR CREEK SOLUTIONS

SDHM 3.0 (Interim Version)



The user selects the rainfall station from the available list.

CLEAR CREEK SOLUTIONS

How SDHM works

- User locates project on county map, inputs pre- and post-development land use, and proposed mitigation measure(s).
- Predevelopment and mitigated flows are compared at Point of Compliance (POC).
- Mitigated flows are not allowed to exceed flow duration standards.

CLEAR CREEK SOLUTIONS

SDHM Basic Elements

13 elements:

1. land use drainage basin
2. trapezoidal pond
3. tank
4. lateral pervious basin
5. vault
6. open channel
7. time series
8. lateral impervious basin
9. gravel trench bed
10. sand filter
11. flow splitter
12. irregular-shaped pond
13. stage-storage-discharge table

CLEAR CREEK SOLUTIONS

SDHM Pro Elements

3 elements:

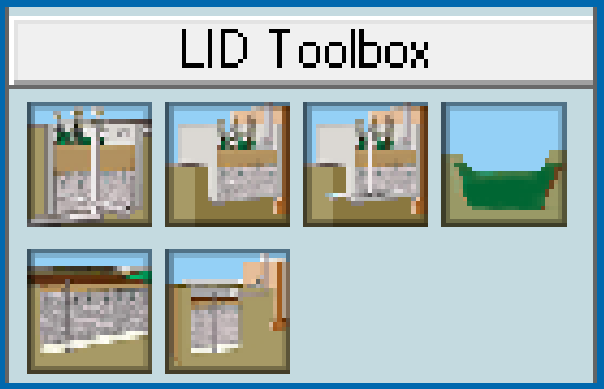
1. bioretention
2. permeable pavement
3. green roof

CLEAR CREEK SOLUTIONS

SDHM LID Toolbox Elements

6 elements:

1. in-ground planter box
2. in-ground infiltration planter
3. flow-through planter box
4. infiltration basin
5. infiltration trench
6. dry well



CLEAR CREEK SOLUTIONS

How SDHM works

- User outputs report file and project file.
- Output files can be submitted to the permitting agency for approval.
- Permitting agency can load project file and rerun analysis, if needed.
- Report file summarizes input data and output results.

CLEAR CREEK SOLUTIONS

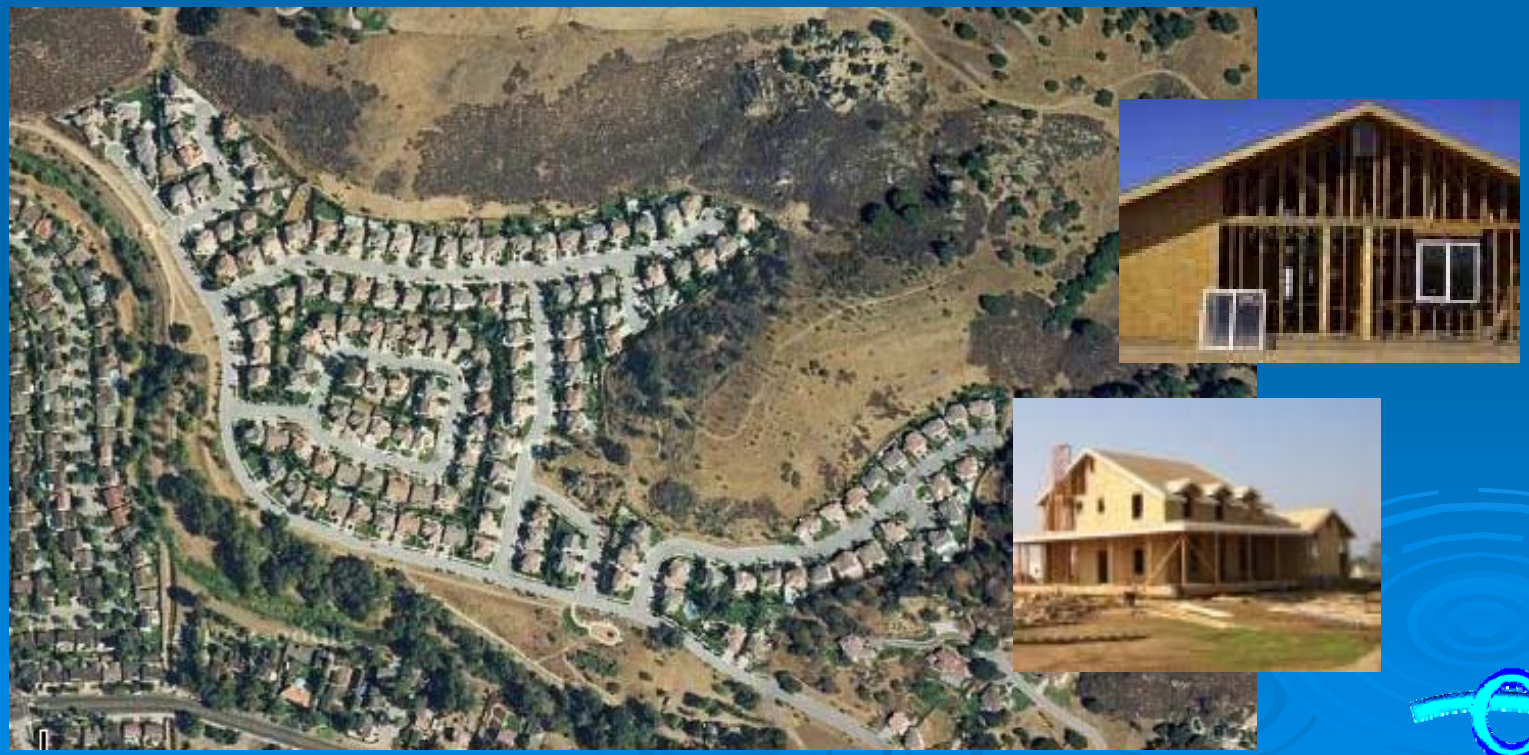
How SDHM works

- Guidance/help is provided by
  - SDHM 3.0 User Manual
  - Program Help File
  - Training Workshops
  - Phone and Email Support

CLEAR CREEK SOLUTIONS

SDHM Application

Example: Convert undeveloped land to suburban residential housing.



CLEAR CREEK SOLUTIONS

SDHM Application
Stormwater Vault Sizing Example

Pre-Project land use:

- Project: 10 ac D soil, Natural vegetation (NatVeg), Moderate land slope (5-15%)
  1 ac C soil, Rock, Flat land slope (0-5%)

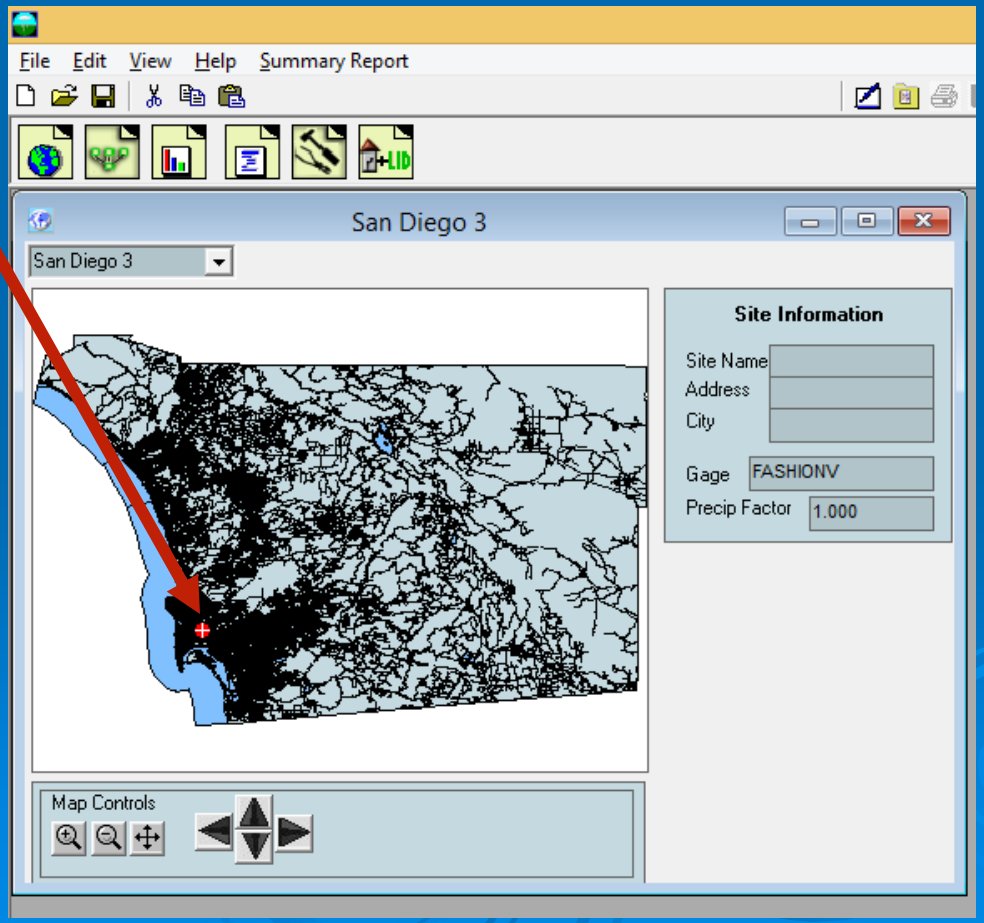
Developed mitigated land use:

- Project: 6.5 ac D soil, Urban landscape with no irrigation (UrbNoIrr), Moderate slope
  1.0 ac D soil, Urban landscape with irrigation (Urban), Moderate slope
  1.0 ac Impervious, Flat slope
  2.5 ac Impervious, Moderate slope

CLEAR CREEK SOLUTIONS

SDHM Application: Step 1

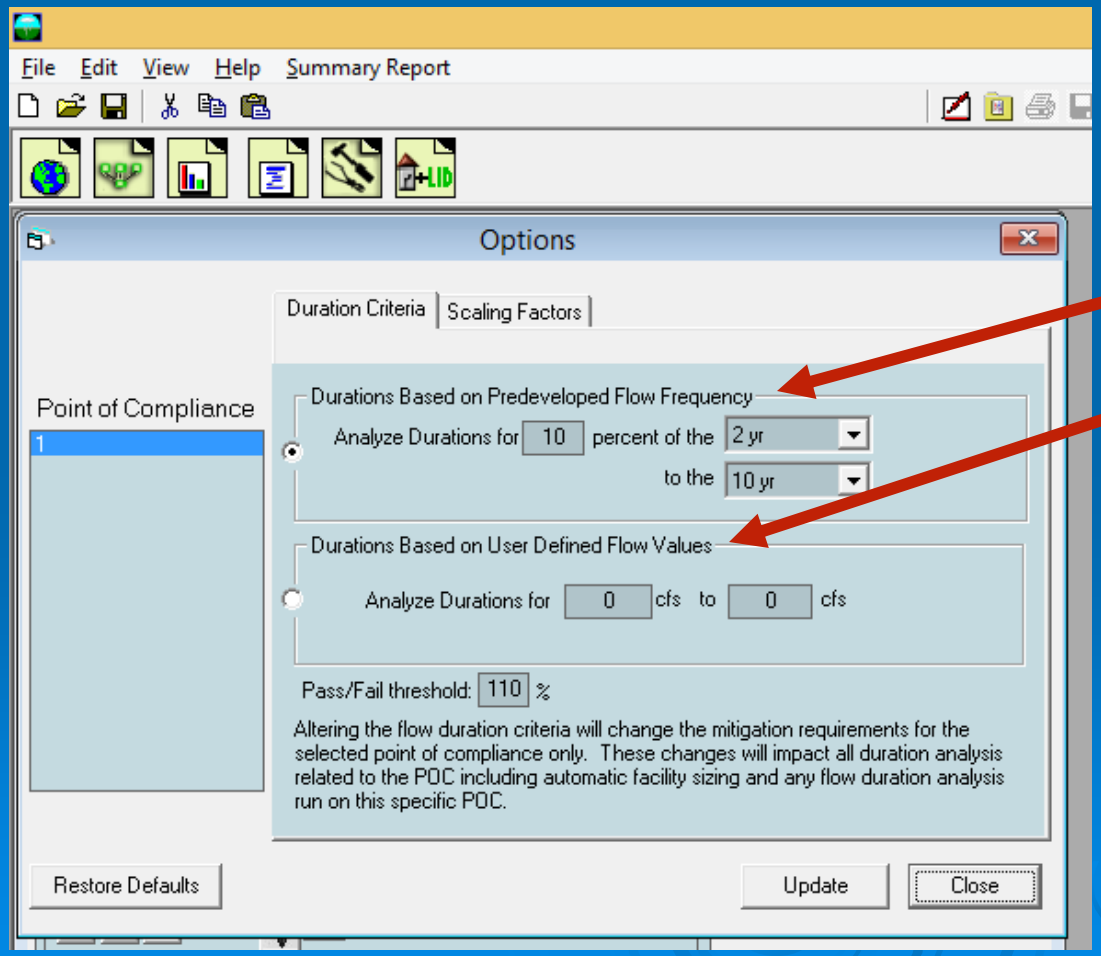
User selects land development location and places red dot on map. Then selects Fashion Valley rainfall.



CLEAR CREEK SOLUTIONS

SDHM Application: Step 2

Select Q2 and Q10 calculation method.



(1) Default: Weibull

(2) User input: USGS

CLEAR CREEK SOLUTIONS

SDHM Application: Step 2

USGS Q2 and Q10 calculation method:

$$Q2 = 3.60*(A^{0.672})*(P^{0.753})$$
$$Q10 = 6.56*(A^{0.783})*(P^{1.07})$$

Where A = drainage area (sq. miles)
P = mean annual precipitation (inches)

CLEAR CREEK SOLUTIONS

SDHM Application: Step 2

Mean Annual Precipitation (inches):

• Bonita	9.1
• Descanso	20.5
• Encinitas	9.3
• Fallbrook	13.9
• Fashion Valley	10.4
• Granite Hills	12.8
• Kearny Mesa	10.8
• Lake Henshaw	22.6
• Lake Wolford	16.8
• Morena Lake	16.6
• Oceanside	11.3
• Poway	11.6
• Ramona	13.0
• Santa Ysabel	21.1

CLEAR CREEK SOLUTIONS

SDHM Application: Step 2

USGS Q2 and Q10 calculation method:

For Fashion Valley 11 ac site

Q2 = 3.60*(A^0.672)*(P^0.753) = 1.368 cfs
Q10 = 6.56*(A^0.783)*(P^1.07) = 3.337 cfs

Where A = drainage area (sq. miles)
P = mean annual precipitation (inches)

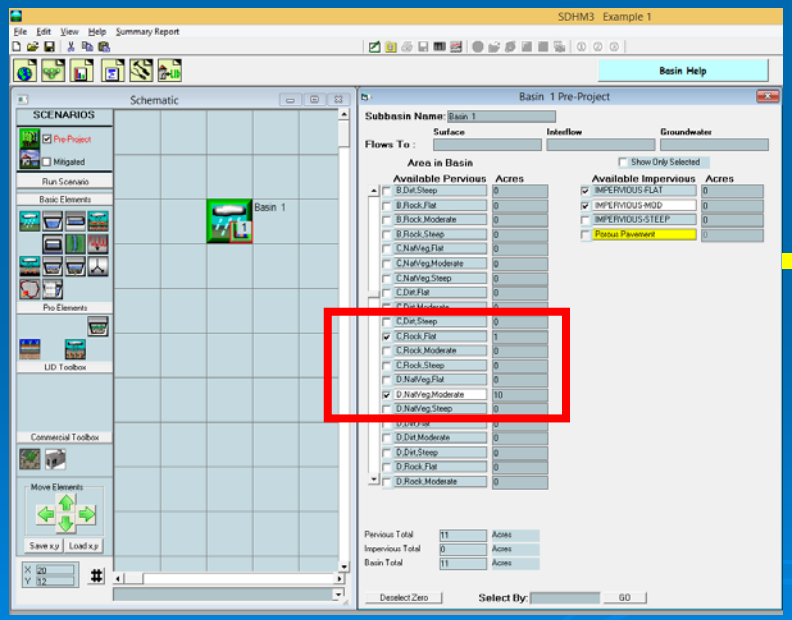
CLEAR CREEK SOLUTIONS

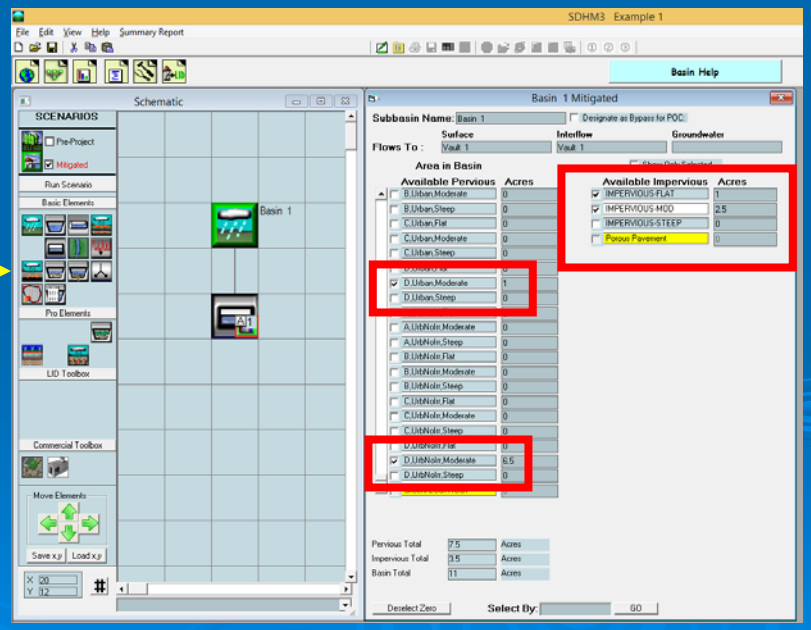
SDHM Application: Step 3

User inputs pre-project and post-development land use.

Pre: D, NatVeg, Mod
C, Rock, Flat

Post: D, UrbNoIrr, Mod; D, Urban, Mod;
Imp, Flat; Imp, Mod

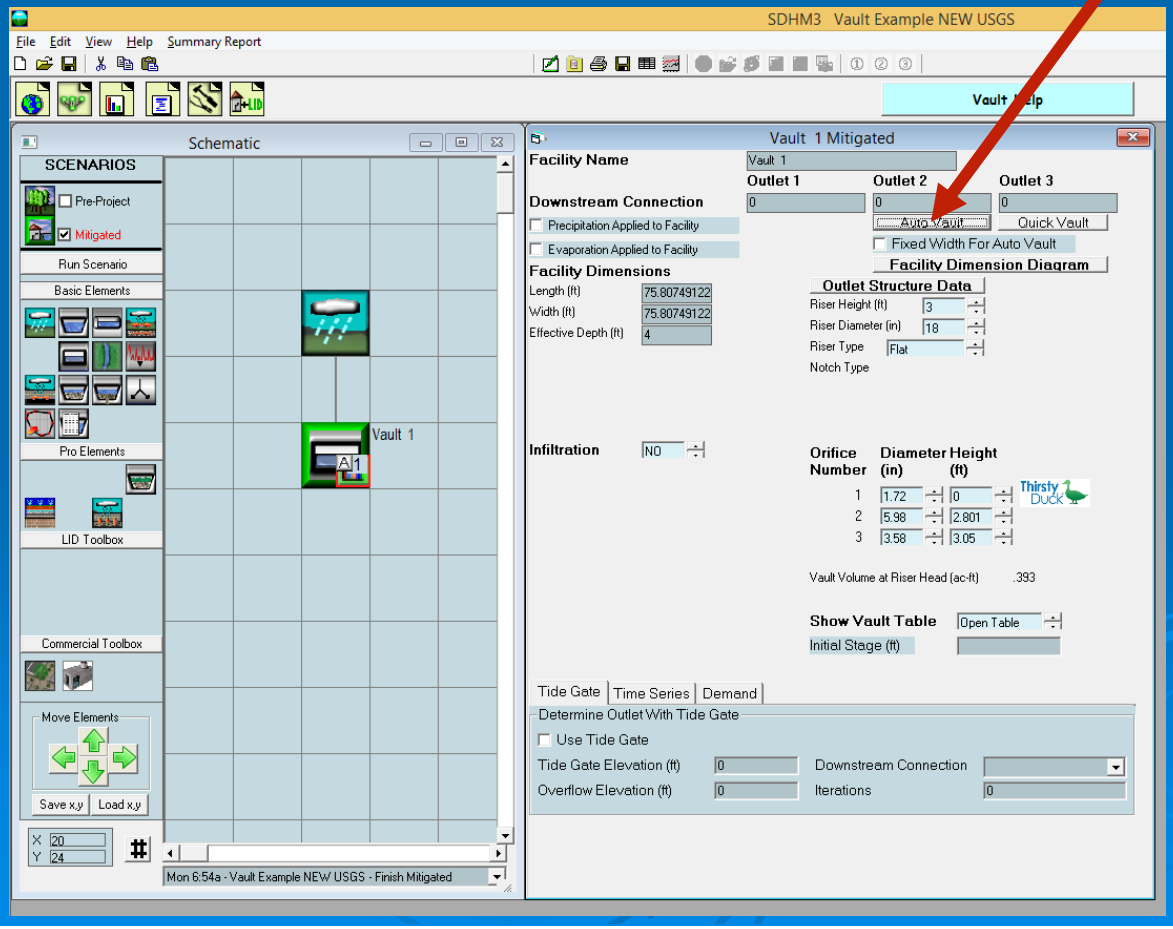




CLEAR CREEK SOLUTIONS

SDHM Application: Step 3 cont'd.

User inputs initial vault specifications or uses Auto Vault to optimize vault size and storage volume.

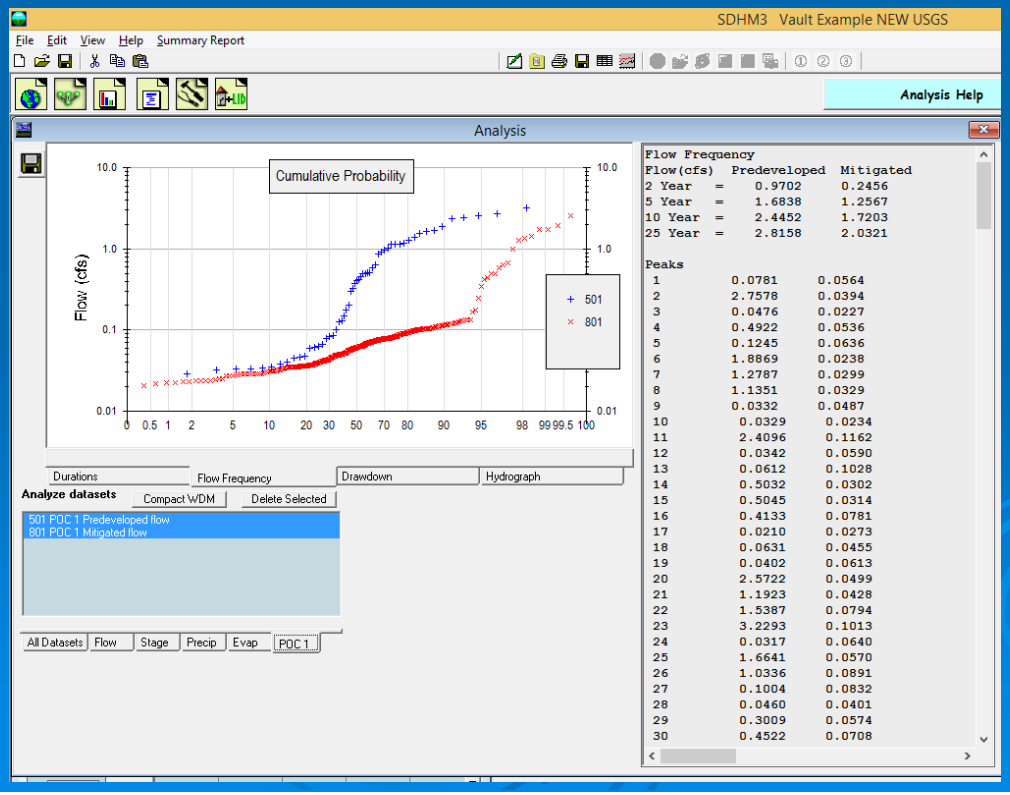


CLEAR CREEK SOLUTIONS

SDHM Application: Step 4

SDHM 3.0 computes and compares pre-project and post-development routed runoff statistics using Weibull partial duration flow frequency method.

Flow frequency (2-year to 25-year):



Flow Frequency

Flow(cfs)	Predeveloped	Mitigated
2 Year =	0.9702	0.2456
5 Year =	1.6838	1.2567
10 Year =	2.4452	1.7203
25 Year =	2.8158	2.0321

Peaks

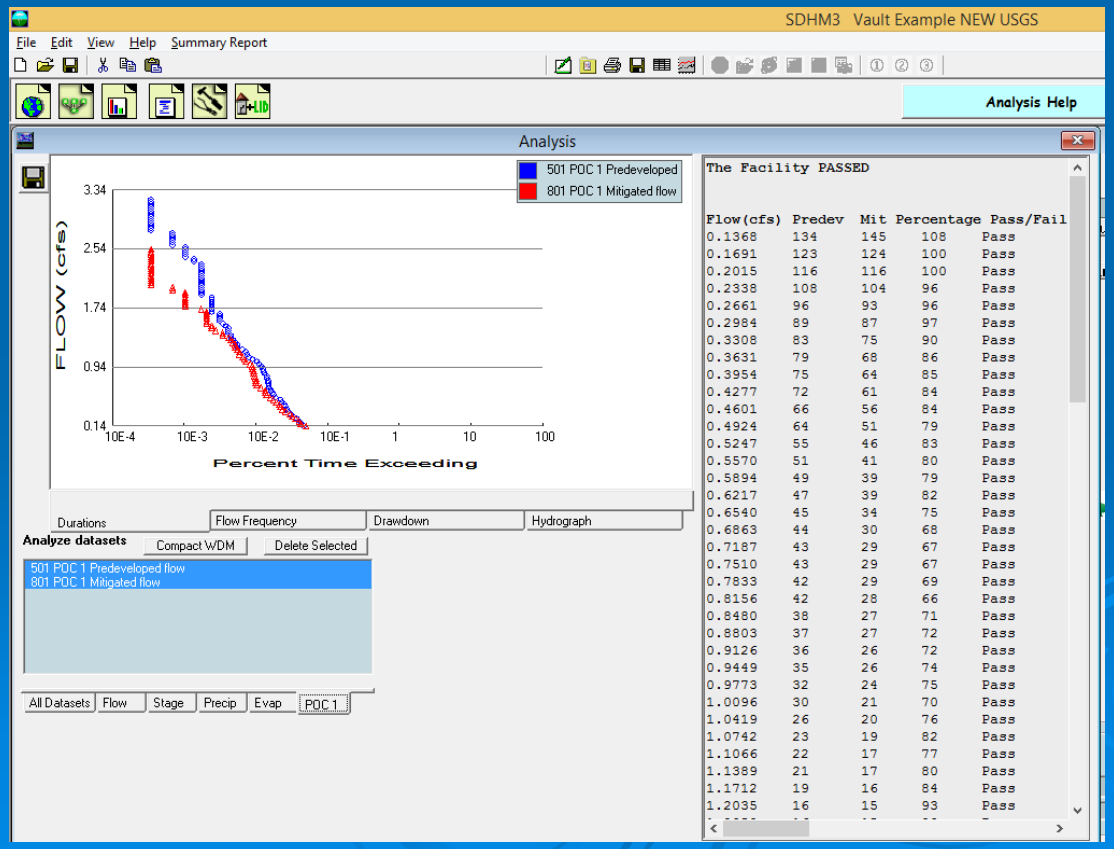
1	0.0781	0.0564
2	2.7578	0.0394
3	0.0476	0.0227
4	0.4922	0.0536
5	0.1245	0.0636
6	1.8869	0.0238
7	1.2787	0.0299
8	1.1351	0.0329
9	0.0332	0.0487
10	0.0329	0.0234
11	2.4096	0.1162
12	0.0342	0.0590
13	0.0612	0.1028
14	0.5032	0.0302
15	0.5045	0.0314
16	0.4133	0.0781
17	0.0210	0.0273
18	0.0631	0.0455
19	0.0402	0.0613
20	2.5722	0.0499
21	1.1923	0.0428
22	1.5387	0.0794
23	3.2293	0.1013
24	0.0317	0.0640
25	1.6641	0.0570
26	1.0336	0.0891
27	0.1004	0.0832
28	0.0460	0.0401
29	0.3009	0.0574
30	0.4522	0.0708

CLEAR CREEK SOLUTIONS

SDHM Application: Step 4 cont'd.

SDHM 3.0 compares pre-project and post-development routed runoff statistics.

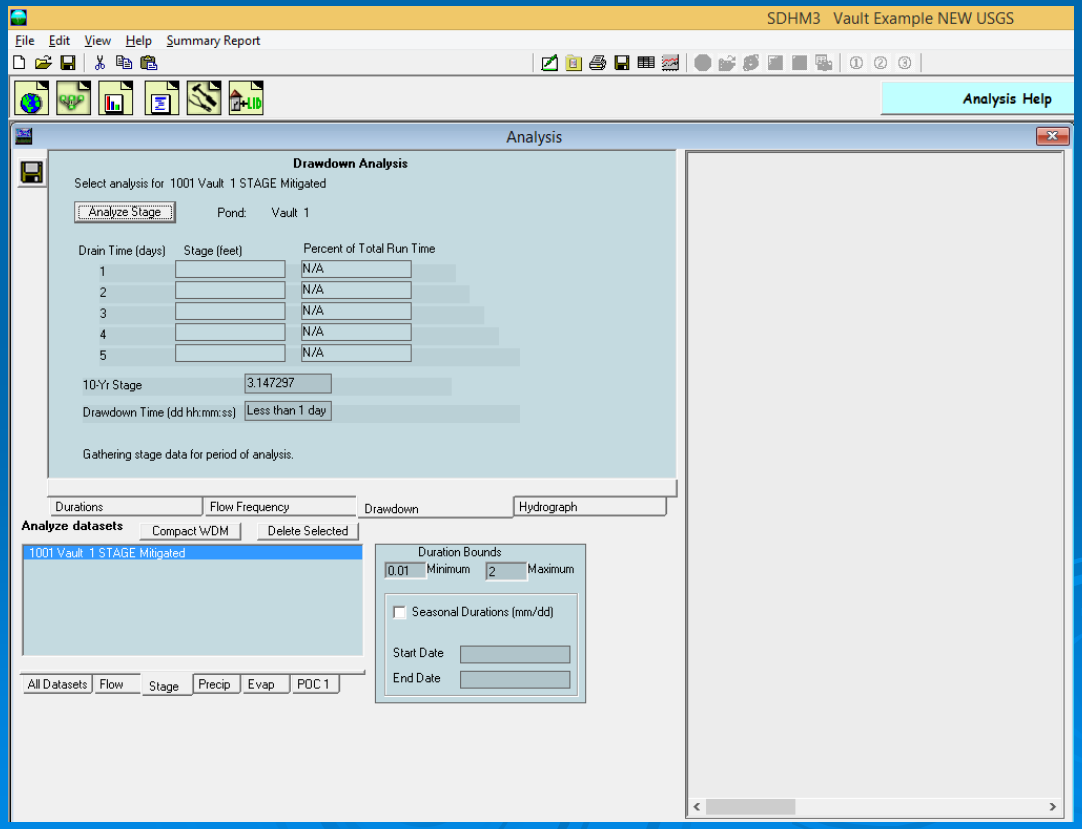
Flow duration (10% of 2-year to 100% of 10-year):



CLEAR CREEK SOLUTIONS

SDHM Application: Step 4 cont'd.

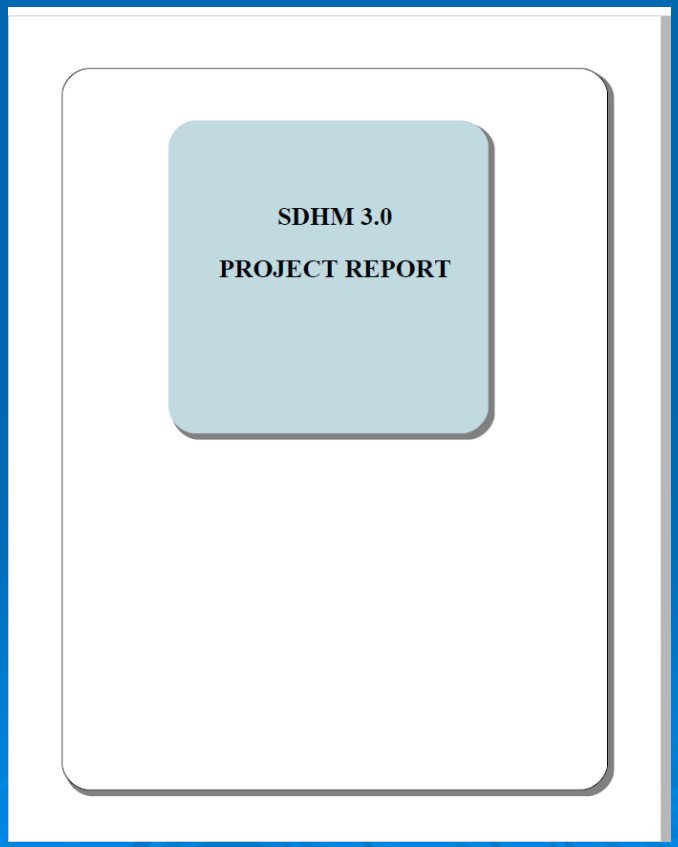
SDHM 3.0 computes the pond drawdown/retention depth (stage) for 1-5 days plus 10-year stage and drawdown time:



CLEAR CREEK SOLUTIONS

SDHM Application: Step 5

SDHM 3.0 output summarizes statistics and whether or not the facility meets the jurisdiction's standards:



CLEAR CREEK SOLUTIONS

After Sizing Facility

- User outputs report file and project file.
- Output files can be submitted to the permitting agency for approval.
- Permitting agency can load project file and rerun analysis, if needed.
- Report file summarizes input data and output results.

CLEAR CREEK SOLUTIONS

SDHM 3.0 File Types

- Project file: _____.WHM
- Backup project file: _____.WH2
- Database file: _____.WDM
- Report file: _____.RTF or
- Report file: _____.PDF

CLEAR CREEK SOLUTIONS

SDHM: LID Options

SDHM 3.0 includes the following LID options:

- Dispersion of impervious surface runoff on adjacent pervious surface (example: roof runoff to lawn).
- Bioretention/rain gardens to retain and infiltrate stormwater.
- Planters/dry wells/infiltration trenches to retain and infiltrate stormwater.
- Permeable pavement to retain and infiltrate stormwater.

CLEAR CREEK SOLUTIONS

SDHM 3.0

Questions?

Contact:

Doug Beyerlein 425.225.5997
beyerlein@clearcreeksolutions.com

Joe Brascher 360.943.0304
brascher@clearcreeksolutions.com

CLEAR CREEK SOLUTIONS