OREGON CITY SCHOOL DISTRICT

MASTER PLAN

OREGON CITY HIGH SCHOOL AND TRANSPORTATION MAINTENANCE FACILITY CAMPUS

Exhibit G – Preliminary Storm Drain Detention & Water Quality Calculations

OCSD Transportation Facility

Oregon City, OR

Developer: Oregon City School District

J.O. SGL 14-070

November 3rd, 2014

PRELIMINARY STORM DRAIN DETENTION & WATER QUALITY CALCULATIONS

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Narrative:

The site is currently undeveloped with one existing shed among a heavily wooded area. The majority of the undeveloped portion of the site is forest land. The property fall towards the northwest anywhere between 2-5%. The site is surrounded on the north by Clackamas Community College, on the east by Oregon City High School, on the south by housing and a future City park currently being master planned by the City Parks Department, and on the west by an undeveloped property.

The site is located in the Caufield Drainage Basin.

The site is proposed to be developed into a new Oregon City School District Transportation Facility that will replace the existing one. The site which is currently all pervious will become mostly impervious area after development. Stormwater detention and water quality facility for storm runoff will be provided by detention ponds to be located on the north side of the property. The water quality requirement for the City of Oregon City is to have a minimum 48-hour retention time for 1/3 of a 2 year storm event. All of these requirements will be met with a detention/water quality pond. Roof drainage will be piped into the on-site system and routed to the detention ponds. A geotechnical infiltration test and report is being prepared by GRI. There memorandum regarding the testing is included as a part of this report.

Detention Requirements:
2yr, 24-hour storm event must be controlled to 50% of the pre-developed runoff rate of a 2yr 24 hour storm event.

5yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 5yr 24-hour storm event.

25yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 10yr 24-hour storm event.

Total Site Conditions & Design Values - Pre Development:

Area:

Total Area = 6.88 Acres
Pervious Area = 6.88 acres
Impervious Area = 0.00 acres

Existing Use: The site is currently undeveloped with one existing shed among a heavily wooded area. The majority of the undeveloped portion of the site is forest land.

Soil Type: This site has (1) soil type as identified by (Soil Survey Clackamas County Area, Oregon) (See Soil Survey Attachments)

Bornstedt silt loam 8B - Hydrologic Group 'C'

Runoff Curve Numbers: (per Table 4-3 MODIFIED CURVE NUMBERS, City of Oregon City Stormwater and Grading Design Standards)

Wood or forest land: established 2nd growth - Hydrologic Group 'C' => 78
Impervious Surfaces, AC, Roofs etc.-Hydrologic Group 'C' => 98

Rainfall Distribution: (per Table 4-1 TOTAL DEPTH, City of Oregon City Stormwater and Grading Design Standards)

2yr, 24-hour duration STD SCS Type 1A Storm => 2.6 inches
5yr, 24-hour duration STD SCS Type 1A Storm => 3.1 inches
10yr, 24-hour duration STD SCS Type 1A Storm => 3.4 inches

Time of Concentration – Pre Developed: (Design Values per Table 4-4 MANNING'S COEFFICIENTS/"K" FACTORS, City of Oregon City Stormwater and Grading Design Standards)

Sheet Flow: $T_1 = \frac{0.42\,(n_s L)^{0.8}}{(P_2)^{0.5} * (s_o)^{0.4}}$

$L = 220$ ft.
$P_2 = 2.6$ in.
$S_o = 0.0364$ ft./ft.
$n_s = 0.40$

Shallow Concentrated Flow: $T_1 = \frac{L}{60 * k * (S_o)^{0.5}}$

$L = 432$ ft.
$S_o = 0.0080$ ft./ft.
$k = 5$

Total Time of Concentration: $T_c = T_1 + T_2$

$T_1 = \frac{0.42\,(0.40 * 220)^{0.8}}{(2.6)^{0.5} * (0.0364)^{0.4}} = 35.23$ minutes

$T_2 = \frac{432}{60 * 5 * (0.0080)^{0.5}} = 16.10$ minutes

$T_c = 35.23 + 16.10 = \underline{51.33 \text{ minutes}}$

Pre Development Hydrographs:

The pre developed hydrographs will be generated using the Santa Barbara Urban Hydrograph (SBUH) Method. (KING COUNTY DEPARTMENT OF PUBLIC WORKS Surface Water Management Division, HYDROGRAPH PROGRAMS Version 4.20)

The following pre-developed hydrographs have been broken up into two separate basins. Each basin will serve a detention pond on the northern part of the property. The basins will be broken into basin 'A' and basin 'B'. Refer to supporting pages to see separation of the basins on-site.

2 year Runoff Rate – Pre Development – Basin 'A'

```
------------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********    2-YEAR  24-HOUR STORM  ****  2.60" TOTAL PRECIP. *********

------------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
4.15,78,0,0,51.33

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       4.2        4.2  78.0      .0    .0        51.3

  PEAK-Q(CFS)   T-PEAK(HRS)     VOL(CU-FT)
       .34          8.17          12766

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-2A.UND
```

5 year Runoff Rate – Pre Development – Basin 'A'

```
------------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********    5-YEAR  24-HOUR STORM  ****  3.10" TOTAL PRECIP. *********

------------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
4.15,78,0,0,51.33

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       4.2        4.2  78.0      .0    .0        51.3

  PEAK-Q(CFS)   T-PEAK(HRS)     VOL(CU-FT)
       .55          8.00          17942

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-5A.UND
```

10 year Runoff Rate – Pre Development – Basin 'A'

```
---------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********  10-YEAR  24-HOUR STORM  ****  3.40" TOTAL PRECIP. *********

---------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
4.15,78,0,0,51.33

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       4.2        4.2  78.0      .0    .0        51.3

  PEAK-Q(CFS)   T-PEAK(HRS)     VOL(CU-FT)
       .68          8.00           21254

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-10A.UND
```

2 year Runoff Rate – Pre Development – Basin 'B'

```
---------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********   2-YEAR  24-HOUR STORM  ****  2.60" TOTAL PRECIP. *********

---------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
2.73,78,0,0,51.33

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       2.7        2.7  78.0      .0    .0        51.3

  PEAK-Q(CFS)   T-PEAK(HRS)     VOL(CU-FT)
       .22          8.17            8398

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-2B.UND
```

5 year Runoff Rate – Pre Development – Basin 'B'

```
---------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********   5-YEAR  24-HOUR STORM  ****  3.10" TOTAL PRECIP. *********

---------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
2.73,78,0,0,51.33

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       2.7        2.7  78.0      .0    .0        51.3
```

```
  PEAK-Q(CFS)    T-PEAK(HRS)     VOL(CU-FT)
       .36           8.00          11803

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-5B.UND
```

10 year Runoff Rate – Pre Development – Basin 'B'

```
------------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********  10-YEAR  24-HOUR STORM  ****  3.40" TOTAL PRECIP. *********

------------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
2.73,78,0,0,51.33

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       2.7        2.7   78.0     .0    .0        51.3

  PEAK-Q(CFS)    T-PEAK(HRS)     VOL(CU-FT)
       .45           8.00          13982

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-10B.UND
```

Site Conditions & Design Values - Post Development:

Area: These calculations are for the area that drains into Detention Pond "A".

Total Area = 4.15 Acres

Total Area = 4.15acres
Pervious Area = 0.39 acres
Impervious Area = 3.76 acres

Area: These calculations are for the area that drains into Detention Pond "B".

Total Area = 2.73 Acres

Total Area = 2.73acres
Pervious Area = 0.33 acres
Impervious Area = 2.40 acres

Runoff Curve Numbers: (per Table 4-3 MODIFIED CURVE NUMBERS, City of Oregon City Stormwater and Grading Design Standards)

Wood or forest land: established 2nd growth - Hydrologic Group 'C' => 78
Impervious Surfaces, AC, Roofs etc.-Hydrologic Group 'C' => 98

Rainfall Distribution: (per Table 4-1 TOTAL DEPTH, City of Oregon City Stormwater and Grading Design Standards)

2yr, 24-hour duration STD SCS Type 1A Storm => 2.6 inches
5yr, 24-hour duration STD SCS Type 1A Storm => 3.1 inches
25yr, 24-hour duration STD SCS Type 1A Storm => 4.0 inches

Time of Concentration – Post Development:

Since a large portion of the site is impervious, the minimum time of concentration of 5 minutes will be used. Tc = 5 minutes

Post Developed Hydrographs:

The post developed hydrographs will be generated using the Santa Barbara Urban Hydrograph (SBUH) Method. (KING COUNTY DEPARTMENT OF PUBLIC WORKS Surface Water Management Division, HYDROGRAPH PROGRAMS Version 4.20)

2 year Runoff Rate – Post Development – Basin 'A'

```
------------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********    2-YEAR  24-HOUR STORM  ****  2.60" TOTAL PRECIP. *********

------------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
.39,78,3.76,98,5

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       4.2         .4  78.0    3.8  98.0        5.0

  PEAK-Q(CFS)   T-PEAK(HRS)     VOL(CU-FT)
      2.58          7.67          33558

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-2A.DEV
```

5 year Runoff Rate – Post Development – Basin 'A'

```
------------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********    5-YEAR  24-HOUR STORM  ****  3.10" TOTAL PRECIP. *********

------------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
.39,78,3.76,98,5

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
```

```
        4.2          .4   78.0     3.8   98.0          5.0

   PEAK-Q(CFS)    T-PEAK(HRS)     VOL(CU-FT)
       3.13           7.67           40842

 ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
 14070-5A.DEV
```

25 year Runoff Rate – Post Development – Basin 'A'

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 ******************** S.C.S. TYPE-1A DISTRIBUTION ********************
 *********  25-YEAR  24-HOUR STORM  ****  4.00" TOTAL PRECIP. *********

 ------------------------------------------------------------------------
 ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
 .39,78,3.76,98,5

 DATA PRINT-OUT:

   AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                   A     CN     A     CN
        4.2         .4   78.0    3.8   98.0         5.0

   PEAK-Q(CFS)    T-PEAK(HRS)     VOL(CU-FT)
       4.12           7.67           54060

 ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
 14070-25A.DEV
```

2 year Runoff Rate – Post Development – Basin 'B'

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 ******************** S.C.S. TYPE-1A DISTRIBUTION ********************
 *********   2-YEAR  24-HOUR STORM  ****  2.60" TOTAL PRECIP. *********

 ------------------------------------------------------------------------
 ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
 .33,78,2.4,98,5

 DATA PRINT-OUT:

   AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                   A     CN     A     CN
        2.7         .3   78.0    2.4   98.0         5.0

   PEAK-Q(CFS)    T-PEAK(HRS)     VOL(CU-FT)
       1.66           7.67           21671

 ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
 14070-2B.DEV
```

5 year Runoff Rate – Post Development – Basin 'B'

```
---------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********   5-YEAR  24-HOUR STORM  ****  3.10" TOTAL PRECIP. *********

---------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
.33,78,2.4,98,5

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       2.7         .3  78.0    2.4  98.0         5.0

  PEAK-Q(CFS)   T-PEAK(HRS)    VOL(CU-FT)
      2.02          7.67          26423

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-5B.DEV
```

25 year Runoff Rate – Post Development – Basin 'B'

```
---------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********  25-YEAR  24-HOUR STORM  ****  4.00" TOTAL PRECIP. *********

---------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
.33,78,2.4,98,5

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       2.7         .3  78.0    2.4  98.0         5.0

  PEAK-Q(CFS)   T-PEAK(HRS)    VOL(CU-FT)
      2.67          7.67          35061

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-25B.DEV
```

Detention Area Routing – Basin 'A':

The detention area will be 2.00 feet deep with 0.50 feet of dead storage, 1.00 feet of detention storage and 0.50 feet of freeboard during a 25 year storm event. The flow control structure for the detention pipe will have one orifice and an overflow riser. The attached spreadsheet shows the detention area routing data.

The routing will be performed using the Santa Barbara Urban Hydrograph (SBUH) Method. (KING COUNTY DEPARTMENT OF PUBLIC WORKS Surface Water Management Division, HYDROGRAPH PROGRAMS Version 4.20)

```
RESERVOIR ROUTING INFLOW/OUTFLOW ROUTINE
```

```
SPECIFY [d:][path]filename[.ext] OF ROUTING DATA
14070A.TXT
 DISPLAY ROUTING DATA (Y or N)?
Y

ROUTING DATA:

STAGE(FT)    DISCHARGE(CFS)    STORAGE(CU-FT)    PERM-AREA(SQ-FT)
    .00              .04           10092.4                  .0
    .25              .05           15299.8                  .0
    .50              .06           20615.9                  .0
    .75              .07           26041.6                  .0
   1.00              .36           31577.9                  .0
   1.25             2.47           37225.8                  .0

AVERAGE PERM-RATE:     .0 MINUTES/INCH
```

2 year Detention Routing:

```
ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
14070-2A.DEV

INFLOW/OUTFLOW ANALYSIS:

  PEAK-INFLOW(CFS)    PEAK-OUTFLOW(CFS)    OUTFLOW-VOL(CU-FT)
        2.58                 .17                  19248

  INITIAL-STAGE(FT)   TIME-OF-PEAK(HRS)    PEAK-STAGE-ELEV(FT)
         .00               24.00                   .83

  PEAK STORAGE:     27890 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
1470-2A.PND
```

5 year Detention Routing:

```
ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
14070-5A.DEV

INFLOW/OUTFLOW ANALYSIS:

  PEAK-INFLOW(CFS)    PEAK-OUTFLOW(CFS)    OUTFLOW-VOL(CU-FT)
        3.13                 .28                  25982

  INITIAL-STAGE(FT)   TIME-OF-PEAK(HRS)    PEAK-STAGE-ELEV(FT)
         .00               23.83                   .93

  PEAK STORAGE:     29990 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
1470-5A.PND
```

25 year Detention Routing:

```
ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
14070-25A.DEV
```

```
INFLOW/OUTFLOW ANALYSIS:

  PEAK-INFLOW(CFS)     PEAK-OUTFLOW(CFS)     OUTFLOW-VOL(CU-FT)
        4.12                  .54                   38952

  INITIAL-STAGE(FT)   TIME-OF-PEAK(HRS)    PEAK-STAGE-ELEV(FT)
        .00                 14.50                  1.02

  PEAK STORAGE:     32060 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
1470-25A.PND
```

Detention Summary – Basin 'A':

The detention requirements are to reduce the following design storm events:

2yr, 24-hour storm event must be controlled to 50% of the pre-developed runoff rate of a 2yr 24 hour storm event.

5yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 5yr 24-hour storm event.

25yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 10yr 24-hour storm event.

The detention area will be 2.00 feet deep with 0.50 feet of dead storage, 1.00 feet of detention storage and 0.50 feet of freeboard during a 25 year storm event. The flow control structure will have one orifice and an overflow riser. The bottom orifice will be 1-1/2 inches in diameter

The following tables show that the detention requirements have been met.

Minimum Peak Rate Stormwater Runoff Control Requirements.

2yr, 24-hour storm event must be controlled to 50% of the pre-developed runoff rate of a 2yr 24 hour storm event.

2-year allowable release rate (1/2 of the 2 year pre dev. runoff)	2-year post development release rate
0.17 cfs	0.17 cfs

5yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 5yr 24-hour storm event.

5-year allowable release rate	5-year post development release rate

0.55 cfs	0.28 cfs

25yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 10yr 24-hour storm event.

25-year allowable release rate	25-year post development release rate
0.68 cfs	0.54 cfs

Detention Area Routing – Basin 'B':

The detention area will be 3.25 feet deep with 0.50 feet of dead storage, 2.25 feet of detention storage and 0.50 feet of freeboard during a 25 year storm event. The flow control structure for the detention pipe will have one orifice and an overflow riser. The attached spreadsheet shows the detention area routing data.

The routing will be performed using the Santa Barbara Urban Hydrograph (SBUH) Method. (KING COUNTY DEPARTMENT OF PUBLIC WORKS Surface Water Management Division, HYDROGRAPH PROGRAMS Version 4.20)

```
RESERVOIR ROUTING INFLOW/OUTFLOW ROUTINE

SPECIFY [d:][path]filename[.ext] OF ROUTING DATA
14070B.TXT
 DISPLAY ROUTING DATA (Y or N)?
Y

ROUTING DATA:

STAGE(FT)    DISCHARGE(CFS)    STORAGE(CU-FT)    PERM-AREA(SQ-FT)
    .00              .03            2753.4                .0
    .25              .04            4268.9                .0
    .50              .04            5879.5                .0
    .75              .05            7587.3                .0
   1.00              .05            9393.9                .0
   1.25              .06           10926.4                .0
   1.50              .06           12561.8                .0
   1.75              .06           14676.8                .0
   2.00              .07           16898.4                .0
   2.25              .07           19228.6                .0
   2.50             1.65           21669.3                .0
   2.75             4.54           24222.1                .0

AVERAGE PERM-RATE:     .0 MINUTES/INCH
```

2 year Detention Routing:

```
ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
14070-2B.DEV

INFLOW/OUTFLOW ANALYSIS:
```

```
   PEAK-INFLOW(CFS)     PEAK-OUTFLOW(CFS)     OUTFLOW-VOL(CU-FT)
         1.66                  .07                  16154

   INITIAL-STAGE(FT)    TIME-OF-PEAK(HRS)     PEAK-STAGE-ELEV(FT)
         .00                  24.00                  2.04

   PEAK STORAGE:     17230 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
1470-2B.PND
```

5 year Detention Routing:

```
ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
14070-5B.DEV

INFLOW/OUTFLOW ANALYSIS:

   PEAK-INFLOW(CFS)     PEAK-OUTFLOW(CFS)     OUTFLOW-VOL(CU-FT)
         2.02                  .20                  19757

   INITIAL-STAGE(FT)    TIME-OF-PEAK(HRS)     PEAK-STAGE-ELEV(FT)
         .00                  23.33                  2.27

   PEAK STORAGE:     19420 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
1470-5B.PND
```

25 year Detention Routing:

```
ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
14070-25B.DEV

INFLOW/OUTFLOW ANALYSIS:

   PEAK-INFLOW(CFS)     PEAK-OUTFLOW(CFS)     OUTFLOW-VOL(CU-FT)
         2.67                  .44                  28301

   INITIAL-STAGE(FT)    TIME-OF-PEAK(HRS)     PEAK-STAGE-ELEV(FT)
         .00                  12.50                  2.31

   PEAK STORAGE:     19790 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
1470-25B.PND
```

Detention Summary – Basin 'B':

The detention requirements are to reduce the following design storm events:

2yr, 24-hour storm event must be controlled to 50% of the pre-developed runoff rate of a 2yr 24 hour storm event.

5yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 5yr 24-hour storm event.

25yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 10yr 24-hour storm event.

The detention area will be 3.25 feet deep with 0.50 feet of dead storage, 2.25 feet of detention storage and 0.50 feet of freeboard during a 25 year storm event. The flow control structure will have one orifice and an overflow riser. The orifice will be 1-1/4 inches in diameter.

The following tables show that the detention requirements have been met.

Minimum Peak Rate Stormwater Runoff Control Requirements.

2yr, 24-hour storm event must be controlled to 50% of the pre-developed runoff rate of a 2yr 24 hour storm event.

2-year allowable release rate (1/2 of the 2 year pre dev. runoff)	2-year post development release rate
0.11 cfs	0.07 cfs

5yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 5yr 24-hour storm event.

5-year allowable release rate	5-year post development release rate
0.36 cfs	0.20 cfs

25yr, 24-hour storm event must be controlled to the pre-developed runoff rate of a 10yr 24-hour storm event.

25-year allowable release rate	25-year post development release rate
0.45 cfs	0.44 cfs

Water Quality Analysis – Basin 'A':

The water quality requirements will be met by retaining the water quality storm event is 1/3 of a 2 year storm event for a minimum of 48 hours.

Water Quality – 1/3 of a 2 Year Storm Event – Basin 'A':

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------------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********   1-YEAR  24-HOUR STORM  ****   .87" TOTAL PRECIP. *********

------------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
0.39,78,3.76,98,5

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       4.2         .4  78.0    3.8  98.0         5.0

  PEAK-Q(CFS)   T-PEAK(HRS)    VOL(CU-FT)
       .72          7.67          9124

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070A.WQ
```

Water Quality – 1/3 of a 2 Year Storm Event—Basin 'A':

```
ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
14070A.WQ

INFLOW/OUTFLOW ANALYSIS:

  PEAK-INFLOW(CFS)    PEAK-OUTFLOW(CFS)    OUTFLOW-VOL(CU-FT)
         .72                 .04                  9649

  INITIAL-STAGE(FT)   TIME-OF-PEAK(HRS)    PEAK-STAGE-ELEV(FT)
         .00                 .00                  .00

  PEAK STORAGE:      5900 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070A-WQ
```

Water Quality Summary – Basin 'A':

The hydraulic residence time for the water quality storm is 62.50 hours. This meets the required 48 hour hydraulic residence time.

Water Quality Analysis – Basin 'B':

The water quality requirements will be met by retaining the water quality storm event is 1/3 of a 2 year storm event for a minimum of 48 hours.

Water Quality – 1/3 of a 2 Year Storm Event – Basin 'B':

```
------------------------------------------------------------------------
******************** S.C.S. TYPE-1A DISTRIBUTION ********************
*********    1-YEAR  24-HOUR STORM  ****   .87" TOTAL PRECIP. *********

------------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
.33,78,2.4,98,5

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS    TC(MINUTES)
                  A     CN     A     CN
       2.7         .3  78.0    2.4  98.0         5.0

  PEAK-Q(CFS)   T-PEAK(HRS)     VOL(CU-FT)
       .46          7.67           5832

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070-1B.WQ
```

Water Quality – 1/3 of a 2 Year Storm Event—Basin 'B':

```
ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
14070B.WQ

INFLOW/OUTFLOW ANALYSIS:

  PEAK-INFLOW(CFS)    PEAK-OUTFLOW(CFS)    OUTFLOW-VOL(CU-FT)
         .46                 .03                 6130

  INITIAL-STAGE(FT)   TIME-OF-PEAK(HRS)    PEAK-STAGE-ELEV(FT)
         .00               24.00                 .12

  PEAK STORAGE:      3460 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
14070B-WQ
```

Water Quality Summary:

The hydraulic residence time for the water quality storm is 56.00 hours. This meets the required 48 hour hydraulic residence time.

Extended Project overview and Description:

The site will also include an extension of Meyers Road westerly. A future right-of-way width of 92' is being proposed though only 56' of the 92' will be constructed. Stormwater runoff will have to meet storm drain requirements.

A water quality and detention swale will be used to meet the storm drain requirements. The swales will be located on the north side of the road. The road will sheet flow towards the swale and enter through curb cuts in the curb. The runoff from the road will drain into a field inlet that will be tied into a storm drain system and will drain to an existing wetland northerly.

Areas:

Swale 'A'
- Impervious Area
  - Road & Sidewalk Area = 11,263 sf
- Total Impervious = 11,263 sf

Swale 'B'
- Impervious Area
  - Road & Sidewalk Area = 9,661 sf
- Total Impervious = 9,661 sf

Swale 'C'
- Impervious Area
  - Road & Sidewalk Area = 3,894 sf
- Total Impervious = 3,894 sf

Methodology:

Existing Drainage of the site:
The site currently undeveloped.

Proposed Drainage of the site:
The developed road extension will sheet flow towards the swale and enter through curb cuts in the curb. The runoff will drain into a field inlet that will be tied into a storm drain system and will drain to an existing wetland northerly.

Infiltration results:
With a flow through planter being used for water quality and detention on the site, an infiltration rate of 2 inches per hour was used for calculations.

Stormwater Hierarchy Category justification:
Hierarchy category 1, requires total on-site infiltration with vegetated infiltration facilities. Category 1 is not possible due to the low infiltration rate of 0.1 inches per hour.

Hierarchy category 2, requires total on-site infiltration with vegetated infiltration facilities that overflow to subsurface infiltration facilities. Category 2 is not possible due to the low infiltration rate of 0.1 inches per hour.

Hierarchy category 3, requires on-site detention with vegetated facilities that overflow to a drainageway, river or storm-only pipe. Category 3 will be used with a water quality and detention swale that drains into a field inlet that will be tied into a storm drain system and will drain to an existing wetland northerly.

Analysis:

Design Assumptions:

1.) The PAC calculator will be used to size the infiltration facilities.
2.) The time of concentration for post development is 5 minutes.
3.) A CN of 98 will be used for determination of post development peak flow.

Escape Route:
Each basin will drain into a field inlet that will then be drained into storm drain system.

PAC Calculator Calculation Description:
The PAC Calculator will be used to size the water quality and detention swales. The planter will have 9" of surface storage and 5"" of freeboard. The growing medium will be 18" deep. The landscape width of the facilities are 9' wide and the bottom width of the swales are a 2' wide.

Engineering Conclusions

The proposed stormwater facilities has been designed in accordance with the 2014 Storm Water Management Manual. The storm water facilities have been designed to meet flow control and pollution control requirements according to the PAC Calculator. See the attached PAC calculations. With each planter meeting the criteria required in the PAC Calculator, the swales therefore meet the standards.

SUPPORTING PAGES

EXISTING WETLAND
50' WETLAND BUFFER
PROPERTY LINE
HIGH SCHOOL ROAD
PROPERTY LINE
PROPERTY LINE
BUS WASH & MAINTENANCE VEHICLE PARKING
FUTURE R.O.W.
STAFF PARKING
SD
SD
SD
SD
SWALE 'C'
SWALE 'B'
SWALE 'A'

Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**A**
Date:	**11/04/14**
Permit Number:	**0**
Run Time	11/4/2014 1:43:59 PM

Project Name:	**OCSD Transportation Facility**
Project Address:	**Oregon City School District**
	Oregon City, OR 97045
Designer:	**JVM**
Company:	**Sisul Engineering**

Drainage Catchment Information

Catchment ID	A	
	Catchment Area	
Impervious Area	11,263	SF
Impervious Area	0.26	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

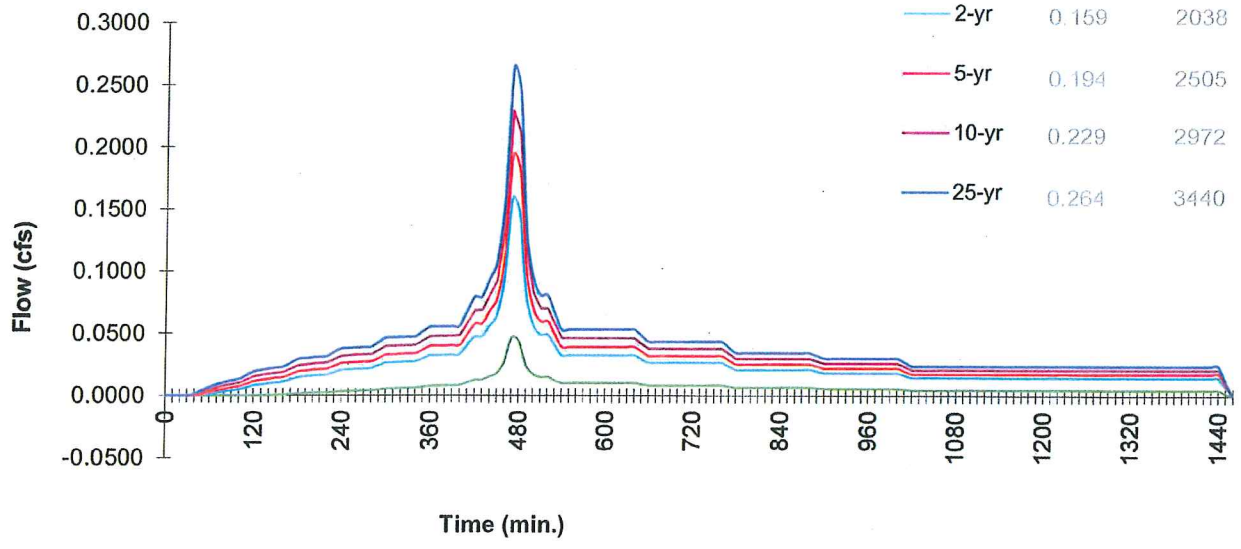
Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations

SBUH Results

	Peak Rate (cfs)	Volume (cf)
PR	0.046	589
2-yr	0.159	2038
5-yr	0.194	2505
10-yr	0.229	2972
25-yr	0.264	3440



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Presumptive Approach Calculator ver. 1.2

Catchment ID: A

Run Time 11/4/2014 1:43:59 PM

Project Name: OCSD Transportation Facility Catchment ID: A Date: 11/4/2014

Instructions:

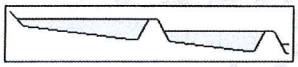
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 3

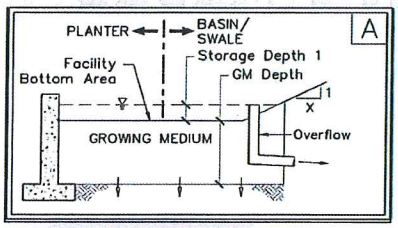
Goal Summary:

Hierarchy Category	SWMM Requirement	RESULTS box below needs to display .	
		Pollution Reduction as a	10-yr (aka disposal) as a
3	Off-site flow to drainageway, river, or storm-only pipe system.	PASS	N/A

Facility Type = Swale



Facility Configuration: A



Refer to Sloped Facility Worksheet and enter Variable Parameters

Calculation Guide
Max. Rock Stor. Bottom Area
Per Swale Dims

DATA FOR ABOVE GRADE STORAGE COMPONENT

Infiltration Area = 356 sf
Surface Capacity Volume = 204.9 cf

BELOW GRADE STORAGE

Rock Storage Bottom Area = 356 sf
Rock Storage Depth = 0 in

Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 205 cf
Infiltration Area at 75% Depth1 = -24 SF
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.016 cfs

Rock Storage Capacity = 0 cf

Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.008 cfs

Native Infiltration Rate Used in P/

RESULTS

Pollution Reduction	Overflow Volume		
PASS	0 CF	56%	Surf. Cap. Used

Run PAC

Output File

	2-yr	5-yr	10-yr	25-yr
Peak cfs	0.151	0.186	0.221	0.256

FACILITY FACTS

Total Facility Area Including Freeboard = 2,097 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.186

Presumptive Approach Calculator Ver 1.2

Instructions:

1. Refer to facility graphics on the Graphics tab, then fill in all relevant facility parameters in the Data Entry table below. Data entry cells vary based on Facility Configuration selected on Facility Design Data tab.
2. Delete all facility parameters that may have been entered by the previous iteration that are no longer applicable.

Project Name: OCSD Transportation Facility

Date: 11/4/2014

Run Time 11/4/2014 1:43:59 PM

Catchment ID: A

Data Entry

Parameters

Facility Segment	Length of facility segment (ft) $L_{segment}$	Downstream Check Dam Length (ft) L_{dam}	Longitudinal Facility Slope (ft/ft) S	Bottom Width (ft) W_{bottom}	Side Slope Right X_{right}:1	Side Slope Left X_{left}:1	Downstream Depth (inches) D_{ds}	Landscape Width (ft) $W_{landscape}$
1	77.67	2.33	0.0175	2	3	3	9	9
2	77.67	2.33	0.0175	2	3	3	9	9
3	77.67	2.33	0.0175	2	3	3	9	9
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Rock Storage Parameters

Rock Storage Width (ft) W_{rock}	Rock Storage Depth (inches) D_{rock}	Rock Void Ratio v

Error Messages

facility segment with warning message not fully utilized. Create shorter facility segments to increase surface storage capacity and infiltration area.

Warning
Warning
Warning

Project Name:

Depth 2=

Depth 3=

Worksheet Calculations

Parameters

Facility Segment	Adjusted Length of facility segment (ft) L_{adjust}	Adjusted Length if $D_{up} = 0$ (ft) $L_{adjust2}$	Upstream Depth (inches) D_{up}	Downstream Top Width (ft) $W_{top\text{-}ds}$	Upstream Top Width (ft) $W_{top\text{-}up}$	Downstream Cross-sectional Area (sf) A_{ds}	Upstream Cross-sectional Area (sf) A_{up}	Surface Capacity Volume (cf) $V_{surface}$	75% of Max. Downstream Depth (inches) $D_{ds75\%}$	75% of Max. Upstream Depth (inches) $D_{up75\%}$	75% of Max. Adjusted Length if $D_{up75\%} = 0$ (ft) $L_{adjust3}$	75% of Max. Downstream Top Width (ft) $W_{top\text{-}ds75\%}$	75% of Max. Upstream Top Width (ft) $W_{top\text{-}up75\%}$	Infiltration Area @ 75% Full (sf) $A_{75\%}$
1	76.51	42.86	0.00	6.50	2.00	3.19	0.00	68	6.75	0.00	32.14	5.38	2.00	119
2	76.51	42.86	0.00	6.50	2.00	3.19	0.00	68	6.75	0.00	32.14	5.38	2.00	119
3	76.51	42.86	0.00	6.50	2.00	3.19	0.00	68	6.75	0.00	32.14	5.38	2.00	119
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
								205	$V_{surface}$ @ Depth1					356

Rock Storage Parameters

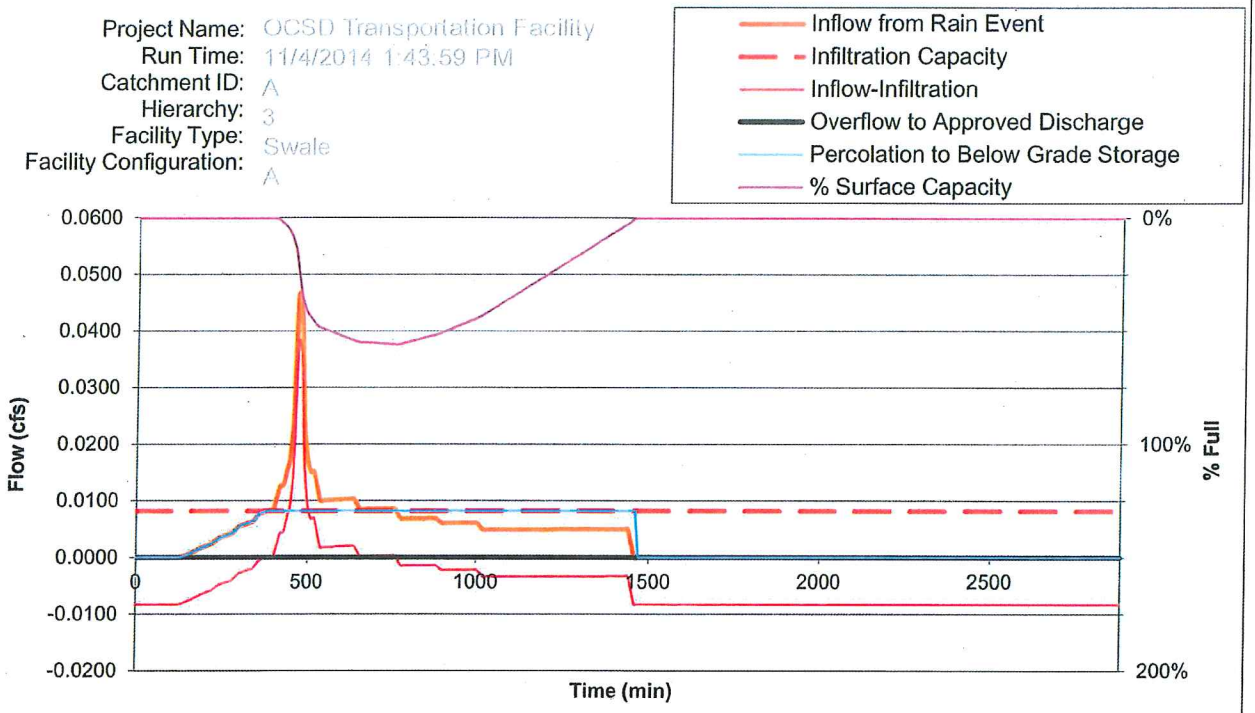
Rock Storage Length (ft) L_{rock}	Rock Storage Bottom Area (sf) A_{rock}	Rock Storage Capacity Volume (cf) V_{rock}
78	119	0
78	119	0
78	119	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
	356	0

BES - Presumptive Approach Calculator - Ver 1.2

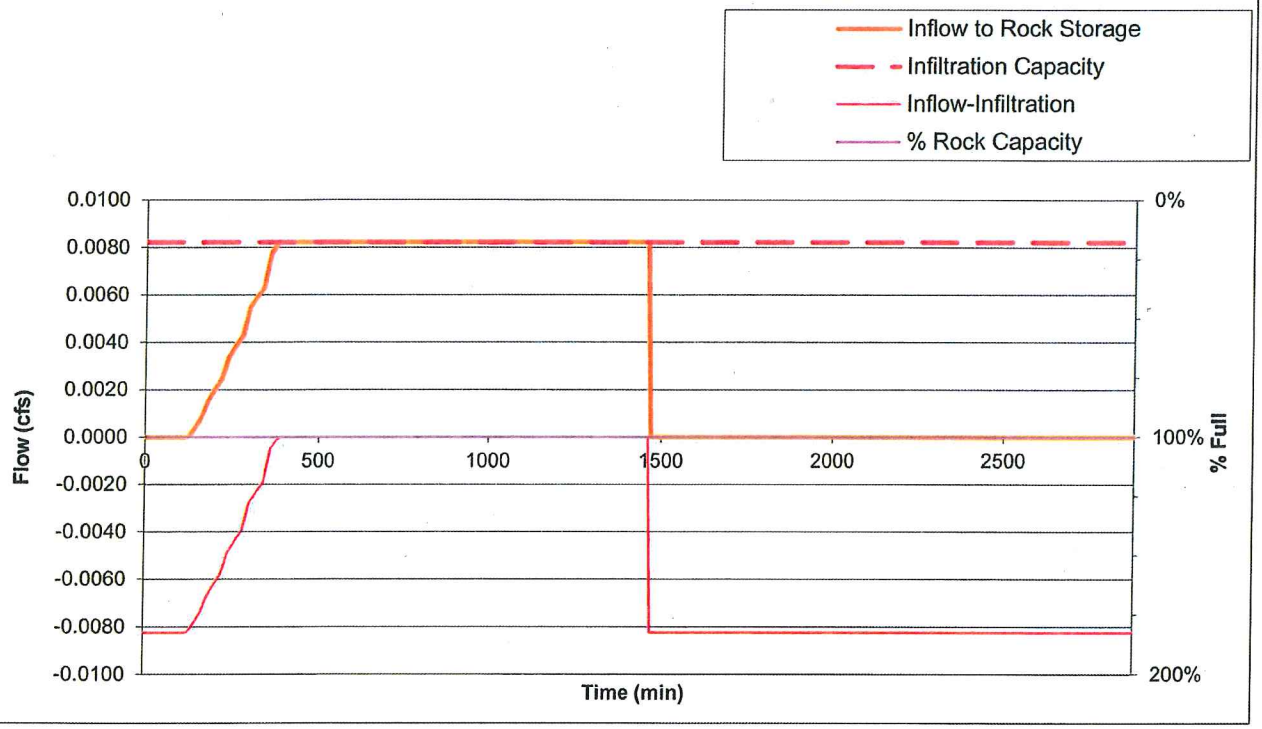
PR Con-A&B

Pollution Reduction Event
Surface Facility Modeling

Project Name: OCSD Transportation Facility
Run Time: 11/4/2014 1:43:59 PM
Catchment ID: A
Hierarchy: 3
Facility Type: Swale
Facility Configuration: A



Pollution Reduction Event
Below Grade Modeling



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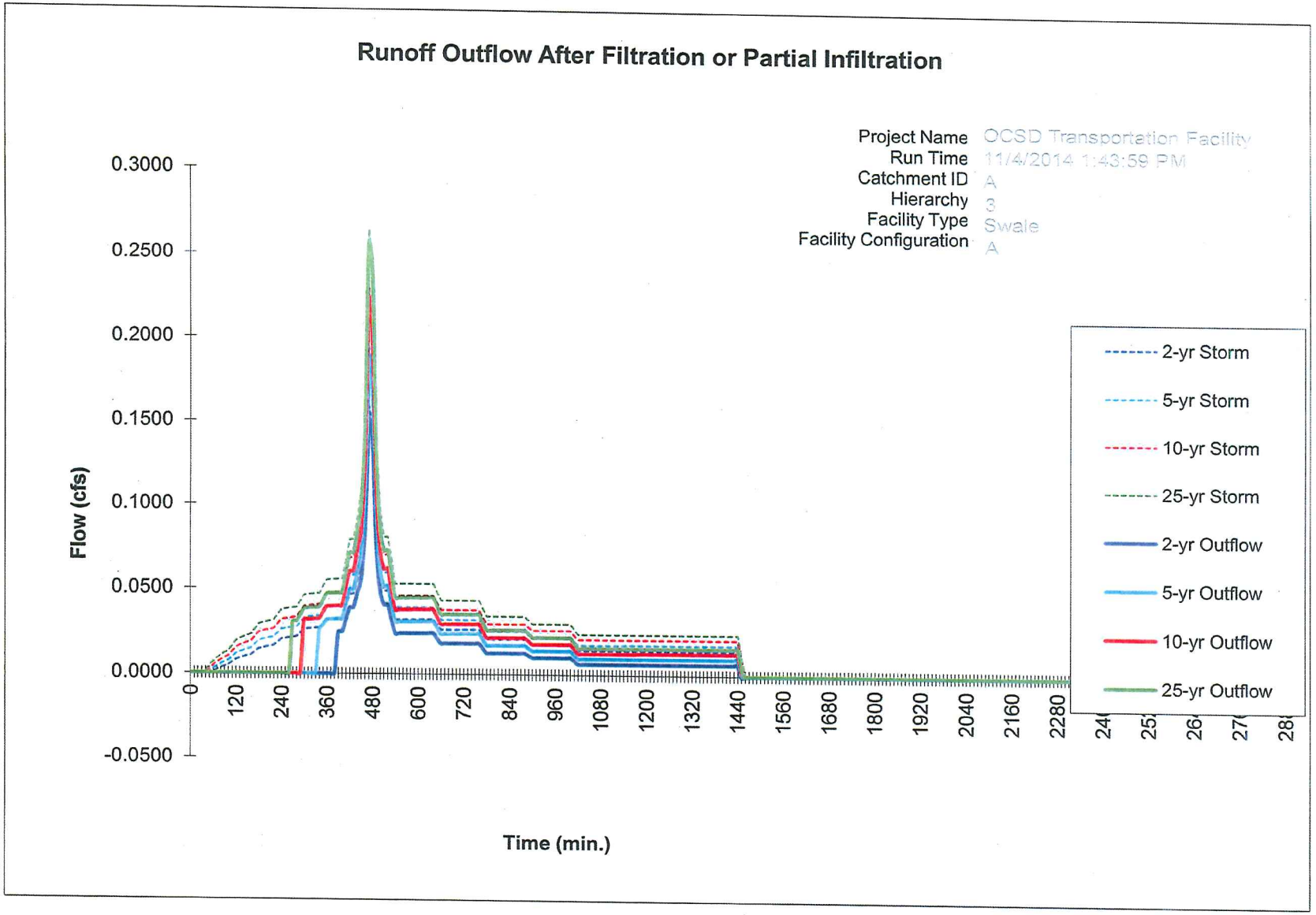
BES - Presumptive Approach Calculator - Ver 1.2

Output Chart



Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID: B

Project Name: OCSD Transportation Facility
Project Address: Oregon City School District
Oregon City, OR 97045
Designer: JVM
Company: Sisul Engineering

Date: 11/04/14
Permit Number: 0
Run Time 11/4/2014 1:44:53 PM

Drainage Catchment Information

Catchment ID	B	
	Catchment Area	
Impervious Area	9,661	SF
Impervious Area	0.22	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

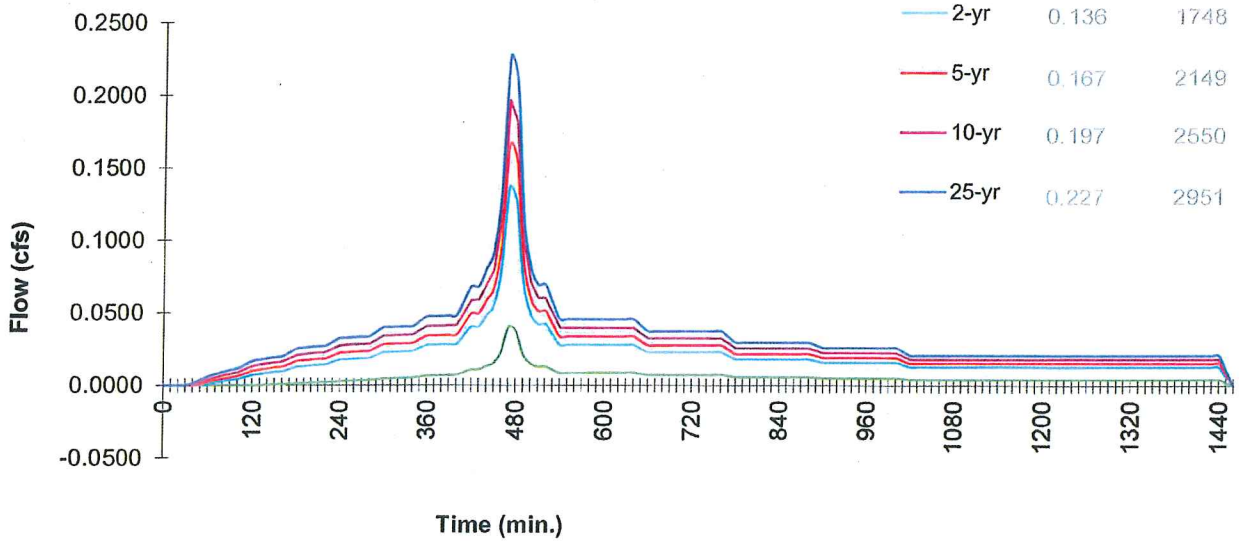
Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations

SBUH Results

	Peak Rate (cfs)	Volume (cf)
PR	0.04	505
2-yr	0.136	1748
5-yr	0.167	2149
10-yr	0.197	2550
25-yr	0.227	2951



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Presumptive Approach Calculator ver. 1.2

Catchment ID: B

Run Time 11/4/2014 1:48:48 PM

Project Name: OCSD Transportation Facility Catchment ID: B Date: 11/4/2014

Instructions:

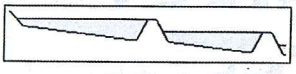
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 3

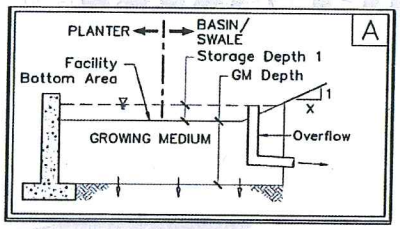
Goal Summary:

Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...	
		Pollution Reduction as a	10-yr (aka disposal) as a
3	Off-site flow to drainageway, river, or storm-only pipe system.	PASS	N/A

Facility Type = Swale



Facility Configuration: A



Refer to Sloped Facility Worksheet and enter Variable Parameters

Calculation Guide
Max. Rock Stor. Bottom Area Per Swale Dims

DATA FOR ABOVE GRADE STORAGE COMPONENT

Infiltration Area = 267 sf
Surface Capacity Volume = 153.9 cf

BELOW GRADE STORAGE

Rock Storage Bottom Area = 267 sf
Rock Storage Depth = 0 in

Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 154 cf
Infiltration Area at 75% Depth1 = -18 SF
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.012 cfs

Rock Storage Capacity = 0 cf

Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.006 cfs

Native Infiltration Rate Used in P/

RESULTS

Pollution Reduction	Overflow Volume		Run PAC
PASS	0 CF	78% Surf. Cap. Used	

Output File

	2-yr	5-yr	10-yr	25-yr
Peak cfs	0.130	0.160	0.190	0.220

FACILITY FACTS

Total Facility Area Including Freeboard = 1,350 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.140

Presumptive Approach Calculator Ver 1.2

Instructions:

1. Refer to facility graphics on the Graphics tab, then fill in all relevant facility parameters in the Data Entry table below. Data entry cells vary based on Facility Configuration selected on Facility Design Data tab.
2. Delete all facility parameters that may have been entered by the previous iteration that are no longer applicable.

Project Name: OCSD Transportation Facility

Date: 11/4/2014

Run Time 11/4/2014 1:44:53 PM

Catchment ID: B

Data Entry

Parameters / **Rock Storage Parameters** / **Error Messages**

Facility Segment	Length of facility segment (ft)	Downstream Check Dam Length (ft)	Longitudinal Facility Slope (ft/ft)	Bottom Width (ft)	Side Slope Right	Side Slope Left	Downstream Depth (inches)	Landscape Width (ft)	Rock Storage Width (ft)	Rock Storage Depth (inches)	Rock Void Ratio	Error Messages
	$L_{segment}$	L_{dam}	S	W_{bottom}	X_{right}:1	X_{left}:1	D_{ds}	$W_{landscape}$	W_{rock}	D_{rock}	v	
1	50	2.33	0.0233	2	3	3	9	9				Warning
2	50	2.33	0.0233	2	3	3	9	9				Warning
3	50	2.33	0.0233	2	3	3	9	9				Warning
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

facility segment with warning message not fully utilized. Create shorter facility segments to increase surface storage capacity and infiltration area.

Project Name:

Depth 2=

Depth 3=

Worksheet Calculations

Parameters / **Rock Storage Parameters**

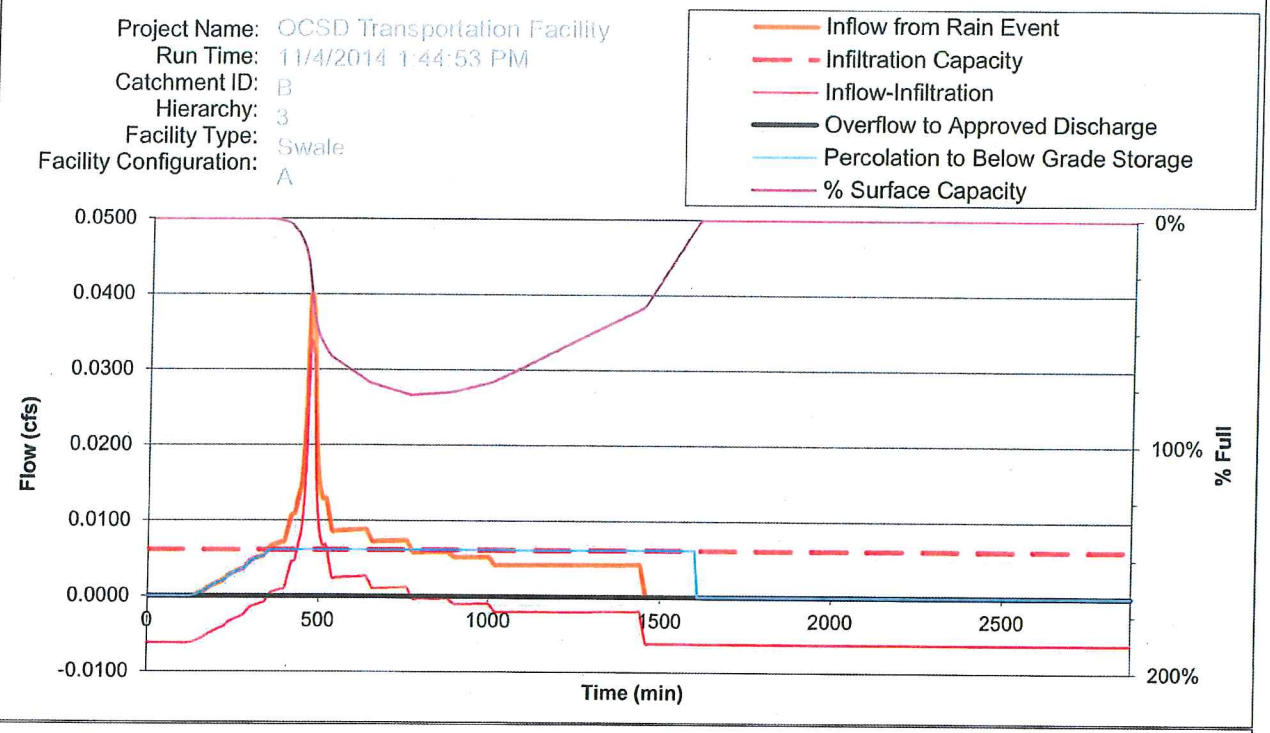
Facility Segment	Adjusted Length of facility segment (ft)	Adjusted Length if D_{up} = 0 (ft)	Upstream Depth (inches)	Downstream Top Width (ft)	Upstream Top Width (ft)	Downstream Cross-sectional Area (sf)	Upstream Cross-sectional Area (sf)	Surface Capacity Volume (cf)	75% of Max. Downstream Depth (inches)	75% of Max. Upstream Depth (inches)	75% of Max. Adjusted Length if $D_{up75\%}$ = 0 (ft)	75% of Max. Downstream Top Width (ft)	75% of Max. Upstream Top Width (ft)	Infiltration Area @ 75% Full (sf)	Rock Storage Length (ft)	Rock Storage Bottom Area (sf)	Rock Storage Capacity Volume (cf)
	L_{adjust}	$L_{adjust2}$	D_{up}	W_{top-ds}	W_{top-up}	A_{ds}	A_{up}	$V_{surface}$	$D_{ds75\%}$	$D_{up75\%}$	$L_{adjust3}$	$W_{top-ds75\%}$	$W_{top-up75\%}$	$A_{75\%}$	L_{rock}	A_{rock}	V_{rock}
1	48.84	32.19	0.00	6.50	2.00	3.19	0.00	51	6.75	0.00	24.14	5.38	2.00	89	50	89	0
2	48.84	32.19	0.00	6.50	2.00	3.19	0.00	51	6.75	0.00	24.14	5.38	2.00	89	50	89	0
3	48.84	32.19	0.00	6.50	2.00	3.19	0.00	51	6.75	0.00	24.14	5.38	2.00	89	50	89	0
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0
								154	$V_{surface}$ @ Depth1					267		267	0

BES - Presumptive Approach Calculator - Ver 1.2

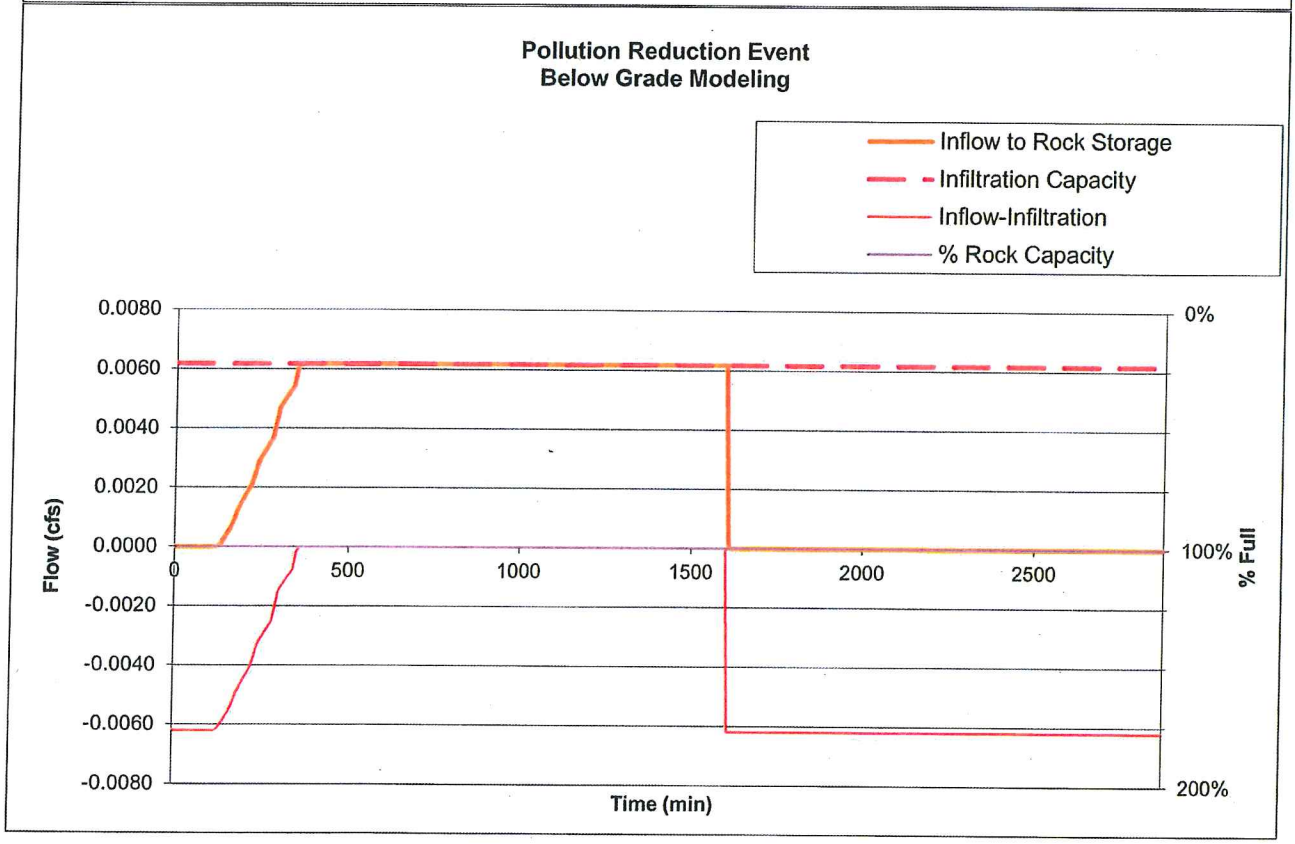
PR Con-A&B

Pollution Reduction Event
Surface Facility Modeling

Project Name: OCSD Transportation Facility
Run Time: 11/4/2014 1:44:53 PM
Catchment ID: B
Hierarchy: 3
Facility Type: Swale
Facility Configuration: A



Pollution Reduction Event
Below Grade Modeling



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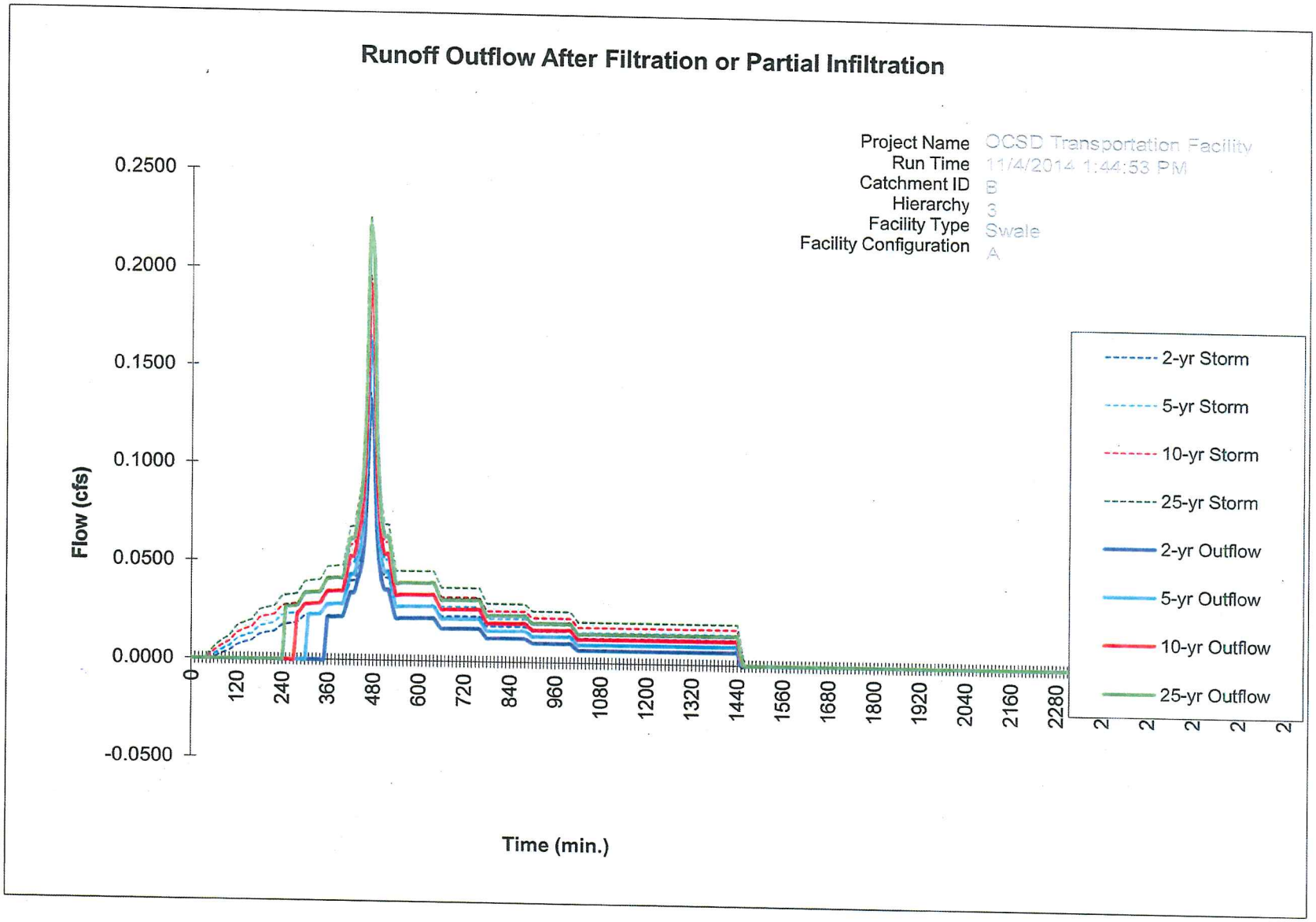
BES - Presumptive Approach Calculator - Ver 1.2

Output Chart



Presumptive Approach Calculator ver. 1.2

Catchment Data

Catchment ID:	**C**
Project Name:	**OCSD Transportation Facility**
Project Address:	**Oregon City School District**
	Oregon City, OR 97045
Date:	**11/04/14**
Permit Number:	**0**
Designer:	**JVM**
Company:	**Sisul Engineering**
Run Time	11/4/2014 1:45:58 PM

Drainage Catchment Information

Catchment ID	C	
	Catchment Area	
Impervious Area	3,894	SF
Impervious Area	0.09	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

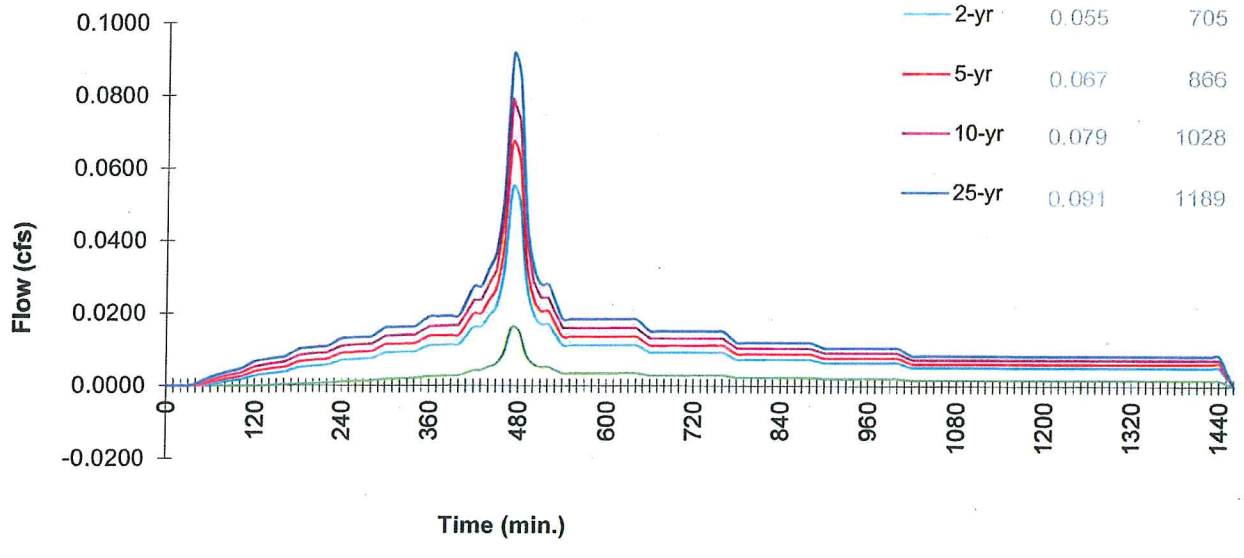
Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations

SBUH Results

	Peak Rate (cfs)	Volume (cf)
PR	0.016	203
2-yr	0.055	705
5-yr	0.067	866
10-yr	0.079	1028
25-yr	0.091	1189



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Presumptive Approach Calculator ver. 1.2

Catchment ID: C

Run Time 11/4/2014 1:47:44 PM

Project Name: OCSD Transportation Facility Catchment ID: C Date: 11/4/2014

Instructions:

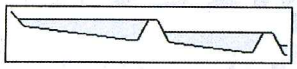
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 3

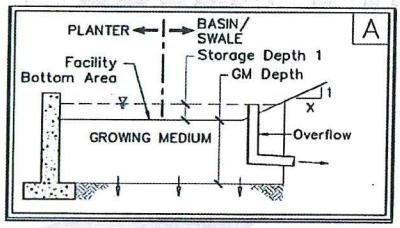
Goal Summary:

Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...	
		Pollution Reduction as a	10-yr (aka disposal) as a
3	Off-site flow to drainageway, river, or storm-only pipe system.	PASS	N/A

Facility Type = Swale



Facility Configuration: A



Refer to Sloped Facility Worksheet and enter Variable Parameters

Calculation Guide: Max. Rock Stor. Bottom Area Per Swale Dims

DATA FOR ABOVE GRADE STORAGE COMPONENT

Infiltration Area = 104 sf
Surface Capacity Volume = 56.0 cf

BELOW GRADE STORAGE

Rock Storage Bottom Area = 104 sf
Rock Storage Depth = 0 in

Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 56 cf
Infiltration Area at 75% Depth1 = -9 SF
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.005 cfs

Rock Storage Capacity = 0 cf

Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.002 cfs

Native Infiltration Rate Used in PA

RESULTS

Pollution Reduction: PASS

Overflow Volume: 0 CF

90% Surf. Cap. Used

Run PAC

Output File

	2-yr	5-yr	10-yr	25-yr
Peak cfs	0.053	0.065	0.077	0.089

FACILITY FACTS

Total Facility Area Including Freeboard = 297 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.076

Presumptive Approach Calculator Ver 1.2

Instructions:

1. Refer to facility graphics on the Graphics tab, then fill in all relevant facility parameters in the Data Entry table below. Data entry cells vary based on Facility Configuration selected on Facility Design Data tab.
2. Delete all facility parameters that may have been entered by the previous iteration that are no longer applicable.

Project Name: OCSD Transportation Facility

Date: 11/4/2014

Run Time 11/4/2014 1:45:58 PM

Catchment ID: C

Data Entry

Parameters

Facility Segment	Length of facility segment (ft) $L_{segment}$	Downstream Check Dam Length (ft) L_{dam}	Longitudinal Facility Slope (ft/ft) S	Bottom Width (ft) W_{bottom}	Side Slope Right X_{right}:1	Side Slope Left X_{left}:1	Downstream Depth (inches) D_{ds}	Landscape Width (ft) $W_{landscape}$
1	33	0	0.02	2	3	3	9	9
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Rock Storage Parameters

Rock Storage Width (ft) W_{rock}	Rock Storage Depth (inches) D_{rock}	Rock Void Ratio v

Error Messages

Project Name:

Worksheet Calculations

Depth 2=

Depth 3=

Parameters

Facility Segment	Adjusted Length of facility segment (ft) L_{adjust}	Adjusted Length if $D_{up} = 0$ (ft) $L_{adjust2}$	Upstream Depth (inches) D_{up}	Downstream Top Width (ft) $W_{top\text{-}ds}$	Upstream Top Width (ft) $W_{top\text{-}up}$	Downstream Cross-sectional Area (sf) A_{ds}	Upstream Cross-sectional Area (sf) A_{up}	Surface Capacity Volume (cf) $V_{surface}$	75% of Max. Downstream Depth (inches) $D_{ds75\%}$	75% of Max. Upstream Depth (inches) $D_{up75\%}$	75% of Max. Adjusted Length if $D_{up75\%} = 0$ (ft) $L_{adjust3}$	75% of Max. Downstream Top Width (ft) $W_{top\text{-}ds75\%}$	75% of Max. Upstream Top Width (ft) $W_{top\text{-}up75\%}$	Infiltration Area @ 75% Full (sf) $A_{75\%}$
1	33.00	N/A	1.08	6.50	2.54	3.19	0.20	56	6.75	0.00	28.13	5.38	2.00	104
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
								56	$V_{surface}$ @ Depth1					104

Rock Storage Parameters

Rock Storage Length (ft) L_{rock}	Rock Storage Bottom Area (sf) A_{rock}	Rock Storage Capacity Volume (cf) V_{rock}
33	104	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
	104	0

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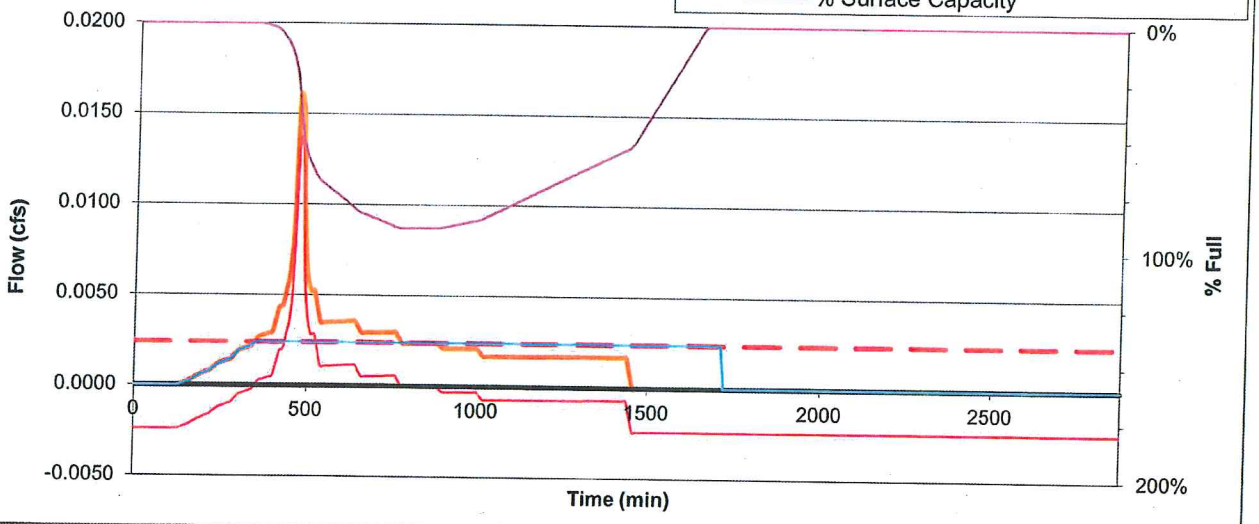
BES - Presumptive Approach Calculator - Ver 1.2

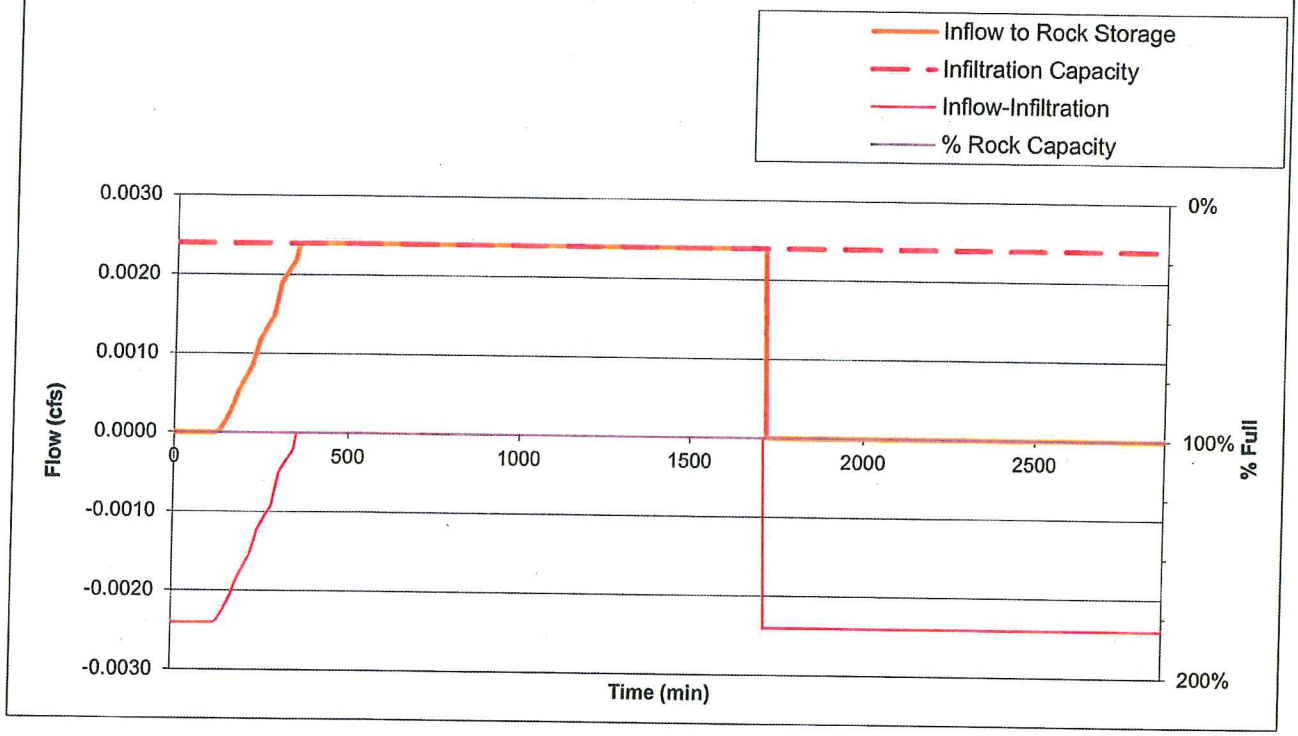
PR Con-A&B

Pollution Reduction Event
Surface Facility Modeling

Project Name: OCSD Transportation Facility
Run Time: 11/4/2014 1:45:58 PM
Catchment ID: C
Hierarchy: 3
Facility Type: Swale
Facility Configuration: A



Pollution Reduction Event
Below Grade Modeling



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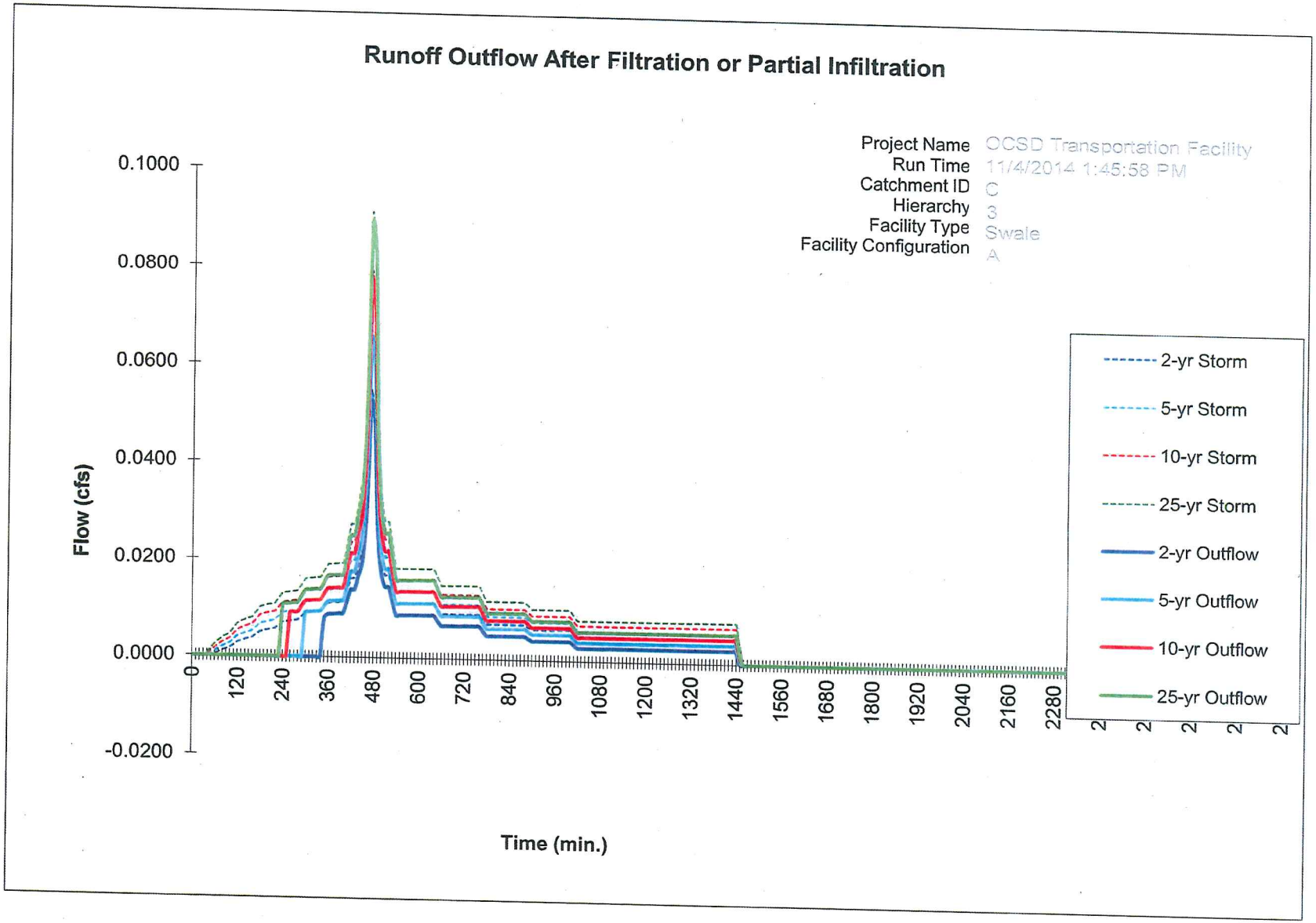
BES - Presumptive Approach Calculator - Ver 1.2

Output Chart



DETENTION POND ROUTING DATA

OCSD Transportation Facility (SGL14-070)

Orifice #1 Diameter:	1 1/2	inches	Overflow Riser Dia:	18	inches	
Orifice #1 Elevation:	0.00	feet	Overflow elevation:	1.42	ft	
Orifice #2 Diameter:	0	inches				
Orifice #2 Elevation:	0.00	feet	Infiltration Rate:	0.0	in/hr =	0.0000000 cfs
Orifice #3 Diameter:	0	inches				
Orifice #3 Elevation:	0.00	feet				

B	C	D	E	F	G	H	I	J	
Stage	Elevation	Surface Area	Storage Volume	Orifice #1 Discharge	Orifice #2 Discharge	Orifice #3 Discharge	Overflow Discharge	Actual Discharge	
	(ft)	(sq.ft)	(cu.ft.)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	
1	0.00	19758	0	0.000	0.000	0.000	0.000	0.000	<= Orifice Outflow
2	0.25	20184	4993	0.031	0.000	0.000	0.000	0.031	
3	0.50	20613	10092	0.043	0.000	0.000	0.000	0.043	
4	0.75	21046	15300	0.053	0.000	0.000	0.000	0.053	
5	1.00	21483	20616	0.061	0.000	0.000	0.000	0.061	
6	1.25	21923	26042	0.068	0.000	0.000	0.000	0.068	
7	1.50	22367	31578	0.075	0.000	0.000	0.286	0.361	
8	1.75	22816	37226	0.081	0.000	0.000	2.394	2.475	

Wat. Quality => & Detention Storage

0.00	0.000	0.0	0.00		
0.25	0.031	4992.8	0.00		
0.50	0.043	10092.4	0.00		
0.75	0.053	15299.8	0.00		
1.00	0.061	20615.9	0.00		
1.25	0.068	26041.6	0.00		
1.50	0.361	31577.9	0.00		
1.75	2.475	37225.8	0.00		

B	Stage Number
C	Water Surface Elevation.
D	Water Surface Area @ given Elevation
E	Storage Volume = [(Average Area) x (d Elevation)] + Previous Volume
ORIFICE	$Q = 0.62 \times (\text{area}) \times (2 \times g \times h)^{1/2}$
F	Q = Orifice Eq.
G	Q = Orifice Eq.
H	Q = Orifice Eq.
I	Overflow Riser as a Weir $Q = 2.68 \times L \times H^{3/2}$
	$L = 2 \cdot pi \cdot r$
J	F+G+H+I

DETENTION POND ROUTING DATA

OCSD Transportation Facility (SGL14-070)

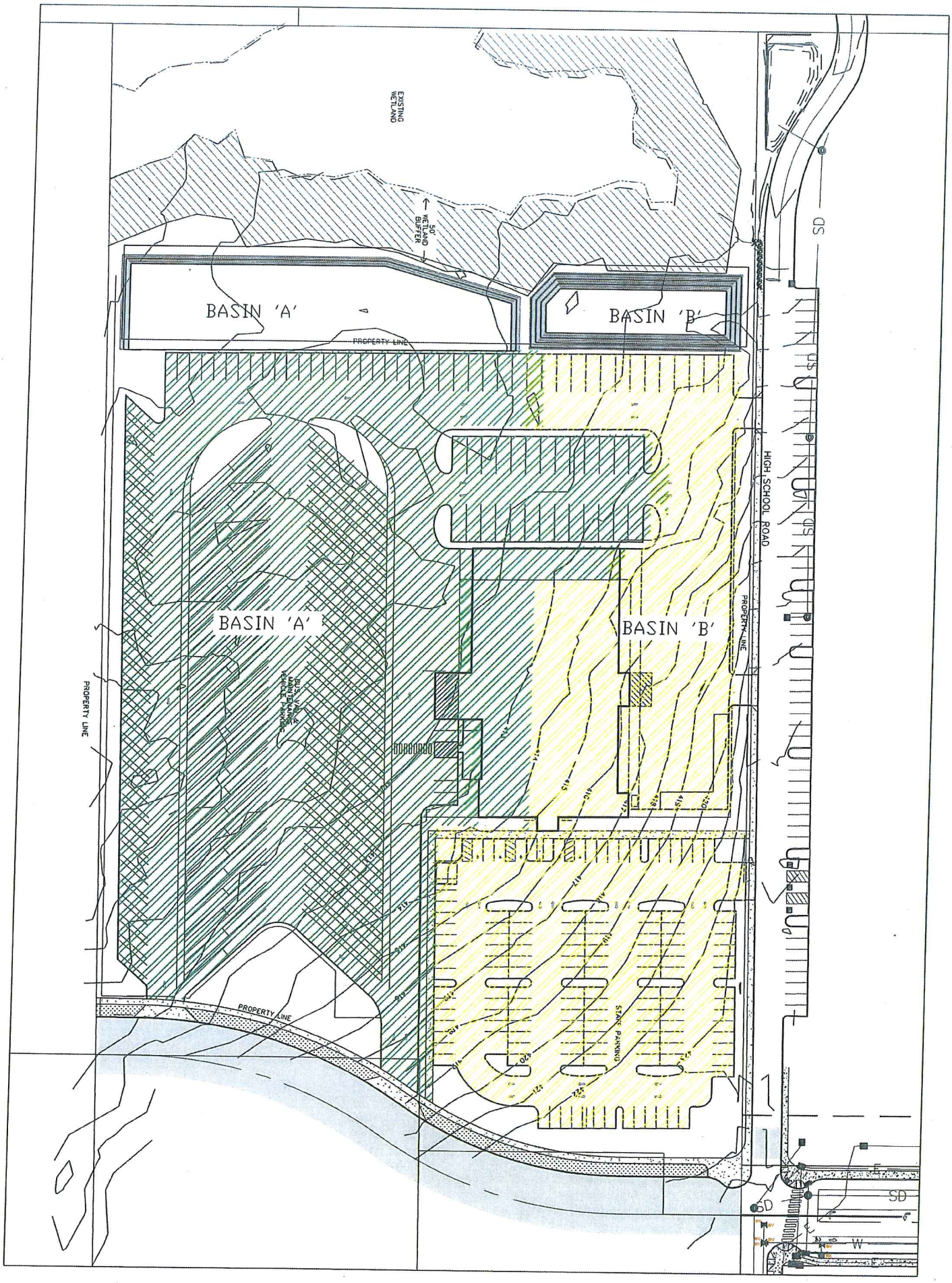
Orifice #1 Diameter:	1 1/4	inches	Overflow Riser Dia:	18	inches	
Orifice #1 Elevation:	0.00	feet	Overflow elevation:	2.75	ft	
Orifice #2 Diameter:	0	inches				
Orifice #2 Elevation:	0.00	feet	Infiltration Rate:	0.0	in/hr =	0.0000000 cfs
Orifice #3 Diameter:	0	inches				
Orifice #3 Elevation:	0.00	feet				

B	C	D	E	F	G	H	I	J	
Stage	Elevation	Surface Area	Storage Volume	Orifice #1 Discharge	Orifice #2 Discharge	Orifice #3 Discharge	Overflow Discharge	Actual Discharge	
	(ft)	(sq.ft)	(cu.ft.)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	
1	0.00	5143	0	0.000	0.000	0.000	0.000	0.000	<= Orifice Outflow
2	0.25	5505	1331	0.021	0.000	0.000	0.000	0.021	
3	0.50	5874	2753	0.030	0.000	0.000	0.000	0.030	
4	0.75	6250	4269	0.037	0.000	0.000	0.000	0.037	
5	1.00	6635	5880	0.042	0.000	0.000	0.000	0.042	
6	1.25	7027	7587	0.047	0.000	0.000	0.000	0.047	
7	1.50	7426	9394	0.052	0.000	0.000	0.000	0.052	
8	1.75	4834	10926	0.056	0.000	0.000	0.000	0.056	
9	2.00	8249	12562	0.060	0.000	0.000	0.000	0.060	
10	2.25	8671	14677	0.064	0.000	0.000	0.000	0.064	
11	2.50	9102	16898	0.067	0.000	0.000	0.000	0.067	
12	2.75	9540	19229	0.070	0.000	0.000	0.000	0.070	
13	3.00	9985	21669	0.073	0.000	0.000	1.579	1.652	
14	3.25	10438	24222	0.076	0.000	0.000	4.465	4.542	

Wat. Quality => & Detention Storage

0.00	0.000	0.0	0.00	
0.25	0.021	1331.0	0.00	
0.50	0.030	2753.4	0.00	
0.75	0.037	4268.9	0.00	
1.00	0.042	5879.5	0.00	
1.25	0.047	7587.3	0.00	
1.50	0.052	9393.9	0.00	
1.75	0.056	10926.4	0.00	
2.00	0.060	12561.8	0.00	
2.25	0.064	14676.8	0.00	
2.50	0.067	16898.4	0.00	
2.75	0.070	19228.6	0.00	
3.00	1.652	21669.3	0.00	
3.25	4.542	24222.1	0.00	

B	Stage Number
C	Water Surface Elevation.
D	Water Surface Area @ given Elevation
E	Storage Volume = [(Average Area) x (d Elevation)] + Previous Volume
ORIFCE	$Q = 0.62 \times (\text{area}) \times (2 \times g \times h)^{1/2}$
F	Q = Orifice Eq.
G	Q = Orifice Eq.
H	Q = Orifice Eq.
I	Overflow Riser as a Weir $Q = 2.68 \times L \times H^{3/2}$
	$L = 2*pi*r$
J	F+G+H+I


EXISTING WETLAND
50' WETLAND BUFFER
BASIN 'A'
BASIN 'B'
PROPERTY LINE
HIGH SCHOOL ROAD
SD
BASIN 'A'
BASIN 'B'
PROPERTY LINE
BUS/VAN/MAINTENANCE VEHICLE PARKING
PROPERTY LINE
STAFF PARKING
SD
W

Soil Map—Clackamas County Area, Oregon

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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: http://websoilsurvey.nrcs.usda.gov
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: Clackamas County Area, Oregon
Survey Area Data: Version 9, Sep 19, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 2011

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.

Map Unit Legend

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
8B	Bornstedt silt loam, 0 to 8 percent slopes	10.2	100.0%
Totals for Area of Interest		**10.2**	**100.0%**

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Report—Physical Soil Properties

Physical Soil Properties–Clackamas County Area, Oregon														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
8B—Bornstedt silt loam, 0 to 8 percent slopes														
Bornstedt	0-8	- 9-	-67-	20-24- 27	1.30-1.50	4.00-14.00	0.15-0.17	0.0-2.9	3.0-4.0	.37	.37	5	6	48
	8-33	- 7-	-62-	27-31- 35	1.40-1.60	4.00-14.00	0.13-0.17	0.0-2.9	1.0-3.0	.37	.37			
	33-71	- 7-	-48-	40-45- 50	1.30-1.50	0.42-1.40	0.12-0.15	0.0-2.9	0.5-1.0	.32	.32			

Data Source Information

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 9, Sep 19, 2014

FIGURE 4-1

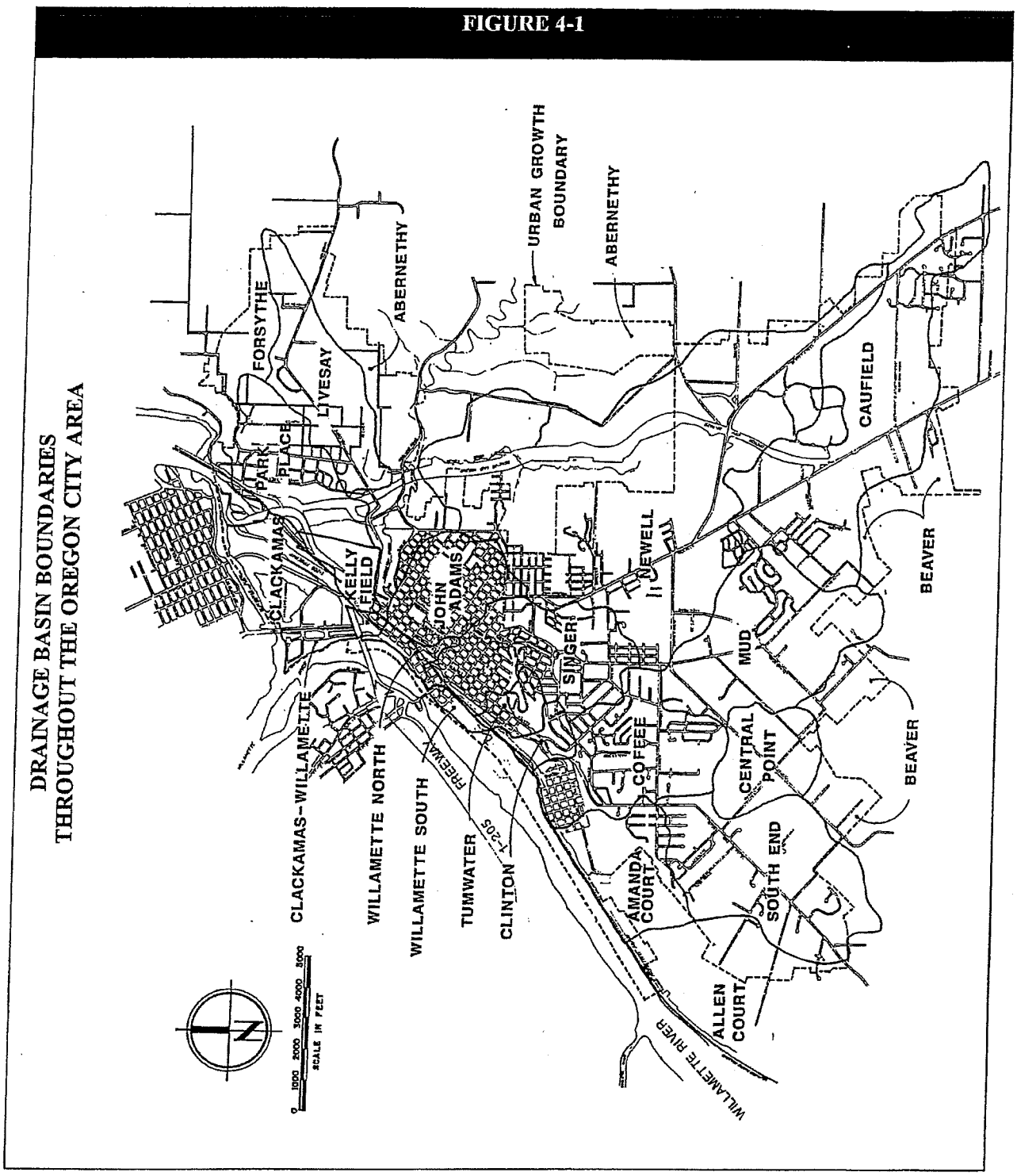

DRAINAGE BASIN BOUNDARIES
THROUGHOUT THE OREGON CITY AREA
FORSYTHE
LIVESAY
ABERNETHY
URBAN GROWTH BOUNDARY
ABERNETHY
CAUFIELD
PARK PLACE
CLACKAMAS
KELLY FIELD
JOHN ADAMS
NEWELL
BEAVER
SINGER
MUD
COFFEE
CENTRAL POINT
BEAVER
CLACKAMAS-WILLAMETTE
WILLAMETTE NORTH
WILLAMETTE SOUTH
TUMWATER
CLINTON
I-205
FREEWAY
AMANDA COURT
SOUTH END
ALLEN COURT
WILLAMETTE RIVER
N
0 1000 2000 3000 4000 5000
SCALE IN FEET

Table 4-3 MODIFIED CURVE NUMBERS

SCS Western Washington Runoff Curve Numbers

Runoff curve numbers for selected agricultural, suburban, and urban land use for Type 1A rainfall distribution, 24-hour storm duration. (Published by SCS in 1982)

LAND USE DESCRIPTION		CURVE NUMBERS BY HYDROLOGIC SOIL GROUP			
		A	B	C	D
Cultivated land[1]	Winter Condition	86	91	94	95
Mountain Open Areas:	Low growing brush and grassland.	74	82	89	92
Meadow or pasture:		65	78	85	89
Wood or forest land:	Undisturbed	42	64	76	81
	Established second growth[2]	48	68	78	83
	Young second growth or brush	55	72	81	86
Orchard:	With over crop	81	88	92	94
Open spaces, lawns, parks, golf courses, cemeteries, landscaping					
Good Condition:	Grass cover on > =75% of area	68	80	86	90
Fair Condition:	Grass cover on 50-75% of area	77	85	90	92
Gravel Roads and Parking Lots:		76	85	89	91
Dirt Roads and Parking Lots:		72	82	87	89
Impervious surfaces, pavement, roofs, etc.		98	98	98	98
Open water bodies:	Lakes, wetlands, ponds, etc.	100	100	100	100

Single Family Residential [3]: Dwelling unit/gross acre	% Impervious[4]	
1.0 DU/GA	15	Select a separate curve number for pervious and impervious portions of the site or basin.
1.5 DU/GA	20	
2.0 DU/GA	25	
2.5 DU/GA	30	
3.0 DU/GA	34	
3.5 DU/GA	38	
4.0 DU/GA	42	
4.5 DU/GA	46	
5.0 DU/GA	48	
5.5 DU/GA	50	
6.0 DU/GA	52	
6.5 DU/GA	54	
7.0 DU/GA	56	
Planned Unit Developments, condominiums, apartments, commercial businesses & industrial areas[3]	% impervious[4] Must be computed	Select a separate curve number for pervious and impervious portions of the site or basin.

[1] For a more detailed description of agricultural land use curve numbers, refer to National Engineering Handbook, Sec. 4, Hydrology, Chapter 9, August 1972.

[2] Modified by KCFW, 1995.

[3] Assumes roof and driveway runoff is directed into street/storm system.

[4] The remaining pervious areas (lawn) are considered to be in good condition for these curve numbers.

Table 4-4 MANNING'S COEFFICIENTS/"K" FACTORS		
"n" AND "k" Value Used in Time Calculations for Hydrographs		
"n" Sheet Flow Equation Manning's Values (for initial 300 ft. of travel)		n_s
Smooth surfaces (concrete, asphalt, gravel, or bare hand packed soil)		0.01
Fallow fields or loose soil surface (no residue)		0.05
Cultivated soil with residue cover (s # 0.20 ft/ft)		0.06
Cultivated soil with residue cover (s > 0.20 ft/ft)		0.17
Short prairie grass and lawns		0.15
Dense grasses		0.24
Bermuda grass		0.41
Range (natural)		0.13
Woods or forest with light underbrush		0.40
Woods or forest with dense underbrush		0.80
* Manning values for sheet flow only, from Overton and Meadows 1976 (See SCS's TR-55, 1986) "k" Values Used in Travel Time/Time of Concentration Calculations Shallow Concentrated Flow (After the initial 300 ft. of sheet flow, R = 0.1)		k_s
1.	Forest with heavy ground litter and meadows (n = 0.10)	3
2.	Brushy ground with some trees (n = 0.060)	5
3.	Fallow or minimum tillage cultivation (n=0.040)	8
4.	High grass (n=0.035)	9
5.	Short grass, pasture, and lawns (n=0.030)	11
6.	Nearly bare ground (n=0.025)	13
7.	Paved and gravel areas (n=0.012)	27
** Channel flow (intermittent) (At beginning of visible channels R=0.2)		k_c
1.	Forested swale with heavy ground litter (n=0.10)	5
2.	Forested drainage course/ravine with defined channel bed (n=0.050)	10
3.	Rock-lined waterway (n=0.035)	15
4.	Grassed waterway (n=0.030)	17
5.	Earth-lined waterway (n=0.025)	20
6.	CMP pipe (n=0.024)	21
7.	Concrete pipe (0.012)	42
8.	Other waterways and pipe 0.508/n	
Channel flow (Continuous stream, R=0.4)		k_c
9.	Meandering stream with some pools (n=0.040)	20
10.	Rock-lined stream (n=0.035)	23
11.	Grass-lined stream (n=0.030)	27
12.	Other streams, man-made channels and pipe 0.807/n **	
** See Table 6-3 for additional Mannings "n" values for open channels.		

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9750 SW Nimbus Avenue
Beaverton, OR 97008-7172
p| 503-641-3478 f| 503-644-8034

MEMORANDUM

To: Ronald Lee / BBL Architects

Date: October 30, 2014

GRI Project No.: 5635

From: Wesley Spang, PhD, PE, GE

Re: Preliminary Design Recommendations
Oregon City School District Transportation Maintenance Facility
Meyers Road and High School Avenue
Oregon City, Oregon

At your request, GRI is completing a geotechnical investigation for the Oregon City School District transportation maintenance facility in Oregon City. Our field investigation was recently completed, and we are in the process of completing the laboratory testing and engineering analyses for the project. This memorandum provides our preliminary conclusions and recommendations regarding seismic considerations and foundation support.

Project Description

We understand the project will consist of grading the site in preparation for construction of a new transportation/maintenance facility. The structure will be two stories tall and include storage, offices, and a bus maintenance area on the lower floor, and a partial second-story mezzanine with offices. A staff parking lot will be constructed in the southern portion of the property; the western half of the site will be used for bus parking.

Field Investigation

Our field investigation consisted of four borings drilled with a trailer-mounted drill rig and five test pits excavated with a track-mounted backhoe. The borings were advanced to a maximum depth of 21.5 ft, and the test pits were excavated to a maximum depth of 10 ft. Soil conditions disclosed by the borings and test pits generally consist of stiff silt that becomes more stiff with depth. Highly weathered basalt, consisting of very stiff to hard silt with gravel-size pieces of weathered basalt, was encountered at depths of 5 to 10 ft and is present to the maximum depth of exploration.

Preliminary Conclusions and Recommendations

Seismic Considerations. Based on our review of the 2012 International Building Code (IBC) and 2014 Oregon Structural Specialty Code, which incorporates recommendations from ASCE 7-10, Minimum Design Loads for Building and Other Structures, and the results of our subsurface explorations, we recommend using Site Class D to evaluate the seismic design of the structure. The maximum horizontal direction spectral response accelerations were obtained from the USGS Seismic Design Maps for the coordinates of 45.32° N latitude and 122.57° W longitude. The S_S and S_1 values identified for the site are 0.89 and 0.38 g, respectively. These bedrock spectral ordinates are adjusted for Site Class with the short- and long-period site coefficients, F_a and F_v, based on subsurface conditions or with a site-specific response

analysis. The short- and long-period site coefficients, F_a and F_v, are 1.14 and 1.63, respectively, for Site Class D. The design-level response spectrum is calculated as two-thirds of the Site Class-adjusted Risk-Targeted Maximum Considered Earthquake (MCE_R) level spectrum.

Based on the results of our preliminary analyses, the cyclic softening potential at the site is considered low for both crustal earthquake and Cascadia Subduction Zone earthquake. The potential for earthquake-induced ground rupture, landslides, liquefaction, and subsidence is low, and the potential for damage by tsunami and/or seiche at the site is absent.

Foundation Support. Discussions with Andrew Leichty of Miller Consulting Engineers, the project structural engineer, indicate the maximum column and wall load will be about 80 kips and 8 kips/ft, respectively. In our opinion, foundation support for the building can be provided by conventional column-type and continuous wall footings founded in the underlying firm, native soils and designed using an allowable bearing value of up to 2,500 psf. This value applies to the total of dead load and/or frequently applied live loads and can be increased by one-half for the total of all loads; dead, live, and wind or seismic.

We recommend establishing all footings in firm, undisturbed native soil or compacted structural fill at a minimum depth of 1.5 ft below the lowest adjacent finished grade. The footing width should not be less than 18 in. for wall footings and 24 in. for column footings. Excavations for all foundations should be made with a smooth-edge bucket, and all footing excavations should be observed by a qualified geotechnical engineer. Soft or otherwise unsuitable material encountered at foundation subgrade level should be overexcavated and backfilled with granular structural fill.

We estimate the total settlement of continuous wall and column footings will be less than 1 in. for footings supporting the loads referenced above. Differential settlement between adjacent comparably loaded footings should be less than half the total settlement.

Limitations

The preliminary information provided in this memorandum is not intended for final design of the project. Additional details regarding site conditions and recommendations for design and construction of the proposed improvements will be provided in our forthcoming geotechnical report.

Submitted for GRI,

A. Wesley Spang, PhD, PE, GE *Renews 6/2016*
Principal

This document has been submitted electronically.

GRI