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MEMORANDUM

Date: May 2, 2018 **BKF Job Number: 20160074**

Deliver To: **Andrew Bielak, Project Manager**
MidPen Housing Corp.

From: **Lauren Boyle, Project Engineer**
BKF Engineers

Subject: **Cypress Point Hydromodification Management (HM) – Revision 2**

Existing Conditions

The existing site is approximately 11 acres in Moss Beach, California and bordered by Carlos Street to the west, Lincoln Street to the east, 16th Street to the North and Sierra Street to the south. The site is relatively undeveloped and consists of several concrete slab-on-grade building foundations, native vegetation, unpaved service roads and water and electrical infrastructure.

The existing site slopes range from 10% to 50% with the high point on the east side of the property and the low point at the northwest corner. There is no existing storm drain, sanitary sewer or known gas infrastructure on the property. Storm water runoff is assumed to percolate on site and excess runoff surface flows towards Carlos Street and 16th Street, ultimately discharging to Montara Creek within the James V. Fitzgerald Area of Specific Biological Significance (ASBS) watershed area. Beside the 11 acre property, an additional 1 acre of offsite runoff drains through the project site and contributes to the overall tributary drainage area.

Project Description

The project proposes to construct 71 units of affordable housing on roughly 5 acres of the site. New improvements will include town homes and flats, a community building, at-grade parking and access roads, an entry road connection to Carlos Street, pedestrian pathways and new pervious landscaping.

Since the existing site does not currently connect directly to the public storm drain system, the project proposes a new connection to the existing storm drain main on Carlos Street, which ultimately outfalls to Montara Creek. Proposed storm drain infrastructure for the project will consist of storm drain lines approximately ranging from 12-inch to 21-inch diameter, inlets at low points throughout the hardscape and landscape areas, manholes at junction areas, building downspout connections, cleanouts and bio-retention infrastructure designed to comply with the development's dual requirements of stormwater treatment and Hydromodification Management (HM) requirements.

Hydromodification Management Requirement

As required by the Municipal Regional Permit (MRP) and the authority given to the Clean Water Program San Mateo, Projects creating one or more acres of impervious area in non-exempt regions of the County are required to attenuate runoff associated with the increase in runoff. This project is required to implement HM, see Attachment A: HM Applicability Worksheet and Attachment B: Hydromodification

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Applicability Map. The goal of the HM program is to control the post-project flow to match pre-project runoff flow rate and duration from 10 percent of the pre-project 2-year peak flow up to the pre-project 10-year peak flow. The Bay Area Hydrology Model (BAHM) program is used to analyze the Project's flows as prescribed in the MRP. The project anticipates utilizing bio-retention areas as the main best management practice (BMP) treatment strategy for MRP and HM compliance. Stormwater attenuation will be achieved in the bio-retention areas by modifying the overflow riser structures and adding orifices to subdrain connections, thereby adding the storage and flow control necessary to meet HM.

HM Model

The project consists of one Point of Compliance (POC) for HM evaluation. The POC is consistent with the pre-project runoff drainage pattern where stormwater is directed to one discharge location at Montara Creek. The Pre-project tributary area land usage, including off-site run-on, is 10 acres pervious and 2 acres impervious. The post-project tributary area is broken into two watersheds: one draining toward the bioretention areas and another that bypasses the bioretention area and follows existing drainage patterns. Cumulatively the post-project land use will be 5 acres impervious and 7 acres pervious.

Preliminary modeling results, included as Attachment C, which are a direct output from the BAHM program show full compliance with the projects HM requirements. Peak flows are attenuated between the flow ranges of 0.49 to 11.07 cfs, 10% of the 2-yr up to the 10-yr storm.

HM Facilities

The size and number of orifices and riser heights were determined by the iterative BAHM modeling process to control the outflow of site runoff to match pre-construction rates. Design parameters for the risers and orifices (i.e. heights, orifice diameter, and number of orifices) were entered into the BAHM modeling program and the output was reviewed to confirm that the post-construction rate of runoff complied with pre-construction rates. This iterative process continued until the results were satisfactory.

HM occurs within the following treatment BMP facilities:

BMP #1

(For this preliminary analysis, site-wide treatment areas were consolidated into one assumed BMP)

- Bioretention Basin 6,500 square foot footprint
- 24-inch diameter riser from 0.5-feet above the bioretention area flowline
- 3:1 Side slopes
- 18" Bioretention Soil Mix Layer underplayed by 12-inch Class 2 Permeable with 6-inch sub-drain

BMP includes the following modifications for HM compliance:

- Deepen 24-inch diameter riser from 0.5-feet to 1.0-foot above the bioretention area surface
- Install a 3.5-inch diameter choke down orifice on the 6-inch sub-drain outfall terminus.

This configuration will be adjusted accordingly as more bioretention areas are introduced into the site plan. In each case, Project will fully comply with HM requirements by controlling the post-project flow to match the pre-project runoff flow rate and duration from 10 percent of the pre-project 2-year peak flow up to the pre-project 10-year peak flow.

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Water Pollution Prevention Program
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County Review Draft

FOR REFERENCE ONLY

Hydromodification Management (HM) Applicability Worksheet

(To be completed by municipal staff, for projects that create and/or replace 43,560 sq. ft. or more of **impervious surface**. Definitions of terms in **bold** text are included on Page 2)

1. Date of Application: N/A Type of application: ❑ parcel/tentative/vesting/tract map ❑ site development review ❑ building permit

2. Project Location or Address: Carlos Street and Sierra Street, Moss Beach, CA

3. Project Name (if applicable): _____

4. Applicant's Name: MP Moss Beach Associates, LP
   ☑ Owner ❑ Contractor ❑ Engineer/Architect ❑ Builder/Developer

5. Applicant's Phone: (650)356-2900 7a. Fax: _____ 7b. Email: abielak@midpen-housing.org

6. Parcel/Tract No.: _____ 8a. Lot No.: _____ 8b. APN # 037-022-070

7. Total Lot (or Parcel/Tract) Area in Sq.Ft: 473,933

8. Total amount of **Impervious Surface** Created and/or Replaced (obtain from the completed Impervious Surface Form): 146,900 sq. ft. *If the amount is less than 1 acre (43,560 sq. ft.), HM requirements do not apply, and this form is not needed.*

9. Is the project located in an area subject to the **hydromodification** management (HM) standard? See **HM Control Areas** map at www.flowstobay.org/bs_new_development.php.

	Check one:
Yes. *Skip to Question 11.*	☒
No. *Attach map, indicating project location. Skip to Question 12 and check 12a.*	❑
Further analysis required. *Continue to Question 10.*	❑

10. If the following condition is met, the project is considered exempt from the HM standard.

	Check if condition is met:
An engineer or qualified environmental professional has determined that runoff from the project flows only through a hardened channel or enclosed pipe along its entire length before emptying into a waterway in the exempt area. *(Attach signed statement by qualified professional. Skip to Question 12 and check 12a.)*	❑

11. Does the project replace existing **impervious surface** (such as a building, parking lot, roadway, etc.) and is the total impervious area NOT increased from the pre-project condition?
   ❑ Yes. *The project is NOT required to incorporate HM measures. Go to Question 12 and check 12a.*
   ☒ No. *The project IS required to incorporate HM measures. Go Question 12, and check 12b.*

Summary of Requirements

12. Is the project…

	Yes (check one):
12a. Exempt from HM requirements?	❑
12b. Subject to HM requirements? *Project is subject to requirements in Provision C.3.g and Attachment E of the **Municipal Regional Stormwater Permit**, available for download at: www.flowstobay.org/ms_municipalities.php.*	☒

Glossary of Terms

for the Hydromodification Management (HM) Applicability Worksheet

Hydromodification - The modification of a stream's hydrograph, caused in general by increases in flows and durations that result when land is developed (e.g., made more impervious). The effects of hydromodification include, but are not limited to, increased bed and bank erosion, loss of habitat, increased sediment transport and deposition, and increased flooding.

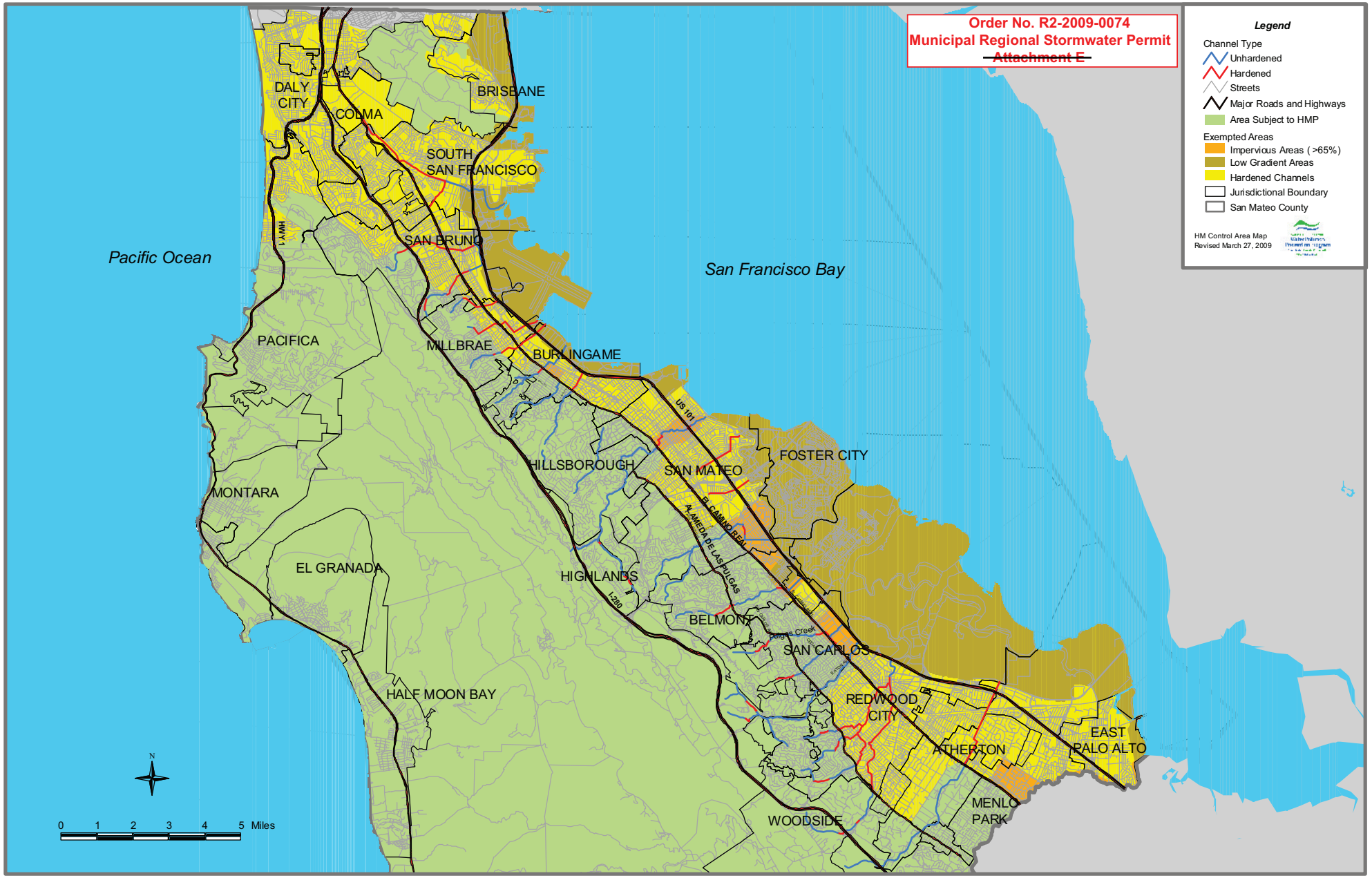
Hydromodification management control area - The areas of HM applicability in San Mateo County as shown in the HM map included in the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit ("Municipal Regional Permit" or "MRP"). The map may be downloaded at *www.flowstobay.org/bs_new_development.php*.

Impervious surface - A surface covering or pavement of a developed parcel of land that prevents the land's natural ability to absorb and infiltrate rainfall/stormwater. Impervious surfaces include, but are not limited to, roof tops; walkways; patios; driveways; parking lots; storage areas; impervious concrete and asphalt; and any other continuous watertight pavement or covering. Landscaped soil and pervious pavement, including pavers with pervious openings and seams, underlain with pervious soil or pervious storage material, such as a gravel layer sufficient to hold at least the MRP Provision C.3.d volume of rainfall runoff are not impervious surfaces. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for purposes of determining whether a project is a Regulated Project under MRP Provisions C.3.b. and C.3.g. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of runoff modeling and meeting the Hydromodification Standard.

Municipal Regional Stormwater NPDES Permit - The San Francisco Bay Regional Water Quality Control Board's Order R2-2009-0074 issuing Waste Discharge Requirements and National Pollutant Discharge Elimination System (NPDES) Permit No. CAS612008, for the discharge of stormwater runoff from the municipal separate storm sewer systems (MS4s) of more than 70 municipalities in the San Francisco Bay Area, including the 21 municipalities within San Mateo County. The MRP may be downloaded at www.flowstobay.org/ms_municipalities.php.

ATTACHMENT B:
HYDROMODIFICATION
APPLICABILITY MAP

County Review Draft



ATTACHMENT C

BAHM2013

PROJECT REPORT

General Model Information

Project Name: MB_BAHM
Site Name: MOSS_BEACH
Site Address:
City:
Report Date: 5/24/2017
Gage: San Francisco
Data Start: 1959/10/01
Data End: 1997/09/30
Timestep: Hourly
Precip Scale: 1.964
Version Date: 2017/04/12

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year
Low Flow Threshold for POC2:	10 Percent of the 2 Year
High Flow Threshold for POC2:	10 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C D,Grass,Mod(5-10%)	10
Pervious Total	10

Impervious Land Use	acre
Roads,Mod(5-10%)	1.5
Roof Area	0.5
Impervious Total	2
Basin Total	12

Element Flows To:

Surface	Interflow	Groundwater

Pre-Development POC2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Mod(5-10%)	10
Pervious Total	10
Impervious Land Use	acre
Roads,Mod(5-10%)	1.5
Roof Area	0.5
Impervious Total	2
Basin Total	12

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

On-Site Basin 1

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C D,Urban,Mod(5-10%)	2
Pervious Total	2

Impervious Land Use	acre
Roads,Mod(5-10%)	0.7
Roof Area	1
Sidewalks,Mod(5-10%)	0.8
Parking,Mod(5-10%)	1
Impervious Total	3.5
Basin Total	5.5

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

Off-Site Basin 1

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Mod(5-10%)	5
Pervious Total	5
Impervious Land Use	acre
Roads,Mod(5-10%)	1.5
Impervious Total	1.5
Basin Total	6.5

Element Flows To:

Surface	Interflow	Groundwater

Post-Development On-Site

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
C D,Urban,Mod(5-10%)	2
Pervious Total	2

Impervious Land Use	acre
Roads,Mod(5-10%)	0.7
Roof Area	1
Sidewalks,Mod(5-10%)	0.8
Parking,Mod(5-10%)	1
Impervious Total	3.5
Basin Total	5.5

Element Flows To:

Surface	Interflow	Groundwater

Post-Development Off-Site

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Mod(5-10%)	5
Pervious Total	5
Impervious Land Use	acre
Roads,Mod(5-10%)	1.5
Impervious Total	1.5
Basin Total	6.5

Element Flows To:

Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	65.00 ft.
Bottom Width:	100.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	BAHM 5
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	3.5
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	300.118
Total Outflow (ac-ft.):	340.078
Percent Through Underdrain:	88.25
Discharge Structure	
Riser Height:	1 ft.
Riser Diameter:	24 in.
Element Flows To:	
Outlet 1	Outlet 2

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.2112	0.0000	0.0000	0.0000
0.0440	0.2102	0.0013	0.0000	0.0000
0.0879	0.2090	0.0025	0.0000	0.0000
0.1319	0.2078	0.0038	0.0000	0.0000
0.1758	0.2067	0.0051	0.0000	0.0000
0.2198	0.2055	0.0076	0.0000	0.0000
0.2637	0.2043	0.0102	0.0056	0.0000
0.3077	0.2032	0.0128	0.0082	0.0000
0.3516	0.2020	0.0154	0.0118	0.0000
0.3956	0.2009	0.0181	0.0164	0.0000
0.4396	0.1997	0.0207	0.0221	0.0000
0.4835	0.1986	0.0234	0.0290	0.0000
0.5275	0.1974	0.0261	0.0371	0.0000
0.5714	0.1963	0.0288	0.0465	0.0000
0.6154	0.1951	0.0315	0.0573	0.0000
0.6593	0.1940	0.0342	0.0618	0.0000
0.7033	0.1929	0.0370	0.0800	0.0000
0.7473	0.1917	0.0398	0.0906	0.0000
0.7912	0.1906	0.0426	0.0947	0.0000
0.8352	0.1895	0.0454	0.1072	0.0000
0.8791	0.1884	0.0482	0.1184	0.0000
0.9231	0.1873	0.0511	0.1286	0.0000
0.9670	0.1861	0.0539	0.1380	0.0000
1.0110	0.1850	0.0568	0.1467	0.0000
1.0549	0.1839	0.0597	0.1550	0.0000
1.0989	0.1828	0.0626	0.1628	0.0000
1.1429	0.1817	0.0655	0.1703	0.0000
1.1868	0.1806	0.0685	0.1774	0.0000
1.2308	0.1795	0.0715	0.1843	0.0000

1.2747	0.1784	0.0745	0.1909	0.0000
1.3187	0.1774	0.0775	0.1973	0.0000
1.3626	0.1763	0.0805	0.2034	0.0000
1.4066	0.1752	0.0835	0.2094	0.0000
1.4505	0.1741	0.0866	0.2152	0.0000
1.4945	0.1730	0.0897	0.2209	0.0000
1.5385	0.1720	0.0931	0.2264	0.0000
1.5824	0.1709	0.0965	0.2318	0.0000
1.6264	0.1698	0.0999	0.2371	0.0000
1.6703	0.1688	0.1033	0.2422	0.0000
1.7143	0.1677	0.1068	0.2473	0.0000
1.7582	0.1667	0.1103	0.2522	0.0000
1.8022	0.1656	0.1138	0.2571	0.0000
1.8462	0.1646	0.1173	0.2618	0.0000
1.8901	0.1635	0.1209	0.2665	0.0000
1.9341	0.1625	0.1245	0.2711	0.0000
1.9780	0.1614	0.1280	0.2757	0.0000
2.0220	0.1604	0.1317	0.2801	0.0000
2.0659	0.1594	0.1353	0.2845	0.0000
2.1099	0.1583	0.1389	0.2888	0.0000
2.1538	0.1573	0.1426	0.2931	0.0000
2.1978	0.1563	0.1463	0.2973	0.0000
2.2418	0.1553	0.1500	0.3015	0.0000
2.2857	0.1543	0.1538	0.3056	0.0000
2.3297	0.1532	0.1575	0.3097	0.0000
2.3736	0.1522	0.1613	0.3137	0.0000
2.4176	0.1512	0.1651	0.3178	0.0000
2.4615	0.1502	0.1689	0.3250	0.0000
2.5000	0.1492	0.1723	0.3356	0.0000

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
2.5000	0.2112	0.1723	0.0000	0.7744	0.0000
2.5440	0.2124	0.1816	0.0000	0.7744	0.0000
2.5879	0.2136	0.1910	0.0000	0.7964	0.0000
2.6319	0.2148	0.2004	0.0000	0.8185	0.0000
2.6758	0.2160	0.2098	0.0000	0.8405	0.0000
2.7198	0.2171	0.2194	0.0000	0.8625	0.0000
2.7637	0.2183	0.2289	0.0000	0.8846	0.0000
2.8077	0.2195	0.2386	0.0000	0.9066	0.0000
2.8516	0.2208	0.2482	0.0000	0.9287	0.0000
2.8956	0.2220	0.2580	0.0000	0.9507	0.0000
2.9396	0.2232	0.2678	0.0000	0.9728	0.0000
2.9835	0.2244	0.2776	0.0000	0.9948	0.0000
3.0275	0.2256	0.2875	0.0000	1.0169	0.0000
3.0714	0.2268	0.2974	0.0000	1.0389	0.0000
3.1154	0.2280	0.3074	0.0000	1.0610	0.0000
3.1593	0.2293	0.3175	0.0000	1.0830	0.0000
3.2033	0.2305	0.3276	0.0000	1.1050	0.0000
3.2473	0.2317	0.3377	0.0000	1.1271	0.0000
3.2912	0.2330	0.3479	0.0000	1.1491	0.0000
3.3352	0.2342	0.3582	0.0000	1.1712	0.0000
3.3791	0.2355	0.3685	0.0000	1.1932	0.0000
3.4231	0.2367	0.3789	0.0000	1.2153	0.0000
3.4670	0.2379	0.3893	0.0000	1.2373	0.0000
3.5110	0.2392	0.3998	0.0245	1.2594	0.0000
3.5549	0.2405	0.4104	0.2732	1.2814	0.0000
3.5989	0.2417	0.4210	0.6592	1.3035	0.0000

3.6429	0.2430	0.4316	1.1428	1.3255	0.0000
3.6868	0.2442	0.4423	1.7049	1.3476	0.0000
3.7308	0.2455	0.4531	2.3316	1.3696	0.0000
3.7747	0.2468	0.4639	3.0111	1.3916	0.0000
3.8187	0.2481	0.4748	3.7318	1.4137	0.0000
3.8626	0.2493	0.4857	4.4822	1.4357	0.0000
3.9066	0.2506	0.4967	5.2505	1.4578	0.0000
3.9505	0.2519	0.5078	6.0247	1.4798	0.0000
3.9945	0.2532	0.5189	6.7926	1.5019	0.0000
4.0000	0.2534	0.5202	7.5423	1.5046	0.0000

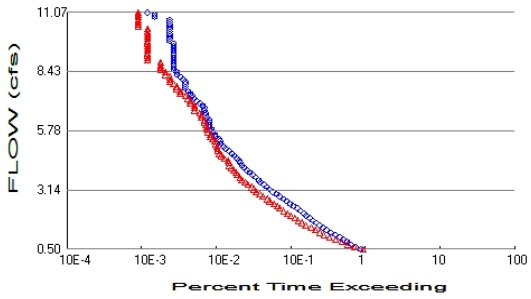
Surface retention 1

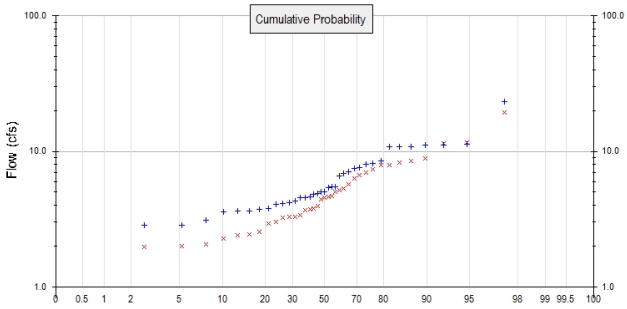
Element Flows To:

Outlet 1	Outlet 2
	Bioretention 1

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 10
Total Impervious Area: 2

Mitigated Landuse Totals for POC #1
Total Pervious Area: 7
Total Impervious Area: 5

Flow Frequency Method: Weibull

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	4.958664
5 year	8.869003
10 year	11.071023
25 year	14.666323

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	4.201812
5 year	7.861603
10 year	9.05394
25 year	13.741631

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1960	4.042	2.421
1961	3.765	2.945
1962	6.833	4.585
1963	5.020	3.760
1964	4.288	4.456
1965	4.167	2.541
1966	3.624	3.219
1967	5.454	5.051
1968	7.447	5.337
1969	8.452	6.297
1970	11.060	11.496
1971	7.987	5.671
1972	3.121	1.967
1973	7.110	6.972

1974	4.097	3.386
1975	4.578	3.012
1976	0.625	0.758
1977	3.584	2.270
1978	3.756	2.439
1979	4.565	4.711
1980	4.596	3.273
1981	3.654	6.661
1982	8.126	7.860
1983	23.115	19.282
1984	5.432	5.177
1985	6.593	3.961
1986	11.347	8.507
1987	4.900	4.538
1988	10.845	7.869
1989	5.462	3.680
1990	4.792	3.733
1991	2.855	1.987
1992	11.206	8.850
1993	7.609	7.326
1994	5.035	3.296
1995	10.845	11.565
1996	2.858	2.048
1997	10.773	8.287

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	23.1150	19.2824
2	11.3472	11.5649
3	11.2057	11.4963
4	11.0598	8.8504
5	10.8453	8.5068
6	10.8451	8.2866
7	10.7732	7.8688
8	8.4525	7.8600
9	8.1261	7.3264
10	7.9867	6.9717
11	7.6090	6.6613
12	7.4474	6.2971
13	7.1100	5.6711
14	6.8328	5.3367
15	6.5934	5.1772
16	5.4622	5.0506
17	5.4536	4.7109
18	5.4316	4.5845
19	5.0352	4.5382
20	5.0201	4.4558
21	4.9003	3.9606
22	4.7919	3.7598
23	4.5957	3.7331
24	4.5780	3.6799
25	4.5649	3.3864
26	4.2884	3.2961
27	4.1669	3.2729
28	4.0970	3.2188
29	4.0418	3.0124
30	3.7646	2.9450

31	3.7562	2.5405
32	3.6536	2.4392
33	3.6245	2.4213
34	3.5835	2.2698
35	3.1208	2.0477
36	2.8575	1.9867
37	2.8545	1.9673
38	0.6248	0.7585

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.4959	2868	3110	108	Pass
0.6027	2466	2396	97	Pass
0.7095	2143	1955	91	Pass
0.8163	1898	1609	84	Pass
0.9231	1686	1325	78	Pass
1.0300	1504	1108	73	Pass
1.1368	1318	931	70	Pass
1.2436	1140	816	71	Pass
1.3504	1007	712	70	Pass
1.4572	901	629	69	Pass
1.5641	809	531	65	Pass
1.6709	728	469	64	Pass
1.7777	664	418	62	Pass
1.8845	601	378	62	Pass
1.9913	540	334	61	Pass
2.0982	505	301	59	Pass
2.2050	456	269	58	Pass
2.3118	403	237	58	Pass
2.4186	360	220	61	Pass
2.5254	325	198	60	Pass
2.6323	292	175	59	Pass
2.7391	267	164	61	Pass
2.8459	237	140	59	Pass
2.9527	216	128	59	Pass
3.0595	192	114	59	Pass
3.1664	172	107	62	Pass
3.2732	160	99	61	Pass
3.3800	143	89	62	Pass
3.4868	131	82	62	Pass
3.5936	124	74	59	Pass
3.7005	114	70	61	Pass
3.8073	103	64	62	Pass
3.9141	94	61	64	Pass
4.0209	87	57	65	Pass
4.1277	79	54	68	Pass
4.2346	74	50	67	Pass
4.3414	70	49	70	Pass
4.4482	68	48	70	Pass
4.5550	63	43	68	Pass
4.6618	59	39	66	Pass
4.7687	54	37	68	Pass
4.8755	49	35	71	Pass
4.9823	45	35	77	Pass
5.0891	42	34	80	Pass
5.1959	39	33	84	Pass
5.3028	38	32	84	Pass
5.4096	36	30	83	Pass
5.5164	33	28	84	Pass
5.6232	32	28	87	Pass
5.7300	30	26	86	Pass
5.8369	29	25	86	Pass
5.9437	27	25	92	Pass
6.0505	27	24	88	Pass

6.1573	27	23	85	Pass
6.2641	27	23	85	Pass
6.3710	25	21	84	Pass
6.4778	24	21	87	Pass
6.5846	24	20	83	Pass
6.6914	23	17	73	Pass
6.7982	23	17	73	Pass
6.9051	22	17	77	Pass
7.0119	20	15	75	Pass
7.1187	18	15	83	Pass
7.2255	17	14	82	Pass
7.3323	16	13	81	Pass
7.4392	15	11	73	Pass
7.5460	14	11	78	Pass
7.6528	13	10	76	Pass
7.7596	13	10	76	Pass
7.8664	13	9	69	Pass
7.9732	13	8	61	Pass
8.0801	12	8	66	Pass
8.1869	11	8	72	Pass
8.2937	10	7	70	Pass
8.4005	10	7	70	Pass
8.5073	9	6	66	Pass
8.6142	9	6	66	Pass
8.7210	9	6	66	Pass
8.8278	9	6	66	Pass
8.9346	9	4	44	Pass
9.0414	9	4	44	Pass
9.1483	9	4	44	Pass
9.2551	9	4	44	Pass
9.3619	9	4	44	Pass
9.4687	9	4	44	Pass
9.5755	9	4	44	Pass
9.6824	9	4	44	Pass
9.7892	8	4	50	Pass
9.8960	8	4	50	Pass
10.0028	8	4	50	Pass
10.1096	8	4	50	Pass
10.2165	8	4	50	Pass
10.3233	8	4	50	Pass
10.4301	8	3	37	Pass
10.5369	8	3	37	Pass
10.6437	8	3	37	Pass
10.7506	8	3	37	Pass
10.8574	5	3	60	Pass
10.9642	5	3	60	Pass
11.0710	4	3	75	Pass

Water Quality

Drawdown Time Results

Pond: Surface retention 1

Days	Stage(feet)	Percent of Total Run Time
1	N/A	0.0006
2	N/A	0.0006
3	N/A	0.0006
4	N/A	0.0006
5	N/A	0.0006

Maximum Stage: 1.494 Drawdown Time: Less than 1 day

Pond: Bioretention 1

Days	Stage(feet)	Percent of Total Run Time
1	2.500	N/A
2	2.500	N/A
3	2.500	N/A
4	2.500	N/A
5	2.500	N/A

Maximum Stage: 2.500 Drawdown Time: Less than 1 day

POC 2

POC #2 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

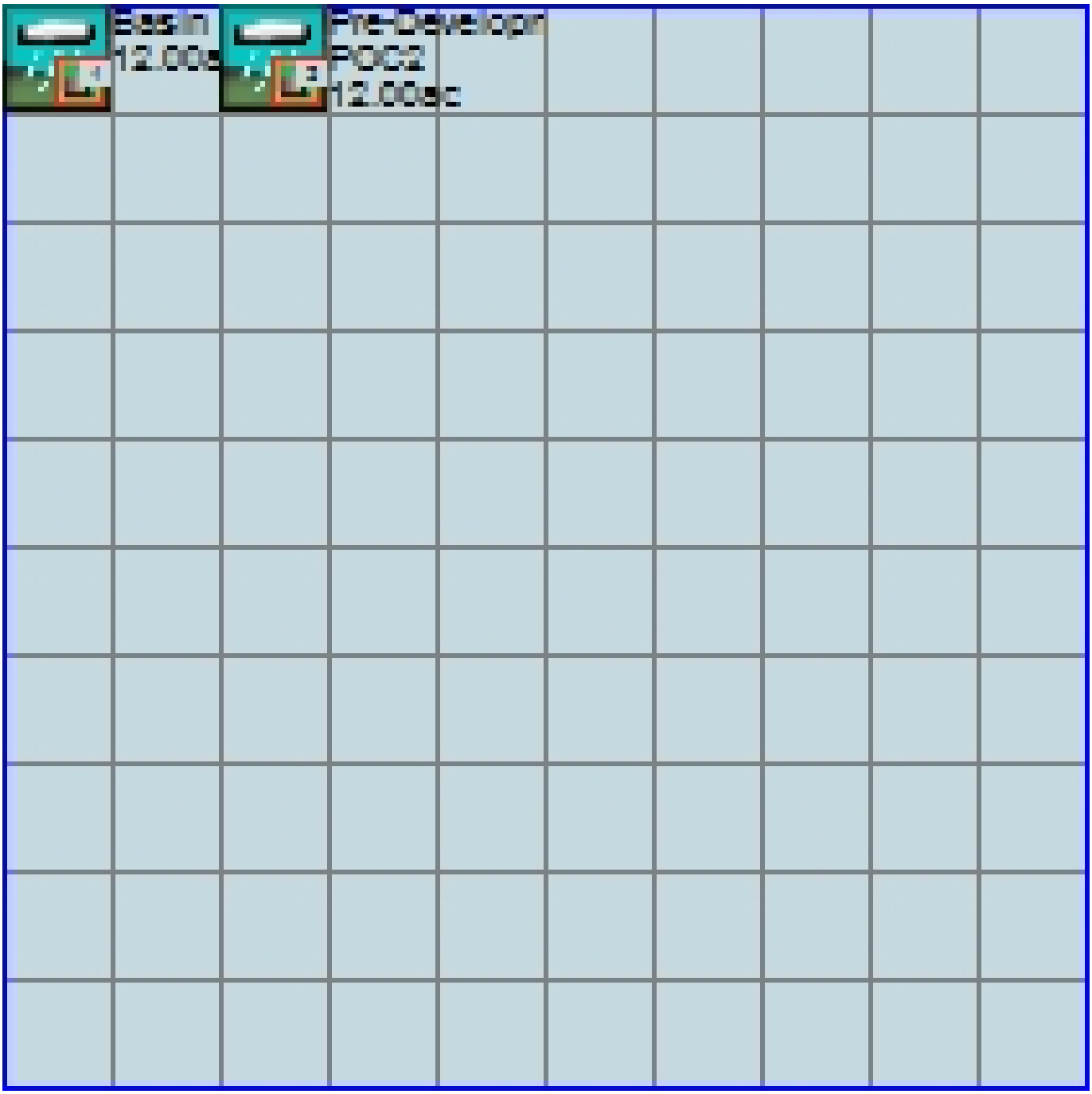
No PERLND changes have been made.

IMPLND Changes

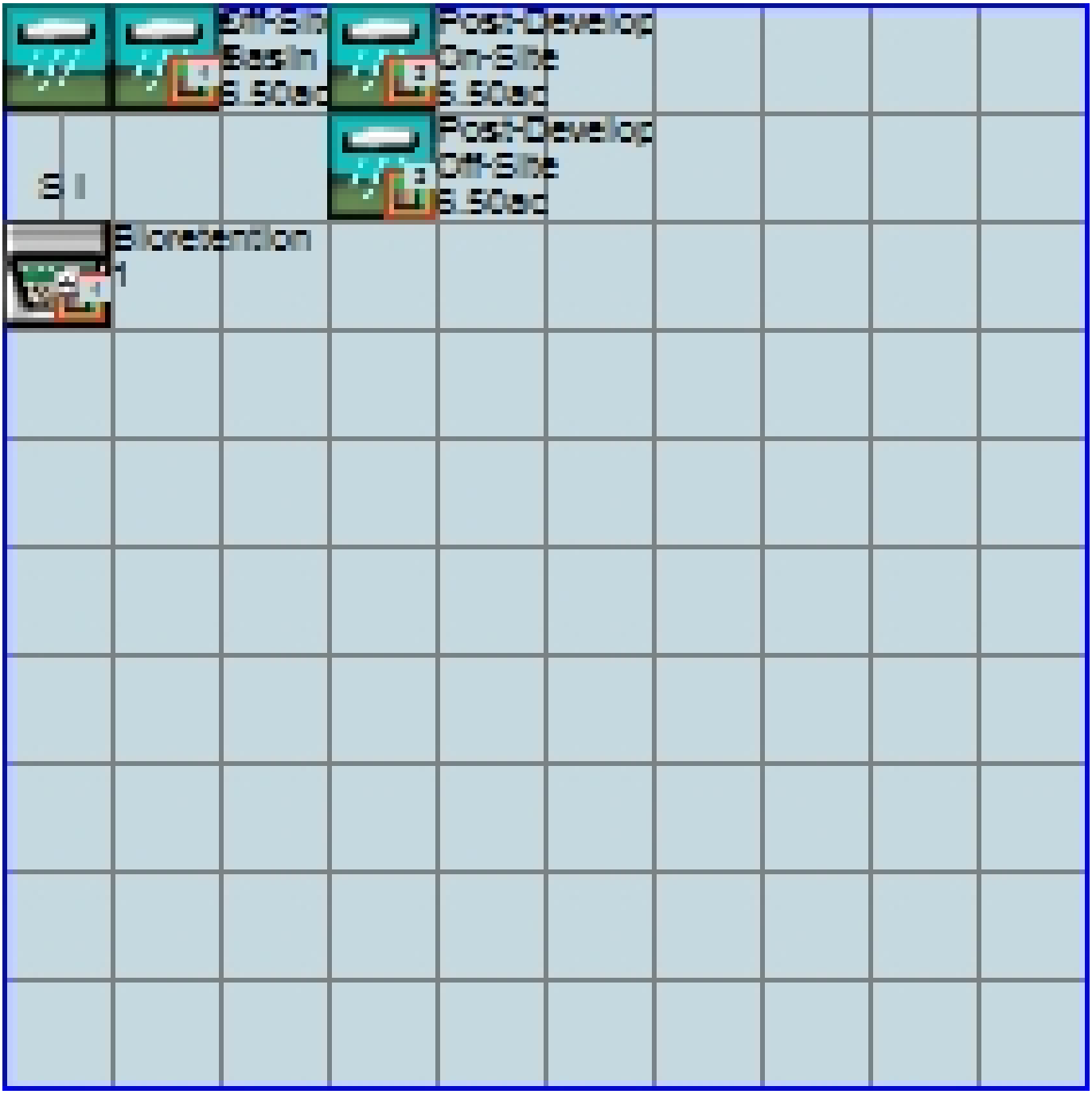
No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    1997 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   MB_BAHM.wdm
MESSU       25   PreMB_BAHM.MES
            27   PreMB_BAHM.L61
            28   PreMB_BAHM.L62
            30   POCMB_BAHM1.dat
            31   POCMB_BAHM2.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:60
      PERLND      42
      IMPLND       2
      IMPLND       5
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                  MAX                    1    2   30    9
    2        Pre-Development POC2       MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out            ***
   42     C/D,Grass,Mod(5-10%)    1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   42         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -   # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   42         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -   # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   42         0    0    0    1    0    0    0    0    1    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2          ***
    # -   # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   42              0       3.8     0.035       350       0.1         2      0.95
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3          ***
    # -   # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   42             40        35         3         2      0.15      0.15         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -   #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   42              0      0.25      0.25       0.5      0.45         0
  END PWAT-PARM4
  MON-LZETPARM
    <PLS >      PWATER input info: Part 3          ***
    # -   #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   42       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
  END MON-LZETPARM
  MON-INTERCEP
    <PLS >      PWATER input info: Part 3          ***
    # -   #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
   42      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
  END MON-INTERCEP

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -   # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS      GWVS
   42              0         0      0.01          0       0.5        0.3      0.01
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -   #                    User  t-series Engl Metr ***
                                     in  out           ***
    2     Roads,Mod(5-10%)         1    1    1   27    0
    5     Roof Area                1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -   # ATMP SNOW IWAT  SLD  IWG IQAL    ***
    2         0    0    1    0    0    0
    5         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -   # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
```

```
    5         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    2         0    0    0    0    0
    5         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2           100       0.1       0.1      0.09
    5           100      0.05       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2             0         0
    5             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2             0         0
    5             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                <--Area-->     <-Target->   MBLK    ***
<Name>   #                <-factor->     <Name>   #   Tbl#    ***
Basin  1***
PERLND  42                         10     COPY   501     12
PERLND  42                         10     COPY   501     13
IMPLND   2                        1.5     COPY   501     15
IMPLND   5                        0.5     COPY   501     15
Pre-Development POC2***
PERLND  42                         10     COPY   502     12
PERLND  42                         10     COPY   502     13
IMPLND   2                        1.5     COPY   502     15
IMPLND   5                        0.5     COPY   502     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   12.1        DISPLY   2     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<----------------><---> User T-series  Engl Metr LKFG             ***
                                      in  out                               ***
  END GEN-INFO
  *** Section RCHRES***
```

```
  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.964          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.964          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     12.1      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1959 10 01        END    1997 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   MB_BAHM.wdm
MESSU       25   MitMB_BAHM.MES
            27   MitMB_BAHM.L61
            28   MitMB_BAHM.L62
            30   POCMB_BAHM1.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:60
      PERLND      46
      IMPLND       2
      IMPLND       5
      IMPLND      11
      IMPLND      15
      PERLND      42
      GENER        2
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      COPY       601
      COPY       502
      COPY       602
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title---------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Surface retention  1        MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
  502         1    1
  602         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                         User  t-series Engl Metr ***
```

```
                                        in  out           ***
 46     C/D,Urban,Mod(5-10%)    1    1    1    1   27    0
 42     C/D,Grass,Mod(5-10%)    1    1    1    1   27    0
END GEN-INFO
*** Section PWATER***

ACTIVITY
  <PLS > ************ Active Sections ****************************
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
 46         0    0    1    0    0    0    0    0    0    0    0    0
 42         0    0    1    0    0    0    0    0    0    0    0    0
END ACTIVITY

PRINT-INFO
  <PLS > ***************** Print-flags **************************** PIVL  PYR
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
 46         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 42         0    0    4    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO

PWAT-PARM1
  <PLS >  PWATER variable monthly parameter value flags  ***
  # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
 46         0    0    0    1    0    0    0    0    1    0    0
 42         0    0    0    1    0    0    0    0    1    0    0
END PWAT-PARM1

PWAT-PARM2
  <PLS >      PWATER input info: Part 2         ***
  # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
 46              0       3.6      0.03       350       0.1         3     0.995
 42              0       3.8     0.035       350       0.1         2      0.95
END PWAT-PARM2

PWAT-PARM3
  <PLS >      PWATER input info: Part 3         ***
  # -  # ***PETMAX     PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
 46             40        35         3         2      0.45      0.15         0
 42             40        35         3         2      0.15      0.15         0
END PWAT-PARM3
PWAT-PARM4
  <PLS >     PWATER input info: Part 4                          ***
  # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
 46              0      0.23      0.25      0.35      0.35         0
 42              0      0.25      0.25       0.5      0.45         0
END PWAT-PARM4
MON-LZETPARM
  <PLS >      PWATER input info: Part 3         ***
  # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
 46       0.5  0.5  0.5  0.6 0.65 0.65 0.65 0.65 0.65 0.65 0.55  0.5
 42       0.4  0.4  0.4 0.45  0.5 0.55 0.55 0.55 0.55 0.55 0.45  0.4
END MON-LZETPARM
MON-INTERCEP
  <PLS >      PWATER input info: Part 3         ***
  # -  #  JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  ***
 46      0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11 0.11
 42      0.12 0.12 0.12 0.11  0.1  0.1  0.1  0.1  0.1  0.1 0.11 0.12
END MON-INTERCEP

PWAT-STATE1
  <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
  # -  # ***  CEPS      SURS       UZS       IFWS       LZS       AGWS       GWVS
 46              0         0      0.01          0       3.5        1.7        0.1
 42              0         0      0.01          0       0.5        0.3       0.01
END PWAT-STATE1

END PERLND

IMPLND
```

```
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                    in  out             ***
    2     Roads,Mod(5-10%)        1    1    1   27    0
    5     Roof Area               1    1    1   27    0
   11     Sidewalks,Mod(5-10%)    1    1    1   27    0
   15     Parking,Mod(5-10%)      1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    ***
    2         0    0    1    0    0    0
    5         0    0    1    0    0    0
   11         0    0    1    0    0    0
   15         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    2         0    0    4    0    0    0    1    9
    5         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
   15         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    2         0    0    0    0    0
    5         0    0    0    0    0
   11         0    0    0    0    0
   15         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    2          100       0.1       0.1      0.09
    5          100      0.05       0.1       0.1
   11          100       0.1       0.1      0.09
   15          100       0.1       0.1      0.09
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    2             0         0
    5             0         0
   11             0         0
   15             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    2             0         0
    5             0         0
   11             0         0
   15             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                <--Area-->     <-Target->   MBLK   ***
<Name>   #                <-factor->     <Name>   #   Tbl#   ***
```

```
On-Site Basin 1***
PERLND  46                          2     RCHRES   1      2
PERLND  46                          2     RCHRES   1      3
IMPLND   2                        0.7     RCHRES   1      5
IMPLND   5                          1     RCHRES   1      5
IMPLND  11                        0.8     RCHRES   1      5
IMPLND  15                          1     RCHRES   1      5
Off-Site Basin 1***
PERLND  42                          5     COPY   501     12
PERLND  42                          5     COPY   601     12
PERLND  42                          5     COPY   501     13
PERLND  42                          5     COPY   601     13
IMPLND   2                        1.5     COPY   501     15
IMPLND   2                        1.5     COPY   601     15
Post-Development On-Site***
PERLND  46                          2     COPY   502     12
PERLND  46                          2     COPY   602     12
PERLND  46                          2     COPY   502     13
PERLND  46                          2     COPY   602     13
IMPLND   2                        0.7     COPY   502     15
IMPLND   2                        0.7     COPY   602     15
IMPLND   5                          1     COPY   502     15
IMPLND   5                          1     COPY   602     15
IMPLND  11                        0.8     COPY   502     15
IMPLND  11                        0.8     COPY   602     15
IMPLND  15                          1     COPY   502     15
IMPLND  15                          1     COPY   602     15
Post-Development Off-Site***
PERLND  42                          5     COPY   502     12
PERLND  42                          5     COPY   602     12
PERLND  42                          5     COPY   502     13
PERLND  42                          5     COPY   602     13
IMPLND   2                        1.5     COPY   502     15
IMPLND   2                        1.5     COPY   602     15

******Routing******
PERLND  46                          2     COPY     1     12
IMPLND   2                        0.7     COPY     1     15
IMPLND   5                          1     COPY     1     15
IMPLND  11                        0.8     COPY     1     15
IMPLND  15                          1     COPY     1     15
PERLND  46                          2     COPY     1     13
RCHRES   1                          1     RCHRES   2      8
RCHRES   2                          1     COPY   501     16
RCHRES   1                          1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   12.1        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0002778     RCHRES   1     EXTNL  OUTDGT 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                             ***
    1     Surface retentio-006    3    1    1    1   28    0    1
    2     Bioretention  1         1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
```

```
    <PLS > ************ Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  6  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN      DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><--------><       ***
    1              1      0.01       0.0       0.0       0.5       0.0
    2              2      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---> *** <---><---><---><---><--->
    1            0        4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0        4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Target Variable Names
***                  addr or                      addr or
***                <------>                     <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                              v2m2           =  6990.
*** Compute remaining available pore space
  GENER   2                              vpo2           =  v2m2
  GENER   2                              vpo2          -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                              vpo2           =  0.0
END IF
*** Infiltration volume
  GENER   2                              v2d2           =  vpo2
END SPEC-ACTIONS
FTABLES
```

```
  FTABLE      2
   58    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.211203  0.000000  0.000000
  0.043956  0.210171  0.001250  0.000000
  0.087912  0.208995  0.002509  0.000000
  0.131868  0.207822  0.003776  0.000000
  0.175824  0.206652  0.005052  0.000000
  0.219780  0.205485  0.007620  0.000000
  0.263736  0.204322  0.010205  0.005578
  0.307692  0.203162  0.012807  0.008250
  0.351648  0.202004  0.015426  0.011840
  0.395604  0.200851  0.018062  0.016440
  0.439560  0.199700  0.020716  0.022132
  0.483516  0.198552  0.023386  0.028991
  0.527473  0.197408  0.026074  0.037090
  0.571429  0.196267  0.028780  0.046497
  0.615385  0.195129  0.031502  0.057275
  0.659341  0.193994  0.034242  0.061793
  0.703297  0.192863  0.037000  0.080020
  0.747253  0.191734  0.039775  0.090613
  0.791209  0.190609  0.042567  0.094652
  0.835165  0.189487  0.045378  0.107217
  0.879121  0.188369  0.048206  0.118396
  0.923077  0.187253  0.051051  0.128567
  0.967033  0.186141  0.053915  0.137962
  1.010989  0.185031  0.056796  0.146734
  1.054945  0.183925  0.059696  0.154994
  1.098901  0.182823  0.062613  0.162823
  1.142857  0.181723  0.065548  0.170282
  1.186813  0.180627  0.068502  0.177420
  1.230769  0.179533  0.071473  0.184275
  1.274725  0.178443  0.074463  0.190878
  1.318681  0.177357  0.077471  0.197257
  1.362637  0.176273  0.080497  0.203431
  1.406593  0.175192  0.083542  0.209421
  1.450549  0.174115  0.086605  0.215243
  1.494505  0.173041  0.089686  0.220909
  1.538462  0.171970  0.093071  0.226432
  1.582418  0.170903  0.096477  0.231822
  1.626374  0.169838  0.099903  0.237090
  1.670330  0.168777  0.103350  0.242243
  1.714286  0.167719  0.106816  0.247288
  1.758242  0.166664  0.110304  0.252234
  1.802198  0.165612  0.113811  0.257085
  1.846154  0.164564  0.117340  0.261847
  1.890110  0.163518  0.120889  0.266526
  1.934066  0.162476  0.124459  0.271126
  1.978022  0.161437  0.128050  0.275652
  2.021978  0.160402  0.131661  0.280107
  2.065934  0.159369  0.135294  0.284497
  2.109890  0.158340  0.138947  0.288825
  2.153846  0.157314  0.142621  0.293095
  2.197802  0.156291  0.146317  0.297311
  2.241758  0.155271  0.150033  0.301477
  2.285714  0.154254  0.153771  0.305599
  2.329670  0.153241  0.157530  0.309683
  2.373626  0.152231  0.161311  0.313740
  2.417582  0.151224  0.165112  0.317786
  2.461538  0.150220  0.168936  0.325027
  2.500000  0.149219  0.361827  0.335607
  END FTABLE  2
  FTABLE      1
   36    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.149219  0.000000  0.000000  0.000000  0.000000
```

```
  0.043956  0.212385  0.009310  0.000000  0.774361  0.000000
  0.087912  0.213571  0.018671  0.000000  0.796407  0.000000
  0.131868  0.214759  0.028085  0.000000  0.818453  0.000000
  0.175824  0.215951  0.037551  0.000000  0.840499  0.000000
  0.219780  0.217146  0.047070  0.000000  0.862545  0.000000
  0.263736  0.218344  0.056641  0.000000  0.884591  0.000000
  0.307692  0.219546  0.066265  0.000000  0.906637  0.000000
  0.351648  0.220750  0.075942  0.000000  0.928682  0.000000
  0.395604  0.221958  0.085672  0.000000  0.950728  0.000000
  0.439560  0.223169  0.095455  0.000000  0.972774  0.000000
  0.483516  0.224383  0.105291  0.000000  0.994820  0.000000
  0.527473  0.225601  0.115181  0.000000  1.016866  0.000000
  0.571429  0.226821  0.125124  0.000000  1.038912  0.000000
  0.615385  0.228045  0.135121  0.000000  1.060958  0.000000
  0.659341  0.229272  0.145172  0.000000  1.083004  0.000000
  0.703297  0.230502  0.155277  0.000000  1.105049  0.000000
  0.747253  0.231735  0.165436  0.000000  1.127095  0.000000
  0.791209  0.232972  0.175649  0.000000  1.149141  0.000000
  0.835165  0.234211  0.185917  0.000000  1.171187  0.000000
  0.879121  0.235454  0.196240  0.000000  1.193233  0.000000
  0.923077  0.236701  0.206617  0.000000  1.215279  0.000000
  0.967033  0.237950  0.217048  0.000000  1.237325  0.000000
  1.010989  0.239202  0.227535  0.024464  1.259370  0.000000
  1.054945  0.240458  0.238077  0.273233  1.281416  0.000000
  1.098901  0.241717  0.248675  0.659242  1.303462  0.000000
  1.142857  0.242979  0.259327  1.142846  1.325508  0.000000
  1.186813  0.244244  0.270035  1.704888  1.347554  0.000000
  1.230769  0.245513  0.280799  2.331616  1.369600  0.000000
  1.274725  0.246784  0.291619  3.011080  1.391646  0.000000
  1.318681  0.248059  0.302495  3.731796  1.413692  0.000000
  1.362637  0.249337  0.313426  4.482207  1.435737  0.000000
  1.406593  0.250618  0.324415  5.250506  1.457783  0.000000
  1.450549  0.251903  0.335459  6.024661  1.479829  0.000000
  1.494505  0.253191  0.346560  6.792578  1.501875  0.000000
  1.500000  0.253352  0.347951  7.542349  1.504631  0.000000
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.964          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.964          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM     22 IRRG     ENGL    0.7       SAME PERLND  46     EXTNL  SURLI
WDM      2 PREC     ENGL    1.964          RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.7            RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   2 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL       REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1001 STAG     ENGL       REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1002 STAG     ENGL       REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1003 FLOW     ENGL       REPL
COPY     1 OUTPUT MEAN   1 1     12.1      WDM    701 FLOW     ENGL       REPL
COPY   501 OUTPUT MEAN   1 1     12.1      WDM    801 FLOW     ENGL       REPL
COPY   601 OUTPUT MEAN   1 1     12.1      WDM    901 FLOW     ENGL       REPL
COPY     2 OUTPUT MEAN   1 1     12.1      WDM      0 FLOW     ENGL       REPL
COPY   502 OUTPUT MEAN   1 1     12.1      WDM    802 FLOW     ENGL       REPL
COPY   602 OUTPUT MEAN   1 1     12.1      WDM    902 FLOW     ENGL       REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
```

```
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1983/ 2/26  8: 0

RCHRES:     1

The volume of water in this reach/mixed reservoir is greater than the value
in the "volume" column of the last row of RCHTAB().  To continue the
simulation the table has been extrapolated, based on information contained
in the last two rows.  This will usually result in some loss of accuracy.
If depth is being calculated it will also cause an error condition.
Relevant data are:

NROWS         V1         V2        VOL
36 1.5096E+04 1.5157E+04 1.5599E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1983/ 2/26  8: 0

RCHRES:     1

Calculation of relative depth, using Newton's method of successive
approximations, converged to an invalid value (not in range 0.0 to 1.0).
Probably ftable was extrapolated.  If extrapolation was small, no problem.
Remedy; extend ftable.  Relevant data are:

A          B          C      RDEP1      RDEP2  COUNT
7.0127E+00 2.2058E+04 -1.833E+05    8.2868  8.2868E+00      3
```

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