

HYDROMODIFICATION CALCULATIONS WERE PERFORMED UTILIZING CONTINUOUS SIMULATION TO SIZE STORM WATER CONTROL FACILITIES. THIS STORM WATER MODELING METHOD IS REQUIRED BY THE CITY OF SAN MARCOS TO MEET SAN DIEGO COUNTY'S HYDROMODIFICATION CRITERIA. SWMM (STORM WATER MANAGEMENT MODEL) VERSION 5.0, DISTRIBUTED BY USEPA WAS USED TO GENERATE COMPUTED PEAK FLOW RECURRENCE AND FLOW DURATION SERIES STATISTICS. CONTINUOUS MODELING USES A LONG TIME SERIES OF ACTUAL RECORDED PRECIPITATION DATA AS INPUT INTO A HYDROLOGIC MODEL. FOR THIS PROJECT WE CHOSE (THE CLOSEST RAIN STATION) OCEANSIDE RAIN GAUGE DATA AS THE TIME SERIES DATA SOURCE FOR THE SIMULATION. OCEANSIDE RAIN DATA HAS APPROXIMATELY 58 YEARS OF HOURLY PRECIPITATION DATA FROM 8/28/1951 THROUGH 5/23/2008 AND GENERATES 58 YEARS OF HOURLY RUNOFF ESTIMATES, WHICH CORRESPONDS TO RUNOFF ESTIMATES FOR EACH OF THE 508,080 TIME STEPS (EACH DATE AND HOUR) OF THE 58 YEAR SIMULATION PERIOD.

LOW FLOW THRESHOLD WAS DETERMINED BY 50% OF TWO-YEAR STORM EVENT (0.5Q2) FROM FIELD CHANNEL ASSESSMENT (THE REPORT WILL BE SUBMITTED ON THE NEXT SUBMITTAL). THEREFORE, CHANNEL ASSESSMENT WAS INDICATED AS A LOW SUSCEPTIBILITY CRITERIA WITH THE 0.5Q2 LOW FLOW THRESHOLD TO MEET PEAK FLOW AND DURATION CONTROLS. THIS LOW FLOW THRESHOLD IS NOT USED AS SWMM INPUT; IT IS USED TO ANALYZE THE FLOW DURATION AND PEAK FLOW FREQUENCY GRAPHS.

THIS PROJECT WILL DEVELOP A NEW PUBLIC AND PRIVATE ROAD SYSTEM AND FUTURE DEVELOPMENT SINGLE FAMILY PADS. THE PADS HAVE BEEN CONSIDERED AT 60% IMPERVIOUS. EACH BIO-RETENTION TREATS ONE BASIN AREA. THE PROJECT SITE IS DIVIDED INTO SEVERAL BASINS WITH SUBCATCHMENT DIVISION BASED ON THEIR UNIFORMITY SURFACE.

TO PERFORM AN EQUAL COMPARISON BETWEEN PRE- AND POST-DEVELOPMENT CONDITIONS, THE PRE-DEVELOPMENT AREAS ARE MATCHED TO THE POST-DEVELOPMENT CONDITION'S SUBCATCHMENT AREAS REGARDLESS OF ITS ACTUAL SUBCATCHMENT'S FLOW DIRECTION. THE INTENT IS TO COMPARE THE SAME AREA BEFORE AND AFTER DEVELOPMENT SO THE INCREASE OR DECREASE OF RUNOFF FLOW RATES DUE TO AN INCREASE IN IMPERVIOUS AREA CAN BE IDENTIFIED. BASED ON SAN DIEGO COUNTY'S SOIL MAP GROUP, THE SOIL CHARACTERISTIC FOR THIS PROJECT IS CATEGORIZED AS SOIL TYPE D. SOIL TYPE D HAS HIGH RUNOFF POTENTIAL WITH VERY SLOW INFILTRATION RATES WHEN THOROUGHLY WETTED. GREEN-AMPT INFILTRATION METHOD WAS SELECTED BASED ON AVAILABLE DATA. SOIL CAPILLARY SUCTION HEAD IS ASSUMED AT 12.60 INCHES FOR A GROUP D SOIL, SOIL SATURATED HYDRAULIC CONDUCTIVITY IS 0.01 in/HR, AND THE INITIAL DEFICIT OF SOIL VOLUME THAT IS INITIALLY DRY IS ASSUMED 9.7% (THE DIFFERENCE BETWEEN SOIL POROSITY AND INITIAL MOISTURE CONTENT).

- LOW IMPACT DEVELOPMENT (BIO-RETENTION) IS UTILIZED TO ACHIEVE COMPLIANCE WITH THE STORMWATER TREATMENT REQUIREMENTS AS WELL AS THE LID REQUIREMENTS IN THE STORM WATER NPDES PERMIT. BIO-RETENTION IS SELECTED AS THE LID TO TREAT THE STORM WATER RUNOFF FROM THE SITE. THERE ARE TWO TYPES OF BIO-RETENTION: BIO-RETENTION STRIP TREATMENT VERSUS STRIP TREATMENT. BIO-RETENTION ADJACENT TO THE STREET IS LABELED AS BIO-STRIP RETENTION AND BIO-RETENTION POND THAT TREATS MOSTLY PAVES AND SOME OF THE STREETS ON THE STEEP SLOPE. BIO-RETENTION STRIP WAS MODELED AS A SUBCATCHMENT WITH A 2 INCH DEPTH OF THE ACTIVE SURFACE STORAGE WITH A TOTAL OF 6" OF WATER QUALITY VOLUME SURFACE PONDING DURING LOW TO MODERATE INTENSITY STORMS. BIO-RETENTION POND WAS MODELED WITH A 6 INCH DEPTH OF THE ACTIVE SURFACE. FOR BOTH TYPES OF BIO-RETENTION, 24" DEPTH OF UNDERDRAIN GRAVEL AND PERFORATED PIPE STORAGE IS PROVIDED AND THE OUTFLOW DISCHARGE IS SIMULATED AS AN ORIFICE DISCHARGE FORMULA $Q = (k_h - h_d)^{0.5}$ WHERE k_h IS COEFFICIENT X AND EXPONENT 0.5 THAT DETERMINES THE RATE OF FLOW THROUGH THE UNDERDRAIN AS A FUNCTION OF HEIGHT OF STORED WATER ABOVE THE DRAIN HEIGHT WHERE Q IS OUTFLOW (IN/HR), H HEIGHT OF STORED WATER (IN), h_d IS THE DRAIN HEIGHT. A ROUGH ESTIMATE FOR X CAN BE BASED ON THE T REQUIRED TO DRAIN A DEPTH D OF STORED WATER. $X = 2\sqrt{D}/T$. IN THIS CALCULATION THE DRAWDOWN TIME IS ASSUMED 72 HRS.

BIO-RETENTION	AREA (AC)	AREA (SF)	PONDING DEPTH (IN)	SOIL THICKNESS (IN)	GRAVEL THICKNESS (IN)	UNDERDRAIN ORIFICE (IN)
POND D	0.316	13,765	6	24	24	1.5
STRIP E	0.0034	148	2	18	24	1.5

THE PEAK FLOW AND FLOW DURATION STATISTICS WERE GENERATED BY THE SWMM PROGRAM WITH PARTIAL DURATION SERIES CRITERIA AS FOLLOWS:

BIO-RETENTION TYPE AND SCENARIO		SEPARATION EVENT (HOURS)	FLOW FLOOR (CFS)	NUMBER OF EVENTS
POND D	PRE-DEVELOPMENT	24	0.00	618
	POST-DEVELOPMENT (MITIGATED)	24	0.244	617
STRIP E	PRE-DEVELOPMENT	24	0.00	694
	POST-DEVELOPMENT (MITIGATED)	24	0.003	694

- A SEPARATION EVENT IS A TIME PERIOD IN WHICH RUNOFF DOES NOT EXCEED A PRESCRIBED THRESHOLD AND SETS THE MINIMUM NUMBER OF HOURS THAT MUST OCCUR BETWEEN THE END OF ONE RAIN EVENT AND THE START OF THE NEXT RAIN EVENT.
- FLOW FLOOR IS THE MAXIMUM VALUE FOR THE INTER-EVENT TIME PERIOD AND IT ALLOWS FOR SEPARATION OF EVENTS. THIS VALUE IS TYPICALLY SET AS AN ARTIFICIALLY LOW FLOW VALUE TO GENERATE PEAK FLOW FREQUENCY AND FLOW DURATION AT A CERTAIN CRITERIA.
- NUMBER OF EVENTS CORRESPOND TO THE TOTAL NUMBER OF DISCRETE RUNOFF EVENTS GENERATED FOR THE LONG-TERM RAINFALL RECORD. TYPICALLY AT THE SAME VALUE OF FLOW FLOOR, THE POST-DEVELOPMENT (UNMITIGATED) WILL DRAMATICALLY INCREASE THE NUMBER OF DISCRETE RUNOFF EVENTS COMPARED TO THE PRE-DEVELOPMENT'S.

THE SWMM PROGRAM RANKS THE PARTIAL DURATION SERIES, THE EXCEEDANCE FREQUENCY AND RETURN PERIOD AND THEY ARE COMPUTED USING THE WEIBULL FORMULA FOR PLOTTING POSITION. SEE THE FLOW DURATION CURVE AND PEAK FLOW FREQUENCY ON THE FOLLOWING PAGES.

TO COMPARE THE CURVES OF THE FLOW DURATION SERIES BETWEEN PRE-DEVELOPMENT AND MITIGATED POST-DEVELOPMENT, THE PRE-DEVELOPMENT FLOW FLOOR IS SET TO A VERY LOW NUMBER WHILE THE OTHERS ARE SET WITH A HIGHER VALUE BY TRIAL AND ERROR SO THAT THE NUMBER OF DISCRETE RUNOFF EVENTS BECOME EQUAL TO OR LESS THAN THAT OF PRE-DEVELOPMENT. AN EQUAL NUMBER OF EVENTS BETWEEN THE TWO WILL GENERATE SIMILAR PERCENT TIME OF EXCEEDANCE VALUES WHICH WILL CREATE A CLOSER LOOK BETWEEN THE TWO CURVES AT THE SAME RANGE EXCEEDANCE FREQUENCY.

BASIN AND SCENARIO		PEAK RUNOFF (CFS) BY RECURRENCE INTERVAL		
		0.5Q ₂	2-YEAR	10-YEAR
POND D	PRE-DEVELOPMENT	5.1	10.2	13.2
	POST-DEVELOPMENT (UNMITIGATED)	N/A	17.9	25.7
STRIP E	PRE-DEVELOPMENT	0.026	0.053	0.090
	POST-DEVELOPMENT (UNMITIGATED)	N/A	0.056	0.094

SAN MARCOS STORMWATER PROGRAM MANAGER	
By:	ERICA RYAN, SW PROGRAM MANAGER
DATE:	

VALLECITOS WATER DISTRICT	
FOR GRADING PERMIT ONLY	
By: _____	_____
KENNETH J. GERDES	DATE
R.C.E. 39307	EXP: 12/13

ENGINEER OF WORK	
	By: _____ Date: _____ Name: <u>ROBERT D. DENTINO</u>
Drawn By	R.C.E.: <u>45629</u> exp: <u>12-31-14</u>

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RECOMMENDED FOR APPROVAL

By: _____
PETER KUEY, PRINCIPAL CIVIL ENGINEER

R.C.E.: 44034 exp.: 06-30-2013

Date: _____

APPROVED FOR CONSTRUCTION

By: MICHAEL D. EDWARDS, CITY ENGINEER

R.C.E.: 32977 exp.: 06-30-2014

Date: _____

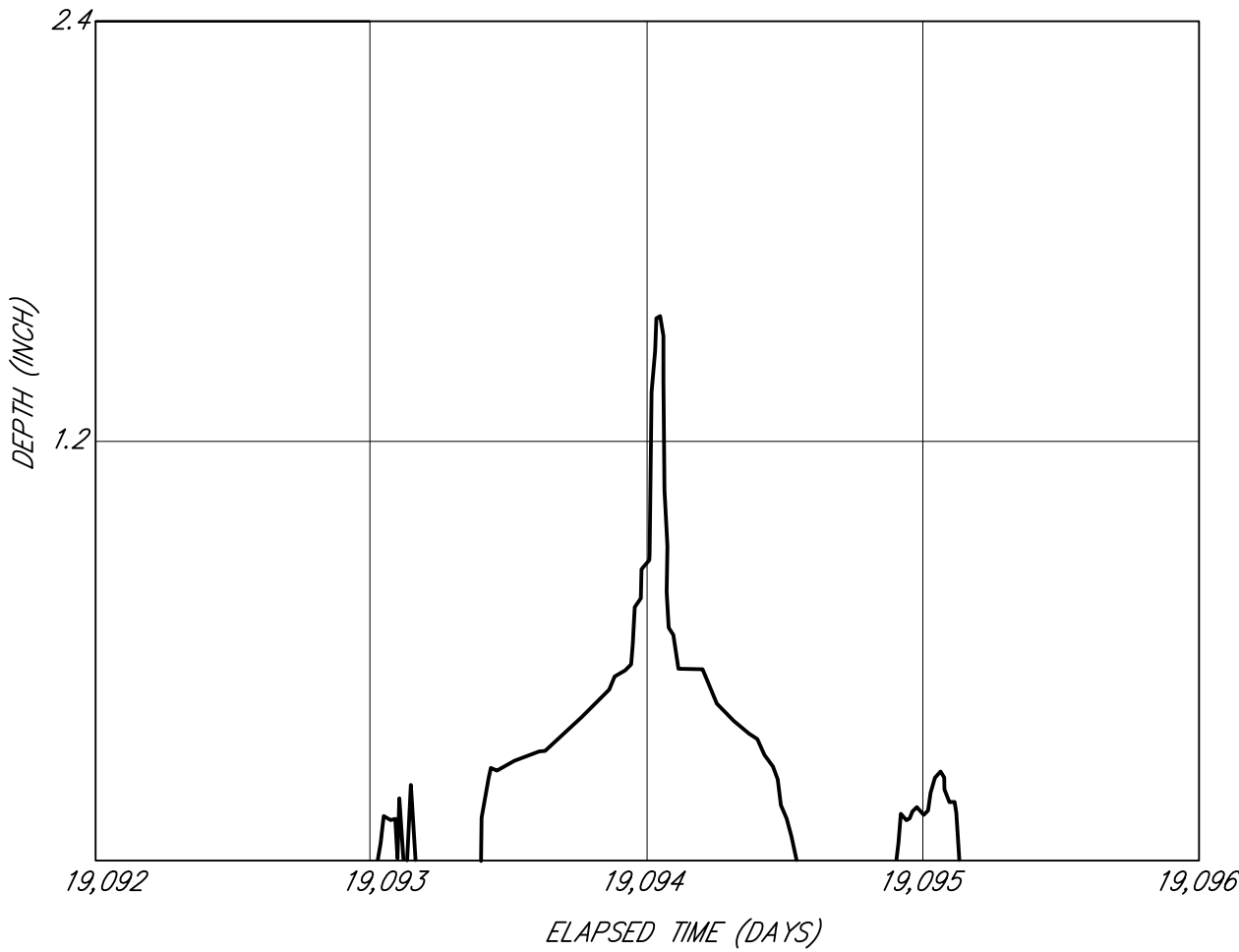
BENCH MARK	

CITY OF SAN MARCOS ENGINEERING DIVISION WATER QUALITY IMPROVEMENT PLAN HYDROMODIFICATION SHEET FOR: XX-00-00 (00X) SAN MARCOS HIGHLANDS
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City Drawing No.
GP—
Sheet 6 of 7

V.W.D.

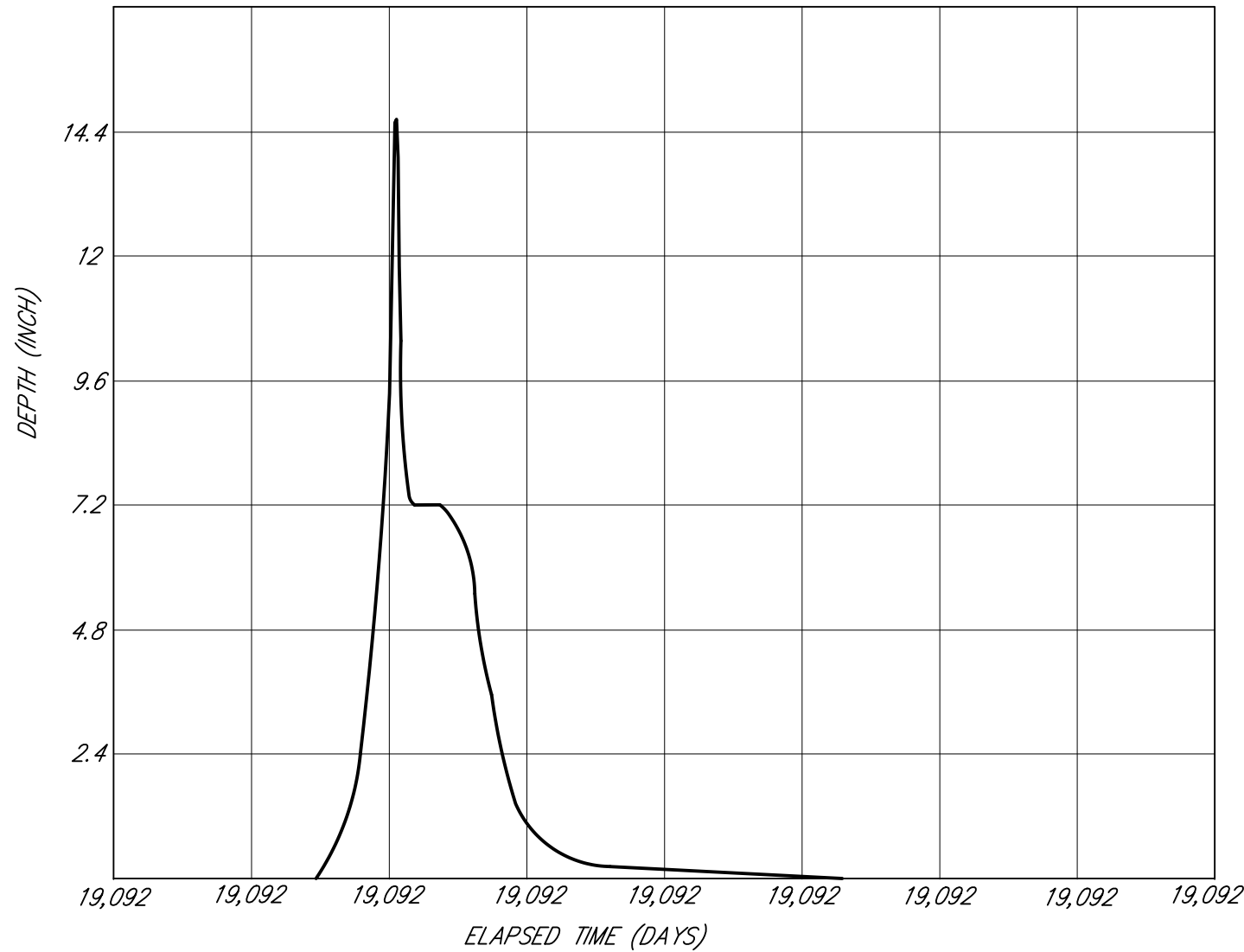
UNDER PRE-DEVELOPMENT CONDITIONS THE MINIMUM GEOMORPHICALLY SIGNIFICANT FLOW RATE OF 0.502 IS 0.026 CFS AND FROM THE GRAPH BELOW, FLOWS WOULD EQUAL OR EXCEED THIS VALUE ABOUT 23.74% OF THE TIME. FOR POST-DEVELOPMENT THIS FLOW RATE WOULD OCCUR MORE OFTEN APPROXIMATELY 22.59% OF THE TIME. THIS INCREASE IN THE DURATION OF THE GEOMORPHICALLY SIGNIFICANT FLOW AFTER DEVELOPMENT ILLUSTRATES WHY DURATION CONTROL IS CLOSELY LINKED TO PROTECTING CREEKS FROM ACCELERATED EROSION IN A LOCAL CREEK, THE MITIGATED EFFECTS OF DEVELOPMENT SHOWS THAT THE FLOWS EXCEED 0.026 CFS ONLY 22.59% OF THE TIME, LESS THAN THAT OF THE PRE-DEVELOPMENT CONDITION. THIS MEANS A PARTICULAR STORM FLOW WOULD OCCUR FOR SHORTER DURATIONS AND THE STORM WATER CONTROL MITIGATIONS WOULD COUNTERACT THE EFFECTS OF THE INCREASED PLAVEMENT ASSOCIATED WITH DEVELOPMENT PROJECTS.



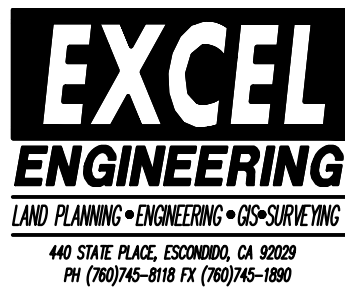
TYPICAL DRAWDOWN TIME AT THE BIO-STRIP ALONG STREET E AVERAGELY WILL DRAIN THE WHOLE SYSTEM WITHIN 27 HOURS.

TO EVALUATE THE DIFFERENCE BETWEEN PRE-DEVELOPMENT AND THE MITIGATED POST-DEVELOPMENT CONDITIONS, A PASS OR FAIL ANALYSIS TABLE IS DEVELOPED. THIS TABLE COMPARES THE PEAK FLOW VERSUS THE PERCENT TIME EXCEEDED OF EACH RETURN PERIOD OF THE MITIGATED POST-DEVELOPMENT AT THE SAME EXCEEDANCE FREQUENCY VALUES AS THE PRE-DEVELOPMENT CONDITION IN THE SAME CUPRA. THE MINIMUM COMPARISON IN THIS TABLE IS THE CUPRA AT WHICH THE MINIMUM COMPARISON IS STARTED AT THE 0.502 THRESHOLD FOR THIS PROJECT TO THE Q10. THE PERCENT OF TIME EXCEEDED VALUES IN THE MITIGATED POST-DEVELOPMENT ARE IN THE CLOSE RANGE BUT NOT EXACTLY THE SAME AS THAT OF THE PRE-DEVELOPMENT.

TO PERFORM AN APPROPRIATE COMPARISON, THE PERCENT OF TIME EXCEEDED (X AXIS) OF THE MITIGATED POST-DEVELOPMENT SHOULD BE EQUAL TO THE PERCENT OF TIME EXCEEDED (X AXIS) OF THE PRE-DEVELOPMENT. THE NUMBER OF EVENTS (Y AXIS) OF THE MITIGATED POST-DEVELOPMENT SHOULD BE LESS THAN OR EQUAL TO THE NUMBER OF EVENTS (Y AXIS) OF THE PRE-DEVELOPMENT. THE STATISTICAL CALCULATION SHOULD BE EQUAL OR AT LEAST THE POST-MITIGATED NUMBER OF EVENTS SHOULD BE LESS THAN THE PRE-DEVELOPMENT NUMBER OF EVENTS (SEE TABLE 4 THIS SHEET). THE TABLES OF PASS AND FAIL CRITERIA ARE PROVIDED IN HYDROLOGY/HYDRAULIC REPORT FOR THIS PROJECT BY EXCEL ENGINEERING DATED FEBRUARY 11, 2013.



DRAWDOWN TIME AT THE WATER QUALITY POND D AVERAGELY WILL DRAIN THE WHOLE SYSTEM WITHIN 4 DAYS OR 96 HOURS.

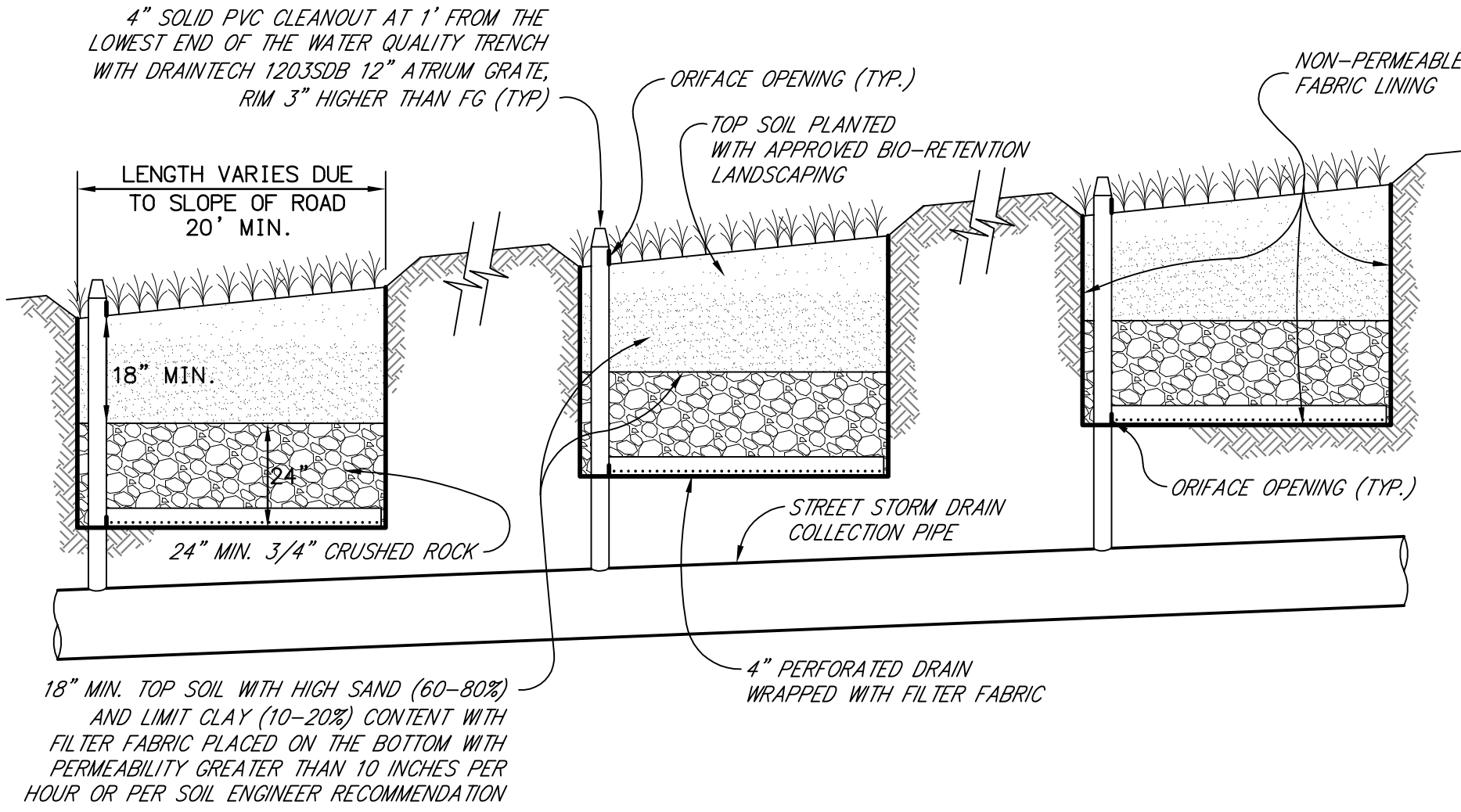


BMP OPERATION AND MAINTENANCE

BMP MAINTENANCE CONDITIONS:
THE PROPERTY OWNER IS REQUIRED, PURSUANT TO THE CITY OF SAN MARCOS MUNICIPAL CODE, SECTION 14.15 AND THE CITY'S CURRENT LOCAL STANDARD URBAN STORMWATER MITGATON PLAN (SUSMP), TO ENTER INTO A STORM WATER MANAGEMENT AND DISCHARGE CONTROL MAINTENANCE AGREEMENT (MAINTENANCE AGREEMENT) FOR THE INSTALLATION AND MAINTENANCE OF PERMANENT BEST MANAGEMENT PRACTICES (PERMANENT STORMWATER BMP'S), PRIOR TO ISSUANCE OF PERMITS. PERMANENT STORMWATER BMP'S SHALL INCLUDE ALL CONSTRUCTED ELEMENTS DESCRIBED IN THE APPROVED PROJECT'S WATER QUALITY TECHNICAL REPORT (WQTR), CONSTRUCTION PLANS, AND THIS EXHIBIT. (eg. LOW IMPACT DEVELOPMENT, SOURCE CONTROL, SITE DESIGN, TREATMENT CONTROL).

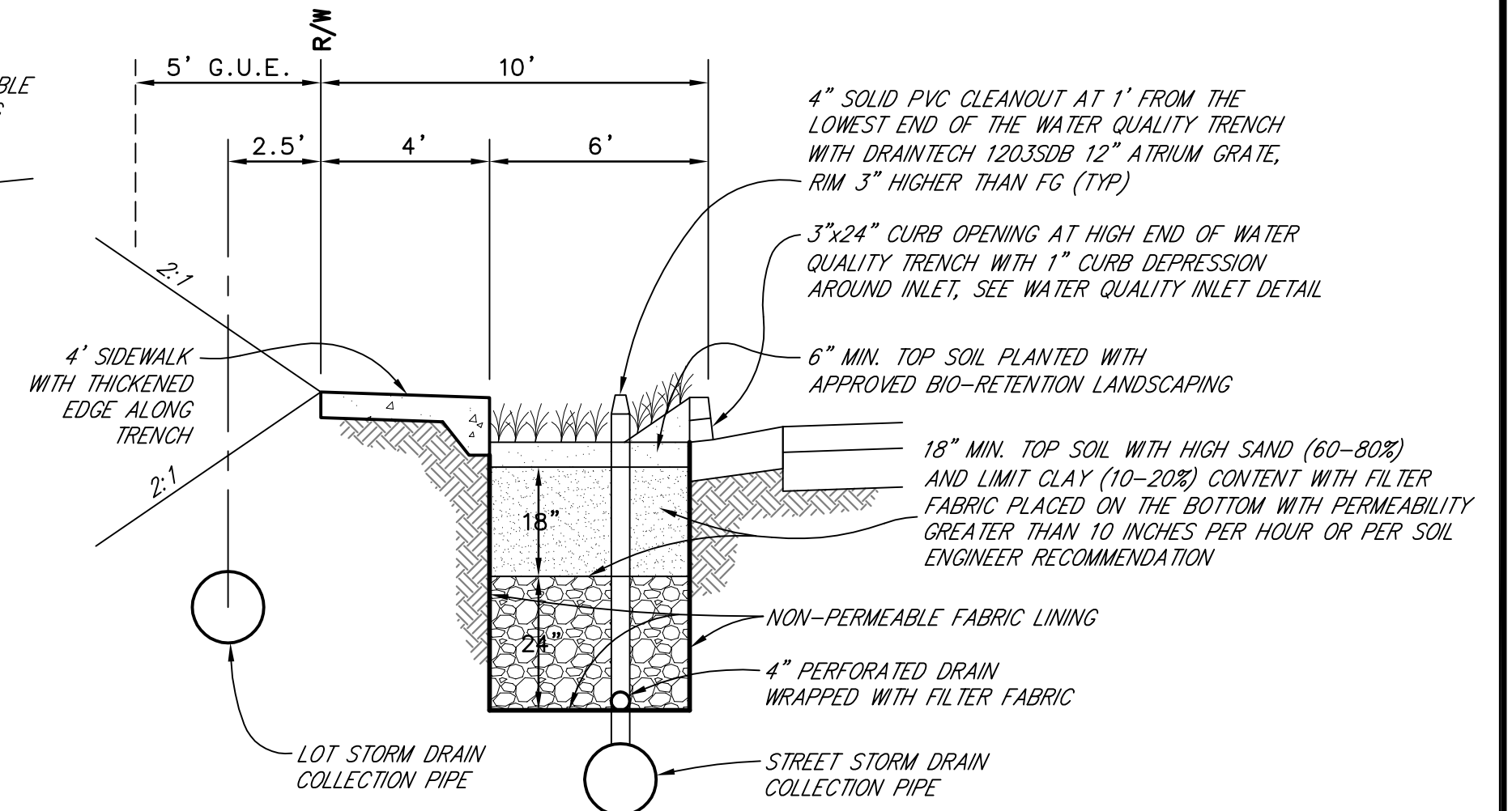
FOR MAINTENANCE OF TREATMENT CONTROL BMP

APN(S)	TYPE	MAINTENANCE RESPONSIBILITY	INSPECTION	MAINTENANCE
184-241-05 184-241-06 184-241-08 184-241-15 184-241-32 184-241-33	BIORETENTION/ TC-32	RESPONSIBLE PARTY AS LISTED HEREON TABLE X	<ul style="list-style-type: none">INSPECT SOIL AND REPAIR ERODED AREAS MONTHLY.INSPECT SEMI-ANNUALLY FOR DAMAGE TO VEGETATION AND PRIOR TO OCTOBER 1 TO SCHEDULE SUMMER MAINTENANCE.INSPECT BEFORE MAJOR RAINFALL EVENTS TO ENSURE THE STRIPS ARE READY FOR RUNOFF. PERFORM ADDITIONAL INSPECTIONS AFTER PERIODS OF HEAVY RUNOFF.CHECK FOR DEBRIS AND LITTER, AND AREAS OF SEDIMENT ACCUMULATION SEMI-ANNUALLY.	<ul style="list-style-type: none">WATER PLANTS DAILY FOR 2 WEEKS AT PROJECT COMPLETIONREMOVE SEDIMENT, TRASH, & DEBRISREMULCH AREAS AS NECESSARYTREAT DISEASED VEGETATION OR REPLACEMOW TURF AREAS (6" GRASS HEIGHT OPTIMUM)REPAIR EROSION AT INFLOW POINTSREPAIR OUTFLOW STRUCTURESUNCLOG THE UNDERDRAIN.REFER TO TC-32 CASDA LITERATURE FOR MORE DETAIL

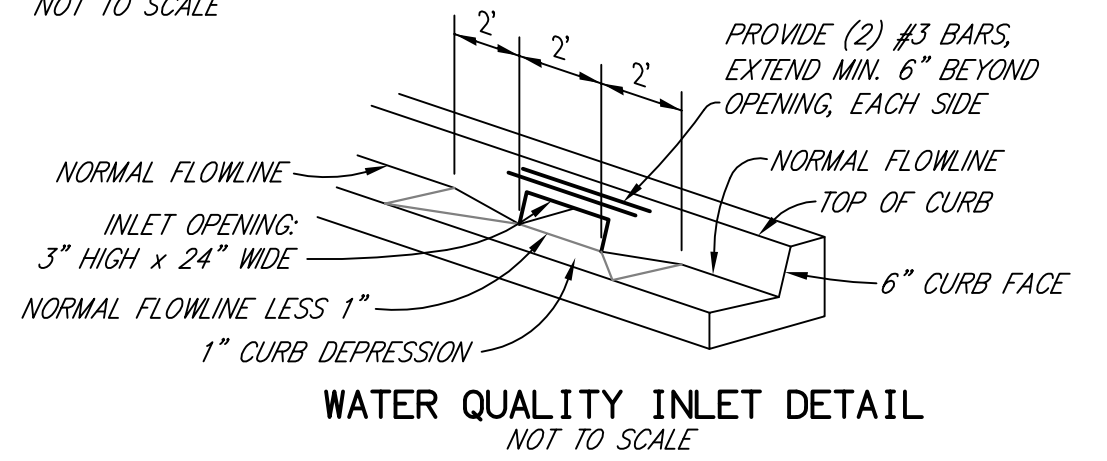


SEE SHEET 2 FOR TYPICAL CROSS-SECTION

WATER QUALITY TRENCH TYPICAL SECTION
NOT TO SCALE

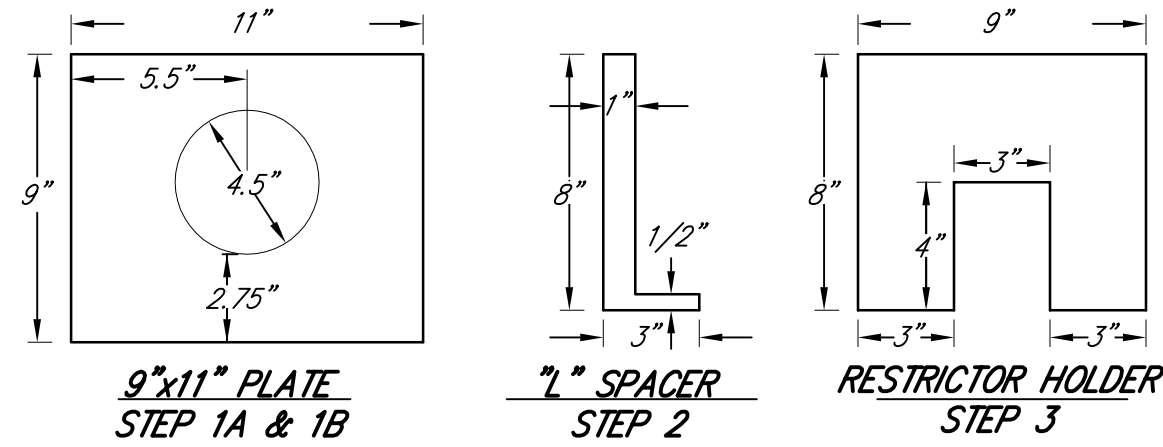


WATER QUALITY TRENCH CROSS-SECTION
NOT TO SCALE



WATER QUALITY INLET DETAIL
NOT TO SCALE

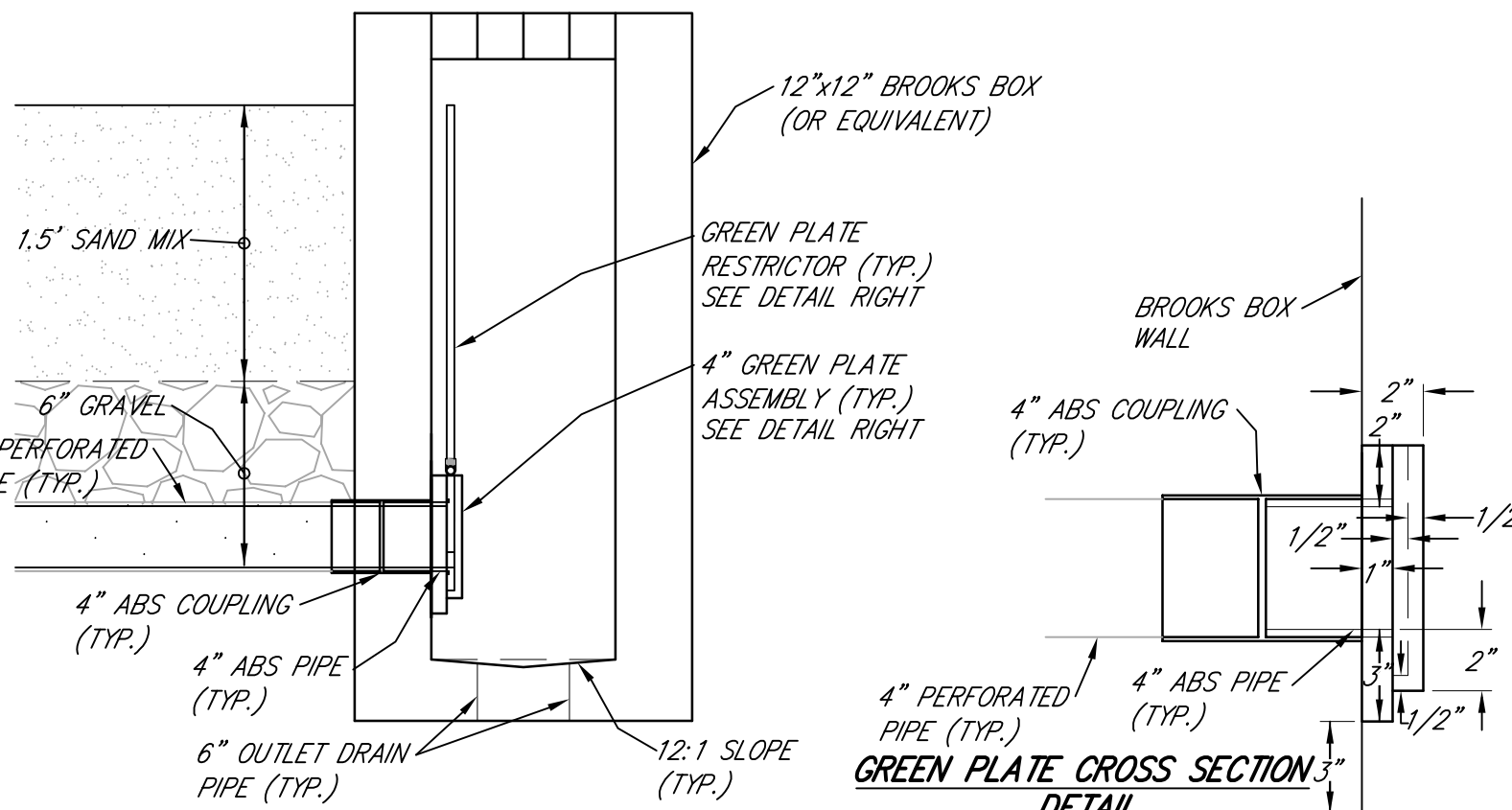
- STEP 1A. CUT A 9"x11" SQUARE FROM 1" ABS SHEET (OR GLUE TOGETHER 2x 1/2" ABS SHEETS).
- STEP 1B. CUT A CIRCULAR HOLE THE SIZE OF THE OUTSIDE DIAMETER OF A 4" ABS PIPE (4.5" TYP) IN THE 9"x11" SQUARE SHEET PER DETAIL RIGHT.
- STEP 2. CUT TWO "L" SHAPE SPACERS FROM 1/2" ABS SHEET PER DETAIL RIGHT.
- STEP 3. CUT A RECTANGULAR RESTRICTOR HOLDER FROM 1/2" ABS SHEET PER DETAIL RIGHT.
- STEP 4A. GLUE 4" ABS PIPE TO A 4" ABS COUPLING. ONCE FULLY CURED PER ADHESIVE SPECIFICATIONS, CUT THE 4" ABS PIPE 1" FROM EDGE OF COUPLING PER DETAIL BELOW.
- STEP 4B. TAKE THE SQUARE PLATE FROM STEP 1B AND GLUE THE 1" ABS SECTION OF 4" ABS PIPE IN THE CIRCULAR HOLE. CUT ANY EXCESS PIPE TO BE FLUSH WITH PLATE FACE PER DETAIL BELOW.
- STEP 5. GLUE AND CLAMP THE RECTANGULAR HOLDER TO THE "L" SHAPE SPACERS TO THE 9"x11" SQUARE PLATE PER DETAIL BELOW. ALLOW TO FULLY CURE PER ADHESIVE MANUFACTURERS INSTRUCTIONS BEFORE REMOVING CLAMPS.
- STEP 6. CUT AND GROOVE A GREEN PLATE RESTRICTOR FROM 1/2" ABS SHEET PER DETAIL BELOW. IN THE 3/16" GROOVE INSTALL 3/16" CORD GASKET. CORD GASKET WHEN SEATED SHOULD BE 1/16" TALLER THEN THE GREEN PLATE RESTRICTOR.



9"x11" PLATE
STEP 1A & 1B

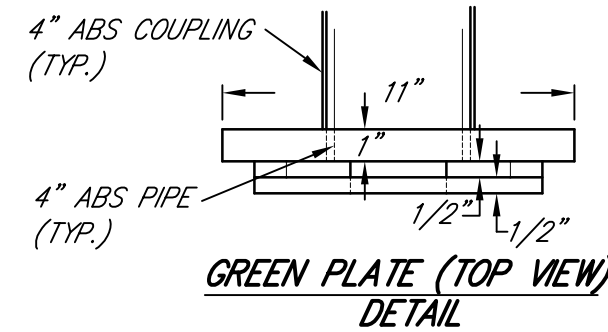
1/2" SPACER
STEP 2

RESTRICTOR HOLDER
STEP 3

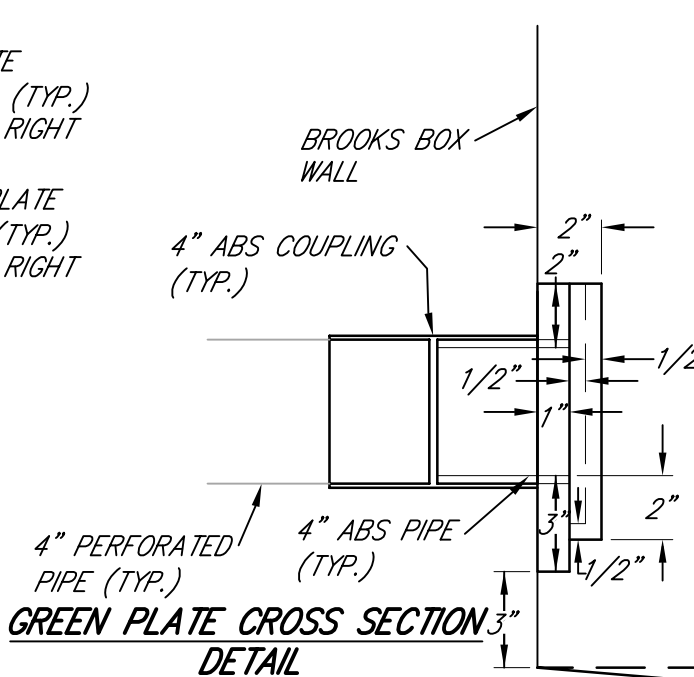


GREEN PLATE

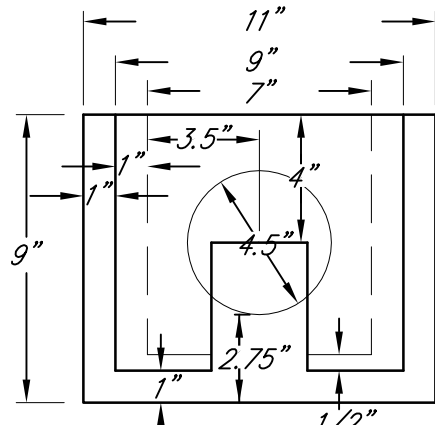
4" GREEN PLATE ASSEMBLY INSTALLED
IN A 12"x12" BROOKS BOX



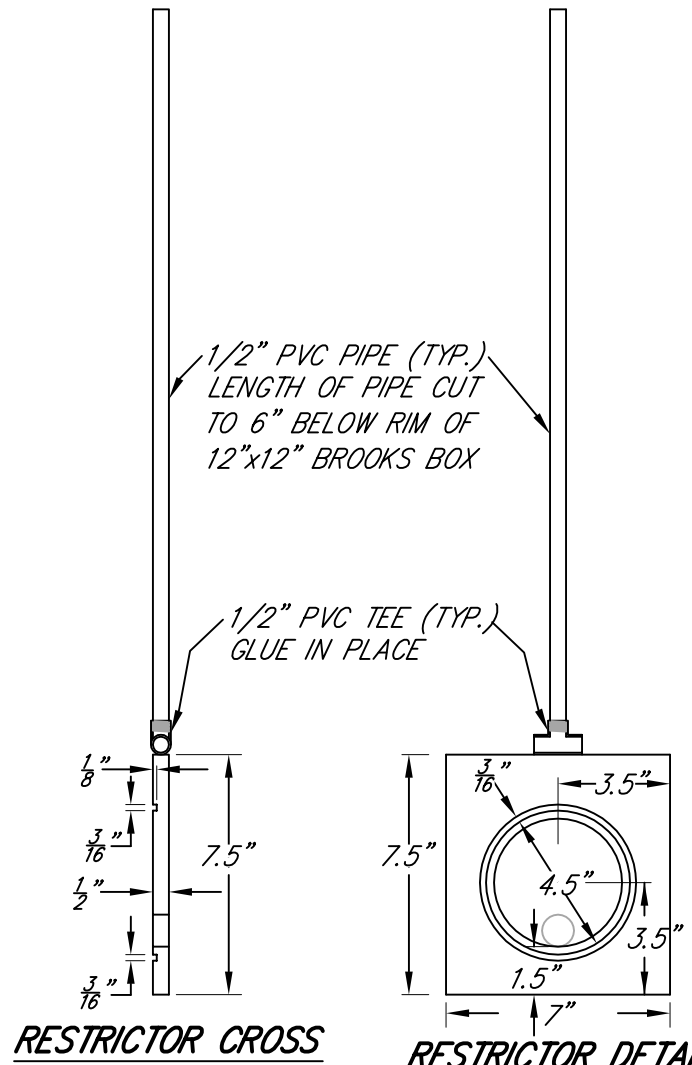
GREEN PLATE (TOP VIEW)
DETAIL



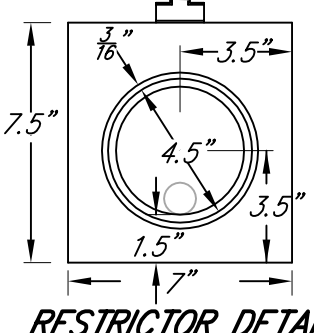
GREEN PLATE CROSS SECTION
DETAIL



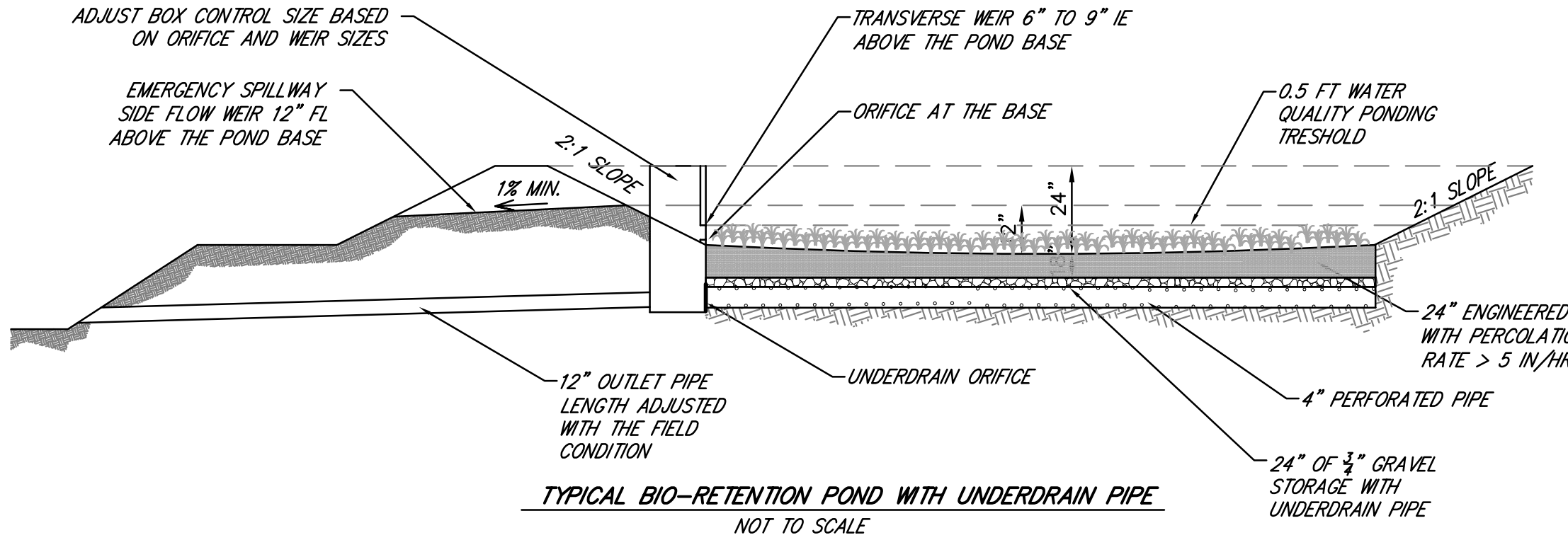
GREEN PLATE
DETAIL



RESTRICTOR CROSS
SECTION DETAIL



GREEN PLATE RESTRICTOR
DETAIL



TYPICAL BIO-RETENTION POND WITH UNDERDRAIN PIPE
NOT TO SCALE

TABLE X
RESPONSIBLE PARTY FOR LONG-TERM MAINTENANCE:

NAME	SAN MARCOS HIGHLANDS HOA
COMPANY NAME	VISTA SAN MARCOS LTD.
PHONE NUMBER	TO BE DETERMINED
STREET ADDRESS	TO BE DETERMINED
CITY/STATE/ZIP	TO BE DETERMINED
EMAIL ADDRESS	TO BE DETERMINED

FUNDING SOURCE(S):
FUNDING SOURCE(S) FOR LONG-TERM OPERATION AND MAINTENANCE OF EACH BMP IS/ARE PROVIDED BY:
LONG TERM O&M FUND WILL BE SUPPLIED BY HOME OWNER ASSOCIATION
(HOA WILL BE ESTABLISHED ON FINAL PHASE)

IF THE CURRENT OWNER TRANSFERS ITS INTEREST IN THE SUBJECT PROPERTY/PROJECT, THE CURRENT OWNER SHALL NOTIFY THE SUCCESSOR IN INTEREST IN WRITING OF ITS RESPONSIBILITY TO IMPLEMENT THIS WATER QUALITY IMPROVEMENT PLAN AND MAINTAIN POST-CONSTRUCTION BEST MANAGEMENT PRACTICES (BMPs) IN PERPETUITY. THE CURRENT OWNER SHALL PROVIDE THE DEPARTMENT OF PUBLIC WORKS, WATERSHED PROTECTION PROGRAM WITH A COPY OF THE SIGNED NOTIFICATION, INCLUDING THE NAME, ADDRESS, AND CONTACT INFORMATION OF THE SUCCESSOR.

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SAN MARCOS FIRE DEPARTMENT	VALLECITOS WATER DISTRICT FOR GRADING PERMIT ONLY	ENGINEER OF WORK	CITY APPROVED CHANGES	RECOMMENDED FOR APPROVAL	APPROVED FOR CONSTRUCTION	BENCH MARK	CITY OF SAN MARCOS ENGINEERING DIVISION WATER QUALITY IMPROVEMENT PLAN OPERATIONS & MAINTENANCE SHEET FOR: XX-00-00 (00X)	City Drawing No.
By: _____ Date: _____	By: KENNETH J. GERDES R.C.E.: 39307 EXP: 12/13	By: _____ Name: ROBERT D. DENTINO R.C.E.: 45629 exp: 12-31-14	No. Description City VMD Date	By: PETER KUEY, PRINCIPAL CIVIL ENGINEER R.C.E.: 44034 exp: 06-30-2013	By: MICHAEL D. EDWARDS, CITY ENGINEER R.C.E.: 32977 exp: 06-30-2014			GP-
								Sheet 7 of 7
							V.W.D. PROJECT NO.	V.W.D.