Appendix E

Hydrological Reports

Brown Barranca Hydraulic Study
(Henderson Road to Telegraph Road)

Parklands Development
City of Ventura

Prepared for:

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December 2006

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2. 100-year Hydraulic Analyses for Future/Interim Improvements (WSPG)

Brown Barranca Hydraulic Study
(Henderson Road to Telegraph Road)

1. INTRODUCTION

The purpose of this report is to summarize the results of a preliminary hydraulic and floodplain study for Brown Barranca as part of the Parklands Development project in the City of Ventura. The proposed Parklands Development will be located adjacent to Brown Barranca west of Wells Road and north of State Highway 126 (HWY 126) (Figure 1). The study area encompassed the reach of the barranca from Henderson Road to south of Telegraph Road, which is under the regulatory jurisdiction of the Ventura County Watershed Protection District (VCWPD). Within this reach, there are a series of RC box culverts and RC open channels that were constructed as part of HWY 126 by Caltrans. The effective FEMA Flood Insurance Rate Map (FIRM) for the area indicates that these facilities are undersized for the 100-year flow, and the excess flow will flood the areas adjacent to the barranca including portions of the proposed development area. This report also provides information on the project's impact to the existing floodplain, and recommendations for mitigation measures.

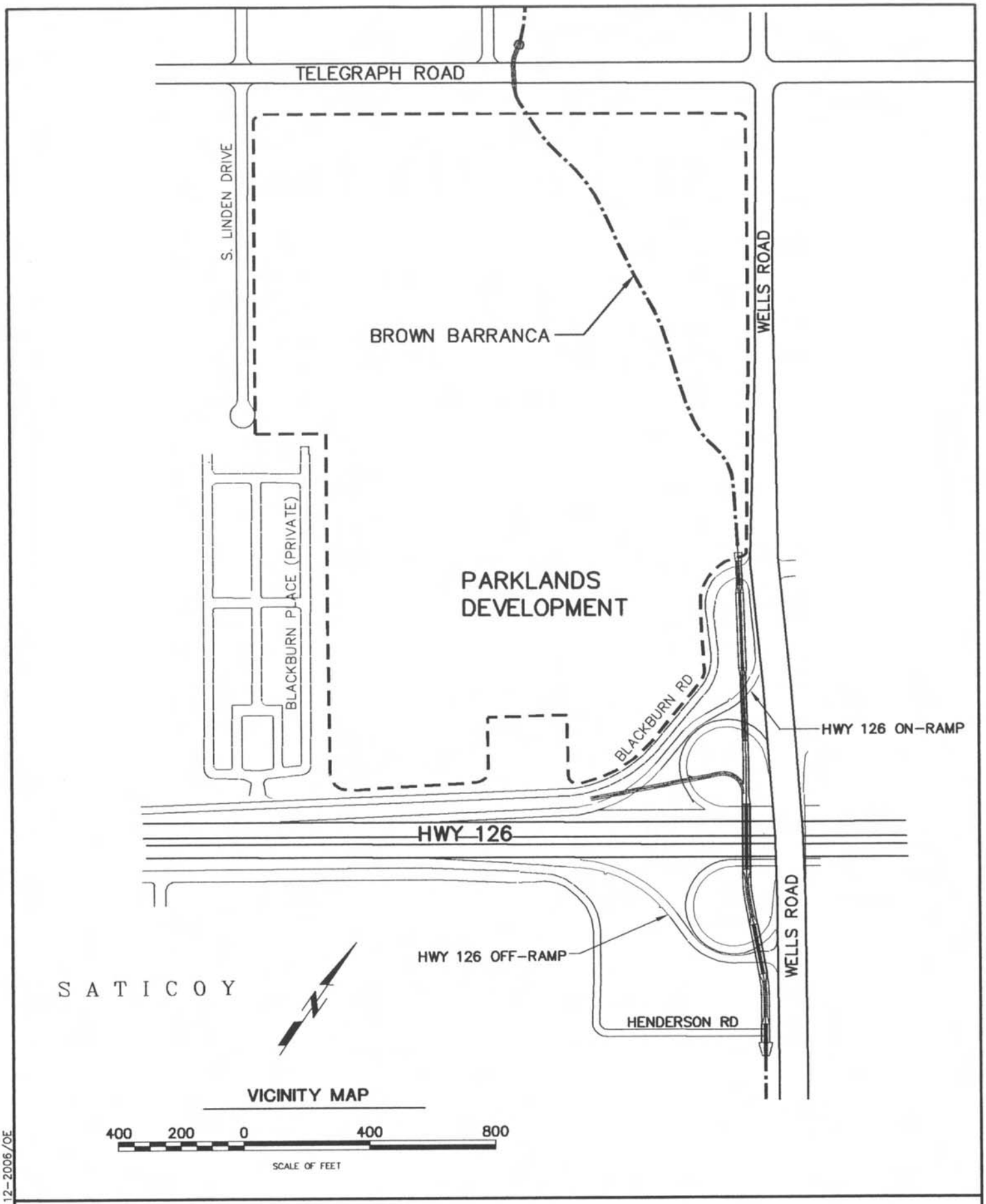
2. HYDROLOGY

Brown Barranca originates from north of Foothill Road and generally flows in a southeasterly direction to its outlet at Santa Clara River. It has a total drainage area of about 2,256 acres with parts of the watershed located in both the County (unincorporated areas) and City of Ventura. One of the main tributaries to Brown Barranca within the reach under study is a lateral drain (drainage area of 178 acres) from the west that joins the barranca just north of HWY 126.

The flow rates for this study were based upon the future condition hydrology study (November 2004) by VCWPD. Table 1 represents the peak flow rates within the scope of the study.

Table 1 – Brown Barranca Future Condition Peak Flows

Location	Drainage Area (acres)	Areal Reduced Peak Flows (cfs)	
		50-YR	100-YR
@ Telegraph Road	1476	1162	1604
North of HWY 126	1780	1408	1845



BROWN BARRANCA HYDRAULIC STUDY

(Henderson Road to Telegraph Road)

FIGURE 1

3. EXISTING CONDITIONS

3.1 Existing Facilities:

Brown Barranca between Henderson Road and Telegraph Road consists of both improved and natural channels. The improved portion of the barranca which is all within the freeway reach including the culvert at Blackburn Road was constructed in 1961 by Caltrans. These improvements consist of five double or triple RC box culverts and the intermediate RC open rectangular or trapezoidal channels through the freeway. The reach of the barranca upstream of Blackburn to Telegraph Road is natural. There is also a tributary rectangular channel that joins Brown Barranca from the west on north side of the HWY 126.

The existing culverts under present conditions are all undersized and can not contain the 100-year flow. The intermediate open channels consist of RC lined trapezoidal sections with a bottom width of 6 to 10 feet and a height of 6 feet. The open channel section from north of the freeway to the on-ramp is a rectangular section with a bottom width of 16 feet and a height of 6 feet. The capacities of the intermediate channels are influenced by the existing deficient culvert sizes. However, for the purpose of this study the capacities of the culverts were determined based on bank-full flows prior to overtopping the adjacent banks.

Brown Barranca upstream of Blackburn Road is a relatively deep and confined channel covered with moderate to heavy vegetation, containing the 100-year flow. This reach of the barranca appears to have experienced severe erosion in some areas.

Table 2 represents the sizes and approximate capacity of the maintained culverts under present conditions. The sizes of existing culverts were based upon the as-built drawings.

Table 2 – Existing Culverts & Capacity

Existing Culverts	Capacity (cfs)	100-YR Overflow (cfs)
8'W x 6'H Triple Box Culvert @ Henderson Road	1300	NA
8'H x 6'H Triple Box Culvert @ HWY 126 South Off-Ramp	1300	NA
8'H x 6'H Triple Box Culvert @ HWY 126	1195	650
8'H x 6'H Double Box Culvert @ HWY 126 North On-Ramp	1055	549
8'W x 6' H Double Box Culvert @ Blackburn Road	1300	304

3.2 Existing Floodplain:

The FEMA Effective FIS analyses for the County (unincorporated areas) and City were completed in 1985 and 1986. Flood elevations for the 100-year event were computed through use of the United States Army Corps of Engineers (USCE) HEC-2 step-backwater computer program.

The 100-year discharges used in the FIS study are 1,450 cfs at Telegraph Road and 2,310 cfs north of the freeway. The effective FIRM shows the 100-year flow contained within the natural channel south of Telegraph Road for approximately 1,000 feet before overtopping the easterly bank and Wells Road. The FIRM also shows water overtopping the westerly bank at approximately 300 feet upstream of Blackburn Road. Overflow also occurs at other existing culverts downstream causing flooding of the westerly property including the southeasterly corner of the proposed development. The overflow will then overtop Blackburn Road and the freeway traveling to the southeasterly direction. *See* Exhibit 2, Appendix "B" for the scanned FEMA 100-year floodplain boundary.

3.3 Topographic Map:

Topographic map and survey information used for this study were provided by the DTR Engineering and Hawks & Associates, and they include:

1. A topographic map that was generated by Hawks & Associates from LiDAR (Light Detection and Ranging) data points taken in February 2005 by Airborne1.
2. Field survey of flowlines (9/2006) for the existing improved reach through the freeway and the natural channel upstream of Blackburn Road were provided by DTR Engineering.
3. All survey and topographic information utilized the California State Zone 5 Coordinate System, North American Datum (NAD) 1983 horizontal datum (metric), and the North American Vertical Datum (NAVD) 1988.

The LiDAR topographic map and surveyed data were supplemented with the as-built information for the hydraulic modeling, and floodplain delineation. Due to the inconsistency in mapping, the topographic data did not correlate to one another in some areas; therefore, some estimation was made in the modeling. This was considered reasonable because of the planning level of this study.

3.4 Hydraulics & Methodology:

The US Army Corps of Engineers HEC-RAS (ver 3.1.3) and the Los Angeles County Water Surface Pressure Gradient (WSPG) computer programs were utilized to perform the analysis for this study. The WSPG program which is more suitable for engineered lined systems was used for the future improved facilities, and for verifying the capacity of some of the existing improved structures.

The HEC-RAS program was used to analyze the existing and proposed conditions floodplain boundaries including the overflow analyses. The HEC-RAS program is capable

of performing standard step method hydraulic calculations in both subcritical and supercritical flow regimes. Special provisions are provided for analysis of bridges/culverts, and split flow conditions where flood flows may leave the channel system and never return. Ineffective flow areas are defined as areas in a cross section that will contain water that is not actively being conveyed and the velocity of the water in the downstream direction is close to zero. Ineffective flow areas are generally caused by obstructions that may be natural or manmade that would block flow from being effectively conveyed to the downstream section. The analyses for this study utilized the ineffective flow area concept at the bridges/culverts where applicable, and areas where water will pond.

For the hydraulic modeling, sufficient cross sections were taken at regular intervals to define the controlling conditions that will determine the flood water surface profile. All the cross sections were coded looking downstream from left to right. Normal depths were assumed for starting water surface elevations at the downstream and upstream limits of study.

It appears that the FEMA FIS study considered the reach of Brown Barranca from Blackburn Road to downstream of the freeway to have a medium debris potential, and doubled the pier widths of the culverts. This study assumed the same conditions for the updated existing and interim floodplain analyses.

The Manning's Roughness Coefficients "n" assigned for the hydraulic modeling were based on the aerial photograph and field investigations. The "Horizontal Variation of *n* Value" method in HEC-RAS was selected to describe the lateral roughness changes in the cross sections. Table 3 represents typical "n" values assigned to various surface features in a cross section.

Table 3 - Manning's Roughness Coefficients

Surface Type & Description	"n" - Value
Concrete structure	0.015
Uniform earth bed or bank	0.03 to 0.035
Rock riprap and rock revetment	0.035 to .040
Scattered brush or plants	0.035
Light to Medium trees	0.040 to 0.055
Light to medium urbanization	0.060
Heavy urbanization	0.07 to 0.150
AC pavement	0 .016 to 0.02

3.5 Updated Existing Floodplain:

The existing floodplain was updated using the available topographic information described above and the future condition hydrological data provided by VCWPD. Similar to the FEMA effective FIS analysis and FIRM, the updated analysis and floodplain (Exhibit 2, Appendix "B") shows that Brown Barranca under current conditions can not contain the 100-year flow.

The analysis indicates approximately 304 cfs overtopping the existing culvert at Blackburn Road and inundating the westerly property. Although the overflow may reach to the crown of Wells Road, it does not appear to overtop Wells Road as shown in the effective FEMA FIRM, unless the culvert inlet is obstructed by debris. This is mainly attributed to the lower westerly bank just upstream of the culvert, and the Blackburn Road embankment which rapidly drops to the west. The undersized culvert and the high embankment at the freeway on-ramp (approx. 300 feet downstream) will divert the excess flow including the overflow from Blackburn (approx. 549 cfs) to the westerly direction where the water will then overtop Blackburn Road, the freeway on-ramp and the freeway heading in a southeasterly direction. The excess flow from the tributary drain just north of the freeway will add to the overflow. The estimated overflow going over the freeway is approximately 650 cfs. Due to the divided flow caused by the freeway on-ramp, the overflow was analyzed separately from the main channel. Downstream of the freeway, the undersized culvert and the high embankment at the freeway off-ramp will cause the water to back up. This condition and the freeway elevation drop to the easterly direction will cause some of the overflow to escape through the freeway under-pass. In the overflow analysis a side weir was assumed to model this condition.

4. PROPOSED PRELIMINARY IMPROVEMENTS & FLOODPLAIN

4.1 Future Improvements:

Future improvements from Blackburn Road to Henderson Road were evaluated based upon the HDR Engineering, Inc. study titled "Brown Barranca Pre-Design Report" prepared for VCWPD in July 2005. The HDR study which encompassed the entire reach of Brown Barranca recommended that all existing culverts and intermediate channels through the freeway to upstream of the Blackburn Road be improved by adding additional culvert cells and replacing the intermediate open channel.

This study generally follows the same planning as outlined in the HDR report, except that the improved culvert at Blackburn Road will be extended approximately 700 feet upstream as part of Parklands Development. The future condition analysis was performed utilizing the WSPG hydraulic program which is more suitable for engineered lined channels. The flow rates were based on the future condition hydrology represented in Table 1, assuming clear water conditions. The preliminary sizes and configuration for the improved culverts and the intermediate open channels through the freeway to upstream of Blackburn are shown in Exhibit 1, Appendix "A".

Similar to the HDR study, the proposed improvements through the freeway assumes adding additional culvert cells to the existing culverts. Considering these facilities are almost fifty years old, their condition and structural integrity will need to be evaluated.

4.2 Proposed Interim Improvements:

The interim improvements of Brown Barranca proposed by Parklands Development include the replacement of existing culvert at Blackburn Road. The new culvert will extend to upstream of the new Road 'E' approximately 700 feet north of Blackburn Road. A RC warped structure and a concreted rock riprap transition structure will also be constructed at the upstream end where the proposed culvert joins the natural channel. It is also recommended to provide a larger section at the entrance to the culvert to account for some potential debris that may reach the inlet. The preliminary sizes and configuration for the proposed interim improvements are shown on Exhibit 1, Appendix "A".

4.3 Proposed (Interim) Condition Floodplain:

Under the proposed conditions most of the existing agricultural land within the updated floodplain will remain as open space which will include an area for a new park. The new Road 'H' is also being proposed at the same grade as the existing Blackburn Road, allowing for inundation by flood water (Exhibit 2, Appendix "B"). Under these conditions and the improvement of the culvert at Blackburn Road, Brown Barranca floodplain south of Blackburn Road will generally be similar to the updated floodplain with the exception of the area to the southeasterly corner of the proposed development. Within this area, the proposed development will encroach into the existing floodplain causing an increase of less than one-foot (0.58') in flood elevation, and a reduction of approximately 135 feet to the updated floodplain width (overflow analysis). The estimated depth of flood water over Blackburn at this location is approximately 2 feet, and the increase in velocity is estimated to be 1.5 ft/s (5.6 ft/s versus 4.1 ft/s). Table 4 summarizes and compares the results between the updated existing overflow and proposed overflow models.

Table 4 - Updated Existing Overflow Model vs. Proposed (Interim) Overflow Model

		Updated Existing Model				Proposed (Interim) Model				Differences		
Station	Overflow (cfs)	W.S. Elev (ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	W.S. Elev (ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	W.S. Elev (ft)	Vel Chnl (ft/s)	Top Width (ft)
8228	304.00	191.60	3.46	87.88	124.71	191.6	3.46	87.9	124.71	0.00	0.00	0.00
8107	549.00	190.42	2.97	184.65	205.27	190.42	2.98	184.13	205.07	0.00	0.01	-0.20
8083	549.00	190.18	3.39	169.98	296.84	190.24	3.07	188.53	302.89	0.06	-0.32	6.05
7977	Existing Culvert @ HWY 126 On-ramp											
7871	549.00	189.37	2.97	203.08	467.80	189.95	3.35	163.73	333.47	0.58	0.38	-134.33
7826	549.00	188.97	4.11	133.45	432.29	189.43	5.55	106.40	378.22	0.46	1.44	-54.07
7771	650.00	188.34	2.01	146.37	442.65	188.30	2.19	124.82	391.92	-0.04	0.18	-50.73
7691	650.00	185.83	3.04	194.56	402.14	185.83	3.04	194.56	402.14	0.00	0.00	0.00
7667	650.00	185.47	3.21	165.29	385.11	185.47	3.21	165.29	385.11	0.00	0.00	0.00

5. CONCLUSIONS AND RECOMMENDATIONS

Under existing conditions, the reach of Brown Barranca from Blackburn Road to downstream of Henderson Road can not convey the 100-year flow. Excess flows will overtop the existing channel banks and flood adjacent properties to the west of the barranca, and HWY 126. The proposed Blackburn Road culvert replacement as part of Parklands Development will convey the 100-year flow and eliminate the flooding of the area immediately to the west of the existing culvert. However, the downstream flooding problems will remain until all the culverts and open channels through the freeway are improved.

The following is a list of some of the assumptions and recommendations for subject development and Brown Barranca improvements.

1. All new building pad elevations shall be above 100-year flood and shall be protected from erosion meeting the FEMA and City's floodplain requirements.

2. The natural channel upstream of Blackburn Road appears to have experienced severe bank and invert erosion. It is important that the natural channel be stabilized. This would require measures to stabilize the invert and the banks to reduce erosion and transport of debris to the existing system downstream.

   Additionally, the existing culvert at Telegraph Road discharges to the natural channel at a steep slope. Some measures will be required to dissipate the energy in the flow at the culvert outlet.

3. The existing culvert at Telegraph Road consists of an old arch concrete pipe that was extended (at the north end) with a 10'x 10' RC box conduit and a drop-box inlet in 2005. The evaluation of the existing culvert system was not included in this study and it will need to be examined.

4. As stated previously, FEMA effective FIS analysis doubled the pier widths for the existing culverts downstream of Blackburn Road to account for debris. The FIS analysis also assumed bulked flow (1.5 x Q100) for the culvert under Telegraph Road. The investigation of the Telegraph Road culvert and the final design of the proposed improvements downstream will need to include measures to address the potential debris.

5. The final design for future and proposed (interim) improvements will need to comply with the VCWPD and City's design requirements and standards.

6. An on-site detention basin will be required in order to provide no increase in post-development runoff from the site meeting the City's and County requirements.

7. The floodplain boundaries determined by this study are only for the flooding caused by Brown Barranca and do not include other potential flooding that could occur because of the inadequate tributary drains.

8. As previously stated, the topographic information for this study was based on different sources requiring some assumptions and estimations. A more detailed analysis with a more detailed topographic map will be required for final design and preparation of a request to FEMA for a Condition Letter of Map Revision (CLOMR) and post-project Letter of Map Revision (LOMR) for the project.

References

1. *Brown Barranca Future Condition Hydrology Study by VCWPD, November 2004*
2. *Brown Barranca Channel & Wells Road Interchange As-built Drawings by Caltarns (May 15, 1961)*
3. *Brown Barranca Pre-Design Report prepared in July 2005 by HDR Engineering, Inc. for VCWPD.*
4. *FEMA effective FIS & FIRM completed in 1985 and 1986 for the County and City*
5. *Parklands Tentative Tract Map No. 5632 by DTR Engineering*

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October 15, 2007

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Westlake Village, CA 91361

Dear Chuck:

RE: Brown Barranca

Pursuant to our recent meeting and my field inspection, I have prepared this letter report to provide my professional opinion on channel improvements for Brown Barranca. The channel reach of Brown Barranca under consideration is between Telegraph Road and Blackburn. The Parkland Development has been planned along this channel reach.

Brown Barranca is an alluvial stream; it is heavily infilled with willow, mulefat, ivy, cat-tail, castor bean, and other native and non-native plants at this time. According to a recent hydrology and hydraulic study by Omrun (2006), the 100-yr flood is contained in the channel and the velocities in the earthen channel ranges from 3 to 13.9 feet per second.

In order to protect future improvements from flood-related damages; the Parkland Development needs to be *flood free* and *flood safe.* While the property along the channel is not subject to flooding, it must also be protected against any potential erosion of the stream channel. In other words, the stream channel must be stabilized to avoid future flood-related damages to the properties. Channel stabilization can be accomplished in different ways. One must consider physical conditions of the stream channel in selecting a suitable method for channel stabilization.

Physical conditions of the stream channel suggest that *vegetative control of stream bank erosion* is a suitable means to control erosion of the channel bank for the proposed development. Protection of a stream bank by vegetation has been a traditional practice in this county (Parsons, 1963). Willow cuttings or stems can be inserted into the channel bank. Such cuttings will develop into low growing bushes or trees; they are pliable and capable of recovery after mauling. Such plants provide protection of the stream bank in the following ways:

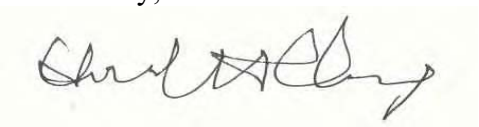
(1) They reduce the flow speed or shear stress at the stream bank to a value below the erosive speed or shear stress.
(2) They provide a buffer for the bank material against transported materials such logs and other kinds of debris.
(3) The root system of plants forms a network of reinforcement for the bank material.

It is also important to point out that the use of vegetation in the stream channel is environmentally friendly. It preserves the natural appearance of the stream channel, the wetland, and natural wildlife habitat and it will continue to allow ground water recharge. Maintenance trimming of the dense growth can be made periodically. Thick branches and leaves can be removed; tree and bush trucks can be trimmed but not removed.

Brown Barranca is an ephemeral stream with storm flows occurring during the winter rainy season. Storm flows at higher velocities are erosive but such flows are typically short in duration. As a safety measure, it is suggested that improvements along the stream channel maintain a minimum setback of 15 feet from existing channel banks that are flatter than 36 degrees and a minimum setback of 25 feet along steeper banks. If any bank erosion occurs in the future, repairs can be made to restore the channel bank. Maintenance repair of the channel bank should be a condition for the proposed development project.

Please let me know if you have any questions regarding this letter.

Sincerely,



Howard H. Chang, Ph.D., P.E.

References

Omrun Engineering, "Brown Barranca Hydraulic Study", prepared for hawks and Associates, October 2006

Parsons, D. A., "Vegetative Control of Streambank Erosion", Proceedings of the Interagency Sedimentation Conference, 1963, pp130-136
Setback

LETTER OF TRANSMITTAL

DTR Engineering

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TO: City of Ventura
Community Development

DATE: Oct. 7, 2005

RE: "Parklands"
Susan Dalruddung

JOB: 3980

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- [ ] MYLARS
- [ ] VELLUMS
- [ ] SPECIFICATIONS
- [ ] LEGAL DESCRIPTIONS
- [ ] APPROVED BILLS
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REMARKS:

Infrastructure report & letter on drainage improvements for John Ashhar's "Parkland" project tract No. 5632

CC: John Ashhar
Dan Holt

BY: David J Rose

Printed on recycled paper

Infrastructure Analysis Wells Community and "Parklands" Development
Tract Number 5632

The following is a status report on infrastructure needs and deficiencies for the Wells Community, and more specifically, the proposed "Parklands" development.

The City, in 1986, commissioned the preparation of the "Wells and Saticoy Communities Capital Improvement Deficiency Study (CIDS). The document was updated in November, 1996.

The CIDS, prepared by the Engineering firm of Penfield and Smith, is a comprehensive analysis of infrastructure needs and deficiencies within the Wells Community covering water, wastewater, storm drainage, traffic, parks and fire protection systems. It also allocates a cost sharing of these needs to all of the developable sites being served.

This document is intended to give an update of progress on these defined needs as they relate to the proposed "Parklands" development, and represents all of the defined needs and deficiencies outlined in the CIDS document.

Water System

As indicated in the Master Plan document for Parklands, the 430 zone water system will serve the subject site. The 430 zone is currently deficient in water storage and distribution for extreme fire flow conditions. These deficiencies were enumerated in the "Capital Improvement Deficiency Study" prepared for the wells and Saticoy communities. The improvements needed are a new reservoir storage, distribution pipelines and a new well site (Saticoy Well #3).

The city is currently under design, having already obtained the necessary property to construct a new reservoir holding 4 million gallons and a 24 inch trunk pipeline within Saticoy Avenue. When complete, those improvements will resolve the fire flow deficiencies in both the Wells and Saticoy communities. Completion is scheduled for mid to late 2005. Saticoy Well #3 will be constructed at a later date when the need calls for it.

Parklands is serviced by a 12-inch distribution pipeline in Telegraph Road, 6-inch in Wells Road and 8-inch in Blackburn Road. A new 8-inch and a new 12-inch pipeline will be installed by this development, including a 12-inch pipeline in Wells Road, which will maintain and improve upon the pipeline GRID

in the area and conform to the City's Water Master Plan document, the "Boyle" report. The Parklands water system is being designed to meet or exceed City standards.

A total fee for CID's improvements is estimated to be $69,714.00, which sum shall be a part of the Parklands' CIDs obligation and paid by Parklands to the City.

Wastewater System

The City has recently completed construction of the North Bank Lift Station and the North Bank Force Main. With the completion of these facilities, the capacity for Parklands has been achieved.

The Bristol Trunk Sewer, which commences at the City treatment plant and terminates at the new Northbank Lift Station, has received substantial upgrades by the City over the last 10 years or so. Studies by the City of the trunk sewer divided the total length into 3 phases. Reconstruction of phase 3 and then phase 2 have occurred. These phases cover the area from the Northbank Lift Station westerly and southerly to Olivas Park Road (near Olivas Park Golf Course). The remaining segment of this total system is not now in need of replacement since wastewater capacity still exists. When capacity begins to run out, the City will complete this final phase. East end development contributes to this entire system through the CIDS program. There is no current plan to complete this last phase which indicates no foreseeable need. Major capital improvements are not undertaken by the City until the need is foreseen.

As part of the infrastructure design for "Parklands," trunk sewer capacities will be determined and where needed, upgraded. This upgrade will be sized to accommodate all upstream areas within the Wells Community and any future hillside areas as is required by the City and good engineering practice. A total fee for CIDS defined improvements estimated to be $347,976 will be paid to the City by "Parklands."

Storm Drain System

Brown Barranca is the only defined regional drainage deficiency listed in CIDS (divided into 4 segments). However, other localized deficiencies have been determined to exist, which will be alleviated through development of "Parklands."

The development of the Parklands site will improve known flooding problems westerly of the site through upgrades to the currently deficient drainage system.

For instance, flooding occurs along Blackburn Road caused by runoff from the existing mobile home park. The Parklands drainage systems will upgrade this system to City standards to alleviate the problem fronting the mobile home park.

Additionally, the Parkands drainage system will extend easterly to intercept stormwater runoff at the southerly terminus of Lindon Drive, alleviating a drainage problem for both Lindon Drive residents and the mobile home park due south of this terminus.

All site storm drains will be sized to accommodate upstream runoff. This includes the Hanson Trust property westerly of the site. That site may be required to provide onsite detention, the same as "Parklands," depending on the timing of this development as it relates to Brown Barranca ultimate improvements.

The subject property drains to Brown Barranca which traverses the site from Telegraph Road to Wells Road at Highway 126. Brown Barranca is deficient in capacity commencing at Highway 126 for large storm flow events (100-year storm), but is adequate for lesser storm flow events (10-year storm).

Parklands will provide storm water detention onsite, while allowing only a 10-year storm flow to discharge to Brown Barranca at Highway 126. This will mitigate downstream impacts along Brown Barranca that may be caused by this development. Additionally, the project will contribute approximately $1,000,000 toward Brown Barranca improvements through the CIDS Program, which along with other contributing properties, will allow for implementation of the CIDS listed Brown Barranca improvements to begin.

A hydraulic study of Brown Barranca, from Foothill Road to the Santa Clara River, has been prepared for the Ventura County Watershed Protection District. Improvements to Brown Barranca by this development will be governed by the results of this study.

However, in any event, improvements to Brown Barranca north of Highway 126 will be addressed as part of this development. For instance, the barranca, as it leaves Telegraph Road and approaches Wells Road, becomes both shallower and narrower. It is at this location where large storms can overtop the barranca and flow across Wells Road. This reach will need to be redesigned to full capacity (100-year storm flow). The culvert crossing at Blackburn Road will be upgraded also. These improvements will allow large storm flows to proceed farther south towards the freeway, effectively removing the current bottleneck. Also, because of infiltration swales, biofilters, previous pavements and signification area dedicated to stormwater detention, it is expected the runoff generated by this site will be reduced to "at" or below existing underdeveloped conditions. While storm flows crossing Highway 126 are limited to downstream

channel capacities, the improvements will lessen or eliminate the potential for flooding across Wells Road. Additional downstream improvements, as may be determined from the hydraulics study, could also be accomplished concurrently utilizing the CIDS contribution funds required of both this development and all others in the area. This would be determined in consort with City staff.

CIDS fees estimated to be $999,280 will be paid to the City by "Parklands."

Traffic System

The CIDS document lists three regional improvements which are impacted by "Parklands." These include Highway 118 improvements (stripping and signing; bridge construction on Darling Road at Highway 118) a new signal at Telegraph Road and Saticoy Avenue and signal improvements at Wells Road and Citrus Drive.

Aside from above, "Parklands" is preparing a Traffic Study to determine project related impacts to the City street system. These will include, at a minimum, the widening of Telegraph Road at Wells Road to 108 feet wide with medians, signal upgrades at Telegraph Road and Wells Road and an east/west street connection across the site from Wells Road east to the Hanson Trust property located along Saticoy Avenue, which upon development of the Hanson Trust property can be extended to Saticoy Avenue. Each of these improvements is in compliance with the city's general Plan. Additional improvements as may be defined and justified through the Traffic Study, will be completed by the Parklands development to mitigate its impact on the traffic system in the area. The three CIDS projects listed above are the only regional projects contained in the CIDS which relate to the Wells Community. The Parklands project will contribute an estimated $59,850 in fees toward these projects.

Parks System

Neighborhood parks are funded through the CIDS fee program. The CIDS made no attempt to locate these parks within the Wells or Saticoy Communities. In the past, City staff has requested the neighborhood parks be approximately 5 acres in size; however, the integration of smaller "pocket" parks throughout developments has been the trend of late.

Parklands, as part of its on-site infrastructure, and at its sole cost, is proposing a variety of park sites, types and sizes totaling 11.7 acres, throughout its 60 acre development, including linear parks along Brown Barranca, joint use parks for play field use and storm water detention, pocket parks and a community center with various community park amenities, instead of one single neighborhood park

site. Should a single 5 acre park site still be considered necessary for the Wells Community, the Hanson Trust site could be considered.

Through the CIDS, Parklands will be contributing an estimated $452,916 toward neighborhood parks, which could be off-set by the proposed park areas within the development.

Pedestrian/Bike System

The CIDS did not specifically address bikeways and pedestrian access ways. The City's General Plan, however, does. Parklands will be conforming to the Traffic Circulation Element of the General Plan including providing Class I and Class II bikeways along major arterial streets, within the linear park and extending west toward the Hanson Trust property within the central portion of the site. Other pedestrian/bike friendly aspects of the project are outlined within the master plan documents including pedestrian and bike friendly street sections and other specific features, all provided at the sole cost of the Parklands project.

Fire Protection

Through the CIDS, Parklands will be contributing an estimated $54,350 toward reimbursing the City for its share of the recently constructed Fire Station No. 6.

Hawks & Associates

Engineering Planning Surveying

October 7, 2005

DTR Engineering
1695 Mesa Verde Avenue
Ventura, CA 93003

Attn: Dave Rose

RE: Review of Brown Barranca Flood Control for Proposed "Parklands Development," City of Ventura

In response to your request we have researched the flood control issues for the proposed Parklands Development adjacent to Brown Barranca east of Wells Road and south Telegraph Road, as shown on attached Exhibit A. The following available information was reviewed to assist in this review:

- Federal Emergency management Agency (FEMA) Flood Insurance Study, Flood Insurance Rate Maps, (FIRM) and Flood Plain Management regulations.
- Ventura County Watershed Protection (VCWPD) District Watercourse permit requirements.
- City of Ventura Flood Plain Management Ordinance
- City of Ventura Stormwater Quality Urban Impact Plan (SQUIMP) Requirements
- "Parklands" Master Plan as well as the site drainage concept as outlined by you.
- Ventura County Watershed Protection District Five Year Capital Projects Program.

The issues are divided into those involved with (a) the site improvement impacts and mitigation measures and (b) Brown Barranca, both existing and future conditions.

Parklands Drainage Impacts and Mitigation Measures

1. The development project proposes on-site stormwater detention and other runoff reduction measures such as vegetated swales and pervious pavement to provide for no increase in post-development runoff from the site and a probable decrease in runoff. No increase in runoff to Brown Barranca will comply with SQUIMP requirements.
2. Through extension of onsite storm drainage facilities, the project proposes to resolve localized drainage problems caused by Linden Drive drainage, affecting the existing mobile home park, and localized flooding on Blackburn Road near the mobile home site.
3. The project proposes to preserve and make a recreational focal point of Brown Barranca as a natural channel through the development from Telegraph to Wells Roads. This will require environmentally friendly measures to stabilize the invert and protect the Brown Barranca banks from erosion.

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4. Project on-site flooding will be eliminated by implementation of two mitigating measures. Enlarging and extending the existing undersized Blackburn Road culvert will not only reduce or eliminate on-site flooding, but also alleviate flooding on Wells Road. Additional flood protection will be assured by the placement of fill, if needed, on any remaining portions of the reduced floodplain.
5. The estimated $1,000,000 development contribution by the project toward planned Brown Barranca improvements by VCWPD could allow work to begin in the most critical downstream locations along Wells Road.

Brown Barranca Flooding – Existing Conditions

The composite FEMA Flood Insurance Rate Mat (FIRM) of the City (1986) and County (1985) attached as Exhibit A shows that the regulatory 100 year flood (1450 cfs+) Zone A7 is confined within the deeply inclined natural Brown Barranca for 1,000 feet south of Telegraph Road. As the channel depth decreases, FEMA data shows a 350 cfs overflow of the east bank and across a 700-foot length of Wells Road, upstream of the Blackburn Road culvert. This becomes a shallow street flow of an average depth of one foot as it continues easterly. Overflow also occurs to the south along Blackburn Road and across the Santa Paula Freeway.

There are a series of box culverts (RCB) and concrete lined channels through the Hwy. 126 Freeway interchange between Blackburn Road on the north and Henderson Road on the south. The culvert sizes vary at locations shown below:

- Henderson Road—Triple 8 X 6 RCB
- Hwy. 126 & Off Ramp—Triple 8 X 6 RCB
- Hwy. 126 On Ramp & Blackburn Road—Double 8 X 6 RCB

FEMA Hydraulic calculations indicate that all of the culverts are inadequate for the FEMA 100-year flood. The undersize Blackburn Road culvert and low upstream banks often result in the overflow of Wells Road to the east and Blackburn Road to the south through the Hwy. 126 Freeway interchange. Portions of the proposed development area are north and west of Blackburn Road within the floodplain. The remaining flow is confined to Brown Barranca south of the freeway on-ramp and continuing its confluence with the Santa Clara River. FEMA and City floodplain regulations require that any new building must be protected from inundation and erosion from the 100-year flood.

Brown Barranca—Future Conditions

The VCWPD has performed a very recent hydrologic analysis of the future developed watershed for Brown Barranca which is under its jurisdiction for planning and regulatory permits. The resulting flood flows shown on attached Exhibit B are higher than the FEMA flows in some reaches and represent the VCWPD required capacity for channel improvements. The VCWPD has commissioned a study to define specific channel improvements to contain the 100-year flood along Brown Barranca from Telegraph Road to the Santa Clara River. After exploring seven alternatives to improve channel capacity and considering several other off-channel alternatives for mitigating flood risk, a draft pre-design report was published in July, 2005. This report recommends a number of modifications to structures, several of which are located in the vicinity of the Parklands site. The VCWPD five-year capital project program includes Brown Barranca improvements, as shown on Exhibit C.

Based on the FEMA Flood Insurance Study, channel capacity analysis, recent storm records and our review of the same, Brown Barranca from Hwy. 126 south has flow capacity up to a 50-year flood. The open channel south of Henderson Road, for instance, was estimated to have a capacity of 1900 cfs. The existing freeway and Henderson Road culverts have approximately the same capacity.

The Parklands development team is coordinating with the VCWPD to finalize a set of improvements that would increase the capacity of Brown Barranca north of the freeway. Construction of these improvements will allow for the additional utilization of the downstream capacity of the channel while reducing the potential of channel overtopping which now exists just north of the freeway. This would be an improvement over the existing condition for areas east of Wells Road, where per the FEMA Study, overflow of the channel would impact existing development.

Summary

It should be noted that the Parkland development, because of its proposed mitigation measures, will not pose an impact upon or increase storm flows within Brown Barranca. It appears that, with the proposed well planned channel improvements north of the freeway in conjunction with planned VCWPD planned improvements, this development would have a positive impact on flooding potential to other areas north of the freeway. The development's CIDS contribution, estimated at $1,000,000, may be earmarked for Brown Barranca improvements. Other prior and future contributions then could be used to enhance the VCWPD Improvement Program

If you have any question or need additional information please give me a call.

Sincerely,

Hawks & Associates

William G. Frank, Principal Engineer

Attachments:

- Exhibit A – FEMA Composite Flood Insurance Rate Map
- Exhibit B – Brown Barranca Future Condition Hydrology
- Exhibit C – Brown Barranca – Proposed VCWPD 5 year Program Project

Brown Barranca Future Condition Hydrology - 11/04							
VCRAT ID	LOCATION	AREA (acres)	AR Factor	AREAL REDUCED Q2	AREAL REDUCED Q10	AREAL REDUCED Q50	AREAL REDUCED Q100
25AF	@ Foothill Rd.	1087	0.902	78	490	980	1353
31A	U/S of Telegraph Rd.	1158	0.895	78	486	972	1342
41AD	@ Telegraph Rd.	1476	0.885	93	581	1162	1604
53AF	@ Hwy. 126	1780	0.873	155	789	1408	1845
67AC	@ Telephone Rd.	2171	0.863	194	987	1763	2309
70A	@ Santa Clara River	2256	0.859	195	993	1773	2323

Note: Q2, Q10 and Q50 Flowrates Approximated From Peak Flow Multipliers - Q100 VCRAT Filename = BRWNBARR.99\99.O

EXHIBIT B

VENTURA COUNTY PUBLIC WORKS AGENCY
WATERSHED PROTECTION DISTRICT

Project Name: Brown Barranca Channel Improvements Project No.:

Supervisorial District: 1 District Zone: 2 Location: City of Ventura

LOCATION MAP

SCOPE OF WORK AND OBJECTIVE

Construct channel improvements from Santa Clara River to Foothill Road to upgrade the existing inadequate earth ditch. Environmentally sensitive approaches will be evaluated during the preliminary design phase. The objective is to provide 100-year flood protection to the adjacent properties.

SCHEDULED FUNDING

ESTIMATED COST PER FISCAL YEAR

	Prev Yrs	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
Preliminary Design		$ 60,000	$ 40,000			
Environ. Processing/Permits			$ 60,000	$ 60,000		
Final Design				$ 200,000		
Right-of-Way/Utility Relocations			$ 50,000			
Construction					$3,750,000	$1,130,000
Mitigation						$ 500,000
Project Closeout						$ 50,000
FY TOTAL		$ 60,000	$ 150,000	$ 260,000	$3,750,000	$1,680,000

Total Estimated Cost: $5,900,000

ENVIRONMENTAL REQUIREMENTS

Cat. Ex. ____ Neg. Dec. ____ EIR/EIS X Date Completed ____ Date Filed ____

REMARKS

Additional Annual Operations and Maintenance Costs = $40,000
Mitigation Maintenance and Monitoring Costs = $200,000

EXHIBIT C

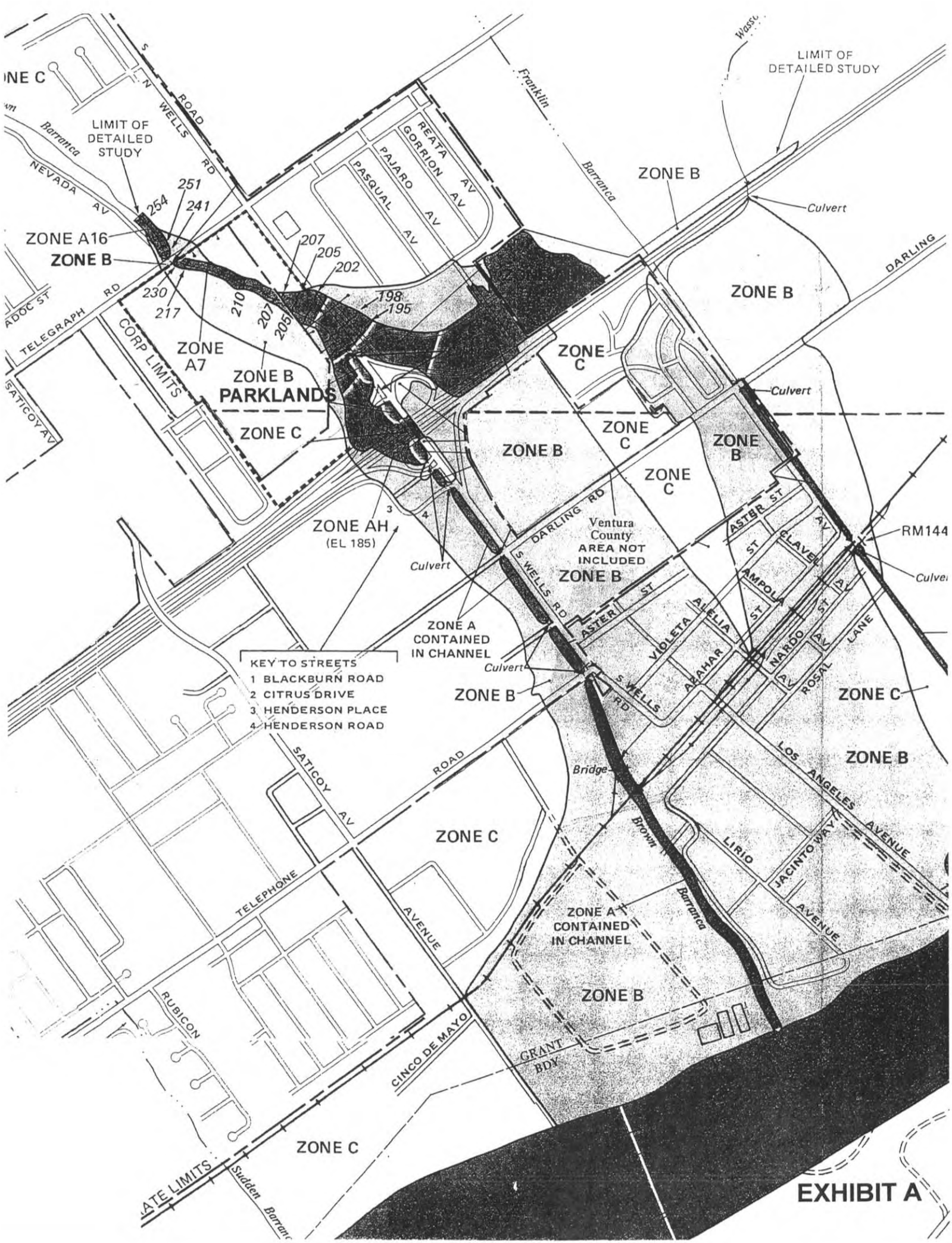
LIMIT OF DETAILED STUDY
LIMIT OF DETAILED STUDY
ZONE C
ZONE A16
ZONE B
ZONE A7
ZONE B
PARKLANDS
ZONE C
ZONE AH
(EL 185)
ZONE A CONTAINED IN CHANNEL
ZONE B
ZONE C
ZONE B
ZONE C
ZONE B
ZONE C
ZONE B
ZONE C
ZONE B
ZONE A CONTAINED IN CHANNEL
ZONE B
ZONE C
Ventura County AREA NOT INCLUDED
Culvert
Culvert
Culvert
Culvert
Culvert
Bridge
RM144
KEY TO STREETS
1 BLACKBURN ROAD
2 CITRUS DRIVE
3 HENDERSON PLACE
4 HENDERSON ROAD
S WELLS RD
N WELLS RD
ROAD
NEVADA AV
TELEGRAPH RD
SATICOY AV
CORP LIMITS
DARLING RD
DARLING
Franklin Barranca
Brown Barranca
Sudden Barranca
REATA AV
GORRION AV
PAJARO AV
PASQUAL AV
ASTER ST
CLAVEL AV
AMPOLA ST
VIOLETA ST
ALELIA ST
AZAHAR AV
NARDO ST
ROSAL LANE
LOS ANGELES AVENUE
LIRIO AVENUE
JACINTO WAY
SATICOY AV
ROAD
TELEPHONE AVENUE
RUBICON
CINCO DE MAYO
GRANT BDY
ATE LIMITS
254
251
241
230
217
210
207
205
202
198
195
3
4

EXHIBIT A

Hawks & Associates

Engineering Planning Surveying

July 29, 2008

City of San Buenaventura
Community Development Department
501 Poli Street
Ventura, CA 93001

RECEIVED
JUL 31 2008
Community Development
PLANNING DIVISION

Attn: Iain Holt, Acting Senior Planner

Subject: Notice of Intent to Adopt a Negative Declaration, Parklands Specific Plan, Responses to Ventura County Watershed Protection District Comments

We reviewed the Ventura County Watershed Protection District comments dated April 15, 2008 and we have the following responses in order of the comments. Also the attached revised plan Detention Design Report reflects the comments and revisions to the detention basin.

1. The proposed plan incorporates measures to mitigate an increase in runoff caused by development including pervious pavement, grass swales and the detention basin. Therefore the check of less than significant impact is appropriate.
2. Although the development plan is composed of two separate areas of 54 acres and 13 acres the detention basin is designed to more effectively mitigate revised runoff from the total 67 acres in a single basin. It will be designed to capture all flows in excess of the pre-development Q_{10} and to discharge these flows at the pre-development flow rate. Flows less than the pre-development Q_2 will bypass the primary underground detention area to provide compliance with storm water quality requirements in a small surface detention basin.
3. A conceptual plan and profile drawing of the basin, low flow pipe, connections to Brown Barranca and location of inlet and outlet structures is attached. Profile elevations and structure details will be included in the final plans.
4. The proposed improvements will remove approximately 2.5 acres of the floodplain within the westerly overbank upstream of HWY 126. The natural detention volume associated with this area is approximately 1 acre-ft.
5. The VCRAT Brown Barranca hydrology analysis of the development impact on flood flow is included in the attached revised Detention Design Report. The results shown in the Report demonstrate that the post development 100-year peak flow in less than the flow for pre-development conditions.

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6. The **interim condition** HEC-RAS analyses included runs for both the mixed flow condition and subcritical flow condition. The subcritical condition was utilized to evaluate the maximum base flood elevations for the reach of the existing undersized channel downstream of the proposed improvements. This is a conservative approach in terms of floodplain delineation since the existing channel cannot contain the 100-year flow. However, we agree that the mixed flow condition should be considered for the proposed improvements including the evaluation of the velocities downstream of the proposed culvert. The HEC-RAS analyses included the proposed culvert in both mixed and subcritical runs. The culvert was modeled as one long culvert approximately 690 feet in length (between Sta 83+73 & Sta 90+63). The results from both condition runs were similar due to the existing subcritical channel conditions and the backwater from the deficient culvert (culvert #3, under HWY 126 on-ramp) located approx. 250 feet downstream. The runs indicate a jump within the proposed box culvert.

   The detailed analysis of the proposed interim condition including the evaluation of the hydraulic jump, the tie-in and the transition configuration to the existing trapezoidal channel will be required during the final design of the project as stated in the Conclusions & Recommendation, Section 5 of the Study. It should be noted that the existing trapezoidal channel downstream of the proposed culvert is a lined concrete system that would accommodate the possible higher velocity that may occur at the outlet of the proposed culvert. However, since the existing channel system was built years ago, its condition and structural integrity should be investigated.

If you have any questions or comments please call Bill Frank at (805) 658-6611.

Sincerely,

Hawks & Associates

Glenn C. Hawks

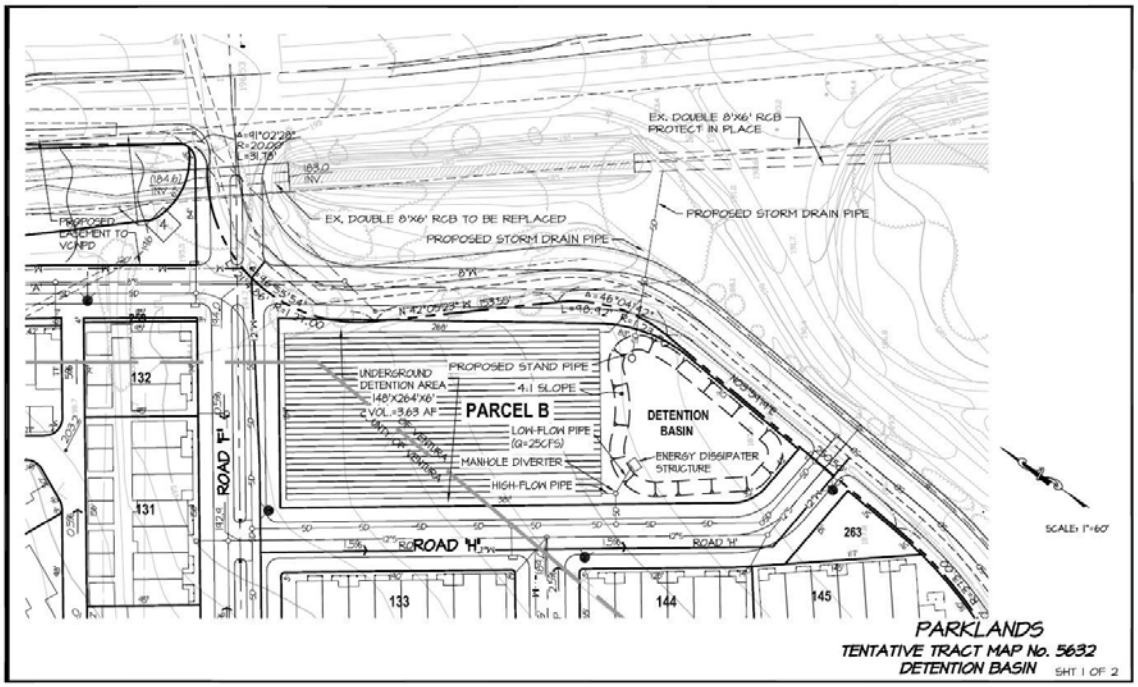
Attachments: Revised Detention Design Report
Updated Detention Basin Plan

\\Hal\eng\!Active Projects\184-11 Brown Barranca\Ltr. to City of Ventura.doc

PARKLANDS DEVELOPMENT

TTM NO. 5632

DETENTION DESIGN



December 28, 2006

Revised July 27, 2008

Second Revision October 20, 2008

REGISTERED PROFESSIONAL ENGINEER
BARRY C. RANDS
No. 72929
Exp. 12-31-08
CIVIL
STATE OF CALIFORNIA

Prepared for:

DTR Engineering
1695 Mesa Verde Avenue, Suite 100
Ventura , CA 93003

Prepared by:

Hawks & Associates
2259 Portola Rd. Suite B
Ventura, CA 93003
(805) 658-6611

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VCRAT map and files.....A7

Parklands Detention Requirements

Introduction

The Parklands project comprises 67 acres of land at the northwest corner of the intersection of the 126 freeway and Wells Road. 13 acres of the site are located on the north side of Brown Barranca and the remaining 54 acres lie to the south. The project will construct a mixture of homes and condominiums on land which is currently used for agricultural purposes. The purpose of this report is to analyze pre- and post-development hydrology and to design a detention system that will mitigate the impact of development on peak runoff rates discharging to Brown Barranca.

Detention Basin Design Approach

The detention basin captures runoff from the 54-acre south portion of the development. Runoff from the northern 13 acres site will not be detained. However, the detention basin will be designed to mitigate increased runoff from the entire site. It will be designed to capture flows in excess of the post-development Q5 and to discharge them at pre-development flow rates. Flows less than the post-development Q5 will bypass the basin. Smaller flows are designed to bypass the basin to increase its efficiency during extreme flood events.

Existing Conditions Hydrology

Hydrology is calculated for the 67-acre parcel as a whole. The existing conditions peak runoff rates for the 67-acre parcel are calculated with the VCWPD Tc Calculator with the following assumptions:

Area: 67 acres
Effective Imperviousness: 0% (agricultural land)
Soil Group: 3
Rainfall Zone: K
Time of Concentration: as shown in Tc Calculator Output Report

The results of this analysis are presented in Table 1:

	EXISTING CONDITIONS HYDROLOGY			
	Q10	Q25	Q50	Q100
Tc (minutes)	16	13	12	10
Peak Flow (cfs)	93	120	150	192

These flows will be used to determine the target maximum discharge rates at the given storm frequencies to design the detention basin.

Proposed Conditions Hydrology

Hydrology is calculated for the 67-acre parcel as a whole and pro-rated by area to the 13-acre and 54-acre portions of the site. The project will incorporate a system of vegetated swales and conventional storm drain pipes designed to handle the Q10 storm event. Excess flows from larger storm events will be conveyed overland in the swales and streets. The VCWPD Tc Calculator was used to calculate peak flows for these conditions, assuming a travel path through the swale/pipe system for the Q10 event and a swale/street flow path for the higher flow events. Other than changes in times of concentration, the effective imperviousness was the other main difference between pre- and post-development runoff. The VCWPD Hydrology Manual has historically used an effective impervious percent of 23% for residential developments, but the higher density residential developments that are more common today (including Parklands) would be better modeled with an effective impervious percentage of 37% as recommended for condominium developments. It should be noted that this is a conservative estimation of effective imperviousness, more appropriate for larger storms, as the development will incorporate many low-impact development (LID) features such as pervious pavement which will act as pervious surfaces in smaller storms.

Based on these assumptions, the results are presented in Table 2:

	PROPOSED CONDITIONS HYDROLOGY			
	Q10	Q25	Q50	Q100
Tc (minutes)	9	9	8	7
67-acre peak flow (cfs)	149	168	202	246
Pro-rated 13-acre peak flow (cfs)	29	33	39	48
Pro-rated 54-acre peak flow (cfs)	120	135	163	198

Target Detention Basin Discharge

Flow from two sources discharge directly to Brown Barranca:

1. Flows designed to bypass the detention basin
2. Peak flows from the northern 13-acre portion of the development.

The detention basin must be designed to discharge the difference between the pre-development flows and the direct flows to Brown Barranca. The direct flows from the 13-

acre site are shown in Table 2. Bypass flows are calculated based on the performance of the diversion structure illustrated in the appendix (A-4). Table 3 shows the values used to develop the target detention basin flows.

Table 3: Target detention flows

Flows (cfs)	TARGET DETENTION FLOWS			
	Q10	Q25	Q50	Q100
Pre-development	93	120	150	192
Bypass flow	31	32	33	35
13-acre site flow	29	33	39	48
Target Basin Outflow	**33**	**55**	**78**	**109**

Proposed Conditions Runoff Volume

The SCS method has been used to calculate runoff volumes needed to design the detention basin. HydroCAD software has been used to facilitate the design and configuration of the detention basin and its outlets. The required inputs in the SCS runoff volume model are area, Curve Number (CN) and 24-hr precipitation for each storm frequency. The area served by the detention basin is 57 acres. The CN for residential condominiums for soil group 3 is 89 (according to VCWPD tables). VCWPD rainfall maps are used to determine the 24-hr precipitation for the design events. Based on these input values, gross storm volumes are calculated. The net storm volume to the basin is then determined by subtracting the volume bypassed.

Table 4: Storm Volumes

	Storm Event			
	Q10	Q25	Q50	Q100
24-hr rainfall (in)	5.5	6.6	7.5	8.3
Gross Storm Volume (af)	19.0	23.8	27.7	31.2
Bypass Volume (af)	15.3	18.4	20.8	22.8
Net Volume to Basin (af)	3.7	5.4	6.9	8.4

The basin configuration and outlet dimensions that provide adequate storage and discharge characteristics have been modeled with HydroCAD with a full report included in the appendix. A summary of volume requirements and discharges are given in Table 5:

Table 5: Basin Performance

	Storm Event			
	Q10	Q25	Q50	Q100
Volume required (af)	2.24	2.83	3.26	3.62
Peak Elevation (ft)	184.9	185.9	187.0	188.0
Peak Discharge (cfs)	32.8	49.5	77.0	104.6
Target Discharge (cfs)	33	55	78	109

Detention Basin Configuration and Operation

The detention basin is an underground system, formed by a bank of arched chambers, connected in series and backfilled with gravel on the outside. The detention volume is based on a combination of the empty space volume of the arched chambers and the void space in the backfill, assumed to be 40% of the backfill volume. The chambers occupy a 148' x 264' space, with a base at elevation 182 feet. They provide a volume of 2.74 af of chamber storage. The backfill material adds an additional 0.89 af for a total storage volume of 3.63 af. The outlets are built into a pre-fab endwall configured so that the Q10 discharges from lower rectangular orifice while larger flows discharge from the higher weir. The outlets will be connected to a pipe or box of sufficient capacity to convey the flow to Brown Barranca.

For modeling purposes, the basin has been designed with ConStorm concrete chambers as shown in the appendix. Alternate materials and configuration may be substituted in the final design, but storage volumes and basic function will remain the same.

Watershed Impact

A comparison of pre- and post-development VCRAT Q100 hydrology was made to determine the impact of the mitigation measures on the flows in Brown Barranca. The VCRAT hydrology files were obtained from VCWPD and modified to model existing conditions of the Parklands site. Changes made to the original model are described and illustrated in the appendix. The run was then revised to model proposed conditions, with and without detention. The results of the runs are presented in table 6:

Table 6: Watershed Impact

Location	***100-year Peak Flow***			
	WPD model	***Existing***	***Proposed (no detention)***	***Proposed (with detention)***
Parklands (67 ac)	~213*	192	246	188
At Hwy 126	2113	2179	2132	2173
At Sta Clara River	2704	2715	2690	2708

* The WPD model does not treat the 67-acre Parklands site separately. The value reported here is extrapolated from the 40-acre subarea 52F.

The results indicate that the detained post-development flow (*proposed with detention*) is less than the flow for existing conditions at both Hwy 126 and the confluence with the Santa Clara River. It may appear unusual that all scenarios show much higher flows at Hwy 126 than the WPD model. The reason for this is that the hydrograph for runoff from the subarea representing 54 acres of the Parklands site was fattened in all three modified runs. Another anomaly is that it appears that the "no detention" scenario has the least impact on the watershed. This is due to the fact that the Parklands site is so close to the main stem of Brown Barranca and at the downstream end of the watershed. The increased runoff from the developed site would "beat the peak" of the hydrograph in the main stem and thus would have a smaller impact on the peak flow in Brown Barranca than in the detained condition. This anomaly is accentuated by the fact that the VCRAT model routinely underestimates hydrograph volumes and their corresponding shapes. This makes confluence hydrographs smaller than they would be if both incoming hydrographs were shaped (fattened) to represent their true volumes.

Another watershed impact to be considered is the loss of floodplain storage (natural detention) with the improvements to Brown Barranca. The estimated loss of natural floodplain storage is 1 acre-foot. The detention basin volume is 3.63 acre-feet. Due to its location in the watershed and elevation relative to Brown Barranca, reverse flow will occur during extreme storm events. Depending on the relative timing of peak flows from the Parklands site and the larger Brown Barranca watershed, the detention basin could provide 1 acre-foot of floodplain storage for Brown Barranca.

TECHNICAL APPENDIX

A1

HYDROLOGY CALCULATIONS

Tc CALCULATOR REPORT

VENTURA COUNTY WATERSHED PROTECTION DISTRICT
TIME OF CONCENTRATION
Project: Parklands
Engineer: Dave Rose
Consultant: Barry Rands

Watershed Name: Parklands

EXISTING CONDITIONS

Sub-Area Name: Parklands Undeveloped Land
Computing Tc for all rainfall frequencies for sub-area Parklands Undeveloped Land...

Tc for frequency = 10.00: 15.977 Minutes
DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 15.977 min. = 16 min.

SUB AREA INPUT DATA

Sub Area Name: Parklands Undeveloped Land
Total Area (ac): 67
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 10
Development Type: Undeveloped
Soil Type: 3.00
Percent Impervious: 0
SUB AREA OUTPUT

Intensity (in/hr): 1.976
C Total: 0.701
Sum Q Segments (cfs): 92.88
Q Total (cfs): 92.88
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 958.61
Time of Concentration (min): 15.977

DATA FOR FLOW PATH 1

Flow Path Name: Fields
FLOW PATH TRAVEL TIME (min): 11.4907
Flow Type: Overland
Length (ft): 300

Top Elevation (ft): 250
Bottom Elevation (ft): 241
Percent of Sub-Area: 5
Overland Type: Valley
Development Type: Undeveloped
Map Slope: 0.0300
Effective Slope: 0.0300
Q (cfs): 4.64
Avg Velocity (ft/s): 0.44

DATA FOR FLOW PATH 2

Flow Path Name: Farm Road
FLOW PATH TRAVEL TIME (min): 3.0941
Flow Type: Natural Channel
Length (ft): 1380
Top Elevation (ft): 241
Bottom Elevation (ft): 200
Percent of Sub-Area: 40
Overland Type: Valley
Map Slope: 0.0297
Effective Slope: 0.0297
Q (cfs): 37.15
Q Top (cfs): 4.64
Q Bottom (cfs): 41.79
Velocity Top (ft/s): 3.57
Velocity Bottom (ft/s): 6.34
Avg Velocity (ft/s): 4.96
Wave Velocity (ft/s): 7.43

DATA FOR FLOW PATH 3

Flow Path Name: Channel
FLOW PATH TRAVEL TIME (min): 1.3920
Flow Type: Natural Channel
Length (ft): 575
Top Elevation (ft): 200
Bottom Elevation (ft): 193
Percent of Sub-Area: 55
Overland Type: Valley
Map Slope: 0.0122
Effective Slope: 0.0122
Q (cfs): 51.08
Q Top (cfs): 41.79

Q Bottom (cfs): 92.88
Velocity Top (ft/s): 4.06
Velocity Bottom (ft/s): 5.12
Avg Velocity (ft/s): 4.59
Wave Velocity (ft/s): 6.88

Tc for frequency = 25.00: 13.262 Minutes
DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 13.262 min. = 13 min.

SUB AREA INPUT DATA

Sub Area Name: Parklands Undeveloped Land
Total Area (ac): 67
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 25
Development Type: Undeveloped
Soil Type: 3.00
Percent Impervious: 0
SUB AREA OUTPUT

Intensity (in/hr): 2.430
C Total: 0.740
Sum Q Segments (cfs): 120.47
Q Total (cfs): 120.47
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 795.73
Time of Concentration (min): 13.262

DATA FOR FLOW PATH 1

Flow Path Name: Fields
FLOW PATH TRAVEL TIME (min): 9.0881
Flow Type: Overland
Length (ft): 300
Top Elevation (ft): 250
Bottom Elevation (ft): 241
Percent of Sub-Area: 5
Overland Type: Valley
Development Type: Undeveloped
Map Slope: 0.0300
Effective Slope: 0.0300

Q (cfs): 6.02
Avg Velocity (ft/s): 0.55

DATA FOR FLOW PATH 2

Flow Path Name: Farm Road
FLOW PATH TRAVEL TIME (min): 2.8848
Flow Type: Natural Channel
Length (ft): 1380
Top Elevation (ft): 241
Bottom Elevation (ft): 200
Percent of Sub-Area: 40
Overland Type: Valley
Map Slope: 0.0297
Effective Slope: 0.0297
Q (cfs): 48.19
Q Top (cfs): 6.02
Q Bottom (cfs): 54.21
Velocity Top (ft/s): 3.80
Velocity Bottom (ft/s): 6.83
Avg Velocity (ft/s): 5.32
Wave Velocity (ft/s): 7.97

DATA FOR FLOW PATH 3

Flow Path Name: Channel
FLOW PATH TRAVEL TIME (min): 1.2892
Flow Type: Natural Channel
Length (ft): 575
Top Elevation (ft): 200
Bottom Elevation (ft): 193
Percent of Sub-Area: 55
Overland Type: Valley
Map Slope: 0.0122
Effective Slope: 0.0122
Q (cfs): 66.26
Q Top (cfs): 54.21
Q Bottom (cfs): 120.47
Velocity Top (ft/s): 4.37
Velocity Bottom (ft/s): 5.54
Avg Velocity (ft/s): 4.96
Wave Velocity (ft/s): 7.43

Tc for frequency = 50.00: 11.711 Minutes

DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 11.711 min. = 12 min.

SUB AREA INPUT DATA

Sub Area Name: Parklands Undeveloped Land
Total Area (ac): 67
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 50
Development Type: Undeveloped
Soil Type: 3.00
Percent Impervious: 0

SUB AREA OUTPUT

Intensity (in/hr): 2.902
C Total: 0.771
Sum Q Segments (cfs): 149.89
Q Total (cfs): 149.89
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 702.65
Time of Concentration (min): 11.711

DATA FOR FLOW PATH 1

Flow Path Name: Fields
FLOW PATH TRAVEL TIME (min): 7.7863
Flow Type: Overland
Length (ft): 300
Top Elevation (ft): 250
Bottom Elevation (ft): 241
Percent of Sub-Area: 5
Overland Type: Valley
Development Type: Undeveloped
Map Slope: 0.0300
Effective Slope: 0.0300
Q (cfs): 7.49
Avg Velocity (ft/s): 0.64

DATA FOR FLOW PATH 2

Flow Path Name: Farm Road
FLOW PATH TRAVEL TIME (min): 2.7169

Flow Type: Natural Channel
Length (ft): 1380
Top Elevation (ft): 241
Bottom Elevation (ft): 200
Percent of Sub-Area: 40
Overland Type: Valley
Map Slope: 0.0297
Effective Slope: 0.0297
Q (cfs): 59.96
Q Top (cfs): 7.49
Q Bottom (cfs): 67.45
Velocity Top (ft/s): 4.01
Velocity Bottom (ft/s): 7.28
Avg Velocity (ft/s): 5.64
Wave Velocity (ft/s): 8.47

DATA FOR FLOW PATH 3

Flow Path Name: Channel
FLOW PATH TRAVEL TIME (min): 1.2077
Flow Type: Natural Channel
Length (ft): 575
Top Elevation (ft): 200
Bottom Elevation (ft): 193
Percent of Sub-Area: 55
Overland Type: Valley
Map Slope: 0.0122
Effective Slope: 0.0122
Q (cfs): 82.44
Q Top (cfs): 67.45
Q Bottom (cfs): 149.89
Velocity Top (ft/s): 4.66
Velocity Bottom (ft/s): 5.92
Avg Velocity (ft/s): 5.29
Wave Velocity (ft/s): 7.94

Tc for frequency = 100.00: 9.579 Minutes
DATA FOR SUB AREA 1

SUB AREA TIME OF CONCENTRATION: 9.579 min. = 10 min.

SUB AREA INPUT DATA

Sub Area Name: Parklands Undeveloped Land

Total Area (ac): 67
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 100
Development Type: Undeveloped
Soil Type: 3.00
Percent Impervious: 0
SUB AREA OUTPUT

Intensity (in/hr): 3.570
C Total: 0.802
Sum Q Segments (cfs): 191.89
Q Total (cfs): 191.89
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 574.75
Time of Concentration (min): 9.579

DATA FOR FLOW PATH 1

Flow Path Name: Fields
FLOW PATH TRAVEL TIME (min): 5.9226
Flow Type: Overland
Length (ft): 300
Top Elevation (ft): 250
Bottom Elevation (ft): 241
Percent of Sub-Area: 5
Overland Type: Valley
Development Type: Undeveloped
Map Slope: 0.0300
Effective Slope: 0.0300
Q (cfs): 9.59
Avg Velocity (ft/s): 0.84

DATA FOR FLOW PATH 2

Flow Path Name: Farm Road
FLOW PATH TRAVEL TIME (min): 2.5358
Flow Type: Natural Channel
Length (ft): 1380
Top Elevation (ft): 241
Bottom Elevation (ft): 200
Percent of Sub-Area: 40
Overland Type: Valley
Map Slope: 0.0297

Effective Slope: 0.0297
Q (cfs): 76.76
Q Top (cfs): 9.59
Q Bottom (cfs): 86.35
Velocity Top (ft/s): 4.26
Velocity Bottom (ft/s): 7.83
Avg Velocity (ft/s): 6.05
Wave Velocity (ft/s): 9.07

DATA FOR FLOW PATH 3

Flow Path Name: Channel
FLOW PATH TRAVEL TIME (min): 1.1208
Flow Type: Natural Channel
Length (ft): 575
Top Elevation (ft): 200
Bottom Elevation (ft): 193
Percent of Sub-Area: 55
Overland Type: Valley
Map Slope: 0.0122
Effective Slope: 0.0122
Q (cfs): 105.54
Q Top (cfs): 86.35
Q Bottom (cfs): 191.89
Velocity Top (ft/s): 5.01
Velocity Bottom (ft/s): 6.39
Avg Velocity (ft/s): 5.70
Wave Velocity (ft/s): 8.55

PROPOSED CONDITIONS

Sub-Area Name: Parklands Developed Land Path 1
Computing Tc for all rainfall frequencies for sub-area Parklands Developed Land Path 1...
Tc for Q10: 9.044 Minutes
DATA FOR SUB AREA 2

SUB AREA TIME OF CONCENTRATION: 9.044 min. = 9 min.

SUB AREA INPUT DATA

Sub Area Name: Parklands Developed Land Path 1
Total Area (ac): 67
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 10
Development Type: Residential
Soil Type: 3.00
Percent Impervious: 37
SUB AREA OUTPUT

Intensity (in/hr): 2.680
C Total: 0.829
Sum Q Segments (cfs): 148.77
Q Total (cfs): 148.77
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 542.66
Time of Concentration (min): 9.044

DATA FOR FLOW PATH 1

Flow Path Name: Lot flow
FLOW PATH TRAVEL TIME (min): 4.0485
Flow Type: Overland
Length (ft): 105
Top Elevation (ft): 249
Bottom Elevation (ft): 246
Percent of Sub-Area: 1
Overland Type: Valley
Development Type: Residential
Map Slope: 0.0286
Effective Slope: 0.0286
Q (cfs): 1.49
Avg Velocity (ft/s): 0.43

DATA FOR FLOW PATH 2

Flow Path Name: Paved Street
FLOW PATH TRAVEL TIME (min): 2.0532
Flow Type: Street
Length (ft): 417
Top Elevation (ft): 246
Bottom Elevation (ft): 241
Percent of Sub-Area: 2
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0120
Q (cfs): 2.98
Q Top (cfs): 1.49
Q Bottom (cfs): 4.46
Velocity Top (ft/s): 1.95
Velocity Bottom (ft/s): 2.57
Avg Velocity (ft/s): 2.26
Wave Velocity (ft/s): 3.38

DATA FOR FLOW PATH 3

Flow Path Name: 18 RCP
FLOW PATH TRAVEL TIME (min): 1.8049
Flow Type: Pipe
Length (ft): 1190
Top Elevation (ft): 241
Bottom Elevation (ft): 213
Percent of Sub-Area: 32
Pipe Diameter (in): 30
Manning's N: 0.014
Map Slope: 0.0235
Q (cfs): 47.61
Q Top (cfs): 4.46
Q Bottom (cfs): 52.07
Avg Velocity (ft/s): 8.21
Wave Velocity (ft/s): 10.99

DATA FOR FLOW PATH 4

Flow Path Name: 24 RCP
FLOW PATH TRAVEL TIME (min): 0.3660
Flow Type: Pipe

Length (ft): 260
Top Elevation (ft): 213
Bottom Elevation (ft): 205
Percent of Sub-Area: 30
Pipe Diameter (in): 36
Manning's N: 0.014
Map Slope: 0.0308
Q (cfs): 44.63
Q Top (cfs): 52.07
Q Bottom (cfs): 96.70
Avg Velocity (ft/s): 9.29
Wave Velocity (ft/s): 11.84

DATA FOR FLOW PATH 5

Flow Path Name: 36 RCP
FLOW PATH TRAVEL TIME (min): 0.7718
Flow Type: Pipe
Length (ft): 515
Top Elevation (ft): 205
Bottom Elevation (ft): 190
Percent of Sub-Area: 35
Pipe Diameter (in): 42
Manning's N: 0.014
Map Slope: 0.0291
Q (cfs): 52.07
Q Top (cfs): 96.70
Q Bottom (cfs): 148.77
Avg Velocity (ft/s): 8.93
Wave Velocity (ft/s): 11.12

Tc for frequency = 25.00: 8.614 Minutes
DATA FOR SUB AREA 2

SUB AREA TIME OF CONCENTRATION: 8.614 min. = 9 min.

SUB AREA INPUT DATA

Sub Area Name: Parklands Developed Land Path 1
Total Area (ac): 67
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 25
Development Type: Residential

Soil Type: 3.00
Percent Impervious: 37
SUB AREA OUTPUT

Intensity (in/hr): 2.987
C Total: 0.840
Sum Q Segments (cfs): 168.19
Q Total (cfs): 168.19
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 516.84
Time of Concentration (min): 8.614

DATA FOR FLOW PATH 1

Flow Path Name: Lot flow
FLOW PATH TRAVEL TIME (min): 3.1996
Flow Type: Overland
Length (ft): 105
Top Elevation (ft): 249
Bottom Elevation (ft): 246
Percent of Sub-Area: 1
Overland Type: Valley
Development Type: Residential
Map Slope: 0.0286
Effective Slope: 0.0286
Q (cfs): 1.68
Avg Velocity (ft/s): 0.55

DATA FOR FLOW PATH 2

Flow Path Name: Cobble Street
FLOW PATH TRAVEL TIME (min): 1.9908
Flow Type: Street
Length (ft): 417
Top Elevation (ft): 246
Bottom Elevation (ft): 241
Percent of Sub-Area: 2
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0120
Q (cfs): 3.36
Q Top (cfs): 1.68
Q Bottom (cfs): 5.05
Velocity Top (ft/s): 2.01

Velocity Bottom (ft/s): 2.65
Avg Velocity (ft/s): 2.33
Wave Velocity (ft/s): 3.49

DATA FOR FLOW PATH 3

Flow Path Name: Nevada Avenue
FLOW PATH TRAVEL TIME (min): 3.1242
Flow Type: Natural Channel
Length (ft): 1630
Top Elevation (ft): 241
Bottom Elevation (ft): 197
Percent of Sub-Area: 65
Overland Type: Valley
Map Slope: 0.0270
Effective Slope: 0.0270
Q (cfs): 109.32
Q Top (cfs): 5.05
Q Bottom (cfs): 114.37
Velocity Top (ft/s): 3.47
Velocity Bottom (ft/s): 8.12
Avg Velocity (ft/s): 5.80
Wave Velocity (ft/s): 8.70

DATA FOR FLOW PATH 4

Flow Path Name: RoadF
FLOW PATH TRAVEL TIME (min): 0.2993
Flow Type: Natural Channel
Length (ft): 200
Top Elevation (ft): 197
Bottom Elevation (ft): 193
Percent of Sub-Area: 32
Overland Type: Valley
Map Slope: 0.0200
Effective Slope: 0.0200
Q (cfs): 53.82
Q Top (cfs): 114.37
Q Bottom (cfs): 168.19
Velocity Top (ft/s): 6.99
Velocity Bottom (ft/s): 7.86
Avg Velocity (ft/s): 7.43
Wave Velocity (ft/s): 11.14

Tc for frequency = 50.00: 7.889 Minutes
DATA FOR SUB AREA 2

SUB AREA TIME OF CONCENTRATION: 7.889 min. = 8 min.

SUB AREA INPUT DATA

Sub Area Name: Parklands Developed Land Path 1
Total Area (ac): 67
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 50
Development Type: Residential
Soil Type: 3.00
Percent Impervious: 37
SUB AREA OUTPUT

Intensity (in/hr): 3.525
C Total: 0.856
Sum Q Segments (cfs): 202.17
Q Total (cfs): 202.17
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 473.34
Time of Concentration (min): 7.889

DATA FOR FLOW PATH 1

Flow Path Name: Lot flow
FLOW PATH TRAVEL TIME (min): 2.7402
Flow Type: Overland
Length (ft): 105
Top Elevation (ft): 249
Bottom Elevation (ft): 246
Percent of Sub-Area: 1
Overland Type: Valley
Development Type: Residential
Map Slope: 0.0286
Effective Slope: 0.0286
Q (cfs): 2.02
Avg Velocity (ft/s): 0.64

DATA FOR FLOW PATH 2

Flow Path Name: Cobble Street

FLOW PATH TRAVEL TIME (min): 1.9008
Flow Type: Street
Length (ft): 417
Top Elevation (ft): 246
Bottom Elevation (ft): 241
Percent of Sub-Area: 2
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0120
Q (cfs): 4.04
Q Top (cfs): 2.02
Q Bottom (cfs): 6.07
Velocity Top (ft/s): 2.10
Velocity Bottom (ft/s): 2.77
Avg Velocity (ft/s): 2.44
Wave Velocity (ft/s): 3.66

DATA FOR FLOW PATH 3

Flow Path Name: Nevada Avenue
FLOW PATH TRAVEL TIME (min): 2.9652
Flow Type: Natural Channel
Length (ft): 1630
Top Elevation (ft): 241
Bottom Elevation (ft): 197
Percent of Sub-Area: 65
Overland Type: Valley
Map Slope: 0.0270
Effective Slope: 0.0270
Q (cfs): 131.41
Q Top (cfs): 6.07
Q Bottom (cfs): 137.47
Velocity Top (ft/s): 3.63
Velocity Bottom (ft/s): 8.59
Avg Velocity (ft/s): 6.11
Wave Velocity (ft/s): 9.16

DATA FOR FLOW PATH 4

Flow Path Name: RoadF
FLOW PATH TRAVEL TIME (min): 0.2829
Flow Type: Natural Channel
Length (ft): 200
Top Elevation (ft): 197

Bottom Elevation (ft): 193
Percent of Sub-Area: 32
Overland Type: Valley
Map Slope: 0.0200
Effective Slope: 0.0200
Q (cfs): 64.69
Q Top (cfs): 137.47
Q Bottom (cfs): 202.17
Velocity Top (ft/s): 7.39
Velocity Bottom (ft/s): 8.32
Avg Velocity (ft/s): 7.86
Wave Velocity (ft/s): 11.78

Tc for frequency = 100.00: 6.960 Minutes
DATA FOR SUB AREA 2

SUB AREA TIME OF CONCENTRATION: 6.960 min. = 7 min.

SUB AREA INPUT DATA

Sub Area Name: Parklands Developed Land Path 1
Total Area (ac): 67
Flood Zone: 3
Rainfall Zone: K
Storm Frequency (years): 100
Development Type: Residential
Soil Type: 3.00
Percent Impervious: 37
SUB AREA OUTPUT

Intensity (in/hr): 4.226
C Total: 0.869
Sum Q Segments (cfs): 246.03
Q Total (cfs): 246.03
Sum Percent Area (%): 100.0
Sum of Flow Path Travel Times (sec): 417.60
Time of Concentration (min): 6.960

DATA FOR FLOW PATH 1

Flow Path Name: Lot flow
FLOW PATH TRAVEL TIME (min): 2.0822
Flow Type: Overland
Length (ft): 105

Top Elevation (ft): 249
Bottom Elevation (ft): 246
Percent of Sub-Area: 1
Overland Type: Valley
Development Type: Residential
Map Slope: 0.0286
Effective Slope: 0.0286
Q (cfs): 2.46
Avg Velocity (ft/s): 0.84

DATA FOR FLOW PATH 2

Flow Path Name: Cobble Street
FLOW PATH TRAVEL TIME (min): 1.8092
Flow Type: Street
Length (ft): 417
Top Elevation (ft): 246
Bottom Elevation (ft): 241
Percent of Sub-Area: 2
Street Width (ft): 32
Curb Height (in): 6
Map Slope: 0.0120
Q (cfs): 4.92
Q Top (cfs): 2.46
Q Bottom (cfs): 7.38
Velocity Top (ft/s): 2.21
Velocity Bottom (ft/s): 2.91
Avg Velocity (ft/s): 2.56
Wave Velocity (ft/s): 3.84

DATA FOR FLOW PATH 3

Flow Path Name: Nevada Avenue
FLOW PATH TRAVEL TIME (min): 2.8024
Flow Type: Natural Channel
Length (ft): 1630
Top Elevation (ft): 241
Bottom Elevation (ft): 197
Percent of Sub-Area: 65
Overland Type: Valley
Map Slope: 0.0270
Effective Slope: 0.0270
Q (cfs): 159.92
Q Top (cfs): 7.38

Q Bottom (cfs): 167.30
Velocity Top (ft/s): 3.81
Velocity Bottom (ft/s): 9.12
Avg Velocity (ft/s): 6.46
Wave Velocity (ft/s): 9.69

DATA FOR FLOW PATH 4

Flow Path Name: RoadF
FLOW PATH TRAVEL TIME (min): 0.2662
Flow Type: Natural Channel
Length (ft): 200
Top Elevation (ft): 197
Bottom Elevation (ft): 193
Percent of Sub-Area: 32
Overland Type: Valley
Map Slope: 0.0200
Effective Slope: 0.0200
Q (cfs): 78.73
Q Top (cfs): 167.30
Q Bottom (cfs): 246.03
Velocity Top (ft/s): 7.85
Velocity Bottom (ft/s): 8.85
Avg Velocity (ft/s): 8.35
Wave Velocity (ft/s): 12.52

A2

RAINFALL CONTOUR MAPS

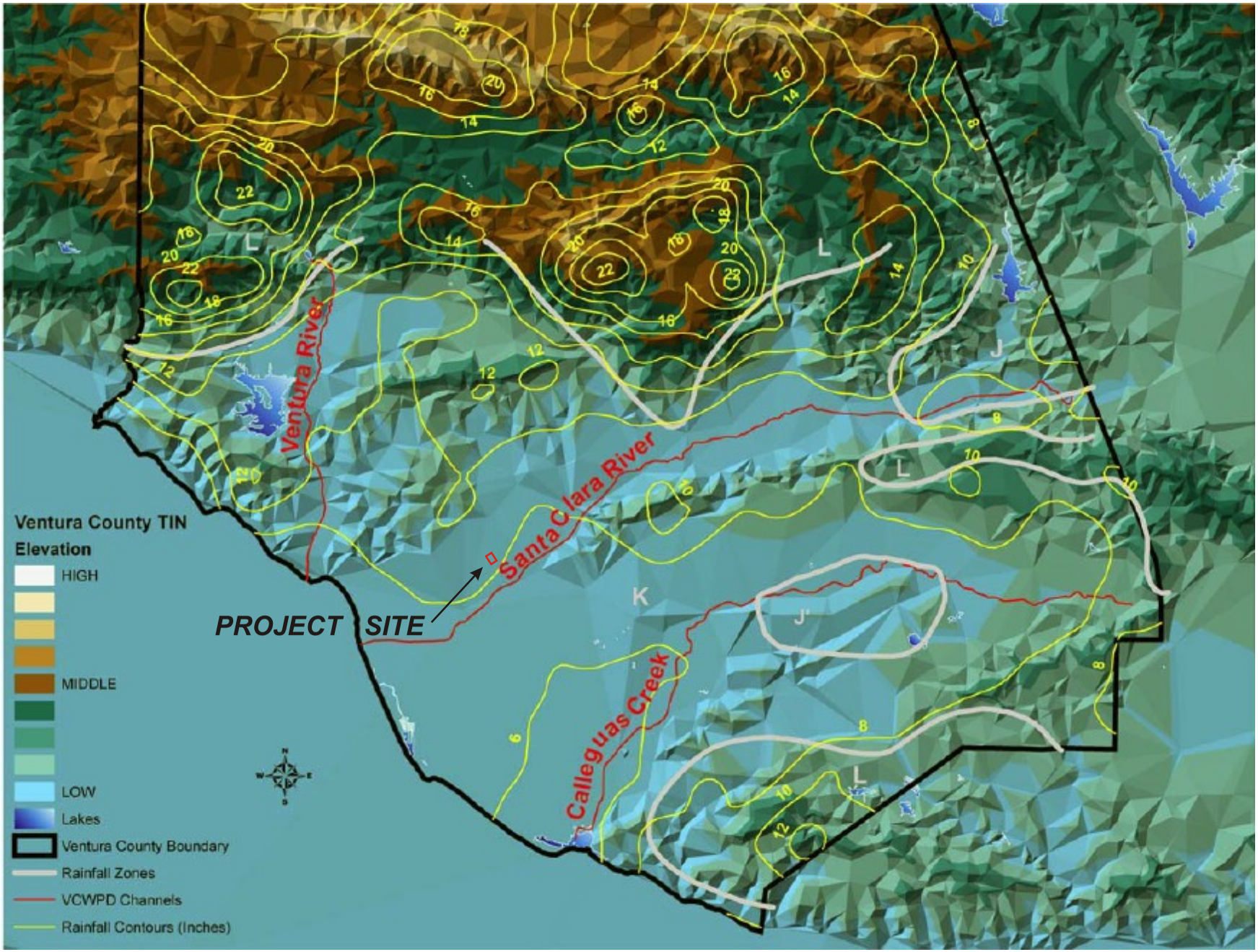


EXHIBIT 1A. DESIGN STORM RAINFALL CONTOURS- 100-YR STORM

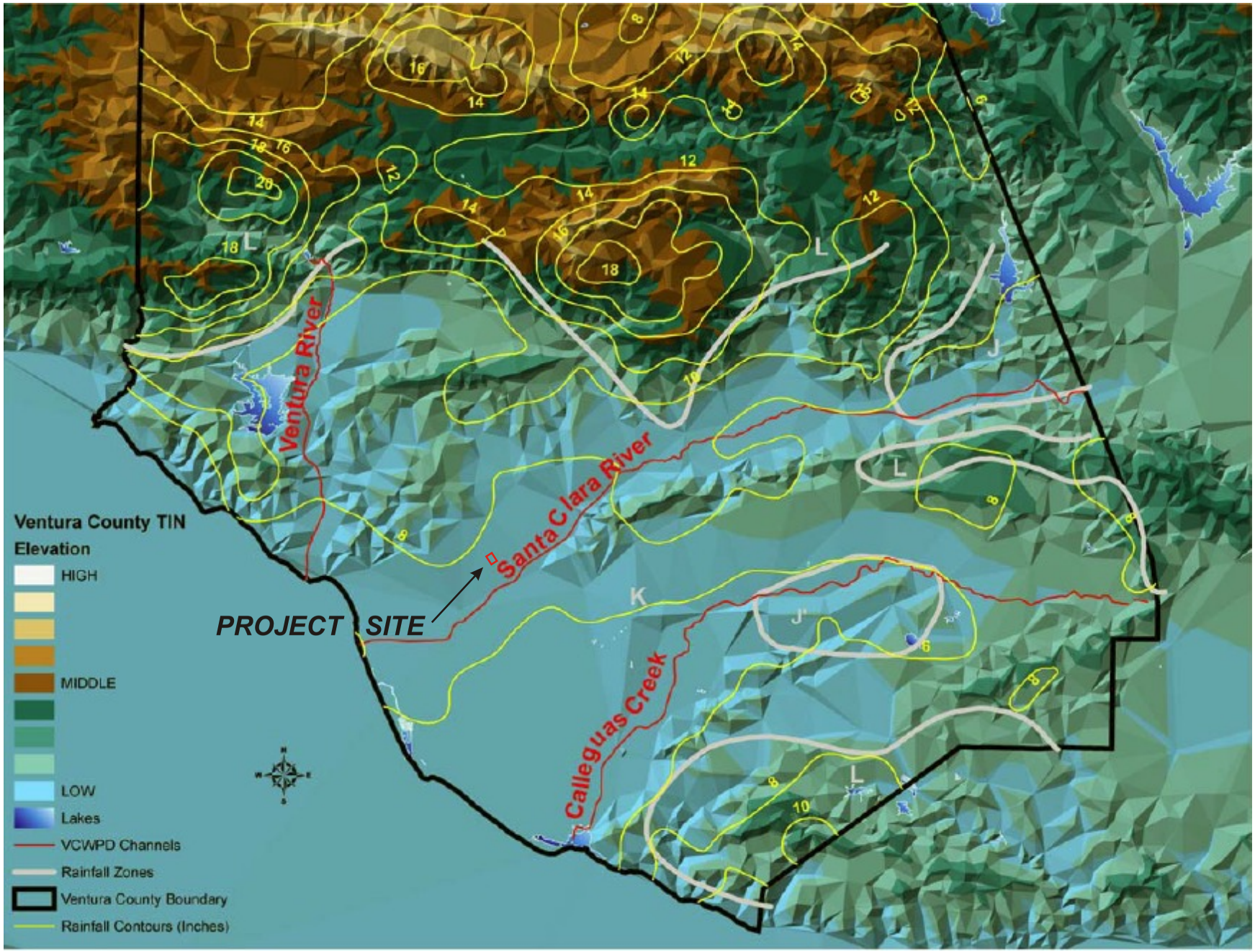


EXHIBIT 1B. DESIGN STORM RAINFALL CONTOURS- 50-YR STORM

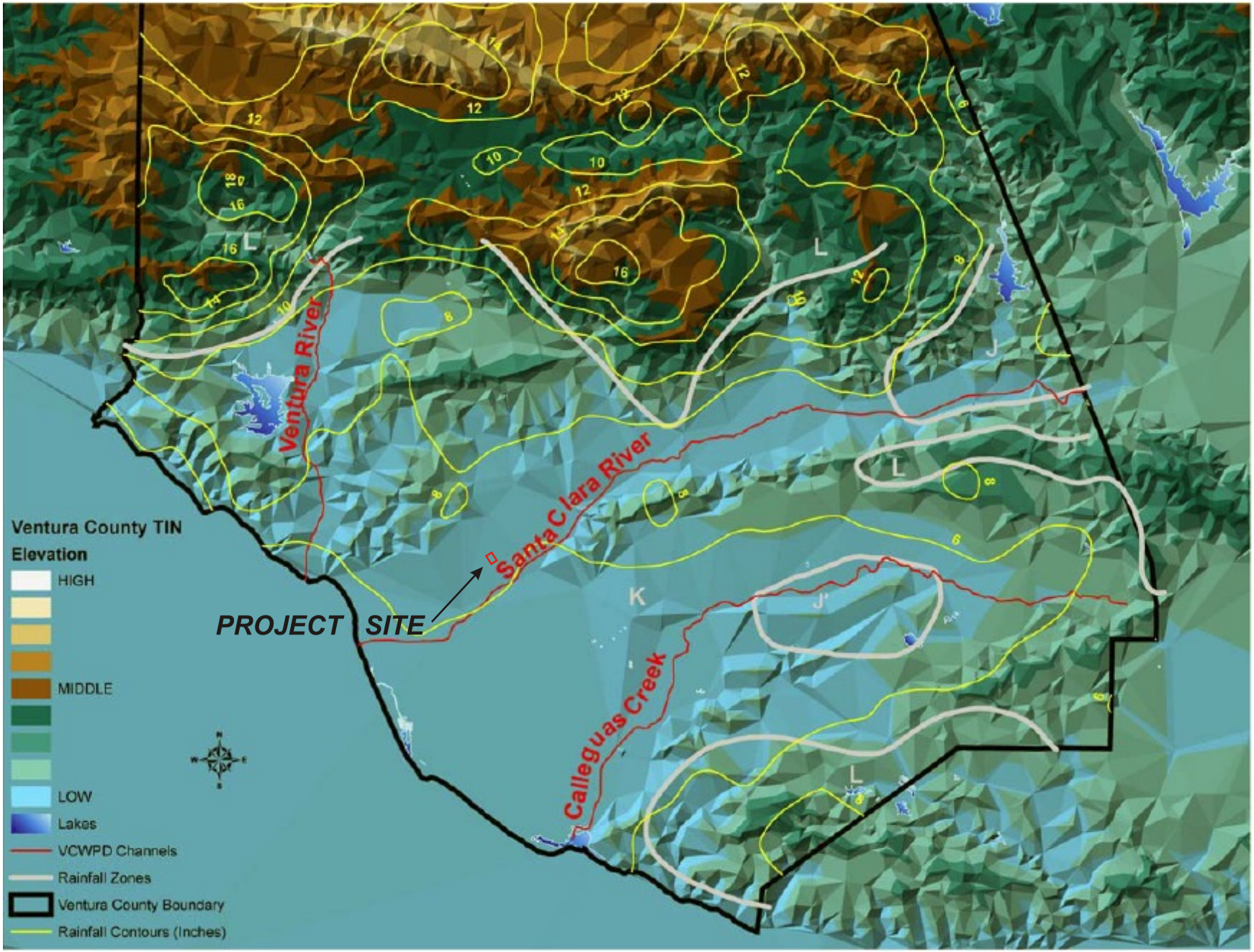


EXHIBIT 1C. DESIGN STORM RAINFALL CONTOURS- 25-YR STORM

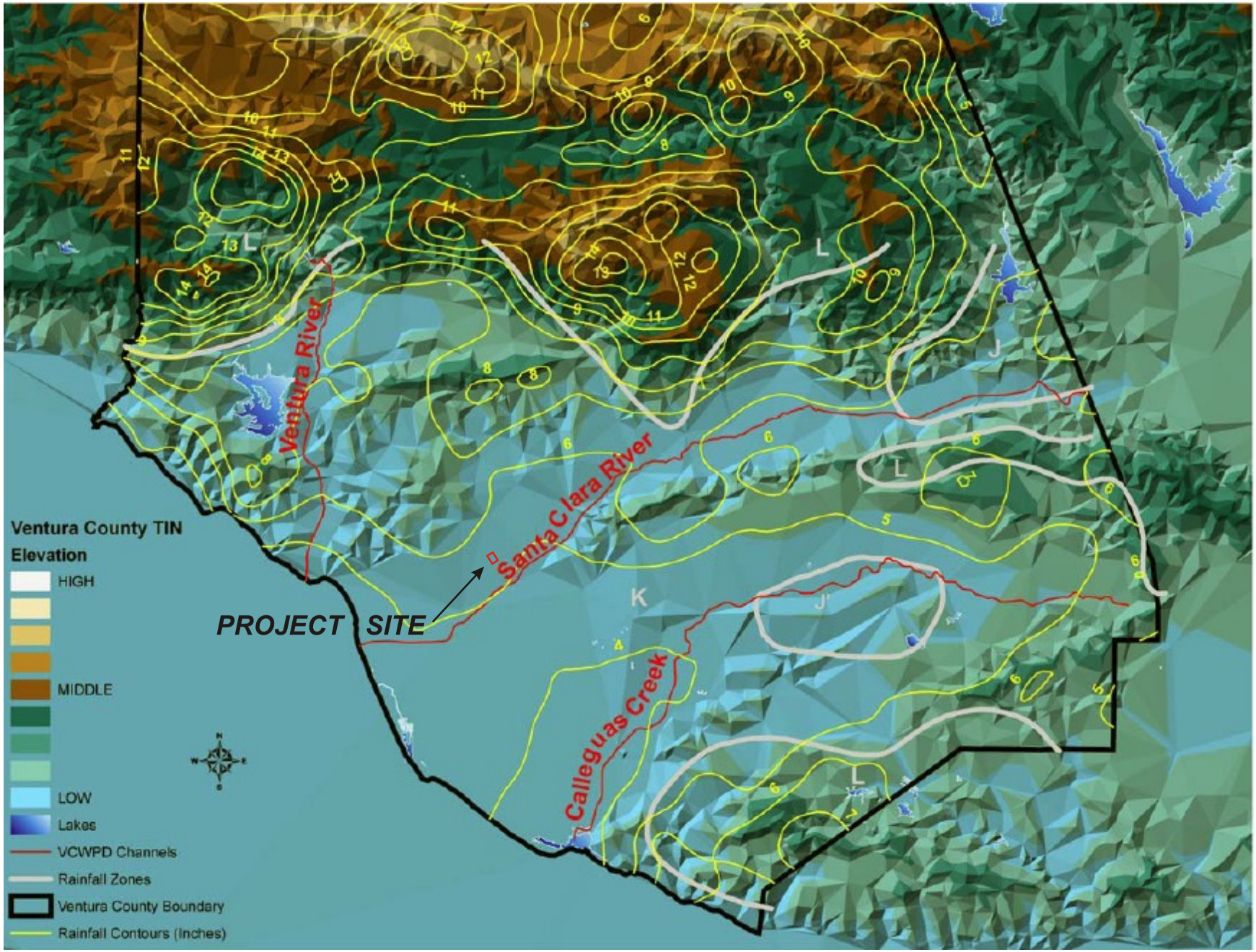


EXHIBIT 1D. DESIGN STORM RAINFALL CONTOURS- 10-YR STORM

A3

RUNOFF CURVE NUMBER TABLE

APPENDIX A **EXHIBITS**

EXHIBIT 14B. CURVE NUMBERS FOR DEVELOPED LAND USES- NRCS

DEVELOPED LAND USE DESCRIPTION	EFFECTIVE IMPERV %	AVERAGE IMPERV %	HYDROLOGIC SOIL GROUP A 7	A 6	B 5	B 4	C 3	C 2	D 1
OPEN SPACES, LAWNS, PARKS, GOLF COURSES, CEMETERIES, ETC., GRASS COVER ON 75% OR MORE	0	0	37	41	60	62	73	75	80
OPEN SPACES...ETC., GRASS COVER ON 50-75%	0	0	48	50	70	71	78	80	84
RESIDENTIAL 1 ACRE LOT	10	20	50	52	67	69	78	80	84
RESIDENTIAL 1/2 ACRE LOT	13	25	53	55	69	71	79	81	85
RESIDENTIAL 1/3 ACRE LOT	15	30	56	58	71	73	80	82	86
RESIDENTIAL 1/4 ACRE LOT	19	38	60	62	74	76	82	84	87
RESIDENTIAL 1/5 ACRE LOT	23	47	65	67	77	79	84	86	89
RESIDENTIAL 1/6 ACRE LOT	28	56	71	73	81	83	87	89	90
RESIDENTIAL 1/8 ACRE LOT	32	65	76	78	84	86	89	91	92
RESIDENTIAL - CONDOMINIUMS	37	69	78	80	86	88	89	92	93
INDUSTRIAL - UNPAVED YARDS, ETC.	36	72	80	82	87	89	90	92	93
COMMERCIAL & BUSINESS	50	85	88	90	91	93	93	95	95
INDUSTRIAL PARKS PAVED PARKING, ETC.	70	93	93	94	95	96	96	97	97
PARKING LOTS, ROOFS, DRIVEWAYS, PAVED STREETS WITH CURBS & DRAINS	90	100	98	98	98	98	98	98	98

NOTE: MODIFIED RATIONAL METHOD USES SOIL TYPES 1-7

Note: Percent effective impervious values apply only to SCS Unit Hydrograph Method

A4

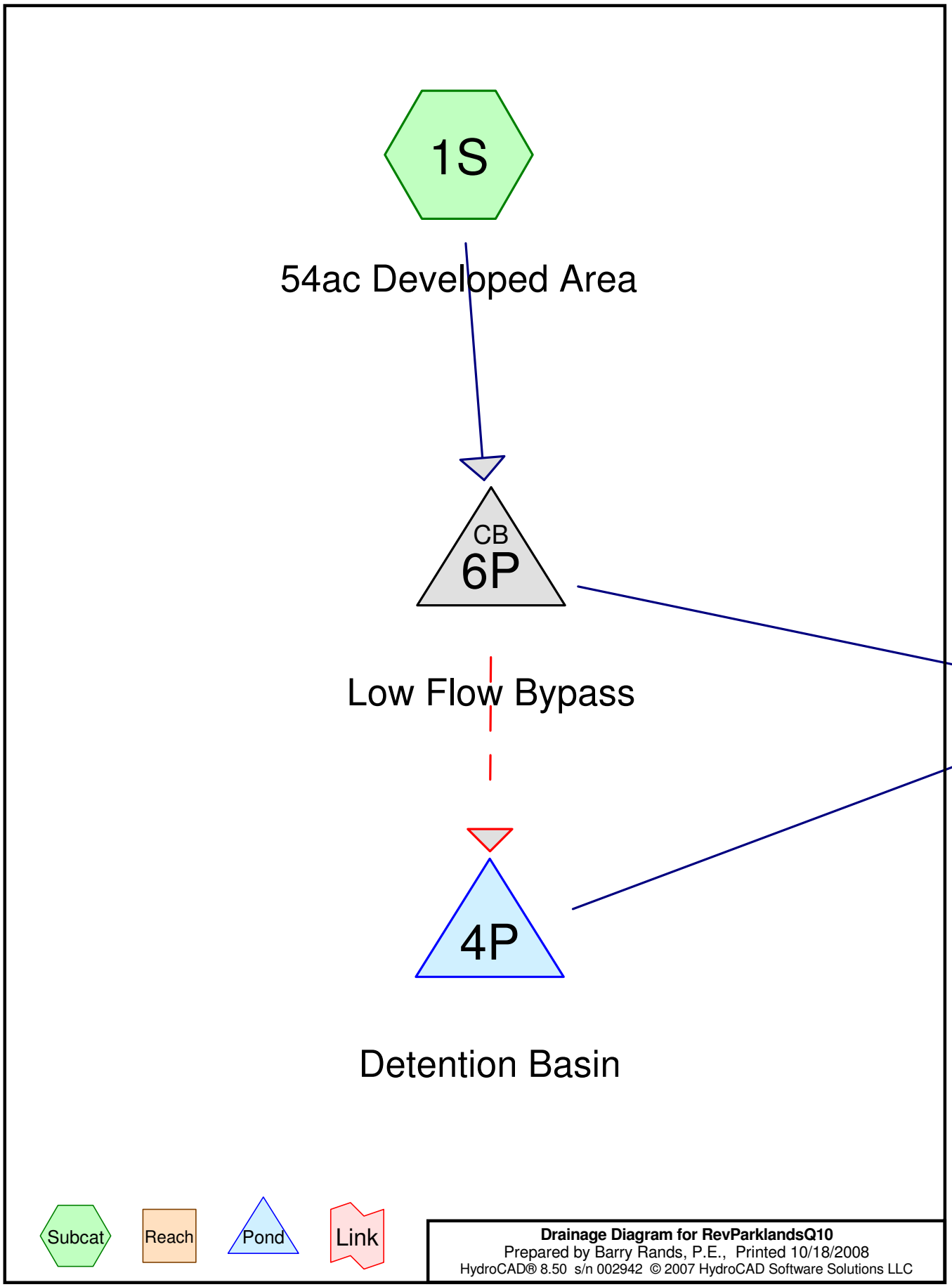
BYPASS DIVERSION STRUCTURE

Stage-Discharge for Pond 6P: Low Flow Bypass

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
182.00	0.00	0.00	0.00
182.10	0.06	0.06	0.00
182.20	0.25	0.25	0.00
182.30	0.55	0.55	0.00
182.40	0.96	0.96	0.00
182.50	1.48	1.48	0.00
182.60	2.09	2.09	0.00
182.70	2.79	2.79	0.00
182.80	3.57	3.57	0.00
182.90	4.43	4.43	0.00
183.00	5.35	5.35	0.00
183.10	6.32	6.32	0.00
183.20	7.34	7.34	0.00
183.30	8.39	8.39	0.00
183.40	9.46	9.46	0.00
183.50	10.54	10.54	0.00
183.60	11.60	11.60	0.00
183.70	12.63	12.63	0.00
183.80	13.60	13.60	0.00
183.90	14.47	14.47	0.00
184.00	15.13	15.13	0.00
184.10	15.87	15.87	0.00
184.20	16.57	16.57	0.00
184.30	17.25	17.25	0.00
184.40	17.90	17.90	0.00
184.50	18.53	18.53	0.00
184.60	19.13	19.13	0.00
184.70	19.72	19.72	0.00
184.80	20.29	20.29	0.00
184.90	20.85	20.85	0.00
185.00	21.39	21.39	0.00
185.10	22.75	21.92	0.83
185.20	24.78	22.44	2.35
185.30	27.26	22.94	4.32
185.40	30.09	23.43	6.66
185.50	33.24	23.92	9.32
185.60	36.66	24.39	12.27
185.70	40.34	24.86	15.48
185.80	44.25	25.31	18.94
185.90	48.39	25.76	22.63
186.00	52.75	26.20	26.55
186.10	57.30	26.63	30.67
186.20	62.05	27.06	34.99
186.30	66.98	27.48	39.50
186.40	72.10	27.89	44.20
186.50	77.39	28.30	49.09
186.60	82.84	28.70	54.14
186.70	88.47	29.10	59.37
186.80	94.25	29.49	64.76
186.90	100.19	29.87	70.31
187.00	106.28	30.25	76.02
187.10	112.52	30.63	81.89
187.20	118.91	31.00	87.90
187.30	125.44	31.37	94.07
187.40	132.11	31.73	100.38
187.50	138.91	32.09	106.83
187.60	145.86	32.44	113.41
187.70	152.93	32.79	120.14
187.80	160.14	33.14	127.00
187.90	167.48	33.48	133.99
188.00	174.94	33.82	141.12
188.10	182.53	34.16	148.37
188.20	190.24	34.49	155.74
188.30	198.07	34.82	163.25
188.40	206.02	35.15	170.87
188.50	214.09	35.48	178.61
188.60	222.27	35.80	186.47
188.70	230.57	36.11	194.45
188.80	238.98	36.43	202.55
188.90	247.50	36.74	210.75
189.00	256.12	37.05	219.07
189.10	264.86	37.36	227.50
189.20	273.71	37.67	236.04
189.30	282.65	37.97	244.69
189.40	291.71	38.27	253.44
189.50	300.86	38.57	262.29
189.60	310.11	38.86	271.25
189.70	319.47	39.15	280.31
189.80	328.92	39.45	289.48
189.90	338.47	39.73	298.74
190.00	348.11	40.02	308.09
190.10	357.85	40.31	317.55
190.20	367.68	40.59	327.10
190.30	377.61	40.87	336.74
190.40	387.62	41.15	346.47
190.50	397.73	41.43	356.30
190.60	407.92	41.70	366.22
190.70	418.19	41.97	376.22
190.80	428.56	42.25	386.31
190.90	439.01	42.52	396.49
191.00	**449.54**	**42.78**	**406.75**

A5

HYDROCAD DETENTION REPORT


1S
54ac Developed Area
CB
6P
Low Flow Bypass
4P
Detention Basin
Subcat
Reach
Pond
Link
Drainage Diagram for RevParklandsQ10
Prepared by Barry Rands, P.E., Printed 10/18/2008
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
54.000	89	1/8 acre lots, 65% imp, HSG C (1S)
54.000		**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
54.000	HSG C	1S
0.000	HSG D	
0.000	Other	
54.000		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: 54ac Developed Area Runoff Area=54.000 ac 65.00% Impervious Runoff Depth>4.23"
Tc=24.5 min CN=89 Runoff=119.57 cfs 19.022 af

Pond 4P: Detention Basin Peak Elev=184.91' Storage=2.235 af Inflow=88.53 cfs 3.722 af
Outflow=32.88 cfs 3.698 af

Pond 6P: Low Flow Bypass Peak Elev=187.21' Inflow=119.57 cfs 19.022 af
Primary=31.04 cfs 15.300 af Secondary=88.53 cfs 3.722 af Outflow=119.57 cfs 19.022 af

Total Runoff Area = 54.000 ac Runoff Volume = 19.022 af Average Runoff Depth = 4.23"
35.00% Pervious = 18.900 ac 65.00% Impervious = 35.100 ac

Summary for Subcatchment 1S: 54ac Developed Area

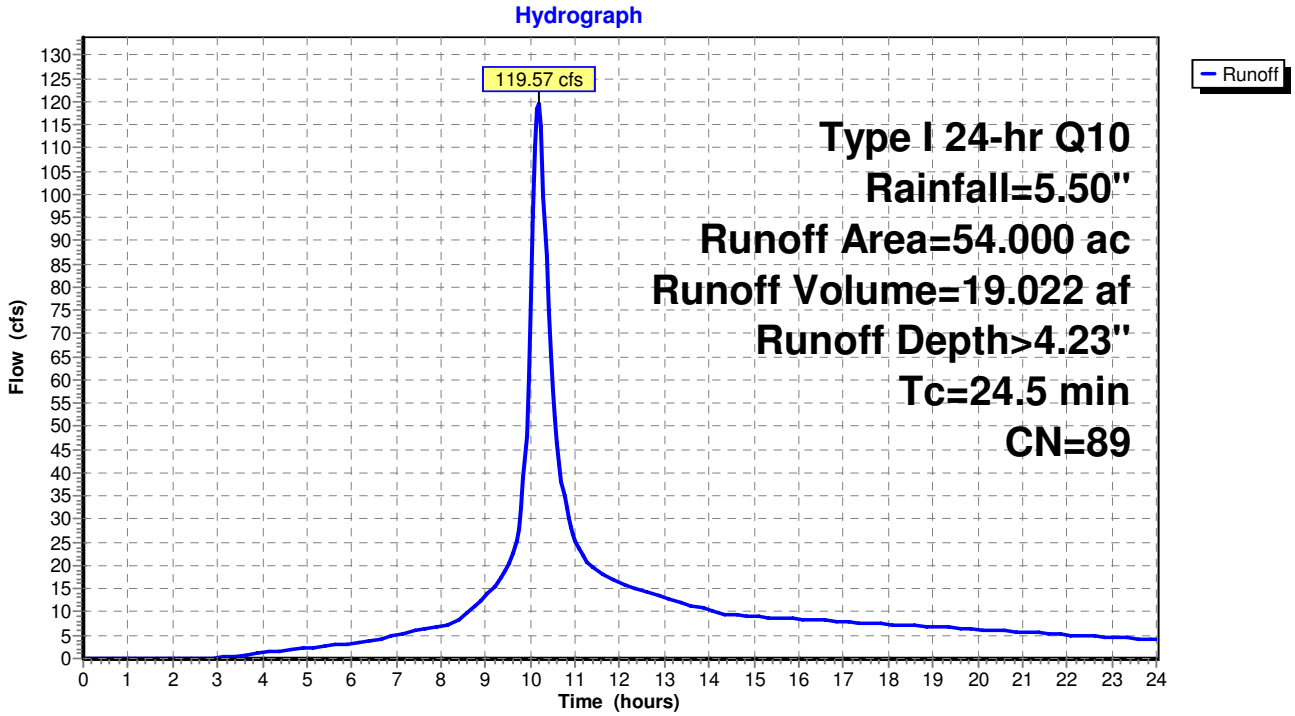
Runoff = 119.57 cfs @ 10.17 hrs, Volume= 19.022 af, Depth> 4.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Q10 Rainfall=5.50"

Area (ac)	CN	Description
54.000	89	1/8 acre lots, 65% imp, HSG C
18.900		Pervious Area
35.100		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.5					**Direct Entry,**

Subcatchment 1S: 54ac Developed Area



Summary for Pond 4P: Detention Basin

Inflow	=	88.53 cfs @	10.17 hrs,	Volume=	3.722 af
Outflow	=	32.88 cfs @	10.49 hrs,	Volume=	3.698 af, Atten= 63%, Lag= 19.0 min
Primary	=	32.88 cfs @	10.49 hrs,	Volume=	3.698 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 184.91' @ 10.49 hrs Surf.Area= 0.897 ac Storage= 2.235 af

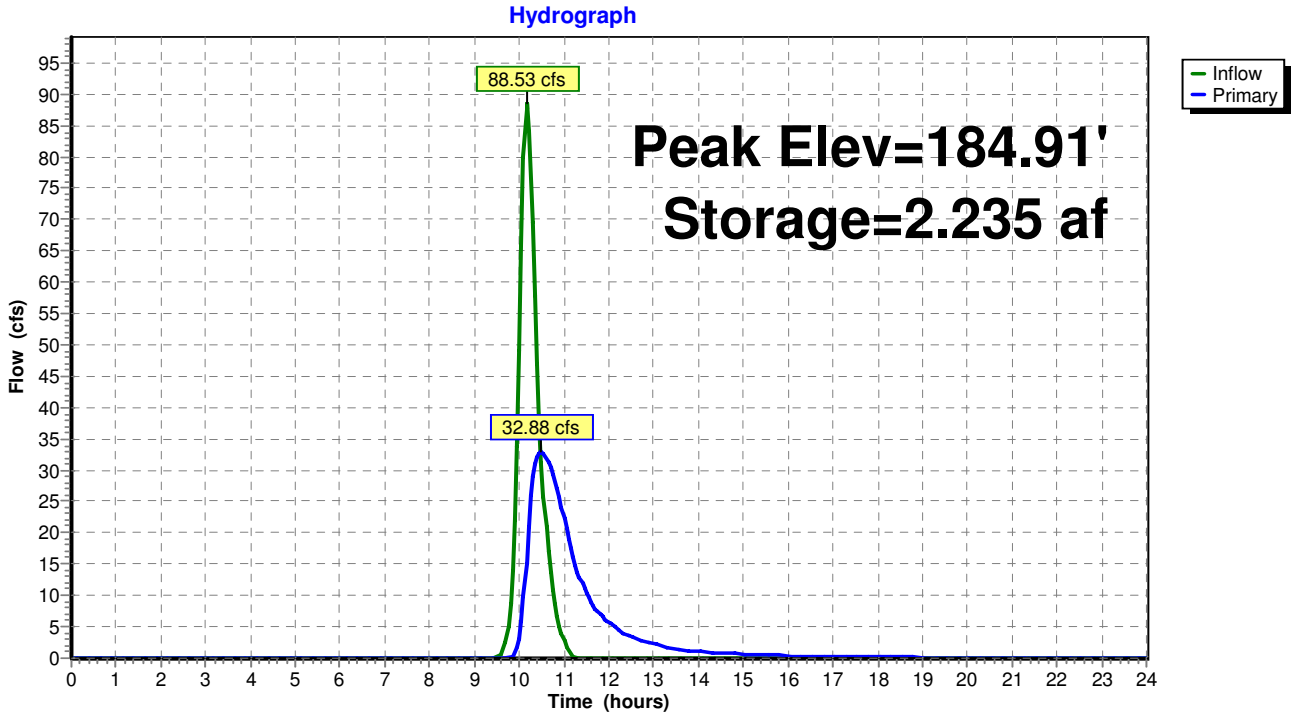
Plug-Flow detention time= 65.0 min calculated for 3.698 af (99% of inflow)
Center-of-Mass det. time= 64.7 min (679.9 - 615.2)

Volume	Invert	Avail.Storage	Storage Description
#1	182.00'	1.251 af	**148.00'W x 264.00'L x 7.00'H Prismatoid**
			6.279 af Overall - 3.152 af Embedded = 3.126 af x 40.0% Voids
#2	182.00'	2.744 af	**96.8"W x 58.0"H x 8.00'L CONSTORM 54** x 594 Inside #1
		3.994 af	Total Available Storage

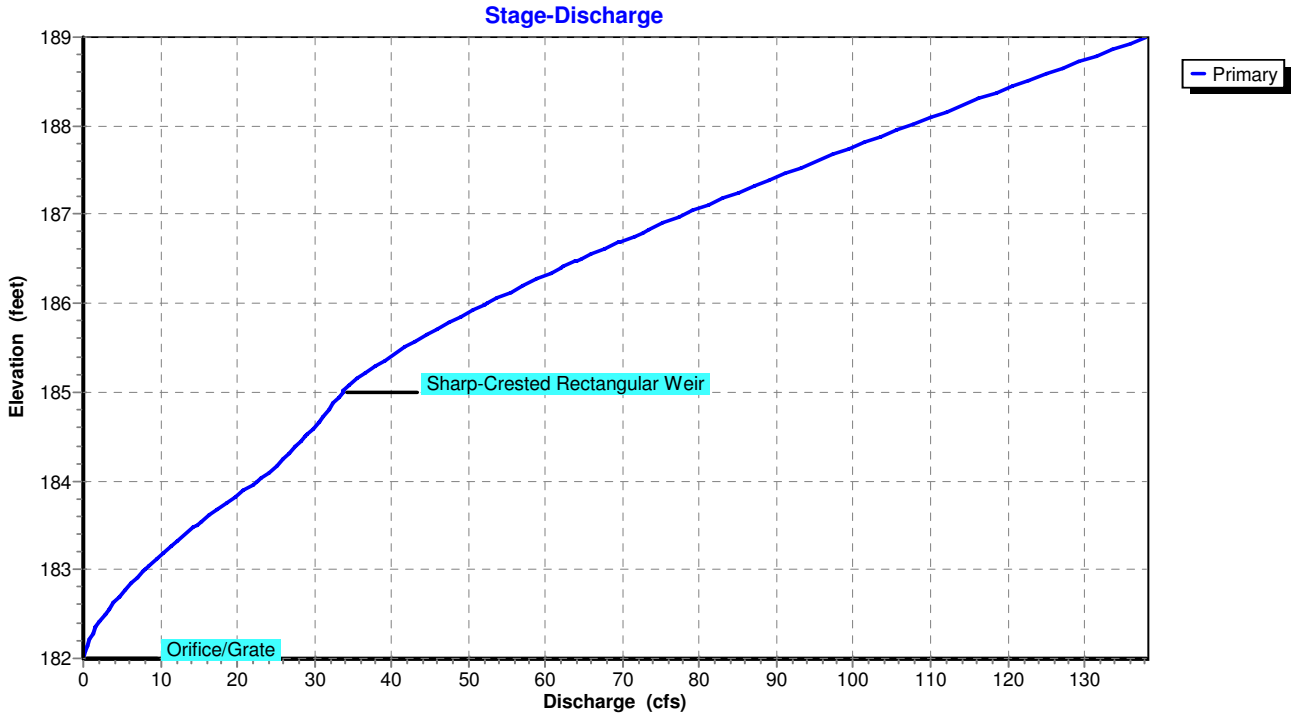
Device	Routing	Invert	Outlet Devices
#1	Primary	182.00'	**2.50' W x 2.00' H Vert. Orifice/Grate** C= 0.600
#2	Primary	185.00'	**3.4' long x 4.00' rise Sharp-Crested Rectangular Weir**
			2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=32.85 cfs @ 10.49 hrs HW=184.91' TW=181.36' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 32.85 cfs @ 6.57 fps)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Detention Basin



Pond 4P: Detention Basin



Summary for Pond 6P: Low Flow Bypass

[57] Hint: Peaked at 187.21' (Flood elevation advised)

Inflow Area =	54.000 ac,	65.00% Impervious,	Inflow Depth >	4.23"	for Q10 event
Inflow =	119.57 cfs @	10.17 hrs,	Volume=	19.022 af	
Outflow =	119.57 cfs @	10.17 hrs,	Volume=	19.022 af,	Atten= 0%, Lag= 0.0 min
Primary =	31.04 cfs @	10.17 hrs,	Volume=	15.300 af	
Secondary =	88.53 cfs @	10.17 hrs,	Volume=	3.722 af	

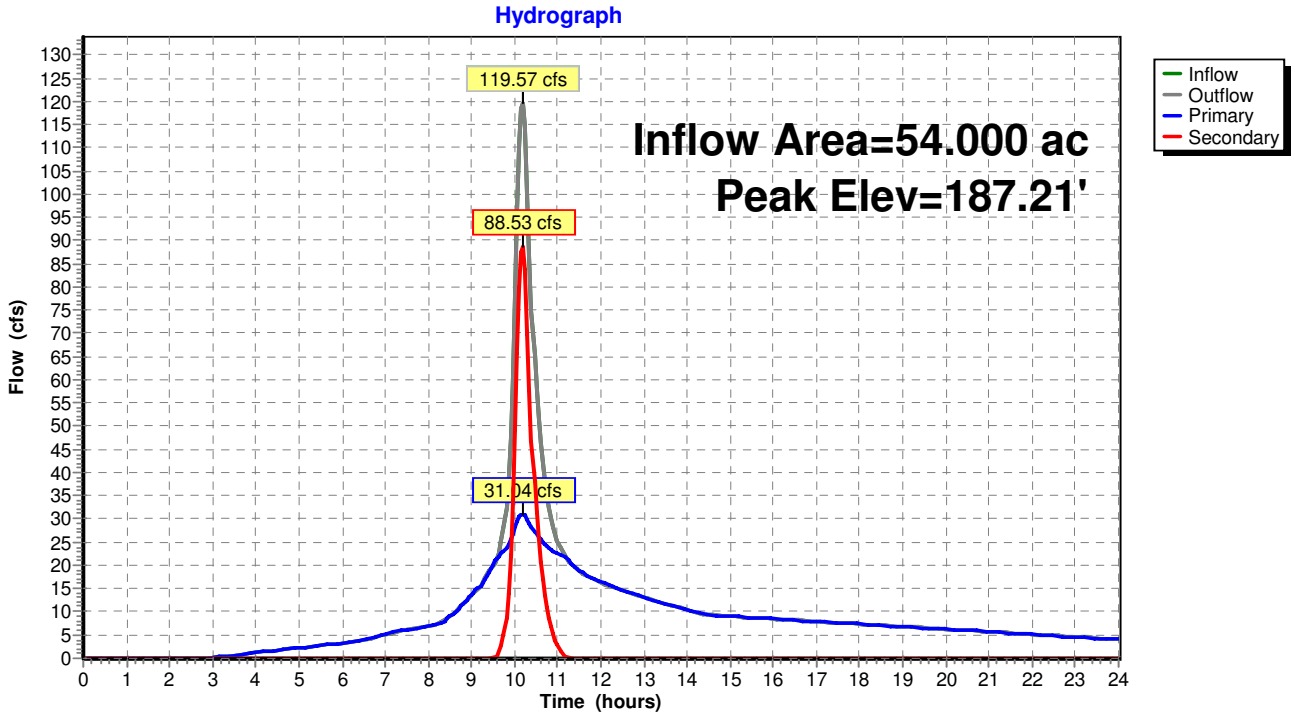
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 187.21' @ 10.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	185.00'	**8.0' long x 6.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#2	Primary	182.00'	**24.0" Vert. Orifice/Grate** C= 0.600

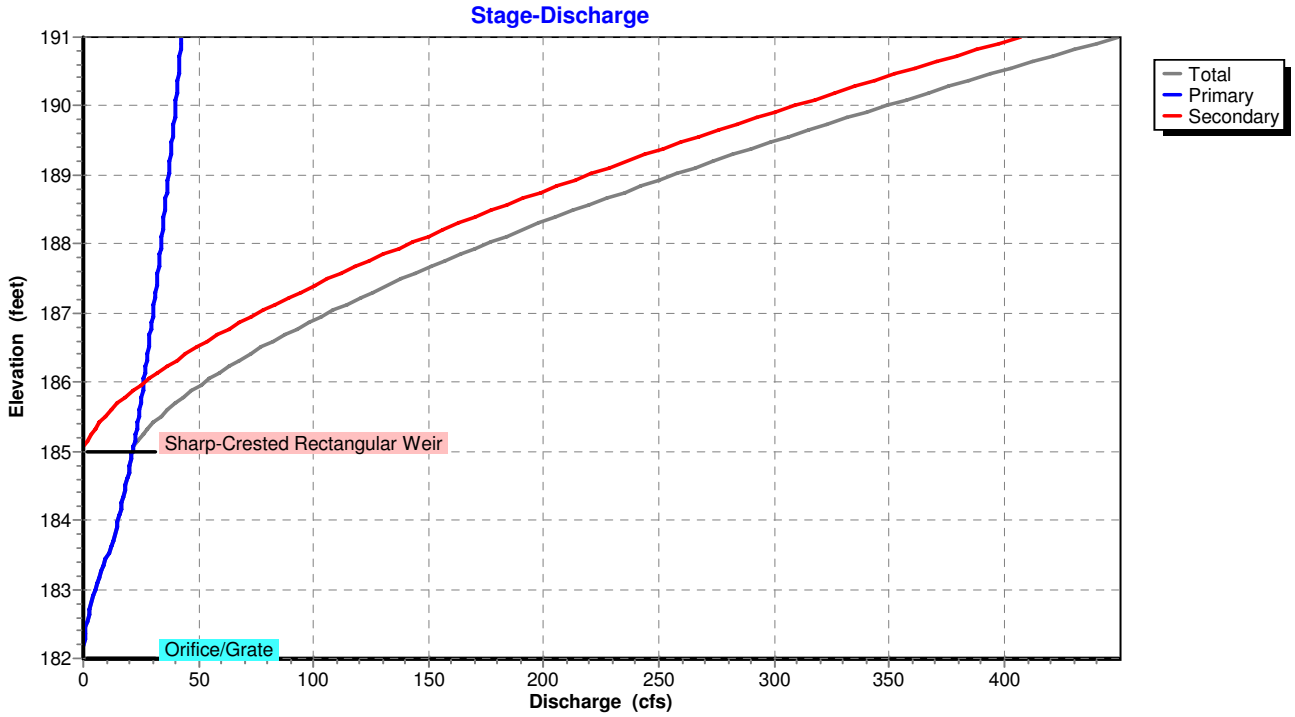
Primary OutFlow Max=30.98 cfs @ 10.17 hrs HW=187.19' TW=181.31' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Orifice Controls 30.98 cfs @ 9.86 fps)

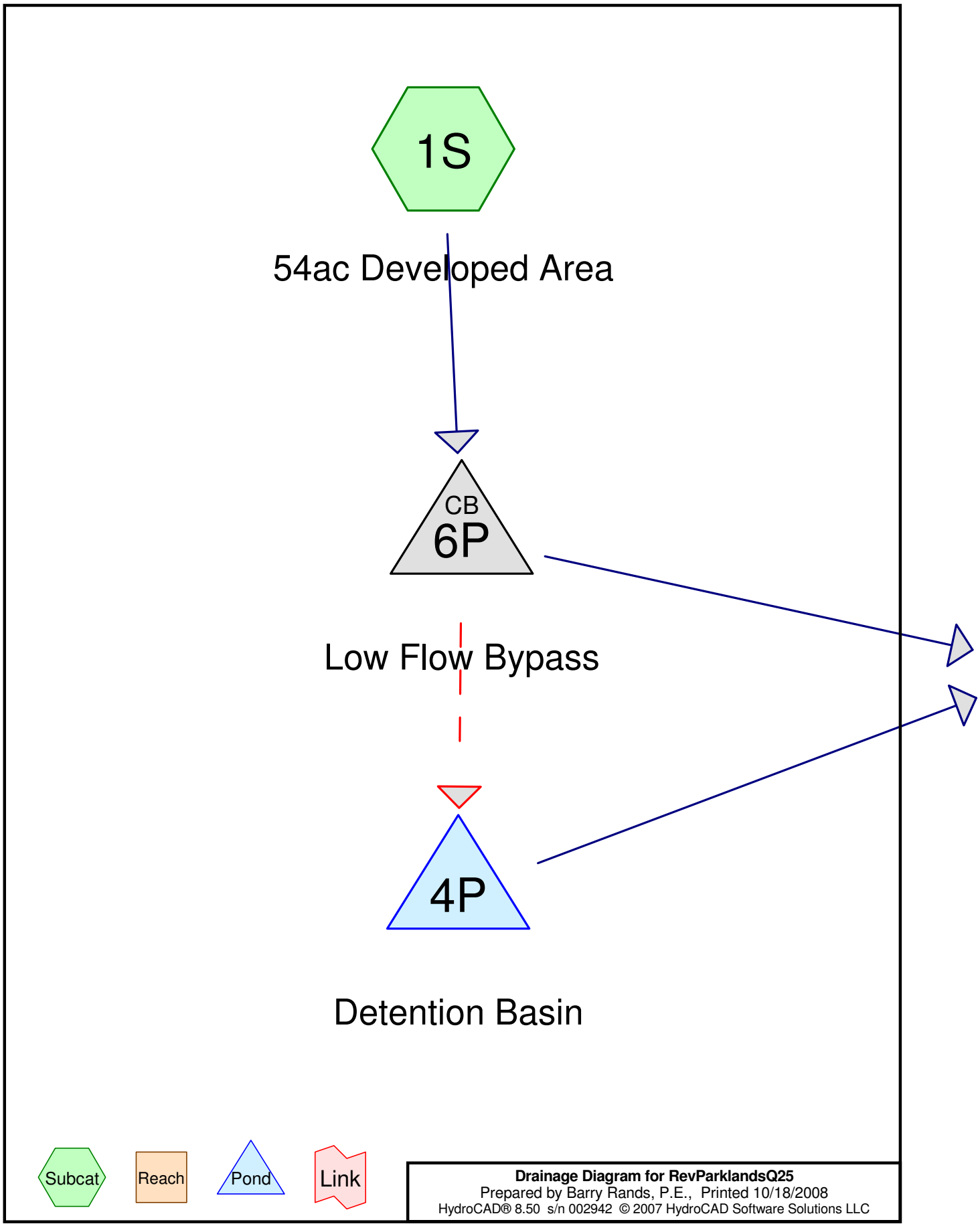
Secondary OutFlow Max=87.53 cfs @ 10.17 hrs HW=187.19' TW=183.70' (Dynamic Tailwater)
└─**1=Sharp-Crested Rectangular Weir** (Weir Controls 87.53 cfs @ 5.28 fps)

Pond 6P: Low Flow Bypass



Pond 6P: Low Flow Bypass





Drainage Diagram for RevParklandsQ25
Prepared by Barry Rands, P.E., Printed 10/18/2008
HydroCAD® 8.50 s/n 002942 © 2007 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
54.000	89	1/8 acre lots, 65% imp, HSG C (1S)
54.000		**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
54.000	HSG C	1S
0.000	HSG D	
0.000	Other	
54.000		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: 54ac Developed Area Runoff Area=54.000 ac 65.00% Impervious Runoff Depth>5.28"
Tc=29.5 min CN=89 Runoff=135.01 cfs 23.763 af

Pond 4P: Detention Basin Peak Elev=185.87' Storage=2.833 af Inflow=103.12 cfs 5.376 af
Outflow=49.50 cfs 5.351 af

Pond 6P: Low Flow Bypass Peak Elev=187.44' Inflow=135.01 cfs 23.763 af
Primary=31.88 cfs 18.387 af Secondary=103.12 cfs 5.376 af Outflow=135.01 cfs 23.763 af

Total Runoff Area = 54.000 ac Runoff Volume = 23.763 af Average Runoff Depth = 5.28"
35.00% Pervious = 18.900 ac 65.00% Impervious = 35.100 ac

Summary for Subcatchment 1S: 54ac Developed Area

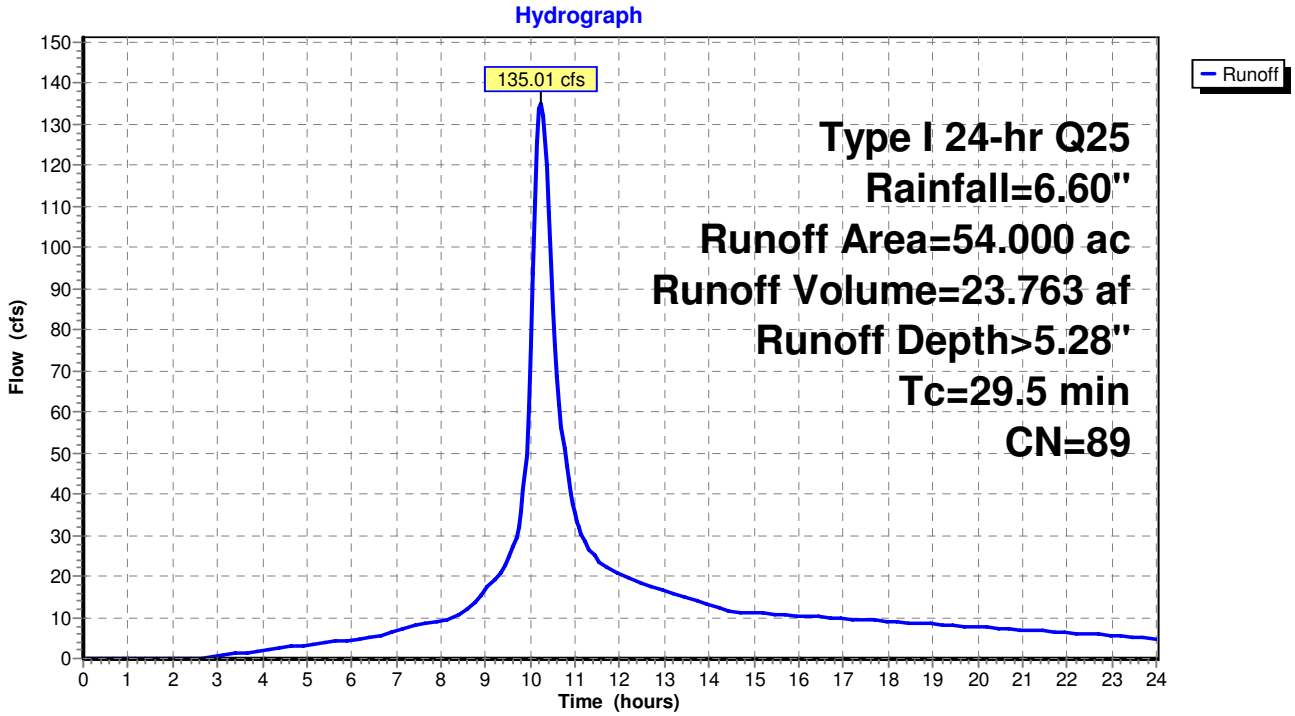
Runoff = 135.01 cfs @ 10.23 hrs, Volume= 23.763 af, Depth> 5.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Q25 Rainfall=6.60"

Area (ac)	CN	Description
54.000	89	1/8 acre lots, 65% imp, HSG C
18.900		Pervious Area
35.100		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.5					**Direct Entry,**

Subcatchment 1S: 54ac Developed Area



Summary for Pond 4P: Detention Basin

Inflow	=	103.12 cfs @	10.23 hrs,	Volume=	5.376 af
Outflow	=	49.50 cfs @	10.54 hrs,	Volume=	5.351 af, Atten= 52%, Lag= 18.5 min
Primary	=	49.50 cfs @	10.54 hrs,	Volume=	5.351 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 185.87' @ 10.54 hrs Surf.Area= 0.897 ac Storage= 2.833 af

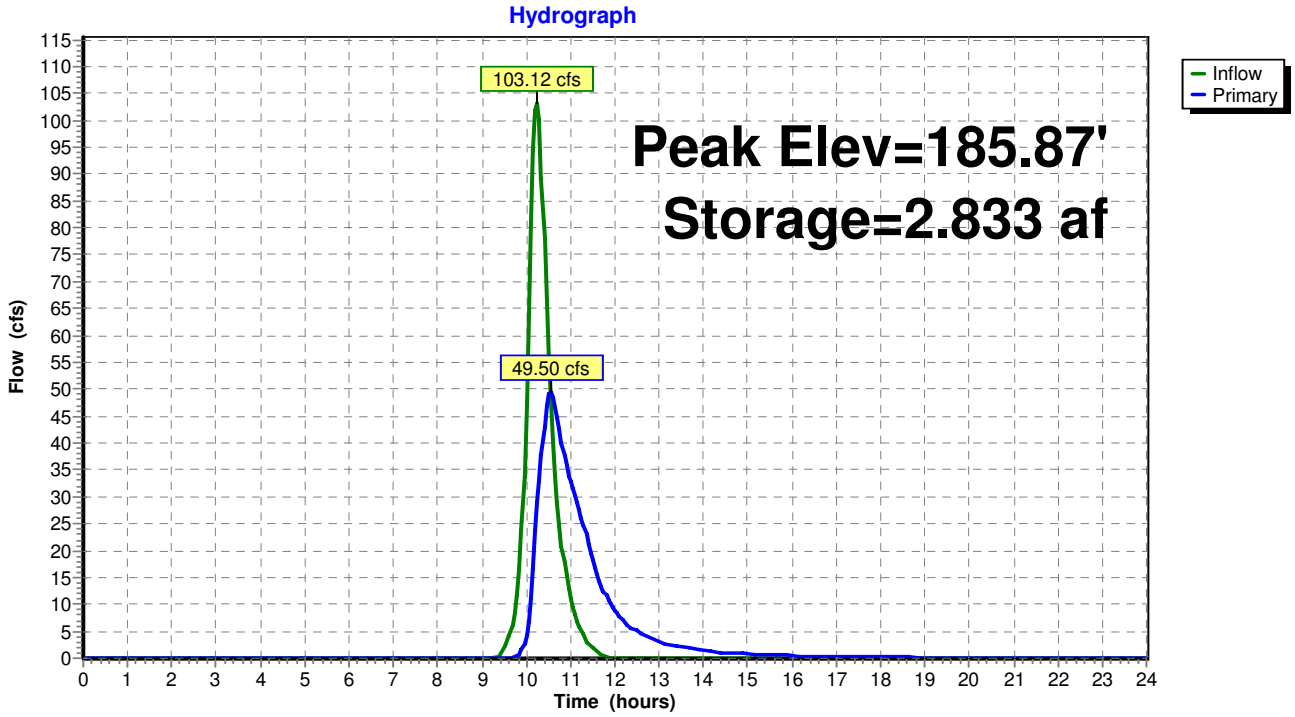
Plug-Flow detention time= 57.0 min calculated for 5.340 af (99% of inflow)
Center-of-Mass det. time= 57.9 min (678.6 - 620.7)

Volume	Invert	Avail.Storage	Storage Description
#1	182.00'	1.251 af	**148.00'W x 264.00'L x 7.00'H Prismatoid**
			6.279 af Overall - 3.152 af Embedded = 3.126 af x 40.0% Voids
#2	182.00'	2.744 af	**96.8"W x 58.0"H x 8.00'L CONSTORM 54** x 594 Inside #1
		3.994 af	Total Available Storage

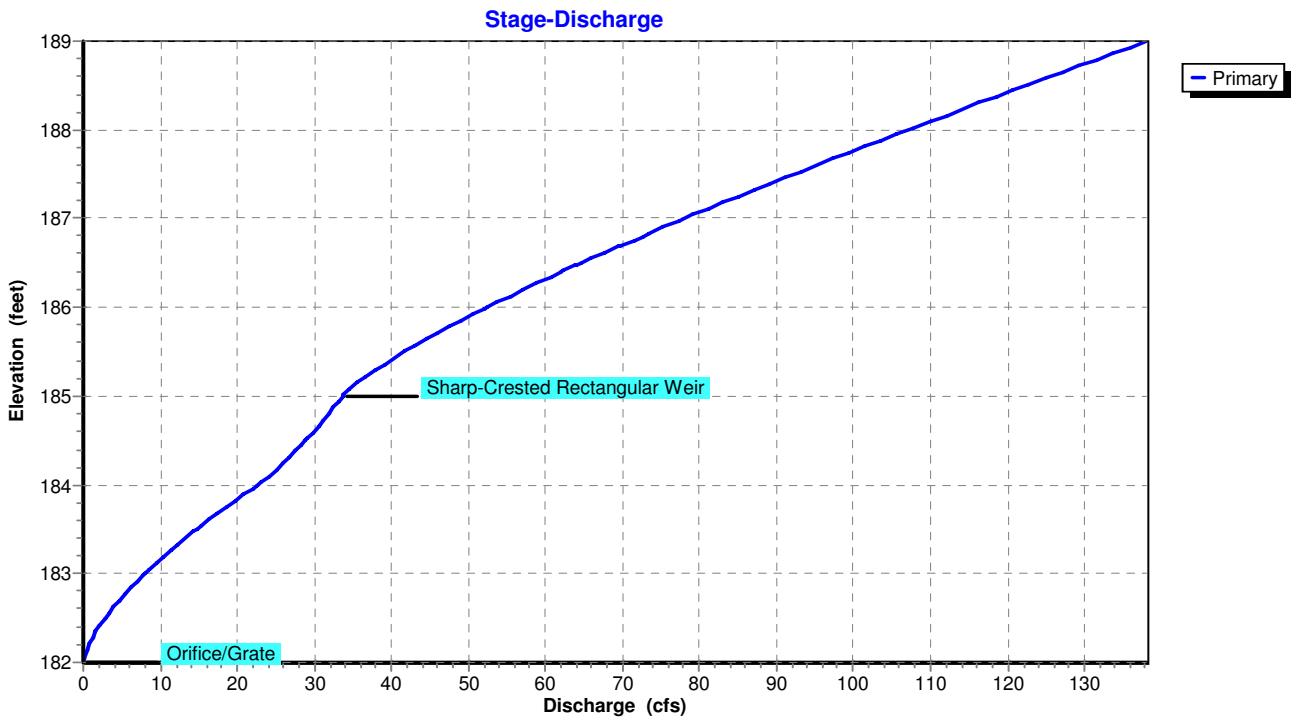
Device	Routing	Invert	Outlet Devices
#1	Primary	182.00'	**2.50' W x 2.00' H Vert. Orifice/Grate** C= 0.600
#2	Primary	185.00'	**3.4' long x 4.00' rise Sharp-Crested Rectangular Weir**
			2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=49.40 cfs @ 10.54 hrs HW=185.87' TW=181.43' (Dynamic Tailwater)
- **1=Orifice/Grate** (Orifice Controls 40.56 cfs @ 8.11 fps)
- **2=Sharp-Crested Rectangular Weir** (Weir Controls 8.84 cfs @ 3.16 fps)

Pond 4P: Detention Basin



Pond 4P: Detention Basin



Summary for Pond 6P: Low Flow Bypass

[57] Hint: Peaked at 187.44' (Flood elevation advised)

Inflow Area =	54.000 ac,	65.00% Impervious,	Inflow Depth >	5.28"	for Q25 event
Inflow =	135.01 cfs @	10.23 hrs,	Volume=	23.763 af	
Outflow =	135.01 cfs @	10.23 hrs,	Volume=	23.763 af,	Atten= 0%, Lag= 0.0 min
Primary =	31.88 cfs @	10.23 hrs,	Volume=	18.387 af	
Secondary =	103.12 cfs @	10.23 hrs,	Volume=	5.376 af	

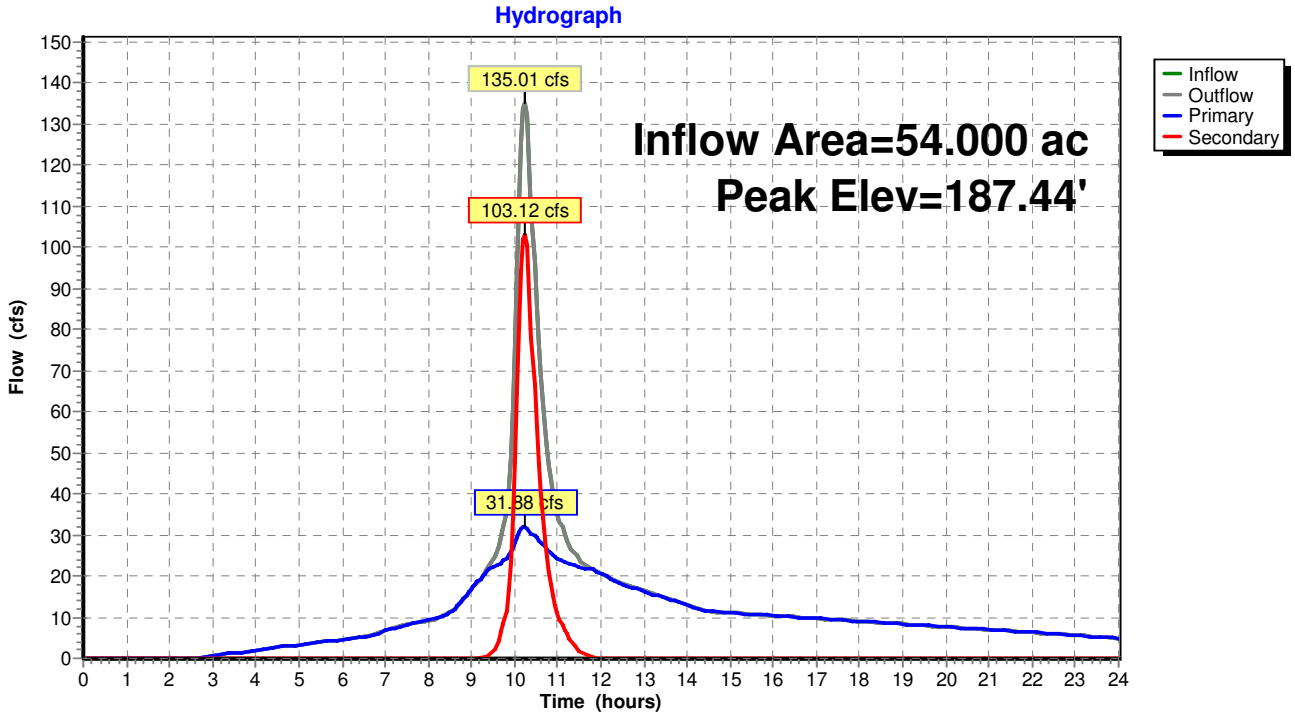
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 187.44' @ 10.23 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	185.00'	**8.0' long x 6.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#2	Primary	182.00'	**24.0" Vert. Orifice/Grate** C= 0.600

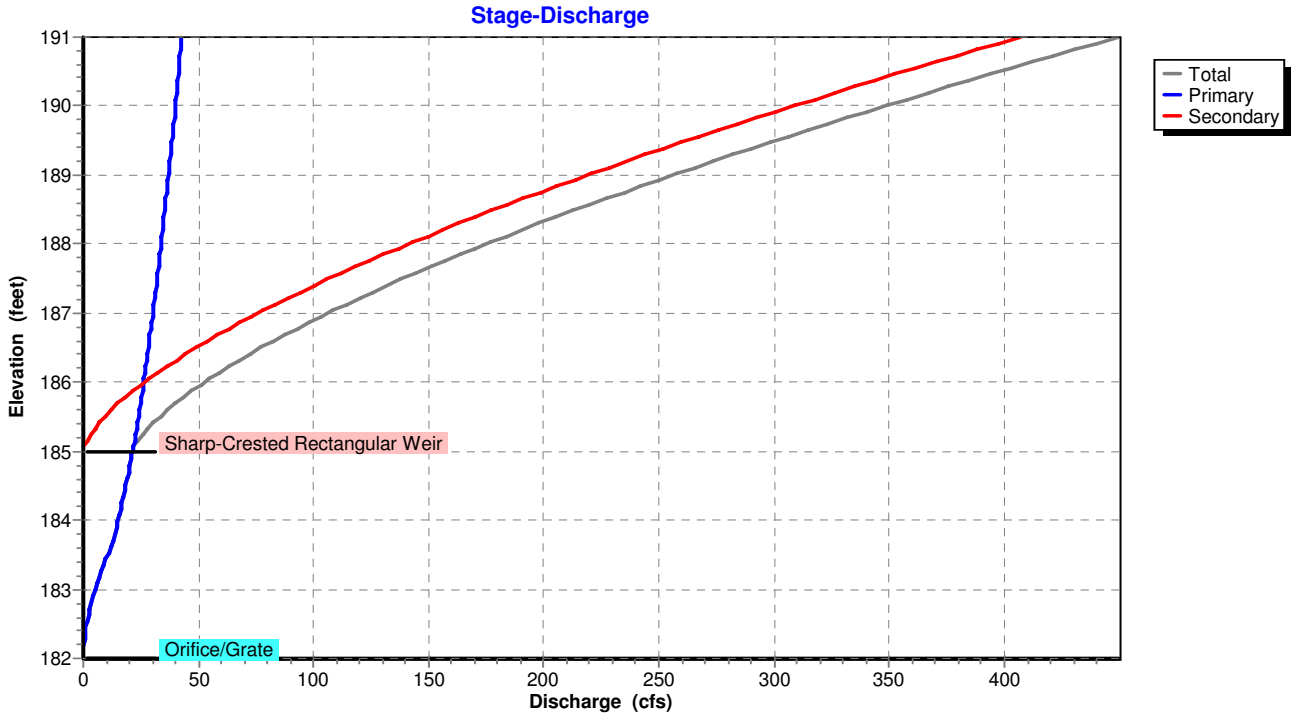
Primary OutFlow Max=31.85 cfs @ 10.23 hrs HW=187.43' TW=181.35' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Orifice Controls 31.85 cfs @ 10.14 fps)

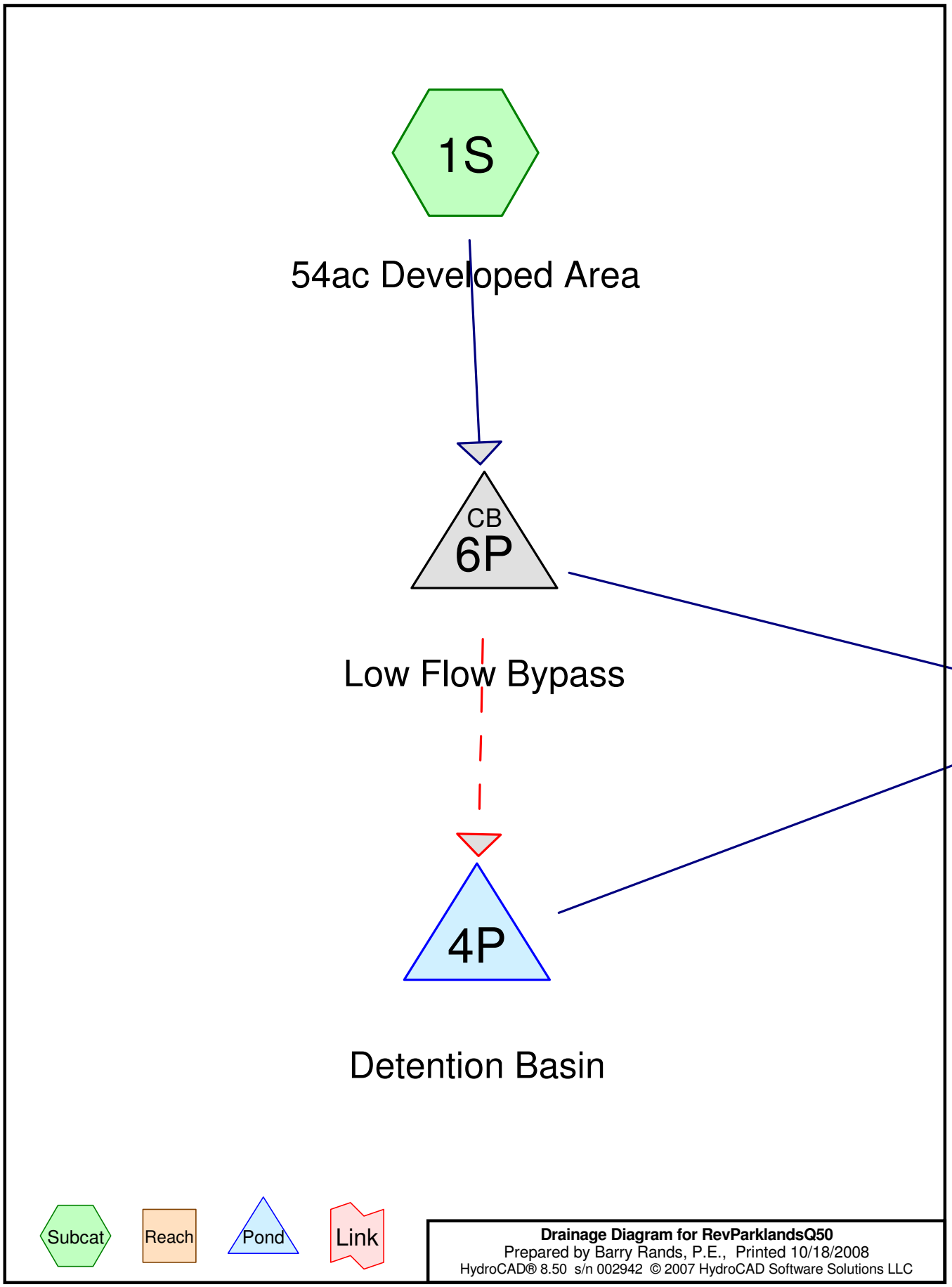
Secondary OutFlow Max=102.46 cfs @ 10.23 hrs HW=187.43' TW=184.34' (Dynamic Tailwater)
└─**1=Sharp-Crested Rectangular Weir** (Weir Controls 102.46 cfs @ 5.61 fps)

Pond 6P: Low Flow Bypass



Pond 6P: Low Flow Bypass





Drainage Diagram for RevParklandsQ50
Prepared by Barry Rands, P.E., Printed 10/18/2008
HydroCAD® 8.50 s/n 002942 © 2007 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
54.000	89	1/8 acre lots, 65% imp, HSG C (1S)
54.000		**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
54.000	HSG C	1S
0.000	HSG D	
0.000	Other	
54.000		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: 54ac Developed Area Runoff Area=54.000 ac 65.00% Impervious Runoff Depth>6.16"
Tc=27.5 min CN=89 Runoff=162.71 cfs 27.707 af

Pond 4P: Detention Basin Peak Elev=186.96' Storage=3.263 af Inflow=129.45 cfs 6.929 af
Outflow=76.97 cfs 6.904 af

Pond 6P: Low Flow Bypass Peak Elev=187.84' Inflow=162.71 cfs 27.707 af
Primary=33.26 cfs 20.778 af Secondary=129.45 cfs 6.929 af Outflow=162.71 cfs 27.707 af

Total Runoff Area = 54.000 ac Runoff Volume = 27.707 af Average Runoff Depth = 6.16"
35.00% Pervious = 18.900 ac 65.00% Impervious = 35.100 ac

Summary for Subcatchment 1S: 54ac Developed Area

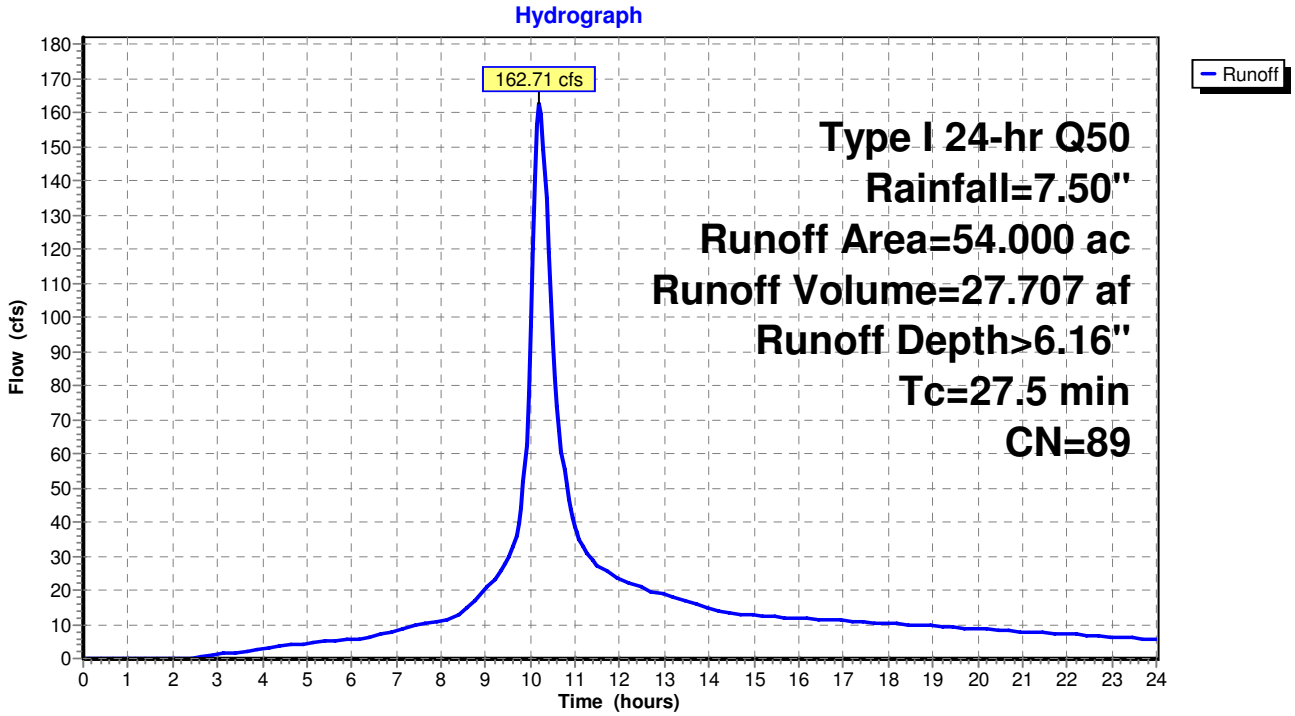
Runoff = 162.71 cfs @ 10.21 hrs, Volume= 27.707 af, Depth> 6.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Q50 Rainfall=7.50"

Area (ac)	CN	Description
54.000	89	1/8 acre lots, 65% imp, HSG C
18.900		Pervious Area
35.100		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.5					**Direct Entry,**

Subcatchment 1S: 54ac Developed Area



Summary for Pond 4P: Detention Basin

Inflow	=	129.45 cfs @	10.21 hrs,	Volume=	6.929 af
Outflow	=	76.97 cfs @	10.44 hrs,	Volume=	6.904 af, Atten= 41%, Lag= 13.9 min
Primary	=	76.97 cfs @	10.44 hrs,	Volume=	6.904 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 186.96' @ 10.44 hrs Surf.Area= 0.897 ac Storage= 3.263 af

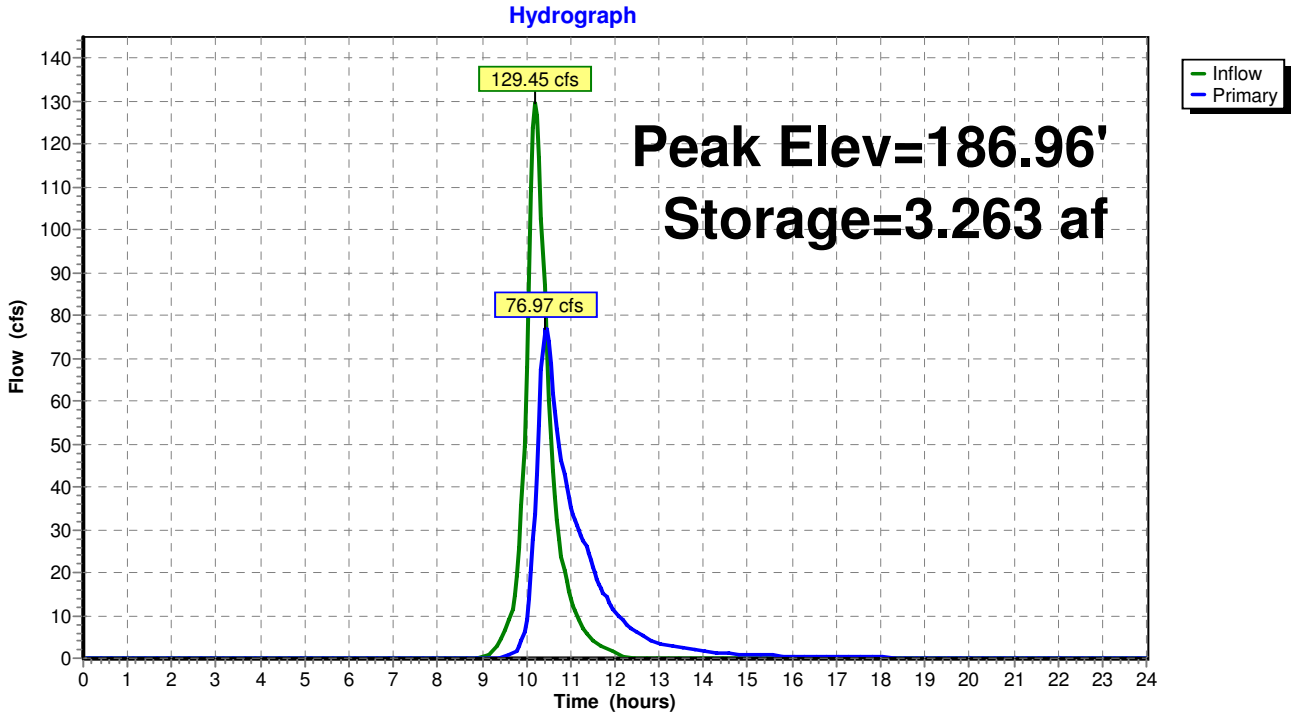
Plug-Flow detention time= 52.2 min calculated for 6.904 af (100% of inflow)
Center-of-Mass det. time= 51.8 min (671.9 - 620.0)

Volume	Invert	Avail.Storage	Storage Description
#1	182.00'	1.251 af	**148.00'W x 264.00'L x 7.00'H Prismatoid**
			6.279 af Overall - 3.152 af Embedded = 3.126 af x 40.0% Voids
#2	182.00'	2.744 af	**96.8"W x 58.0"H x 8.00'L CONSTORM 54** x 594 Inside #1
		3.994 af	Total Available Storage

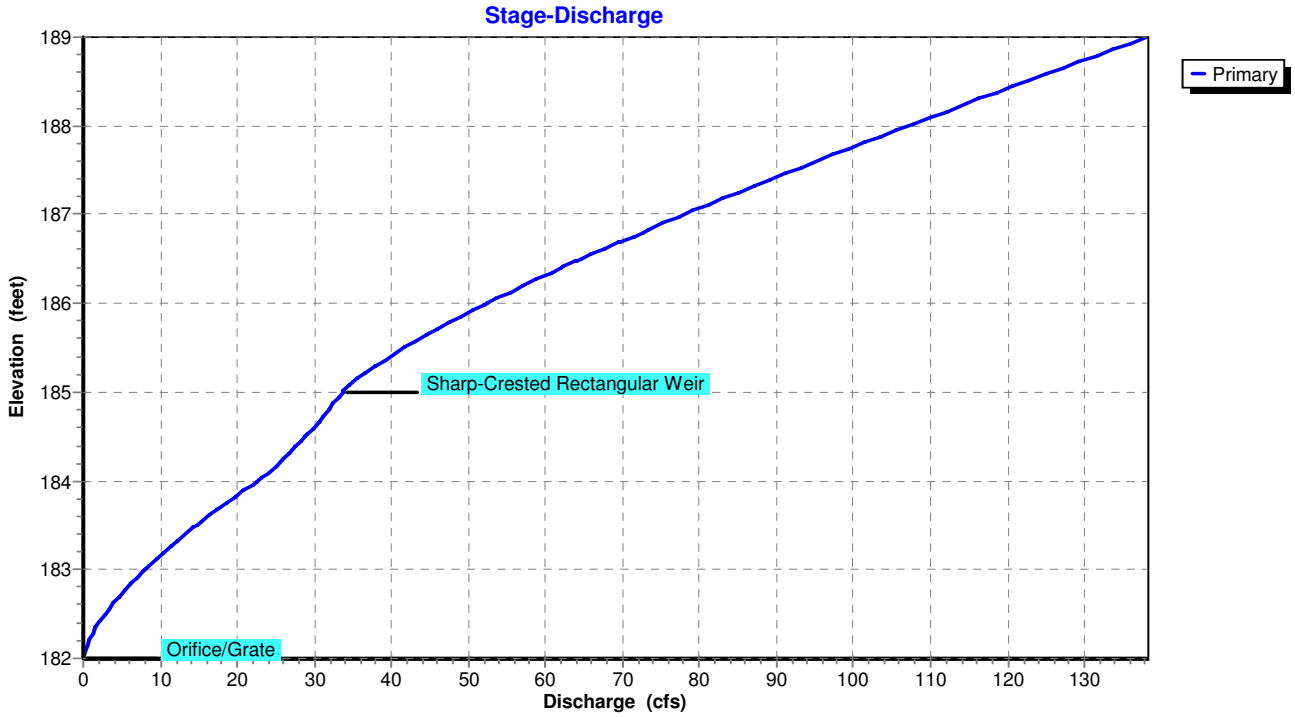
Device	Routing	Invert	Outlet Devices
#1	Primary	182.00'	**2.50' W x 2.00' H Vert. Orifice/Grate** C= 0.600
#2	Primary	185.00'	**3.4' long x 4.00' rise Sharp-Crested Rectangular Weir**
			2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=76.64 cfs @ 10.44 hrs HW=186.95' TW=181.53' (Dynamic Tailwater)
- **1=Orifice/Grate** (Orifice Controls 47.71 cfs @ 9.54 fps)
- **2=Sharp-Crested Rectangular Weir** (Weir Controls 28.92 cfs @ 4.93 fps)

Pond 4P: Detention Basin



Pond 4P: Detention Basin



Summary for Pond 6P: Low Flow Bypass

[57] Hint: Peaked at 187.84' (Flood elevation advised)

Inflow Area =	54.000 ac,	65.00% Impervious,	Inflow Depth >	6.16"	for Q50 event
Inflow =	162.71 cfs @	10.21 hrs,	Volume=	27.707 af	
Outflow =	162.71 cfs @	10.21 hrs,	Volume=	27.707 af,	Atten= 0%, Lag= 0.0 min
Primary =	33.26 cfs @	10.21 hrs,	Volume=	20.778 af	
Secondary =	129.45 cfs @	10.21 hrs,	Volume=	6.929 af	

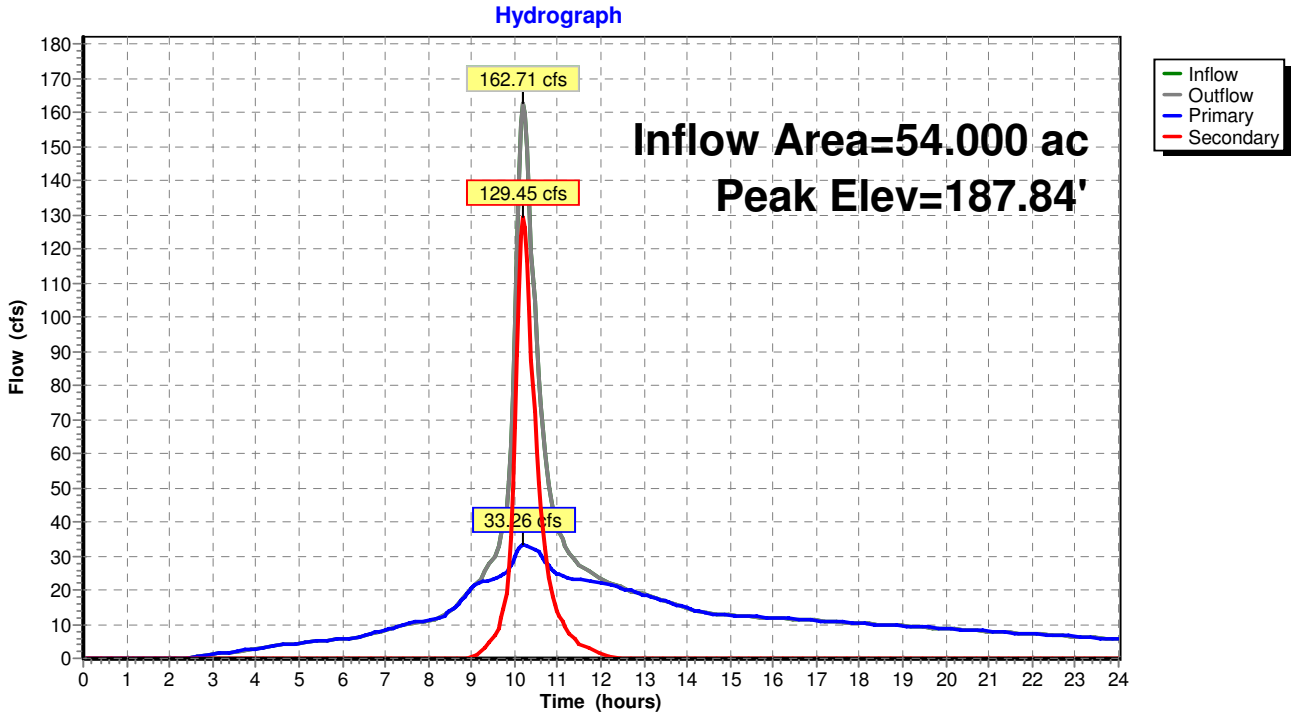
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 187.84' @ 10.21 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	185.00'	**8.0' long x 6.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#2	Primary	182.00'	**24.0" Vert. Orifice/Grate** C= 0.600

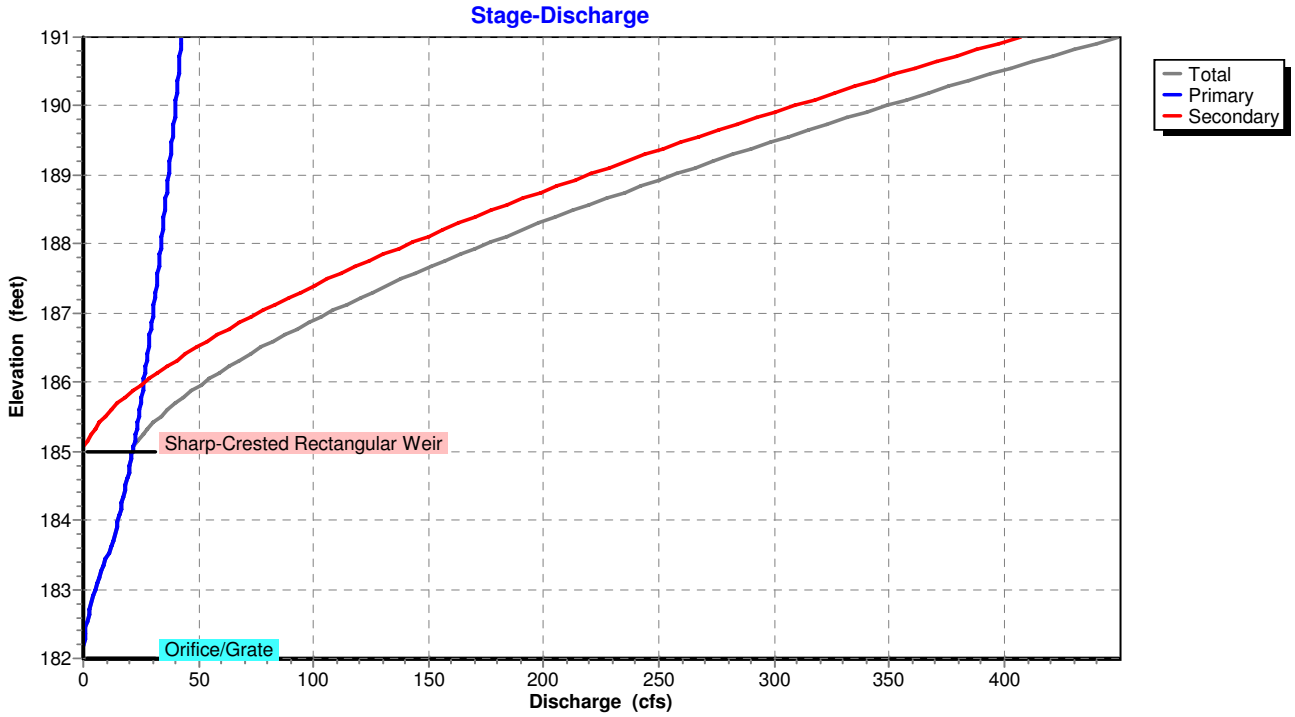
Primary OutFlow Max=33.23 cfs @ 10.21 hrs HW=187.83' TW=181.39' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Orifice Controls 33.23 cfs @ 10.58 fps)

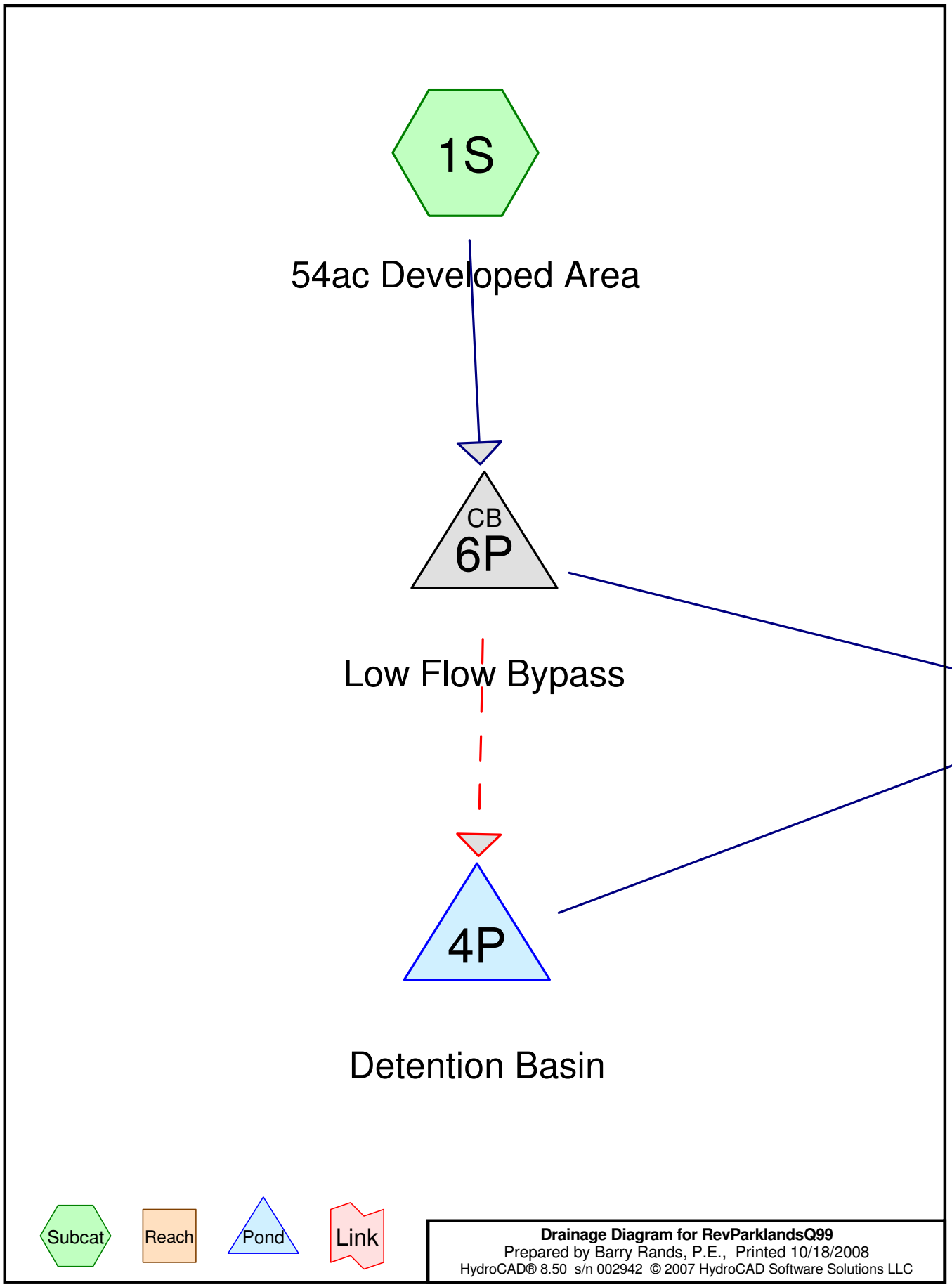
Secondary OutFlow Max=128.81 cfs @ 10.21 hrs HW=187.83' TW=185.07' (Dynamic Tailwater)
└─**1=Sharp-Crested Rectangular Weir** (Weir Controls 128.81 cfs @ 6.13 fps)

Pond 6P: Low Flow Bypass



Pond 6P: Low Flow Bypass





Drainage Diagram for RevParklandsQ99
Prepared by Barry Rands, P.E., Printed 10/18/2008
HydroCAD® 8.50 s/n 002942 © 2007 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
54.000	89	1/8 acre lots, 65% imp, HSG C (1S)
54.000		**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
54.000	HSG C	1S
0.000	HSG D	
0.000	Other	
54.000		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: 54ac Developed Area Runoff Area=54.000 ac 65.00% Impervious Runoff Depth>6.94"
Tc=23.5 min CN=89 Runoff=198.32 cfs 31.249 af

Pond 4P: Detention Basin Peak Elev=187.97' Storage=3.624 af Inflow=163.47 cfs 8.443 af
Outflow=106.15 cfs 8.416 af

Pond 6P: Low Flow Bypass Peak Elev=188.46' Inflow=198.32 cfs 31.249 af
Primary=35.34 cfs 22.807 af Secondary=163.47 cfs 8.443 af Outflow=198.32 cfs 31.249 af

Total Runoff Area = 54.000 ac Runoff Volume = 31.249 af Average Runoff Depth = 6.94"
35.00% Pervious = 18.900 ac 65.00% Impervious = 35.100 ac

Summary for Subcatchment 1S: 54ac Developed Area

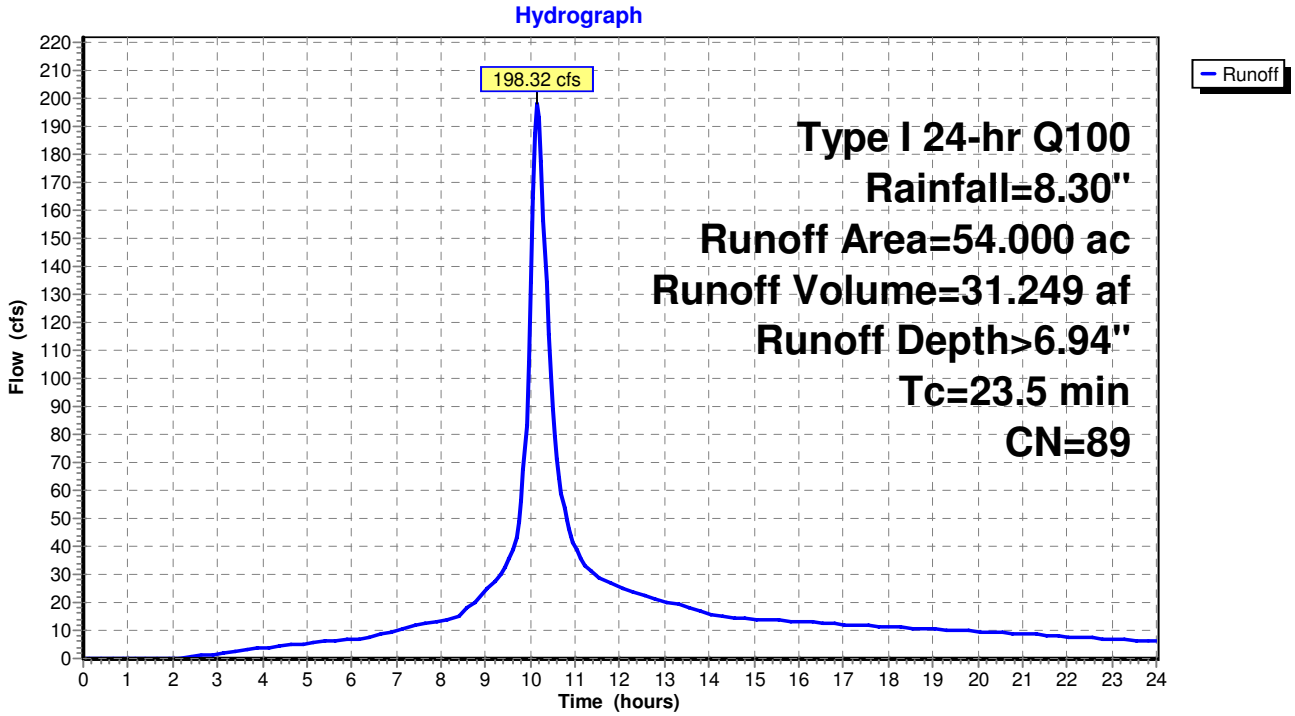
Runoff = 198.32 cfs @ 10.16 hrs, Volume= 31.249 af, Depth> 6.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Q100 Rainfall=8.30"

Area (ac)	CN	Description
54.000	89	1/8 acre lots, 65% imp, HSG C
18.900		Pervious Area
35.100		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.5					**Direct Entry,**

Subcatchment 1S: 54ac Developed Area



Summary for Pond 4P: Detention Basin

Inflow	=	163.47 cfs @	10.16 hrs,	Volume=	8.443 af
Outflow	=	106.15 cfs @	10.34 hrs,	Volume=	8.416 af, Atten= 35%, Lag= 10.7 min
Primary	=	106.15 cfs @	10.34 hrs,	Volume=	8.416 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 187.97' @ 10.34 hrs Surf.Area= 0.897 ac Storage= 3.624 af

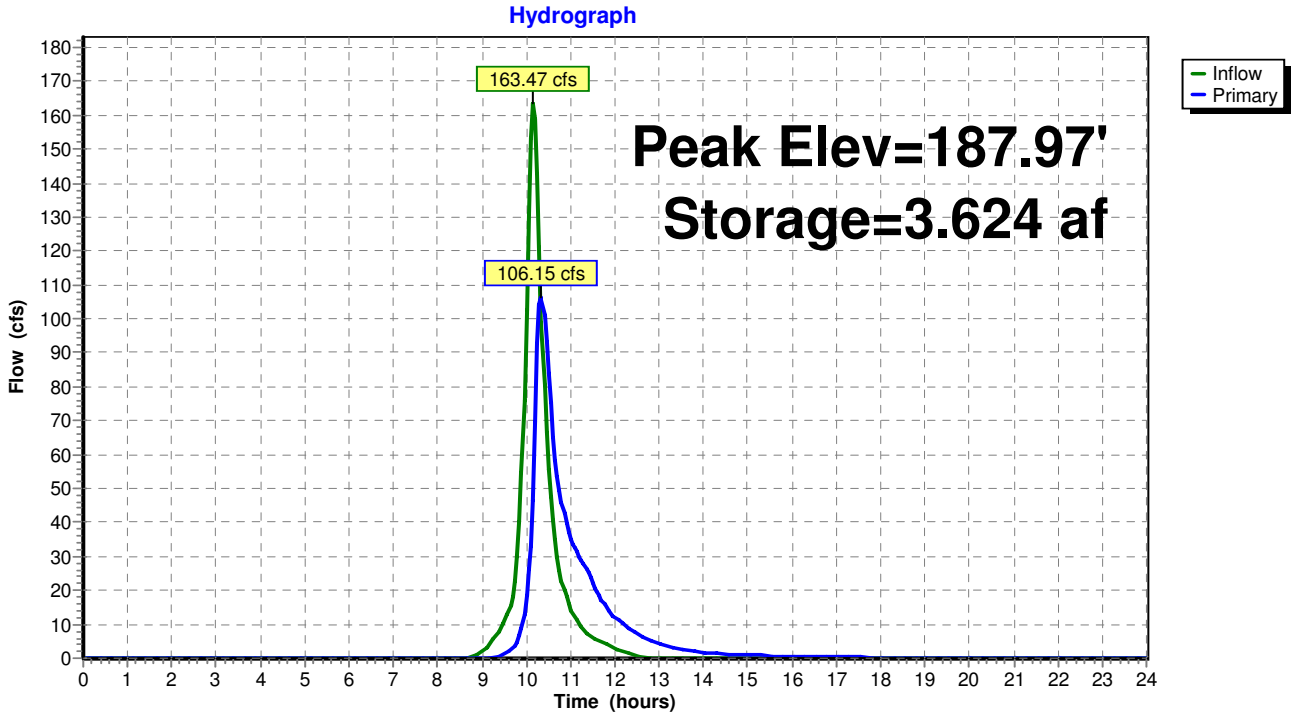
Plug-Flow detention time= 47.6 min calculated for 8.416 af (100% of inflow)
Center-of-Mass det. time= 47.2 min (664.8 - 617.7)

Volume	Invert	Avail.Storage	Storage Description
#1	182.00'	1.251 af	**148.00'W x 264.00'L x 7.00'H Prismatoid**
			6.279 af Overall - 3.152 af Embedded = 3.126 af x 40.0% Voids
#2	182.00'	2.744 af	**96.8"W x 58.0"H x 8.00'L CONSTORM 54** x 594 Inside #1
		3.994 af	Total Available Storage

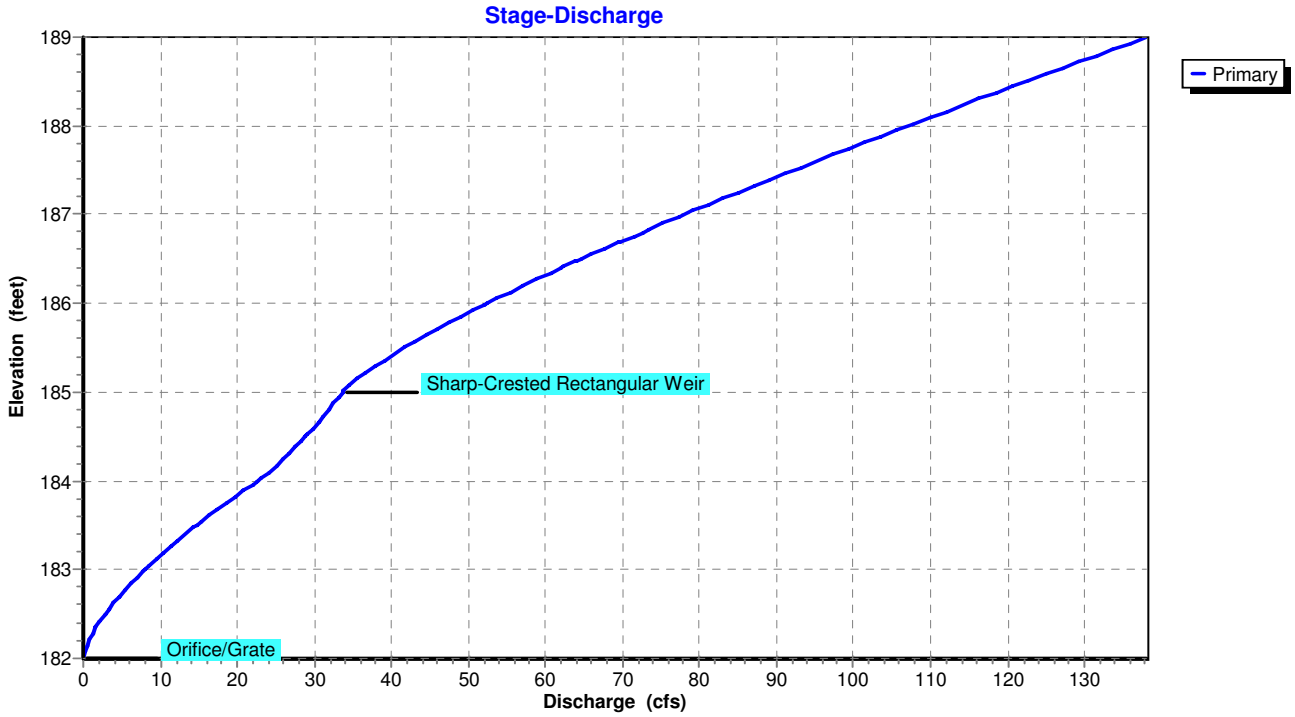
Device	Routing	Invert	Outlet Devices
#1	Primary	182.00'	**2.50' W x 2.00' H Vert. Orifice/Grate** C= 0.600
#2	Primary	185.00'	**3.4' long x 4.00' rise Sharp-Crested Rectangular Weir**
			2 End Contraction(s) 3.0' Crest Height

Primary OutFlow Max=105.57 cfs @ 10.34 hrs HW=187.95' TW=181.63' (Dynamic Tailwater)
- **1=Orifice/Grate** (Orifice Controls 53.46 cfs @ 10.69 fps)
- **2=Sharp-Crested Rectangular Weir** (Weir Controls 52.11 cfs @ 6.29 fps)

Pond 4P: Detention Basin



Pond 4P: Detention Basin



Summary for Pond 6P: Low Flow Bypass

[57] Hint: Peaked at 188.46' (Flood elevation advised)

Inflow Area =	54.000 ac,	65.00% Impervious,	Inflow Depth >	6.94"	for Q100 event
Inflow =	198.32 cfs @	10.16 hrs,	Volume=	31.249 af	
Outflow =	198.32 cfs @	10.16 hrs,	Volume=	31.249 af,	Atten= 0%, Lag= 0.0 min
Primary =	35.34 cfs @	10.34 hrs,	Volume=	22.807 af	
Secondary =	163.47 cfs @	10.16 hrs,	Volume=	8.443 af	

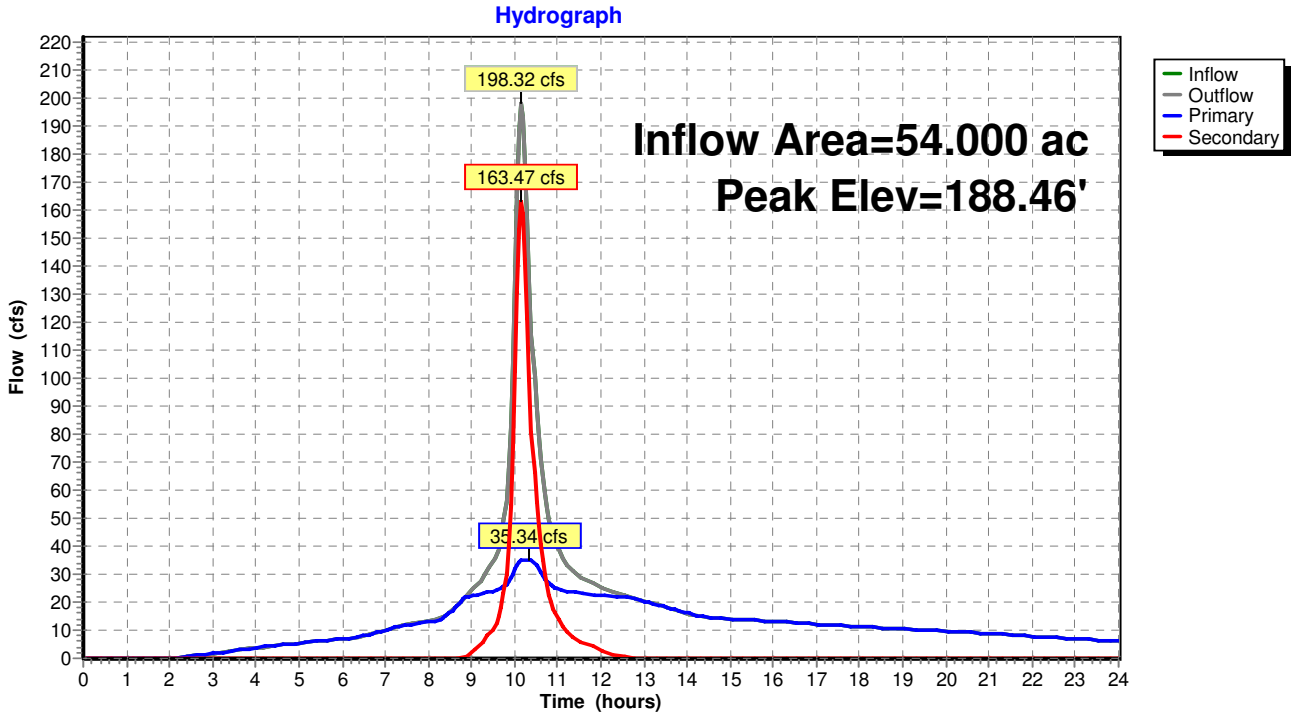
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 188.46' @ 10.34 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	185.00'	**8.0' long x 6.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#2	Primary	182.00'	**24.0" Vert. Orifice/Grate** C= 0.600

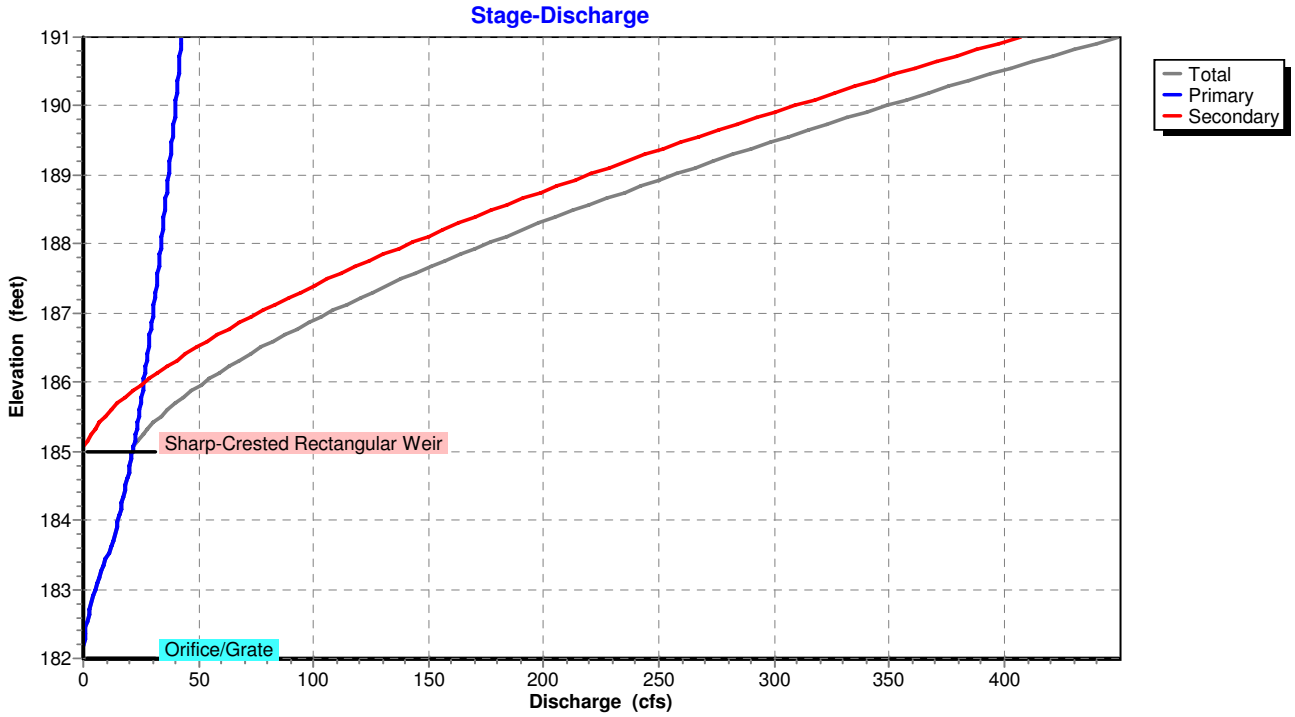
Primary OutFlow Max=35.29 cfs @ 10.34 hrs HW=188.44' TW=181.63' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Orifice Controls 35.29 cfs @ 11.23 fps)

Secondary OutFlow Max=157.80 cfs @ 10.16 hrs HW=188.30' TW=185.91' (Dynamic Tailwater)
└─**1=Sharp-Crested Rectangular Weir** (Weir Controls 157.80 cfs @ 6.52 fps)

Pond 6P: Low Flow Bypass



Pond 6P: Low Flow Bypass

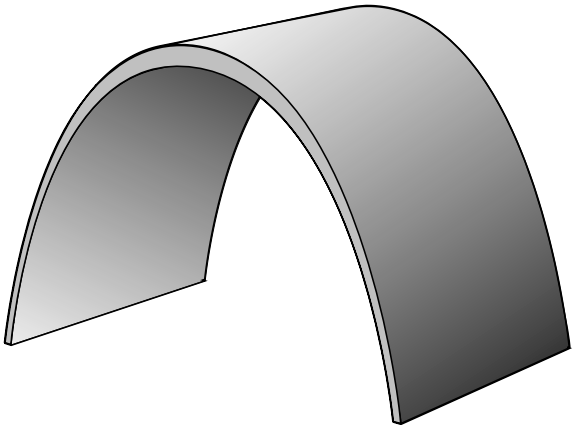


A6

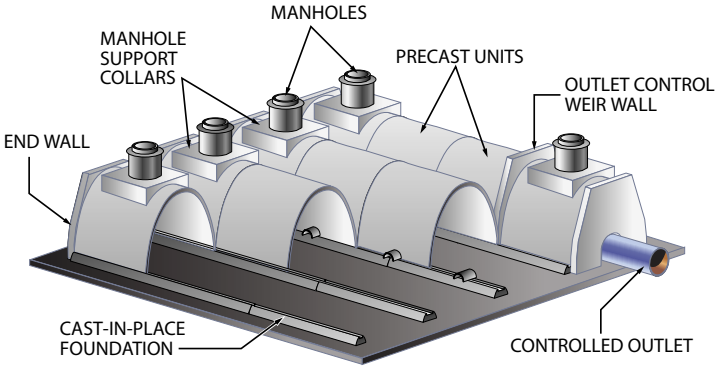
UNDERGROUND DETENTION MATERIALS

CON/STORM

CON/STORM™ is a modular precast system designed to provide economic concrete below-grade detention. The fundamental element of the system is the distinctive high-profile arch shaped unit. CON/STORM concrete detention facilities provide tremendous versatility in accommodating footprint needs. CON/STORM detention systems are designed for HS 20-44 and HS 25-44 loading with as little as 1′-0″ of cover to bottom of flexible pavement. Each element of the CON/STORM precast detention system weighs 2.65 tons or less. The lightweight units have been designed to minimize freight costs and can be set into place without heavy equipment thereby reducing installation costs. The system is most commonly used on sites in which the depth from finished grade to storm sewer outlet elevation is less than 10′. However, the system can be utilized in high cover situations as well. The arch shape of the unit also makes it a preferred solution when using stone backfill as part of the overall storage volume.



Typical Properties
- 8′-0″ span x 6′-0″ rise x 8′-0″ length
- Storage volume = 36.25 ft^3/ft
- Total weight = 2.65 tons/unit



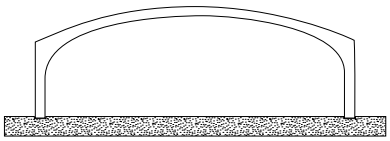
Span (ft-in)	Rise (ft-in)	Active Waterway Area (sf)	Unit Weight (tons)
7′-4 1/4″	4′-0″	20.80	2.11
7′-7 1/4″	4′-6″	24.52	2.25
7′-9 1/2″	5′-0″	28.35	2.39
7′-11 1/8″	5′-6″	32.27	2.52
8′-0″	6′-0″	36.25	2.65
* All active waterway areas assume a base slab foundation			

Modular Concrete Detention Systems

Foundation Versatility

The CON/SPAN and CON/STORM precast elements are three-sided arch units. In order to create a complete system and ensure structural integrity, both systems are installed on top of cast-in-place concrete foundations. These foundations provide continuous support beneath the unit legs and prevent the possibility of any differential settlement between adjacent precast units. Precast elements are set in a keyway that is cast into the foundation. CON/SPAN and CON/STORM systems can be installed on either a full structural base slab or strip foundations. Strip foundations, when utilized, extend around the perimeter of each cell of the vault system. In order to create additional vertical rise the CON/SPAN system can also be installed on top of a pedestal wall foundation. Engineers at CONTECH can assist with providing horizontal and vertical foundation reactions or can perform the complete foundation design upon request.

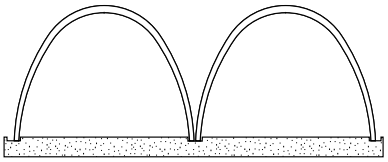
CON/SPAN

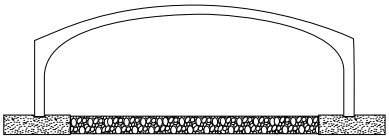


Base Slab Foundation

The base slab is the most common foundation for the CON/SPAN and CON/STORM detention systems. A base slab is the ideal solution when creating a water-tight system. It's also the most practical solution when dealing with high water table issues or sub grade soils sensitive to water infiltration.

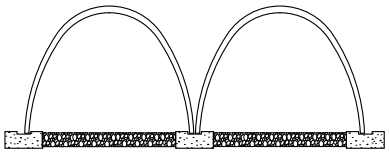
CON/STORM

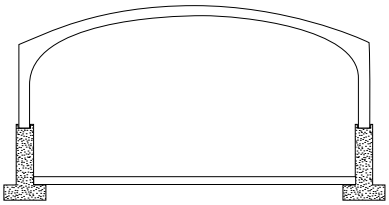




Strip Foundations

Construction of cast-in-place strip foundations beneath the unit legs and endwalls allows for a large open area in the center of each cell. This open area is typically filled with a crushed stone or granular material. The CON/SPAN or CON/STORM system can then be utilized for infiltration or recharge by percolating runoff through the granular material inside of the foundations.





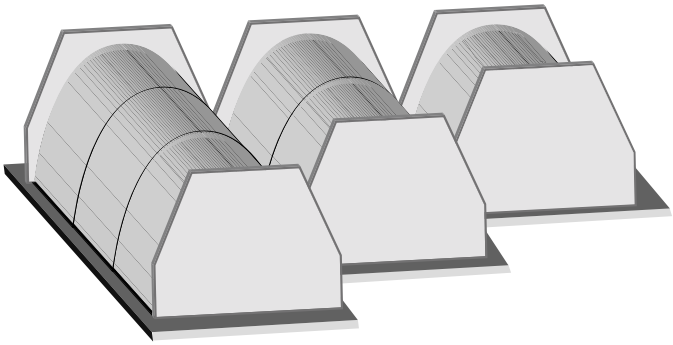
Pedestal Wall Foundation

Creating additional vertical rise through the use of a cast-in-place stem wall allows the CON/SPAN system to be designed for the most storage in the smallest possible footprint.

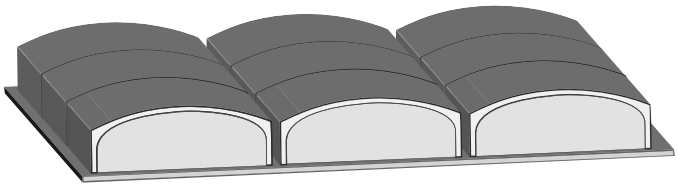
Layout Versatility

The modular nature of the CON/SPAN and CON/STORM system allows for tremendous versatility in layout. The systems can be installed in multiple cells and with staggered ends to accommodate nearly any footprint. Further versatility comes from the ability to create skewed or "pie-shaped" pieces. This provides the ability to construct a vault along a curved alignment to follow a roadway or other challenging location.

Staggered Ends



Multiple Cells

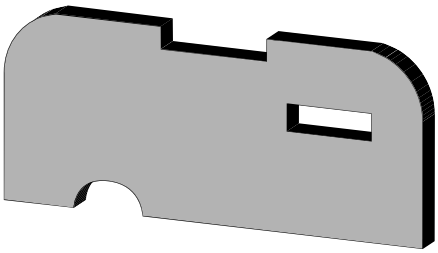


Outlet Control Versatility

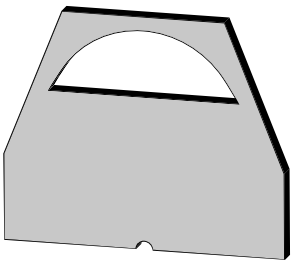
All CON/SPAN and CON/STORM detention structures come with precast end walls on all ends to create an enclosed vault. In addition, supplemental precast walls can be placed inside the structure to control flows. Placing a precast wall inside the structure provides the versatility to cast a wide variety of outlet openings into the system. Typical openings include a low-flow circular orifice, rectangular openings, multiple stage weirs, and overflow weirs. The number of openings that can be provided is essentially unlimited allowing for the ability to accommodate a large number of design storms. Using longer weirs in CON/SPAN structures minimizes the head that must be created over the weir to bypass larger flow rates. Integrating these walls into the overall system eliminates the need for downstream outlet controls.

Outlet control weir wall

Variable weirs to accommodate any flow rate and multiple design storms.



CON/SPAN



CON/STORM

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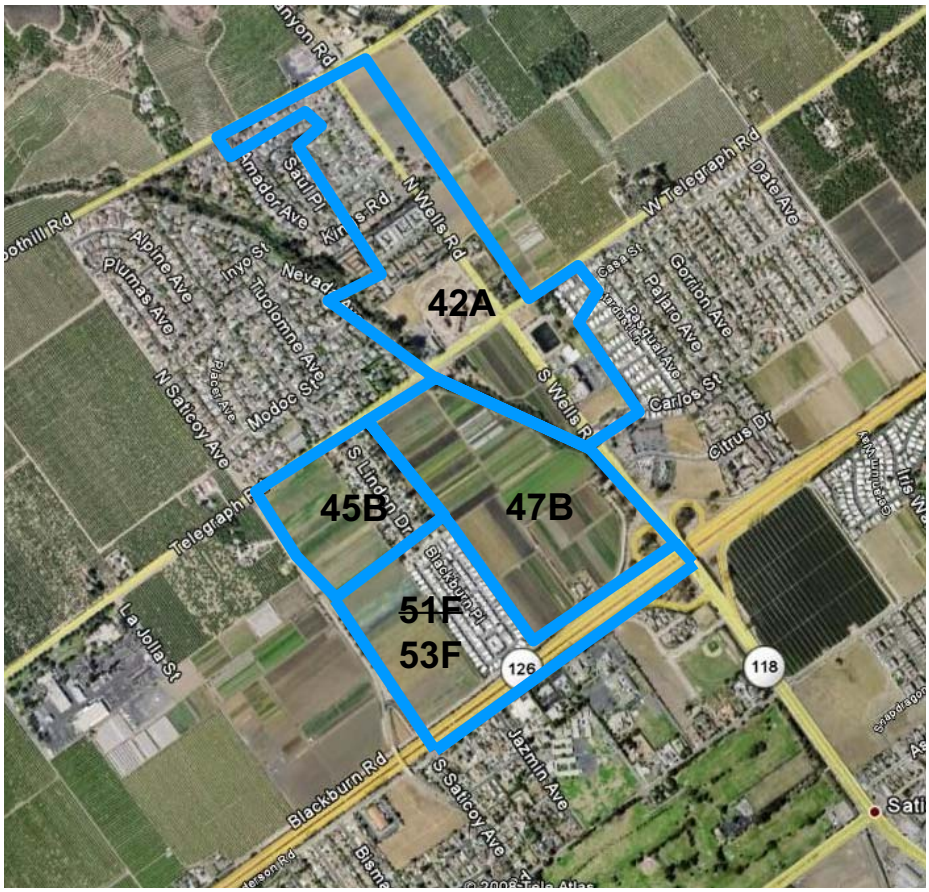
VCRAT Map and Files



VCRAT HYDROLOGY MAP

The top map shows the original subarea configuration in the WPD model
The lower version shows the subareas modified in this report. An explanation of the changes made to these subarea is given on the following page.

Modifications: Existing Conditions

42A: The 13-acre portion of Paklands north of the barranca are part of this sub-area. The impervious % was reduced from 34 to 28% to account for existing conditions (ag fields) in the Parklands site. The Tc was increased from 12 to 13 for the same reason.

45B: A 24-acre portion of the Parklands area was removed from this sub-area and made part of 47B. The Tc was reduced from 13 to 12.

47B: was created (formerly a place-holder) to represent the 54-acre portion of Parklands south of the barranca. Tc is 10 (from Tc calculator) and imp% is zero (ag fields)

48BD: For consistency with the other models, low flow bypass was added to the existing conditions as a B/D flow split (120/35)

49AD: The low flow in D is added to the main stem

50BC: The B line is fattened

51AB: Confluence of B and A

From this point on, the original numbering is changed by adding 2 to each node ID. Original numbering is indicated in *italics*.

53F: *51F* was enlarged by 10 acres of freeway taken from *52F*. The impervious % was increased from 24 to 40.

52F was deleted (30 acres to 47B and 10 acres to 53F/*51F*)

Modifications: Proposed Conditions (without detention)

42A: The 13-acre portion of Parklands north of the barranca is part of this sub-area. The impervious % was increased to 37% and Tc decreased to 12 to reflect proposed conditions. This adds 11 cfs to the flow from this subarea.

45B: same as existing

47B: The 54-acre portion of Parklands south of the barranca is changed to reflect proposed conditions. Tc is 7 (from Tc calculator) and imp% is 37

48BD: Modify B/D flow split (163/35)

From this point forward, all nodes are identical to Existing Conditions

Modifications: Proposed Conditions (with detention)

50BC: The detention basin was added to the node. This is the only change from the proposed conditions without detention.

Ventura County Watershed Protection District
Modified Rational Method Hydrology Program (VCRat v2.5)

Modified Rational Model Results Report

Job: 82510 Project: Brown Barranca Existing

Project Description

BROWN BARRANCA, Q100F DDT/DL 7/04
Modified 7/08 to model Parklands area in existing conditions
Node 42A modified to existing
SubAreas 45B, 47A, 51F modified, 52F deleted

VCRat version: 2.5.2008.7
VCRain version: 200703
DOS EXE version: PC 2.2-200604

Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
SUBAREA DATA AND RESULTS							ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
1A : BROWN BARRANCA, Q100F DDT/DL 7/04																		
1A	030	K100	14	0	54	125	54	125	1154	MOUNTAIN	1150	0.04350	---	----	-----	-----	--	--
2A	020	K100	10	0	47	143	101	241	1158	MOUNTAIN	1750	0.04000	---	----	-----	-----	--	--
3A	030	K100	13	0	47	114	148	307	1161	MOUNTAIN	1600	0.04060	---	----	-----	-----	--	--
4B	030	K100	8	0	64	206	64	206	1154	MOUNTAIN	1100	0.04090	---	----	-----	-----	--	--
5B	030	K100	13	0	77	186	141	367	1157	MOUNTAIN	250	0.04090	---	----	-----	-----	--	--
6B	---	---	--	--	---	---	141	366	1158	-------	----	-------	---	----	-----	-----	--	--
7C	030	K100	14	0	67	155	67	155	1154	MOUNTAIN	1375	0.10000	---	----	-----	-----	--	--
8C	020	K100	17	0	22	48	89	198	1159	-------	----	-------	---	----	-----	-----	--	--
9BC	---	---	--	--	89	198	230	563	1158	MOUNTAIN	1100	0.05180	---	----	-----	-----	--	--
10B	030	K100	7	0	25	87	255	569	1160	-------	----	-------	---	----	-----	-----	--	--
11AB	---	---	--	--	255	569	403	812	1162	MOUNTAIN	1600	0.03940	---	----	-----	-----	--	--
12A	030	K100	13	2	87	212	490	909	1164	-------	----	-------	---	----	-----	-----	--	--
13D	030	K100	12	0	77	196	77	196	1154	-------	----	-------	---	----	-----	-----	--	--
14AD	---	---	--	--	77	196	567	1010	1161	MOUNTAIN	2125	0.03620	---	----	-----	-----	--	--
15A	030	K100	13	2	81	197	648	1057	1164	MOUNTAIN	2400	0.03540	---	----	-----	-----	--	--
16A	020	K100	11	0	50	143	698	1022	1169	MOUNTAIN	1300	0.03540	---	----	-----	-----	--	--
17A	020	K100	14	2	67	166	765	1037	1172	-------	----	-------	---	----	-----	-----	--	--
18E	030	K100	11	0	32	86	32	86	1154	MOUNTAIN	675	0.05000	---	----	-----	-----	--	--
19E	050	K100	14	7	78	161	110	240	1157	MOUNTAIN	300	0.04000	---	----	-----	-----	--	--
20E	030	K100	10	2	42	121	152	350	1157	#PIPE	1950	0.03200	4.50	----	-----	-----	--	--
21E	030	K100	11	5	61	166	213	492	1158	MOUNTAIN	3500	0.02570	---	----	-----	-----	--	--
22AE	---	---	--	--	213	379	978	1395	1171	CHANNEL	400	0.02900	3	2.00	0.035	0.035	--	--
23F	030	K100	14	0	55	128	55	128	1154	MOUNTAIN	2450	0.06120	---	----	-----	-----	--	--
24F	020	K100	12	2	54	147	109	225	1160	-------	----	-------	---	----	-----	-----	--	--
25AF: BROWN BARRANCA AT FOOTHILL RD.Q100F																		
25AF	**********																	
	* Peak in A: 1393 @ 1171 Q in F: 107 Combined Q: 1500 *																	
	* Peak in F: 225 @ 1160 Q in A: 900 Combined Q: 1125 *																	
	* Combined Peak: 1500 @ 1171 Q in A: 1393 Q in F: 107 *																	
	**********																	
25AF	---	---	--	--	109	225	1087	1500	1171	MOUNTAIN	1400	0.02920	---	----	-----	-----	--	--
26A	---	---	--	--	---	---	1087	1485	1173	-------	----	-------	---	----	-----	-----	--	--
27D	030	K100	14	5	55	129	55	129	1154	CHANNEL	800	0.03500	1	2.00	0.030	0.030	--	--
28D	040	K100	14	5	41	90	96	217	1156	CHANNEL	750	0.03467	1	2.00	0.030	0.030	--	--
29B	030	K100	7	23	39	140	39	140	1153	-------	----	-------	---	----	-----	-----	--	--
30AB	**********																	
	* Peak in A: 1485 @ 1173 Q in B: 11 Combined Q: 1496 *																	
	* Peak in B: 140 @ 1153 Q in A: 543 Combined Q: 683 *																	
	* Combined Peak: 1496 @ 1174 Q in A: 1485 Q in B: 11 *																	
	**********																	
30AB	---	---	--	--	39	140	1126	1496	1174	CHANNEL	1350	0.02920	3	2.00	0.035	0.035	--	--
31A : BROWN BARRANCA UPSTREAM OF TELEGRAPH RD. Q100F																		
31A	030	K100	9	20	32	100	1158	1499	1175	-------	----	-------	---	----	-----	-----	--	--
32C	040	K100	19	5	49	89	49	89	1156	CHANNEL	1050	0.02095	1	2.00	0.030	0.030	--	--
33C	040	K100	14	5	33	73	82	156	1158	CHANNEL	2450	0.01020	1	2.00	0.030	0.030	--	--
34C	040	K100	14	15	64	145	146	238	1162	-------	----	-------	---	----	-----	-----	--	--
35D	040	K100	12	5	26	63	122	274	1158	CHANNEL	200	0.03500	5	0.00	0.014	0.014	--	--

Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
	SUBAREA DATA AND RESULTS						ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
36CD	**********																	
	* Peak in C: 238 @ 1162 Q in D: 242 Combined Q: 480 *																	
	* Peak in D: 274 @ 1158 Q in C: 222 Combined Q: 496 *																	
	* Combined Peak: 500 @ 1160 Q in C: 233 Q in D: 268 *																	
	**********																	
36CD	---	---	--	--	122	274	268	500	1160	-------	----	-------	---	----	-----	-----	--	--
37CD:	Control/Diversion: Up to 260cfs to channel C																	
	**********																	
	* Combined Peak: 500 @ 1160 Q in C: 260 Q in D: 240 *																	
	* Peak in C: 260 @ 1151 Q in D: 14 Combined Q: 274 *																	
	* Peak in D: 240 @ 1160 Q in C: 260 Combined Q: 500 *																	
	**********																	
37CD	---	---	--	--	---	---	268	260	1151	PIPE	1800	0.01000	5.00	----	-----	-----	--	--
38D	---	---	--	--	---	---	0	240	1160	40' ROAD	800	0.01100	---	----	-----	-----	--	--
39AC	**********																	
	* Peak in A: 1499 @ 1175 Q in C: 192 Combined Q: 1691 *																	
	* Peak in C: 260 @ 1169 Q in A: 1345 Combined Q: 1605 *																	
	* Combined Peak: 1701 @ 1173 Q in A: 1471 Q in C: 230 *																	
	**********																	
39AC	---	---	--	--	268	260	1426	1701	1173	-------	----	-------	---	----	-----	-----	--	--
40D	030	K100	9	23	50	157	50	294	1160	#PIPE	950	0.01110	5.00	----	-----	-----	--	--
41AD:	BROWN BARRANCA AT TELEGRAPH RD. Q100F																	
41AD	**********																	
	* Peak in A: 1701 @ 1173 Q in D: 88 Combined Q: 1790 *																	
	* Peak in D: 278 @ 1162 Q in A: 1255 Combined Q: 1532 *																	
	* Combined Peak: 1812 @ 1171 Q in A: 1676 Q in D: 136 *																	
	**********																	
41AD	---	---	--	--	50	278	1476	1812	1171	CHANNEL	1350	0.03230	11	0.00	0.014	0.014	--	--
42A	030	K100	13	28	59	151	1535	1832	1172	CHANNEL	425	0.03230	11	0.00	0.014	0.014	--	--
43F	040	K100	9	50	37	118	37	118	1153	CHANNEL	1300	0.01615	1	2.00	0.030	0.030	--	--
44F	030	K100	10	50	38	119	75	217	1157	CHANNEL	1100	0.00818	2	2.00	0.030	0.030	--	--
45B :	Revised to exclude Parklands area (less 24 ac. and less 1 min. Tc add routing to barranca)																	
45B	030	K100	11	30	43	123	43	123	1154	40' ROAD	1400	0.02140	---	----	-----	-----	--	--
46AB	**********																	
	* Peak in A: 1832 @ 1172 Q in B: 36 Combined Q: 1868 *																	
	* Peak in B: 110 @ 1161 Q in A: 1594 Combined Q: 1704 *																	
	* Combined Peak: 1870 @ 1171 Q in A: 1829 Q in B: 41 *																	
	**********																	
46AB	---	---	--	--	43	110	1578	1870	1171	CHANNEL	820	0.01951	12	0.00	0.014	0.014	--	--
47B	030	K100	10	0	54	155	54	155	1154	-------	----	-------	---	----	-----	-----	--	--
48BD:	Bypass to Brown Barranca																	
48BD:	Control/Diversion: Above 120cfs to channel B																	
	**********																	
	* Combined Peak: 155 @ 1154 Q in B: 120 Q in D: 35 *																	
	* Peak in B: 120 @ 1154 Q in D: 35 Combined Q: 155 *																	
	* Peak in D: 35 @ 1140 Q in B: 1 Combined Q: 36 *																	
	**********																	
48BD	---	---	--	--	---	---	54	120	1154	-------	----	-------	---	----	-----	-----	--	--
48D :	Lateral Flow after Split/Diversion																	
48D	---	---	--	--	---	---	0	35	1140	PIPE	200	0.00500	2.75	----	-----	-----	--	--

Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
	SUBAREA DATA AND RESULTS						ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
49AD	**********																	
	* Peak in A: 1869 @ 1172 Q in D: 13 Combined Q: 1881 *																	
	* Peak in D: 35 @ 1142 Q in A: 546 Combined Q: 581 *																	
	* Combined Peak: 1881 @ 1172 Q in A: 1869 Q in D: 13 *																	
	**********																	
49AD	---	---	--	--	0	35	1578	1881	1172	-------	----	-------	---	----	-----	-----	--	--
50BC:	Parklands South Existing fattened																	
50BC	---	---	--	--	0	260	54	120	1154	-------	----	-------	---	----	-----	-----	--	--
	**********																	
	* INCOMING HYDROGRAPH PEAK (cfs): 120.00 VOLUME (acre-ft): 1.78 *																	
	* NO HYDROGRAPH ADJUSTMENT *																	
	* RUNOFF FACTOR(in): 5.67 TOTAL RAIN(in): 8.30 SCS Curve: 78 *																	
	* FATTENED HYDROGRAPH PEAK (cfs): 120.00 VOLUME (acre-ft): 25.51 *																	
	**********																	
50B	---	---	--	--	---	---	54	120	1154	PIPE	120	0.01000	3.75	----	-----	-----	--	--
51AB	**********																	
	* Peak in A: 1881 @ 1172 Q in B: 64 Combined Q: 1945 *																	
	* Peak in B: 120 @ 1154 Q in A: 1147 Combined Q: 1266 *																	
	* Combined Peak: 1945 @ 1171 Q in A: 1881 Q in B: 64 *																	
	**********																	
51AB	---	---	--	--	54	120	1632	1945	1171	CHANNEL	450	0.03200	10	0.00	0.014	0.014	--	--
52F	030	K100	12	20	34	90	109	283	1160	CHANNEL	1325	0.01595	4	0.00	0.014	0.014	--	--
53F :	Added 10 acres of roadway from 52F																	
53F	030	K100	12	40	39	107	148	363	1160	#CHANNEL	1000	0.03200	6	0.00	0.014	0.014	--	--
54A :	52F removed (10 ac. added to 51F and 30 added to 47A)																	
54A	---	---	--	--	---	---	1632	1945	1172	-------	----	-------	---	----	-----	-----	--	--
55AF:	BROWN BARRANCA AT SANTA PAULA FRWY (HWY 126) Q100F																	
55AF	**********																	
	* Peak in A: 1945 @ 1172 Q in F: 135 Combined Q: 2080 *																	
	* Peak in F: 359 @ 1161 Q in A: 1791 Combined Q: 2150 *																	
	* Combined Peak: 2179 @ 1162 Q in A: 1824 Q in F: 355 *																	
	**********																	
55AF	---	---	--	--	148	359	1780	2179	1162	CHANNEL	750	0.01143	10	0.00	0.014	0.014	--	--
56A	---	---	--	--	---	---	1780	2176	1163	CHANNEL	650	0.01143	20	2.00	0.030	0.030	--	--
57B	030	K100	11	15	36	100	36	100	1154	CHANNEL	1300	0.02231	1	2.00	0.030	0.030	--	--
58B	030	K100	11	30	50	143	86	224	1157	-------	----	-------	---	----	-----	-----	--	--
59AB	**********																	
	* Peak in A: 2172 @ 1165 Q in B: 95 Combined Q: 2267 *																	
	* Peak in B: 224 @ 1157 Q in A: 1612 Combined Q: 1837 *																	
	* Combined Peak: 2279 @ 1164 Q in A: 2168 Q in B: 111 *																	
	**********																	
59AB	---	---	--	--	86	224	1866	2279	1164	CHANNEL	1325	0.00830	21	0.00	0.035	0.035	--	--
60A	---	---	--	--	---	---	1866	2260	1166	-------	----	-------	---	----	-----	-----	--	--
61A	030	K100	20	10	70	133	1936	2373	1166	-------	----	-------	---	----	-----	-----	--	--
62C	040	K100	9	37	51	159	51	159	1153	40' ROAD	925	0.00865	---	----	-----	-----	--	--
63C	040	K100	9	50	30	96	81	216	1157	-------	----	-------	---	----	-----	-----	--	--
64C	040	K100	12	30	25	65	106	278	1157	CHANNEL	1425	0.00100	3	2.00	0.030	0.030	--	--
65C	040	K100	11	30	31	85	137	242	1162	-------	----	-------	---	----	-----	-----	--	--
66C	040	K100	8	45	41	138	178	313	1156	#CHANNEL	900	0.00280	9	0.00	0.014	0.014	--	--
67C	050	K100	12	50	23	61	201	364	1157	#CHANNEL	1550	0.03333	6	0.00	0.014	0.014	--	--

Model Results

SUBAREA DATA AND RESULTS							ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
68C : BROWN BARR.EAST LAT.PRIOR TO JCT.W/BRN.AT TELEPHONE RD.Q100F																		
68C	040	K100	11	50	34	98	235	449	1159	#CHANNEL	150	0.03330	6	0.00	0.014	0.014	--	--
69AC	**********																	
	* Peak in A: 2373 @ 1166 Q in C: 310 Combined Q: 2683 *																	
	* Peak in C: 449 @ 1159 Q in A: 1856 Combined Q: 2305 *																	
	* Combined Peak: 2692 @ 1165 Q in A: 2363 Q in C: 329 *																	
	**********																	
69AC	---	---	--	--	235	449	2171	2692	1165	CHANNEL	150	0.00667	5	2.00	0.030	0.030	--	--
70B	030	K100	8	37	67	229	67	229	1154	-------	----	-------	---	----	-----	-----	--	--
71AB	---	---	--	--	67	229	2238	2727	1165	CHANNEL	2525	0.01000	3	2.00	0.014	0.014	--	--
72A : BROWN BARRANCA AT SANTA CLARA RIVER Q100F																		
72A	030	K100	10	10	18	53	2256	2715	1168	-------	----	-------	---	----	-----	-----	--	--

Issue/Warning Messages

TYPE	ERR NO	PROCEDURE	LOCATION	MESSAGE
Caution	Err1103	ROUTING	38D	Forcing all flows to remain in a 40' Road. May lead to unrealistic flows on road.
Caution	Err57	SUBAREA	40D	Using a subarea operation on same bank used for diversion. Consider clearing bank first. Diversion located at: 37CD
Caution	Err1103	ROUTING	62C	Forcing all flows to remain in a 40' Road. May lead to unrealistic flows on road.

Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
SUBAREA DATA AND RESULTS							ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
1A : BROWN BARRANCA, Q100F DDT/DL 7/04																		
1A	030	K100	14	0	54	125	54	125	1154	MOUNTAIN	1150	0.04350	---	----	-----	-----	--	--
2A	020	K100	10	0	47	143	101	241	1158	MOUNTAIN	1750	0.04000	---	----	-----	-----	--	--
3A	030	K100	13	0	47	114	148	307	1161	MOUNTAIN	1600	0.04060	---	----	-----	-----	--	--
4B	030	K100	8	0	64	206	64	206	1154	MOUNTAIN	1100	0.04090	---	----	-----	-----	--	--
5B	030	K100	13	0	77	186	141	367	1157	MOUNTAIN	250	0.04090	---	----	-----	-----	--	--
6B	---	---	--	--	---	---	141	366	1158	-------	----	-------	---	----	-----	-----	--	--
7C	030	K100	14	0	67	155	67	155	1154	MOUNTAIN	1375	0.10000	---	----	-----	-----	--	--
8C	020	K100	17	0	22	48	89	198	1159	-------	----	-------	---	----	-----	-----	--	--
9BC	---	---	--	--	89	198	230	563	1158	MOUNTAIN	1100	0.05180	---	----	-----	-----	--	--
10B	030	K100	7	0	25	87	255	569	1160	-------	----	-------	---	----	-----	-----	--	--
11AB	---	---	--	--	255	569	403	812	1162	MOUNTAIN	1600	0.03940	---	----	-----	-----	--	--
12A	030	K100	13	2	87	212	490	909	1164	-------	----	-------	---	----	-----	-----	--	--
13D	030	K100	12	0	77	196	77	196	1154	-------	----	-------	---	----	-----	-----	--	--
14AD	---	---	--	--	77	196	567	1010	1161	MOUNTAIN	2125	0.03620	---	----	-----	-----	--	--
15A	030	K100	13	2	81	197	648	1057	1164	MOUNTAIN	2400	0.03540	---	----	-----	-----	--	--
16A	020	K100	11	0	50	143	698	1022	1169	MOUNTAIN	1300	0.03540	---	----	-----	-----	--	--
17A	020	K100	14	2	67	166	765	1037	1172	-------	----	-------	---	----	-----	-----	--	--
18E	030	K100	11	0	32	86	32	86	1154	MOUNTAIN	675	0.05000	---	----	-----	-----	--	--
19E	050	K100	14	7	78	161	110	240	1157	MOUNTAIN	300	0.04000	---	----	-----	-----	--	--
20E	030	K100	10	2	42	121	152	350	1157	#PIPE	1950	0.03200	4.50	----	-----	-----	--	--
21E	030	K100	11	5	61	166	213	492	1158	MOUNTAIN	3500	0.02570	---	----	-----	-----	--	--
22AE	---	---	--	--	213	379	978	1395	1171	CHANNEL	400	0.02900	3	2.00	0.035	0.035	--	--
23F	030	K100	14	0	55	128	55	128	1154	MOUNTAIN	2450	0.06120	---	----	-----	-----	--	--
24F	020	K100	12	2	54	147	109	225	1160	-------	----	-------	---	----	-----	-----	--	--
25AF: BROWN BARRANCA AT FOOTHILL RD.Q100F																		
25AF																		
* Peak in A: 1393 @ 1171 Q in F: 107 Combined Q: 1500 *																		
* Peak in F: 225 @ 1160 Q in A: 900 Combined Q: 1125 *																		
* Combined Peak: 1500 @ 1171 Q in A: 1393 Q in F: 107 *																		
25AF	---	---	--	--	109	225	1087	1500	1171	MOUNTAIN	1400	0.02920	---	----	-----	-----	--	--
26A	---	---	--	--	---	---	1087	1485	1173	-------	----	-------	---	----	-----	-----	--	--
27D	030	K100	14	5	55	129	55	129	1154	CHANNEL	800	0.03500	1	2.00	0.030	0.030	--	--
28D	040	K100	14	5	41	90	96	217	1156	CHANNEL	750	0.03467	1	2.00	0.030	0.030	--	--
29B	030	K100	7	23	39	140	39	140	1153	-------	----	-------	---	----	-----	-----	--	--
30AB																		
* Peak in A: 1485 @ 1173 Q in B: 11 Combined Q: 1496 *																		
* Peak in B: 140 @ 1153 Q in A: 543 Combined Q: 683 *																		
* Combined Peak: 1496 @ 1174 Q in A: 1485 Q in B: 11 *																		
30AB	---	---	--	--	39	140	1126	1496	1174	CHANNEL	1350	0.02920	3	2.00	0.035	0.035	--	--
31A : BROWN BARRANCA UPSTREAM OF TELEGRAPH RD. Q100F																		
31A	030	K100	9	20	32	100	1158	1499	1175	-------	----	-------	---	----	-----	-----	--	--
32C	040	K100	19	5	49	89	49	89	1156	CHANNEL	1050	0.02095	1	2.00	0.030	0.030	--	--
33C	040	K100	14	5	33	73	82	156	1158	CHANNEL	2450	0.01020	1	2.00	0.030	0.030	--	--
34C	040	K100	14	15	64	145	146	238	1162	-------	----	-------	---	----	-----	-----	--	--
35D	040	K100	12	5	26	63	122	274	1158	CHANNEL	200	0.03500	5	0.00	0.014	0.014	--	--

Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
	SUBAREA DATA AND RESULTS						ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
36CD	**********																	
	* Peak in C:				238 @ 1162		Q in D:	242		Combined Q:	480	*						
	* Peak in D:				274 @ 1158		Q in C:	222		Combined Q:	496	*						
	* Combined Peak:				500 @ 1160		Q in C:	233		Q in D:	268	*						
	**********																	
36CD	---	---	--	--	122	274	268	500	1160	-------	----	-------	---	----	-----	-----	--	--
37CD:	Control/Diversion: Up to 260cfs to channel C																	
	**********																	
	* Combined Peak:				500 @ 1160		Q in C:	260		Q in D:	240	*						
	* Peak in C:				260 @ 1151		Q in D:	14		Combined Q:	274	*						
	* Peak in D:				240 @ 1160		Q in C:	260		Combined Q:	500	*						
	**********																	
37CD	---	---	--	--	---	---	268	260	1151	PIPE	1800	0.01000	5.00	----	-----	-----	--	--
38D	---	---	--	--	---	---	0	240	1160	40' ROAD	800	0.01100	---	----	-----	-----	--	--
39AC	**********																	
	* Peak in A:				1499 @ 1175		Q in C:	192		Combined Q:	1691	*						
	* Peak in C:				260 @ 1169		Q in A:	1345		Combined Q:	1605	*						
	* Combined Peak:				1701 @ 1173		Q in A:	1471		Q in C:	230	*						
	**********																	
39AC	---	---	--	--	268	260	1426	1701	1173	-------	----	-------	---	----	-----	-----	--	--
40D	030	K100	9	23	50	157	50	294	1160	#PIPE	950	0.01110	5.00	----	-----	-----	--	--
41AD:	BROWN BARRANCA AT TELEGRAPH RD. Q100F																	
41AD	**********																	
	* Peak in A:				1701 @ 1173		Q in D:	88		Combined Q:	1790	*						
	* Peak in D:				278 @ 1162		Q in A:	1255		Combined Q:	1532	*						
	* Combined Peak:				1812 @ 1171		Q in A:	1676		Q in D:	136	*						
	**********																	
41AD	---	---	--	--	50	278	1476	1812	1171	CHANNEL	1350	0.03230	11	0.00	0.014	0.014	--	--
42A	030	K100	12	37	59	162	1535	1833	1172	CHANNEL	425	0.03230	11	0.00	0.014	0.014	--	--
43F	040	K100	9	50	37	118	37	118	1153	CHANNEL	1300	0.01615	1	2.00	0.030	0.030	--	--
44F	030	K100	10	50	38	119	75	217	1157	CHANNEL	1100	0.00818	2	2.00	0.030	0.030	--	--
45B :	Revised to exclude Parklands area (less 24 ac. and less 1 min. Tc add routing to barranca)																	
45B	030	K100	11	30	43	123	43	123	1154	40' ROAD	1400	0.02140	---	----	-----	-----	--	--
46AB	**********																	
	* Peak in A:				1833 @ 1172		Q in B:	36		Combined Q:	1869	*						
	* Peak in B:				110 @ 1161		Q in A:	1590		Combined Q:	1701	*						
	* Combined Peak:				1871 @ 1171		Q in A:	1830		Q in B:	41	*						
	**********																	
46AB	---	---	--	--	43	110	1578	1871	1171	CHANNEL	820	0.01951	12	0.00	0.014	0.014	--	--
47B	030	K100	7	37	54	198	54	198	1153	-------	----	-------	---	----	-----	-----	--	--
48BD:	Bypass to Brown Barrance																	
48BD:	Control/Diversion: Up to 163cfs to channel B																	
	**********																	
	* Combined Peak:				198 @ 1153		Q in B:	163		Q in D:	35	*						
	* Peak in B:				163 @ 1152		Q in D:	13		Combined Q:	176	*						
	* Peak in D:				35 @ 1153		Q in B:	163		Combined Q:	198	*						
	**********																	
48BD	---	---	--	--	---	---	54	163	1152	-------	----	-------	---	----	-----	-----	--	--
48D :	Lateral Flow after Split/Diversion																	
48D	---	---	--	--	---	---	0	35	1153	PIPE	200	0.00500	2.75	----	-----	-----	--	--

Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
	SUBAREA DATA AND RESULTS						ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
49AD	**********																	
	* Peak in A: 1870 @ 1172 Q in D: 0 Combined Q: 1871 *																	
	* Peak in D: 35 @ 1155 Q in A: 1227 Combined Q: 1262 *																	
	* Combined Peak: 1871 @ 1172 Q in A: 1870 Q in D: 0 *																	
	**********																	
49AD	---	---	--	--	0	35	1578	1871	1172	-------	----	-------	---	----	-----	-----	--	--
50BC:	Parklands South Proposed fattened but not detained																	
50BC	---	---	--	--	0	260	54	163	1152	-------	----	-------	---	----	-----	-----	--	--
	**********																	
	* INCOMING HYDROGRAPH PEAK (cfs): 163.00 VOLUME (acre-ft): 19.12 *																	
	* NO HYDROGRAPH ADJUSTMENT *																	
	* RUNOFF FACTOR(in): 6.98 TOTAL RAIN(in): 8.30 SCS Curve: 89 *																	
	* FATTENED HYDROGRAPH PEAK (cfs): 163.00 VOLUME (acre-ft): 31.55 *																	
	**********																	
50B	---	---	--	--	---	---	54	163	1152	PIPE	120	0.01000	4.25	----	-----	-----	--	--
51AB	**********																	
	* Peak in A: 1871 @ 1172 Q in B: 54 Combined Q: 1925 *																	
	* Peak in B: 163 @ 1153 Q in A: 1028 Combined Q: 1191 *																	
	* Combined Peak: 1925 @ 1172 Q in A: 1871 Q in B: 54 *																	
	**********																	
51AB	---	---	--	--	54	163	1632	1925	1172	CHANNEL	450	0.03200	10	0.00	0.014	0.014	--	--
52F	030	K100	12	20	34	90	109	283	1160	CHANNEL	1325	0.01595	4	0.00	0.014	0.014	--	--
53F :	Added 10 acres of roadway from 52F																	
53F	030	K100	12	40	39	107	148	363	1160	#CHANNEL	1000	0.03200	6	0.00	0.014	0.014	--	--
54A :	52F removed (10 ac. added to 51F and 30 added to 47A)																	
54A	---	---	--	--	---	---	1632	1924	1172	-------	----	-------	---	----	-----	-----	--	--
55AF:	BROWN BARRANCA AT SANTA PAULA FRWY (HWY 126) Q100F																	
55AF	**********																	
	* Peak in A: 1924 @ 1172 Q in F: 135 Combined Q: 2060 *																	
	* Peak in F: 359 @ 1161 Q in A: 1743 Combined Q: 2102 *																	
	* Combined Peak: 2132 @ 1163 Q in A: 1788 Q in F: 345 *																	
	**********																	
55AF	---	---	--	--	148	359	1780	2132	1163	CHANNEL	750	0.01143	10	0.00	0.014	0.014	--	--
56A	---	---	--	--	---	---	1780	2131	1164	CHANNEL	650	0.01143	20	2.00	0.030	0.030	--	--
57B	030	K100	11	15	36	100	36	100	1154	CHANNEL	1300	0.02231	1	2.00	0.030	0.030	--	--
58B	030	K100	11	30	50	143	86	224	1157	-------	----	-------	---	----	-----	-----	--	--
59AB	**********																	
	* Peak in A: 2127 @ 1165 Q in B: 95 Combined Q: 2222 *																	
	* Peak in B: 224 @ 1157 Q in A: 1659 Combined Q: 1884 *																	
	* Combined Peak: 2240 @ 1162 Q in A: 2064 Q in B: 176 *																	
	**********																	
59AB	---	---	--	--	86	224	1866	2240	1162	CHANNEL	1325	0.00830	20	0.00	0.035	0.035	--	--
60A	---	---	--	--	---	---	1866	2220	1166	-------	----	-------	---	----	-----	-----	--	--
61A	030	K100	20	10	70	133	1936	2333	1166	-------	----	-------	---	----	-----	-----	--	--
62C	040	K100	9	37	51	159	51	159	1153	40' ROAD	925	0.00865	---	----	-----	-----	--	--
63C	040	K100	9	50	30	96	81	216	1157	-------	----	-------	---	----	-----	-----	--	--
64C	040	K100	12	30	25	65	106	278	1157	CHANNEL	1425	0.00100	3	2.00	0.030	0.030	--	--
65C	040	K100	11	30	31	85	137	242	1162	-------	----	-------	---	----	-----	-----	--	--
66C	040	K100	8	45	41	138	178	313	1156	#CHANNEL	900	0.00280	9	0.00	0.014	0.014	--	--
67C	050	K100	12	50	23	61	201	364	1157	#CHANNEL	1550	0.03333	6	0.00	0.014	0.014	--	--

Model Results

SUBAREA DATA AND RESULTS							ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
68C : BROWN BARR.EAST LAT.PRIOR TO JCT.W/BRN.AT TELEPHONE RD.Q100F																		
68C	040	K100	11	50	34	98	235	449	1159	#CHANNEL	150	0.03330	6	0.00	0.014	0.014	--	--
69AC	**********																	
	* Peak in A: 2333 @ 1166 Q in C: 310 Combined Q: 2643 *																	
	* Peak in C: 449 @ 1159 Q in A: 1895 Combined Q: 2344 *																	
	* Combined Peak: 2660 @ 1164 Q in A: 2313 Q in C: 347 *																	
	**********																	
69AC	---	---	--	--	235	449	2171	2660	1164	CHANNEL	150	0.00667	5	2.00	0.030	0.030	--	--
70B	030	K100	8	37	67	229	67	229	1154	-------	----	-------	---	----	-----	-----	--	--
71AB	---	---	--	--	67	229	2238	2699	1164	CHANNEL	2525	0.01000	3	2.00	0.014	0.014	--	--
72A : BROWN BARRANCA AT SANTA CLARA RIVER Q100F																		
72A	030	K100	10	10	18	53	2256	2690	1167	-------	----	-------	---	----	-----	-----	--	--

Issue/Warning Messages

TYPE	ERR NO	PROCEDURE	LOCATION	MESSAGE
Caution	Err1103	ROUTING	38D	Forcing all flows to remain in a 40' Road. May lead to unrealistic flows on road.
Caution	Err57	SUBAREA	40D	Using a subarea operation on same bank used for diversion. Consider clearing bank first. Diversion located at: 37CD
Caution	Err1103	ROUTING	62C	Forcing all flows to remain in a 40' Road. May lead to unrealistic flows on road.

Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
SUBAREA DATA AND RESULTS							ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
1A : BROWN BARRANCA, Q100F DDT/DL 7/04																		
1A	030	K100	14	0	54	125	54	125	1154	MOUNTAIN	1150	0.04350	---	----	-----	-----	--	--
2A	020	K100	10	0	47	143	101	241	1158	MOUNTAIN	1750	0.04000	---	----	-----	-----	--	--
3A	030	K100	13	0	47	114	148	307	1161	MOUNTAIN	1600	0.04060	---	----	-----	-----	--	--
4B	030	K100	8	0	64	206	64	206	1154	MOUNTAIN	1100	0.04090	---	----	-----	-----	--	--
5B	030	K100	13	0	77	186	141	367	1157	MOUNTAIN	250	0.04090	---	----	-----	-----	--	--
6B	---	---	--	--	---	---	141	366	1158	-------	----	-------	---	----	-----	-----	--	--
7C	030	K100	14	0	67	155	67	155	1154	MOUNTAIN	1375	0.10000	---	----	-----	-----	--	--
8C	020	K100	17	0	22	48	89	198	1159	-------	----	-------	---	----	-----	-----	--	--
9BC	---	---	--	--	89	198	230	563	1158	MOUNTAIN	1100	0.05180	---	----	-----	-----	--	--
10B	030	K100	7	0	25	87	255	569	1160	-------	----	-------	---	----	-----	-----	--	--
11AB	---	---	--	--	255	569	403	812	1162	MOUNTAIN	1600	0.03940	---	----	-----	-----	--	--
12A	030	K100	13	2	87	212	490	909	1164	-------	----	-------	---	----	-----	-----	--	--
13D	030	K100	12	0	77	196	77	196	1154	-------	----	-------	---	----	-----	-----	--	--
14AD	---	---	--	--	77	196	567	1010	1161	MOUNTAIN	2125	0.03620	---	----	-----	-----	--	--
15A	030	K100	13	2	81	197	648	1057	1164	MOUNTAIN	2400	0.03540	---	----	-----	-----	--	--
16A	020	K100	11	0	50	143	698	1022	1169	MOUNTAIN	1300	0.03540	---	----	-----	-----	--	--
17A	020	K100	14	2	67	166	765	1037	1172	-------	----	-------	---	----	-----	-----	--	--
18E	030	K100	11	0	32	86	32	86	1154	MOUNTAIN	675	0.05000	---	----	-----	-----	--	--
19E	050	K100	14	7	78	161	110	240	1157	MOUNTAIN	300	0.04000	---	----	-----	-----	--	--
20E	030	K100	10	2	42	121	152	350	1157	#PIPE	1950	0.03200	4.50	----	-----	-----	--	--
21E	030	K100	11	5	61	166	213	492	1158	MOUNTAIN	3500	0.02570	---	----	-----	-----	--	--
22AE	---	---	--	--	213	379	978	1395	1171	CHANNEL	400	0.02900	3	2.00	0.035	0.035	--	--
23F	030	K100	14	0	55	128	55	128	1154	MOUNTAIN	2450	0.06120	---	----	-----	-----	--	--
24F	020	K100	12	2	54	147	109	225	1160	-------	----	-------	---	----	-----	-----	--	--
25AF: BROWN BARRANCA AT FOOTHILL RD.Q100F																		
25AF	**********																	
	* Peak in A: 1393 @ 1171 Q in F: 107 Combined Q: 1500 *																	
	* Peak in F: 225 @ 1160 Q in A: 900 Combined Q: 1125 *																	
	* Combined Peak: 1500 @ 1171 Q in A: 1393 Q in F: 107 *																	
	**********																	
25AF	---	---	--	--	109	225	1087	1500	1171	MOUNTAIN	1400	0.02920	---	----	-----	-----	--	--
26A	---	---	--	--	---	---	1087	1485	1173	-------	----	-------	---	----	-----	-----	--	--
27D	030	K100	14	5	55	129	55	129	1154	CHANNEL	800	0.03500	1	2.00	0.030	0.030	--	--
28D	040	K100	14	5	41	90	96	217	1156	CHANNEL	750	0.03467	1	2.00	0.030	0.030	--	--
29B	030	K100	7	23	39	140	39	140	1153	-------	----	-------	---	----	-----	-----	--	--
30AB	**********																	
	* Peak in A: 1485 @ 1173 Q in B: 11 Combined Q: 1496 *																	
	* Peak in B: 140 @ 1153 Q in A: 543 Combined Q: 683 *																	
	* Combined Peak: 1496 @ 1174 Q in A: 1485 Q in B: 11 *																	
	**********																	
30AB	---	---	--	--	39	140	1126	1496	1174	CHANNEL	1350	0.02920	3	2.00	0.035	0.035	--	--
31A : BROWN BARRANCA UPSTREAM OF TELEGRAPH RD. Q100F																		
31A	030	K100	9	20	32	100	1158	1499	1175	-------	----	-------	---	----	-----	-----	--	--
32C	040	K100	19	5	49	89	49	89	1156	CHANNEL	1050	0.02095	1	2.00	0.030	0.030	--	--
33C	040	K100	14	5	33	73	82	156	1158	CHANNEL	2450	0.01020	1	2.00	0.030	0.030	--	--
34C	040	K100	14	15	64	145	146	238	1162	-------	----	-------	---	----	-----	-----	--	--
35D	040	K100	12	5	26	63	122	274	1158	CHANNEL	200	0.03500	5	0.00	0.014	0.014	--	--

Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
	SUBAREA DATA AND RESULTS						ACCUMULATED DATA			ROUTING AFTER ACCUMULATION								
36CD	**********																	
	* Peak in C:				238 @ 1162		Q in D:	242		Combined Q:	480	*						
	* Peak in D:				274 @ 1158		Q in C:	222		Combined Q:	496	*						
	* Combined Peak:				500 @ 1160		Q in C:	233		Q in D:	268	*						
	**********																	
36CD	---	---	--	--	122	274	268	500	1160	-------	----	-------	---	----	-----	-----	--	--
37CD:	Control/Diversion: Up to 260cfs to channel C																	
	**********																	
	* Combined Peak:				500 @ 1160		Q in C:	260		Q in D:	240	*						
	* Peak in C:				260 @ 1151		Q in D:	14		Combined Q:	274	*						
	* Peak in D:				240 @ 1160		Q in C:	260		Combined Q:	500	*						
	**********																	
37CD	---	---	--	--	---	---	268	260	1151	PIPE	1800	0.01000	5.00	----	-----	-----	--	--
38D	---	---	--	--	---	---	0	240	1160	40' ROAD	800	0.01100	---	----	-----	-----	--	--
39AC	**********																	
	* Peak in A:				1499 @ 1175		Q in C:	192		Combined Q:	1691	*						
	* Peak in C:				260 @ 1169		Q in A:	1345		Combined Q:	1605	*						
	* Combined Peak:				1701 @ 1173		Q in A:	1471		Q in C:	230	*						
	**********																	
39AC	---	---	--	--	268	260	1426	1701	1173	-------	----	-------	---	----	-----	-----	--	--
40D	030	K100	9	23	50	157	50	294	1160	#PIPE	950	0.01110	5.00	----	-----	-----	--	--
41AD:	BROWN BARRANCA AT TELEGRAPH RD. Q100F																	
41AD	**********																	
	* Peak in A:				1701 @ 1173		Q in D:	88		Combined Q:	1790	*						
	* Peak in D:				278 @ 1162		Q in A:	1255		Combined Q:	1532	*						
	* Combined Peak:				1812 @ 1171		Q in A:	1676		Q in D:	136	*						
	**********																	
41AD	---	---	--	--	50	278	1476	1812	1171	CHANNEL	1350	0.03230	11	0.00	0.014	0.014	--	--
42A	030	K100	12	37	59	162	1535	1833	1172	CHANNEL	425	0.03230	11	0.00	0.014	0.014	--	--
43F	040	K100	9	50	37	118	37	118	1153	CHANNEL	1300	0.01615	1	2.00	0.030	0.030	--	--
44F	030	K100	10	50	38	119	75	217	1157	CHANNEL	1100	0.00818	2	2.00	0.030	0.030	--	--
45B :	Revised to exclude Parklands area (less 24 ac. and less 1 min. Tc add routing to barranca)																	
45B	030	K100	11	30	43	123	43	123	1154	40' ROAD	1400	0.02140	---	----	-----	-----	--	--
46AB	**********																	
	* Peak in A:				1833 @ 1172		Q in B:	36		Combined Q:	1869	*						
	* Peak in B:				110 @ 1161		Q in A:	1590		Combined Q:	1701	*						
	* Combined Peak:				1871 @ 1171		Q in A:	1830		Q in B:	41	*						
	**********																	
46AB	---	---	--	--	43	110	1578	1871	1171	CHANNEL	820	0.01951	12	0.00	0.014	0.014	--	--
47B	030	K100	7	37	54	198	54	198	1153	-------	----	-------	---	----	-----	-----	--	--
48BD:	Bypass to Brown Barrance																	
48BD:	Control/Diversion: Up to 163cfs to channel B																	
	**********																	
	* Combined Peak:				198 @ 1153		Q in B:	163		Q in D:	35	*						
	* Peak in B:				163 @ 1152		Q in D:	13		Combined Q:	176	*						
	* Peak in D:				35 @ 1153		Q in B:	163		Combined Q:	198	*						
	**********																	
48BD	---	---	--	--	---	---	54	163	1152	-------	----	-------	---	----	-----	-----	--	--
48D :	Lateral Flow after Split/Diversion																	
48D	---	---	--	--	---	---	0	35	1153	PIPE	200	0.00500	2.75	----	-----	-----	--	--

Model Results

```
|---------- SUBAREA DATA AND RESULTS --------|-- ACCUMULATED DATA --|------------ ROUTING AFTER ACCUMULATION ---------------------------------|
| NODE   SOIL  RAIN   TC    %    AREA  FLOW  |  AREA    FLOW   TIME |  CHANNEL  LENGTH   SLOPE     SIZE    H:V       N VALUES      VEL  DEPTH |
|  ID    TYPE  ZONE (MIN)  IMP   (AC)  (CFS) |  (AC)    (CFS)  (MIN)|    TYPE    (FT)   (FT/FT)    (FT)    (Z)     CHNL   SIDES  (FT/S)  (FT) |
|-------------------------------------------|----------------------|-----------------------------------------------------------------------------|
   49AD  ******************************************************************************
         *          Peak in A:     1870 @ 1172  Q in D:        0  Combined Q:     1871     *
         *          Peak in D:       35 @ 1155  Q in A:     1227  Combined Q:     1262     *
         *      Combined Peak:     1871 @ 1172  Q in A:     1870      Q in D:        0     *
         ******************************************************************************
   49AD  ---   ---    --   --      0     35     1578    1871   1172    -------    ----  -------    ---     ----    -----  -----    --     --
   50BC:  Parklands South Proposed and Detained
   50BC  ---   ---    --   --      0    260       54     163   1152    -------    ----  -------    ---     ----    -----  -----    --     --
    50B :  Underground Detention
         ******************************************************************************************
         *      INCOMING HYDROGRAPH  PEAK (cfs):    163.00         VOLUME (acre-ft):     19.12      *
         *      NO HYDROGRAPH ADJUSTMENT                                                            *
         *      RUNOFF FACTOR(in):   6.98      TOTAL RAIN(in):   8.30      SCS Curve: 89            *
         *      FATTENED HYDROGRAPH  PEAK (cfs):    163.00         VOLUME (acre-ft):     31.55      *
         *      RESERVOIR INFLOW:    PEAK (cfs):    163.00 @ 1152  VOLUME (acre-ft):     31.55      *
         *      MAXIMUM ELEVATION:   STAGE (ft):    188.62 @ 1158  VOLUME (acre-ft):      3.86      *
         *      EMERGENCY SPILLWAY:   ELEV (ft):    189.00         VOLUME (acre-ft):      4.00      *
         *          DIFFERENCE:   IN STAGE (ft):     -0.38      IN VOLUME (acre-ft):      0.14      *
         *          NO SPILL EXPECTED.       PERCNT OF VOLUME REMAINING TO SPILLWAY:      3.4%      *
         *      TOP OF DAM:           ELEV (ft):    190.00         VOLUME (acre-ft):      4.36      *
         *          DIFFERENCE    IN STAGE (ft):     -1.38      IN VOLUME (acre-ft):      0.50      *
         *          NO OVERTOP EXPECTED.   PERCNT OF VOLUME REMAINING TO TOP OF DAM:     11.4%      *
         *      RESERVOIR OUTFLOW:   PEAK (cfs):    126.22 @ 1158  VOLUME (acre-ft):     29.71      *
         ******************************************************************************************
   50B   ---   ---    --   --    ---    ---       54     126   1158    PIPE        120  0.01000      3.75  ----    -----  -----    --     --
   51AB  ******************************************************************************
         *          Peak in A:     1871 @ 1172  Q in B:       78  Combined Q:     1949     *
         *          Peak in B:      126 @ 1159  Q in A:     1568  Combined Q:     1694     *
         *      Combined Peak:     1950 @ 1171  Q in A:     1869      Q in B:       81     *
         ******************************************************************************
   51AB  ---   ---    --   --     54    126     1632    1950   1171    CHANNEL     450  0.03200     10     0.00    0.014  0.014    --     --
   52F   030   K100   12   20     34     90      109     283   1160    CHANNEL    1325  0.01595      4     0.00    0.014  0.014    --     --
   53F :  Added 10 acres of roadway from 52F
   53F   030   K100   12   40     39    107      148     363   1160   #CHANNEL    1000  0.03200      6     0.00    0.014  0.014    --     --
   54A :  52F removed (10 ac. added to 51F and 30 added to 47A)
   54A   ---   ---    --   --    ---    ---     1632    1949   1172    -------    ----  -------    ---     ----    -----  -----    --     --
   55AF:  BROWN BARRANCA AT SANTA PAULA FRWY (HWY 126) Q100F
   55AF  ******************************************************************************
         *          Peak in A:     1949 @ 1172  Q in F:      135  Combined Q:     2084     *
         *          Peak in F:      359 @ 1161  Q in A:     1784  Combined Q:     2143     *
         *      Combined Peak:     2173 @ 1163  Q in A:     1828      Q in F:      345     *
         ******************************************************************************
   55AF  ---   ---    --   --    148    359     1780    2173   1163    CHANNEL     750  0.01143     10     0.00    0.014  0.014    --     --
   56A   ---   ---    --   --    ---    ---     1780    2171   1164    CHANNEL     650  0.01143     20     2.00    0.030  0.030    --     --
   57B   030   K100   11   15     36    100       36     100   1154    CHANNEL    1300  0.02231      1     2.00    0.030  0.030    --     --
   58B   030   K100   11   30     50    143       86     224   1157    -------    ----  -------    ---     ----    -----  -----    --     --
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Model Results

NODE ID	SOIL TYPE	RAIN ZONE	TC (MIN)	% IMP	AREA (AC)	FLOW (CFS)	AREA (AC)	FLOW (CFS)	TIME (MIN)	CHANNEL TYPE	LENGTH (FT)	SLOPE (FT/FT)	SIZE (FT)	H:V (Z)	N VALUES CHNL	N VALUES SIDES	VEL (FT/S)	DEPTH (FT)
59AB	**********																	
	* Peak in A:				2167	@ 1165	Q in B:	95	Combined Q:		2262	*						
	* Peak in B:				224	@ 1157	Q in A:	1607	Combined Q:		1831	*						
	* Combined Peak:				2272	@ 1164	Q in A:	2161	Q in B:		111	*						
	**********																	
59AB	---	---	--	--	86	224	1866	2272	1164	CHANNEL	1325	0.00830	21	0.00	0.035	0.035	--	--
60A	---	---	--	--	---	---	1866	2254	1167	-------	----	-------	---	----	-----	-----	--	--
61A	030	K100	20	10	70	133	1936	2366	1166	-------	----	-------	---	----	-----	-----	--	--
62C	040	K100	9	37	51	159	51	159	1153	40' ROAD	925	0.00865	---	----	-----	-----	--	--
63C	040	K100	9	50	30	96	81	216	1157	-------	----	-------	---	----	-----	-----	--	--
64C	040	K100	12	30	25	65	106	278	1157	CHANNEL	1425	0.00100	3	2.00	0.030	0.030	--	--
65C	040	K100	11	30	31	85	137	242	1162	-------	----	-------	---	----	-----	-----	--	--
66C	040	K100	8	45	41	138	178	313	1156	#CHANNEL	900	0.00280	9	0.00	0.014	0.014	--	--
67C	050	K100	12	50	23	61	201	364	1157	#CHANNEL	1550	0.03333	6	0.00	0.014	0.014	--	--
68C : BROWN BARR.EAST LAT.PRIOR TO JCT.W/BRN.AT TELEPHONE RD.Q100F																		
68C	040	K100	11	50	34	98	235	449	1159	#CHANNEL	150	0.03330	6	0.00	0.014	0.014	--	--
69AC	**********																	
	* Peak in A:				2366	@ 1166	Q in C:	310	Combined Q:		2676	*						
	* Peak in C:				449	@ 1159	Q in A:	1839	Combined Q:		2288	*						
	* Combined Peak:				2684	@ 1165	Q in A:	2355	Q in C:		329	*						
	**********																	
69AC	---	---	--	--	235	449	2171	2684	1165	CHANNEL	150	0.00667	5	2.00	0.030	0.030	--	--
70B	030	K100	8	37	67	229	67	229	1154	-------	----	-------	---	----	-----	-----	--	--
71AB	---	---	--	--	67	229	2238	2719	1165	CHANNEL	2525	0.01000	3	2.00	0.014	0.014	--	--
72A : BROWN BARRANCA AT SANTA CLARA RIVER Q100F																		
72A	030	K100	10	10	18	53	2256	2708	1168	-------	----	-------	---	----	-----	-----	--	--

Issue/Warning Messages

TYPE	ERR NO	PROCEDURE	LOCATION	MESSAGE
Caution	Err1103	ROUTING	38D	Forcing all flows to remain in a 40' Road. May lead to unrealistic flows on road.
Caution	Err57	SUBAREA	40D	Using a subarea operation on same bank used for diversion. Consider clearing bank first. Diversion located at: 37CD
Caution	Err1103	ROUTING	62C	Forcing all flows to remain in a 40' Road. May lead to unrealistic flows on road.