Meeting of the Central Valley Flood Protection Board
July 26, 2013

Staff Report – Encroachment Permit 18834

Brent Barton
Barton Ranch Creek Crossing, San Joaquin County

1.0 - ITEM

Consider approval of Permit No. 18834 (Attachment B)

2.0 – APPLICANT

Brent Barton

3.0 – LOCATION

The project is located approximately 2.2 miles downstream of Farmington Dam on Littlejohns Creek, one mile west of Henry Road and a half mile south of Sonora Road in San Joaquin County.(Littlejohns Creek, San Joaquin County, See Attachment A)

4.0 – DESCRIPTION

To remove an existing timber bridge and construct a dual-culvert crossing at the same location. The crossing will utilize two 42-inch diameter and 48-feet long Class IV reinforced concrete pipes.

5.0 – PROJECT ANALYSIS

The applicant is proposing to remove and replace the existing bridge crossing over Littlejohns Creek that provides access to his property when the creek is flowing, typically during the rainy season. The current crossing is a dilapidated timber structure that is in dire need of replacement or significant repair.

The proposed project is to replace the timber structure with a dual-culvert crossing utilizing two 42-inch diameter reinforced concrete pipes (RCP). To accommodate the two pipes approximately 35 cubic yards of material will be excavated from the channel. The pipelines will be embedded in ¾ inch crushed rock and covered with imported backfill built up to the existing grade of the banks. Riprap will be placed along the slopes of the crossing immediately upstream and downstream to prevent erosion. The private roadway over the RCP will be 18-feet wide and be covered with 6-inches of crushed rock.

The proposed project is located on the regulated stream of Littlejohns Creek and there are no levees in the project vicinity. The project conforms to all standards in California Code of Regulations Title 23.

5.1 – Hydraulic Analysis

A hydrologic and hydraulic study was conducted by MCR Engineering (MCR) to determine the hydrologic conditions of Littlejohns Creek, particularly the 100 year storm flow and whether two 42-inch culverts could pass the corresponding flow. A Hydraulic Technical Memorandum was issued by MCR on July 3rd, 2013 to supplement the prior study and address Board Staff's specific concerns.

The watershed associated with this project is relatively small; Littlejohns Creek dead-ends at Farmington Dam approximately 2.2 miles upstream of the project site. The dam does not release any water into this portion of the creek, thus the only flow is the runoff from the watershed that drains into the creek. Utilizing the USGS quad maps and appropriate methods, MCR calculated the 100-year storm event at 153.4 cubic feet per second (cfs).

The majority of flow passing through the project site is restricted by several upstream impediments including; several retention ponds, a 24-inch concrete culvert and a 36-inch CMP culvert. The hydrologic analysis conservatively assumed that the culverts were free flowing and omitted the retention ponds. Historically the channel handled significantly higher flows, however since the construction of Farmington Dam this water is diverted to another channel. The channel geometry associated with these higher flows remains, the channel is on average 50 feet wide with banks at least 6 feet high. The calculated water depth within the channel corresponding to the 100-year flow is about 2 feet, leaving approximately 4 feet of freeboard.

MCR analyzed the proposed culverts for gravity flow and pressure flow. Under gravity flow or open channel flow conditions it was calculated that the capacity of the two culverts was 284 cfs, well above the calculated 100-year event of 153.4 cfs. If in the event that the culverts are submerged, the pipes would act under pressure flow conditions. Under these conditions it would take approximately 1.72 feet of head difference across the road to discharge the 100-year event through the pipes. Upstream properties would not be in danger of being inundated due to this 1.72 feet rise, as there is plenty of freeboard available in the creek.

Based on the hydrologic and hydraulic information provided, Board staff agrees with MCR's conclusions that two 42-inch culverts will sufficiently pass the 100-year flow and not have a negative effect on the hydraulic conditions in Littlejohns Creek at the project location.

5.2 – Geotechnical Analysis

The scope of work for this project does not require a geotechnical analysis.

6.0 – AGENCY COMMENTS AND ENDORSEMENTS

The comments and endorsements associated with this project from all pertinent agencies are shown below:

- The U.S. Army Corps of Engineers 208.10 comment letter has not been received for this application. Staff anticipates receipt of a letter indicating that the USACE District Engineer has no objection to the project, subject to conditions. Upon receipt of the letter, staff will review to ensure conformity with the permit language and incorporate it into the permit as Exhibit A.

- The San Joaquin County Flood Control and Water Conservation District endorsed the project on February 22, 2013, with conditions. The conditions will be incorporated into the permit as Exhibit B.

7.0 – CEQA ANALYSIS

Board staff has prepared the following California Environmental Quality Act (CEQA) determination:

The Board determined that the project is categorically exempt from CEQA under a Class 2 Categorical Exemption (CEQA Guidelines Section 15302) covering replacement or reconstruction of existing structures.

8.0 – SECTION 8610.5 CONSIDERATIONS

1. Evidence that the Board admits into its record from any party, State or local public agency, or nongovernmental organization with expertise in flood or flood plain management:

   The Board will make its decision based on the evidence in the permit application and attachments, this staff report, and any other evidence presented by any individual or group.

2. The best available science that related to the scientific issues presented by the executive officer, legal counsel, the Department or other parties that raise credible scientific issues.

   The accepted industry standards for the work proposed under this permit as regulated by Title 23 have been applied to the review of this permit.

3. Effects of the decision on the entire State Plan of Flood Control:

   The proposed culverts and crossing will have no adverse effect on facilities of the State Plan of Flood Control and is consistent with the Central Valley Flood Protection Plan

4. Effects of reasonable projected future events, including, but not limited to, changes in hydrology, climate, and development within the applicable watershed:

   There will be no effects to the proposed project from reasonable projected future events.

9.0 – STAFF RECOMMENDATION

Staff recommends that the Board adopt the CEQA findings and approve the permit, conditioned upon receipt of a U.S. Army Corps of Engineers comment letter indicating that the District Engineer has no objection to the project, subject to conditions, and direct staff to file a Notice of Determination with the State Clearinghouse.

10.0 – LIST OF ATTACHMENTS

A. Location Maps and Photos
B. Draft Permit No. 18834
C. Project Plans
D. Hydrologic Report
E. Hydraulic Technical Memorandum

Design Review: Ashley Cousin P.E.
Environmental Review: James Herota, Andrea Mauro
Document Review: Gary Lemon P.E., Mitra Emami P.E., Len Marino P.E.

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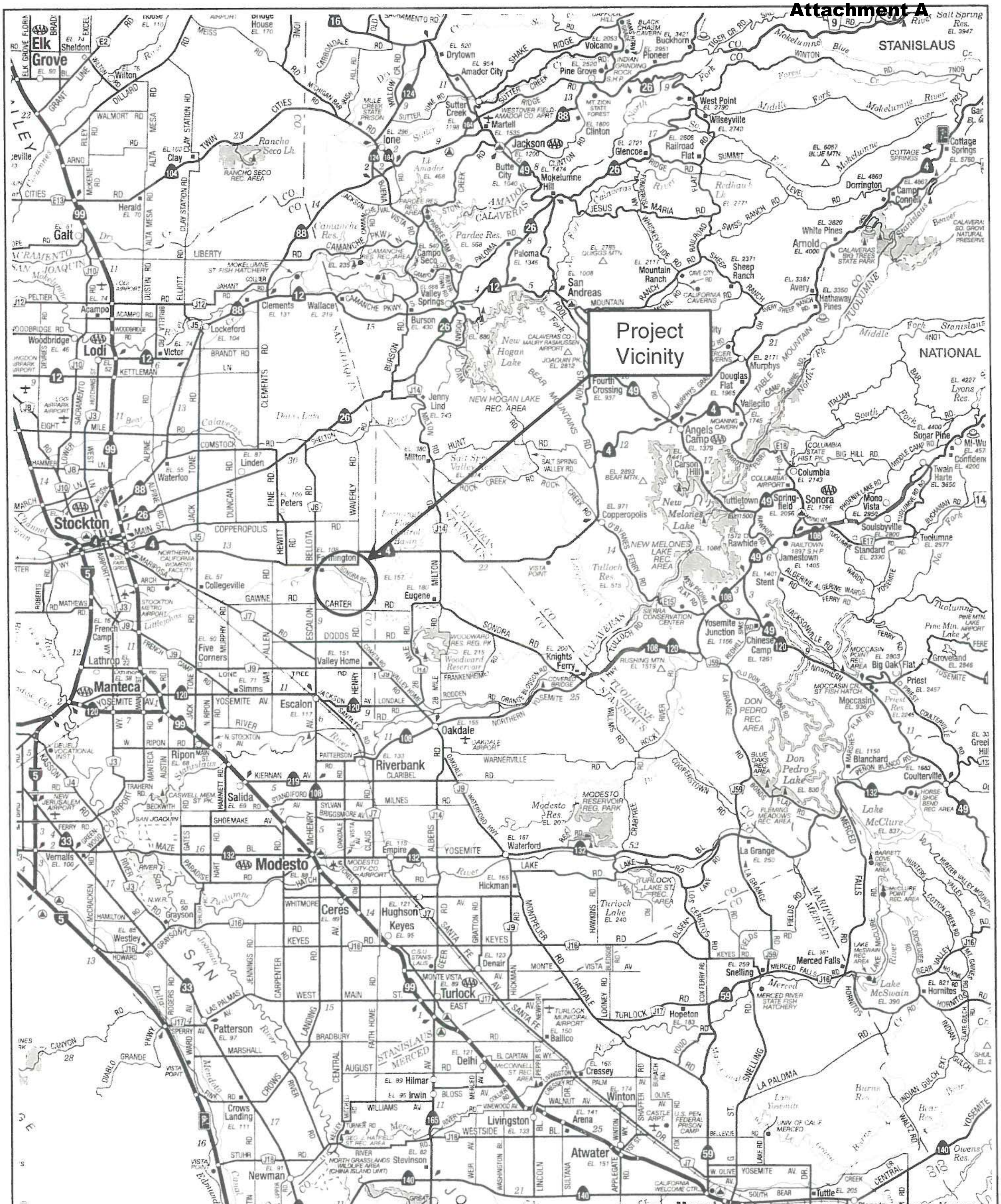
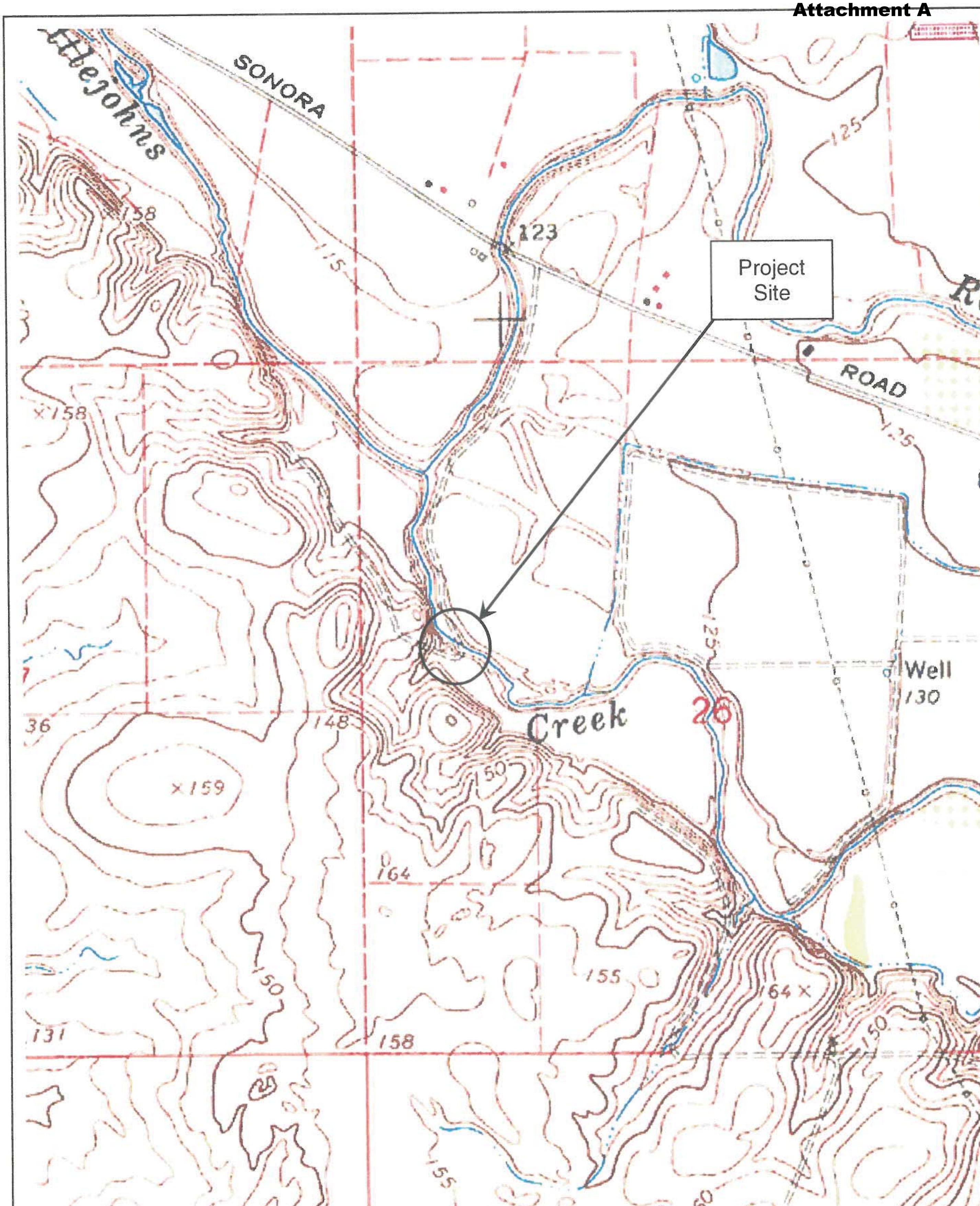
Attachment A



Source: Calif. State Automobile Association

Moore Biological Consultants	0 — 18 Miles; N, E, S, W	**FIGURE 1** **PROJECT VICINITY**

Attachment A



Source: USGS 7.5-minute Farmington topographic quadrangle

Moore Biological

0 1000 2000 Feet

N S E W

FIGURE 2

PROJECT LOCATION

Attachment A

Source (Basemap): Google Earth

Scale: 1 inch = 100+/- feet

Moore Biological

FIGURE 3

AERIAL PHOTOGRAPH

Existing bridge, looking southeast; 09/26/12.

Existing bridge, looking northwest; 09/26/12.

Existing bridge, looking northeast; 09/26/12.

Littlejohn's Creek, looking southeast from the existing bridge; 09/26/12.

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DRAFT

STATE OF CALIFORNIA
THE RESOURCES AGENCY

THE CENTRAL VALLEY FLOOD PROTECTION BOARD

PERMIT NO. 18834 BD

This Permit is issued to:

Brent Barton
22398 McBride Road
Escalon, California 95320

To remove an existing timber bridge and construct a dual-culvert crossing in the same location. The crossing will utilize two 42-inch diameter and 48-feet long Class IV reinforced concrete pipes. The project is located on Littlejohns Creek approximately one mile west of Henry Road and a half mile south of Sonora Road in San Joaquin County. (Section 26, T1N, R9E, MDB&M, San Joaquin County Flood Control and Water Conservation District, Littlejohns Creek, San Joaquin County).

NOTE: Special Conditions have been incorporated herein which may place limitations on and/or require modification of your proposed project as described above.

(SEAL)

Dated: ______________________ ______________________________
Executive Officer

GENERAL CONDITIONS:

ONE: This permit is issued under the provisions of Sections 8700 – 8723 of the Water Code.

TWO: Only work described in the subject application is authorized hereby.

THREE: This permit does not grant a right to use or construct works on land owned by the Sacramento and San Joaquin Drainage District or on any other land.

FOUR: The approved work shall be accomplished under the direction and supervision of the State Department of Water Resources, and the permittee shall conform to all requirements of the Department and The Central Valley Flood Protection Board.

FIVE: Unless the work herein contemplated shall have been commenced within one year after issuance of this permit, the Board reserves the right to change any conditions in this permit as may be consistent with current flood control standards and policies of The Central Valley Flood Protection

Board.

SIX: This permit shall remain in effect until revoked. In the event any conditions in this permit are not complied with, it may be revoked on 15 days' notice.

SEVEN: It is understood and agreed to by the permittee that the start of any work under this permit shall constitute an acceptance of the conditions in this permit and an agreement to perform work in accordance therewith.

EIGHT: This permit does not establish any precedent with respect to any other application received by The Central Valley Flood Protection Board.

NINE: The permittee shall, when required by law, secure the written order or consent from all other public agencies having jurisdiction.

TEN: The permittee is responsible for all personal liability and property damage which may arise out of failure on the permittee's part to perform the obligations under this permit. If any claim of liability is made against the State of California, or any departments thereof, the United States of America, a local district or other maintaining agencies and the officers, agents or employees thereof, the permittee shall defend and shall hold each of them harmless from each claim.

ELEVEN: The permittee shall exercise reasonable care to operate and maintain any work authorized herein to preclude injury to or damage to any works necessary to any plan of flood control adopted by the Board or the Legislature, or interfere with the successful execution, functioning or operation of any plan of flood control adopted by the Board or the Legislature.

TWELVE: Should any of the work not conform to the conditions of this permit, the permittee, upon order of The Central Valley Flood Protection Board, shall in the manner prescribed by the Board be responsible for the cost and expense to remove, alter, relocate, or reconstruct all or any part of the work herein approved.

SPECIAL CONDITIONS FOR PERMIT NO. 18834 BD

THIRTEEN: All work approved by this permit shall be in accordance with the submitted drawings and specifications except as modified by special permit conditions herein. No further work, other than that approved by this permit, shall be done in the area without prior approval of the Central Valley Flood Protection Board.

FOURTEEN: The permittee is responsible for all liability associated with construction, operation, and maintenance of the permitted facilities and shall defend, indemnify, and hold the Central Valley Flood Protection Board and the State of California; including its agencies, departments, boards, commissions, and their respective officers, agents, employees, successors and assigns (collectively, the "State"), safe and harmless, of and from all claims and damages arising from the project undertaken pursuant to this permit, all to the extent allowed by law. The State expressly reserves the right to supplement or take over its defense, in its sole discretion.

FIFTEEN: The permittee shall defend, indemnify, and hold the Central Valley Flood Protection Board and the State of California, including its agencies, departments, boards, commissions, and their respective officers, agents, employees, successors and assigns (collectively, the "State"), safe and harmless, of and from all claims and damages related to the Central Valley Flood Protection Board's approval of this permit, including but not limited to claims filed pursuant to the California Environmental Quality Act. The State expressly reserves the right to supplement or take over its defense, in its sole discretion.

SIXTEEN: The Central Valley Flood Protection Board, Department of Water Resources, and San Joaquin County Flood Control and Water Conservation District shall not be held liable for any damages to the permitted encroachment(s) resulting from flood fight, operation, maintenance, inspection, or emergency repair.

SEVENTEEN: No construction work of any kind shall be done during the flood season from November 1 to April 15 without prior approval of the Central Valley Flood Protection Board.

EIGHTEEN: Upon receipt of a signed copy of the issued (not approved only) permit the permittee shall contact the Department of Water Resources by telephone, (916) 574-0609, and submit the enclosed postcard to schedule a preconstruction conference. Failure to do so at least 10 working days prior to start of work may result in delay of the project.

NINETEEN: The permittee shall maintain the permitted encroachment(s) and the project works within the utilized area in the manner required and as requested by the authorized representative of the Department of Water Resources or any other agency responsible for maintenance.

TWENTY: The permitted encroachment(s) shall not interfere with operation and maintenance of the flood control project. If the permitted encroachment(s) are determined by any agency responsible for operation or maintenance of the flood control project to interfere, the permittee shall be required, at permittee's cost and expense, to modify or remove the permitted encroachment(s) under direction of the Central Valley Flood Protection Board or Department of Water Resources. If the permittee does not comply, the Central Valley Flood Protection Board may modify or remove the encroachment(s) at the permittee's expense.

TWENTY-ONE: The permittee may be required, at permittee's cost and expense, to remove, alter, relocate, or reconstruct all or any part of the permitted encroachment(s) if removal, alteration, relocation, or reconstruction is necessary as part of or in conjunction with any present or future flood control plan or project or if damaged by any cause. If the permittee does not comply, the Central Valley Flood Protection Board may remove the encroachment(s) at the permittee's expense.

TWENTY-TWO: All cleared trees and brush shall be completely burned or removed from the floodway, and downed trees or brush shall not remain in the floodway during the flood season from November 1 to April 15.

TWENTY-THREE: The abandoned or dismantled bridge shall be completely removed and disposed of outside the limits of the levee section and floodway.

TWENTY-FOUR: Piers, bents, and abutments being dismantled shall be removed to at least 1 foot below the natural ground line and at least 3 feet below the bottom of the low-water channel.

TWENTY-FIVE: The work area shall be restored to the condition that existed prior to start of work.

TWENTY-SIX: Trees, brush, sediment, and other debris shall be kept cleared from the project site and disposed of outside the floodway to maintain the design flow capacity and flowage area.

TWENTY-SEVEN: Debris that may accumulate on the permitted encroachment(s) and related facilities shall be cleared off and disposed of outside the floodway after each period of high water.

TWENTY-EIGHT: Fill material shall be placed only within the area indicated on the approved plans.

TWENTY-NINE: The culverts shall be constructed parallel to the direction of flow.

THIRTY: Precast reinforced-concrete pipe, box culvert, or concrete cylinder pipe below the design flood plane elevation shall meet or exceed ASTM Specification C76-90.

THIRTY-ONE: Revetment shall be uniformly placed and properly transitioned into the bank, levee slope, or adjacent revetment and in a manner which avoids segregation.

THIRTY-TWO: If the project, or any portion thereof, is to be abandoned in the future, the permittee or successor shall abandon the project under direction of the Central Valley Flood Protection Board and Department of Water Resources, at the permittee's or successor's cost and expense.

THIRTY-THREE: If erosion occurs adjacent to the permitted encroachment(s), the permittee shall repair the eroded areas and place adequate revetment on the affected areas to prevent further erosion.

THIRTY-FOUR: If the culverts are damaged to the extent that it may impair the channel or floodway capacity, it shall be repaired or removed prior to the next flood season.

THIRTY-FIVE: If the permitted encroachments result(s) in an adverse hydraulic impact, the permittee shall provide appropriate mitigation measures, to be approved by the Central Valley Flood Protection Board, prior to implementation of mitigation measures.

THIRTY-SIX: The permittee shall comply with all conditions set forth in the letter from the Department of the Army (U.S. Army Corps of Engineers, Sacramento District) dated July XX, 2013, which is attached to this permit as Exhibit A and is incorporated by reference.

THIRTY-SEVEN: The permittee shall comply with all conditions set forth in the letter from San Joaquin County Flood Control and Water Conservation District dated February 22, 2013, which is attached to this permit as Exhibit B and is incorporated by reference.

THIRTY-EIGHT: Upon completion of the project, the permittee shall submit As-Built Drawings to: Department of Water Resources, Flood Project Inspection Section, 3310 El Camino Avenue, Suite 256, Sacramento, California 95821.

Exhibit B

THOMAS M. GAU
DIRECTOR

FRITZ BUCHMAN
DEPUTY DIRECTOR

MICHAEL SELLING
DEPUTY DIRECTOR

ROGER JANES
BUSINESS ADMINISTRATOR

Public Works San Joaquin County
Working for YOU

P. O. BOX 1810 - 1810 E. HAZELTON AVENUE
STOCKTON, CALIFORNIA 95201
(209) 468-3000 FAX (209) 468-2999
www.sjgov.org/pubworks

February 22, 2013

The Central Valley Flood Protection Board
3310 El Camino Avenue
Sacramento, California 95821

Attention: Floodway Protection Section

SUBJECT: CENTRAL VALLEY FLOOD PROTECTION BOARD PERMIT APPLICATION FOR MR. BRENT BARTON TO REPLACE A BRIDGE OVER LITTLEJOHNS CREEK

Gentlemen:

Reference is made to the Central Valley Flood Protection Board (Board) Permit Application of Mr. Brent Barton, to replace an old timber bridge with a dual-culvert crossing at North Littlejohns Creek. The new crossing will consist of two-42-inch diameter and 48 feet long class IV reinforced concrete pipes, 6-inch-thick bedding of 3/4-inch crushed rock, Class II AB backfill material, and 18-inch-deep 6-inch to 12-inch diameter riprap at the upstream and downstream ends of the culverts. Approximately 35 cubic yards of dirt will be excavated from the channel to accommodate the culverts.

The project is located at Littlejohns Creek approximately 2.25 miles west of Farmington Dam, about one mile west of Henry Road and about half a mile south of Sonora Road, in San Joaquin County, Section 26, Township 1 North, Range 9 East, Mount Diablo Base and Meridian.

The San Joaquin County Flood Control and Water Conservation District (District) has reviewed the Board's Permit Application of Mr. Brent Barton (Permittee), and endorses the Project subject to the following conditions:

1. The District shall not be responsible for the maintenance of the facilities specified in this Permit.

2. The District shall not be held liable for damage(s) to the permitted encroachment(s) due to the District's operation, maintenance, flood fight, inspection, or emergency repairs.

3. The Permittee or the Successors-in-Interest shall be responsible for the modification or possible removal of the facilities, as requested by the District, if required for any future flood control plans at the Permittee or the Successors-in-Interest sole cost and expense.

4. The Permittee shall be liable for any damage to Littlejohns Creek that may occur as a result of this Project.

5. The Project shall be constructed in accordance with the plans dated December 14, 2012, submitted with the application dated January 10, 2013. Any revisions to the Project will require the submittal of the revised plans to the District for review and approval.

6. No work shall be allowed in Littlejohns Creek's channel between November 1st and April 15th without prior approval of the Central Valley Flood Protection Board and the District.

7. The Permittee or Successors-in-Interest shall keep the encroachments properly maintained in accordance with applicable current or future local, State, and Federal standards.

8. Excess excavated material shall be transported from the project site and disposed of at an approved location.

9. Stockpiled materials, coffer dams, and construction equipment shall be removed from Littlejohns Creek's channel prior to November 1st.

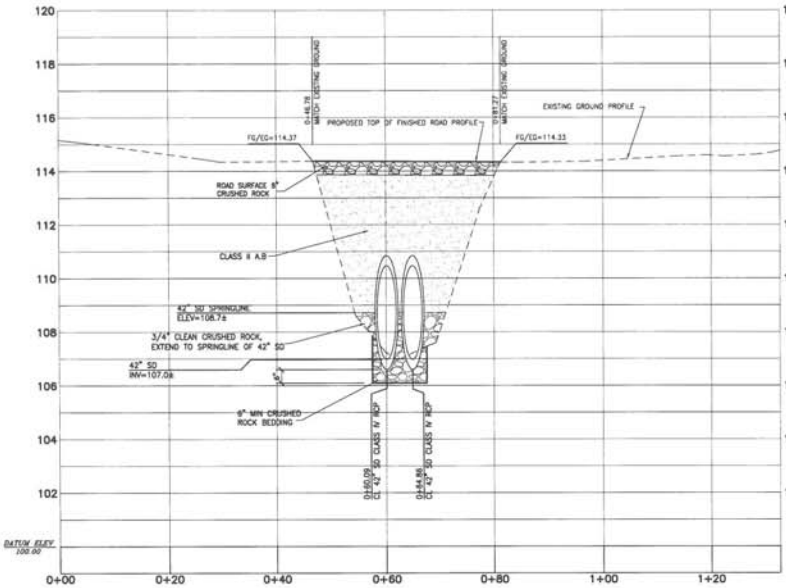
10. The Permittee shall restore Littlejohns Creek's banks to the condition that existed prior to commencement of work.

Should you have any questions regarding these comments, please contact me at (209) 953-7617.

Sincerely,

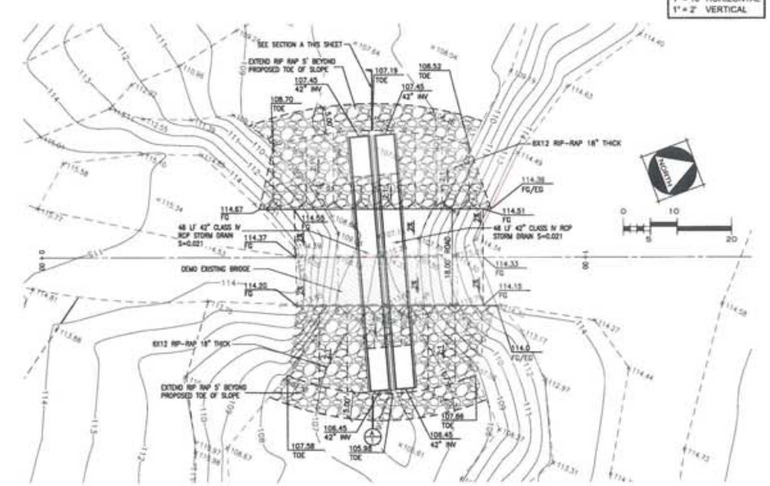
JOHN I. MAGUIRE
Engineering Services Manager

JM:SS:rc
FM-13B037-R1.DOC



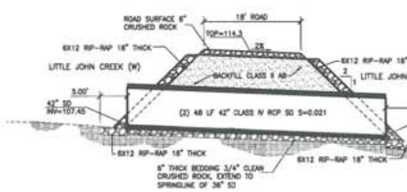
CREEK CROSSING - PROFILE

PROFILE SCALE
1" = 10' HORIZONTAL
1" = 2' VERTICAL



CREEK CROSSING - PLAN

IMPROVEMENT PLANS FOR:
BARTON RANCH PROPOSED CREEK CROSSING
SAN JOAQUIN COUNTY, FARMINGTON, CALIFORNIA



SECTION A
NTS

VICINITY MAP
NTS

PROJECT INFORMATION

STORM PIPE INFORMATION = 42" DIAMETER CLASS IV REINFORCED CONCRETE PIPE 96 LINEAL FEET

TOTAL DISTURBED AREA WITHIN CREEK = 2,112 SF

DIRT VOLUME EXCAVATED FROM CREEK = ±35 CY

CLASS II AB BACKFILL = ±155 CY

ROAD SURFACE 6" THICK 3/4" CRUSHED ROCK = ±15 CY

PIPE BEDDING & BACKFILL TO PIPE SPRING LINE, 3/4" CRUSHED ROCK = ±30 CY

18" THICK 6"-12" RIP RAP = ±82 CY

GENERAL NOTES:

1. ALL IMPROVEMENTS SHALL BE CONSTRUCTED IN STRICT ACCORDANCE WITH THE FOLLOWING: COUNTY OF SAN JOAQUIN STANDARD SPECIFICATIONS, AND ALL AMENDMENTS TO DATE, CALIFORNIA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS (CALTRANS) (LATEST EDITION), WHERE APPLICABLE. ALL WORK SHALL BE UNDER THE INSPECTION OF THE RESPECTIVE ENTITY.
2. IT IS INTENDED THAT THESE PLANS AND SPECIFICATIONS REQUIRE ALL LABOR AND MATERIALS NECESSARY AND PROPER FOR THE WORK CONTEMPLATED AND THAT THE WORK BE COMPLETED IN ACCORDANCE WITH THEIR TRUE INTENT AND PURPOSE. THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY REGARDING ANY DISCREPANCIES AND AMBIGUITIES WHICH MAY EXIST IN THE PLANS AND SPECIFICATIONS. IF THE PLANS OR SPECIFICATIONS DESCRIBE PORTIONS OF THE WORK IN GENERAL TERMS BUT NOT IN COMPLETE DETAIL, IT IS UNDERSTOOD THAT ONLY THE BEST GENERAL PRACTICE IS TO PREVAIL AND THAT ONLY MATERIALS AND WORKMANSHIP OF THE FIRST QUALITY ARE TO BE USED.
3. M.C.R. ENGINEERING IS NOT CONTRACTED TO PROVIDE CONSTRUCTION STAKING FOR THIS PROJECT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CONSTRUCTION STAKING, INCLUDING ANY ASSOCIATED COSTS. SHOULD THE CONTRACTOR ELECT NOT TO USE M.C.R. ENGINEERING FOR CONSTRUCTION STAKING, ALL CONSTRUCTION STAKING FOR GRADING, SEWER, STORM DRAIN, WATER, CONCRETE & PAVING SHALL BE DONE UNDER THE DIRECTION OF M.C.R. ENGINEERING.
4. CONTRACTOR AGREES THAT HE SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE OWNER, ENGINEER AND THE CITY HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER OR THE ENGINEER.
5. THE CONTRACTOR SHALL OBTAIN AN ENCROACHMENT PERMIT FROM THE COUNTY OF SAN JOAQUIN, DEPARTMENT OF PUBLIC WORKS OR ANY OTHER APPLICABLE AGENCIES PRIOR TO COMMENCEMENT OF WORK WITHIN EXISTING COUNTY RIGHT-OF-WAY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL PERMITS AND LICENSES REQUIRED FOR THE CONSTRUCTION AND COMPLETION OF THE PROJECT.
6. PRIOR TO COMMENCING ANY WORK, IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO HAVE EACH UTILITY COMPANY LOCATE, IN THE FIELD, THEIR MAIN AND SERVICE LINES. THE CONTRACTOR SHALL NOTIFY MEMBERS OF THE UNDERGROUND SERVICE ALERT (U.S.A.) 48 HOURS IN ADVANCE OF PERFORMING ANY EXCAVATION WORK BY CALLING THE TOLL-FREE NUMBER (800) 227-2600. THE CONTRACTOR SHALL RECORD THE U.S.A. ORDER NUMBER AND FURNISH ORDER NUMBER TO OWNER PRIOR TO ANY EXCAVATION. IT SHALL BE THE CONTRACTOR'S SOLE RESPONSIBILITY TO PROTECT ALL EXISTING UTILITIES SO THAT NO DAMAGE RESULTS TO THEM DURING THE PERFORMANCE OF THIS CONTRACT. ANY REPAIRS NECESSARY TO DAMAGED UTILITIES SHALL BE PAID FOR BY THE CONTRACTOR. THE CONTRACTOR SHALL BE REQUIRED TO COOPERATE WITH OTHER CONTRACTORS AND UTILITY COMPANIES INSTALLING NEW STRUCTURES, UTILITIES AND SERVICE TO THE DEVELOPMENT.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING EXISTING IMPROVEMENTS FROM DAMAGE. COST OF REPLACING EXISTING IMPROVEMENTS SHALL BE INCLUDED IN THE UNIT PRICE BID FOR ITEMS REQUIRING REMOVAL AND REPLACEMENT OF EXISTING IMPROVEMENTS.
8. WE CALL YOUR ATTENTION TO TITLE 8 CALIFORNIA ADMINISTRATION CODE SECTION 1540 (A) (1) OF THE CONSTRUCTION SAFETY ORDERS ISSUED BY THE OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD PURSUANT TO THE CALIFORNIA OCCUPATIONS SAFETY AND HEALTH ACT OF 1973 AS AMENDED WHICH STATES: (1) PRIOR TO OPENING AN EXCAVATION EFFORT SHALL BE MADE TO DETERMINE WHETHER UNDERGROUND INSTALLATIONS; I.E. SEWER, WATER, FUEL, ELECTRICAL LINES, ETC., WILL BE ENCOUNTERED AND IF SO, WHERE SUCH UNDERGROUND INSTALLATIONS ARE LOCATED. WHEN THE EXCAVATION APPROACHES THE APPROXIMATE LOCATION OF SUCH INSTALLATION, THE EXACT LOCATION SHALL BE DETERMINED BY CAREFUL PROBING OR HAND DIGGING; AND, WHEN IT IS UNCOVERED, ADEQUATE PROTECTION SHALL BE PROVIDED FOR THE EXISTING INSTALLATION. ALL KNOWN OWNERS OF UNDERGROUND FACILITIES IN THE AREA CONCERNED SHALL BE ADVISED OF PROPOSED WORK AT LEAST 48 HOURS PRIOR TO THE START OF ACTUAL EXCAVATION.
9. APPROPRIATE DUST CONTROL SHALL BE PROVIDED, AT THE CONTRACTOR'S EXPENSE, TO MINIMIZE ANY DUST NUISANCE AND SHALL BE IN ACCORDANCE WITH SECTION 10 OF CALTRANS STANDARD SPECIFICATIONS, THE REQUIREMENTS OF SAN JOAQUIN COUNTY AND THE APPROVED SWPPP.
10. THE CONTRACTOR SHALL NOTIFY M.C.R. ENGINEERING AT LEAST 48 HOURS PRIOR TO BACKFILLING OF ANY PIPE WHICH STUBS TO A FUTURE PHASE OF CONSTRUCTION FOR INVERT VERIFICATION. TOLERANCE SHALL BE IN ACCORDANCE WITH THE CITY OF STOCKTON STANDARD SPECIFICATIONS.
11. ANY AND ALL SEDIMENT AND/OR EROSION CONTROL DETAILS CONTAINED WITHIN THESE PLANS ARE TO BE CONSIDERED AS "REFERENCE DETAILS" ONLY AND THE COUNTY'S APPROVAL OF THESE PLANS AND "REFERENCE DETAILS" DOES NOT RELIEVE THE OWNER/DEVELOPER FROM COMPLIANCE WITH THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AS APPROVED BY THE COUNTY'S STORMWATER DIVISION.
12. IN ADDITION TO ALL OF THE OTHER REQUIRED PERMITS, THE CONTRACTOR SHALL HAVE A GRADING AND EROSION CONTROL PERMIT COMPLETE WITH AN APPROVED SWPPP.
13. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF THE STATE WATER RESOURCES CONTROL BOARD (SWRCB) ORDER NO. 99-08-DWQ, NPDES GENERAL PERMIT NO. CAS000002. THE CONTRACTOR SHALL IMPLEMENT AND MONITOR A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) IN ACCORDANCE WITH THE SWRCB REGULATIONS.

GRADING NOTES:

1. EARTHWORK SHALL BE PERFORMED IN ACCORDANCE WITH THE COUNTY OF SAN JOAQUIN STANDARDS AND F.H.A. STANDARDS.
2. IT IS ANTICIPATED THAT THE SITE GRADING WILL REQUIRE IMPORT OF SOIL. THE CONTRACTOR SHALL INCLUDE IMPORT OF SOIL IN THE GRADING PRICE.
3. THE CONTRACTOR SHALL REVIEW SITE PRIOR TO BIDDING. ALL VEGETATION AND DELETERIOUS MATERIALS SHALL BE REMOVED FROM THE SITE AT THE EXPENSE OF THE CONTRACTOR AND SHALL BE INCLUDED IN THE LUMP SUM CLEARING COST.
4. THE CONTRACTOR SHALL PRESERVE ALL STAKES AND POINTS SET FOR LINES, GRADES OR MEASUREMENT OF THE WORK IN THEIR PROPER PLACES UNTIL AUTHORIZED TO REMOVE THEM BY THE ENGINEER. ALL EXPENSES INCURRED IN REPLACING STAKES THAT HAVE BEEN REMOVED WITHOUT PROPER AUTHORITY SHALL BE PAID FOR BY THE GENERAL CONTRACTOR.

STORM DRAIN NOTES:

1. ALL CONSTRUCTION AND MATERIALS FOR DRAINAGE SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE COUNTY OF SAN JOAQUIN IMPROVEMENT STANDARDS AND STANDARD CONSTRUCTION SPECIFICATIONS. WHERE DISCREPANCIES EXIST, APPROPRIATE NOTES SHALL BE ADDED TO THE PLANS, TAKING PRECEDENCE OVER THE STANDARD CONSTRUCTION SPECIFICATIONS.
2. STORM DRAINAGE PIPE SHALL BE CLASS IV REINFORCED CONCRETE PIPE.
3. THE CONTRACTOR SHALL PLACE THE PROPER STRENGTH PIPE IF TRENCH CONDITIONS ENCOUNTERED DIFFER FROM THE DESIGN TRENCH.
4. THE CONTRACTOR SHALL PROVIDE ALL SHORING, BRACING, SLOPING OR OTHER PROVISIONS NECESSARY TO PROTECT WORKMEN FOR ALL AREAS TO BE EXCAVATED TO A DEPTH OF 5 FEET OR MORE. SAID PROTECTION TO BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF THE COUNTY OF SAN JOAQUIN DEPARTMENT OF PUBLIC WORKS, AND STATE REGULATIONS.

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MANTECA, CA 95336
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REVISIONS			
NO.	DESCRIPTIONS	DATE	APPROVED

JOB NO. 12-048
DATE 12-14-12
SCALE AS NOTED
DR. BY KRL
CK. BY TM
FILE: 12-048 BARTON RANCH CROSSING

PLAN AND PROFILE AND CROSS SECTION
BARTON RANCH
PROPOSED CREEK CROSSING
SAN JOAQUIN COUNTY, FARMINGTON, CALIFORNIA

SHEET 1 OF 1 SHEETS

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Attachment D

BARTON RANCH FARM CROSSING AT LITTLEJOHN'S CREEK

HYDROLOGY & HYDRAULICS STUDY

SAN JOAQUIN COUNTY, CALIFORNIA

PREPARED BY:

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Manteca, California 95336
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PREPARED FOR:

BARTON RANCH

REGISTERED PROFESSIONAL ENGINEER
No. C51015
Exp. 9-30-13
CIVIL
STATE OF CALIFORNIA

December 5, 2012

1.0 BACKGROUND

The Barton family desires to replace an existing wood bridge over Littlejohn's Creek with a culvert on their farm near Farmington, in San Joaquin County. The site includes both the old wood bridge that is used during rainy season, and an at-grade crossing that is used when the creek is dry. The crossings are located about ½ mile south of Sonora Road and approximately 1½ miles west of Henry Road in San Joaquin County. Photos of the bridge and at grade crossing are included below:

Existing Wood Bridge

Existing at-grade crossing

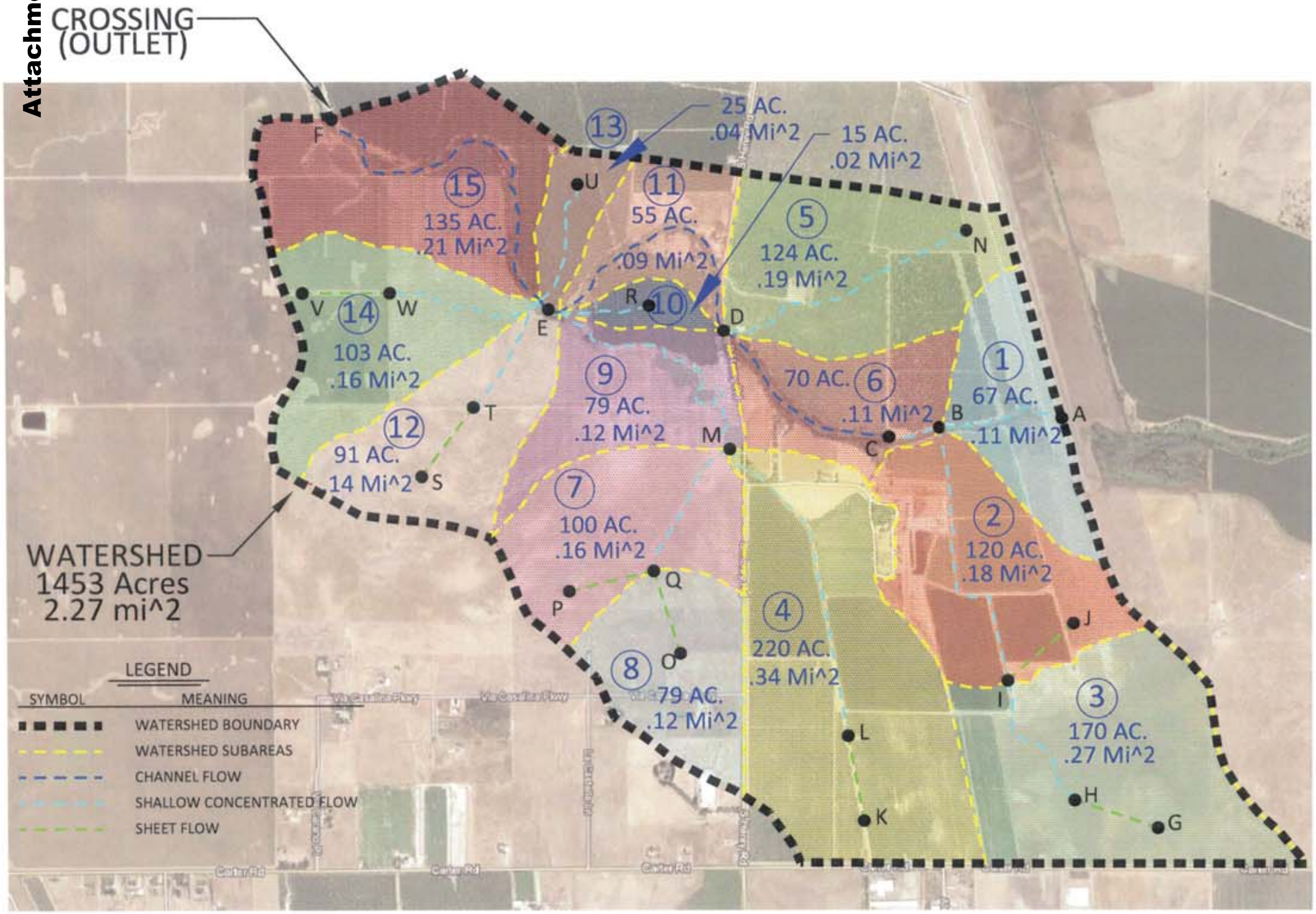
An aerial photo of the site is shown below, with the location of the crossing circled in red. The Farmington Dam (visible on the right side of the photo) releases flow into Rock Creek, which feeds Littlejohn's Creek downstream of the project site. The project site is about ¼ mile upstream and of the conversion of Rock Creek and Littlejohn's Creek, and approximately 10 feet higher in elevation.

2.0 HYDROLOGY & HYDRAULICS

The purpose of this study is to determine the size of culvert that will be required to accommodate the peak flow in Littlejohn's Creek during a 100-year storm event. There are no public records of discharges in Littlejohn's Creek in the vicinity of the project. The project lies on a "finger" of Littlejohn's Creek that extends from the junction of Rock Creek and Littlejohn's Creek approximately 1 ½ miles east where it dead ends at the Farmington Dam. The dam does not release any water into this portion of Littlejohn's creek, and so the only flow in the creek is runoff from the watershed that drains into it.

To determine the 100-year storm flow in the Creek at the proposed culvert crossing, MCR Engineering prepared hydrology calculations using the TR-55 method. We used USGS Quad maps to determine the size of the watershed as well as the size and characteristics of the sub-areas within the watershed. The overall watershed consists of 1453 acres of mostly farmland (row crops and orchards), with soil types varying from B to D.

Attachment D



SUBAREA	SOIL TYPE	HYDROLOGIC SOIL GOUP	DRAINAGE AREA (mi^2)
1	CROPS + RESIDUE	B,D	.11 mi^2
2	CROPS + RESIDUE	B,D	.18 mi^2
3	WOODS	D	.27 mi^2
4	CROPS + RESIDUE	B,D	.34 mi^2
5	WOODS (ORCHARD)	B,C	.19 mi^2
6	WOODS (ORCHARD)	B	.11 mi^2
7	GRASSLAND/BRUSH	B,D	.16 mi^2
8	GRASSLAND/BRUSH	D	.12 mi^2
9	WOODS/BRUSH	B,D	.12 mi^2
10	WOODS/GRASS	B	.02 mi^2
11	WOODS/GRASS	B,C	.09 mi^2
12	WOODS/BRUSH	B,D	.14 mi^2
13	WOODS/GRASS	B,C	.04 mi^2
14	CROPS + RESIDUE	B,D	.16 mi^2
15	WOODS/GRASS	B,C,D	.21 mi^2

REACH	FLOW TYPE	LENGTH (ft)	SLOPE (%)
AB	SHALLOW CONCENTRATED	1485'	1.35%
BC	SHALLOW CONCENTRATED	589'	1.35%
CD	CHANNEL	2396'	.32%
DE	CHANNEL	3311'	.55%
EF	CHANNEL	4565'	.32%
GH	SHEET	1000'	.8%
HI	SHALLOW CONCENTRATED	1734'	.85%
JI	SHEET	1000'	.85%
IB	SHALLOW CONCENTRATED	3331'	.85%
KL	SHEET	1000'	1.0%
LM	SHALLOW CONCENTRATED	3760'	.50%
ND	SHALLOW CONCENTRATED	3205'	.40%
OQ	SHEET	1000'	1.0%
PQ	SHEET	1000'	1.0%
QM	SHALLOW CONCENTRATED	1751'	.70%
ME	SHALLOW CONCENTRATED	3493'	.30%
RE	SHALLOW CONCENTRATED	1039'	.50%
ST	SHEET	1000'	.60%
TE	SHALLOW CONCENTRATED	1471'	.60%
UE	SHALLOW CONCENTRATED	1503'	.32%
VW	SHEET	1000'	.60%
WE	SHALLOW CONCENTRATED	1833'	.60%

We delineated 15 subareas ranging in size from .02 to .34 square miles, as shown on the previous exhibit. To keep the study relatively simple (and the cost down), we made conservative assumptions wherever possible. The two most notable assumptions that make our results conservative are as follows:

1. Detention Ponds – the runoff from Subarea 4 passes through a series of retention ponds that we did account for in the model. These ponds will attenuate the peak flow and increase the travel time. Moreover, the flow through these ponds are restricted by a culvert crossing under Henry Road (near point M on map) that is not accounted for in the model. Accounting for these characteristics in the model would flatten the hydrograph and reduce the peak flow at the proposed crossing.

2. Henry Road Crossings – The existing culvert crossing in Littlejohn's creek under Henry road is a 36" CMP pipe that is approximately 80% filled with mud and debri. The photo below shows that the bottom of the creek is less than a foot from the top of the pipe. The model predicts that runoff that passes through this culvert from subareas 1, 2, 3, 5 & 6 will contribute almost 69 cfs to the peak flow at the proposed crossing (see green highlighted cells in hydrograph). This is simply not possible, given the limited area available in the culvert (see photo below).

3.0 CONCLUSIONS

The attached TR-55 calculations demonstrate that the computed peak flow in Littlejohn's Creek at the proposed culvert crossing for a 100-year storm event is **153.4 cfs.**

We analyzed two 42" RCP culverts, with 2 feet of cover under these flow conditions and found that the 100-year storm will pass through the culvert with only 1.72' of head loss. This appears to be a reasonable size, given the fact that the culvert under Henry Road is a 36" CMP culvert, and local farmers have no recollection of that culvert ever backing up, even during the 1997 floods.

RUNOFF CURVE NUMBER AND RUNOFF

Watershed CN Values

December-2012

Project: Barton Creek Ranch

Location: Farmington, CA

1. Runoff Curve Number

Subarea & Hydrological Soil Group (appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	Area (mi^2)	Product of CN x Area
1	CROPS + RESIDUE	70	0.11	7.7
2	CROPS + RESIDUE	75	0.18	13.5
3	WOODS	75	0.27	20.25
4	CROPS + RESIDUE	75	0.34	25.5
5	WOODS (ORCHARD)	68	0.19	12.92
6	WOODS (ORCHARD)	72	0.11	7.92
7	GRASSLAND/BRUSH	73	0.16	11.68
8	GRASSLAND/BRUSH	73	0.12	8.76
9	WOODS/BRUSH	56	0.12	6.72
10	WOODS/GRASS	58	0.02	1.16
11	WOODS/GRASS	65	0.09	5.85
12	WOODS/GRASS	62	0.14	8.68
13	WOODS/GRASS	65	0.04	2.6
14	CROPS + RESIDUE	75	0.16	12
15	WOODS/GRASS	58	0.21	12.18
		TOTALS:	2.26	157.4

$$\text{CN (Weighted)} = \frac{\text{Total Product}}{\text{Total Area}} = \frac{157.4}{2.26}$$

Use CN 70

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency:	yr	10	100	
Rainfall, P (24-hr):	in	2.4	3.36	
Runoff, Q:	in	0.4	0.9	

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 1

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Units	Segment ID		
1. Surface Description (table 3-1)				
2. Manning's Roughness coefficient, n (table3-1)				
3. Flow Length, L	ft			
4. 24-hour Rainfall, P	in			
5. Land Slope, s	ft/ft			
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5}s^{.4}}$	Totals:			
	T_t (hr) =			

Shallow Concentrated Flow

	Units	Segment ID AB		
7. Surface Description (paved or unpaved)		U		
8. Flow Length, L	ft	1485		
9. Watercourse slope, s	ft/ft	0.135		
10. Average velocity, V (figure 3-1)	ft/s	1.9		
11. $T_t = \frac{L}{3600V}$	Totals:	0.217		
	T_t (hr) =			0.217

Channel Flow

	Units	Segment ID		
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$	Totals:			
	T_t (hr) =			
20. Watershed or subarea T_c or T_t	Hr			0.22

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 2

December-2012

Project: Barton Creek Ranch

Location: Farmington, CA

Sheet Flow

	Units			
Segment ID		JI		
1. Surface Description (table 3-1)		GRASS		
2. Manning's Roughness coefficient,n (table3-1)		0.15		
3. Flow Length, L	ft	1000		
4. 24-hour Rainfall, P	in	3.36		
5. Land Slope, s	ft/ft	0.0085		
6. $T_t = \frac{.007(nL)^{8}}{p_2^{.5} s^{.4}}$	**Totals:**	1.416		
	T_t (hr)		=	1.416

Shallow Concentrated Flow

	Units			
Segment ID		IB		
7. Surface Description (paved or unpaved)		U		
8. Flow Length, L	ft	3331		
9. Watercourse slope, s	ft/ft	0.0085		
10. Average velocity, V (figure 3-1)	ft/s	1.487527		
11. $T_t = \frac{L}{3600V}$	**Totals:**	0.622		
	T_t (hr)		=	0.622

Channel Flow

	Units			
Segment ID				
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$	**Totals:**			
	T_t (hr)		=	
20. Watershed or subarea T_c or T_t	Hr			2.04

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 3

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Segment ID		GH		
1.	Surface Description (table 3-1)		GRASS		
2.	Manning's Roughness coefficient,n (table3-1)		0.17		
3.	Flow Length, L	ft	1000		
4.	24-hour Rainfall, P	in	3.36		
5.	Land Slope, s	ft/ft	0.008		
6.	$T_t = \frac{.007(nL)^{.8}}{P_2^{.5}s^{.4}}$	Totals:	1.603		
			T_t (hr)	=	1.603

Shallow Concentrated Flow

	Segment ID		HI		
7.	Surface Description (paved or unpaved)		U		
8.	Flow Length, L	ft	1734		
9.	Watercourse slope, s	ft/ft	0.0085		
10.	Average velocity, V (figure 3-1)	ft/s	1.488		
11.	$T_t = \frac{L}{3600V}$	Totals:	0.323804		
			T_t (hr)	=	0.324

Channel Flow

	Segment ID				
12.	Cross Sectional Flow Area, a	ft^2			
13.	Wetted Perimeter, Pw	ft			
14.	Hydraulic Radius, r = a/Pw	ft			
15.	Channel Slope, s	ft/ft			
16.	Manning's Roughness Coefficient, n				
17.	$\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s			
18.	Flow Length, L	ft			
19.	$T_t = \frac{L}{3600V}$	Totals:			
			T_t (hr)	=	
20.	Watershed or subarea T_c or T_t			Hr	1.93

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 4

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Segment ID	KL		
1. Surface Description (table 3-1)		GRASS		
2. Manning's Roughness coefficient,n (table3-1)		0.15		
3. Flow Length, L	ft	1000		
4. 24-hour Rainfall, P	in	3.36		
5. Land Slope, s	ft/ft	0.01		
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5} s^{.4}}$	**Totals:**	1.327		
		T_t (hr)	=	1.327

Shallow Concentrated Flow

	Segment ID	LM		
7. Surface Description (paved or unpaved)		U		
8. Flow Length, L	ft	3760		
9. Watercourse slope, s	ft/ft	0.005		
10. Average velocity, V (figure 3-1)	ft/s	1.141		
11. $T_t = \frac{L}{3600V}$	**Totals:**	0.915472		
		T_t (hr)	=	0.915

Channel Flow

	Segment ID			
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$	**Totals:**			
		T_t (hr)	=	
20. Watershed or subarea T_c or T_t			Hr	2.24

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 5

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

		Segment ID			
1.	Surface Description (table 3-1)				
2.	Manning's Roughness coefficient,n (table3-1)				
3.	Flow Length, L	ft			
4.	24-hour Rainfall, P	in			
5.	Land Slope, s	ft/ft			
6.	$T_t = \frac{.007(nL)^{8}}{p_2^{.5}s^{4}}$	Totals:			
		T_t (hr) =			

Shallow Concentrated Flow

		Segment ID	ND		
7.	Surface Description (paved or unpaved)		U		
8.	Flow Length, L	ft	3205		
9.	Watercourse slope, s	ft/ft	0.004		
10.	Average velocity, V (figure 3-1)	ft/s	1.020435		
11.	$T_t = \frac{L}{3600V}$	Totals:	0.872		
		T_t (hr) =			0.872

Channel Flow

		Segment ID			
12.	Cross Sectional Flow Area, a	ft^2			
13.	Wetted Perimeter, Pw	ft			
14.	Hydraulic Radius, r = a/Pw	ft			
15.	Channel Slope, s	ft/ft			
16.	Manning's Roughness Coefficient, n				
17.	$\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s			
18.	Flow Length, L	ft			
19.	$T_t = \frac{L}{3600V}$	Totals:			
		T_t (hr) =			
20.	Watershed or subarea T_c or T_t	Hr			0.87

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 6

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

		Segment ID			
1.	Surface Description (table 3-1)				
2.	Manning's Roughness coefficient,n (table3-1)				
3.	Flow Length, L	ft			
4.	24-hour Rainfall, P	in			
5.	Land Slope, s	ft/ft			
6.	$T_t = \frac{.007(nL)^{.8}}{p_2^{.5}s^{.4}}$	Totals:			
		T_t (hr) =			

Shallow Concentrated Flow

		Segment ID	BC		
7.	Surface Description (paved or unpaved)		U		
8.	Flow Length, L	ft	585		
9.	Watercourse slope, s	ft/ft	0.135		
10.	Average velocity, V (figure 3-1)	ft/s	5.928194		
11.	$T_t = \frac{L}{3600V}$	Totals:	0.027		
		T_t (hr) =			0.027

Channel Flow

		Segment ID	CD		
12.	Cross Sectional Flow Area, a	ft^2	788		
13.	Wetted Perimeter, Pw	ft	178		
14.	Hydraulic Radius, r = a/Pw	ft	4.427		
15.	Channel Slope, s	ft/ft	0.0032		
16.	Manning's Roughness Coefficient, n		0.15		
17.	$\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s	1.51		
18.	Flow Length, L	ft	2396		
19.	$T_t = \frac{L}{3600V}$	Totals:	0.439		
		T_t (hr) =			0.44
20.	Watershed or subarea T_c or T_t	Hr			0.47

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 7

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Units			
Segment ID		PQ		
1. Surface Description (table 3-1)		GRASS		
2. Manning's Roughness coefficient,n (table3-1)		0.15		
3. Flow Length, L	ft	1000		
4. 24-hour Rainfall, P	in	3.36		
5. Land Slope, s	ft/ft	0.01		
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5} s^{.4}}$	Totals:	1.327		
	T_t (hr)		=	1.327

Shallow Concentrated Flow

	Units			
Segment ID		QM		
7. Surface Description (paved or unpaved)		U		
8. Flow Length, L	ft	1751		
9. Watercourse slope, s	ft/ft	0.007		
10. Average velocity, V (figure 3-1)	ft/s	1.349909		
11. $T_t = \frac{L}{3600V}$	Totals:	0.360		
	T_t (hr)		=	0.360

Channel Flow

	Units			
Segment ID				
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$	Totals:			
	T_t (hr)		=	
20. Watershed or subarea T_c or T_t	Hr			1.69

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 8

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Unit			
Segment ID		OQ		
1. Surface Description (table 3-1)		GRASS		
2. Manning's Roughness coefficient,n (table3-1)		0.15		
3. Flow Length, L	ft	1000		
4. 24-hour Rainfall, P	in	3.36		
5. Land Slope, s	ft/ft	0.01		
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5} s^{.4}}$	**Totals:**	1.327		
	T_t (hr)	=		1.327

Shallow Concentrated Flow

	Unit			
Segment ID				
7. Surface Description (paved or unpaved)				
8. Flow Length, L	ft			
9. Watercourse slope, s	ft/ft			
10. Average velocity, V (figure 3-1)	ft/s			
11. $T_t = \frac{L}{3600V}$	**Totals:**			
	T_t (hr)	=		0.000

Channel Flow

	Unit			
Segment ID				
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$	**Totals:**			
	T_t (hr)	=		
20. Watershed or subarea T_c or T_t	Hr			1.33

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 9

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

		Segment ID			
1.	Surface Description (table 3-1)				
2.	Manning's Roughness coefficient,n (table3-1)				
3.	Flow Length, L	ft			
4.	24-hour Rainfall, P	in			
5.	Land Slope, s	ft/ft			
6.	$T_t = \frac{.007(nL)^{8}}{p_2^{.5} s^{4}}$	Totals:			
		T_t (hr) =			

Shallow Concentrated Flow

		Segment ID	ME		
7.	Surface Description (paved or unpaved)		U		
8.	Flow Length, L	ft	3493		
9.	Watercourse slope, s	ft/ft	0.003		
10.	Average velocity, V (figure 3-1)	ft/s	0.883723		
11.	$T_t = \frac{L}{3600V}$	Totals:	1.098		
		T_t (hr) =			1.098

Channel Flow

		Segment ID			
12.	Cross Sectional Flow Area, a	ft^2			
13.	Wetted Perimeter, Pw	ft			
14.	Hydraulic Radius, r = a/Pw	ft			
15.	Channel Slope, s	ft/ft			
16.	Manning's Roughness Coefficient, n				
17.	$\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s			
18.	Flow Length, L	ft			
19.	$T_t = \frac{L}{3600V}$	Totals:			
		T_t (hr) =			

20. Watershed or subarea T_c or T_t .... Hr **1.10**

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 10

December-2012

Project: Barton Creek Ranch

Location: Farmington, CA

Sheet Flow

	Unit			
Segment ID				
1. Surface Description (table 3-1)				
2. Manning's Roughness coefficient,n (table3-1)				
3. Flow Length, L	ft			
4. 24-hour Rainfall, P	in			
5. Land Slope, s	ft/ft			
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5} s^{.4}}$	**Totals:**			
	T_t (hr) =			

Shallow Concentrated Flow

	Unit			
Segment ID		RE		
7. Surface Description (paved or unpaved)		U		
8. Flow Length, L	ft	1039		
9. Watercourse slope, s	ft/ft	0.005		
10. Average velocity, V (figure 3-1)	ft/s	1.140881		
11. $T_t = \frac{L}{3600V}$	**Totals:**	0.253		
	T_t (hr) =			0.253

Channel Flow

	Unit			
Segment ID				
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$	**Totals:**			
	T_t (hr) =			

20. Watershed or subarea T_c or T_t .... Hr **0.25**

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 11

December-2012

Project: Barton Creek Ranch

Location: Farmington, CA

Sheet Flow

	Unit	Segment ID		
1. Surface Description (table 3-1)				
2. Manning's Roughness coefficient,n (table3-1)				
3. Flow Length, L	ft			
4. 24-hour Rainfall, P	in			
5. Land Slope, s	ft/ft			
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5} s^{.4}}$	Totals:			
	T_t (hr) =			

Shallow Concentrated Flow

	Unit	Segment ID		
7. Surface Description (paved or unpaved)				
8. Flow Length, L	ft			
9. Watercourse slope, s	ft/ft			
10. Average velocity, V (figure 3-1)	ft/s			
11. $T_t = \frac{L}{3600V}$	Totals:			
	T_t (hr) =			

Channel Flow

	Unit	Segment ID DE		
12. Cross Sectional Flow Area, a	ft^2	788		
13. Wetted Perimeter, Pw	ft	178		
14. Hydraulic Radius, r = a/Pw	ft	4.427		
15. Channel Slope, s	ft/ft	0.0055		
16. Manning's Roughness Coefficient, n		0.15		
17. $\frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s	1.99		
18. Flow Length, L	ft	3311		
19. $T_t = \frac{L}{3600V}$	Totals:	0.463		
	T_t (hr) =			0.46

20. Watershed or subarea T_c or T_t .... Hr **0.46**

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 12

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Segment ID	ST		
1. Surface Description (table 3-1)		GRASS		
2. Manning's Roughness coefficient,n (table3-1)		0.15		
3. Flow Length, L	ft	1000		
4. 24-hour Rainfall, P	in	3.36		
5. Land Slope, s	ft/ft	0.006		
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5}s^{.4}}$	**Totals:**	1.628		
	T_t (hr)	=		1.628

Shallow Concentrated Flow

	Segment ID	TE		
7. Surface Description (paved or unpaved)		U		
8. Flow Length, L	ft	1471		
9. Watercourse slope, s	ft/ft	0.006		
10. Average velocity, V (figure 3-1)	ft/s	1.249773		
11. $T_t = \frac{L}{3600V}$	**Totals:**	0.327		
	T_t (hr)	=		0.327

Channel Flow

	Segment ID			
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$	**Totals:**			
	T_t (hr)	=		
20. Watershed or subarea T_c or T_t		Hr		1.95

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 13

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Unit			
Segment ID				
1. Surface Description (table 3-1)				
2. Manning's Roughness coefficient,n (table3-1)				
3. Flow Length, L	ft			
4. 24-hour Rainfall, P	in			
5. Land Slope, s	ft/ft			
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5} s^{.4}}$ — Totals:				
T_t (hr) =				

Shallow Concentrated Flow

	Unit			
Segment ID		UE		
7. Surface Description (paved or unpaved)		U		
8. Flow Length, L	ft	1503		
9. Watercourse slope, s	ft/ft	0.0032		
10. Average velocity, V (figure 3-1)	ft/s	0.912705		
11. $T_t = \frac{L}{3600V}$ — Totals:		0.457		
T_t (hr) =				0.457

Channel Flow

	Unit			
Segment ID				
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$ — Totals:				
T_t (hr) =				

20. Watershed or subarea T_c or T_t .... Hr **0.46**

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 14

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Segment ID	VW		
1. Surface Description (table 3-1)		GRASS		
2. Manning's Roughness coefficient,n (table3-1)		0.15		
3. Flow Length, L	ft	1000		
4. 24-hour Rainfall, P	in	3.36		
5. Land Slope, s	ft/ft	0.006		
6. $T_t = \frac{.007(nL)^{.8}}{p_2^{.5} s^{4}}$	**Totals:**	1.628		
		T_t (hr)	=	1.628

Shallow Concentrated Flow

	Segment ID	WE		
7. Surface Description (paved or unpaved)		U		
8. Flow Length, L	ft	1833		
9. Watercourse slope, s	ft/ft	0.006		
10. Average velocity, V (figure 3-1)	ft/s	1.249773		
11. $T_t = \frac{L}{3600V}$	**Totals:**	0.407		
		T_t (hr)	=	0.407

Channel Flow

	Segment ID			
12. Cross Sectional Flow Area, a	ft^2			
13. Wetted Perimeter, Pw	ft			
14. Hydraulic Radius, r = a/Pw	ft			
15. Channel Slope, s	ft/ft			
16. Manning's Roughness Coefficient, n				
17. $\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s			
18. Flow Length, L	ft			
19. $T_t = \frac{L}{3600V}$	**Totals:**			
		T_t (hr)	=	
20. Watershed or subarea T_c or T_t			Hr	2.03

TIME OF CONCENTRATION (Tc)/TRAVEL TIME (Tt)

SUB-AREA 15

December-2012

Project: Barton Creek Ranch
Location: Farmington, CA

Sheet Flow

	Segment ID			
1. Surface Description (table 3-1)				
2. Manning's Roughness coefficient,n (table3-1)				
3. Flow Length, L	ft			
4. 24-hour Rainfall, P	in			
5. Land Slope, s	ft/ft			
6. $T_t = \frac{.007(nL)^{8}}{p_2^{.5}s^{.4}}$	Totals:			
	T_t (hr) =			

Shallow Concentrated Flow

	Segment ID			
7. Surface Description (paved or unpaved)				
8. Flow Length, L	ft			
9. Watercourse slope, s	ft/ft			
10. Average velocity, V (figure 3-1)	ft/s			
11. $T_t = \frac{L}{3600V}$	Totals:			
	T_t (hr) =			

Channel Flow

	Segment ID	EF		
12. Cross Sectional Flow Area, a	ft^2	788		
13. Wetted Perimeter, Pw	ft	178		
14. Hydraulic Radius, r = a/Pw	ft	4.427		
15. Channel Slope, s	ft/ft	0.005		
16. Manning's Roughness Coefficient, n		0.15		
17. $\frac{1.49r^{2/3}s^{1/2}}{n}$ Compute V	ft/s	1.89		
18. Flow Length, L	ft	4565		
19. $T_t = \frac{L}{3600V}$	Totals:	0.670		
	T_t (hr) =			0.67
20. Watershed or subarea T_c or T_t	Hr			0.67

Attachment D

Project: Barton Ranch Creek Crossing

Location: Farmington, CA

Date: December-2012

Tabular Method for Hydrograph Discharge

Frequency (yr): 100 Rainfall (P): 3.36

Subarea name	Drainage area A_m $1mi^2$=640 AC (mi2)	time of concen-tration T_c (hr)	Travel time through subarea T_t (hr)	downstream subarea names	Travel time summation to outlet ΣT_t (hr)	24-hr rainfall P (in)	Runoff curve number CN	Runoff Q (in)	A_mQ (mi^2-in)	Initial abstraction I_a (in)	I_a/P	I_a/P Rounded (.1, .3, or .5)
1	0.11	0.22	0.00	CD,DE,EF	1.57	3.4	70	0.92	0.10	0.857	0.26	0.3
2	0.18	2.04	0.00	CD,DE,EF	1.57	3.4	75	1.20	0.22	0.667	0.20	0.3
3	0.27	1.93	0.00	CD,DE,EF	1.57	3.4	75	1.20	0.32	0.667	0.20	0.3
4	0.34	2.24	0.00	CD,DE,EF	1.57	3.4	75	1.20	0.41	0.667	0.20	0.3
5	0.19	0.87	0.00	CD,DE,EF	1.57	3.4	68	0.82	0.16	0.941	0.28	0.3
6	0.11	0.47	0.44	DE,EF	1.13	3.4	72	1.03	0.11	0.778	0.23	0.3
7	0.16	1.69	0.00	DE,EF	1.13	3.4	73	1.09	0.17	0.740	0.22	0.3
8	0.12	1.33	0.00	DE,EF	1.13	3.4	73	1.09	0.13	0.740	0.22	0.3
9	0.12	1.10	0.00	DE,EF	1.13	3.4	56	0.33	0.04	1.571	0.47	0.5
10	0.02	0.25	0.00	DE,EF	1.13	3.4	58	0.40	0.01	1.448	0.43	0.5
11	0.09	0.46	0.46	EF	0.67	3.4	65	0.68	0.06	1.077	0.32	0.3
12	0.14	1.95	0.00	EF	0.67	3.4	62	0.55	0.08	1.226	0.36	0.3
13	0.04	0.46	0.00	EF	0.67	3.4	65	0.68	0.03	1.077	0.32	0.3
14	0.16	2.03	0.00	EF	0.67	3.4	75	1.20	0.19	0.667	0.20	0.3
15	0.21	0.67	0.67	-	0.00	3.4	58	0.40	0.08	1.448	0.43	0.5

Attachment D

Project: Barton Ranch Creek Crossing
Location: Farmington, CA
Date: December-2012

Tabular Method for Hydrograph Discharge

Frequency (yr): 100

Subarea name	Basic Watershed Data Used				Select and enter hydrograph times in hours from exhibit (per rainfall dist. Category)										
	Sub-area Tc	ΣT_t to outlet	I_a/P	A_mQ	11.8	12.0	12.3	12.6	13.0	13.5	14.0	14.5	15.0	15.5	16.0	17.0
					Discharges at selected hydrograph times											
1	0.22	1.57	0.3	0.10	12.79	12.28	10.05	8.12	6.80	6.19	5.68	5.38	4.97	4.47	4.16	3.96
2	2.04	1.57	0.3	0.22	2.17	4.12	8.23	12.57	16.90	17.98	16.47	14.73	13.43	12.35	11.48	9.75
3	1.93	1.57	0.3	0.32	3.25	6.17	12.35	18.85	25.35	26.97	24.70	22.10	20.15	18.52	17.22	14.62
4	2.24	1.57	0.3	0.41	0.82	1.64	5.32	11.87	22.51	31.51	33.56	30.69	27.83	25.37	23.33	19.64
5	0.87	1.57	0.3	0.16	8.58	12.48	16.23	16.23	13.73	11.39	9.83	9.05	8.27	7.65	7.02	6.40
6	0.47	1.13	0.3	0.11	12.69	10.88	8.84	7.82	7.03	6.46	6.12	5.67	5.21	4.76	4.53	4.42
7	1.69	1.13	0.3	0.17	5.91	8.52	11.82	14.08	14.78	13.39	12.00	10.95	10.08	9.21	8.52	7.48
8	1.33	1.13	0.3	0.13	9.00	10.95	12.39	12.00	10.56	9.26	8.21	7.56	6.91	6.39	5.87	5.35
9	1.10	1.13	0.5	0.04	0.68	0.96	1.35	1.63	1.83	1.87	1.87	1.87	1.87	1.87	1.87	1.87
10	0.25	1.13	0.5	0.01	0.35	0.38	0.40	0.41	0.42	0.42	0.42	0.42	0.40	0.40	0.40	0.39
11	0.46	0.67	0.3	0.06	5.32	4.71	4.16	3.85	3.61	3.36	3.12	2.88	2.63	2.51	2.45	2.39
12	1.95	0.67	0.3	0.08	5.17	5.94	6.71	6.56	5.94	5.32	4.86	4.48	4.17	3.78	3.55	3.16
13	0.46	0.67	0.3	0.03	2.37	2.09	1.85	1.71	1.60	1.50	1.39	1.28	1.17	1.11	1.09	1.06
14	2.03	0.67	0.3	0.19	10.78	13.29	15.79	16.37	15.41	13.87	12.52	11.56	10.59	9.82	9.05	8.09
15	0.67	0.00	0.5	0.08	4.02	4.11	4.11	4.11	4.11	4.11	4.11	4.11	4.11	4.11	4.11	4.11
Composite hydrograph at outlet					83.90	98.52	119.60	136.17	150.57	153.60	144.85	132.72	121.80	112.33	104.65	92.68

Discharge at Point D at Henry Rd (cfs): 69.00

Subarea name	Actual Sum	METHOD 1 SEPARATE ROUNDING				METHOD 2 T_C DOWN T_T UP				METHOD 3 T_C UP T_T DOWN			
		T_C	T_T	SUM	Difference	T_C	T_T	SUM	Difference	T_C	T_T	SUM	Difference
1	1.79	0.2	1.5	**1.7**	= 0.09	0.2	2	**2.2**	= 0.41	0.3	1.5	**1.8**	= 0.01
2	3.61	2	1.5	**3.5**	= 0.11	2	2	**4**	= 0.39	2	1.5	**3.5**	= 0.11
3	3.50	2	1.5	**3.5**	= 0.00	1.5	2	**3.5**	= 0.00	2	1.5	**3.5**	= 0.00
4	3.81	2	1.5	**3.5**	= 0.31	2	2	**4**	= 0.19	2	1.5	**3.5**	= 0.31
5	2.44	0.75	1.5	**2.25**	= 0.19	0.75	2	**2.75**	= 0.31	1	1.5	**2.5**	= 0.06
6	1.60	0.5	1	**1.5**	= 0.10	0.4	1.5	**1.9**	= 0.30	0.5	1	**1.5**	= 0.10
7	2.82	1.5	1	**2.5**	= 0.32	1.5	1.5	**3**	= 0.18	2	1	**3**	= 0.18
8	2.46	1.25	1	**2.25**	= 0.21	1.25	1.5	**2.75**	= 0.29	1.5	1	**2.5**	= 0.04
9	2.23	1	1	**2**	= 0.23	1	1.5	**2.5**	= 0.27	1.25	1	**2.25**	= 0.02
10	1.39	0.3	1	**1.3**	= 0.09	0.2	1.5	**1.7**	= 0.31	0.3	1	**1.3**	= 0.09
11	1.13	0.5	0.75	**1.25**	= 0.12	0.4	0.75	**1.15**	= 0.02	0.5	0.5	**1**	= 0.13
12	2.62	2	0.75	**2.75**	= 0.13	1.5	0.75	**2.25**	= 0.37	2	0.5	**2.5**	= 0.12
13	1.13	0.5	0.75	**1.25**	= 0.12	0.4	0.75	**1.15**	= 0.02	0.5	0.5	**1**	= 0.13
14	2.70	2	0.75	**2.75**	= 0.05	2	0.75	**2.75**	= 0.05	2	0.5	**2.5**	= 0.20
15	0.67	0.75	0	**0.75**	= 0.08	0.5	0	**0.5**	= 0.17	0.75	0	**0.75**	= 0.08

T_c Values	T_t Values
0.1	0
0.2	0.1
0.3	0.2
0.4	0.3
0.5	0.4
0.75	0.5
1	0.75
1.25	1
1.5	1.5
2	2
	2.5
	3

Attachment D

11.8	12.0	12.3	12.6	13.0	13.5	14.0	14.5	15.0	15.5	16.0	17.0	Subarea
Discharges at selected hydrograph times												
126	121	99	80	67	61	56	53	49	44	41	39	1
10	19	38	58	78	83	76	68	62	57	53	45	2
10	19	38	58	78	83	76	68	62	57	53	45	3
2	4	13	29	55	77	82	75	68	62	57	48	4
55	80	104	104	88	73	63	58	53	49	45	41	5
112	96	78	69	62	57	54	50	46	42	40	39	6
34	49	68	81	85	77	69	63	58	53	49	43	7
69	84	95	92	81	71	63	58	53	49	45	41	8
17	24	34	41	46	47	47	47	47	47	47	47	9
44	47	50	51	52	52	52	52	50	50	50	49	10
87	77	68	63	59	55	51	47	43	41	40	39	11
67	77	87	85	77	69	63	58	54	49	46	41	12
87	77	68	63	59	55	51	47	43	41	40	39	13
56	69	82	85	80	72	65	60	55	51	47	42	14
48	49	49	49	49	49	49	49	49	49	49	49	15
83.90	98.52	119.60	136.17	150.57	153.60	144.85	132.72	121.80	112.33	104.65	92.68	

Subarea name	TC	Ia/P	Tt
1	0.30	0.3	1.5
2	2.00	0.3	1.5
3	2.00	0.3	1.5
4	2.00	0.3	2
5	1.00	0.3	1.5
6	0.50	0.3	1
7	2.00	0.3	1
8	1.50	0.3	1
9	1.25	0.5	1
10	0.30	0.5	1
11	0.40	0.3	0.75
12	2.00	0.3	0.5
13	0.40	0.3	0.75
14	2.00	0.3	0.75
15	0.75	0.5	0

T_c Values	T_t Values
0.1	0
0.2	0.1
0.3	0.2
0.4	0.3
0.5	0.4
0.75	0.5
1	0.75
1.25	1
1.5	1.5
2	2
	2.5
	3

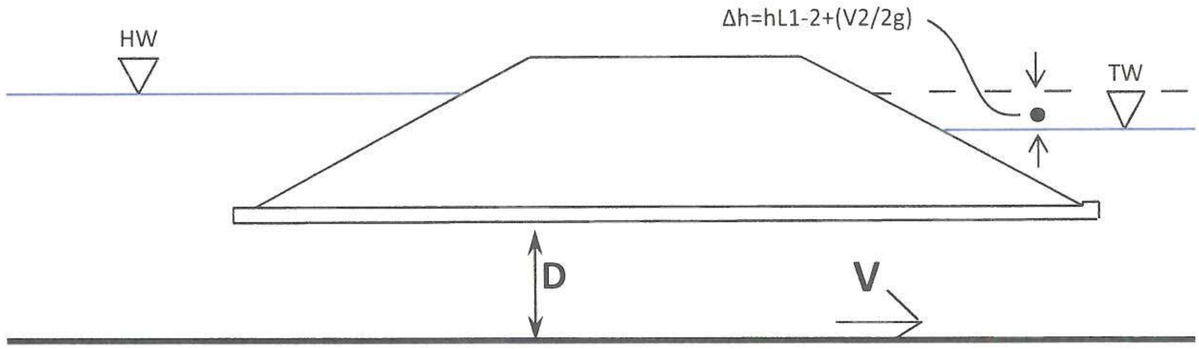
Attachment D

CULVERT DESIGN

100-YEAR EVENT

December-2012

CHANNEL GEOMETRY



Culvert Calculations

Equation

$\Delta h = (k_e + (29.2n^2L/Rh^{4/3}) + 1) * V^2/2g$

Diameter of Culvert: 3.5 ft

Where,	Q_t	=	Total Peak Flow	Q	=	155.3 cfs
	Q_1	=	Peak Flow through each pipe (2 pipe system)	Q	=	77.7 cfs
	A	=	Area of Pipe	A	=	9.6 sf
	k_e	=	entrance coefficient	k_e	=	0.5
	n	=	Friction Factor	n	=	0.012
	L	=	Length of pipe	L	=	40 ft
	R_h	=	Hydraulic Radius = D/4	R_h	=	0.88 ft
	V	=	Velocity = Q/A	V	=	8.07 ft/s
	g	=	Gravity	g	=	32.2 ft/s^2
	Δh	=	Head loss	Δh	=	1.722 ft

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MCR ENGINEERING
1242 DUPONT COURT • MANTECA, CALIFORNIA 95336 • TEL: 209.239.6229 • FAX: 209.239.8839

MEMORANDUM

		DATE:	July 3, 2013
PROJECT:	**Barton Ranch Farm Crossing At Littlejohn's Creek**	**JOB NO:**	**12-048**
FROM:	Tony Marshall, P.E.	**E-MAIL:**	tony@mcreng.com
TO:	Ashley Cousin Water Resource Engineer Central Valley Flood Protection Board 3310 El Camino Ave., Room 151 Sacramento, CA 95821	**E-MAIL:** **PHONE:**	Ashley.Cousin@water.ca.gov (916) 574-2380

The purpose of this technical memorandum is to provide additional hydraulic information & documentation to supplement the Hydrology/Hydraulics Report prepared by MCR Engineering for this project, dated December 5, 2012. Specifically, the Central Valley Flood Protection Board (CVFPB) asked us to address four specific concerns. These concerns are listed below along with our response:

1. Why was a hydraulic model not prepared for this project and/or why it is not appropriate for this project to do so?

The proposed project is a simple farm access crossing. After inspecting the site and reviewing topographic maps and the contributing watershed, we were convinced that the cost to prepare a full hydraulic model of the channel is simply not justified. The majority of the flow passing through the creek at the project location must first pass under Henry Road (upstream of the project) through two culverts; a 24" concrete culvert and a 36" CMP culvert. By installing two 42" RCP culverts at the project location, we will be providing more than double the combined capacity of the two upstream culverts.

2. Provide justification that this project will not result in any adverse hydraulic impact, that the post-project conditions will not be worse than the existing conditions.

In lieu of a full hydraulic model, we prepared a TR-55 hydrograph using the tabular method, to estimate the flow in the creek at the project location during a 100-yr storm event. We knew that this method would give us very conservative results in terms of flow, because in order to use this method, we had to oversimplify the watershed and sub-shed areas considerably. Our main purpose in preparing the model was to determine how the watershed functions and where the flows in the creek at the location of the project originate.

ENGINEERING

MEMORANDUM

1242 DUPONT COURT • MANTECA, CALIFORNIA 95336 • TEL: 209.239.6229 • FAX: 209.239.8839

What we learned from these calculations is that the flow passing under Henry Road through the 24" and 36" culverts represents roughly two-thirds of the flow at the project site. The hydrograph estimates the flow across Henry Road (through the two culverts) to be a combined 100 cfs. The estimated flow at the project site is 155 cfs, or approximately 55% more than the flow crossing Henry Road.

3. Provide justification that these culverts will pass the existing design flow without creating tail-water effects that will inundate adjacent properties.

Prior to the construction of the Farmington Dam, this portion of Littlejohn's Creek (from the Dam to the junction of Rock Creek) carried much larger flows than it does today. The dam releases into Rock Creek, and so this portion of Littlejohn's creek has been cut off from the historic upstream flows. Consequently, the natural channel is significantly larger than it needs to be. Upstream of the project site the channel varies in width, but maintains well defined banks. The bottom of the channel is consistently at least 6 feet below the banks. All farming lands and structures are well above the banks. The average width of the channel in this area is about 50 feet, and the overall slope (from Henry Road to the project site) is 0.12%. The channel bottom is mostly gravel and dirt, with wild grasses growing in it. Assigning at manning's roughness coefficient of 0.05 (Maximum High Grass, Chow, 1959), and modeling this configuration yields a water depth of about 24 inches to carry the 100-yr flow calculated by our hydrograph. This leaves approximately 4 feet of freeboard in the natural creek during a 100-year event.

The proposed, dual 42" pipes will be set at a slope of .02. At this slope these two pipes can carry approximately 142 cfs each under gravity conditions (open channel flow), for a total capacity of 284 cfs, well beyond the calculated 100-yr flow of 155 cfs. However, in the event that downstream conditions prevent open channel flow, and these two pipes are fully submerged, they will function as culverts. In this case, our original report demonstrates that it will take approximately 1.72 feet of head difference across the road to discharge 155 cfs through these two pipes. Even under these conditions, the upstream properties will not in danger of being inundated, as there is plenty of freeboard available in the existing creek. The channel invert at Henry Road is approximately 9 feet higher than the channel invert at the project site. So, a 1.75' jump in the hydraulic grade line at the project site will certainly resolve itself prior to the Henry Road crossing.

4. Provide any other calculations used in sizing these culverts.

See "Exhibit A" for channel calculations. Pipe capacity under open channel flow below:

$Q = (1.49/n)A(Rh^{2/3})S^{1/2}$

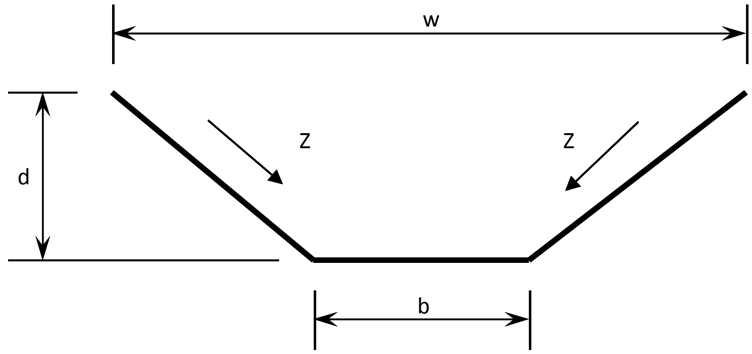
$Q = (1.49/.013)(3.14*1.75*1.75)((1.75/2)^{2/3}).02^{1/2}$

<u>Q = 142.6 cfs</u>

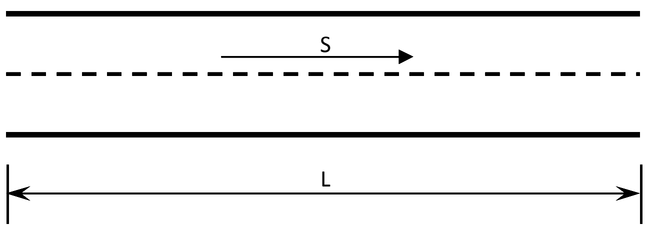
EXHIBIT A

100 YR CHANNEL FLOW EVENT

CHANNEL GEOMETRY



b =	Bottom Width	=	50.0 ft
d =	Depth of Flow	=	24.0 in
w =	Top Width	=	54.0 ft
Z =	Side Slope	=	1:1



S =	Longitudinal Slope	=	0.12%

HYDRAULIC CALCULATIONS

Channel Information

a	=	Cross-Sectional Area	=	104.00	SF
P	=	Wetted Perimeter	=	55.66	ft
R_H	=	Hydraulic Radius	=	1.87	ft
S	=	Slope	=	0.12	%
n	=	Manning Roughness Coefficient	=	0.05	

Velocity and Flow Rate

V	=	Velocity = $(1.49/n)*R_H^{2/3}*S^{0.5}$	=	1.57	ft/sec
Q	=	Volumetric Flow Rate (V x a)	=	162.87	cfs