HYDROLOGY REPORT

Tentative Parcel Map 21204

Los Coches Road (APN 397-060-80-00)

Lakeside, CA

PREPARED BY:

Jim Magee
2718 Powhatan Avenue
San Diego CA 92117
PHONE: (619) 894-1057
Jim@JimMagee.com

FOR: Panwebster Investments, Inc.
Jonathan Webster, President
2445 Brant Street #511
San Diego, CA 92101
(310) 871-6806

WO 6537

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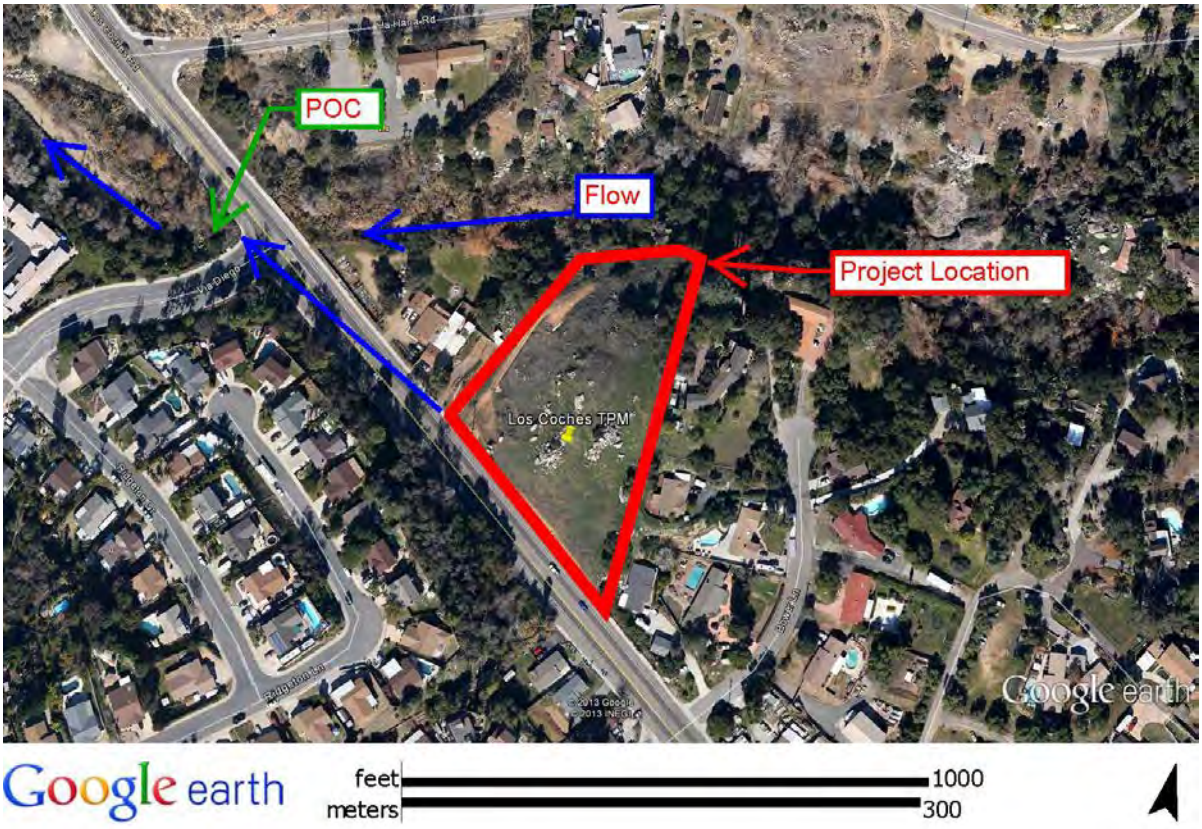
PROJECT DISCUSSION

PROJECT PURPOSE

The purpose of this project is to provide a TPM in order to provide building sites for five single family dwellings on a vacant lot on the east side of Los Coches Road, approximately ¾ mile north of Old Highway 80 and ½ blocks south of Ha Hanna Road. See the following vicinity map and aerial photograph. The area surrounding the project site is developing with urban residential uses such as the one proposed for this project. This report evaluates the hydrologic impact of this development. Particular attention was paid to the impact of this development on the adjacent properties.

VICINITY MAP

AERIAL PHOTOGRAPH



DESCRIPTION OF WATERSHED

As can be seen from the above photos and the map on page 9, the drainage basins of this project consists almost entirely of the project property only. As a consequence, the basins and the flows are very small. The project site sets on the north side of a small hill and consists of barren ground flowing to the west, north and east. The storm flows consists of almost entirely of sheet flow into Los Coches Creek to the East, the neighboring property to the north and Los Coches Road to the west. This flow pattern will generally be maintained for the eastern half of the project.

The construction of the private road will affect the flow on the western half of the project to some degree. A portion of it will continue to sheet flow onto Los Coches road and the neighbor to the north, much of the flow will be collected, treated and discharged through a storm drain directly to

the Entrance Facility of the Los Coches Creek Flood Control Channel labeled as POC on the aerial photograph above. This Entrance Facility was constructed as a natural channel about 600 feet long connecting the trapezoidal concrete channel to the bridge under Los Coches Road. It is widest near Los Coches Road and narrows down as it approaches the concrete channel.

This should significantly reduce the existing storm flows onto the neighbor directly to the north of the project.

METHODOLOGY

The hydrology analysis for this project was conducted in accordance with the San Diego County Hydrology Manual dated June 2003. Because of the size of the drainage basins involved, the Rational Method was used as specified on page 3-1 of the Hydrology Manual. There are no junctions of independent basins as described in Section 3.4 of the Hydrology Manual. Therefore, it was not necessary to use the Modified Rational Method to combine flows.

All hydraulic analysis was conducted in accordance with standard engineering practice. The references used for these analyses include King's Handbook of Hydraulics, nomographs from the San Diego County Drainage Design Manual, the Bureau of Public Roads, the City of San Diego and other commonly accepted sources.

RAINFALL

The rainfall amounts for this analysis are presented on page 14. They were taken from the isopluvial maps in the San Diego County Hydrology Manual.

SUMMARY

The following table summarizes the results of this analysis. See the Hydrology Calculations section of this report for the detailed calculations of each event. It should be noted that the flows shown for the project are very small flows. This is a result of the project property being at the top of a small hill.

It should be noted that table below does not adequately encapsulate the impact of the project on storm flows on the neighboring properties. Currently all of the storm flows from the property exit as surface flow. After the project Basin C and the reconfigured Basin D (including a part of the old basin E) will no longer exit as surface flow. The flow will be collected, treated and discharged into the storm drain discharging into the Entrance Facility of the Los Coches Creek Flood Control Channel described above.

Flows before and after the project **not considering Hydromodification**

All flows are in Cubic Feet per Sec	Basins			
	B	C	D	E
Before 100-yr	1.29	0.62	0.80	1.71
Before 10-yr	0.86	0.42	0.52	1.15
Before 2-yr	0.58	0.28	0.66	0.78
After 100-yr	2.36	0.62	3.77	1.07
After 10-yr	1.58	0.42	2.54	0.39
After 2-yr	1.07	0.28	1.73	0.26
Diff 100-yr	1.07	0.00	2.97	-0.64
Diff 10-yr	0.72	0.00	2.03	-0.76
Diff 2-yr	0.49	0.00	1.08	-0.51
Diff % 100-yr	83%	0%	373%	-37%
Diff % 10-yr	83%	0%	391%	-66%
Diff % 2-yr	83%	1%	164%	-66%

The RWQCB and the County of San Diego have adopted regulations requiring projects which substantially increase flood flows to adopt Hydromodification mitigating measures**. It has been determined that this project is subject to the Hydromodification requirements.** Therefore the runoff from the affected areas of the project will be collected and treated for both water quality and volume control. The project's Storm Water Management Plan and the project plans provide the detail of the treatment BMPs. This includes both the BMP design, layout and sizing calculations which is **summarized in the SWMP's Attachment D (Hydromodification Calculations)**. A copy of the attachment D is included with this report.

The Hydromodification Calculations and BMP facility sizing are meant to ensure that the storm flows after the project do not exceed those before the project. The San Diego County BMP Sizing Calculator was used for this project as recommended in the County regulations.

Additionally a detention basin sizing analysis was conducted in accordance with the San Diego County Hydrology Manual. The purpose of the analysis still is to ensure that the volumes produced by the BMP Sizing Calculator were sufficient to control the 100 year flood. Those calculations and discussions are included in the Detention Basin Analysis portion of this report.

CONCLUSIONS

This project will have a **positive impact** on the drainage flow patterns of this property. The project is designed to reduce surface discharge from the project onto adjacent properties.

Because of the project design, there will not be any changes that will result in substantial erosion or siltation on- or off-site. For the same reasons discussed above, the project will be not substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. In fact the project should reduce flooding on the property to the north. This storm flows that would have gone on to the property to the north will be discharged into the Entrance Facility described above, which is where the flow goes now. Therefore this rerouting of the storm flows does not represent a diversion.

For the same reasons discussed in the above, the proposed project will not create or contribute additional runoff water which will exceed the capacity of existing or planned storm water drainage systems.

The housing pads for this project set above and clear of any drainage flows. The areas within the project mapped on a federal Flood Hazard Boundary or Flood Insurance Flood Map or other flood hazard delineation map including County Floodplain Maps are shown on the project plans.

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

HYDROLOGY REPORT

OWNER: Panwebster Investments, Inc.
Jonathan Webster, President
2445 Brant Street #511
San Diego, CA 92101
(310) 871-6806

DECLARATION OF RESPONSIBLE CHARGE

I hereby declare that I am the engineer of work for the storm water aspects of this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

I understand the check of the project drawings and reports by the County of San Diego is confined to review and does not relieve me of responsibilities for project design.

Jim Magee
2718 Powhatan Avenue
San Diego, CA 92117

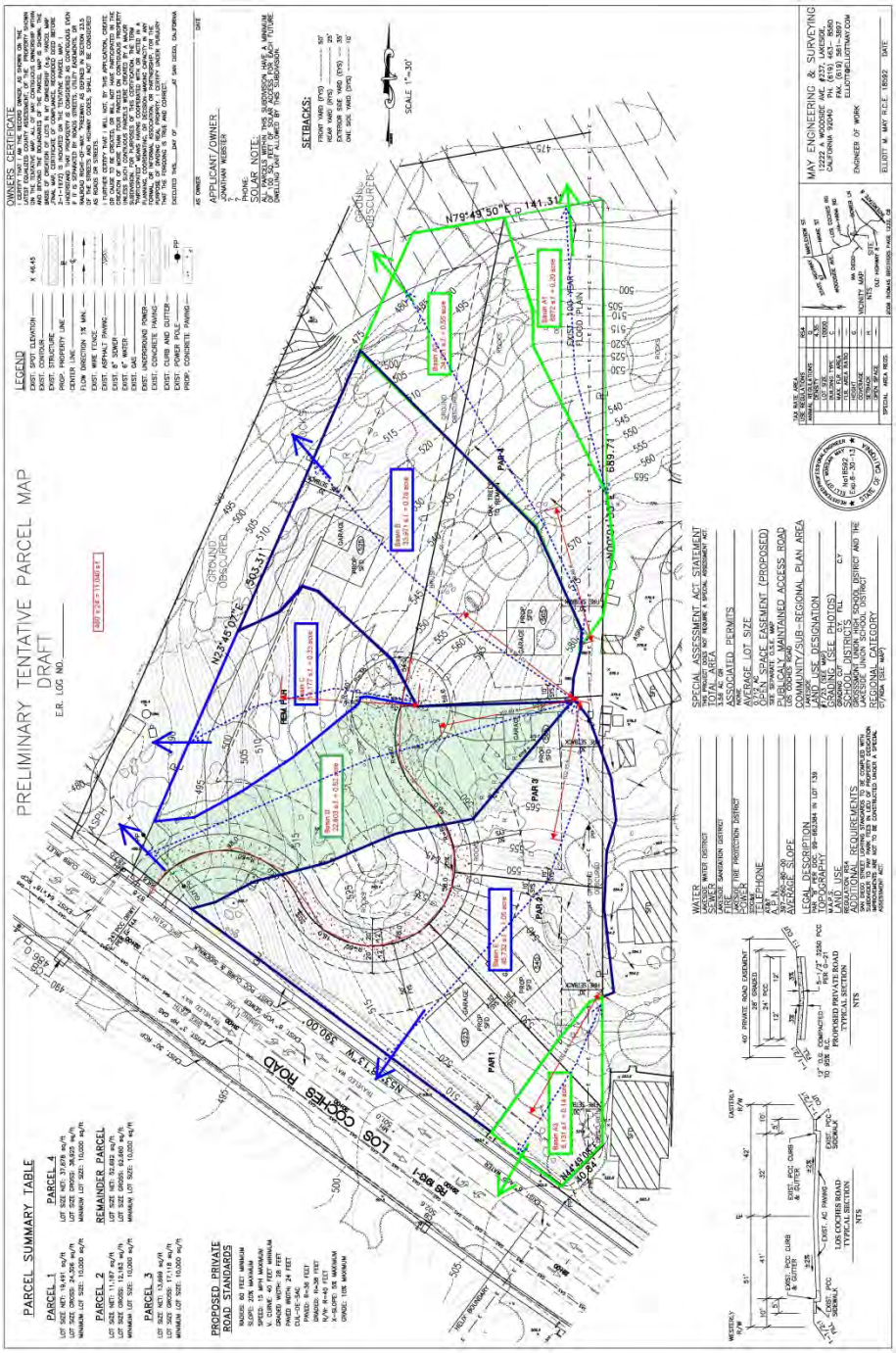
_____ ~~6/27/2013~~ ~~3/14/2014~~ 5/5/2014

Jim Magee R.C.E. 21058 Date

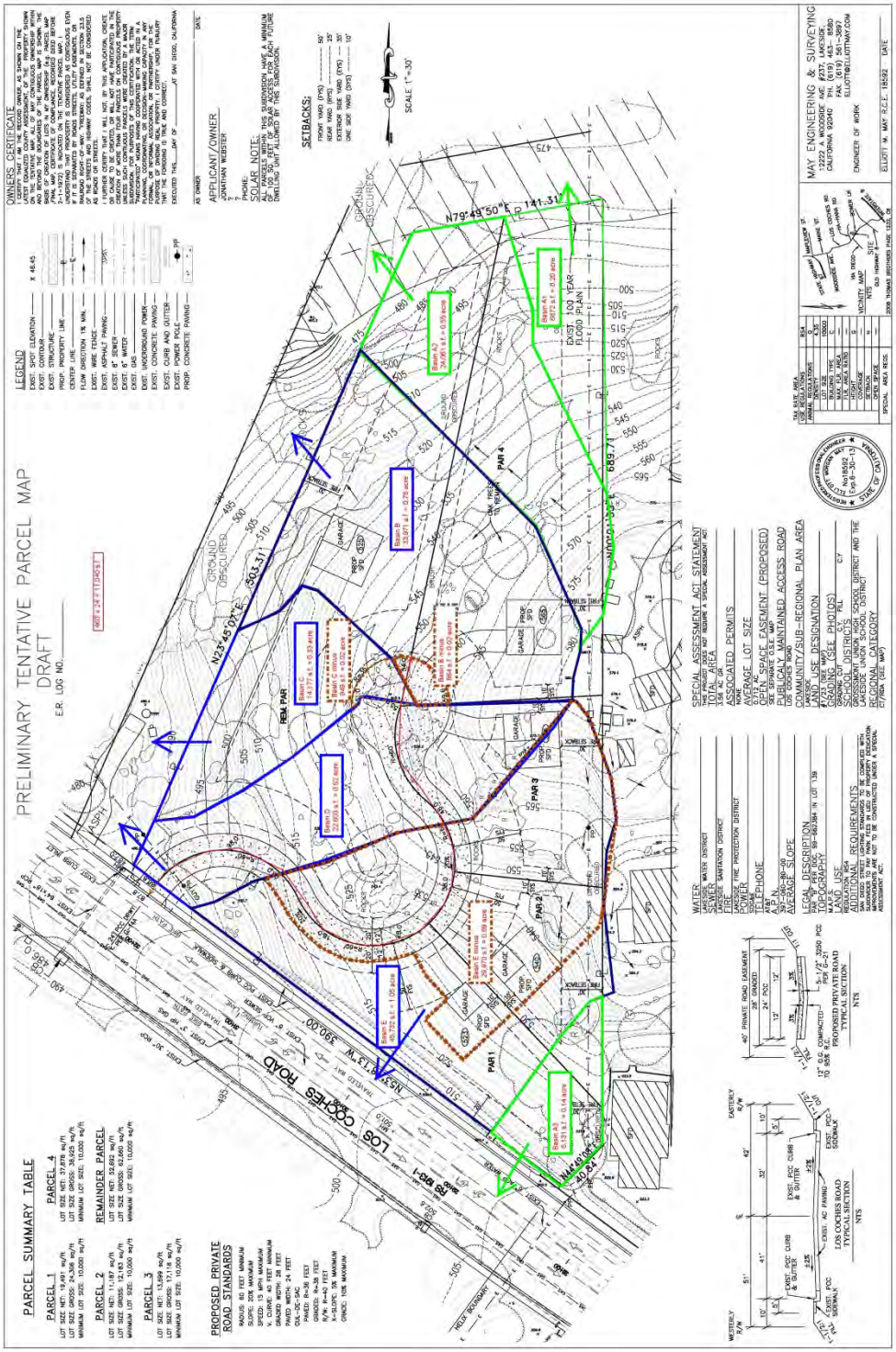
My registration expires 9-30-2015

HYDROLOGIC PARAMETERS

WATERSHED BOUNDARY - TOPOGRAPHIC MAP BEFORE



WATERSHED BOUNDARY - TOPOGRAPHIC MAP AFTER



The above maps are from the project plans and are at the scale shown. They show the watershed boundaries and the concentration points used in this analysis. They are NOT shown at a particular scale so that it would fit within this report. The following table summarizes the hydrologic factors of the basins.

Drainage Basins A1, A2 and A3 are outside the development envelope. They will not be disturbed by the project and the flows will not change after the project.

Drainage Basin B currently sheet flows for small distance across the property where it is intercepted by a graded road and empties onto Los Coches Road at the northwest corner of the property. Any flows that exceed the capacity of the graded road sheet flows across onto the neighbor to the north and then into Los Coches Creek. This will be the same drainage pattern after the project it, except that the sheet flow onto the neighbor to the North will not occur.

Drainage Basin C currently sheet flows to the north toward the neighbor's home. No development is occurring within this area until the driveway is built to the most northerly house. At that time most of the flow from this drainage basin can be intercepted into the storm drain and away from the home.

Drainage Basin D currently flows toward the northwest corner of the property and then north toward the neighbor's home. After construction of the private access road, almost the entire basin will be intercepted by the storm drain. This should significantly reduce the existing chance of flooding to this home.

Drainage Basin E currently sheet flows toward the top of the cut along Los Coches Road. The house pads in this basin will be graded to drain toward the private road. This will allow treatment and containment of these flows within the storm drain system to the Los Coches Creek Flood Control Channel Entrance Facility. It will also reduce the flows going toward the top of the cut bank.

The storm drain discussed above empties into the vegetated Entrance Facility of the Los Coches Creek Flood Control Channel. This channel was designed by the U.S. Army Corps of Engineers and the San Diego County Flood Control District to handle the 100-year flood. The channel empties into the Upper San Diego River, an Exempt Facility under Hydromodification regulations.

BASIN PROPERTIES

Basin Properties								
Concentration Point #	Basin #	Area (acres)	Hi pt	Low pt	Ti elev	Elev change	Basin Length	Basin slope (%)
1.1	A1 Before	0.20	565.0	480.0	525.0	85.0	212	40.1%
1.2	A2 Before	0.55	580.7	475.0	550.0	105.7	295	35.8%
1.3	A3 Before	0.14	545.0	510.0	522.0	35.0	125	13.5%
2.1	B Before	0.78	580.6	507.0	556.0	73.6	260	28.3%
2.2	B After	0.76	580.6	507.0	556.0	73.6	260	28.3%
3.1	C Before	0.33	558.0	496.0	518.0	62.0	171	36.3%
3.2	C After	0.31	550.0	496.0	503.0	54.0	131	41.2%
4.1	D Before	0.52	580.6	486.6	562.0	94.0	334	28.1%
4.2	D After	1.25	580.6	486.6	562.0	94.0	364	25.8%
5.1	E Before	1.05	580.6	500.0	558.0	80.6	312	25.8%
5.2	E After	0.36	542.0	500.0	526.0	42.0	160	26.3%

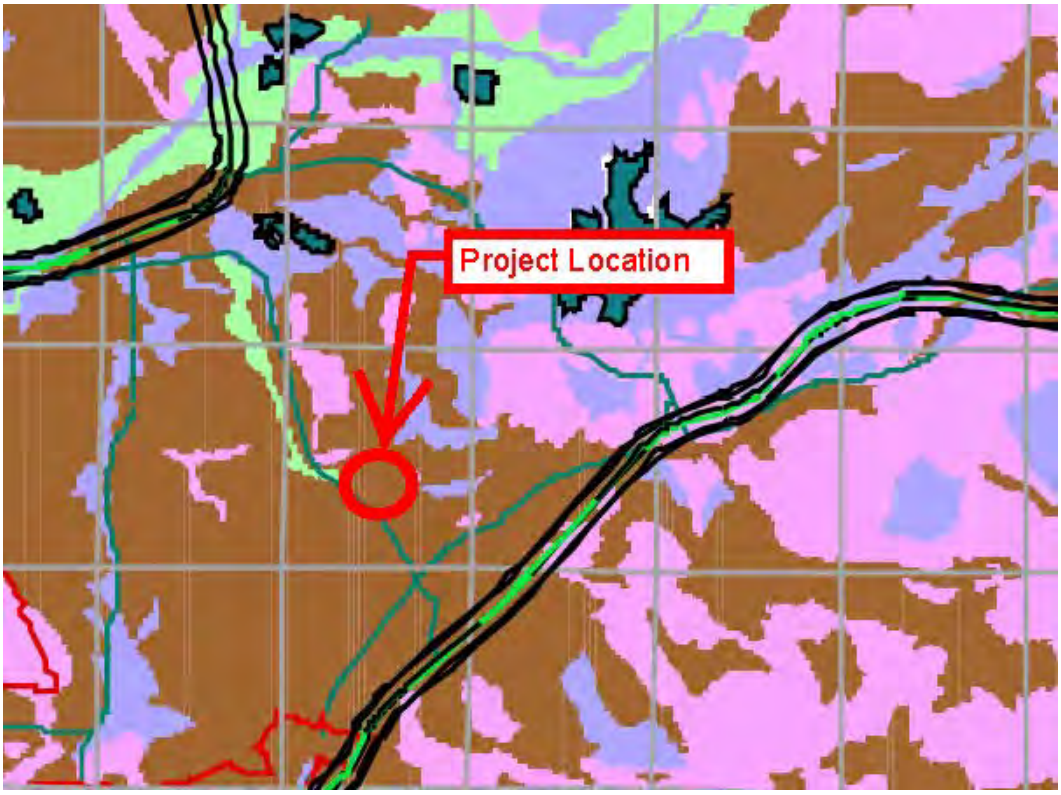
RUNOFF FACTORS

The following table is from the County of San Diego Hydrology Manual and provides runoff factors "C" based on soil type and land use.

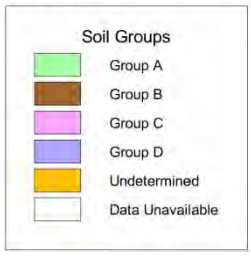
	Table 3-1		Soil Type		
Index	Land Use	A	B	C	D
1	Natural	0.20	0.25	0.30	0.35
2	LDR 1.0 DU/A or less	0.27	0.32	0.36	0.41
3	LDR 2.0 DU/A or less	0.34	0.38	0.42	0.46
4	LDR 2.9 DU/A or less	0.38	0.41	0.45	0.49
5	MDR 4.3 DU/A or less	0.41	0.45	0.48	0.52
6	MDR 7.3 DU/A or less	0.48	0.51	0.54	0.57
7	MDR 10.9 DU/A or less	0.52	0.54	0.57	0.60
8	MDR 14.5 DU/A or less	0.55	0.58	0.60	0.63
9	HDR 24.0 DU/A or less	0.66	0.67	0.69	0.71
10	HDR 43.0 DU/A or less	0.76	0.77	0.78	0.79
11	Neighborhood Commercial	0.76	0.77	0.78	0.79
12	General Commercial	0.80	0.80	0.81	0.82
13	Office Professional/Commercial	0.83	0.84	0.84	0.85
14	Commercial/Industrial Limited	0.83	0.84	0.84	0.85
15	Commercial/Industrial General	0.87	0.87	0.87	0.87
16	RDR 0.125 DU/A or less	0.22	0.27	0.32	0.37
17	RDR 0.25 DU/A or less	0.25	0.30	0.34	0.39
18	RDR 0.50 DU/A or less	0.26	0.31	0.35	0.40

Soil Hydrologic Groups

The following map of Soil Groups is from the San Diego County Hydrology Manual. As can be seen, the soil group for the drainage basins of this project is Soil Group "B". This type of soil results in moderate runoff during storms because of its ability to absorb the rainwater. This fact is reflected in the above Runoff Factor "C". Those "C" values were used in the analysis of the basins as shown later in this report.



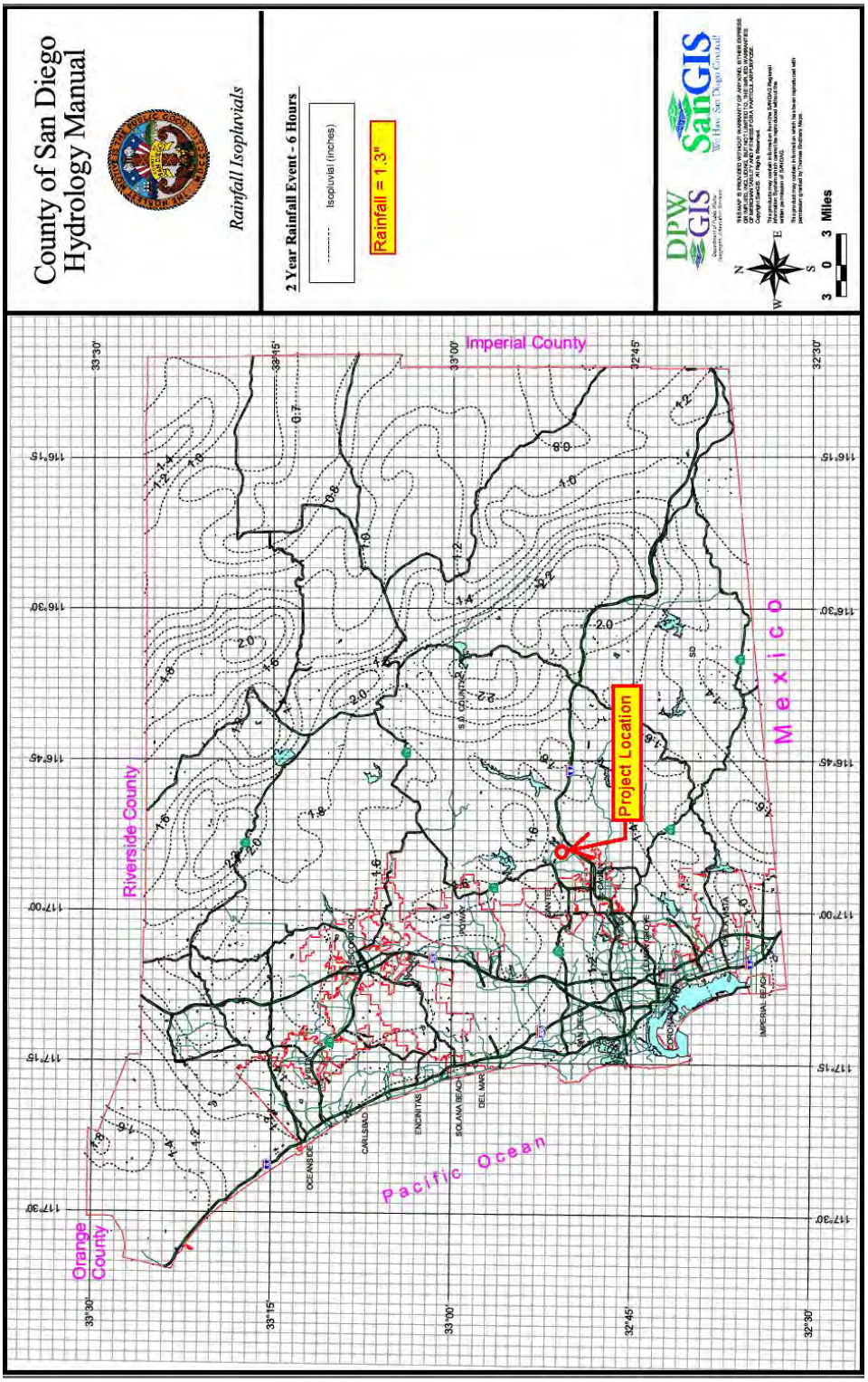
Legend

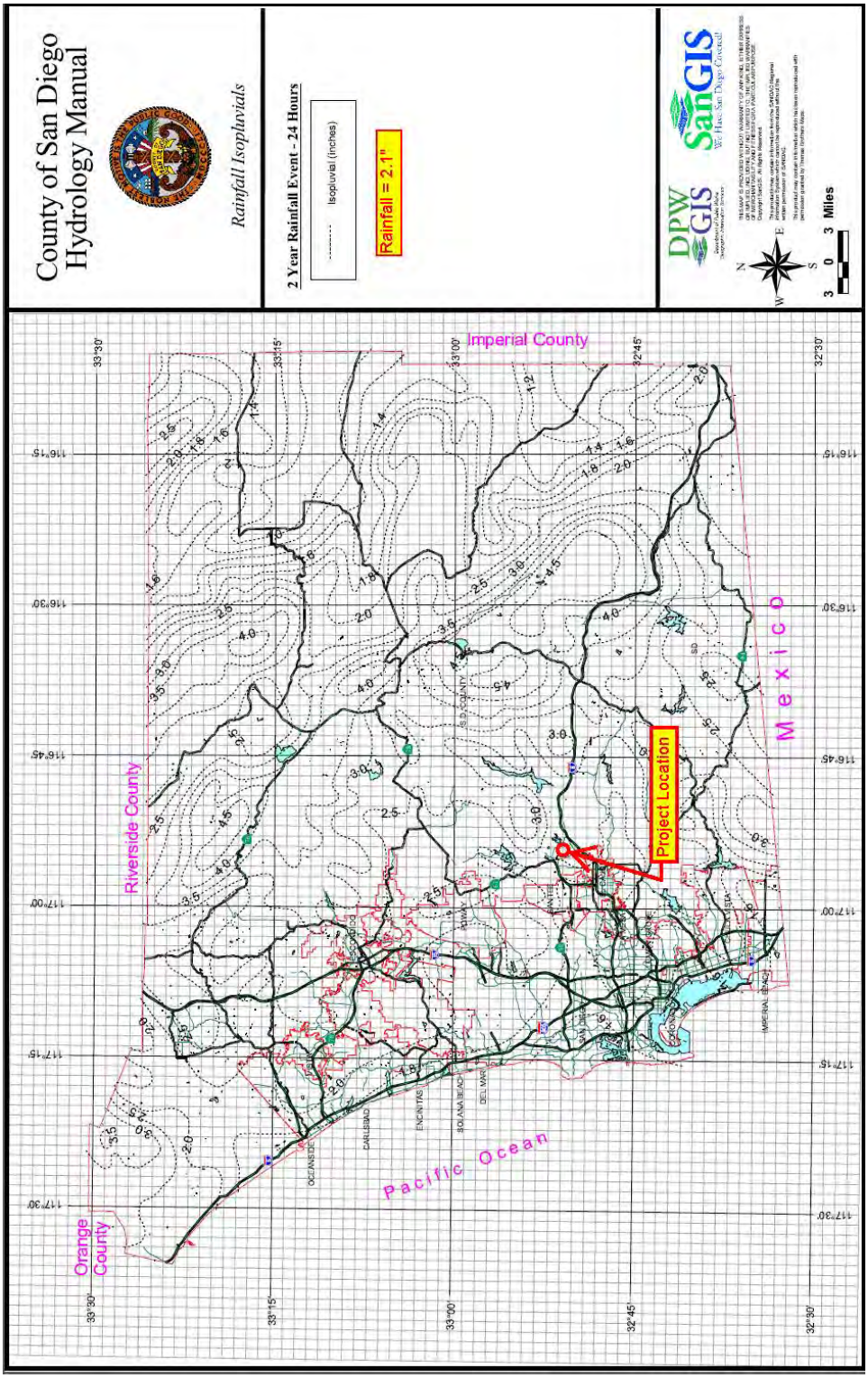


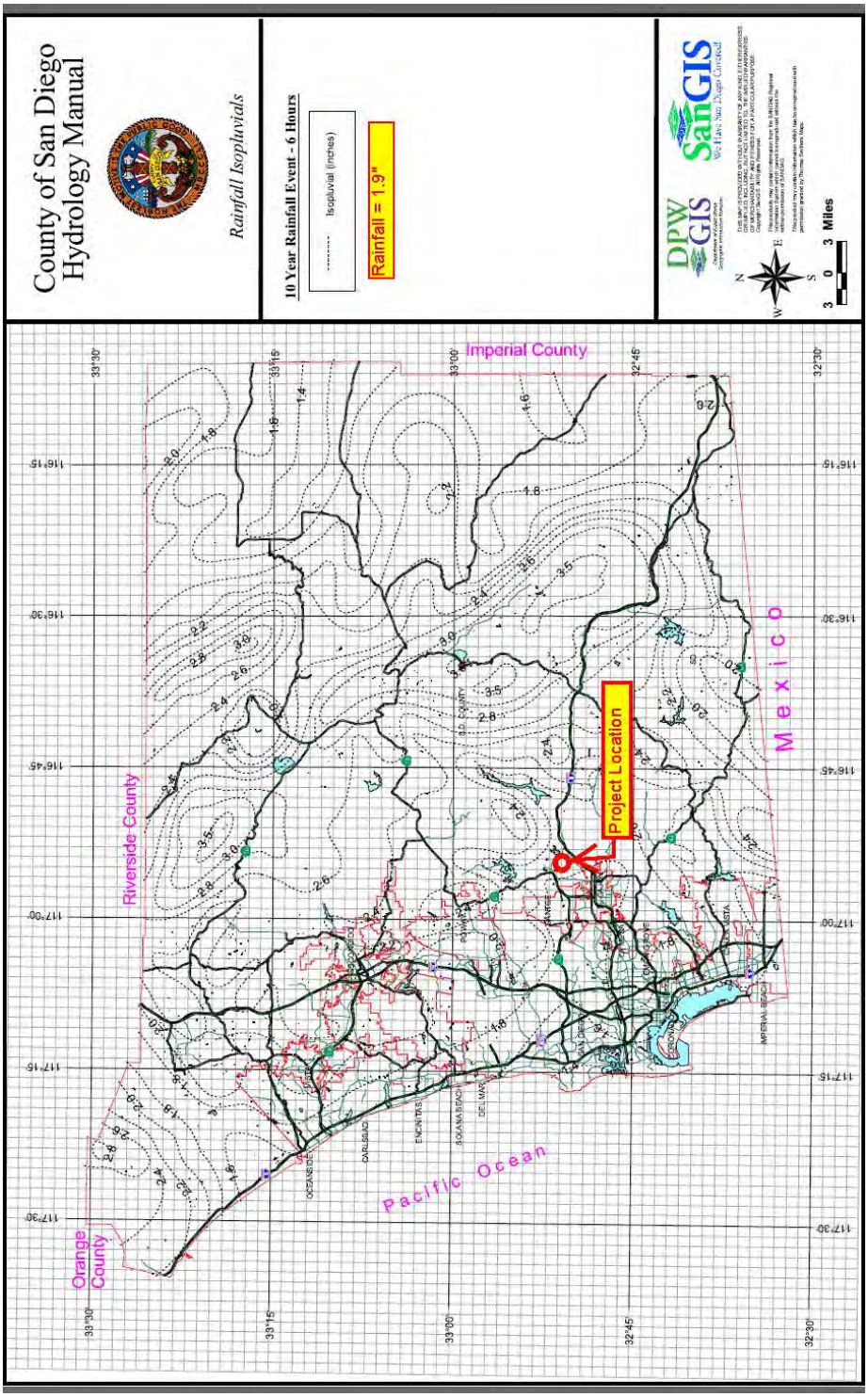
RAINFALL ISOPLUVIALS

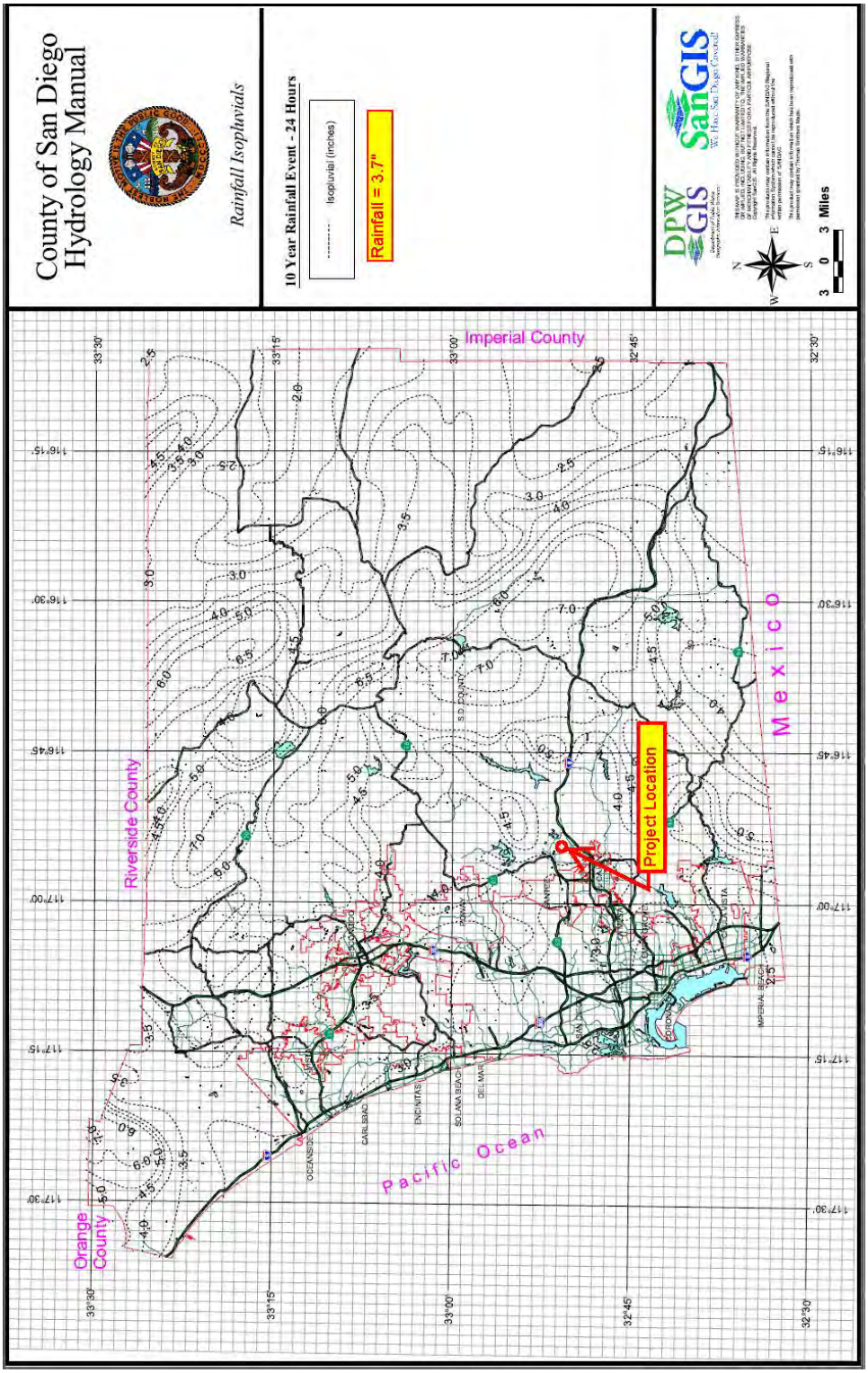
The following rainfall amounts are from the isopluvial maps in the San Diego County Hydrology Manual. For the analysis of small basins the Rational Method uses the 100-year 6-hour event as the controlling event and that is used for this analysis. The 6-hour event is between 0.45 and 0.65 of the 24-hour event for all return intervals and therefore did not need to be adjusted as described in the Hydrology Manual.

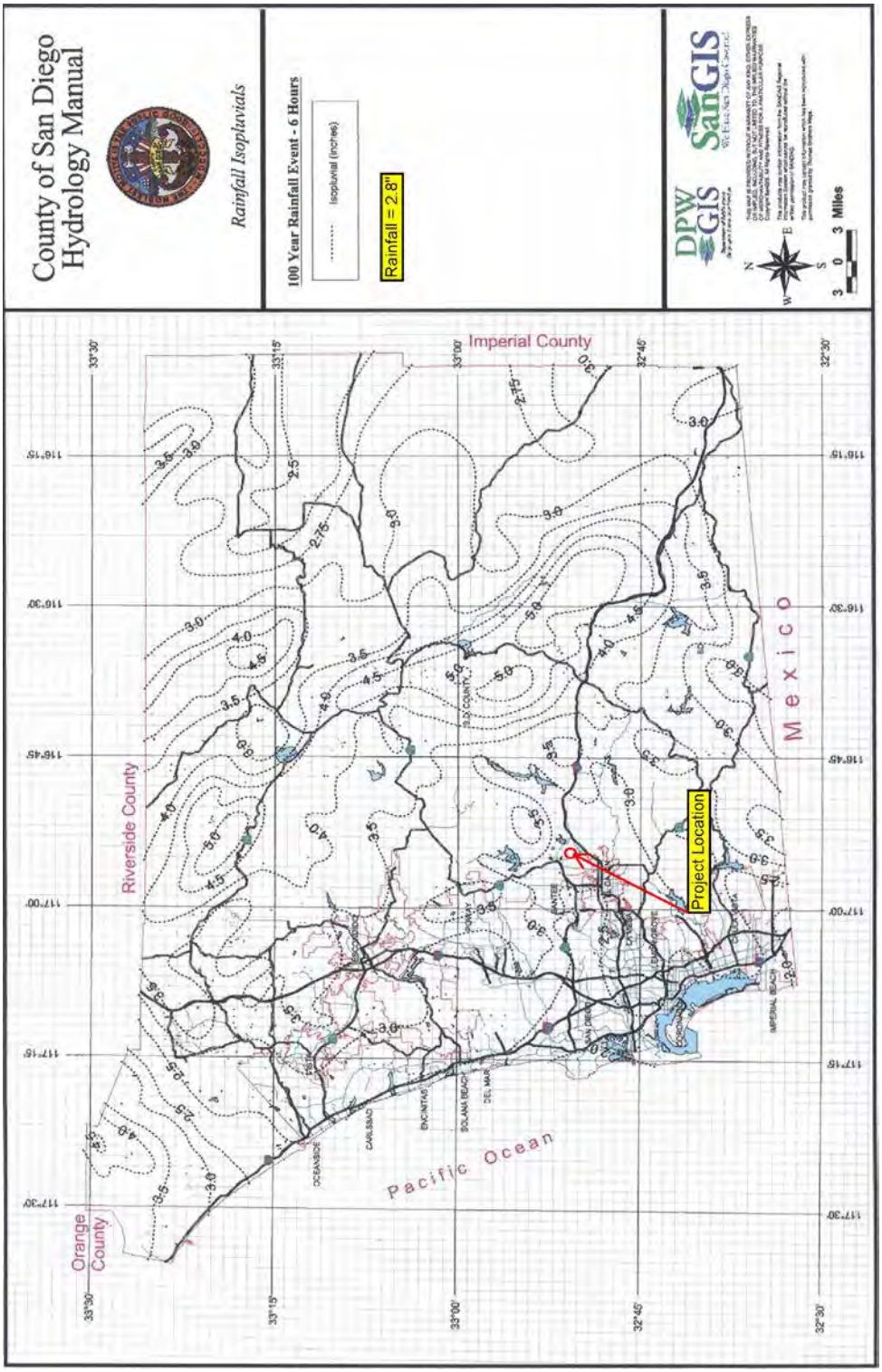
Storm Properties						
Selected Frequency =	100	year	10	year	2	year
6 hr precipitation =	2.8	inch	1.9	inch	1.3	inch
24 hr precipitation =	6.1	inch	3.7	inch	2.1	inch

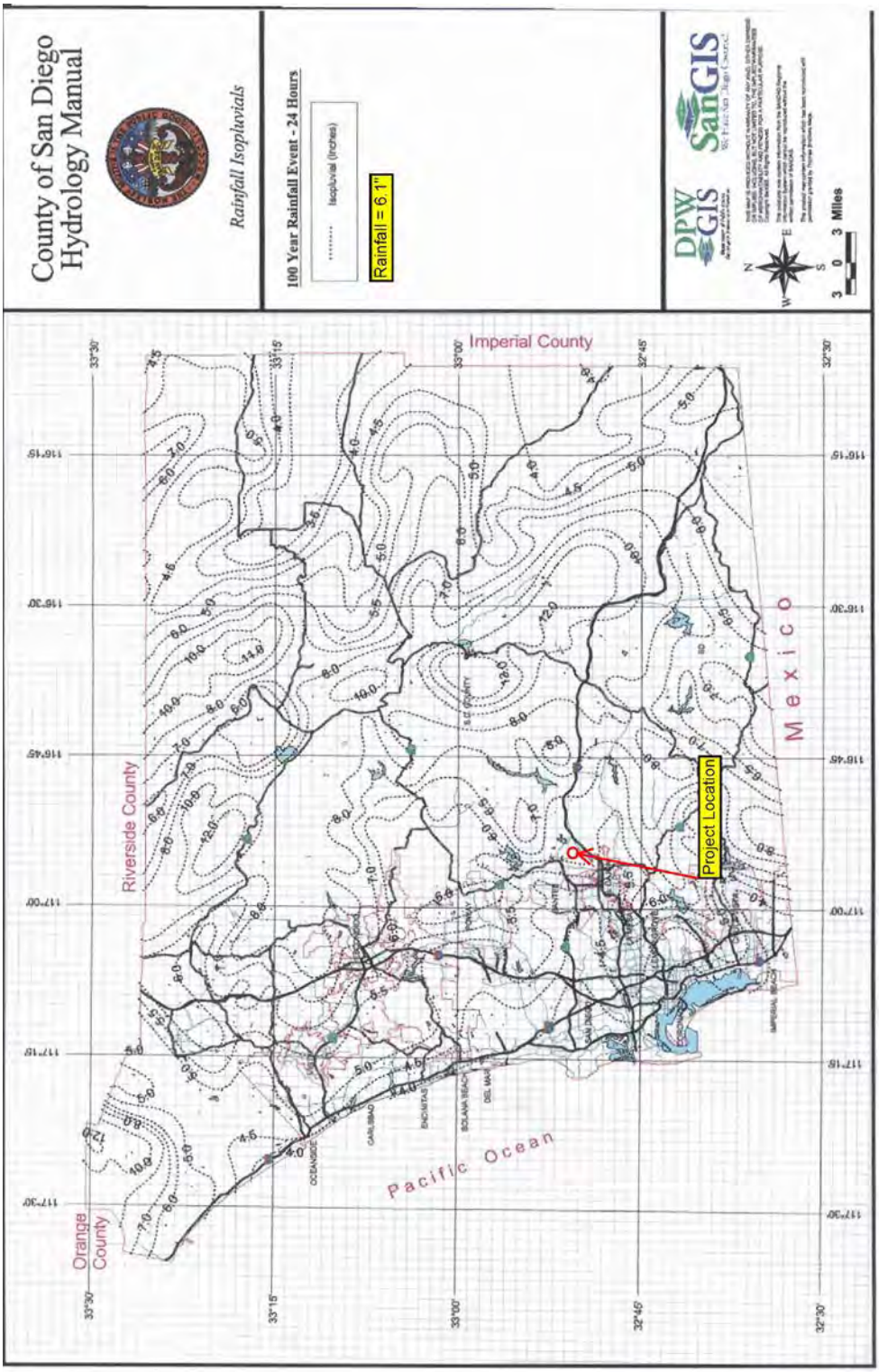

County of San Diego
Hydrology Manual
Rainfall Isopluvials
2 Year Rainfall Event - 6 Hours
Isopluvial (inches)
Rainfall = 1.3"
DPW GIS
SanGIS
3 0 3 Miles
Imperial County
Riverside County
Orange County
Pacific Ocean
Mexico
Project Location


County of San Diego
Hydrology Manual
Rainfall Isopluvials
2 Year Rainfall Event - 24 Hours
Isopluvial (inches)
Rainfall = 2.1"
DPW GIS
SanGIS
3 0 3 Miles
Imperial County
Riverside County
Orange County
Pacific Ocean
Mexico
Project Location


County of San Diego
Hydrology Manual
Rainfall Isopluvials
10 Year Rainfall Event - 6 Hours
Isopluvial (inches)
Rainfall = 1.9"
DPW GIS
SanGIS
3 0 3 Miles
Imperial County
Riverside County
Orange County
Pacific Ocean
Mexico
Project Location


County of San Diego
Hydrology Manual
Rainfall Isophuvials
10 Year Rainfall Event - 24 Hours
Isopluvial (inches)
Rainfall = 3.7"
DPW GIS
SanGIS
Miles
Imperial County
Riverside County
Orange County
Mexico
Pacific Ocean
Project Location


County of San Diego
Hydrology Manual
Rainfall Isopluvials
100 Year Rainfall Event - 6 Hours
Isopluvial (inches)
Rainfall = 2.8"
DPW GIS
SanGIS
3 0 3 Miles
Imperial County
Riverside County
Orange County
Pacific Ocean
Mexico
Project Location


County of San Diego
Hydrology Manual
Rainfall Isopluvials
100 Year Rainfall Event - 24 Hours
Isopluvial (inches)
Rainfall = 6.1"
DPW GIS
SanGIS
3 0 3 Miles
Imperial County
Riverside County
Orange County
Mexico
Pacific Ocean
Project Location

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

HYDROLOGY ANALYSIS

BEFORE PROJECT

			Hydrology Calculations (100-year)			
Hydrology Analysis area(s) =		A1 Before		Conc Pt =	1.1	
Development Conditions =		Before & After Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.20				
Area A soil	0%	0.00	0.20	0.00		
Area B soil	100%	0.20	0.25	0.05		
Area C soil	0%	0.00	0.30	0.00		
Area D soil	0%	0.00	0.35	0.00		
Sum C*A			0.25	0.05		
High Point		565.0				
Low Point		480.0				
Ti elevation		525.0				
Slope after Ti		40.2%				
Calculate Tc						
Approximate slope for the Ti distance of the basin=				40%		
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.5	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.2	c.f.s.	a=	0.07	sq.ft
BW =		2	feet	p=	2.10	ft.
Z =		5.0	:1	r=	0.03	ft.
s =		40.2%		Q=	0.18	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		2.7	f.p.s.			
Basin Length =		212	feet			
less Ti distance =		100	feet			
Tt distance =		112	feet			
Tt distance/Velocity =		41	seconds			
=		0.7	minutes			
Tc = Ti + Tt =		5.2	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		7.22	inch/hr			
Q=Sum(C*A) * I		**0.36**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

WO 6537 | Hydrology Report TPM | APN 397-060-80-00
Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations (100-year)			
Hydrology Analysis area(s) =		A2 Before		Conc Pt =	1.2	
Development Conditions =		Before & After Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.55				
Area A soil	0%	0.00	0.20	0.00		
Area B soil	100%	0.55	0.25	0.14		
Area C soil	0%	0.00	0.30	0.00		
Area D soil	0%	0.00	0.35	0.00		
Sum C*A			0.25	0.14		
High Point		581				
Low Point		475				
100' elevation		550				
Slope after 100'		38.46%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				31	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.9	min.			
Tt = Travel time in natural channel						
Assume a 1' wide bottom with 4:1 side slopes as average shape of the swale.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.47	c.f.s.	a=	0.09	sq.ft
BW =		1	feet	p=	1.14	ft.
Z =		4.0	:1	r=	0.08	ft.
s =		38%		Q=	0.40	
n =		0.035		diff	0.07	
Depth =		0.02	feet			
Velocity =		4.7	f.p.s.			
Basin Length =		295	feet	Additional travel time through BMP		
less Ti distance =		100	feet		L(ft) =	0
Tt distance =		195	feet		V(f.p.s.) =	0.01
Tt distance/Velocity =		41	seconds		t(BMP) =	0.0
=		0.7	minutes		Tbmp (min) =	0.0
Tc = Ti + Tt +Tbmp =		5.6	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		6.87	inch/hr			
Q=Sum(C*A) * I		**0.94**	**c.f.s.**			

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Civil Engineering

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WO 6537 | Hydrology Report TPM | APN 397-060-80-00
Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations (100-yr)			
Hydrology Analysis area(s) =		A3 Before		Conc Pt =	1.3	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.14				
Area A soil	0%	0.00	0.20	0.00		
Area B soil	100%	0.14	0.25	0.04		
Area C soil	0%	0.00	0.30	0.00		
Area D soil	0%	0.00	0.35	0.00		
Sum C*A			0.25	0.04		
High Point		545.0				
Low Point		510.0				
100' elevation		522.0				
Slope after 100'		48.00%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				23	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.4	min.			
Tt = Travel time in natural channel						
Assume a 1' wide bottom with 4:1 side slopes as average shape of the ground.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.1	c.f.s.	a=	0.04	sq.ft
BW =		1	feet	p=	1.06	ft.
Z =		4.0	:1	r=	0.04	ft.
s =		48%		Q=	0.12	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		3.2	f.p.s.			
Basin Length =		125	feet			
less Ti distance =		100	feet			
Tt surface distance =		25	feet			
Tt distance/Velocity =		8	seconds			
=		0.1	minutes			
Tc = Ti + Tt =		5.5	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		6.92	inch/hr			
Q=Sum(C*A) * I		**0.24**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations (100-yr)			
Hydrology Analysis area(s) =		B Before		Conc Pt =	2.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.78				
Area A soil	0%	0.00	0.20	0.00		
Area B soil	100%	0.78	0.25	0.20		
Area C soil	0%	0.00	0.30	0.00		
Area D soil	0%	0.00	0.35	0.00		
Sum C*A			0.25	0.20		
High Point		580.6				
Low Point		507.0				
Ti elevation		556.0				
Slope after Ti		30.63%				
Calculate Tc						
Approximate slope for the Ti distance of the basin=				25	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.3	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the ground.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.6	c.f.s.	a=	0.16	sq.ft
BW =		2	feet	p=	2.23	ft.
Z =		5.0	:1	r=	0.07	ft.
s =		31%		Q=	0.64	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		4.0	f.p.s.			
Basin Length =		260	feet			
less Ti distance =		100	feet			
Tt distance =		160	feet			
Tt distance/Velocity =		40	seconds			
=		0.7	minutes			
Tc = Ti + Tt =		5.9	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		6.61	inch/hr			
Q=Sum(C*A) * I		**1.29**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

			Hydrology Calculations (100-yr)			
Hydrology Analysis area(s) =		C Before		Conc Pt =	3.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.3				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.3	0.25	0.08		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.08		
High Point		558				
Low Point		496				
100' elevation		518				
Slope after 100'		30.99%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				40	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.5	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.3	c.f.s.	a=	0.10	sq.ft
BW =		2	feet	p=	2.14	ft.
Z =		4.0	:1	r=	0.05	ft.
s =		31%		Q=	0.31	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		3.1	f.p.s.			
Basin Length =		171	feet			
less Ti distance =		100	feet			
Tt distance =		71	feet			
Tt distance/Velocity =		23	seconds			
=		0.4	minutes			
Tc = Ti + Tt =		4.9	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		7.51	inch/hr			
Q=Sum(C*A) * I		**0.62**	**c.f.s.**			

			Hydrology Calculations			
Hydrology Analysis area(s) =		D Before		Conc Pt =	4.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.5				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.5	0.25	0.13		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.13		
High Point		581				
Low Point		487				
100' elevation		562				
Slope after 100'		32.22%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				19	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.8	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.4	c.f.s.	a=	0.09	sq.ft
BW =		1	feet	p=	1.15	ft.
Z =		5.0	:1	r=	0.08	ft.
s =		32%		Q=	0.40	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		4.4	f.p.s.			
Basin Length =		334	feet			
less Ti distance =		100	feet			
Tt distance =		234	feet			
Tt distance/Velocity =		53	seconds			
=		0.9	minutes			
Tc = Ti + Tt =		6.7	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		6.13	inch/hr			
Q=Sum(C*A) * I		**0.80**	**c.f.s.**			

			Hydrology Calculations			
Hydrology Analysis area(s) =		E Before		Conc Pt =	5.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	1.1				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	1.1	0.25	0.26		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.26		
High Point		581				
Low Point		500				
100' elevation		558				
Slope after 100'		27.36%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				23	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.4	min.			
Tt = Travel time in natural channel						
Assume a 1' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.9	c.f.s.	a=	0.16	sq.ft
BW =		1	feet	p=	1.26	ft.
Z =		4.0	:1	r=	0.12	ft.
s =		27%		Q=	0.86	
n =		0.035		diff	0.00	
Depth =		0.03	feet			
Velocity =		5.5	f.p.s.			
Basin Length =		312	feet			
less Ti distance =		100	feet			
Tt distance =		212	feet			
Tt distance/Velocity =		38	seconds			
=		0.6	minutes			
Tc = Ti + Tt =		6.1	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		6.52	inch/hr			
Q=Sum(C*A) * I		**1.71**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations (10-yr)			
Hydrology Analysis area(s) =		B Before		Conc Pt =	2.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.78				
Area A soil	0%	0.00	0.20	0.00		
Area B soil	100%	0.78	0.25	0.20		
Area C soil	0%	0.00	0.30	0.00		
Area D soil	0%	0.00	0.35	0.00		
Sum C*A			0.25	0.20		
High Point		580.6				
Low Point		507.0				
Ti elevation		556.0				
Slope after Ti		30.63%				
Calculate Tc						
Approximate slope for the Ti distance of the basin=				25	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.3	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.4	c.f.s.	a=	0.12	sq.ft
BW =		2	feet	p=	2.18	ft.
Z =		5.0	:1	r=	0.06	ft.
s =		31%		Q=	0.43	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		3.5	f.p.s.			
Basin Length =		260	feet			
less Ti distance =		100	feet			
Tt distance =		160	feet			
Tt distance/Velocity =		46	seconds			
=		0.8	minutes			
Tc = Ti + Tt =		6.0	minutes			
Selected Frequency =		10	year			
6 hr precipitation =		1.9	inch			
24 hr precipitation =		3.7	inch			
6 hr/24 hr precip =		0.51	(0.45 - .65)	OK		
Adjusted 6 hr =		1.9	inch			
I = (7.44*P6)*(D^-0.645) =		4.44	inch/hr			
Q=Sum(C*A) * I		**0.86**	**c.f.s.**			

			Hydrology Calculations			
Hydrology Analysis area(s) =		C Before		Conc Pt =	3.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.3				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.3	0.25	0.08		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.08		
High Point		558				
Low Point		496				
100' elevation		518				
Slope after 100'		30.99%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				40	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.5	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.2	c.f.s.	a=	0.08	sq.ft
BW =		2	feet	p=	2.11	ft.
Z =		4.0	:1	r=	0.04	ft.
s =		31%		Q=	0.21	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		2.6	f.p.s.			
Basin Length =		171	feet			
less Ti distance =		100	feet			
Tt distance =		71	feet			
Tt distance/Velocity =		27	seconds			
=		0.4	minutes			
Tc = Ti + Tt =		4.9	minutes			
Selected Frequency =		10	year			
6 hr precipitation =		1.9	inch			
24 hr precipitation =		3.7	inch			
6 hr/24 hr precip =		0.51	(0.45 - .65)	OK		
Adjusted 6 hr =		1.9	inch			
I = (7.44*P6)*(D^-0.645) =		5.05	inch/hr			
Q=Sum(C*A) * I		**0.42**	**c.f.s.**			

			Hydrology Calculations			
Hydrology Analysis area(s) =		D Before		Conc Pt =	4.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.5				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.5	0.25	0.13		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.13		
High Point		581				
Low Point		487				
100' elevation		562				
Slope after 100'		32.22%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				19	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.8	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.3	c.f.s.	a=	0.09	sq.ft
BW =		2	feet	p=	2.13	ft.
Z =		5.0	:1	r=	0.04	ft.
s =		32%		Q=	0.26	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		2.9	f.p.s.			
Basin Length =		334	feet			
less Ti distance =		100	feet			
Tt distance =		234	feet			
Tt distance/Velocity =		80	seconds			
=		1.3	minutes			
Tc = Ti + Tt =		7.1	minutes			
Selected Frequency =		10	year			
6 hr precipitation =		1.9	inch			
24 hr precipitation =		3.7	inch			
6 hr/24 hr precip =		0.51	(0.45 - .65)	OK		
Adjusted 6 hr =		1.9	inch			
I = (7.44*P6)*(D^-0.645) =		3.99	inch/hr			
Q=Sum(C*A) * I		**0.52**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations (10-year)			
Hydrology Analysis area(s) =		E Before		Conc Pt =	5.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	1.1				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	1.1	0.25	0.26		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.26		
High Point		581				
Low Point		500				
100' elevation		558				
Slope after 100'		27.36%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				23	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.4	min.			
Tt = Travel time in natural channel						
Assume a 1' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.6	c.f.s.	a=	0.12	sq.ft
BW =		1	feet	p=	1.20	ft.
Z =		4.0	:1	r=	0.10	ft.
s =		27%		Q=	0.57	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		4.8	f.p.s.			
Basin Length =		312	feet			
less Ti distance =		100	feet			
Tt distance =		212	feet			
Tt distance/Velocity =		44	seconds			
=		0.7	minutes			
Tc = Ti + Tt =		6.2	minutes			
Selected Frequency =		10	year			
6 hr precipitation =		1.9	inch			
24 hr precipitation =		3.7	inch			
6 hr/24 hr precip =		0.51	(0.45 - .65)	OK		
Adjusted 6 hr =		1.9	inch			
I = (7.44*P6)*(D^-0.645) =		4.38	inch/hr			
Q=Sum(C*A) * I		**1.15**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations (2-yr)			
Hydrology Analysis area(s) =		B Before		Conc Pt =	2.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.78				
Area A soil	0%	0.00	0.20	0.00		
Area B soil	100%	0.78	0.25	0.20		
Area C soil	0%	0.00	0.30	0.00		
Area D soil	0%	0.00	0.35	0.00		
Sum C*A			0.25	0.20		
High Point		580.6				
Low Point		507.0				
Ti elevation		556.0				
Slope after Ti		30.63%				
Calculate Tc						
Approximate slope for the Ti distance of the basin=				25	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.3	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.3	c.f.s.	a=	0.10	sq.ft
BW =		2	feet	p=	2.14	ft.
Z =		5.0	:1	r=	0.05	ft.
s =		31%		Q=	0.29	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		3.0	f.p.s.			
Basin Length =		260	feet			
less Ti distance =		100	feet			
Tt distance =		160	feet			
Tt distance/Velocity =		53	seconds			
=		0.9	minutes			
Tc = Ti + Tt =		6.2	minutes			
Selected Frequency =		2	year			
6 hr precipitation =		1.3	inch			
24 hr precipitation =		2.1	inch			
6 hr/24 hr precip =		0.62	(0.45 - .65)	OK		
Adjusted 6 hr =		1.3	inch			
I = (7.44*P6)*(D^-0.645) =		3.00	inch/hr			
Q=Sum(C*A) * I		**0.58**	**c.f.s.**			

			Hydrology Calculations			
Hydrology Analysis area(s) =		C Before		Conc Pt =	3.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.3				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.3	0.25	0.08		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.08		
High Point		558				
Low Point		496				
100' elevation		518				
Slope after 100'		30.99%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				40	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.5	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.1	c.f.s.	a=	0.06	sq.ft
BW =		2	feet	p=	2.09	ft.
Z =		4.0	:1	r=	0.03	ft.
s =		31%		Q=	0.14	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		2.3	f.p.s.			
Basin Length =		171	feet			
less Ti distance =		100	feet			
Tt distance =		71	feet			
Tt distance/Velocity =		31	seconds			
=		0.5	minutes			
Tc = Ti + Tt =		5.0	minutes			
Selected Frequency =		2	year			
6 hr precipitation =		1.3	inch			
24 hr precipitation =		2.1	inch			
6 hr/24 hr precip =		0.62	(0.45 - .65)	OK		
Adjusted 6 hr =		1.3	inch			
I = (7.44*P6)*(D^-0.645) =		3.43	inch/hr			
Q=Sum(C*A) * I		**0.28**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

			Hydrology Calculations			
Hydrology Analysis area(s) =		D Before		Conc Pt =	4.1	
Development Conditions =		Before Project				
Land Use Designation =		LDR 2.9 DU/A or less		Index=	4	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.5				
Area A soil	0%	0.0	0.38	0.00		
Area B soil	100%	0.5	0.41	0.21		
Area C soil	0%	0.0	0.45	0.00		
Area D soil	0%	0.0	0.49	0.00		
Sum C*A			0.41	0.21		
High Point		581				
Low Point		487				
100' elevation		562				
Slope after 100'		32.22%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				19	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.7	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.3	c.f.s.	a=	0.10	sq.ft
BW =		2	feet	p=	2.15	ft.
Z =		5.0	:1	r=	0.05	ft.
s =		32%		Q=	0.33	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		3.2	f.p.s.			
Basin Length =		334	feet			
less Ti distance =		100	feet			
Tt distance =		234	feet			
Tt distance/Velocity =		73	seconds			
=		1.2	minutes			
Tc = Ti + Tt =		5.9	minutes			
Selected Frequency =		2	year			
6 hr precipitation =		1.3	inch			
24 hr precipitation =		2.1	inch			
6 hr/24 hr precip =		0.62	(0.45 - .65)	OK		
Adjusted 6 hr =		1.3	inch			
I = (7.44*P6)*(D^-0.645) =		3.07	inch/hr			
Q=Sum(C*A) * I		**0.66**	**c.f.s.**			

			Hydrology Calculations			
Hydrology Analysis area(s) =		E Before		Conc Pt =	5.1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	1.1				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	1.1	0.25	0.26		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.26		
High Point		581				
Low Point		500				
100' elevation		558				
Slope after 100'		27.36%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				23	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.4	min.			
Tt = Travel time in natural channel						
Assume a 1' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.4	c.f.s.	a=	0.09	sq.ft
BW =		1	feet	p=	1.15	ft.
Z =		4.0	:1	r=	0.08	ft.
s =		27%		Q=	0.39	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		4.2	f.p.s.			
Basin Length =		312	feet			
less Ti distance =		100	feet			
Tt distance =		212	feet			
Tt distance/Velocity =		51	seconds			
=		0.8	minutes			
Tc = Ti + Tt =		6.3	minutes			
Selected Frequency =		2	year			
6 hr precipitation =		1.3	inch			
24 hr precipitation =		2.1	inch			
6 hr/24 hr precip =		0.62	(0.45 - .65)	OK		
Adjusted 6 hr =		1.3	inch			
I = (7.44*P6)*(D^-0.645) =		2.96	inch/hr			
Q=Sum(C*A) * I		**0.78**	**c.f.s.**			

AFTER PROJECT

			Hydrology Calculations (100-yr)			
Hydrology Analysis area(s) =		B After		Conc Pt =	2.2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.9 DU/A or less		Index=	4	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.76				
Area A soil	0%	0.00	0.38	0.00		
Area B soil	100%	0.76	0.41	0.31		
Area C soil	0%	0.00	0.45	0.00		
Area D soil	0%	0.00	0.49	0.00		
Sum C*A			0.41	0.31		
High Point		580.6				
Low Point		507.0				
Ti elevation		556.0				
Slope after Ti		30.63%				
Calculate Tc						
Approximate slope for the Ti distance of the basin=				25	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.3	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the ground.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		1.2	c.f.s.	a=	0.23	sq.ft
BW =		2	feet	p=	2.34	ft.
Z =		5.0	:1	r=	0.10	ft.
s =		31%		Q=	1.18	
n =		0.035		diff	0.00	
Depth =		0.03	feet			
Velocity =		5.1	f.p.s.			
Basin Length =		260	feet			
less Ti distance =		100	feet			
Tt distance =		160	feet			
Tt distance/Velocity =		32	seconds			
=		0.5	minutes			
Tc = Ti + Tt =		4.8	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		7.57	inch/hr			
Q=Sum(C*A) * I		**2.36**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations (100-yr)			
Hydrology Analysis area(s) =		C After		Conc Pt =	3.2	
Development Conditions =		After Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.3				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.3	0.25	0.08		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.08		
High Point		550				
Low Point		496				
100' elevation		503				
Slope after 100'		22.58%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				47	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.2	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.3	c.f.s.	a=	0.11	sq.ft
BW =		2	feet	p=	2.15	ft.
Z =		4.0	:1	r=	0.05	ft.
s =		23%		Q=	0.31	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		2.8	f.p.s.			
Basin Length =		131	feet			
less Ti distance =		100	feet			
Tt distance =		31	feet			
Tt distance/Velocity =		11	seconds			
=		0.2	minutes			
Tc = Ti + Tt =		4.4	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		7.98	inch/hr			
Q=Sum(C*A) * I		**0.62**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

			Hydrology Calculations			
Hydrology Analysis area(s) =		D After		Conc Pt =	4.2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.9 DU/A or less		Index=	4	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	1.3				
Area A soil	0%	0.0	0.38	0.00		
Area B soil	100%	1.3	0.41	0.51		
Area C soil	0%	0.0	0.45	0.00		
Area D soil	0%	0.0	0.49	0.00		
Sum C*A			0.41	0.51		
High Point		581				
Low Point		487				
100' elevation		562				
Slope after 100'		28.56%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				19	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.7	min.			
Tt = Travel time in natural channel						
Assume a 0.5' wide bottom with 30:1 side slopes as average shape of the road.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		1.9	c.f.s.	a=	0.14	sq.ft
BW =		0.5	feet	p=	0.78	ft.
Z =		30.0	:1	r=	0.18	ft.
s =		29%		Q=	1.89	
n =		0.019		diff	0.00	
Depth =		0.00	feet			
Velocity =		13.4	f.p.s.			
Basin Length =		364	feet			
less Ti distance =		100	feet			
Tt distance =		264	feet			
Tt distance/Velocity =		20	seconds			
=		0.3	minutes			
Tc = Ti + Tt =		5.0	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		7.36	inch/hr			
Q=Sum(C*A) * I		**3.77**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

WO 6537 | Hydrology Report TPM | APN 397-060-80-00
Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations			
Hydrology Analysis area(s) =		E After		Conc Pt =	5.2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.9 DU/A or less		Index=	4	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.4				
Area A soil	0%	0.0	0.38	0.00		
Area B soil	100%	0.4	0.41	0.15		
Area C soil	0%	0.0	0.45	0.00		
Area D soil	0%	0.0	0.49	0.00		
Sum C*A			0.41	0.15		
High Point		542				
Low Point		500				
100' elevation		526				
Slope after 100'		43.33%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				16	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.9	min.			
Tt = Travel time in natural channel						
Assume a 1' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.5	c.f.s.	a=	0.10	sq.ft
BW =		1	feet	p=	1.16	ft.
Z =		4.0	:1	r=	0.09	ft.
s =		43%		Q=	0.54	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		5.4	f.p.s.			
Basin Length =		160	feet			
less Ti distance =		100	feet			
Tt distance =		60	feet			
Tt distance/Velocity =		11	seconds			
=		0.2	minutes			
Tc = Ti + Tt =		5.1	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.1	inch			
6 hr/24 hr precip =		0.46	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		7.27	inch/hr			
Q=Sum(C*A) * I		**1.07**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

WO 6537 | Hydrology Report TPM | APN 397-060-80-00
Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations (10-yr)			
Hydrology Analysis area(s) =		B After		Conc Pt =	2.2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.9 DU/A or less		Index=	4	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.76				
Area A soil	0%	0.00	0.38	0.00		
Area B soil	100%	0.76	0.41	0.31		
Area C soil	0%	0.00	0.45	0.00		
Area D soil	0%	0.00	0.49	0.00		
Sum C*A			0.41	0.31		
High Point		580.6				
Low Point		507.0				
Ti elevation		556.0				
Slope after Ti		30.63%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				25	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.3	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.8	c.f.s.	a=	0.18	sq.ft
BW =		2	feet	p=	2.25	ft.
Z =		4.0	:1	r=	0.08	ft.
s =		31%		Q=	0.79	
n =		0.035		diff	0.00	
Depth =		0.03	feet			
Velocity =		4.4	f.p.s.			
Basin Length =		260	feet			
less Ti distance =		100	feet			
Tt distance =		160	feet			
Tt distance/Velocity =		37	seconds			
=		0.6	minutes			
Tc = Ti + Tt =		4.9	minutes			
Selected Frequency =		10	year			
6 hr precipitation =		1.9	inch			
24 hr precipitation =		3.7	inch			
6 hr/24 hr precip =		0.51	(0.45 - .65)	OK		
Adjusted 6 hr =		1.9	inch			
I = (7.44*P6)*(D^-0.645) =		5.08	inch/hr			
Q=Sum(C*A) * I		**1.58**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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			Hydrology Calculations (10-year)			
Hydrology Analysis area(s) =		C After		Conc Pt =	3.2	
Development Conditions =		After Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.3				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.3	0.25	0.08		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.08		
High Point		550				
Low Point		496				
100' elevation		503				
Slope after 100'		22.58%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				47	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.2	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.2	c.f.s.	a=	0.09	sq.ft
BW =		2	feet	p=	2.12	ft.
Z =		4.0	:1	r=	0.04	ft.
s =		23%		Q=	0.21	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		2.4	f.p.s.			
Basin Length =		131	feet			
less Ti distance =		100	feet			
Tt distance =		31	feet			
Tt distance/Velocity =		13	seconds			
=		0.2	minutes			
Tc = Ti + Tt =		4.5	minutes			
Selected Frequency =		10	year			
6 hr precipitation =		1.9	inch			
24 hr precipitation =		3.7	inch			
6 hr/24 hr precip =		0.51	(0.45 - .65)	OK		
Adjusted 6 hr =		1.9	inch			
I = (7.44*P6)*(D^-0.645) =		5.39	inch/hr			
Q=Sum(C*A) * I		**0.42**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

			Hydrology Calculations			
Hydrology Analysis area(s) =		D After		Conc Pt =	4.2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.9 DU/A or less		Index=	4	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	1.3				
Area A soil	0%	0.0	0.38	0.00		
Area B soil	100%	1.3	0.41	0.51		
Area C soil	0%	0.0	0.45	0.00		
Area D soil	0%	0.0	0.49	0.00		
Sum C*A			0.41	0.51		
High Point		581				
Low Point		487				
100' elevation		562				
Slope after 100'		28.56%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				19	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.7	min.			
Tt = Travel time in natural channel						
Assume a 0.5' wide bottom with 30:1 side slopes as average shape of the road.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		1.3	c.f.s.	a=	0.11	sq.ft
BW =		0.5	feet	p=	0.71	ft.
Z =		30.0	:1	r=	0.15	ft.
s =		29%		Q=	1.27	
n =		0.019		diff	0.00	
Depth =		0.00	feet			
Velocity =		11.9	f.p.s.			
Basin Length =		364	feet			
less Ti distance =		100	feet			
Tt distance =		264	feet			
Tt distance/Velocity =		22	seconds			
=		0.4	minutes			
Tc = Ti + Tt =		5.1	minutes			
Selected Frequency =		10	year			
6 hr precipitation =		1.9	inch			
24 hr precipitation =		3.7	inch			
6 hr/24 hr precip =		0.51	(0.45 - .65)	OK		
Adjusted 6 hr =		1.9	inch			
I = (7.44*P6)*(D^-0.645) =		4.97	inch/hr			
Q=Sum(C*A) * I		**2.54**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

			Hydrology Calculations (10-year)			
Hydrology Analysis area(s) =		E After		Conc Pt =	5.2	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.4				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.4	0.25	0.09		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.09		
High Point		542				
Low Point		500				
100' elevation		526				
Slope after 100'		43.33%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				16	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		6.1	min.			
Tt = Travel time in natural channel						
Assume a 1' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.2	c.f.s.	a=	0.05	sq.ft
BW =		1	feet	p=	1.09	ft.
Z =		4.0	:1	r=	0.05	ft.
s =		43%		Q=	0.19	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		3.7	f.p.s.			
Basin Length =		160	feet			
less Ti distance =		100	feet			
Tt distance =		60	feet			
Tt distance/Velocity =		16	seconds			
=		0.3	minutes			
Tc = Ti + Tt =		6.3	minutes			
Selected Frequency =		10	year			
6 hr precipitation =		1.9	inch			
24 hr precipitation =		3.7	inch			
6 hr/24 hr precip =		0.51	(0.45 - .65)	OK		
Adjusted 6 hr =		1.9	inch			
I = (7.44*P6)*(D^-0.645) =		4.29	inch/hr			
Q=Sum(C*A) * I		**0.39**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

			Hydrology Calculations (2-yr)			
Hydrology Analysis area(s) =		B After		Conc Pt =	2.2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.9 DU/A or less		Index=	4	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.76				
Area A soil	0%	0.00	0.38	0.00		
Area B soil	100%	0.76	0.41	0.31		
Area C soil	0%	0.00	0.45	0.00		
Area D soil	0%	0.00	0.49	0.00		
Sum C*A			0.41	0.31		
High Point		580.6				
Low Point		507.0				
Ti elevation		556.0				
Slope after Ti		30.63%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				25	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.3	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.5	c.f.s.	a=	0.14	sq.ft
BW =		2	feet	p=	2.21	ft.
Z =		5.0	:1	r=	0.06	ft.
s =		31%		Q=	0.53	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		3.8	f.p.s.			
Basin Length =		260	feet			
less Ti distance =		100	feet			
Tt distance =		160	feet			
Tt distance/Velocity =		42	seconds			
=		0.7	minutes			
Tc = Ti + Tt =		5.0	minutes			
Selected Frequency =		2	year			
6 hr precipitation =		1.3	inch			
24 hr precipitation =		2.1	inch			
6 hr/24 hr precip =		0.62	(0.45 - .65)	OK		
Adjusted 6 hr =		1.3	inch			
I = (7.44*P6)*(D^-0.645) =		3.43	inch/hr			
Q=Sum(C*A) * I		**1.07**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

			Hydrology Calculations			
Hydrology Analysis area(s) =		C After		Conc Pt =	3.2	
Development Conditions =		After Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.3				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.3	0.25	0.08		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.08		
High Point		550				
Low Point		496				
100' elevation		503				
Slope after 100'		22.58%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				47	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.2	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.1	c.f.s.	a=	0.07	sq.ft
BW =		2	feet	p=	2.09	ft.
Z =		4.0	:1	r=	0.03	ft.
s =		23%		Q=	0.14	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		2.1	f.p.s.			
Basin Length =		131	feet			
less Ti distance =		100	feet			
Tt distance =		31	feet			
Tt distance/Velocity =		15	seconds			
=		0.2	minutes			
Tc = Ti + Tt =		4.5	minutes			
Selected Frequency =		2	year			
6 hr precipitation =		1.3	inch			
24 hr precipitation =		2.1	inch			
6 hr/24 hr precip =		0.62	(0.45 - .65)	OK		
Adjusted 6 hr =		1.3	inch			
I = (7.44*P6)*(D^-0.645) =		3.67	inch/hr			
Q=Sum(C*A) * I		**0.28**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

			Hydrology Calculations			
Hydrology Analysis area(s) =		D After		Conc Pt =	4.2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.9 DU/A or less		Index=	4	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	1.3				
Area A soil	0%	0.0	0.38	0.00		
Area B soil	100%	1.3	0.41	0.51		
Area C soil	0%	0.0	0.45	0.00		
Area D soil	0%	0.0	0.49	0.00		
Sum C*A			0.41	0.51		
High Point		581				
Low Point		487				
100' elevation		562				
Slope after 100'		28.56%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				19	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		4.7	min.			
Tt = Travel time in natural channel						
Assume a 0.5' wide bottom with 30:1 side slopes as average shape of the road.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.9	c.f.s.	a=	0.08	sq.ft
BW =		0.5	feet	p=	0.66	ft.
Z =		30.0	:1	r=	0.12	ft.
s =		29%		Q=	0.87	
n =		0.019		diff	0.00	
Depth =		0.00	feet			
Velocity =		10.5	f.p.s.			
Basin Length =		364	feet			
less Ti distance =		100	feet			
Tt distance =		264	feet			
Tt distance/Velocity =		25	seconds			
=		0.4	minutes			
Tc = Ti + Tt =		5.1	minutes			
Selected Frequency =		2	year			
6 hr precipitation =		1.3	inch			
24 hr precipitation =		2.1	inch			
6 hr/24 hr precip =		0.62	(0.45 - .65)	OK		
Adjusted 6 hr =		1.3	inch			
I = (7.44*P6)*(D^-0.645) =		3.38	inch/hr			
Q=Sum(C*A) * I		**1.73**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

			Hydrology Calculations			
Hydrology Analysis area(s) =		E After		Conc Pt =	5.2	
Development Conditions =		After Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.4				
Area A soil	0%	0.0	0.20	0.00		
Area B soil	100%	0.4	0.25	0.09		
Area C soil	0%	0.0	0.30	0.00		
Area D soil	0%	0.0	0.35	0.00		
Sum C*A			0.25	0.09		
High Point		542				
Low Point		500				
100' elevation		526				
Slope after 100'		43.33%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				16	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		6.1	min.			
Tt = Travel time in natural channel						
Assume a 1' wide bottom with 4:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.1	c.f.s.	a=	0.04	sq.ft
BW =		1	feet	p=	1.07	ft.
Z =		4.0	:1	r=	0.04	ft.
s =		43%		Q=	0.13	
n =		0.035		diff	0.00	
Depth =		0.01	feet			
Velocity =		3.2	f.p.s.			
Basin Length =		160	feet			
less Ti distance =		100	feet			
Tt distance =		60	feet			
Tt distance/Velocity =		19	seconds			
=		0.3	minutes			
Tc = Ti + Tt =		6.4	minutes			
Selected Frequency =		2	year			
6 hr precipitation =		1.3	inch			
24 hr precipitation =		2.1	inch			
6 hr/24 hr precip =		0.62	(0.45 - .65)	OK		
Adjusted 6 hr =		1.3	inch			
I = (7.44*P6)*(D^-0.645) =		2.92	inch/hr			
Q=Sum(C*A) * I		**0.26**	**c.f.s.**			

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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DETENTION BASIN ANALYSIS

	Detention Basin #			3				
Input Variable (Urban Conditions)								
	Six hour precipitation amount (inches)					P_6	2.8	
	Time of Concentration (min.)					T_c	4.8	
	Coefficient of runoff					C	0.41	
	Basin Area (acres)					A	0.8	
Computation								
	Time to Peak							
		$T_p=2.0T_cK_D/(1+K_p)=1.1072T_c$				T_p	5.3	
	Time of hydrograph to begin							
		$T_B=20-T_p$				T_B	14.7	
	Time of hydrograph to end							
		$T_E=20+1.5T_B$				T_E	42.0	
	Peak Flow					Q_p	2.4	cfs
		$Q_p=CIA$						
		$Itc=7.44P_6/T_c^{0.645}=$		7.57	in./hr.			
	Surrounding Flow (Q_s)							
		Depth of precipitation for 2 hours						
		$D_{120}=7.44P_6/120^{0.645}$ (2 hr.)						
		$D_{120}=0.6785P_6=$		1.9	in.			
		Depth of precipitation for hydrograph						
		$D_H=(P_6T_c^{0.355})/5.83=$		0.8	in.			
		Surrounding Intensity						
		$I_S=60(D_{120}-D_H)/(120-2.5T_c)$						
		$I_S=$	0.6	in./hr.				
		$Q_s=CI_sA$				Q_s	0.2	cfs
Plot Hydrograph and Surrounding Flow								
Outflow / Basin Size (Natural Conditions)								
	Outflow							
	C=	0.25	$T_c=$	5.9	min.			
		$I=7.44P_6/T_c^{0.645}=$		6.61	in./hr.			
	$Q_N=CIA=$	1.3	cfs					
	1. Plot on Hydrograph							
		a. Draw line from surrounding flow intercept with beginning hydrograph limb to Q_N						
	2. Estimate volume needed for reservoir =				905	Cu.Ft.		
		a. Determine preliminary reservoir dimensions						
		b. Surrounding flow discharges directly through reservoir without detaining any storage						
	3. Size outlet works							
		a. Outlet flow, Q_O less than or equal to Q_N						
		b. Stay within the limits of the reservoir						
	4. Rout							
		a. Refine reservoir dimensions and/or outflow facility						
	Hydrograph							
	Project Flows			Natural Flows				
	Time	Flow		Time	Flow			
	14.7	0.2		14.7	0.2			
	20.0	2.4		31.2	1.3			
	42.0	0.2		42.0	0.2			
	Volume Calc			Volume Calc				
	1785	Cu.Ft.		880	Cu.Ft.			
		Volume Change (Reservoir Volume)						
		905	**Cu.Ft.**					

2718 Powhatan Avenue
San Diego, CA 92117

Jim Magee
Civil Engineering

Phone (619) 894-1057
Jim@JimMagee.com

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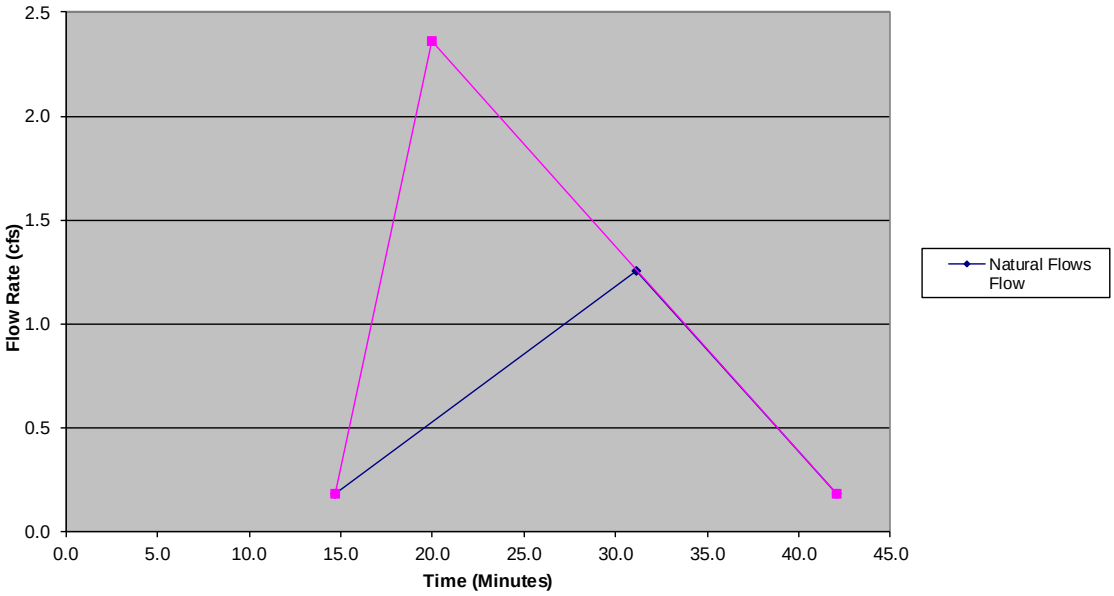
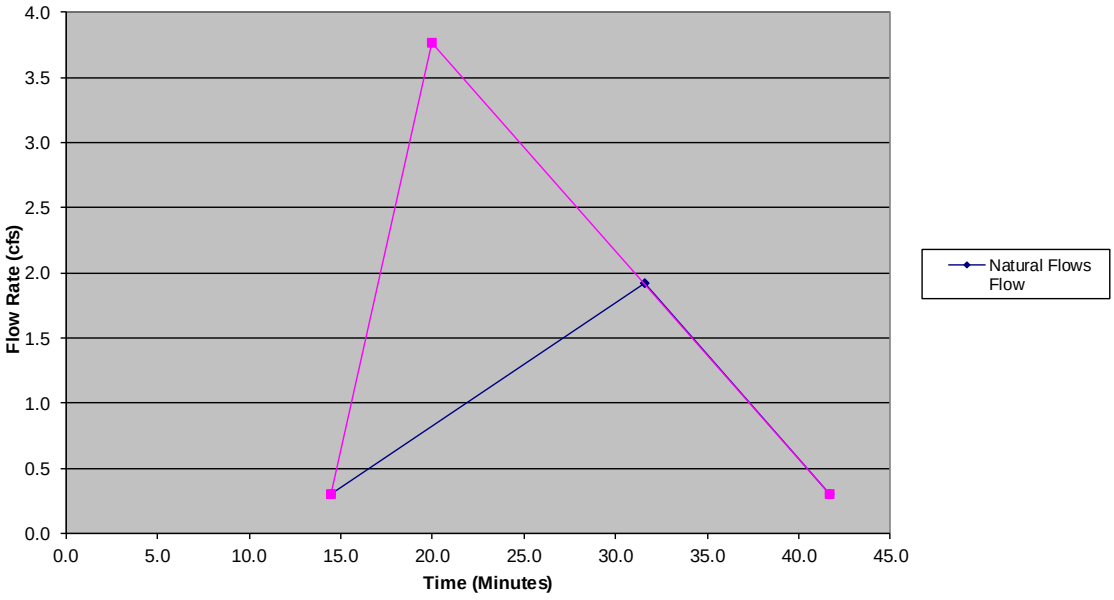
Mr. Jonathan Webster | Los Coches Road | Lakeside, CA

	Detention Basin #		5					
Input Variable (Urban Conditions)								
	Six hour precipitation amount (inches)					P_6	2.8	
	Time of Concentration (min.)					T_c	5.0	
	Coefficient of runoff					C	0.41	
	Basin Area (acres)					A	1.3	
Computation								
	Time to Peak							
		$T_p=2.0T_cK_D/(1+K_p)=1.1072T_c$				T_p	5.6	
	Time of hydrograph to begin							
		$T_B=20-T_p$				T_B	14.4	
	Time of hydrograph to end							
		$T_E=20+1.5T_B$				T_E	41.7	
	Peak Flow					Q_p	3.8	cfs
		$Q_p=CIA$						
		$Itc=7.44P_6/T_c^{0.645}=$		7.36	in./hr.			
	Surrounding Flow (Q_s)							
		Depth of precipitation for 2 hours						
		$D_{120}=7.44P_6/120^{0.645}$ (2 hr.)						
		$D_{120}=0.6785P_6=$		1.9	in.			
		Depth of precipitation for hydrograph						
		$D_H=(P_6T_c^{0.355})/5.83=$		0.9	in.			
		Surrounding Intensity						
		$I_s=60(D_{120}-D_H)/(120-2.5T_c)$						
		$I_s=$	0.6	in./hr.				
		$Q_s=CI_sA$				Q_s	0.3	cfs
Plot Hydrograph and Surrounding Flow								
Outflow / Basin Size (Natural Conditions)								
	Outflow							
	C=	0.25	$T_c=$	6.7	min.			
		$I=7.44P_6/T_c^{0.645}=$		6.13	in./hr.			
	$Q_N=CIA=$	1.9	cfs					
	1. Plot on Hydrograph							
		a. Draw line from surrounding flow intercept with beginning hydrograph limb to Q_N						
	2. Estimate volume needed for reservoir =				1515	Cu.Ft.		
		a. Determine preliminary reservoir dimensions						
		b. Surrounding flow discharges directly through reservoir without detaining any storage						
	3. Size outlet works							
		a. Outlet flow, Q_O less than or equal to Q_N						
		b. Stay within the limits of the reservoir						
	4. Rout							
		a. Refine reservoir dimensions and/or outflow facility						
	Hydrograph							
	Project Flows			Natural Flows				
	Time	Flow		Time	Flow			
	14.4	0.3		14.4	0.3			
	20.0	3.8		31.6	1.9			
	41.7	0.3		41.7	0.3			
	Volume Calc			Volume Calc				
	2834	Cu.Ft.		1319	Cu.Ft.			
		Volume Change (Reservoir Volume)						
		1515	**Cu.Ft.**					

Detention Basin3 Flows



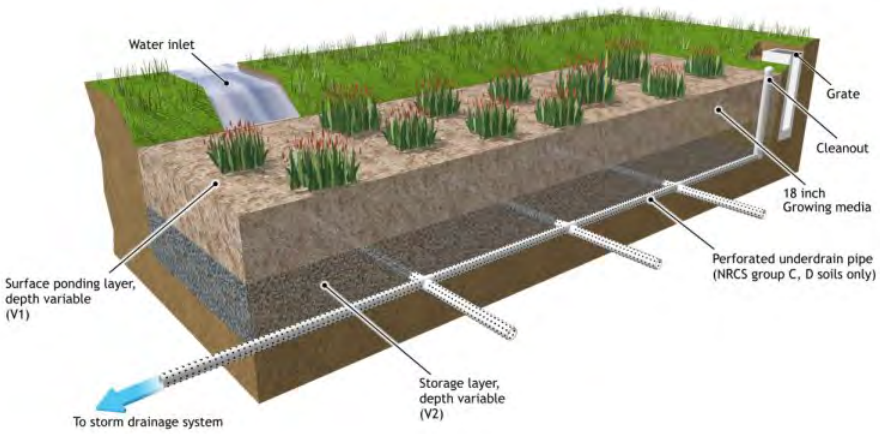
Detention Basin5 Flows



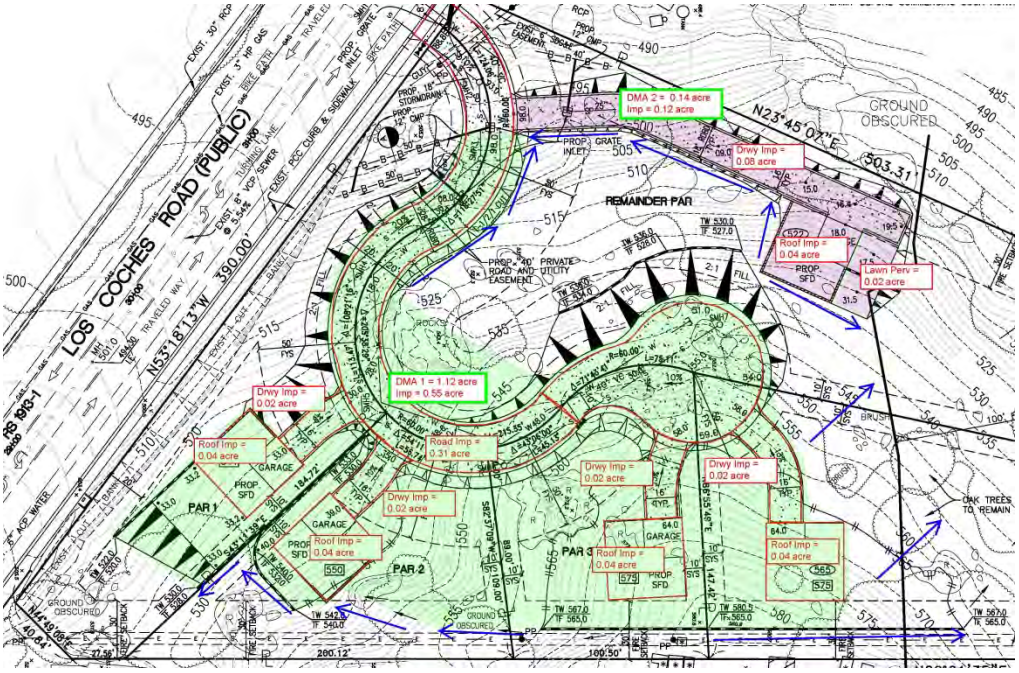
As indicated earlier, detention basin volumes were calculated in accordance with the San Diego County hydrology manual. The above calculations and graphs reflect these calculations for Basin B (3) and Basin D (5). The table below summarizes the results, including the total required volume for the BMPs draining to the northwest corner of the property (2,420 cu. ft.). The table also summarizes the available Hydrology Manual volume of the BMPs proposed on the project plans. This volume is less than the total volume of the BMPs because only one third of the V_2 volume (the voids) counts toward the total. Even so the current proposed volume is 3,655 cu. ft. which is 1,235 cu. ft. (51%) more than the required 2,420 cu. ft. of volume. Part of the reason for the large excess volume is because of the physical restrictions encountered during construction. The excess insurers that the required volume can still be constructed.

Totals of BMP Length and Volume							
Location	Length (ft.)	Width (ft.)	Area (sq. ft)	V1 (cu. ft.)	V2 (cu. ft.)	Total V (cu. ft.)	Hydro (cu. ft.)
North of Road							
	45	5	225	270	338	608	
	35	5	175	210	263	473	
Total North of Road			400	480	600	1,080	680
West of Road							
	50	5	250	300	375	675	
	50	5	250	300	375	675	
	30	5	150	180	225	405	
	30	5	150	180	225	405	
	40	5	200	240	300	540	
Total west of Road			1,000	1,200	1,500	2,700	1,700
Lots							
Lot 1	40	5	200	240	300	540	
Lot 2	30	5	150	180	225	405	
Lot 3	40	5	200	240	300	540	
Lot 4	40	5	200	240	300	540	
Total of Lots			750	900	1,125	2,025	1,275
Grand Total Provided			2,150	2,580	3,225	5,805	**3,655**
Total Required							
Basin B						905	
Basin D						1,515	
Total Required						**2,420**	
Excess Provided							**1,235**

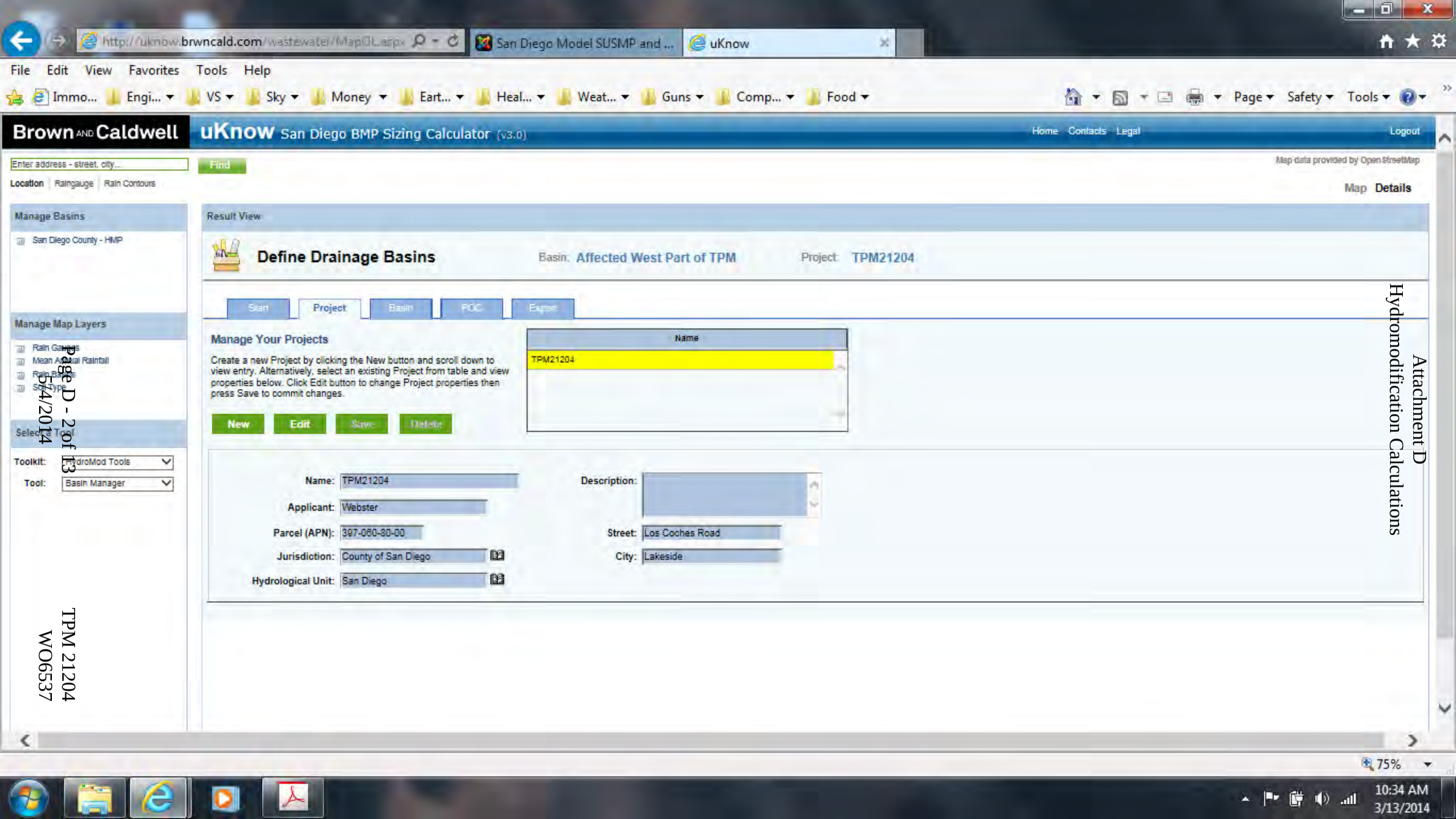
The design of the Bioretention facility is shown below as specified in the County's BPM Calculator.



The following is the layout, sizes and labeling of the DMAs as used in the Calculator.

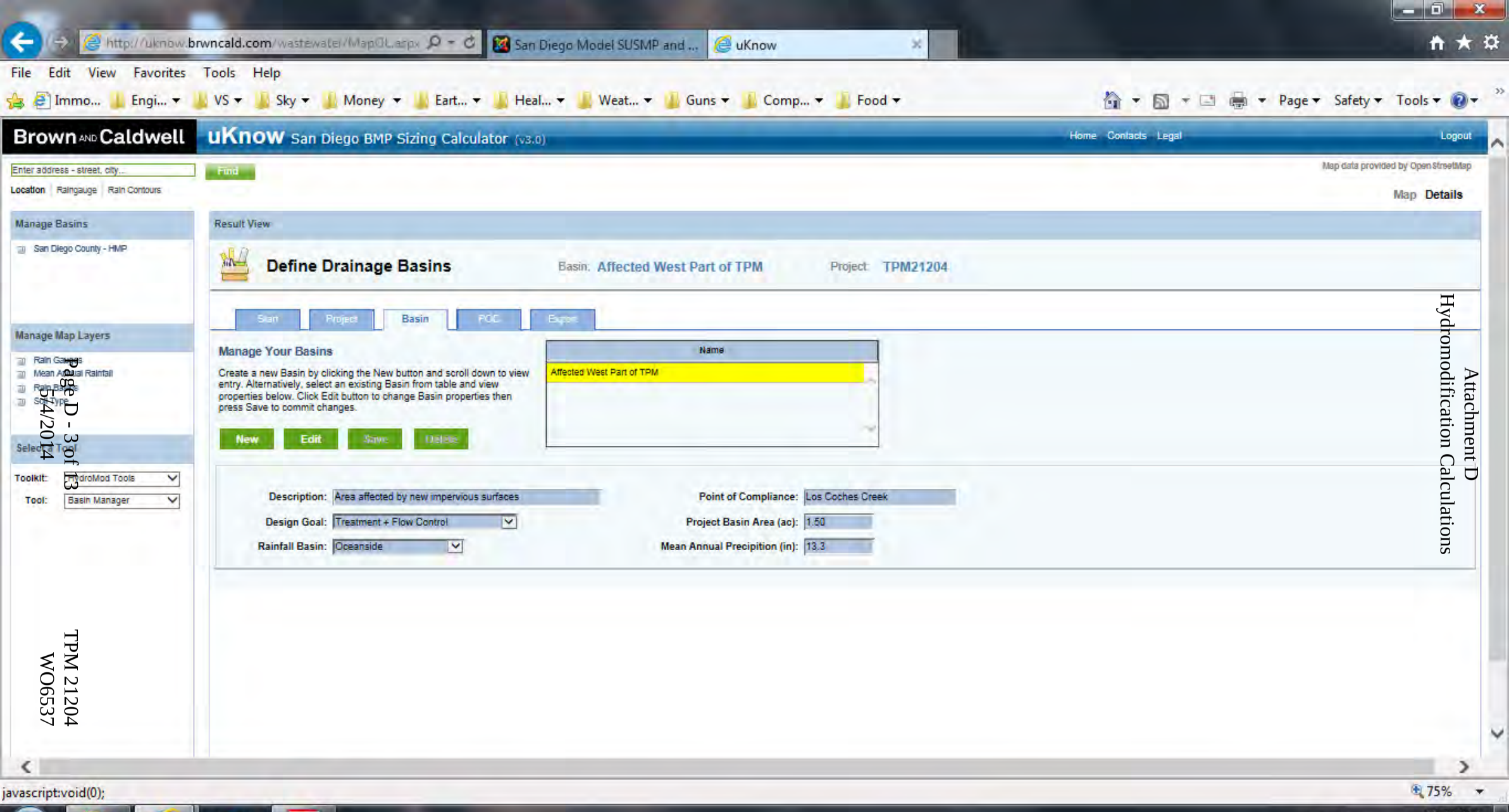


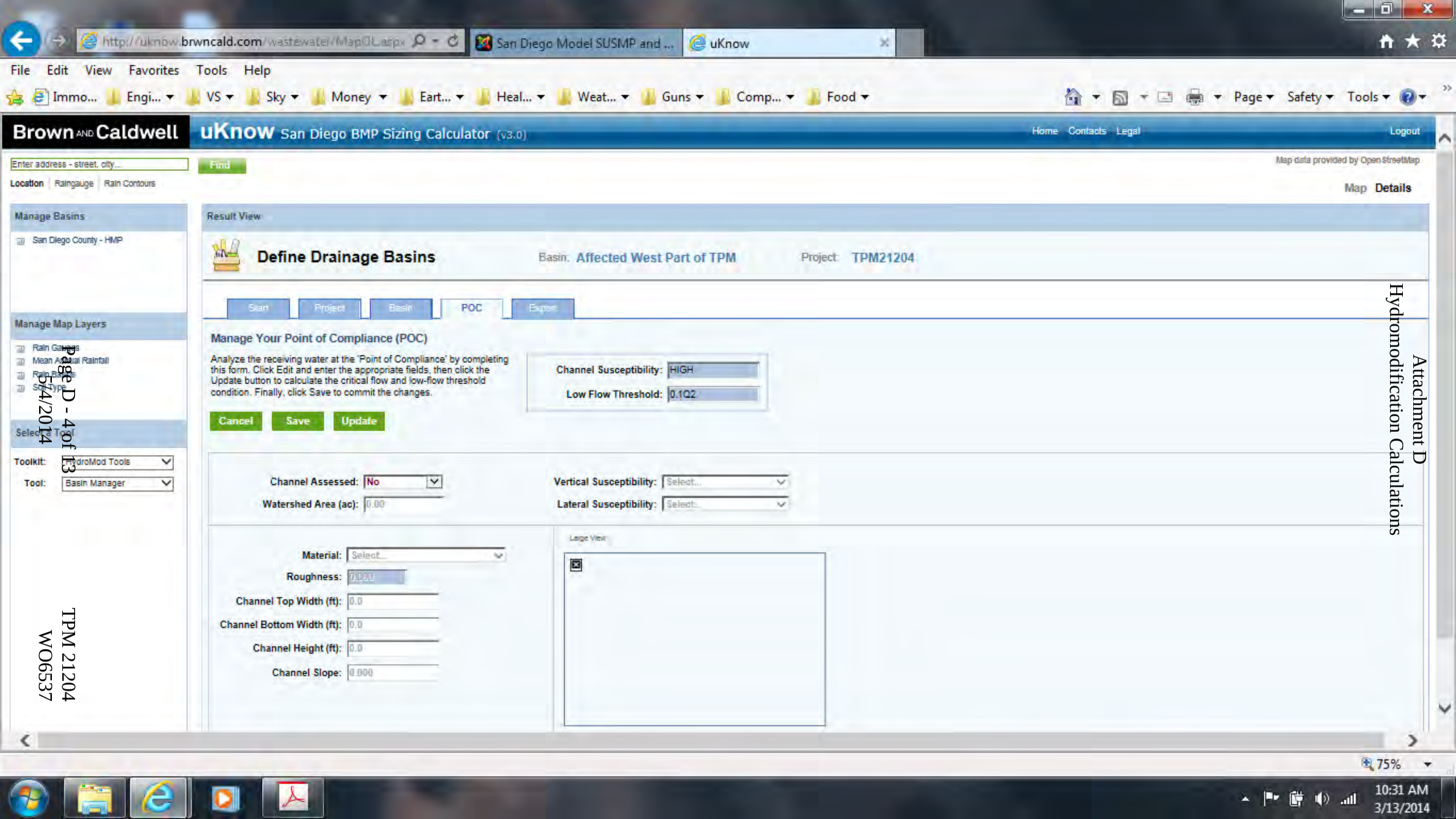
The BMP Calculator was used to determine the required sizes of the BMPs as shown on the following pages. Included is a typical lot calcuation for the BMPs on the individual lots.



TPM 21204
WO6537

Attachment D
Hydromodification Calculations


http://uknow.brwncald.com/wastewater/MapOL.aspx
San Diego Model SUSMP and ...
uKnow
File Edit View Favorites Tools Help
Brown AND Caldwell
uKnow San Diego BMP Sizing Calculator (v3.0)
Home Contacts Legal
Logout
Enter address - street, city...
Find
Location Raingauge Rain Contours
Map data provided by OpenStreetMap
Map Details
Manage Basins
San Diego County - HMP
Manage Map Layers
Rain Gauges
Mean Annual Rainfall
Rain Bands
Soil Type
Select a Tool
Toolkit: HydroMod Tools
Tool: Basin Manager
Result View
Define Drainage Basins
Basin: Affected West Part of TPM
Project: TPM21204
Start
Project
Basin
POC
Export
Manage Your Basins
Create a new Basin by clicking the New button and scroll down to view entry. Alternatively, select an existing Basin from table and view properties below. Click Edit button to change Basin properties then press Save to commit changes.
New
Edit
Save
Delete
Name
Affected West Part of TPM
Description: Area affected by new impervious surfaces
Design Goal: Treatment + Flow Control
Rainfall Basin: Oceanside
Point of Compliance: Los Coches Creek
Project Basin Area (ac): 1.50
Mean Annual Precipition (in): 13.3
javascript:void(0);
75%
10:33 AM
3/13/2014


http://uknow.brwncald.com/wastewater/MapOL.aspx
San Diego Model SUSMP and ...
uKnow
File Edit View Favorites Tools Help
Brown AND Caldwell
uKnow San Diego BMP Sizing Calculator (v3.0)
Home Contacts Legal
Logout
Enter address - street, city...
Find
Location Raingauge Rain Contours
Map data provided by OpenStreetMap
Map Details
Manage Basins
San Diego County - HMP
Manage Map Layers
Rain Gauges
Mean Annual Rainfall
Rain Bands
Soil Type
Select a Tool
Toolkit: HydroMod Tools
Tool: Basin Manager
Result View
Define Drainage Basins
Basin: Affected West Part of TPM
Project: TPM21204
Start
Project
Basin
POC
Export
Manage Your Point of Compliance (POC)
Analyze the receiving water at the 'Point of Compliance' by completing this form. Click Edit and enter the appropriate fields, then click the Update button to calculate the critical flow and low-flow threshold condition. Finally, click Save to commit the changes.
Channel Susceptibility: HIGH
Low Flow Threshold: 0.1Q2
Cancel
Save
Update
Channel Assessed: No
Watershed Area (ac): 0.00
Vertical Susceptibility: Select...
Lateral Susceptibility: Select...
Material: Select...
Roughness: 0.000
Channel Top Width (ft): 0.0
Channel Bottom Width (ft): 0.0
Channel Height (ft): 0.0
Channel Slope: 0.000
Large View
75%
10:31 AM
3/13/2014

Brown AND Caldwell uKnow San Diego BMP Sizing Calculator (v3.0)

Enter address - street, city... Find

Location | Raingauge | Rain Contours

Map data provided by OpenStreetMap

Map **Details**

Manage Basins

- San Diego County - HMP

Manage Map Layers

- Rain Gauges
- Mean Annual Rainfall
- Rain Zones
- Soil Type

Select a Tool

Toolkit: HydroMod Tools

Tool: LID Sizer

Result View

Size LID Facility

Basin: **Affected West Part of TPM** Project: **TPM21204**

Start | DMA | LID | Report | Export

Manage Your LID's

Create a new LID by clicking the New button and scroll down to view new entry. Alternatively select an existing LID from the table and view properties below. Click the Edit button to change LID properties and press SAVE to update the calculations.

BMP ID	Description
BMP 1	BMP 1

New | Edit | Save | Delete

LID Type: Bioretention

Flow Threshold (cfs): 0.020

Drainage Area (ac): 1.12

Minimum Area (sqft):	1983.1	Proposed Area (sqft):	2000.0
Minimum Volume V1 (cft):	1652.6	Proposed Volume V1 (cft):	1700.0
Minimum Volume V2 (cft):	N/A	Proposed Volume V2 (cft):	0.0
Maximum Orifice Size (in):	0.7	Proposed Orifice Size (in):	0.7

Messages:

Large View

Manage Basins

San Diego County - HMP

Manage Map Layers

Rain Gauges
Mean Annual Rainfall
Rain Basins
Soil Type

Select a Tool

Toolkit: HydroMod Tools
Tool: LID Sizer

Result View

Size LID Facility

Basin: Affected West Part of TPM Project: TPM21204

Start | DMA | LID | Report | Export

Manage Your LID's

Create a new LID by clicking the New button and scroll down to view new entry. Alternatively select an existing LID from the table and view properties below. Click the Edit button to change LID properties and press SAVE to update the calculations.

New | Edit | Save | Delete

BMP ID	Description
BMP 1	BMP 1
BMP 2	BMP 2

LID Sizing

LID Type:	Bioretention	Flow Threshold (cfs):	0.002
Drainage Area (ac):	0.14		
Minimum Area (sqft):	398.5	Proposed Area (sqft):	400.0
Minimum Volume V1 (cft):	332.1	Proposed Volume V1 (cft):	340.0
Minimum Volume V2 (cft):	N/A	Proposed Volume V2 (cft):	0.0
Maximum Orifice Size (in):	0.2	Proposed Orifice Size (in):	0.2

Messages:

LID Layout

Large View

75%

12:40 PM
3/13/2014

Project Summary

Project Name	TPM21204
Project Applicant	Webster
Jurisdiction	County of San Diego
Parcel (APN)	397-060-80-00
Hydrologic Unit	San Diego

Compliance Basin Summary

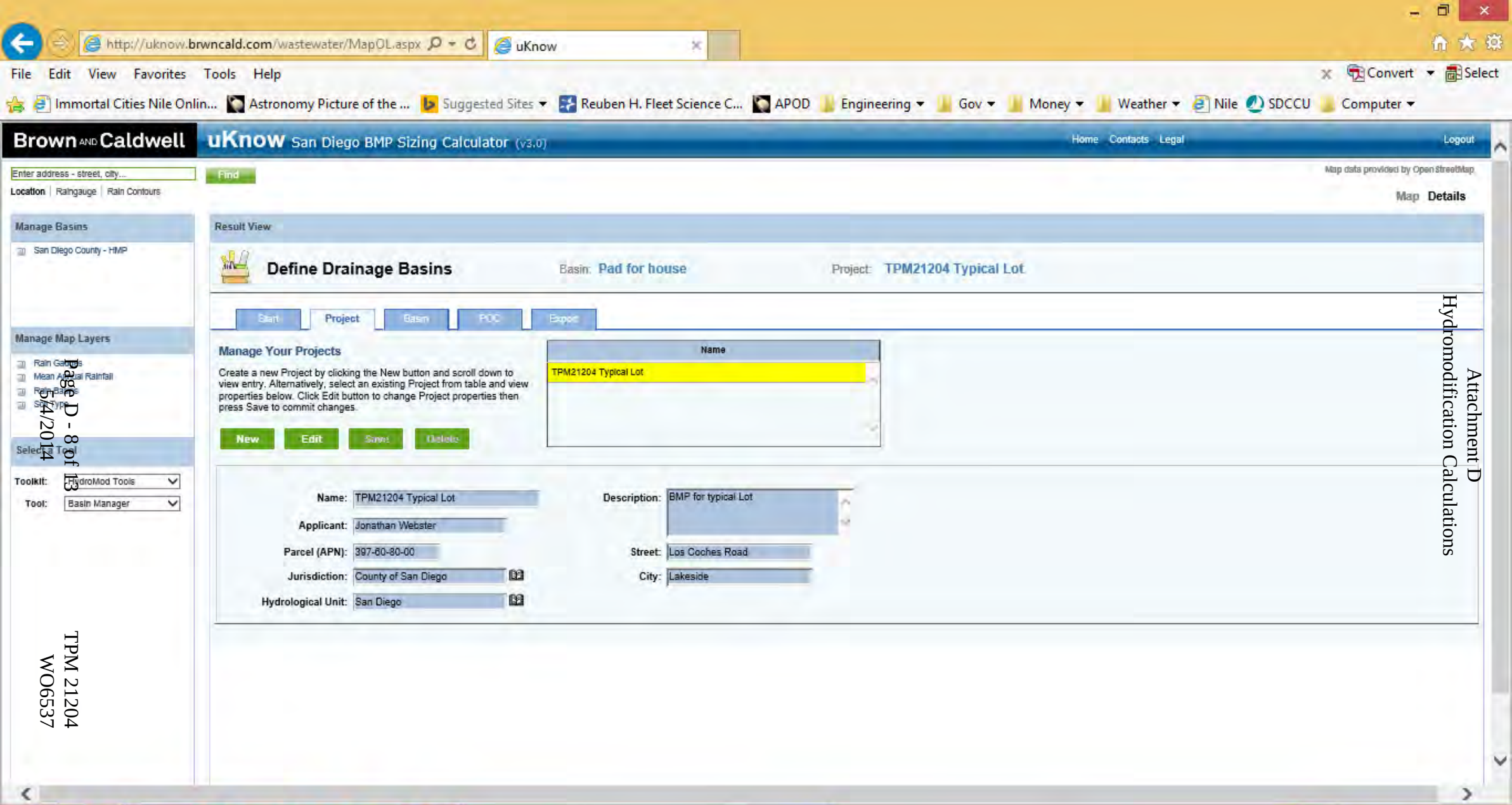
Basin Name:	Affected West Part of TPM
Receiving Water:	Los Coches Creek
Rainfall Basin	Oceanside
Mean Annual Precipitation (inches)	13.3
Project Basin Area (acres):	1.50
Watershed Area (acres):	0.00
SCCWRP Lateral Channel Susceptiblity (H, M, L):	
SCCWRP Vertifical Channel Susceptiblity (H, M, L):	
Overall Channel Susceptibility (H, M, L):	HIGH
Lower Flow Threshold (% of 2-Year Flow):	0.1

Drainage Management Area Summary

ID	Type	BMP ID	Description	Area (ac)	Pre-Project Cover	Post Surface Type	Drainage Soil	Slope
33853	Drains to LID	BMP 1	DMA 1 Impervious After	0.55	Pervious (Pre)	Concrete or asphalt	Type B (moderate infiltration)	Steep (greater 10%)
33854	Drains to LID	BMP 1	DMA 1 Pervious After	0.57	Pervious (Pre)	Landscaping	Type B (moderate infiltration)	Steep (greater 10%)
33856	Drains to LID	BMP 2	DMA 2 Impervious After	0.12	Pervious (Pre)	Concrete or asphalt	Type B (moderate infiltration)	Steep (greater 10%)
33857	Drains to LID	BMP 2	DMA 2 Pervious After	0.02	Pervious (Pre)	Landscaping	Type B (moderate infiltration)	Steep (greater 10%)

LID Facility Summary

BMP ID	Type	Description	Plan Area (sqft)	Volume 1(cft)	Volume 2(cft)	Orifice Flow (cfs)	Orifice Size (inch)
BMP 1	Bioretention	BMP 1	1983	1652	0.00	0.020	0.7
BMP 2	Bioretention	BMP 2	398	332	0.00	0.002	0.2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APOD
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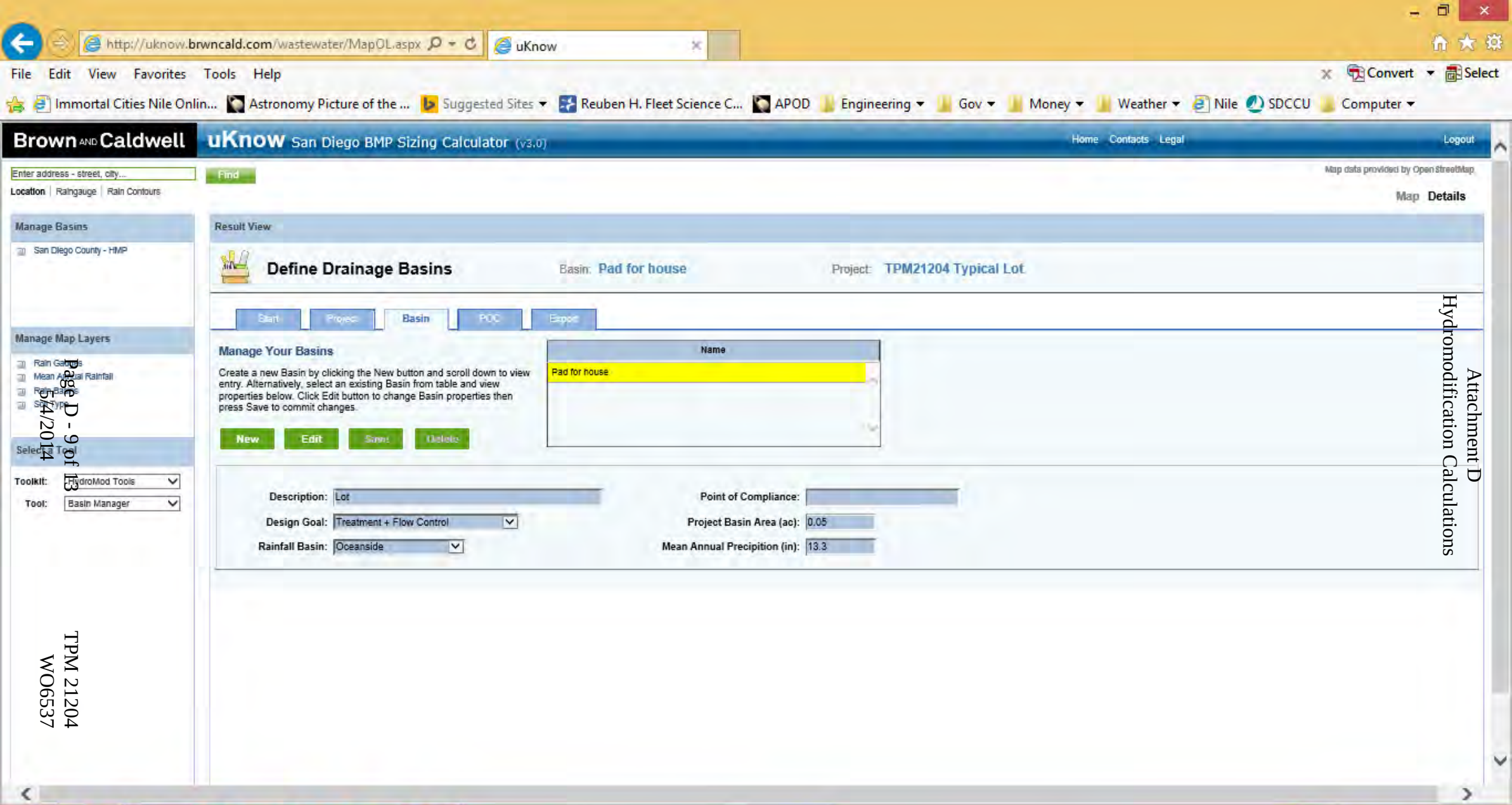
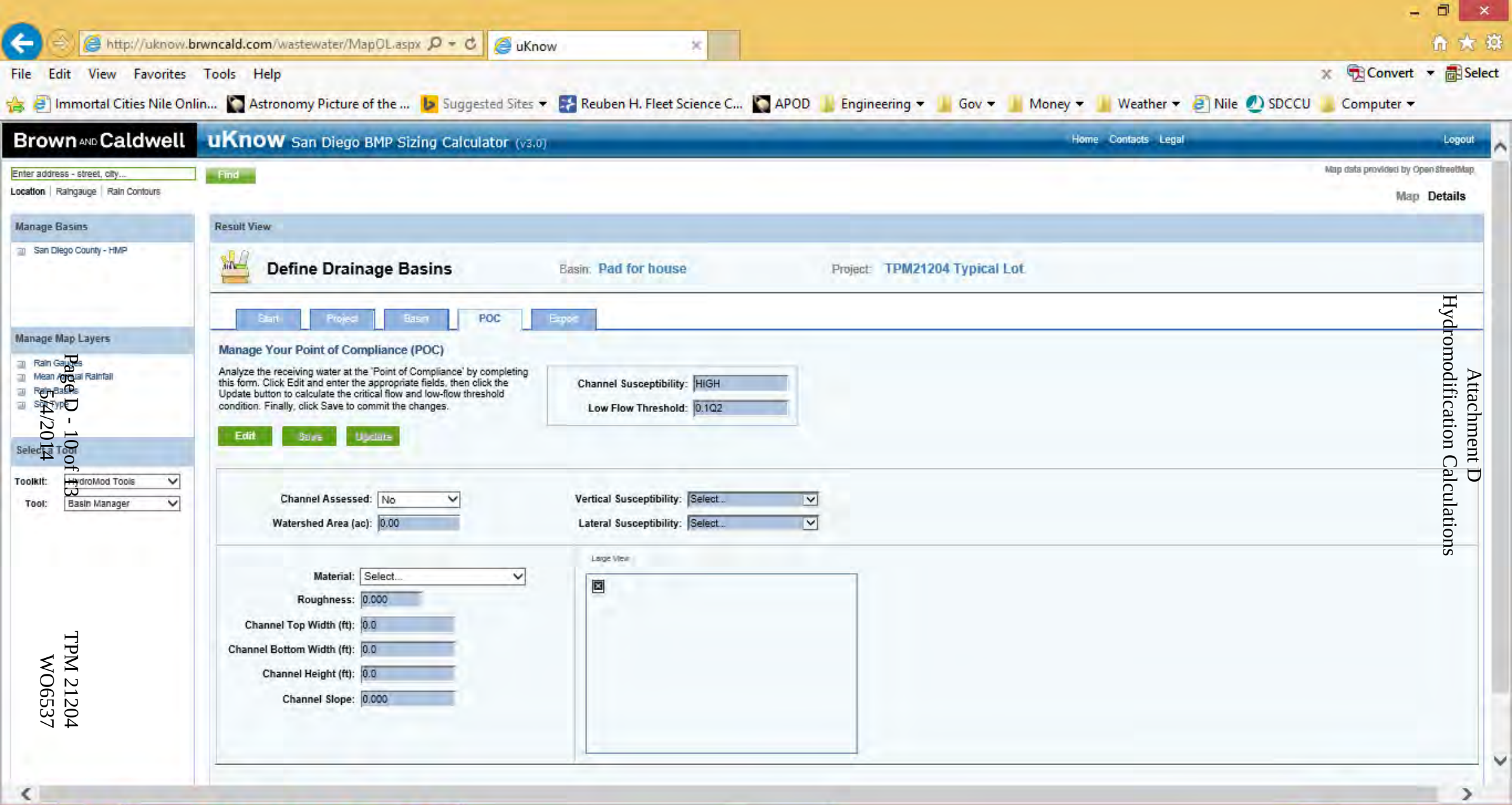
Nile
SDCCU
Computer
Brown AND Caldwell
uKnow San Diego BMP Sizing Calculator (v3.0)
Home Contacts Legal
Logout
Enter address - street, city...
Find
Location | Raingauge | Rain Contours
Map data provided by OpenStreetMap
Map Details
Manage Basins
San Diego County - HMP
Manage Map Layers
Rain Gauges
Mean Annual Rainfall
Rain Bands
Soil Type
Select a Tool
Toolkit: HydroMod Tools
Tool: Basin Manager
Result View
Define Drainage Basins
Basin: Pad for house
Project: TPM21204 Typical Lot
Start
Project
Basin
POC
Export
Manage Your Projects
Create a new Project by clicking the New button and scroll down to view entry. Alternatively, select an existing Project from table and view properties below. Click Edit button to change Project properties then press Save to commit changes.
New
Edit
Save
Delete
Name
TPM21204 Typical Lot
Name: TPM21204 Typical Lot
Applicant: Jonathan Webster
Parcel (APN): 397-60-80-00
Jurisdiction: County of San Diego
Hydrological Unit: San Diego
Description: BMP for typical Lot
Street: Los Coches Road
City: Lakeside
6:37 AM
5/3/2014



TPM 21204
WO6537

Attachment D
Hydromodification Calculations


http://uknow.brwncald.com/wastewater/MapOL.aspx
uKnow
File Edit View Favorites Tools Help
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Immortal Cities Nile Onlin...
Astronomy Picture of the ...
Suggested Sites
Reuben H. Fleet Science C...
APOD
Engineering
Gov
Money
Weather
Nile
SDCCU
Computer
Brown AND Caldwell
uKnow San Diego BMP Sizing Calculator (v3.0)
Home Contacts Legal
Logout
Enter address - street, city...
Find
Location | Raingauge | Rain Contours
Map data provided by OpenStreetMap
Map Details
Manage Basins
San Diego County - HMP
Manage Map Layers
Mean Annual Rainfall
Select Tool
Toolkit: HydroMod Tools
Tool: Basin Manager
Result View
Define Drainage Basins
Basin: Pad for house
Project: TPM21204 Typical Lot
Start
Project
Basin
POC
Export
Manage Your Point of Compliance (POC)
Analyze the receiving water at the 'Point of Compliance' by completing this form. Click Edit and enter the appropriate fields, then click the Update button to calculate the critical flow and low-flow threshold condition. Finally, click Save to commit the changes.
Channel Susceptibility: HIGH
Low Flow Threshold: 0.1Q2
Edit
Save
Update
Channel Assessed: No
Watershed Area (ac): 0.00
Vertical Susceptibility: Select...
Lateral Susceptibility: Select...
Material: Select...
Roughness: 0.000
Channel Top Width (ft): 0.0
Channel Bottom Width (ft): 0.0
Channel Height (ft): 0.0
Channel Slope: 0.000
Large View
6:39 AM
Solve PC issues: 1 message

Brown AND Caldwell **uKnow** San Diego BMP Sizing Calculator (v3.0)

Home Contacts Legal Logout

Enter address - street, city... Find

Location | Raingauge | Rain Contours

Map data provided by OpenStreetMap

Map Details

Manage Basins

San Diego County - HMP

Manage Map Layers

Rain Gauges
Mean Annual Rainfall
Rain Bands
Soil Type

Select a Tool

Toolkit: HydroMod Tools

Tool: LID Sizer

Result View

Size LID Facility

Basin: Pad for house

Project: TPM21204 Typical Lot

Start | DMA | LID | Report | Export

Manage Your DMA's

Create a new DMA by clicking the New button and scroll down to view entry. Alternatively, select an existing DMA from table and view properties below. Click Edit button to change DMA properties then press Save to commit changes.

DMA ID	Description
34447	Roof
34448	Lawn

New Edit Save Delete

Define DMA Properties

DMA Type: Drains to LID

Drainage Area (ac): 0.03

BMP ID: BMP 4

Drain To DMA ID:

Drainage Soil: Type B (moderate infiltration)

Pre-Project Cover: Pervious (Pre)

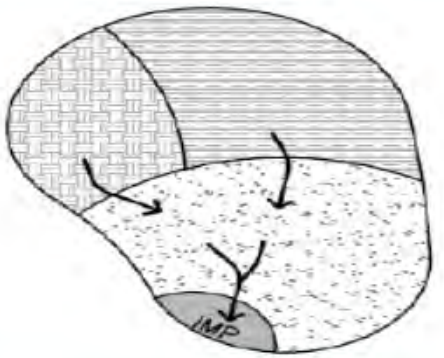
Post Surface: Roofs

Pre-Project Slope: Moderate (5 - 10%)

Messages:

DMA Layout

Large View



http://uknow.brwncald.com/wastewater/MapOL.aspx — uKnow

File Edit View Favorites Tools Help — Convert — Select

Immortal Cities Nile Onlin... | Astronomy Picture of the ... | Suggested Sites | Reuben H. Fleet Science C... | APOD | Engineering | Gov | Money | Weather | Nile | SDCCU | Computer

Brown AND Caldwell **uKnow** San Diego BMP Sizing Calculator (v3.0) — Home Contacts Legal — Logout

Enter address - street, city... Find

Location | Raingauge | Rain Contours

Map data provided by OpenStreetMap

Map **Details**

Manage Basins

San Diego County - HMP

Manage Map Layers

Rain Gauges
Mean Annual Rainfall
Rain Bands
Soil Type

Select Tool

Toolkit: HydroMod Tools
Tool: LID Sizer

Result View

Size LID Facility

Basin: **Pad for house** Project: **TPM21204 Typical Lot**

Start | DMA | LID | Report | Export

Manage Your LID's

Create a new LID by clicking the New button and scroll down to view new entry. Alternatively select an existing LID from the table and view properties below. Click the Edit button to change LID properties and press SAVE to update the calculations.

BMP ID	Description
BMP 4	Bioretention

New | Edit | Save | Delete

LID Type: Bioretention — Flow Threshold (cfs): 0.000

Drainage Area (ac): 0.04

Minimum Area (sqft):	147.1	Proposed Area (sqft):	150.0
Minimum Volume V1 (cft):	122.6	Proposed Volume V1 (cft):	150.0
Minimum Volume V2 (cft):	N/A	Proposed Volume V2 (cft):	150.0
Maximum Orifice Size (in):	0.1	Proposed Orifice Size (in):	0.1

Messages:

Large View

6:29 AM 5/3/2014

Project Summary

Project Name	TPM21204 Typical Lot
Project Applicant	Jonathan Webster
Jurisdiction	County of San Diego
Parcel (APN)	397-60-80-00
Hydrologic Unit	San Diego

Compliance Basin Summary

Basin Name:	Pad for house
Receiving Water:	
Rainfall Basin	Oceanside
Mean Annual Precipitation (inches)	13.3
Project Basin Area (acres):	0.05
Watershed Area (acres):	0.00
SCCWRP Lateral Channel Susceptiblity (H, M, L):	
SCCWRP Vertifical Channel Susceptiblity (H, M, L):	
Overall Channel Susceptibility (H, M, L):	HIGH
Lower Flow Threshold (% of 2-Year Flow):	0.1

Drainage Management Area Summary

ID	Type	BMP ID	Description	Area (ac)	Pre-Project Cover	Post Surface Type	Drainage Soil	Slope
34447	Drains to LID	BMP 4	Roof	0.03	Pervious (Pre)	Roofs	Type B (moderate infiltration)	Moderate (5 - 10%)
34448	Drains to LID	BMP 4	Lawn	0.01	Pervious (Pre)	Amended, mulched soil	Type B (moderate infiltration)	Moderate (5 - 10%)

LID Facility Summary

BMP ID	Type	Description	Plan Area (sqft)	Volume 1(cft)	Volume 2(cft)	Orifice Flow (cfs)	Orifice Size (inch)
BMP 4	Bioretention	Bioretention	147	122	0.00	0.000	0.1