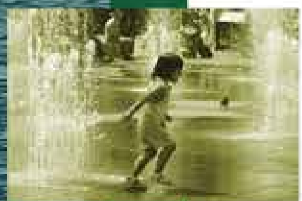
Appendix G

Groundwater and Surface Water Evaluation Report
Eastwood/Odello Water Right Change Petition Project
(West Yost Associates, 2013)



Groundwater and Surface Water Evaluation Report Eastwood/Odello

Water Right Change Petition Project

Macaulay Water Resources and Barkiewicz, Kronick, & Shanahan

October 2013

WEST YOST ASSOCIATES
Consulting Engineers

555-00-13-03

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consulting engineers

WATER WASTEWATER STORMWATER

Groundwater and Surface Water Evaluation Report Eastwood/Odello Water Right Change Petition Project

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Prepared for

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Exp. 4/30/14

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CHAPTER 1
Introduction

In response to the requests from Bartkiewicz, Kronick, & Shanahan, P. C. (BKS) and Macaulay Water Resources (MWR), in connection with their work on the Eastwood/Odello Water Right Change Petition Project (Project), West Yost Associates (West Yost) has prepared this report. It evaluates the potential effects of the Project on groundwater and surface water resources in the Carmel Valley.

1.1 REPORT ORGANIZATION

Chapter 1 of this report provides introductory information including a summary of the Project background, study objectives and the water resources setting. Chapter 2 describes the methods and procedures followed for the groundwater evaluation. Chapter 3 presents evaluation results and Chapter 4 presents conclusions.

1.2 PROJECT BACKGROUND

This Project will be located in Carmel Valley, as shown on Figure 1-1, and is described as follows:

1. Clint Eastwood and Margaret Eastwood Trust (collectively, “Eastwood”) intend to donate their Odello East property to Big Sur Land Trust or other non-profit entity or governmental agency immediately after Eastwood receives the necessary regulatory approvals for the Project. This property will be restored to native vegetation which, after it is established, will not require any irrigation.
2. Eastwood will petition the State Water Resources Control Board (SWRCB) to split Eastwood’s existing water right License 13868 into two new licenses. One new license, License 13868A, will authorize the California-American Water Company (Cal-Am) to divert water through its seven most downstream wells in the Carmel Valley and to convey this water to existing lots of record in the Carmel River watershed or the City of Carmel. (Figure 1-2 shows the locations of the well that currently is being used to irrigate the Eastwood/Odello property and of these seven Cal-Am wells.) The other new license, License 13868B, will be for the remaining part of License 13868 and will be dedicated to instream uses.
3. To ensure that the water rights assignment will not adversely affect water flows in the Carmel River or the amount of water in the groundwater aquifer, 46.2 acre-feet per year (AFY) of the right under License 13868 will be dedicated to instream uses under License 13868B. This amount equals the estimated annual average of return flows from the existing irrigation of the Eastwood/Odello property.
4. The amount of water right that will be assigned to License 13868A for use by owners of existing lots of record in Carmel Valley or the City of Carmel, 85.6 AFY, equals the estimated annual average consumptive use by the existing irrigation of the Eastwood/Odello property under License 13868. This amount is described in the April 15, 2013, Technical Memorandum by Davids Engineering and summarized is summarized in Table 1-1 (Davids Engineering, 2013).

Table 1-1. Estimated Long-Term Mean Monthly Applied Water and Evapotranspiration

Month	Applied Water[a], AF	Monthly Evapotranspiration Percentage[b]	Estimated Monthly Evapotranspiration[c], AF	Equivalent Flow Rate[d]	
				cfs	gpm
January	4.1	3.3%	2.8	0.046	20
February	4.2	3.4%	2.9	0.052	23
March	5.8	4.7%	4.0	0.065	29
April	9.3	7.5%	6.4	0.108	48
May	13.6	11.0%	9.4	0.153	69
June	16.0	12.9%	11.0	0.185	83
July	16.0	12.9%	11.1	0.181	81
August	15.6	12.6%	10.8	0.176	79
September	13.8	11.1%	9.5	0.16	72
October	12.2	9.8%	8.4	0.137	61
November	8.0	6.5%	5.5	0.092	41
December	5.5	4.4%	3.8	0.062	28
ANNUAL	**124.0**	**100.0%**	**85.6**	**0.118**	**53**

(a) Estimated long-term monthly average applied irrigation water, distributed by month.
(s) Percent of long term annual evapotranspiration by month.
(d) Estimated long-term monthly average evapotranspiration, distributed by month
(d) cfs = cubic feet per second; gpm = gallons per minute. Totals at the bottom of these columns are the annual average flow rates.

1.3 STUDY OBJECTIVES

The objectives of this groundwater evaluation are to address the following questions regarding the potential effects of the Project on the groundwater aquifer associated with the Carmel Valley and Carmel River surface water flows:

1. What effects will the Project have on water levels in wells near the Cal-Am wells that will be used for the Project?
2. What effects will the Project have on surface water flows in the Carmel River?

Because the seven Cal-Am wells that will be used for the Project all pump water from Aquifer Subunits (AS) 3 and AS4 of the Carmel Valley Aquifer system (see Figure 1-5 and Appendix A), this evaluation focuses on these subunits and the reaches of the Carmel River that overlie these subunits.

1.4 WATER RESOURCES SETTING

Key aspects of the water resources setting discussed in this section are:

- Study Area
- Rainfall
- Surface Water Hydrology
- Groundwater Hydrology
- Aquifer Properties

1.4.1 Study Area

The study area is located in the alluvial portion of the Carmel River. The Carmel River watershed is located in the central coastal region of California, southeast of Monterey (see Figure 1-1). The watershed has an area about 250 square miles, of which the valley floor containing the alluvial groundwater basin covers about six square miles. Urban and agricultural activities are confined primarily to the valley floor, which is approximately 16 miles long and from 300 to 4,500 feet wide. Altitudes on the valley floor ranges from sea level at Carmel Bay to about 350 feet in the upper parts of the valley.

The watershed is bounded on the northeast by the Sierra de Salinas range with altitudes as high as 4,470 feet, and on the southeast by the Santa Lucia Range with altitudes up to 4,850 feet. Both ranges have steep slopes and dense foliage. North slopes rising from the valley floor average about 430 feet/mile, and south slopes average about 350 feet/mile. Slopes in the upper part of the watershed rise about 360 feet/mile. The Sierra de Salinas range, in the lower 7 to 8 miles of the watershed, has less vegetation and is characterized by a chaparral environment.

1.4.2 Rainfall

The Carmel Valley has typical coastal California wet-dry seasonal patterns. About 80 percent of the annual precipitation falls during January through April. Mean annual rainfall in the Carmel River watershed varies from about 14 inches along the northeast perimeter of the watershed to over 40 inches in the upper watershed area, with an average of about 17 inches/year (USGS, 1984). More than 90 percent of the annual rainfall occurs over the watershed during the six month period between November and April as illustrated on Figure 1-3. In addition, annual rainfall totals can vary significantly from year to year, as illustrated on Figure 1-4.

1.4.3 Surface Water Hydrology

Runoff flows into and through the Carmel River and its tributaries. Flows in the Carmel River are gauged by the United States Geological Survey (USGS) at two locations: Robles Del Rio, located approximately 14 miles from the river's mouth; and near Carmel, located approximately 3 miles from the river's mouth (Figure 1-4). Flows in the Carmel River and its tributaries respond rapidly to rainfall, and there is a high rate of runoff per unit area. The peak flow of record (1962 through 2012) in the Carmel River was 9,590 cubic feet per second (cfs) on February 28, 1983, and the mean flow during the 1962 through 2012 period was about 103 cfs.

This mean flow represents an average runoff per unit area of about 0.4 cfs/square mile. For comparison, the Salinas basin just north of the Carmel Valley, with a drainage area of about 4,200 square miles, has an average runoff per unit area of about 0.l cfs/square mile.

Average river flows increase in the downstream direction as inflows from tributary streams exceed the amounts of losses from the river through infiltration. During 1962 through 2012, the average flow at the Robles Del Rio gauge was about 96 cfs, compared to 103 cfs at the Carmel gauge for that same period. Monthly records indicate that, in general, the river flows increase in the downstream direction during the first half of the year and decrease during the second half of the year. This response is expected, based on examination of seasonal pumping and rainfall patterns. Mean monthly flows from the two USGS gauges for the period of 1962 through 2012 are shown in Figure 1-4. Inflows to the lower Carmel River historically have been regulated slightly by the Los Padres and San Clemente Reservoirs, which have a combined capacity of 4,600 acre-feet (USGS, 1984). (San Clemente Reservoir now is in the process of being taken out of service.)

1.4.4 Groundwater Hydrology

Aquifer thickness ranges from about 30 feet at the narrows near the upper end of the aquifer to about 180 feet one mile from the mouth of the Carmel River basin. The Monterey Peninsula Water Management District (MPWMD) has divided the aquifer into four subunits for descriptive and computer modeling purposes. AS-1 and AS-2 are collectively referred to as the upper aquifer, and AS-3 and AS-4 are referred to as the lower aquifer (see Figure 1-5). These aquifer subunits are shown in detail in Appendix A.

Recharge to the aquifer is derived mainly from river infiltration, which comprises about 85 percent of the net recharge. The potential recharge rate from the river to the aquifer is high, perhaps 100 cfs or more (USGS, 1984), and during normal or above normal flow years, the water table recovers completely from the dry season lows. After the two-year drought of 1976 through 1977, precipitation that began in January 1978 caused water levels in the aquifer to recover to normal by February 1978. Thus, it appears that the aquifer can recover in a month or less, even after large drawdowns. Water levels after recovery are often a few feet above the riverbed, indicating that additional and significant recharge occurs, mostly from tributary stream infiltration.

Groundwater flow is generally down valley, with gradients ranging from about 50 feet/mile in the upper drainage basin to about 10 feet/mile toward the lower end. After recovery, water table depths range from about 5 to 30 feet below the land surface with an average of about 15 feet. During normal rainfall years, water-level fluctuations are about 5 to 15 feet; during drought years, water levels drop to as much as 50 feet below the land surface. Previous estimates of the aquifer's storage potential indicate a total storage in the spring of about 50,000 acre-feet (USGS, 1984). The volume of usable groundwater storage in the aquifer is estimated at 28,500 acre-feet (MPWMD, 1998). The estimated subsurface discharge to the ocean is 140 acre-feet/year (USGS, 1984).

Key well hydrographs for selected groundwater monitoring wells maintained by MPWMD are shown on Figure 1-5. These and other monitoring wells shown on Figure 1-5 are maintained and monitored monthly by MPWMD staff. Hydrographs for all monitoring wells shown on Figure 1-5 are included in Appendix B.

1.4.5 Aquifer Properties

Aquifer properties used for this groundwater evaluation were obtained from a Cal-Am report documenting aquifer testing performed in 1982 on four Cal-Am wells using procedures approved by MPWMD (Mount, 1983). Levels in 38 monitoring wells were recorded during the test of the four production wells. The total area of testing, including the area with the observation wells, comprises about four miles of the valley length between Cal-Am's Cañada and Manor wells (located between Schulte and Begonia #2) shown on Figure 1-2. Aquifer test results are summarized in Table 1-2.

Table 1-2. Results of Aquifer Simulation Studies

Production Well	Discharge, gpm	100-hour Specific Capacity, gpm/ft	Saturated Thickness, ft	Transmissivity, gpd/ft	Permeability		Specific Yield
					gpd/ft^2	ft/d	
Pearce	2,142	51.0	120	250,000	2,080	278	0.07
Cypress	2,150	59.7	83	175,000	2,110	282	0.10
San Carlos	1,029	28.6	63	100,000	1,590	213	0.20
Rancho Cañada	2,021	63.2	110	165,000	1,500	200	0.15

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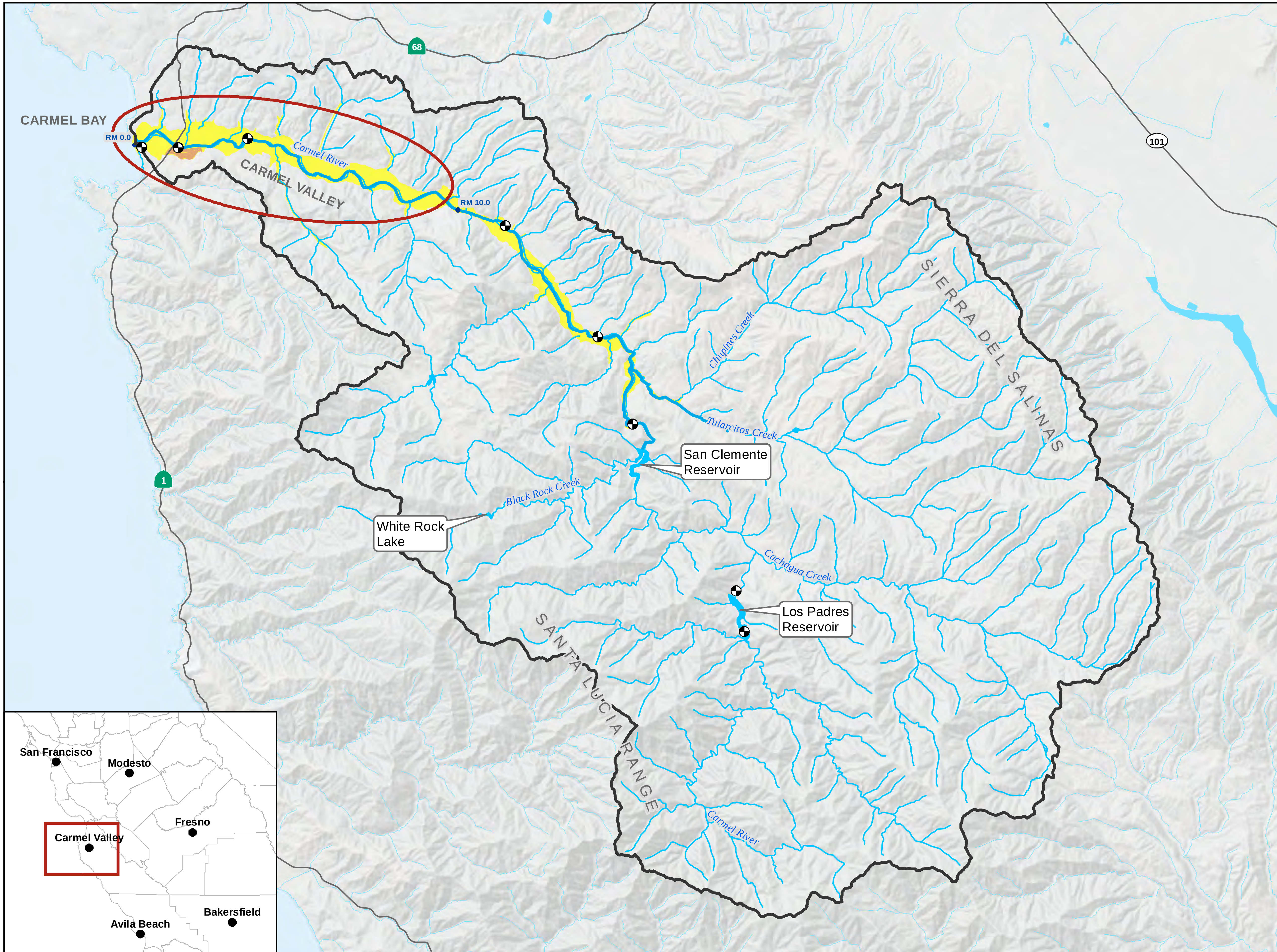

FIGURE 1-1

Eastwood/Odello Water Right Change Petition Project

PROJECT LOCATION WITHIN CARMEL RIVER WATERSHED

N

0 6,000 12,000

Scale in Feet

Notes

1. Both San Clemente Reservoir and Los Padres Reservoir are dammed reservoirs.
2. Carmel River watershed delineation was obtained from California-American Water Company (June, 2013).
3. Streamgage locations were obtained from the United States Geological Survey (USGS) and from the Monterey Peninsula Water Management District (MPWMD) (April, 2013).

LEGEND

- Streamgage
- River Mile Marker
- Hydrologic System
- Carmel River
- Reservoir
- Carmel Valley Alluvial
- License 13868 Current Place of Use
- Project Location
- Carmel River Watershed Boundary

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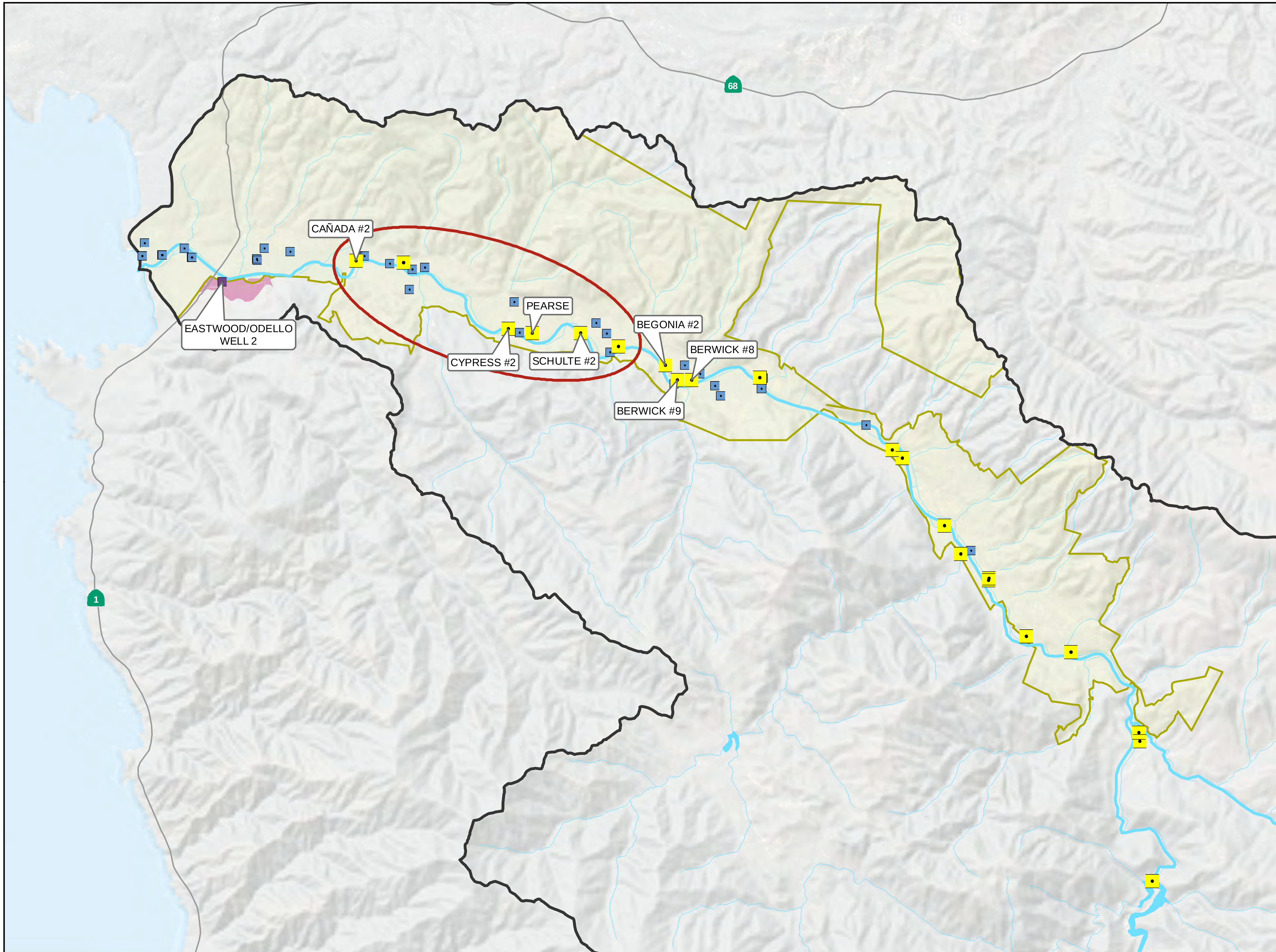
FIGURE 1-2

Eastwood/Odello Water Right Change Petition Project

CALIFORNIA-AMERICAN WATER COMPANY WELLS



N

0 3,000 6,000

Scale in Feet

Notes

1. Cal-Am = California-American Water Company
2. MPWMD = Monterey Peninsula Water Management District
3. Carmel River watershed delineation was obtained from Cal-Am (June, 2013).
4. The Cal-Am place of use boundary was obtained from Cal-Am (June, 2013).
5. Cal-Am wells were obtained from Cal-Am (April, 2013).
6. MPWMD monitoring wells were obtained from MPWMD (March, 2013).

LEGEND

- Cal-Am Production Well (Labels Provided for Evaluated Wells)
- MPWMD Monitoring Well
- Eastwood/Odello Well 2
- Carmel River
- Aquifer Test Area Evaluated by Mount (1983)
- Carmel River Watershed Boundary
- License 13868 Current Place of Use
- Cal-Am Place of Use within Carmel River Watershed

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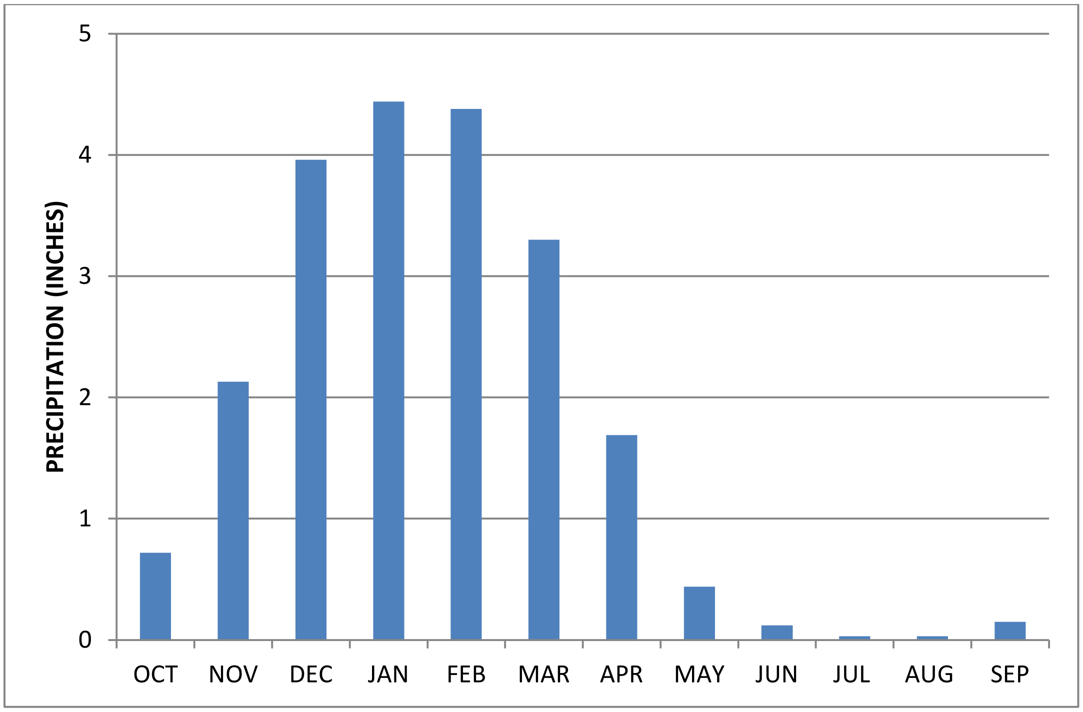
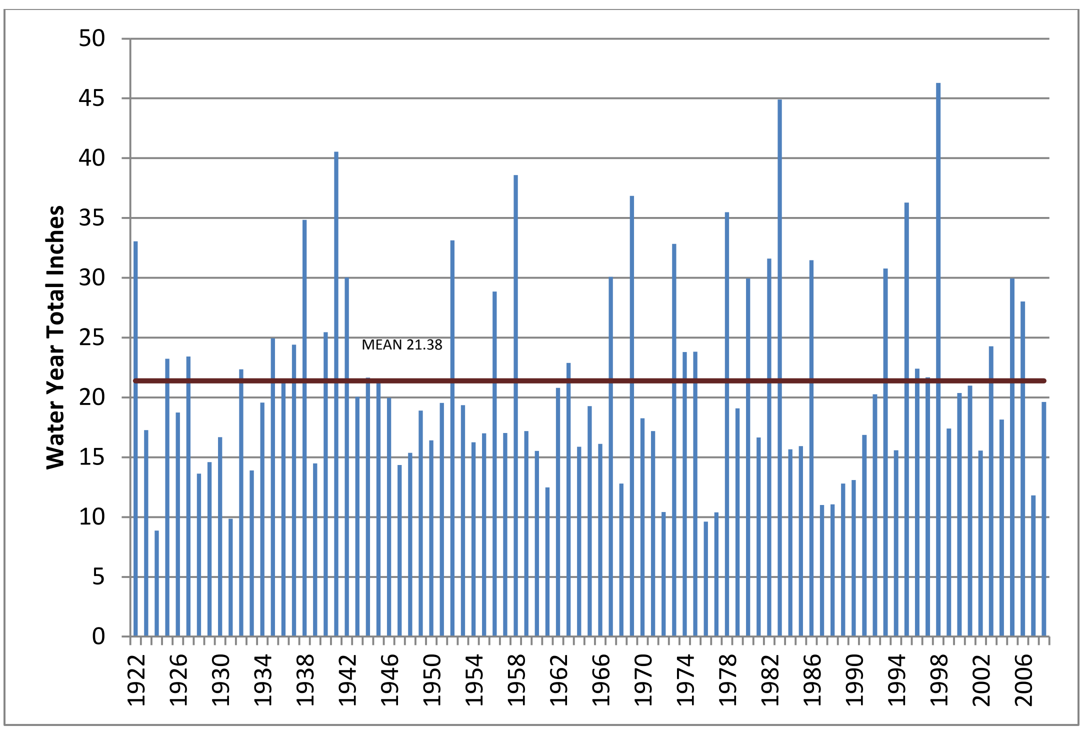
Figure 1-3. Rainfall at San Clemente Reservoir



Average Monthly Distribution (Period of Record 1922-2008)

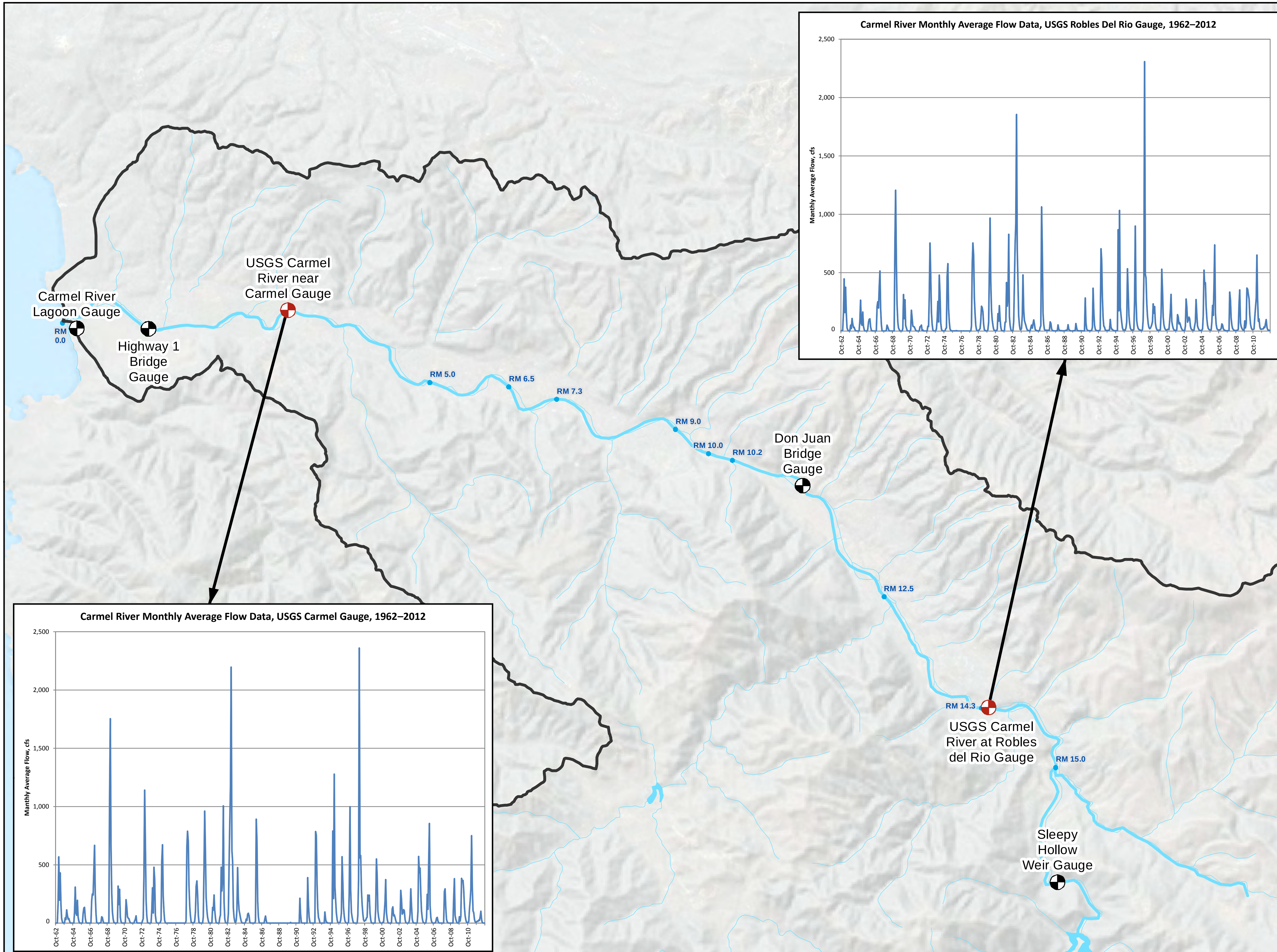


Rainfall at San Clemente Reservoir Water Years 1922-2008

FIGURE 1-4

Eastwood/Odello Water Right Change Petition Project

CARMEL RIVER STREAMGAGES



Notes

1. United States Geological Survey (USGS) river flow data was downloaded from the USGS National Water Information System Web Interface (http://waterdata.usgs.gov/nwis/gw) for stations 11143200 (Robles del Rio) and 11143250 (Carmel).
2. Monterey Peninsula Water Management District (MPWMD) streamgages were obtained from MPWMD (April, 2013).

LEGEND

- USGS Streamgage
- MPWMD Streamgage
- River Mile Marker
- Carmel River
- Carmel River Watershed Boundary

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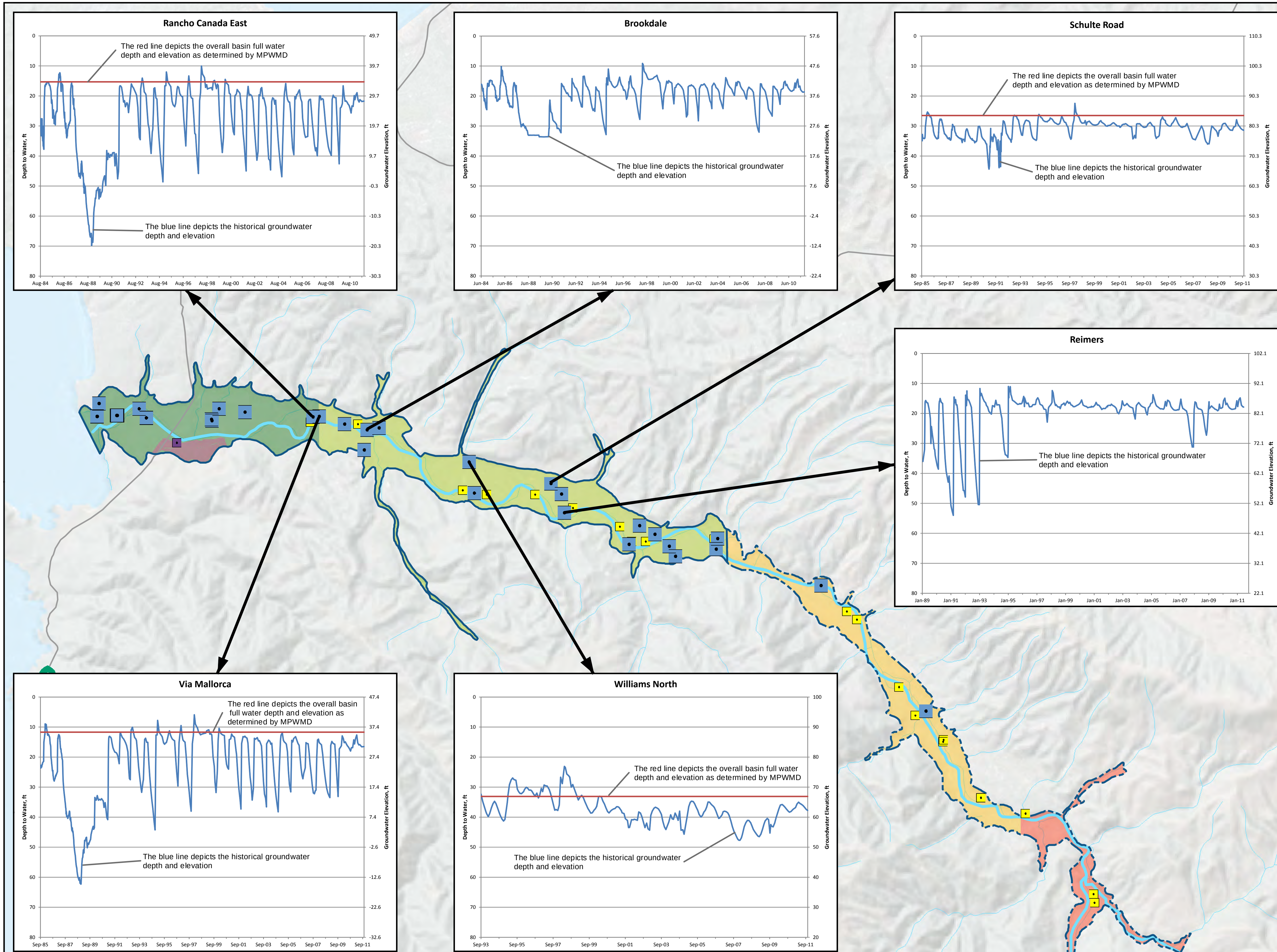

FIGURE 1-5

Eastwood/Odello Water Right Change Petition Project

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT MONITORING WELLS AND KEY WELL HYDROGRAPHS

0 3,000 6,000

Scale in Feet

Notes

1. Cal-Am = California-American Water Company
2. MPWMD = Monterey Peninsula Water Management District
3. MPWMD monitoring wells were obtained from MPWMD (March, 2013).
4. Cal-Am wells were obtained from Cal-Am (April, 2013).
5. Aquifer subunit endpoints were obtained from MPWMD (September, 2012).

LEGEND

- MPWMD Monitoring Well
- Cal-Am Production Well
- Eastwood/Odello Well 2
- Carmel River
- Lower Aquifer
- Upper Aquifer
- License 13868 Current Place of Use
- Aquifer Subunit 1
- Aquifer Subunit 2
- Aquifer Subunit 3
- Aquifer Subunit 4

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CHAPTER 2
Methodology

This chapter describes the key information that was compiled and reviewed for this study, and the methodology that was followed to conduct the groundwater and surface water evaluations in this study. Consideration was given to using a numerical groundwater model to complete this analysis. Specifically, a numerical MODFLOW model provided by MPWMD staff was reviewed for potential use in this analysis. However, it was determined that this model was inadequate to quantify the impacts resulting from the proposed Eastwood/Odello water right assignment (Assignment) at the desired accuracy and precision. Developing a new a numerical groundwater model, or making the necessary improvements to the existing MODFLOW model, were beyond the scope of this study.

2.1 DATA COMPILATION AND REVIEW

A summary of the key data and reports compiled and reviewed for this groundwater evaluation is provided in Table 2-1.

2.2 EVALUATION OF GROUNDWATER LEVEL IMPACTS

This section documents the methods used to estimate the changes in groundwater elevations that will occur with implementation of the Project, over time and at different distances from the pumping wells. Specifically, a mathematical solution developed by Moench (1997) was used for determining the drawdowns in the aquifer system over time and at various distances from the pumping wells. The Moench solution allows for evaluation of both pumping well and observation well data, and makes the following assumptions:

1. The aquifer is homogeneous, infinite in lateral extent, horizontal, and of uniform thickness.
2. The aquifer can be anisotropic (vertical conductivity can be different from horizontal conductivity).
3. Vertical flow across the lower boundary of the aquifer is negligible.
4. The well pumps at a constant rate from a specified zone below an initially horizontal water table.
5. The change in saturated thickness of the aquifer due to pumping is small compared with the initial saturated thickness.
6. The porous medium and fluid are slightly compressible and have constant physical properties.
7. The initial hydraulic head is the same everywhere.

Although assumption 1 above is never strictly met in any aquifer system, this assumption is suitable for this analysis because our objective is to quantify the increment of additional drawdowns that will result from the Project relative to drawdowns associated with the ongoing Cal-Am pumping, and not to quantify and absolute drawdown.

Table 2-1. Key Data and Reports Compiled and Reviewed for This Evaluation

	Information Type	Relevance to Study	Reference/Source
Reports			
1	Analysis of the Carmel Valley Alluvial Basin	Description of groundwater and surface water conditions in upper and lower Carmel Valley	USGS, 1984
2	Pumping Tests of Four Wells in Lower Carmel Valley, California for the California American Water Company	Aquifer properties in study area	Mount, 1983
3	State Water Resources Control Board Order No. WR 95-10	Description of the watershed and mitigation for Cal Am pumping in the valley	SWRCB, 1995
4	Carmel River Dam and Reservoir Project Draft Supplemental EIR	Surface and groundwater hydrology including storage estimates	MPWMD, 1998
Groundwater Level Data			
1	Historic depth to groundwater and groundwater elevation for monitoring wells in Carmel Valley	Used to evaluate aquifer system response to pumping and stream flow	MPWMD, 2013
2	Monitoring Well Locations		
Groundwater Production Data			
1	Non Cal Am production data for 2011-2012 including approximate (within 100 feet) pumping locations	Used to evaluate the impact of proposed Eastwood Assignment on non Cal Am pumpers in Carmel Valley	MPWMD, 2013
2	Cal Am production records from 2008 to 2012 including exact pumping locations	Used to evaluate the impact to other pumper resulting from of adding Eastwood Assignment to other Cal Am pumping in the Camel Valley	Cal Am, 2013
Surface Water Hydrology			
1	Stream Flow Records	Used to understand historic stream flow conditions in the Carmel Valley study area. Use this information as the baseline condition, the impact of the proposed Eastwood Assignment was evaluated.	USGS, 2013 and MPWMD, 2013

For this evaluation, AquiferWin32 (Rumbaugh, 2011) was used to run the Moench analytical solution. The model input parameters include the following:

- Top of screen and screen lengths for both pumping wells and observation wells
- Horizontal distances between pumping wells and observation wells
- Aquifer thickness
- Hydraulic conductivity
- Storativity
- Specific yield
- Pumping capacity
- Ratio of vertical to horizontal conductivity in the aquifer (assumed to be 1:10 for this analysis)

Table 2-2 lists the model parameters used as inputs for these analyses.

Estimated effects on groundwater levels that will result from the Project were evaluated by following the steps listed here:

1. Generate a map displaying the locations of: a) each pumping well, relative to Carmel River; b) all other pumping wells in the vicinity; and c) the MPWMD monitoring wells in the vicinity. Use this map to calculate the distances from pumping well to the river and to other wells.
2. Evaluate the effect of current pumping at the Eastwood/Odello well using the highest estimated pumping rate of 0.185 cfs (83 gpm), which occurs in June (Table 1-1).
3. Evaluate the record of historical pumping for each of the seven Cal-Am wells considered in the evaluation (Figure 1-2) and select the highest pumping month on record for each well.
4. Run the Moench solution to quantify the drawdown effects resulting from current Cal-Am pumping at the rates selected in step 3 above.
5. Compute the monthly pumping rates that will occur with the Project, which will involve pumping on a municipal demand pattern, rather than on the agricultural demand pattern shown in Table 1-1. Results of this computation are summarized in Table 2-3.
6. Add the Project pumping rates to the existing Cal-Am pumping rates selected in step 3 above. The Project pumping rate that was added to the existing Cal-Am pumping rate was selected from Table 2-3. For example, if the highest pumping rate at the Cañada Well occurred in June 2010 and was 2,400 gpm, then 65 gpm (the June Project pumping rate in Table 2-3) of Project pumping was added, for a total new pumping rate of 2,465 gpm.
7. Run the Moench solution to quantify the drawdown that would result from the total pumping rate determined in step 6 above.
8. Generate a plot showing drawdowns with and without the Project pumping.
9. Tabulate the difference in drawdown with and without Project pumping after 10 days, 30 days, and 100 days.

Table 2-2. Model Input Parameters for Quantification of Groundwater Level Drawdown								
Well / River	Distance From Pumping Well (ft)	Aquifer Thickness (ft)	Hydraulic Conductivity, K (ft/d)	Transmissivity (g/d ft)	Storativity, S	Specific Yield, Sy	Base Pumping Rate (GPM)	Base + Assignment Pumping Rate (GPM)
Odello		120	180	21600	0.01	0.1	68	NA
River	310							
Canada		129	200	25800	0.01	0.15	2432	2478
River	121							
P199	360							
P186	219							
P209	923							
Cypress		105	282	29610	0.01	0.1	1617	1682
River	137							
P130	465							
MWWS	759							
P161	877							
Pearse		140	278	38920	0.01	0.07	1876	1916
River	477							
P143	303							
P122	584							
MWWS	767							
Schulte		130	285	37050	0.01	0.15	1690	1730
River	95							
P142	296							
P136	446							
P155	860							
Begonia #2		110	300	33000	0.01	0.15	1322	1389
River	275							
P89	851							
P90	425							
P91	812							
Berwick#9		90	325	29250	0.01	0.2	1014	1054
River	357							
MWMVM	275							
P73	692							
CAWellB8	880							
Berwick#8		130	330	42900	0.01	0.2	701	769
River	301							
MWKM	678							
P74	445							
CAWellB9	880							

Table 2-3. Proposed Eastwood/Odello Assignment on Municipal Demand Pattern

Month	Monthly Municipal Demand Pattern[(a)]	Monthly Diversion of Proposed Eastwood/Odello Assignment (AF)	Well Extraction Rate for Diversion of Proposed Assignment (GPM)
January	6.4%	5.5	40
February	5.8%	5.0	40
March	6.7%	5.7	42
April	7.4%	6.4	48
May	9.4%	8.0	59
June	10.0%	8.6	65
July	10.8%	9.2	67
August	10.8%	9.2	67
September	9.8%	8.4	63
October	9.1%	7.8	57
November	7.2%	6.1	46
December	6.6%	5.6	41
ANNUAL	**100.0%**	**85.6**	**53**

Source: Cal-Am monthly production records submitted to MPWMD.

(a) MPWMD, 2013. Cal-Am Main System monthly demand distribution based on reported production for the 10-year period from Water Year 1998 to 2007.

2.3 EVALUATION OF STREAM FLOW IMPACTS

As noted above, Eastwood/Odello water right License 13868 has historically been utilized for irrigation purposes. As a result, a portion of the pumped water re-enters the groundwater basin through infiltration from irrigation return flows, while the rest of the pumped water is consumed through evapotranspiration (ET). The amounts of consumptive use were quantified by Davids Engineering in 2013 and are summarized by month in Table 1-1. As indicated in Table 1-1, the estimated average annual consumptive use is 85.6 acre-feet, which equates to an annual average flow rate of 0.118 cfs.

For this analysis, it is assumed that, for the Project, the total annual additional pumping of the seven Cal-Am wells that will be used for the Project will equal the annual ET rate in Table 1-1. All of these wells pump from either aquifer zone AS3 or aquifer zone AS4. It is also assumed that the pumping of water for the Project through these Cal-Am wells will cause instantaneous, one-to-one flow reductions in the surface water flows in the reach of the Carmel River between the point of the river that is adjacent to the well point and the point on the river that is adjacent to the existing Eastwood/Odello well. The actual impacts of this change in pumping location on river flows are likely to be delayed, and are likely to be less than one-to-one, due to the attenuating effects of withdrawing water from the aquifer rather than directly from the river. The instantaneous one-to-one flow reduction assumption is thus considered to result in an estimated level of river flow effect that probably is higher than the level of effect that actually will occur.

Existing USGS Carmel River gauge data from the 50-year period of October 1962 through September 2012 was used to specify the base flow condition. The effects on Carmel River flows of moving the point of diversion in License 13868 from its current location on the Eastwood/Odello property upstream to the seven Cal-Am wells then are described in comparison to this base condition. As discussed above, the USGS maintains two Carmel River gauges: one just upstream of the Odello East property (the “Carmel gauge”), and one somewhat farther upstream at Robles Del Rio. The latter gauge is located over aquifer zone AS-2, and flows at this gauge will not be affected by the Project. For this reason, the Carmel gauge is used as the gauge to assess the effects of the Project on surface water flows in river. Specifically, it is assumed that the Project will reduce surface water flows in the Carmel River at the Carmel gauge by the monthly ET amounts in Table 1-1.

CHAPTER 3
Results

Results for both the groundwater drawdown analysis and the surface water stream flow analysis are presented in this chapter.

3.1 RESULTS OF GROUNDWATER DRAWDOWN ANALYSIS

This section discusses the following topics:

- Well Maps and Groundwater Pumping Assessment
- Quantification of Groundwater Drawdown Resulting from Project Pumping
- Groundwater Storage Considerations

3.1.1 Well Maps and Groundwater Pumping Assessment

The maps in Appendix C show the general locations of the private wells in the Carmel Valley aquifer and the general amounts of pumping by these wells during water years 2011 and 2012. These maps indicate that pumping in excess of 25 AFY occurs at ten to twelve locations throughout the Valley. Private pumping of less than 5 AFY per well is much more widespread through the Valley.

As described in Section 2.2, GIS maps were prepared for the Eastwood/Odello well and each of the seven Cal-Am wells evaluated in this report. These maps show distances from each of these wells to the Carmel River and to other wells considered in the analysis. Figure 3-1 is an example of one of these maps. Appendix D contains similar maps for all of the wells analyzed in this report. The locations of the Cal-Am wells were provided by Cal-Am staff and are assumed to be exact pumping locations. Well construction information and exact locations of private pumping wells in the study area were not available from MPWMD due to confidentiality requirements. Instead, MPWMD provided approximate locations of the private wells on a coarse location grid. The colored squares indicate that pumping through a private well occurred somewhere within that 100-foot by 100-foot area in water year 2012. A color-coding system was developed to show approximate total annual pumping from each active grid, with red indicating high-use wells that pumped in excess of 25 AFY (*e.g.*, landscape irrigation wells). These maps show that low-use domestic wells (indicated in purple) that pump in the range of 0.01 to 1.0 AFY are widespread.

Monthly total Cal-Am pumping data for 2008 to 2012 was plotted, and the highest pumping month on record for each was identified. Appendix F contains these plots for each of the seven Cal-Am wells analyzed in this report, with a red circle on each plot showing the peak pumping month for the well that is covered by that plot. The dashed curve in each of these plots shows the historical Cal-Am pumping for each well for the 2008 to 2012 period. The solid curve in each of these plots indicates, for each month, the total of the historic Cal-Am pumping amount for that well for that month plus the calculated Project amount for that month. These plots show that, even if the entire additional pumping for the Project all were to occur at each of the Cal-Am well depicted in each of these plots, the percentage increase in the total pumping at that well still would be very small. For example, if all Project pumping were to occur through the Cañada well, then the total pumping by that well location would increase by about 4 to 6 percent. These plots also demonstrate that Cal-Am pumping is lower in the eastern portion of the Carmel Valley than in the western portion of the valley. Because of this lower pumping, if all Project pumping were to occur through the Berwick #8 well, then the percentage increase in pumping by this well would range between 10 and 20 percent. These plots show the effects that would occur if all of the Project pumping were to occur through one well. These plots, therefore, show “worst case” scenarios, because Project pumping therefore will be distributed among several or all of the seven Cal-Am wells that are analyzed in this report.

3.1.2 Quantification of Estimated Groundwater Drawdowns That Would Result from All Project Pumping at Each Cal-Am Well

The Moench Solution was utilized to calculate predicted groundwater level reductions resulting from two conditions: 1) Historic groundwater pumping by each of the seven Cal-Am wells shown in Figure 1-2; and 2) the additional drawdowns that would result if all of the Project pumping were to occur at each of these wells. The results of these analyses are summarized in Table 3-1, and Appendix E contains plots of these calculated drawdowns for each Cal-Am well at various observation points.

Table 3-1 lists the calculated percentage of increased drawdown for each well that would result from the Project after 100 days of continuous pumping at a rate equal to the highest pumping rate of record for that well. This approach overestimates the actual drawdowns that will occur with the Project, because 100 days of sustained pumping at the pumping rate that occurred during the month of record with the highest pumping rate (for the period 2008 to 2012) would be unlikely. As indicated by Table 3-1, the percentages of increased drawdown that would result from all Project pumping at each well range from 1.9 percent for the Cañada Well to 9.7 percent for the Berwick #8 Well. As discussed above, these plots are based on the assumption that all Project pumping for would occur through a single well, which is unlikely. It is more likely that the Project pumping will be distributed among several or all seven of the Cal-Am wells. If this occurs, then the percentage of increased drawdown that would occur at each Cal-Am well as a result of the Project would be substantially lower than the percentages shown in Table 3-1.

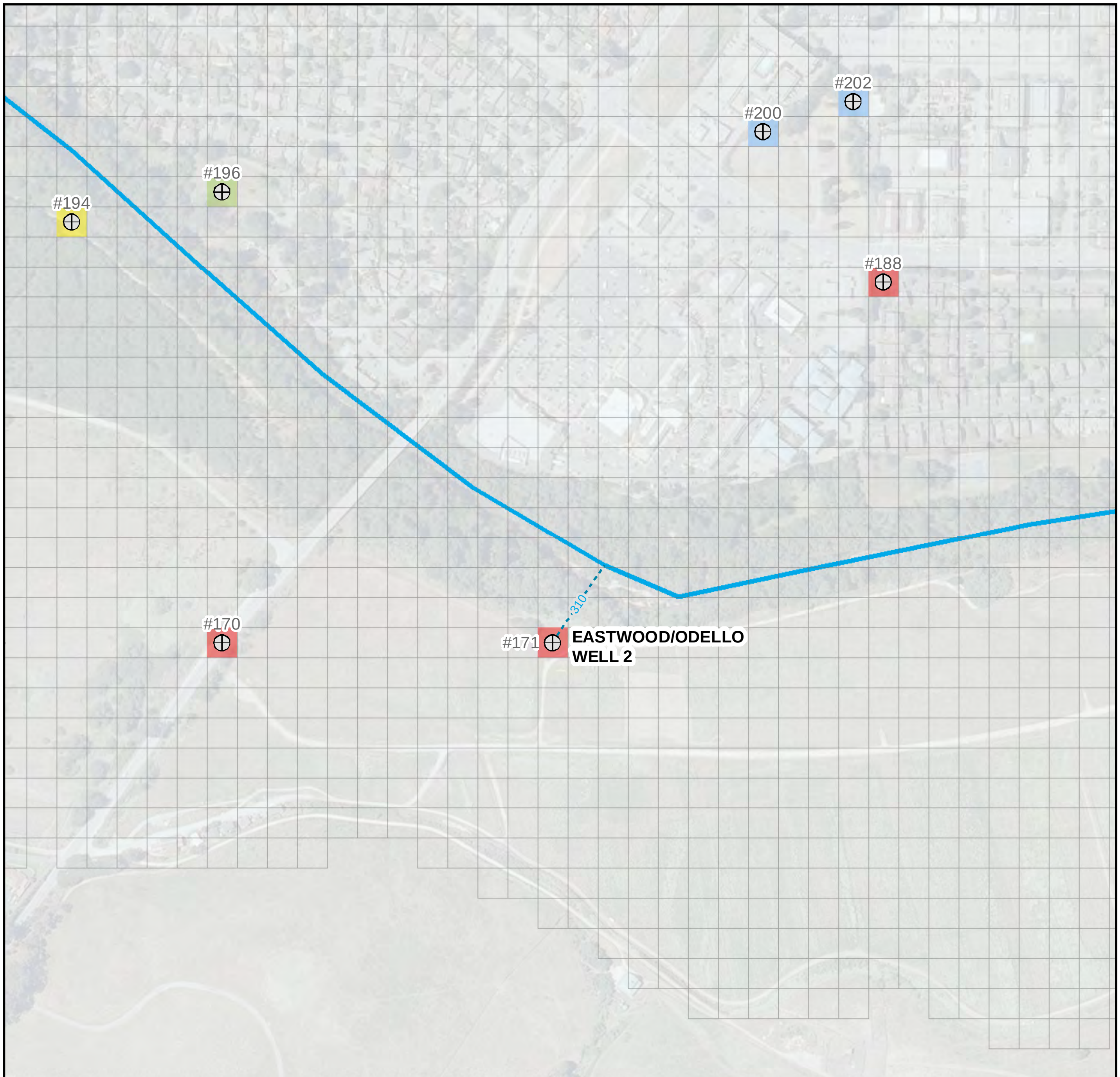
3.1.3 Groundwater Storage Considerations

MPWMD staff use groundwater level information to calculate and track groundwater storage. Figure 3-2 shows the groundwater storage sectors tracked by MPWMD staff. Figure 3-3 shows the changes in storage for each of the storage zones in AS3 and AS4 that occurred between November 2009 and November 2012. Although groundwater levels fluctuated on the order of 20 to 30 feet seasonally at some locations (see Figure 1-5 and Appendix B), Figure 3-3 shows that overall basin storage trends were more stable during this period.

Figure 3-4 shows that total aquifer storage for a full basin condition is about 40,000 acre-feet. For the 2009 to 2012 period, actual basin storage fluctuated between 37,000 and 39,000 acre-feet. For basin management purposes, MPWMD staff has determined that the usable groundwater in storage in the lower Carmel Valley aquifer is 21,927 acre-feet. In contrast, the proposed Project pumping would be 85.6 AFY. This amount is a very small percentage of total usable aquifer storage. Also, as discussed in Chapter 1, the current average annual consumptive use associated with the Eastwood/Odello pumping and irrigation already is 85.6 AFY, so the Project would not cause any net reductions in total aquifer storage.

Table 3-1. Summary of Predicted Groundwater Level Declines Resulting from Historical Cal-Am Pumping and Eastwood Assignment Pumping

Pumping Well	Observation Point	Distance From Pumping Well, ft	Base Case Pumping Rate, gpm	Drawdown After 30 days of Pumping, ft	Drawdown After 100 days of Pumping, ft	Base + Assignment Pumping Pumping Rate, gpm	Drawdown After 30 days of Pumping, ft	Drawdown After 100 days of Pumping, ft	Difference in Drawdown, s After 30 Days, ft	After 100 Days, ft	% Increase in s after 100 days
Odello			68			NA					
	River	310		0.21	0.27		0	0			
Canada			2432			2478					
	River	121		10.92	12.96		11.13	13.21	0.21	0.25	1.9%
	P199	360		7.2437	9.27337		7.38071	9.44877	0.14	0.18	1.9%
	P186	219		8.92	10.95		9.09	11.16	0.17	0.21	1.9%
	P209	923		4.13	6.11		4.21	6.22	0.08	0.12	1.9%
Cypress			1617			1682					
	River	137		6.34	7.62		6.60	7.92	0.25	0.31	4.0%
	P130	465		3.77168	5.034		3.92329	5.23636	0.15	0.20	4.0%
	MWWS	759		2.76	4.01		2.87	4.17	0.11	0.16	4.0%
	P161	877		2.47	3.70		2.57	3.85	0.10	0.15	4.0%
Pearse			1876			1916					
	River	477		3.80564	4.83876		3.88678	4.94193	0.08	0.10	2.1%
	P143	303		4.58	5.62		4.68	5.74	0.10	0.12	2.1%
	P122	584		3.46	4.49		3.53	4.59	0.07	0.10	2.1%
	MWWS	767		3.00	4.02		3.06	4.11	0.06	0.09	2.1%
Schulte			1690			1730					
	River	95		5.21	6.05		5.33	6.19	0.12	0.14	2.4%
	P142	296		3.62	4.46		3.71	4.57	0.09	0.11	2.4%
	P136	446		3.05	3.89		3.13	3.98	0.07	0.09	2.4%
	P155	860		2.14911	2.97753		2.19998	3.04801	0.05	0.07	2.4%
Begonia #2			1322			1389					
	River	275		3.21947	3.95709		3.38263	4.15764	0.16	0.20	5.1%
	P89	851		1.83	2.56		1.92	2.69	0.09	0.13	5.1%
	P90	425		2.67	3.41		2.81	3.58	0.14	0.17	5.1%
	P91	812		1.89	2.61		1.98	2.75	0.10	0.13	5.1%
Berwick#9			1014			1054					
	River	357		2.28722	2.9238		2.37744	3.03914	0.09	0.12	3.9%
	MWMVM	275		2.56	3.20		2.66	3.33	0.10	0.13	3.9%
	P73	692		1.60	2.22		1.66	2.31	0.06	0.09	3.9%
	CAWellB8	880		1.35	1.97		1.40	2.05	0.05	0.08	3.9%
Berwick#8			701			769					
	River	301		1.25841	1.55915		1.38048	1.7104	0.12	0.15	9.7%
	MWKM	678		0.86	1.15		0.94	1.27	0.08	0.11	9.7%
	P74	445		1.06	1.36		1.17	1.50	0.10	0.13	9.7%
	CAWellB9	880		0.73	1.02		0.80	1.12	0.07	0.10	9.7%



LEGEND

- ⊕ Private Production Well
- ----- Distance to River (feet)
- ━━ Carmel River

Private Pumping

(acre-feet per year)

- < 0.01
- 0.01 - 1.0
- 1.0 - 5.0
- 5.0 - 10
- 10 - 25
- > 25

NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.
4. Eastwood/Odello Well 2 falls in the private pumping zone labeled as #171.

N

0 250 500

Scale in Feet

FIGURE 3-1

Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM EASTWOOD/ODELLO WELL 2

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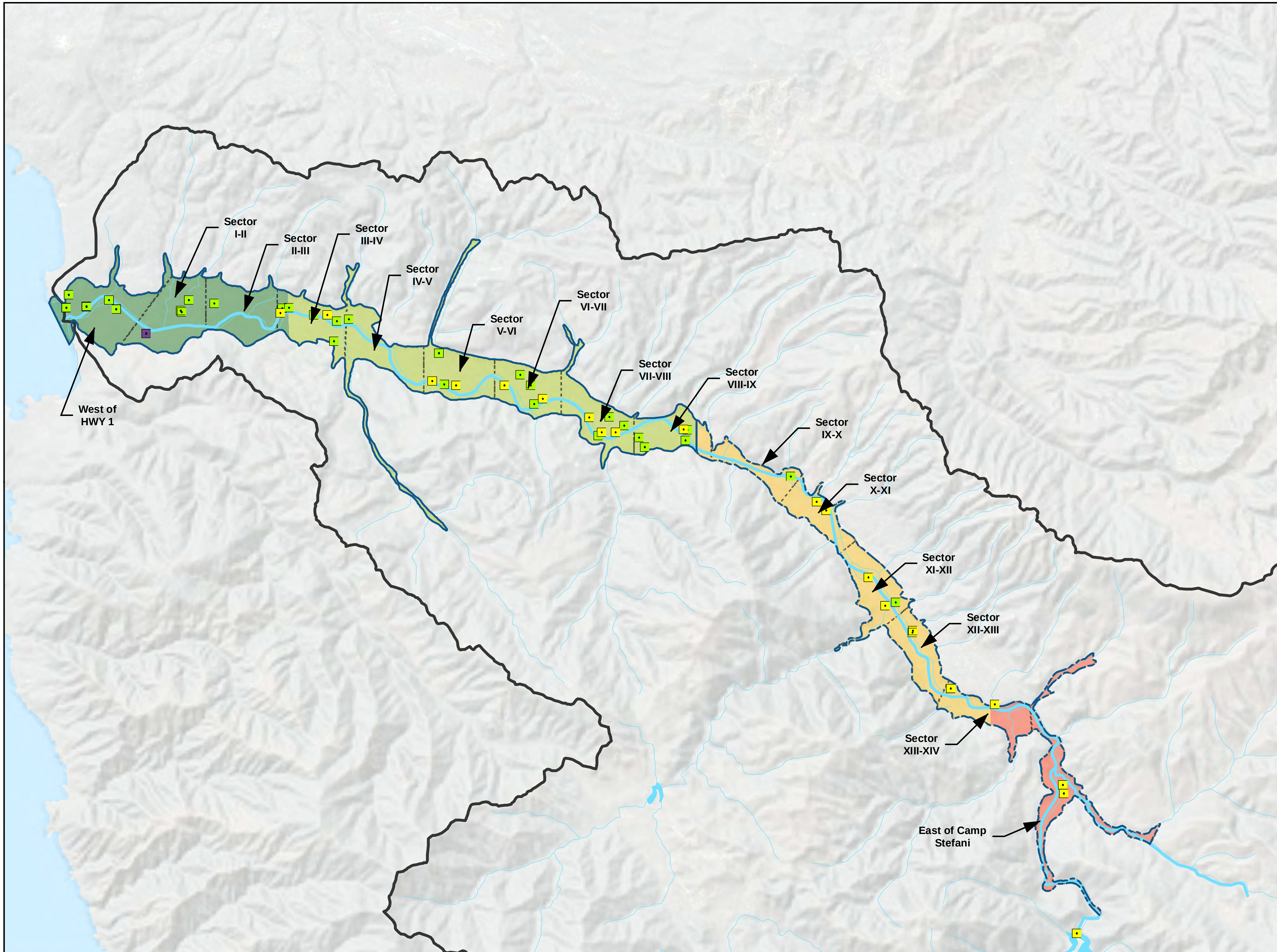
FIGURE 3-2

Eastwood/Odello Water Right Change Petition Project

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT AQUIFER STORAGE SECTORS



Notes
1. Cal-Am = California-American Water Company
2. MPWMD = Monterey Peninsula Water Management District
3. MPWMD monitoring wells were obtained from MPWMD (March, 2012).
4. Cal-Am wells were obtained from Cal-Am (April, 2013).
5. Aquifer subunit points were obtained from MPWMD (September, 2012).
6. MPWMD aquifer storage sectors were obtained from MPWMD (April, 2013).

LEGEND
- Cal-Am Production Well
- MPWMD Monitoring Well
- Eastwood/Odello Well 2
- Carmel River
- MPWMD Aquifer Storage Sectors
- Aquifer Subunit 1
- Aquifer Subunit 2
- Aquifer Subunit 3
- Aquifer Subunit 4
- Lower Aquifer
- Upper Aquifer
- Carmel River Watershed Boundary

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Figure 3-3. Lower Carmel Valley Aquifer Storage by Zone, 2009 to 2012

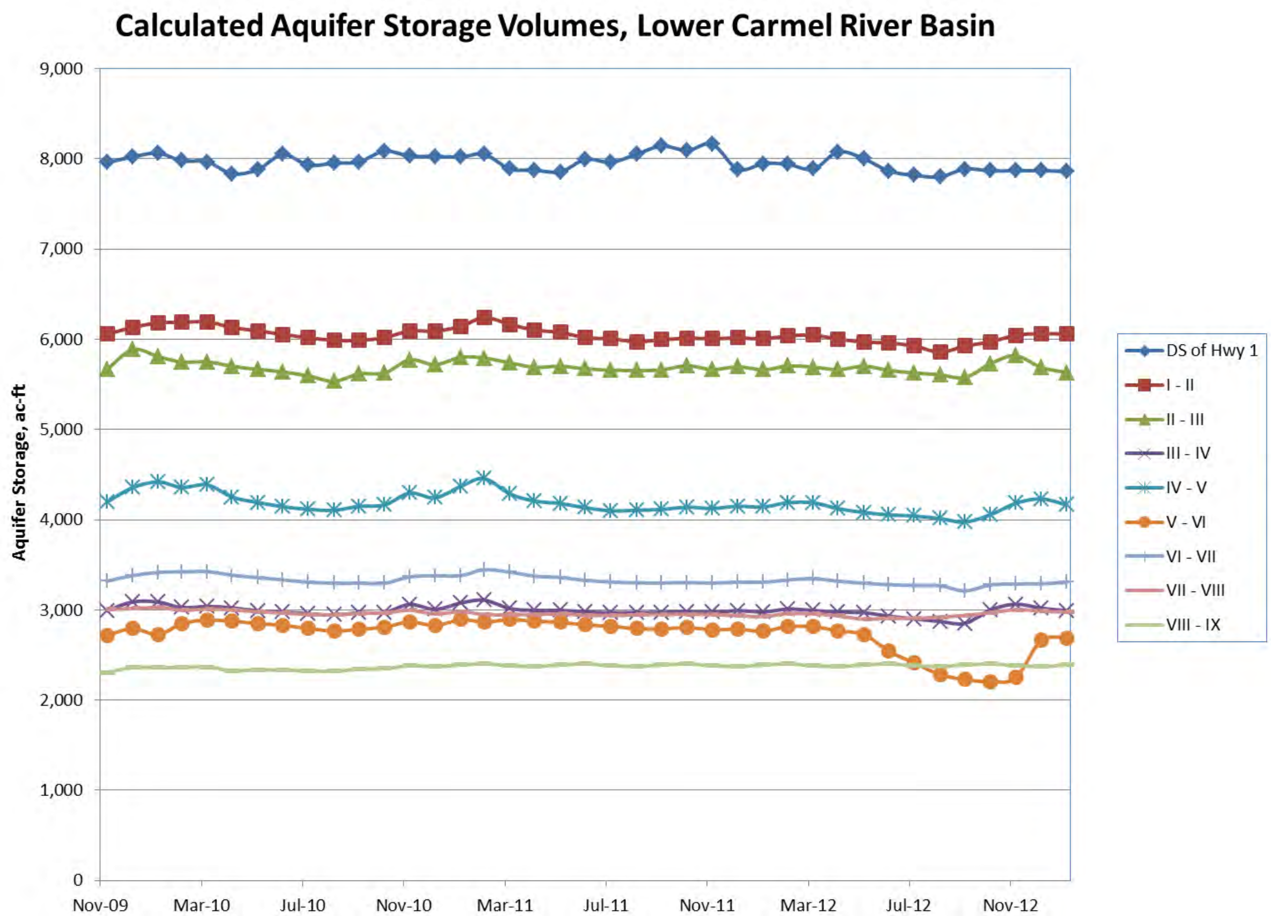
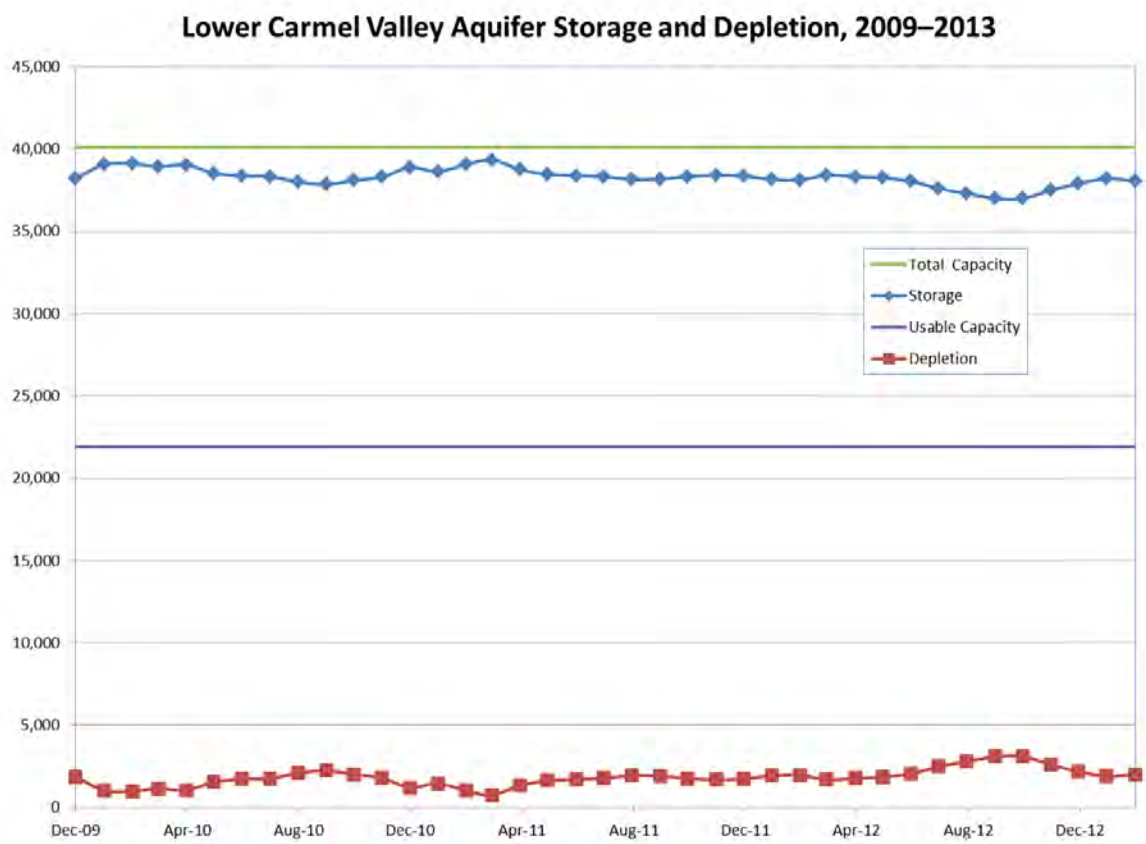


Figure 3-4. Total Aquifer Storage, Usable Capacity and Storage Depletion in Lower Carmel Valley, 2009 to 2012.



3.2 RESULTS OF SURFACE WATER STREAM FLOW ANALYSIS

As discussed above, the Project would involve moving the point of diversion for 85.6 AFY of water under License 13868 from the well on the Eastwood/Odello property upstream to Cal-Am's seven wells described above. The effects of this change in point of diversion on surface water flows in the Carmel River at the USGS Carmel Gauge are indicated in Figures 3-5 and 3-6.

These figures contain exceedance plots of unadjusted (that is "without Project") river flows at the Carmel gauge and of the estimated adjusted flows that could occur with the Project. The plots for the unadjusted flows in these figures were prepared using daily flows at the Carmel gauge for the 50-year period of October 1962 to September 2012. These flows are ranked from largest to smallest, and then used to prepare the plots of the cumulative frequency of occurrence for the unadjusted flows. The plots of adjusted flows were prepared by subtracting the monthly Project diversions from the corresponding unadjusted flows and then preparing the exceedance plots for adjusted flows. (As discussed above, these adjusted flows were calculated assuming that the additional pumping of Cal-Am's wells will have 1-to-1 effects on surface water flows in the Carmel River at the Carmel gauge.)

Because the monthly amounts of the Project diversions are small relative to the monthly flows in the river at higher river flows, the differences between the unadjusted and adjusted plots are not detectable in Figure 3-5, which shows the full range of flows for the 50-year period of record. Figure 3-6 is a magnification of the part of Figure 3-5 for flow in the range of 0 to 5 cfy. Thus, the highest river flow shown in Figure 3-6 is 5 cfs, while the highest river flow shown in Figure 3-5 is 2,500 cfs.

As indicated in Figure 3-6, monthly average Carmel River surface water flows at the Carmel gauge have historically been less than five cfs but greater than zero approximately 16 percent of the time, and these flows have been zero approximately 37 percent of the time.

Appendix G contains a set of similar plots of flows for each month. Table 3-2 lists, separately for each month, the percentages of time for which these monthly flows are greater than 5 cfs, less than 5 but greater than zero cfs, and zero cfs, for the unadjusted and adjusted flows.

Table 3-2. Summary of Carmel River Flow Ranges by Month, Carmel Gauge, 1962–2012

Month	Maximum Measured Flow, cfs	Percent of Time the Indicated Flows (Q) Occurred					
		Unadjusted Flow			Adjusted flow		
		Q > 5 cfs	0<Q≤5 cfs	Q = 0 cfs	Q > 5 cfs	0<Q≤5 cfs	Q = 0 cfs
January	6,750	72	7	21	72	7	21
February	9,050	85	2	12	85	2	12
March	8,000	88	4	9	88	4	9
April	3,770	87	5	8	86	5	9
May	1,250	76	11	13	76	9	15
June	261	49	22	29	49	21	30
July	121	23	27	50	23	24	53
August	43	8	30	62	8	25	67
September	23	5	26	69	5	20	76
October	759	9	21	70	9	18	73
November	863	19	20	61	18	20	61
December	3,100	46	13	41	46	13	41
Year Round	**9,050**	**47**	**16**	**37**	**47**	**14**	**39**

Figure 3-5. Distribution of Year-Round Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012

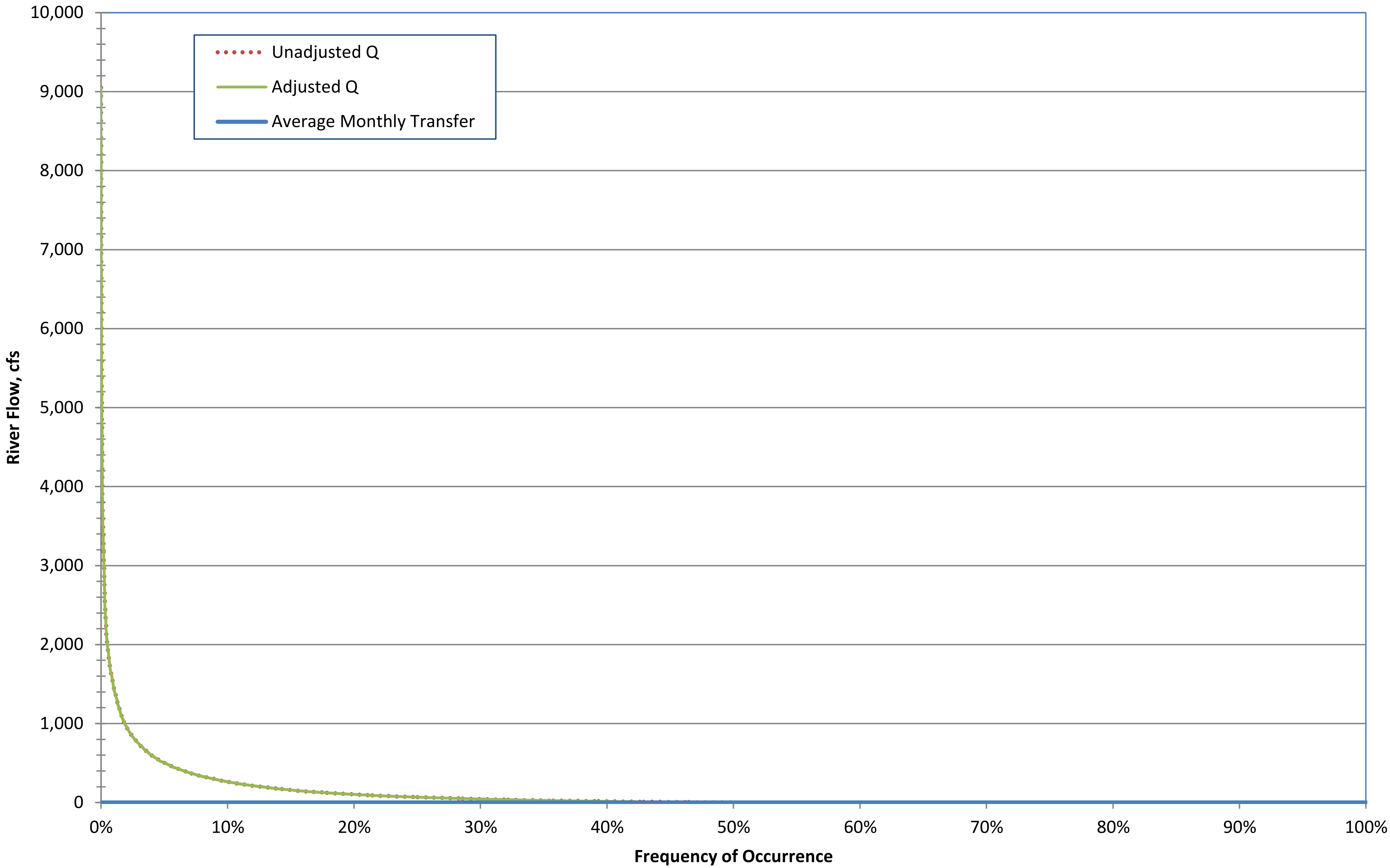
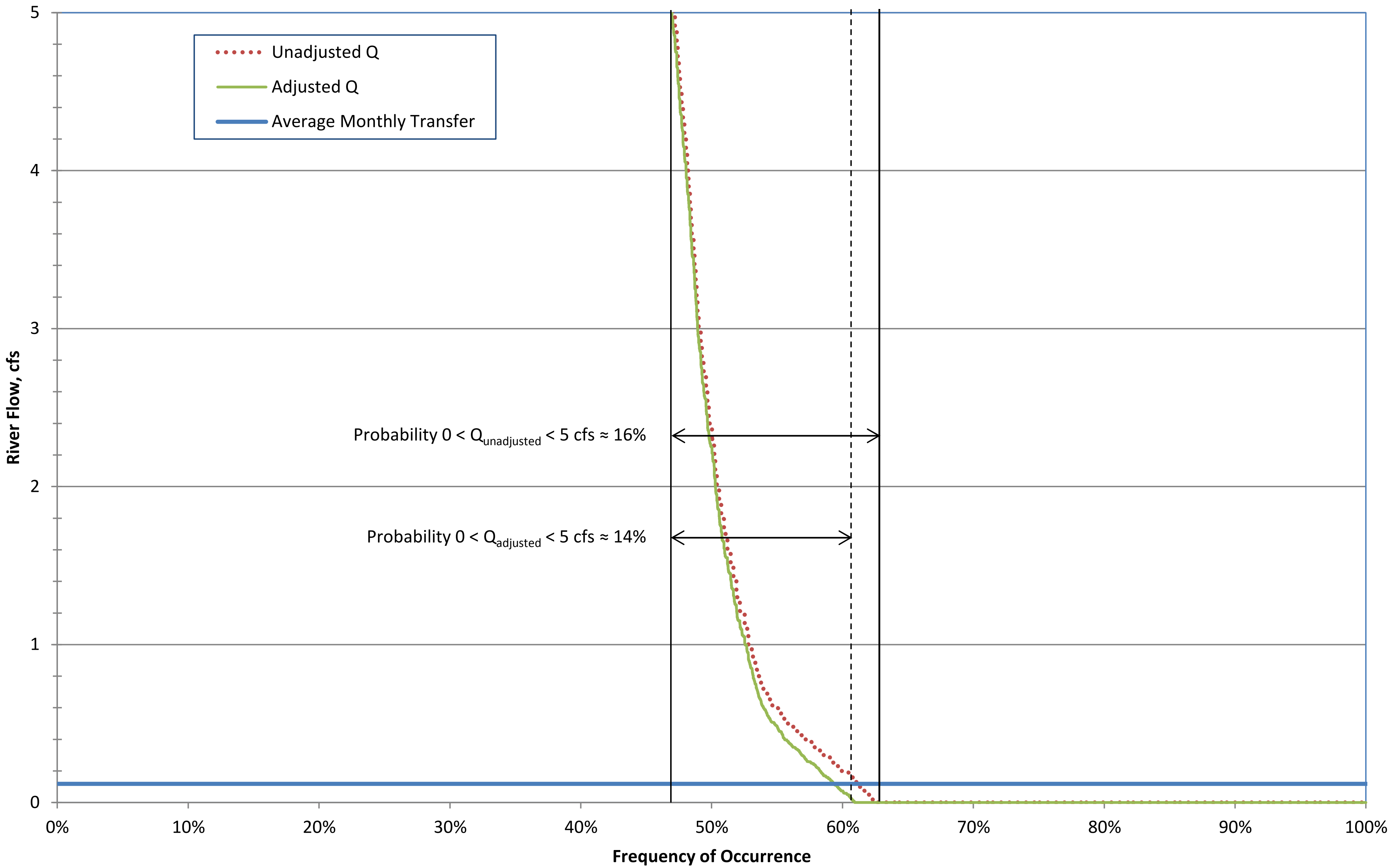


Figure 3-6. Distribution of Year-Round Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)



CHAPTER 4
Summary and Conclusions

As discussed above, the following two questions are addressed in this report:

1. What effects will the Project have on water levels in wells near the Cal-Am wells that will be used for the Project?
2. What effects will the Project have on surface water flows in the Carmel River?

The following sections summarize our answers to these questions.

4.1 GROUNDWATER PUMPING IMPACTS

This evaluation considered the impact shift groundwater pumping from the Eastwood/Odello well to Cal-Am's seven wells in the lower Carmel Valley. For each of these Cal-Am wells, the evaluation quantified the predicted groundwater level declines associated with present Cal-Am pumping and the estimated incremental increased groundwater declines that would occur with Project pumping, if all Project pumping were to occur at each Cal-Am well. A mathematical solution developed by Moench (1997) was used for determining the drawdown in the aquifer system over time and with distance away from the pumping well. Key findings are summarized here:

1. For the period 2009 to 2012, actual basin storage in the lower Carmel Valley Aquifer has fluctuated between 37,000 and 39,000 acre-feet. For basin management purposes, MPWMD staff has determined that the usable groundwater in storage in the lower valley is 22,000 acre-feet. The Project would move the ET of 85.6 AFY that is associated with the current well pumping and associated irrigation at the Eastwood/Odello property to these seven Cal-Am wells.
2. Based on a review of recent (2008 to 2012) Cal-Am pumping records, the additional pumping associated with the Project would increase pumping through the Cañada well by about 4 to 6 percent on average, if all Project pumping were made through this well (the most downstream Cal-Am well). If all Project pumping were made through the Berwick #8 well (the most upstream Cal-Am well evaluated), then the percentage increase in pumping through this well would range between 10 and 20 percent. The plots in Appendix E show the impacts that would occur if all Project pumping were to occur through each well. These plots therefore show "worst case" scenarios, because Project pumping probably will be distributed among several or all of these seven Cal-Am wells.
3. The plots in Appendix E show that the increased drawdowns that would result from all Project pumping at each Cal-Am well would be on the order of inches and never would exceed 0.5 foot at any observation point considered in this evaluation.
4. The percentages of increased drawdowns that would result from all Project pumping at each Cal-Am well range from 1.9 percent at the Cañada Well to 9.7 percent at the Berwick #8 Well. These percentage drawdowns probably are "worst case" scenarios, because Project pumping probably will be distributed among several or all of these seven Cal-Am wells.

5. If the Project pumping is distributed among several or all of these seven Cal-Am wells, then the incremental drawdowns at any well will be less than the incremental drawdowns shown in the plots in Appendix E.

4.2 SURFACE WATER IMPACTS

The primary conclusions of the analysis of surface water impacts are:

1. The amounts of monthly Project pumping are very small in comparison to the average monthly flows in the Carmel River at higher river flows. Specifically, the highest monthly Project pumping would be approximately 0.12 cfs, while the average monthly flow in the river at the Carmel gauge for the period of 1962 through 2012 is approximately 103 cfs. Thus, the highest monthly Project pumping rate is less than 0.2 percent of the average monthly flow in the river.
2. Historically, river flows normally are high in the river during January through May.
3. Historically, monthly average river flows at the Carmel Gauge were zero approximately 37 percent of the time. Zero flows occurred much more often during the months of July through November. During these months, the changes in points of diversion associated with Project pumping would have no impacts on river flows when the river already would be dry under the without Project condition.
4. Historically, monthly average river flows are greater than zero but less than five cfs approximately 16 percent of the time. Flows in that range are most common during the months of June through November.
5. The changes in percentage exceedances for average monthly flows in the greater than five cfs, less than five cfs but greater than zero, and zero cfs ranges that would occur with Project implementation are shown in the plots in Appendix G and are summarized in Table 3-2.

CHAPTER 5
References

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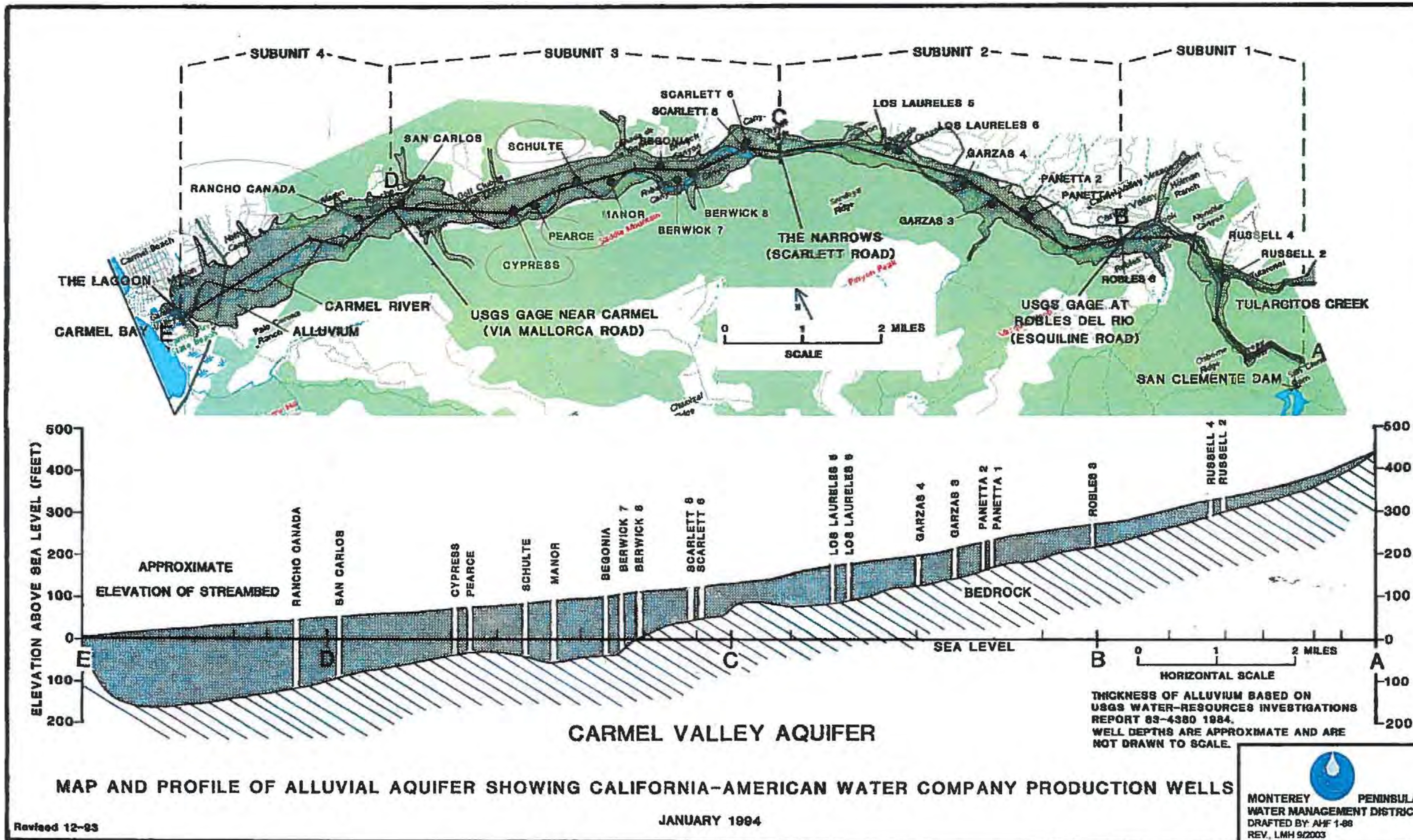
APPENDIX A

Carmel Valley Aquifer Designations



Appendix A

Eastwood/Odello Water Right Change Petition Project

CARMEL VALLEY AQUIFER DESIGNATIONS

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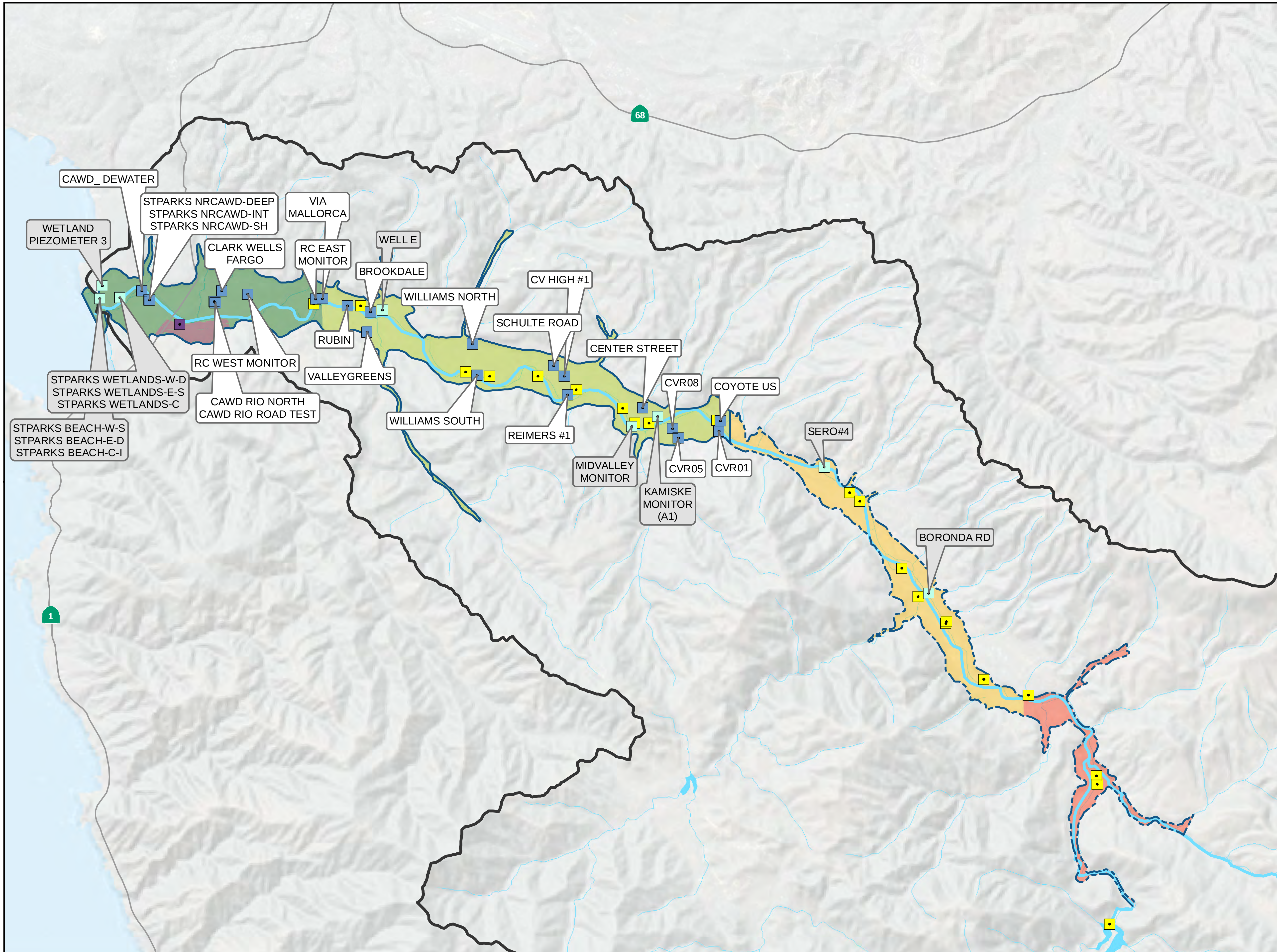
APPENDIX B

Monitoring Well Hydrographs

FIGURE B-1

Eastwood/Odello Water Right Change Petition Project

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT MONITORING WELLS



Notes
1. Cal-Am = California-American Water Company
2. MPWMD = Monterey Peninsula Water Management District
3. MPWMD monitoring wells were obtained from MPWMD (March, 2013).
4. Cam-Am wells were obtained from Cal-Am (April, 2013).
5. Aquifer subunit endpoints were obtained from MPWMD (September, 2012).
6. MPWMD monitoring wells without hydrographs have grey labels. MPWMD monitoring wells with hydrographs have white labels.

LEGEND

- MPWMD Monitoring Well without Hydrograph
- MPWMD Monitoring Well with Hydrograph
- Cal-Am Production Well
- Eastwood/Odello Well 2
- Carmel River
- Lower Aquifer
- Upper Aquifer
- Carmel River Watershed Boundary
- License 13868 Current Place of Use
- Aquifer Subunit 1
- Aquifer Subunit 2
- Aquifer Subunit 3
- Aquifer Subunit 4

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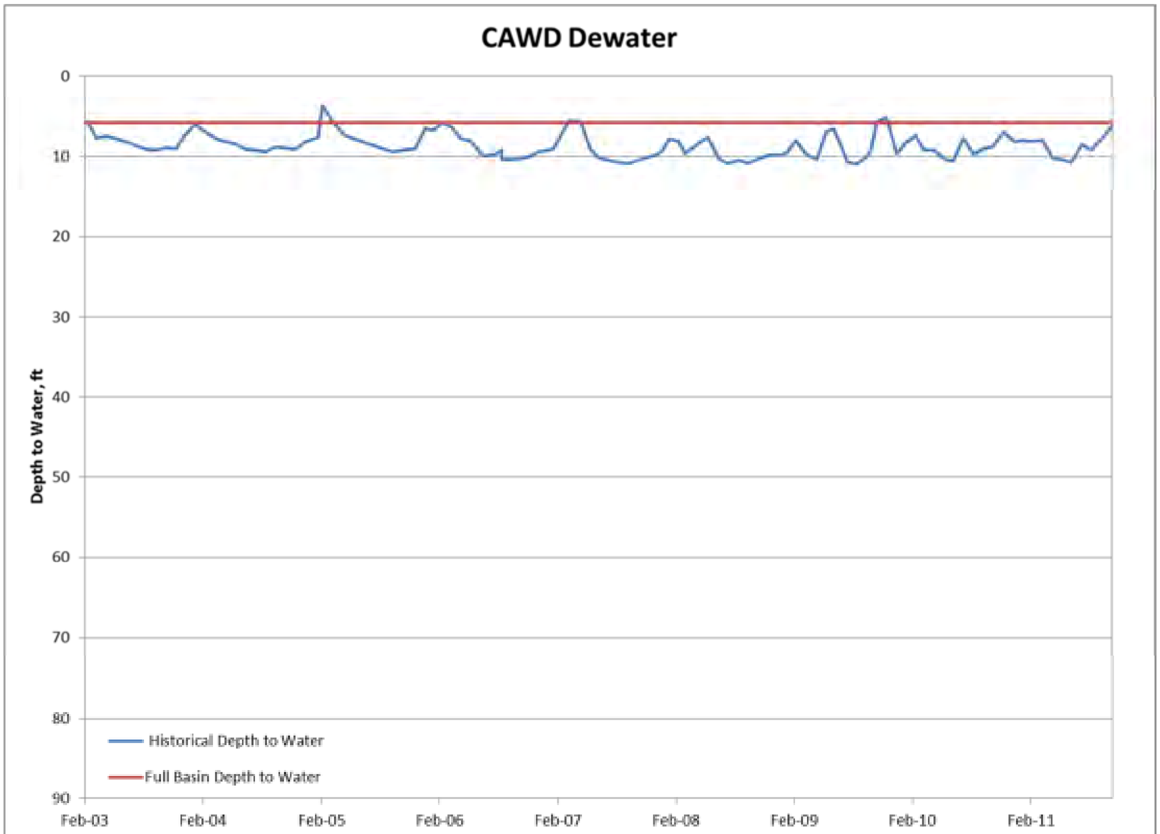
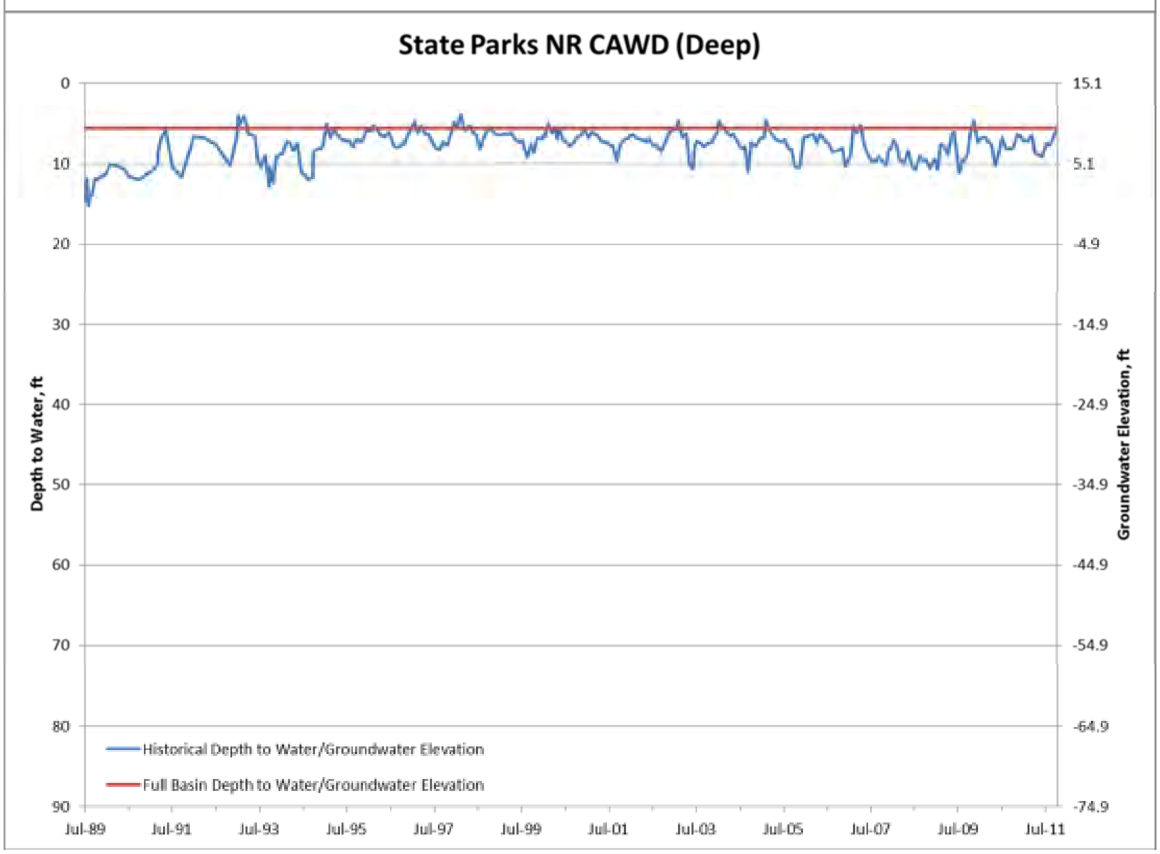
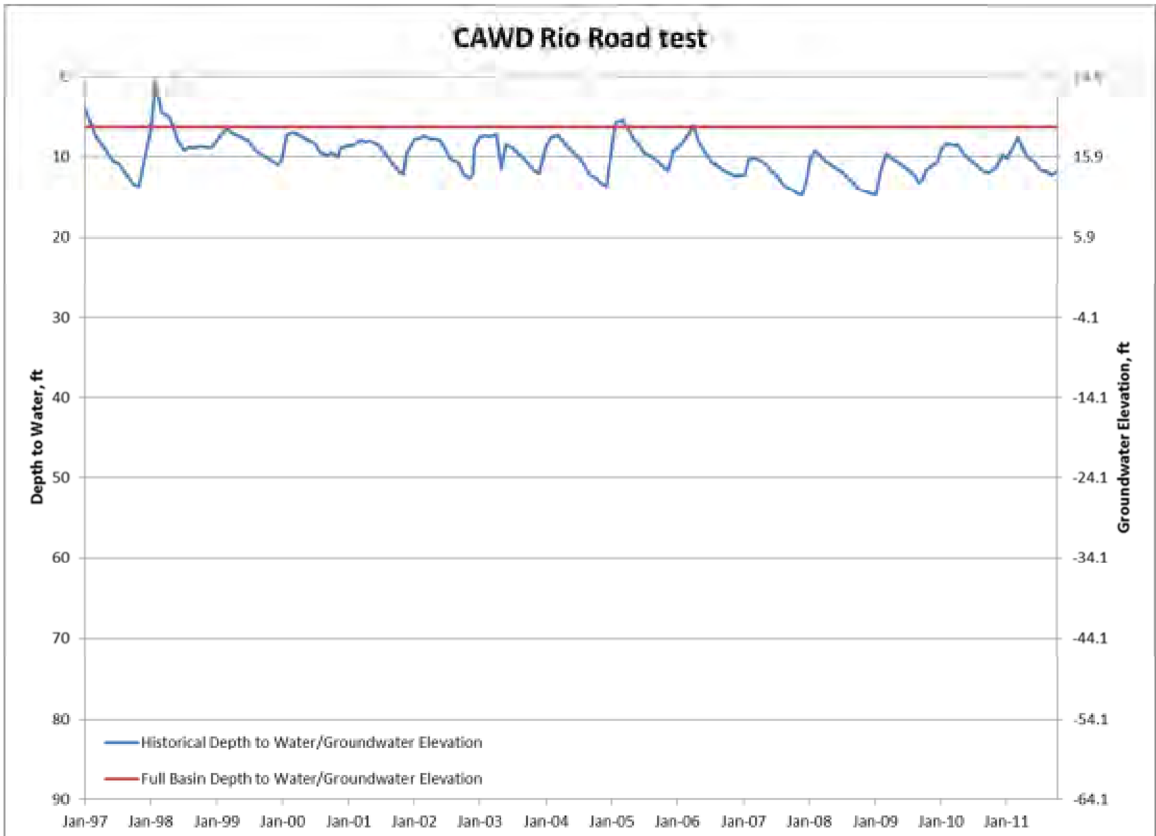
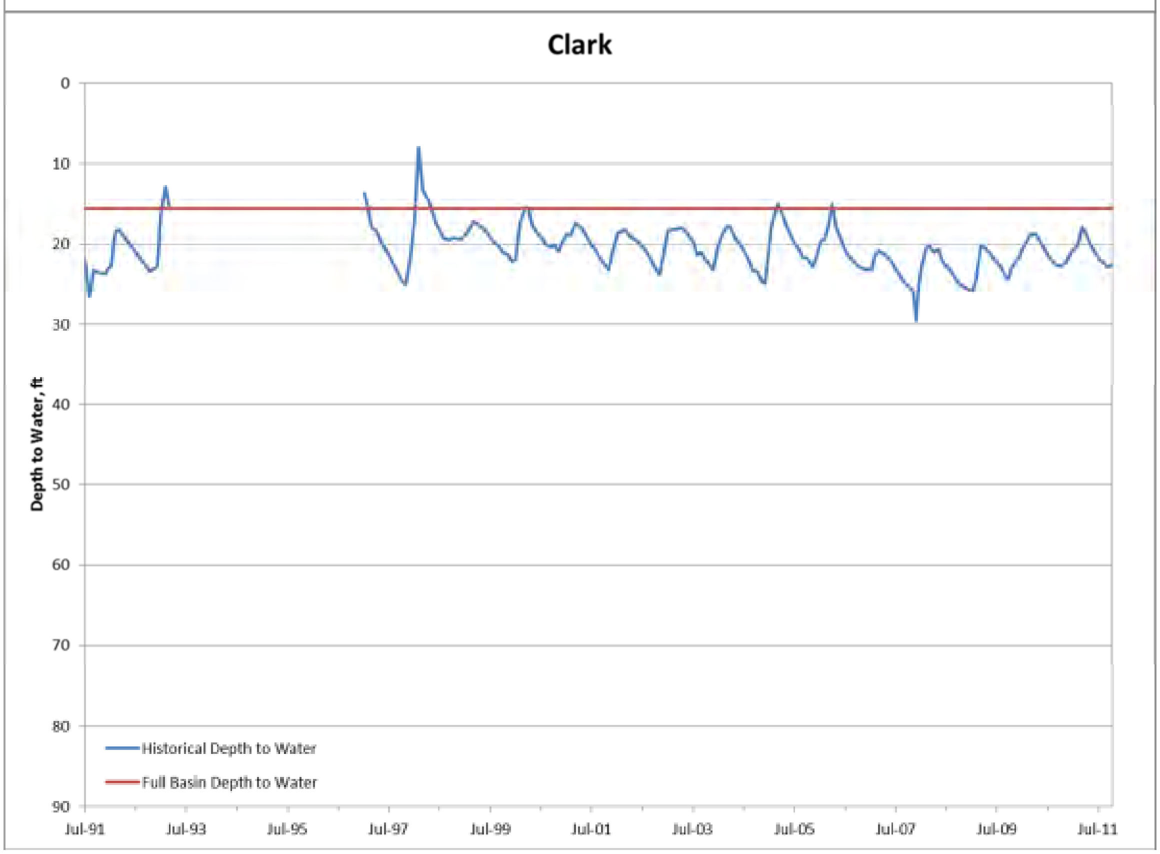

CAWD Dewater
Depth to Water, ft
0
10
20
30
40
50
60
70
80
90
Historical Depth to Water
Full Basin Depth to Water
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Feb-10
Feb-11

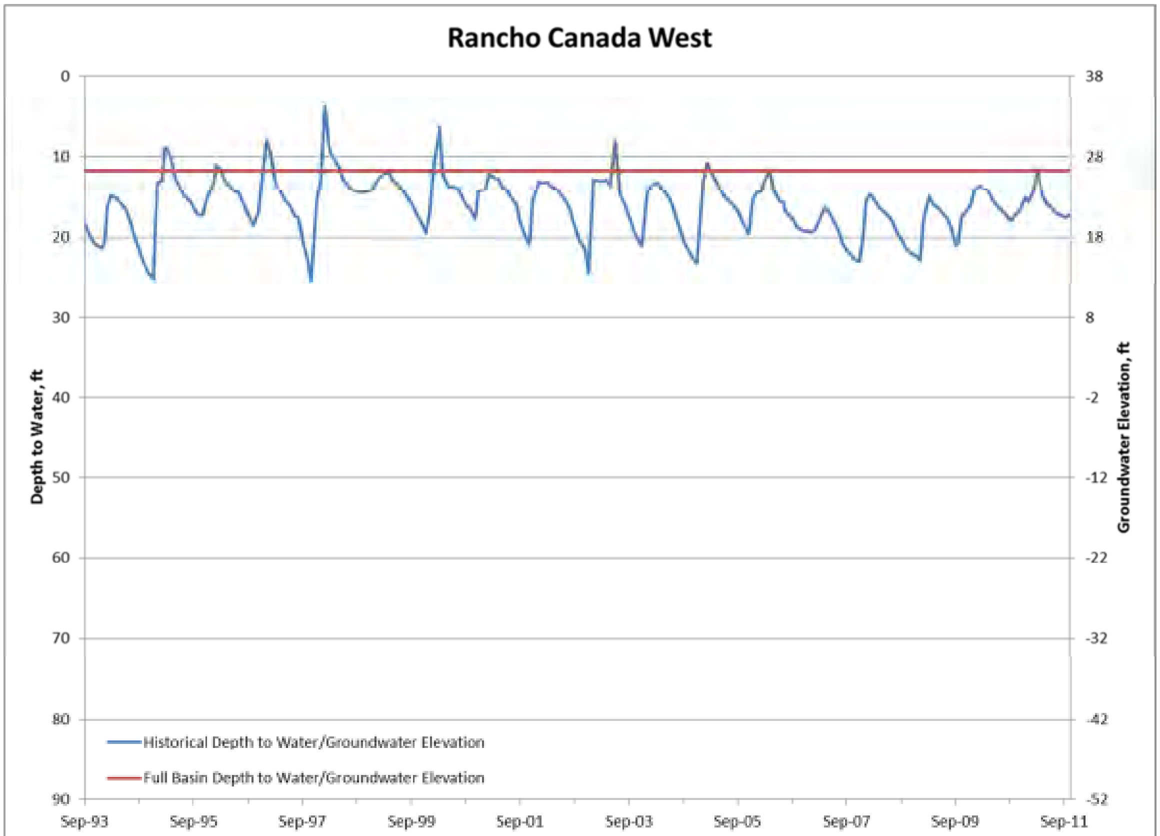

State Parks NR CAWD (Deep)
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
15.1
5.1
-4.9
-14.9
-24.9
-34.9
-44.9
-54.9
-64.9
-74.9
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
Jul-89
Jul-91
Jul-93
Jul-95
Jul-97
Jul-99
Jul-01
Jul-03
Jul-05
Jul-07
Jul-09
Jul-11



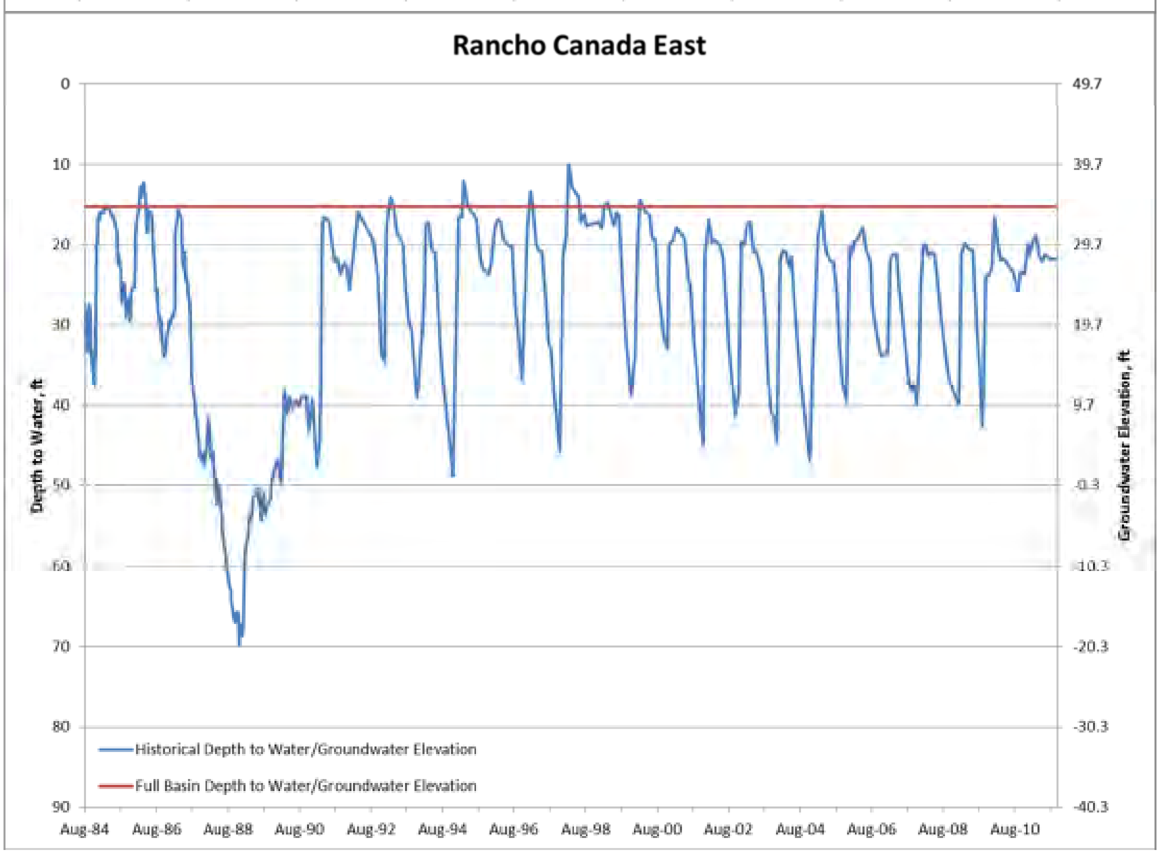
CAWD Rio Road test
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
15.9
5.9
-4.1
-14.1
-24.1
-34.1
-44.1
-54.1
-64.1
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11



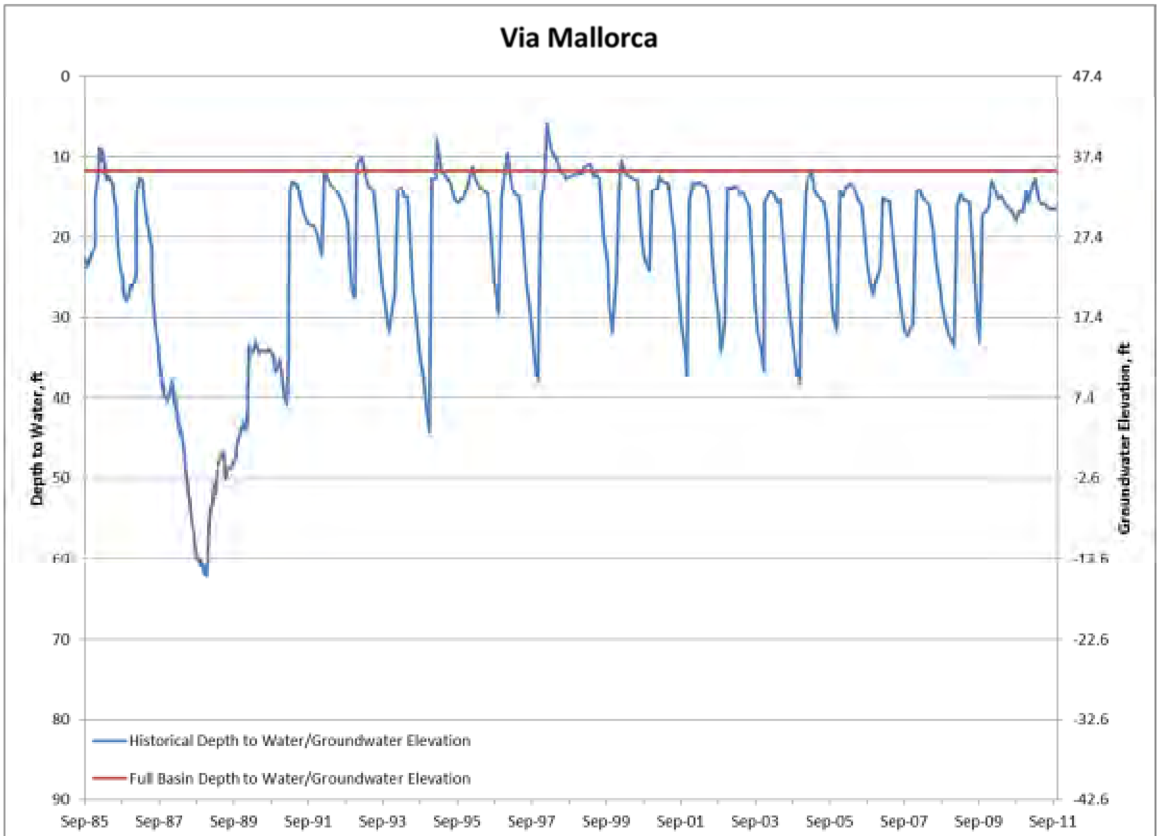
Clark
Depth to Water, ft
0
10
20
30
40
50
60
70
80
90
Historical Depth to Water
Full Basin Depth to Water
Jul-91
Jul-93
Jul-95
Jul-97
Jul-99
Jul-01
Jul-03
Jul-05
Jul-07
Jul-09
Jul-11

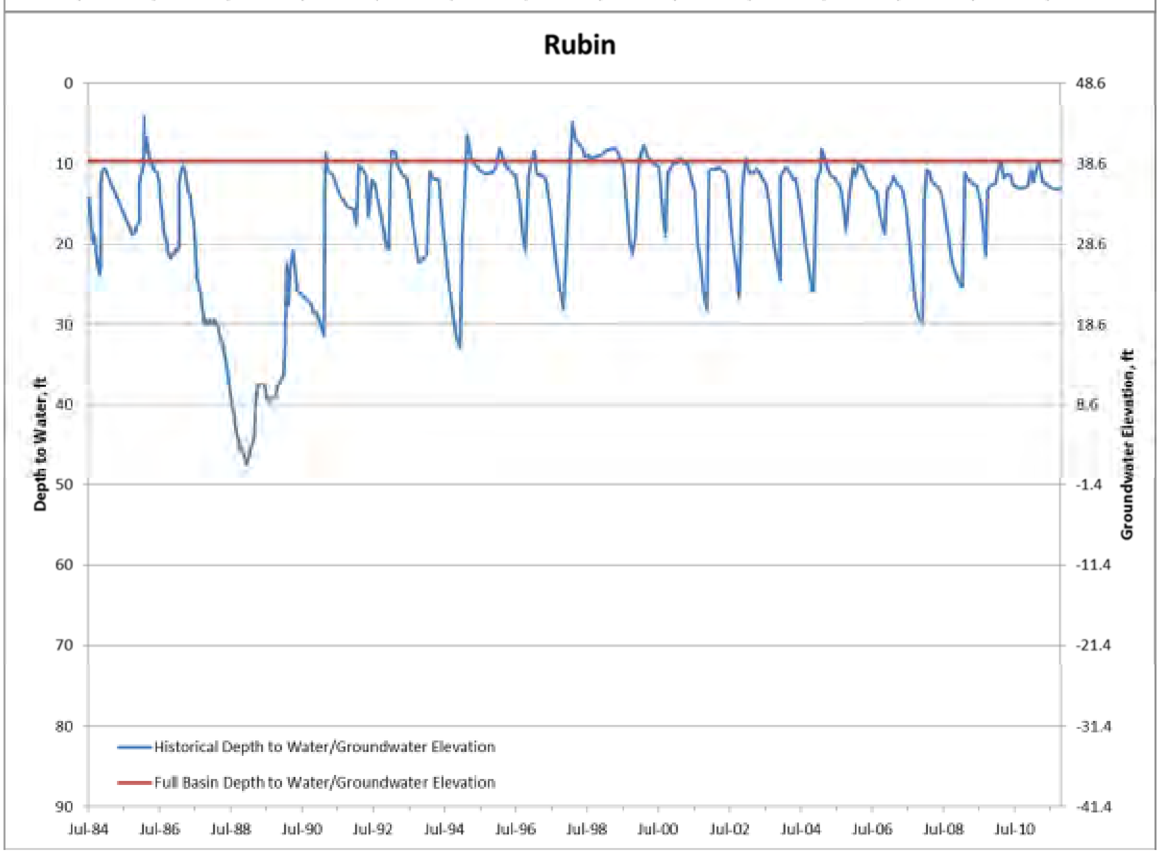


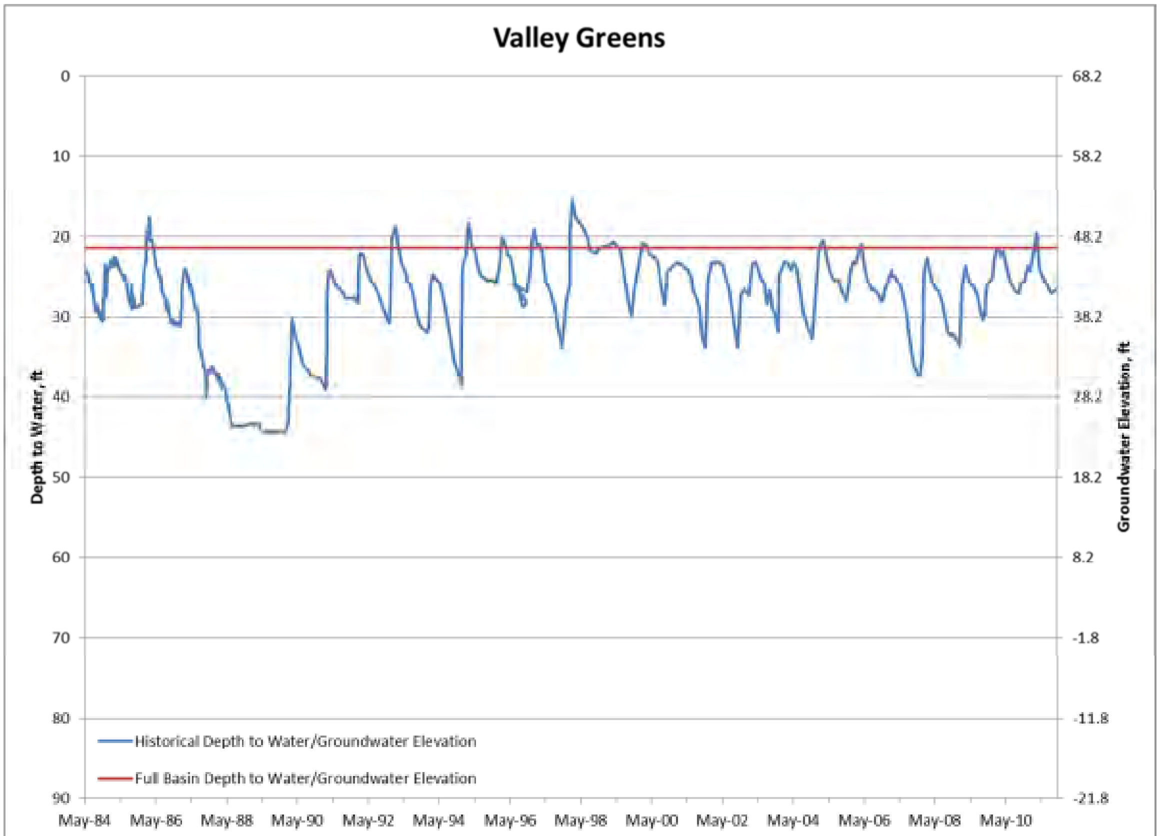
Rancho Canada West
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
38
28
18
8
-2
-12
-22
-32
-42
-52
Sep-93
Sep-95
Sep-97
Sep-99
Sep-01
Sep-03
Sep-05
Sep-07
Sep-09
Sep-11
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation



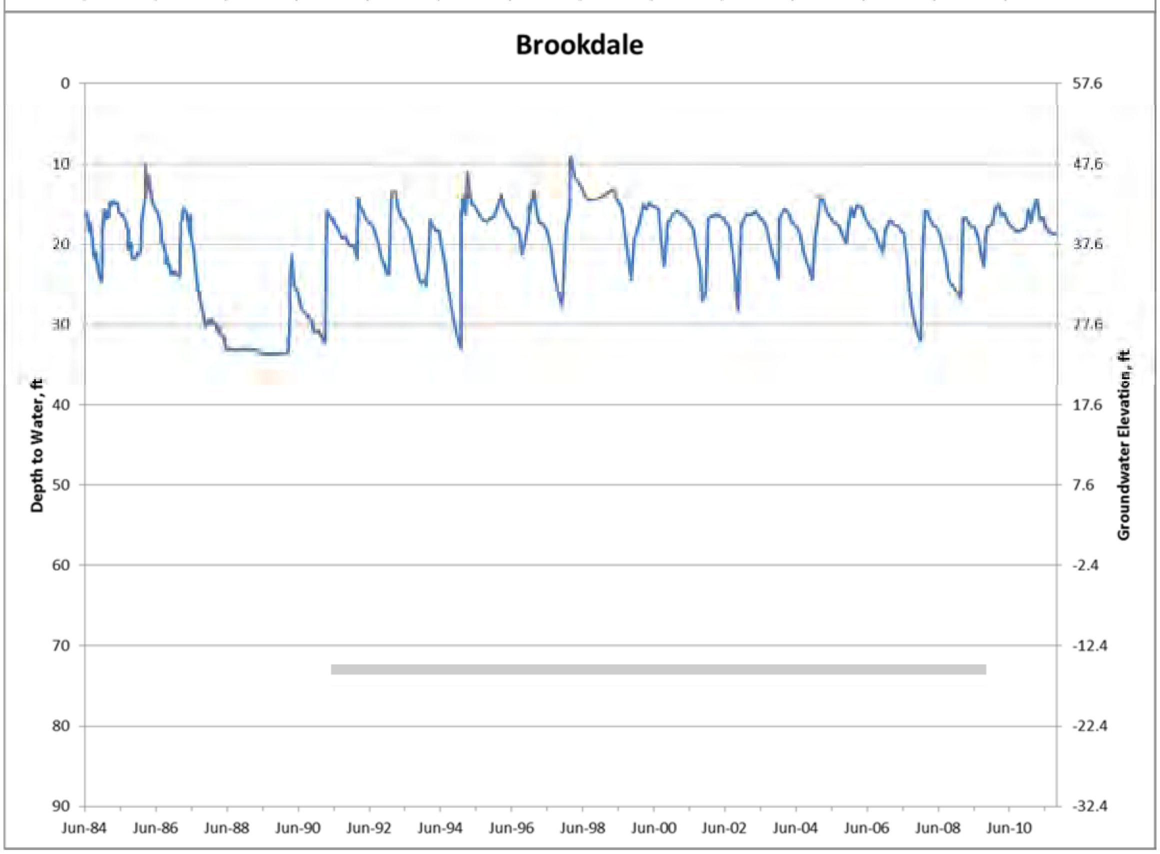
Rancho Canada East
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
49.7
39.7
29.7
19.7
9.7
-0.3
-10.3
-20.3
-30.3
-40.3
Aug-84
Aug-86
Aug-88
Aug-90
Aug-92
Aug-94
Aug-96
Aug-98
Aug-00
Aug-02
Aug-04
Aug-06
Aug-08
Aug-10
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation


Via Mallorca
Depth to Water, ft
Groundwater Elevation, ft
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
0
10
20
30
40
50
60
70
80
90
47.4
37.4
27.4
17.4
7.4
-2.6
-12.6
-22.6
-32.6
-42.6
Sep-85
Sep-87
Sep-89
Sep-91
Sep-93
Sep-95
Sep-97
Sep-99
Sep-01
Sep-03
Sep-05
Sep-07
Sep-09
Sep-11


Rubin
Depth to Water, ft
Groundwater Elevation, ft
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
0
10
20
30
40
50
60
70
80
90
48.6
38.6
28.6
18.6
8.6
-1.4
-11.4
-21.4
-31.4
-41.4
Jul-84
Jul-86
Jul-88
Jul-90
Jul-92
Jul-94
Jul-96
Jul-98
Jul-00
Jul-02
Jul-04
Jul-06
Jul-08
Jul-10



Valley Greens
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
68.2
58.2
48.2
38.2
28.2
18.2
8.2
-1.8
-11.8
-21.8
May-84
May-86
May-88
May-90
May-92
May-94
May-96
May-98
May-00
May-02
May-04
May-06
May-08
May-10
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation



Brookdale
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
57.6
47.6
37.6
27.6
17.6
7.6
-2.4
-12.4
-22.4
-32.4
Jun-84
Jun-86
Jun-88
Jun-90
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Jun-94
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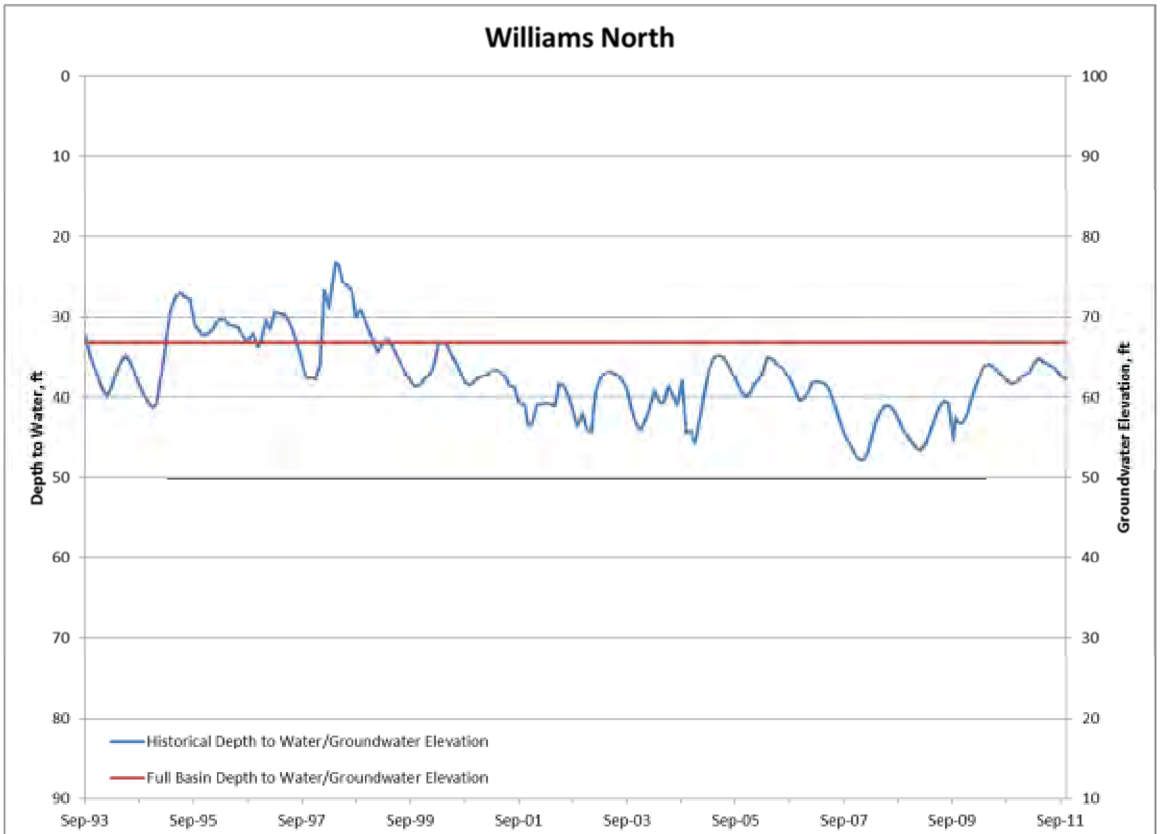
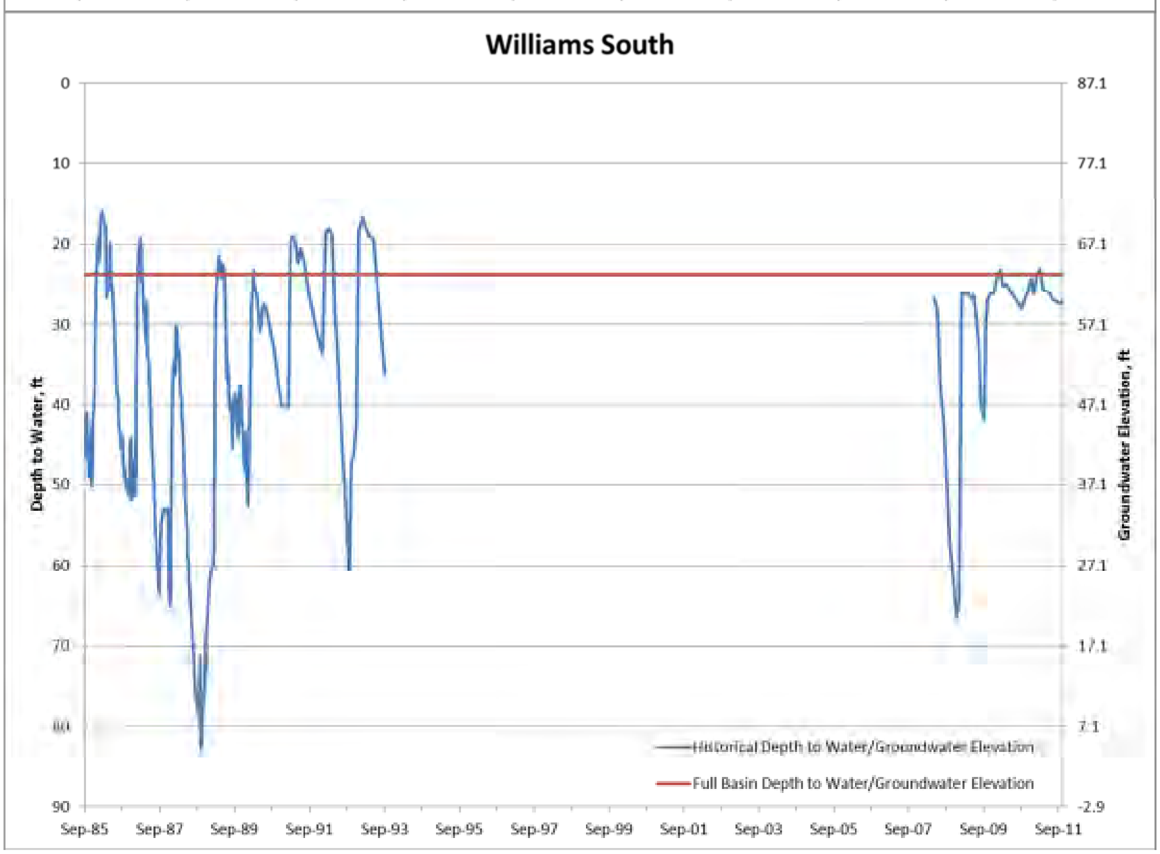
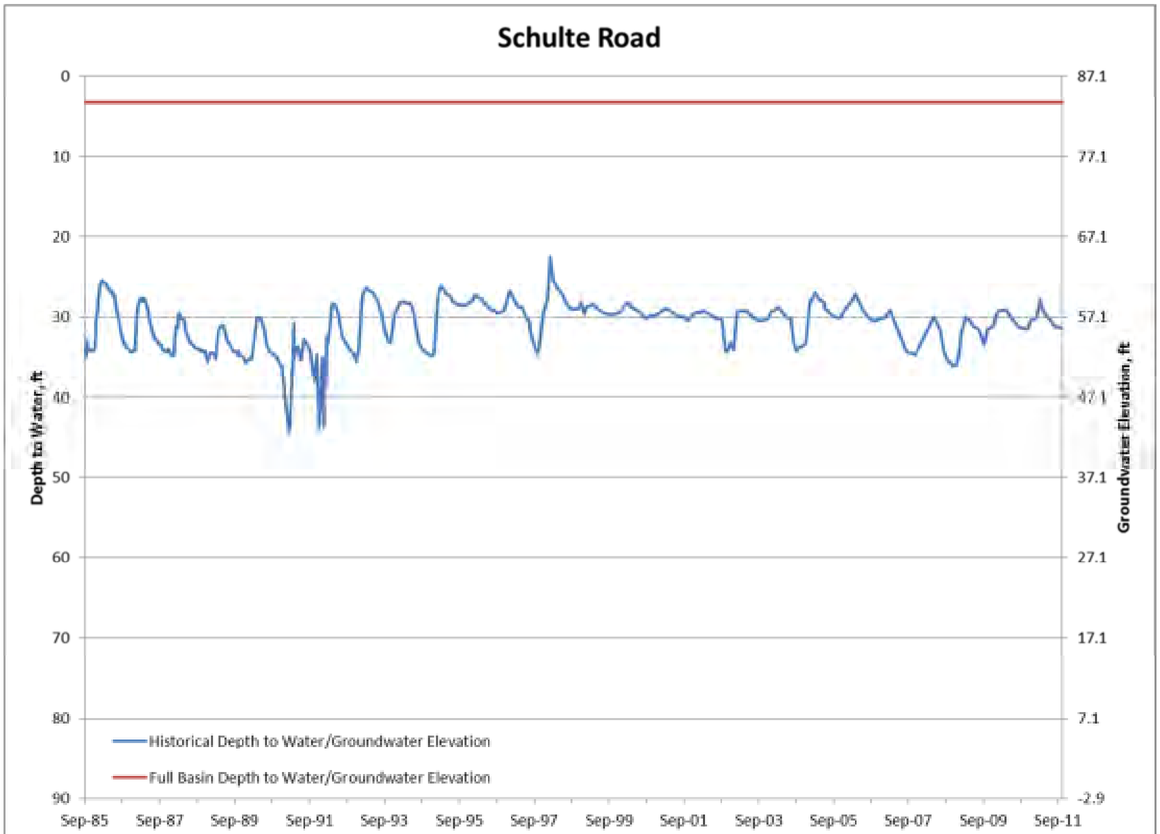
Jun-04
Jun-06
Jun-08
Jun-10

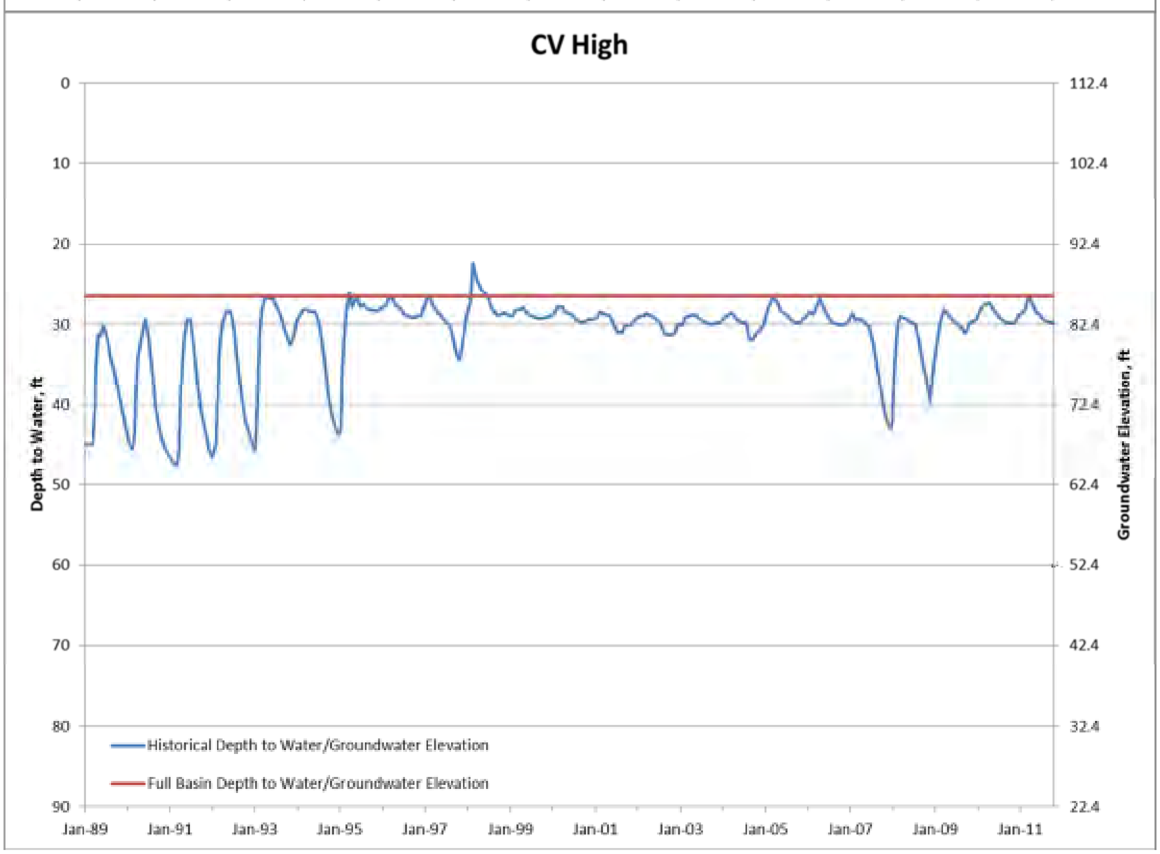


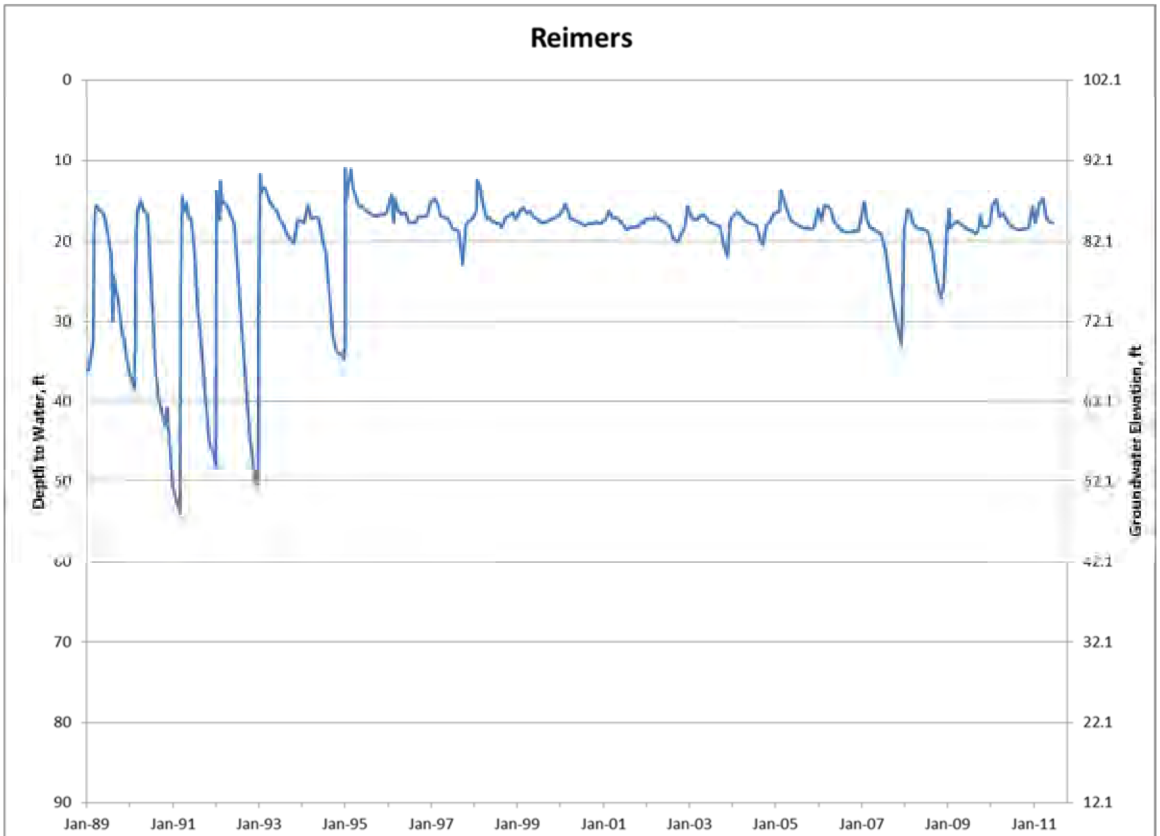
Williams North
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
100
90
80
70
60
50
40
30
20
10
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
Sep-93
Sep-95
Sep-97
Sep-99
Sep-01
Sep-03
Sep-05
Sep-07
Sep-09
Sep-11



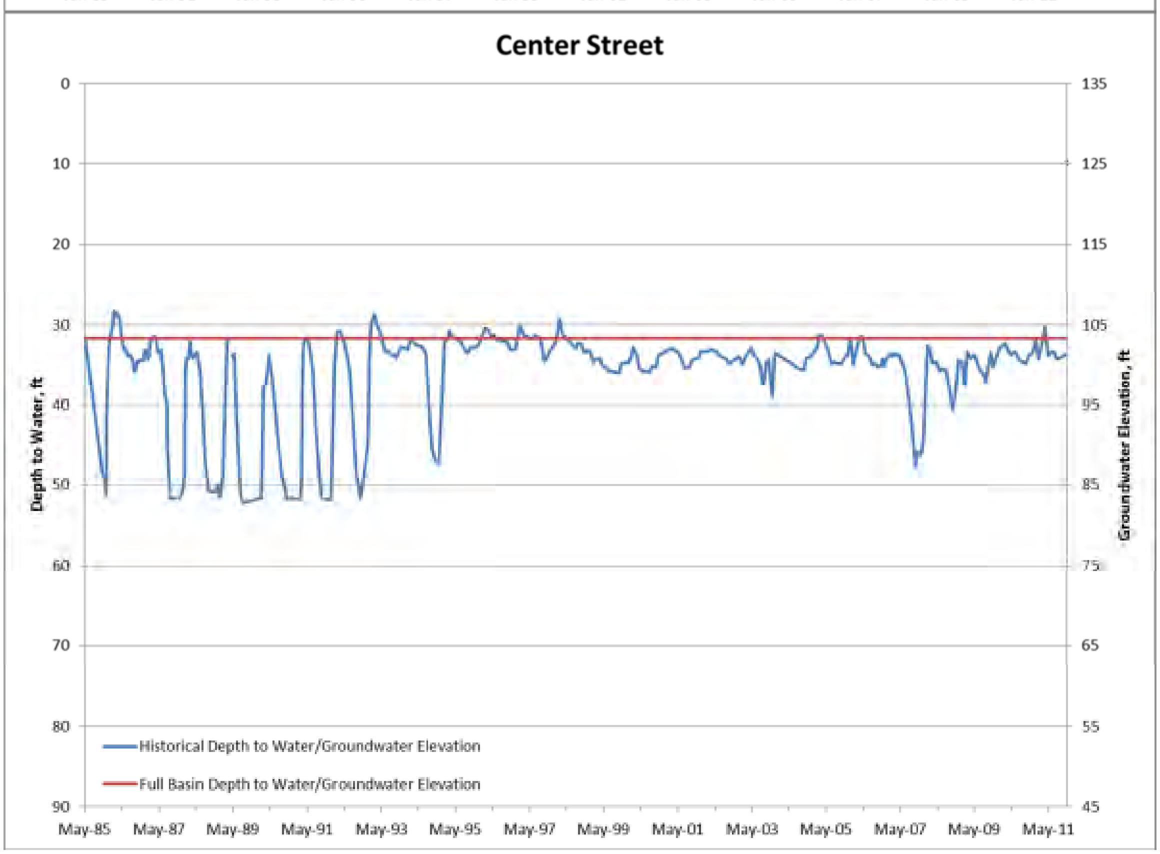
Williams South
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
87.1
77.1
67.1
57.1
47.1
37.1
27.1
17.1
7.1
-2.9
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
Sep-85
Sep-87
Sep-89
Sep-91
Sep-93
Sep-95
Sep-97
Sep-99
Sep-01
Sep-03
Sep-05
Sep-07
Sep-09
Sep-11


Schulte Road
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
87.1
77.1
67.1
57.1
47.1
37.1
27.1
17.1
7.1
-2.9
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
Sep-85
Sep-87
Sep-89
Sep-91
Sep-93
Sep-95
Sep-97
Sep-99
Sep-01
Sep-03
Sep-05
Sep-07
Sep-09
Sep-11

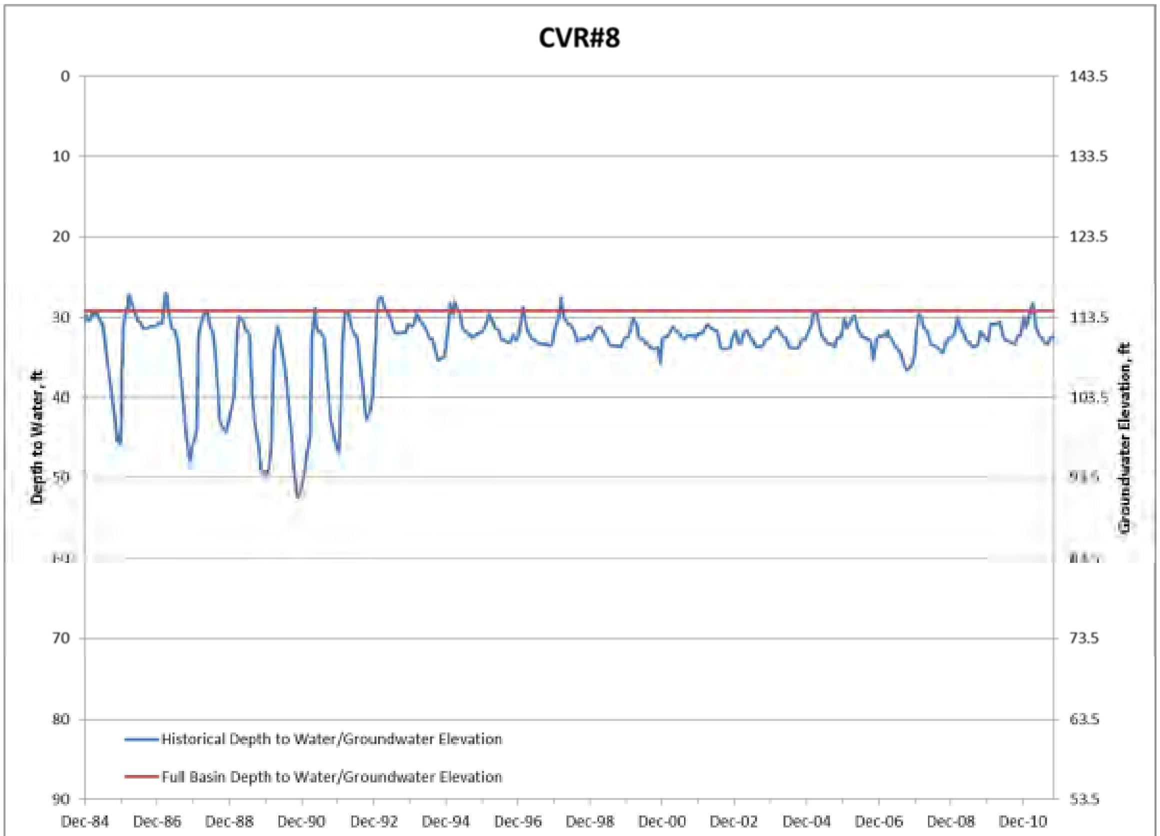

CV High
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
112.4
102.4
92.4
82.4
72.4
62.4
52.4
42.4
32.4
22.4
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
Jan-11

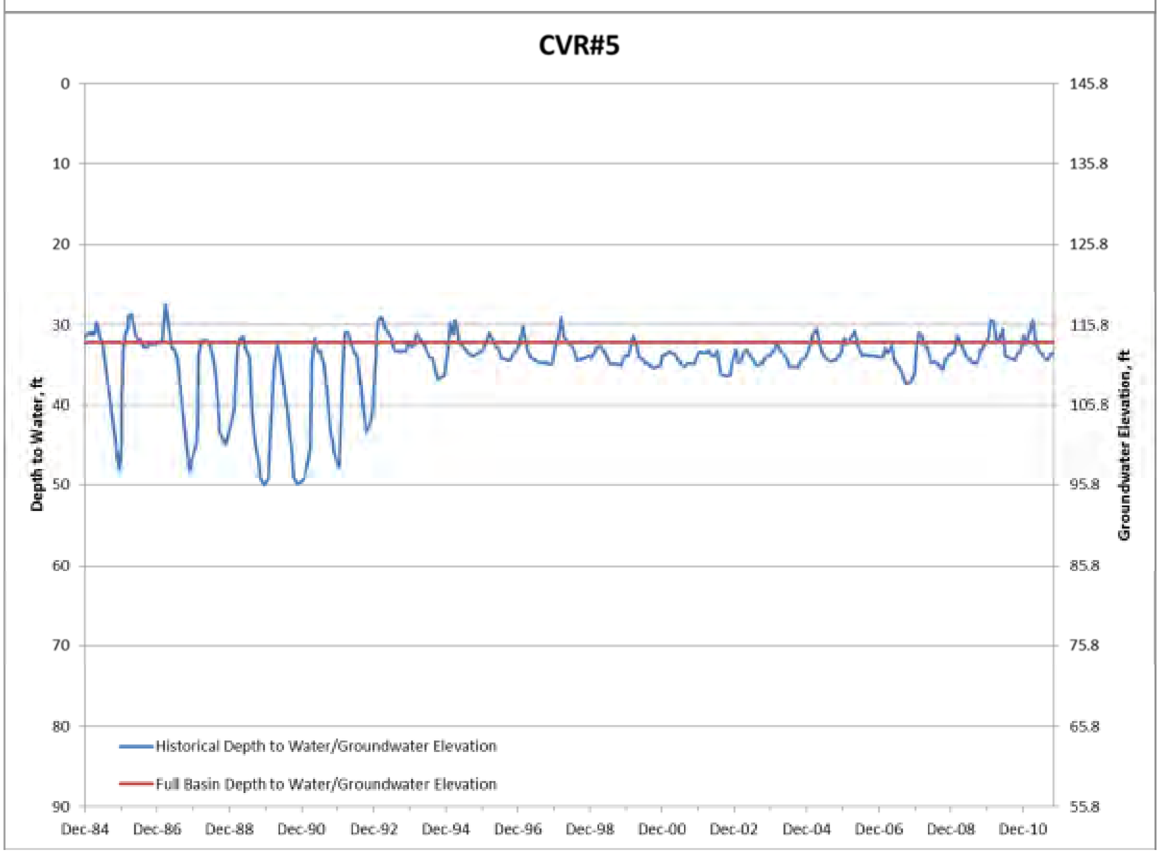


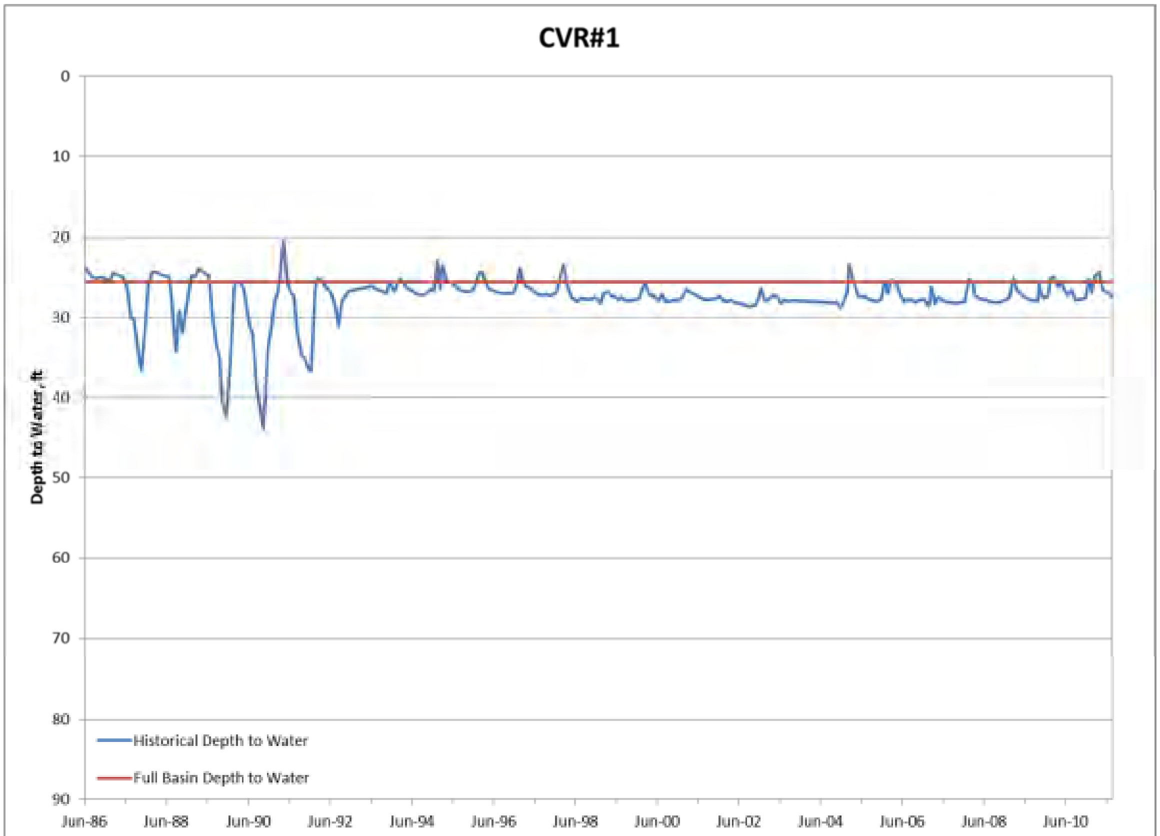
Reimers
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
102.1
92.1
82.1
72.1
42.1
32.1
22.1
12.1
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
Jan-11



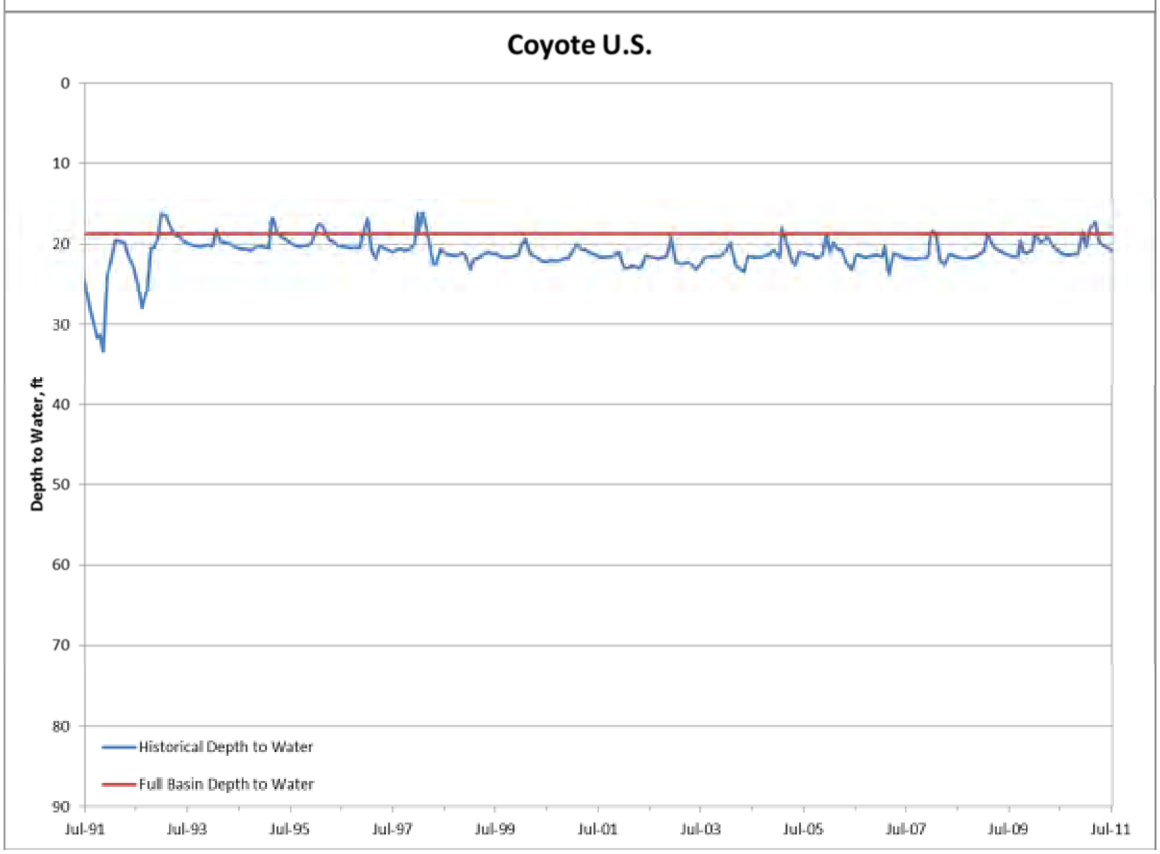
Center Street
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
135
125
115
105
95
85
75
65
55
45
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
May-85
May-87
May-89
May-91
May-93
May-95
May-97
May-99
May-01
May-03
May-05
May-07
May-09
May-11


CVR#8
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
70
80
90
143.5
133.5
123.5
113.5
103.5
73.5
63.5
53.5
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
Dec-84
Dec-86
Dec-88
Dec-90
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10


CVR#5
Depth to Water, ft
Groundwater Elevation, ft
0
10
20
30
40
50
60
70
80
90
145.8
135.8
125.8
115.8
105.8
95.8
85.8
75.8
65.8
55.8
Historical Depth to Water/Groundwater Elevation
Full Basin Depth to Water/Groundwater Elevation
Dec-84
Dec-86
Dec-88
Dec-90
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10



CVR#1
Depth to Water, ft
0
10
20
30
40
50
60
70
80
90
Historical Depth to Water
Full Basin Depth to Water
Jun-86
Jun-88
Jun-90
Jun-92
Jun-94
Jun-96
Jun-98
Jun-00
Jun-02
Jun-04
Jun-06
Jun-08
Jun-10



Coyote U.S.
Depth to Water, ft
0
10
20
30
40
50
60
70
80
90
Historical Depth to Water
Full Basin Depth to Water
Jul-91
Jul-93
Jul-95
Jul-97
Jul-99
Jul-01
Jul-03
Jul-05
Jul-07
Jul-09
Jul-11

APPENDIX C

Private Pumping Well Locations, 2011/2012

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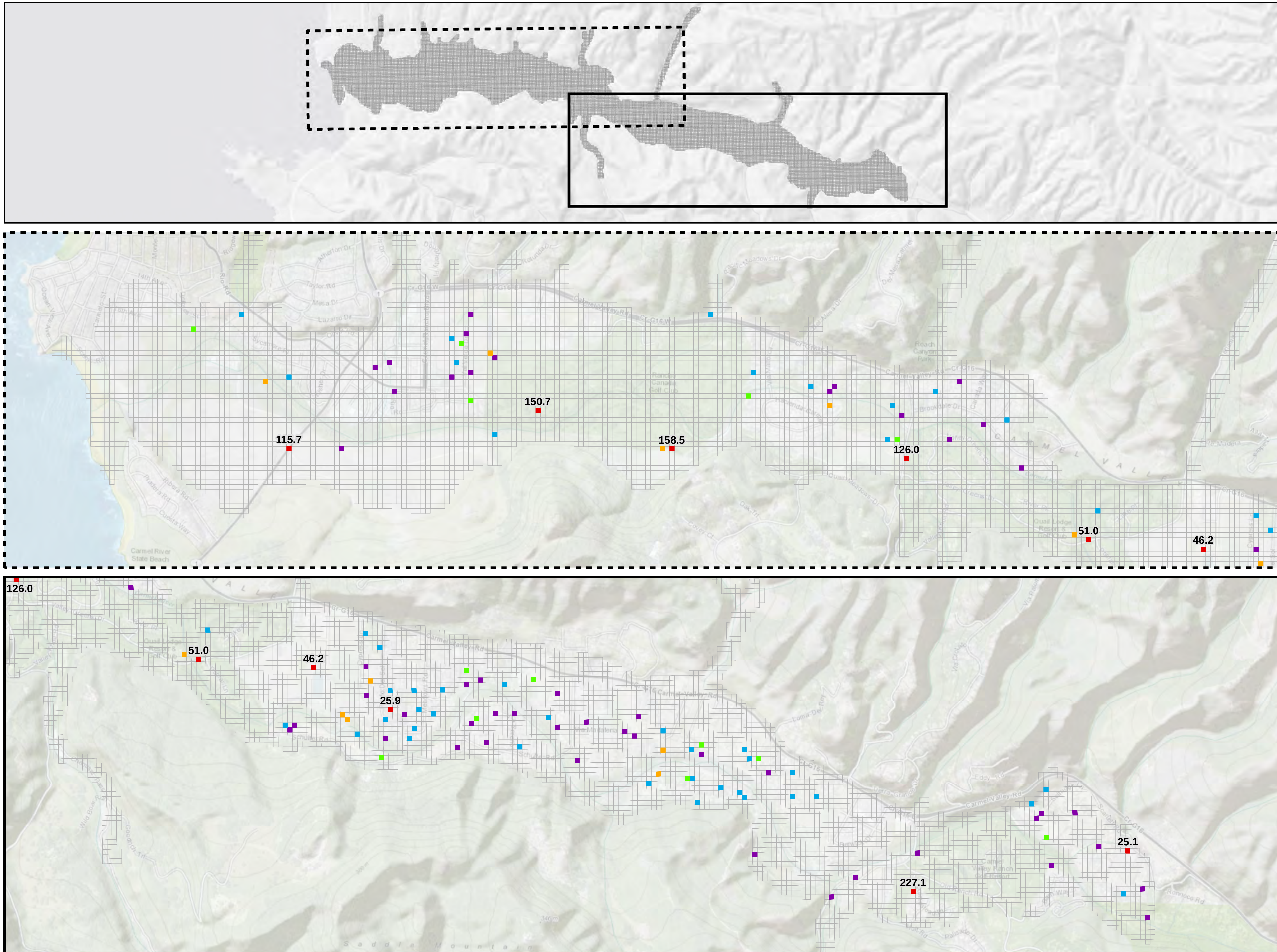
FIGURE C-1

Eastwood/Odello Water Right Change Petition Project

2011 PRIVATE PUMPING



N

0 1,000 2,000

Scale in Feet

Notes
1. Grid cells with more than 25 acre-feet per year production (colored red) are labeled with the total yearly pumping.
2. Private pumping grid was provided by Monterey Peninsula Water Management District (MPWMD) (March, 2013).

LEGEND

Pumping per 100-foot Grid (acre-feet per year)

- < 0.01
- 0.01 - 1
- 1 - 5
- 5 - 10
- 10 - 25
- > 25

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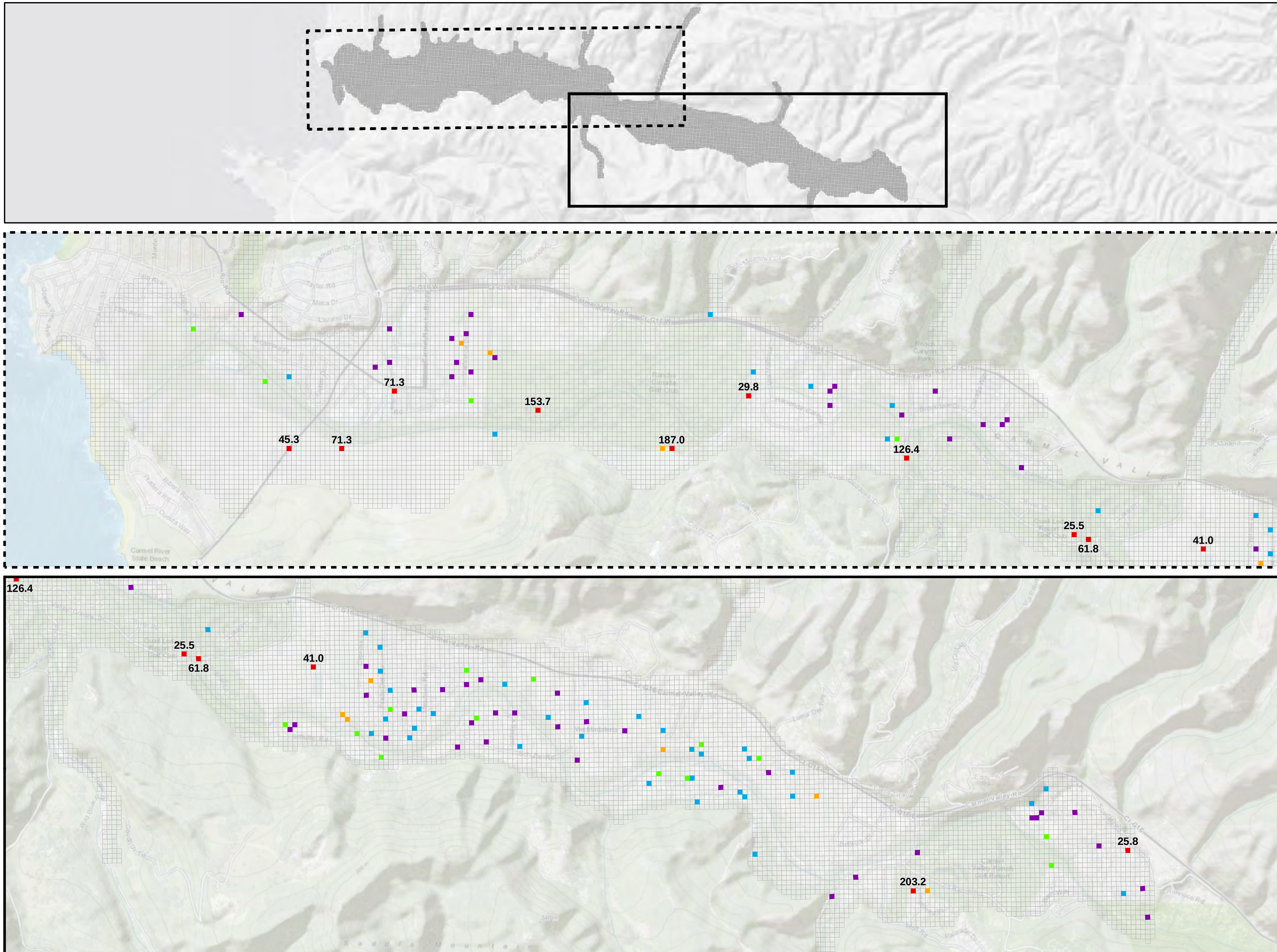
FIGURE C-2

Eastwood/Odello Water Right Change Petition Project

2012 PRIVATE PUMPING



0 1,000 2,000

Scale in Feet

Notes

1. Grid cells with more than 25 acre-feet per year production (colored red) are labeled with the total yearly pumping.
2. Private pumping grid was provided by Monterey Peninsula Water Management District (MPWMD) (March, 2013).

LEGEND

Pumping per 100-foot Grid (acre-feet per year)

- < 0.01
- 0.01 - 1
- 1 - 5
- 5 - 10
- 10 - 25
- > 25

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Consulting Engineers

APPENDIX D

Well Site Maps

LEGEND

- CalAm Production Well
- MPWMD Monitoring Well
- Private Production Well (1 well)
- Private Production Well (2 wells)
- Distance to Wells (feet)
- Distance to River (feet)
- Carmel River

Private Pumping

(acre-feet per year)

- < 0.01
- 0.01 - 1.0
- 1.0 - 5.0
- 5.0 - 10
- 10 - 25
- > 25

NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.

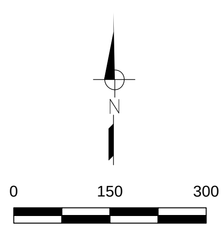

FIGURE D-1
Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM EASTWOOD/ODELLO WELL 2

WEST YOST ASSOCIATES *Consulting Engineers*

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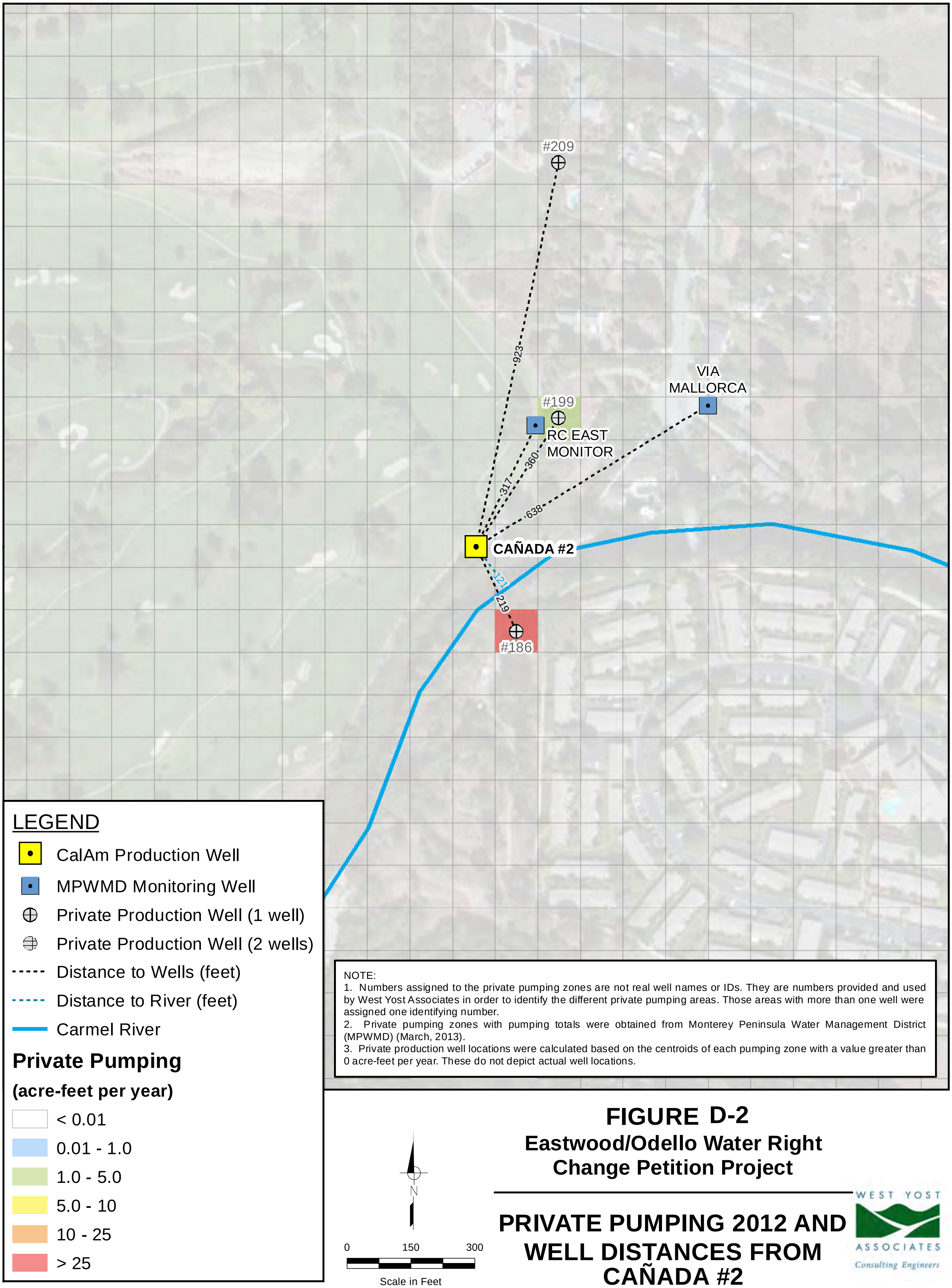

NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.

FIGURE D-2

Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM CAÑADA #2

WEST YOST ASSOCIATES
Consulting Engineers

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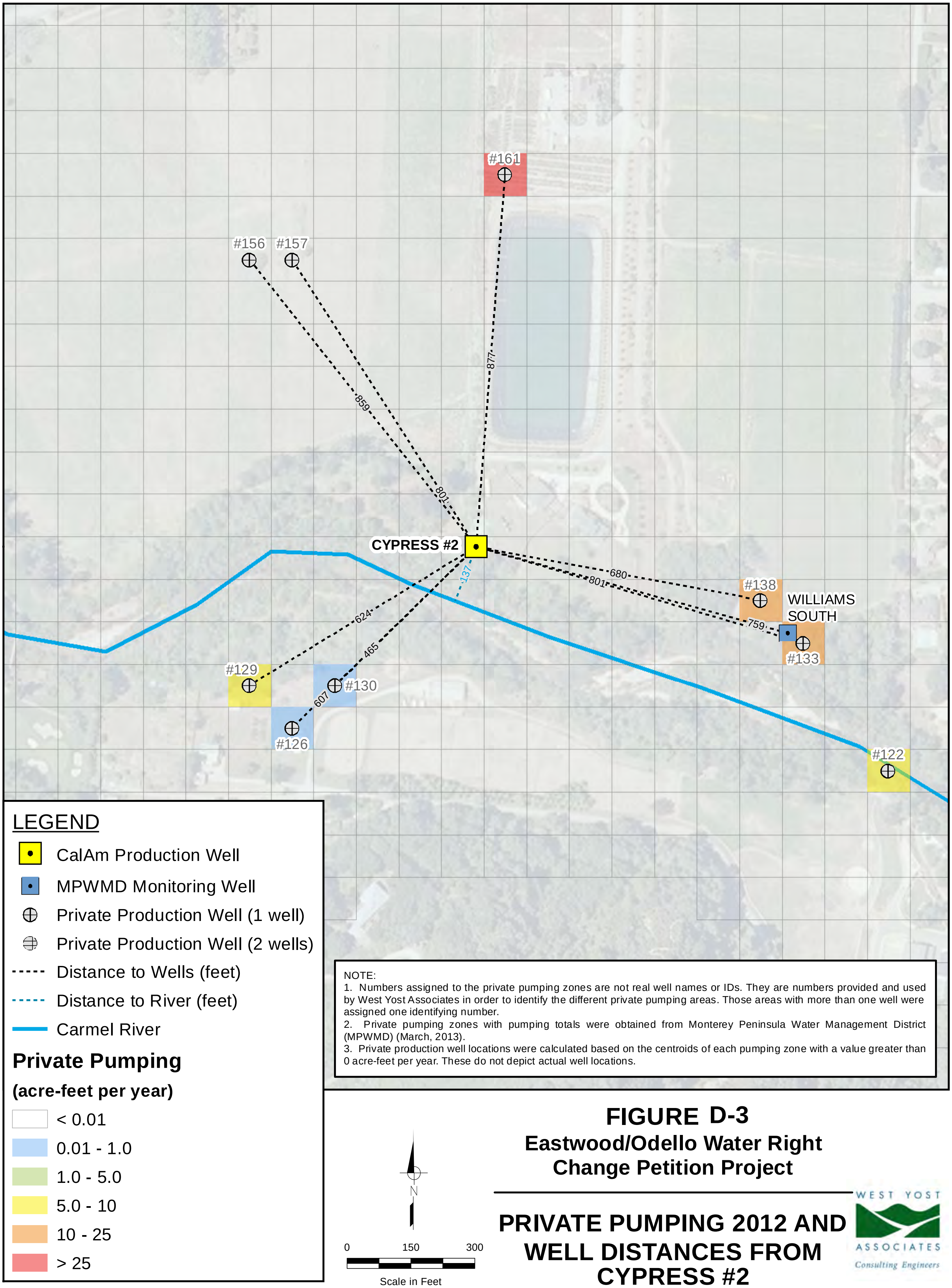

NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.

FIGURE D-3

Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM CYPRESS #2

WEST YOST ASSOCIATES
Consulting Engineers

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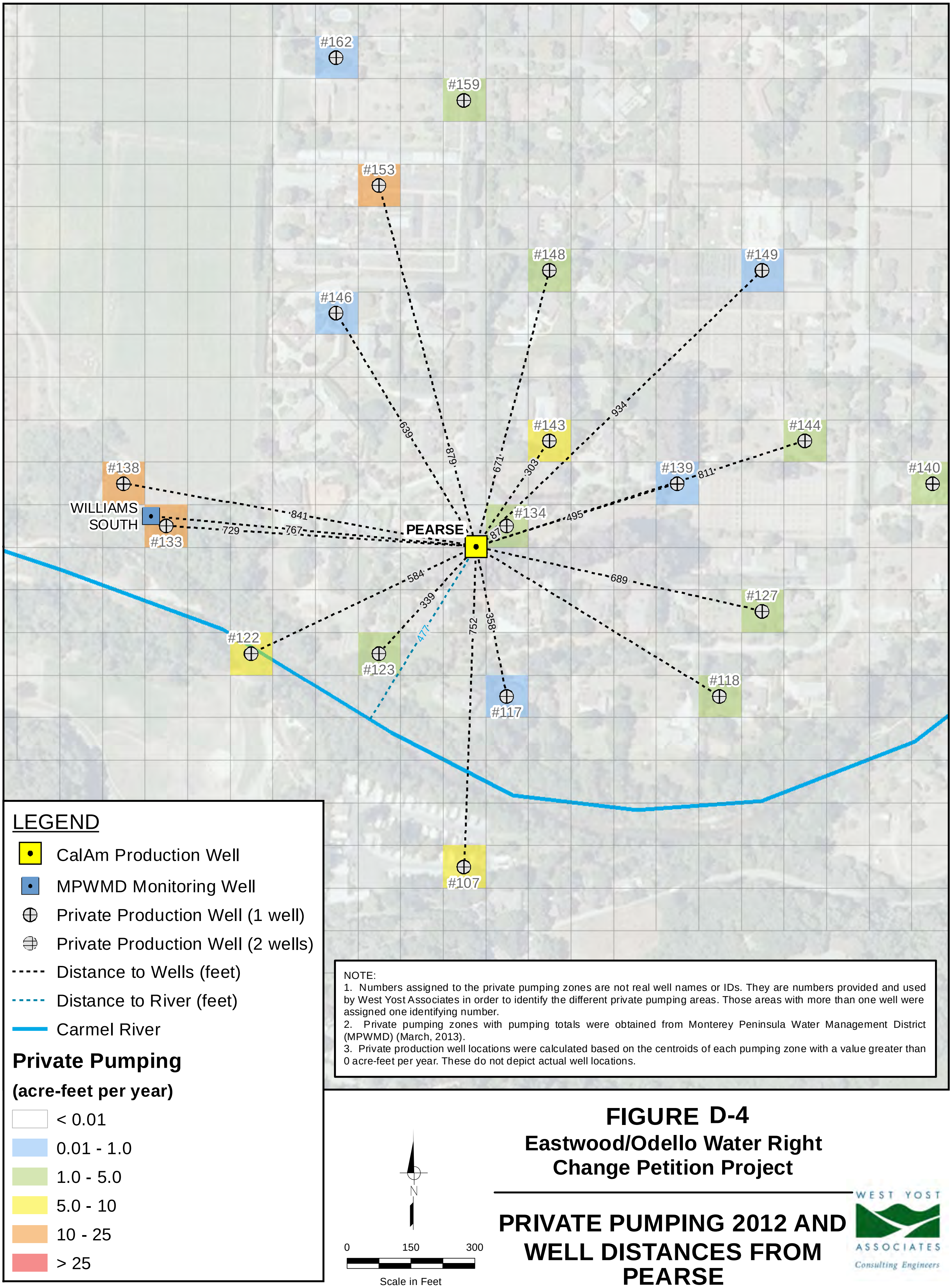


NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.

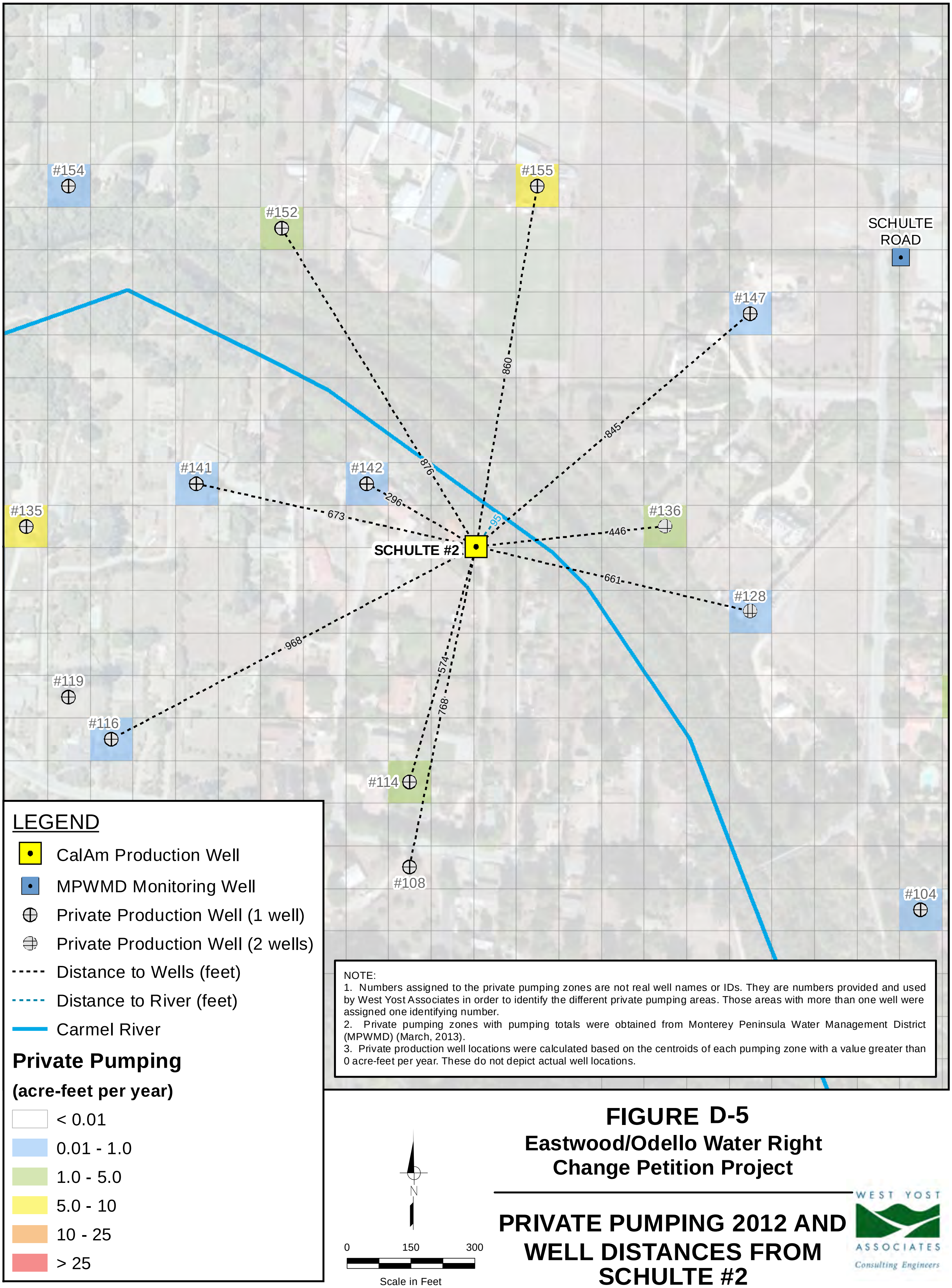
N

0 150 300
Scale in Feet

FIGURE D-4
Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM PEARSE

WEST YOST ASSOCIATES
Consulting Engineers



NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.

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FIGURE D-5
Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM SCHULTE #2

WEST YOST ASSOCIATES
Consulting Engineers

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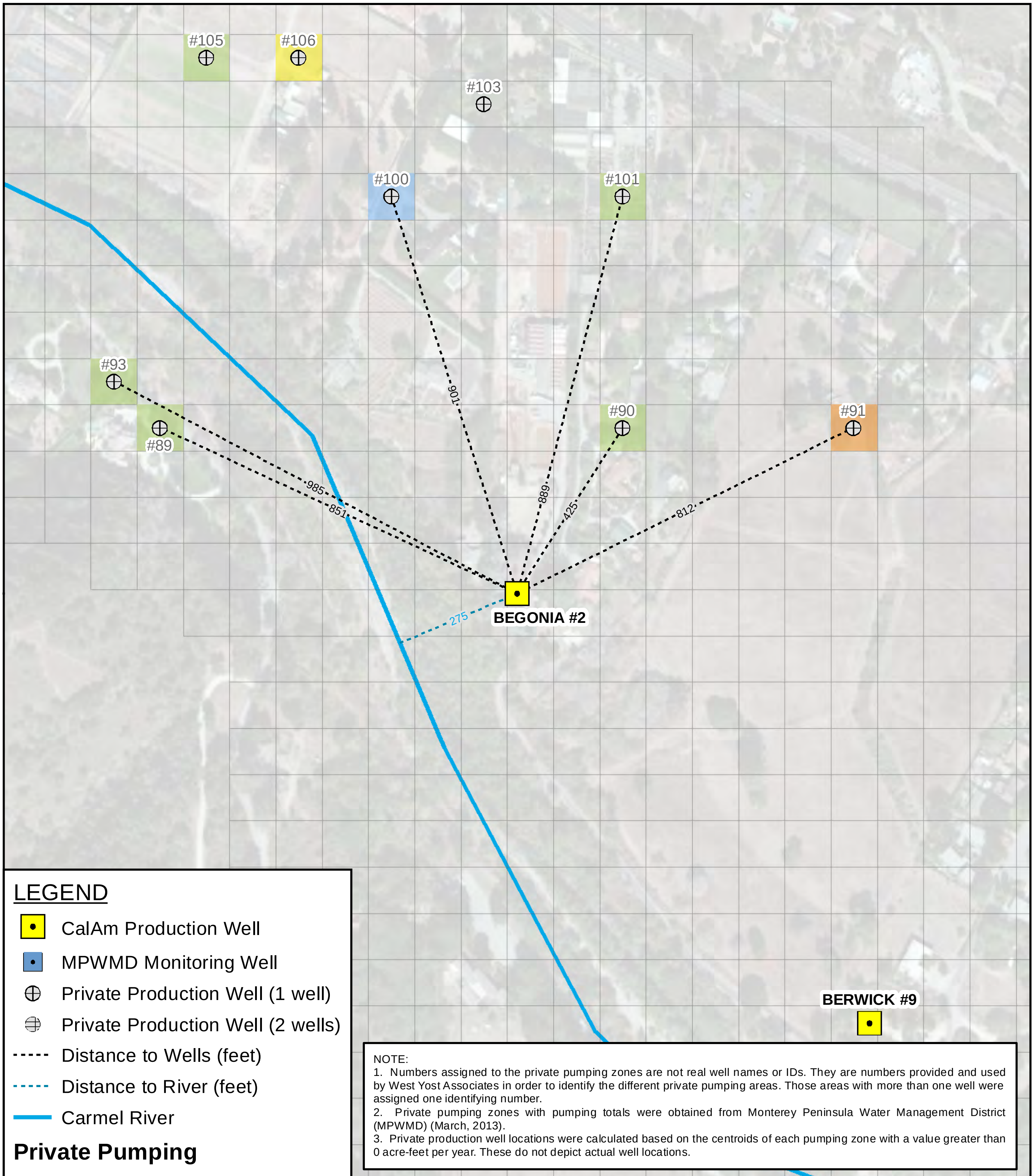

LEGEND

- CalAm Production Well
- MPWMD Monitoring Well
- Private Production Well (1 well)
- Private Production Well (2 wells)
- Distance to Wells (feet)
- Distance to River (feet)
- Carmel River

Private Pumping

(acre-feet per year)

- < 0.01
- 0.01 - 1.0
- 1.0 - 5.0
- 5.0 - 10
- 10 - 25
- > 25

NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.

N

0 150 300
Scale in Feet

FIGURE D-6
Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM BEGONIA #2

WEST YOST ASSOCIATES
Consulting Engineers

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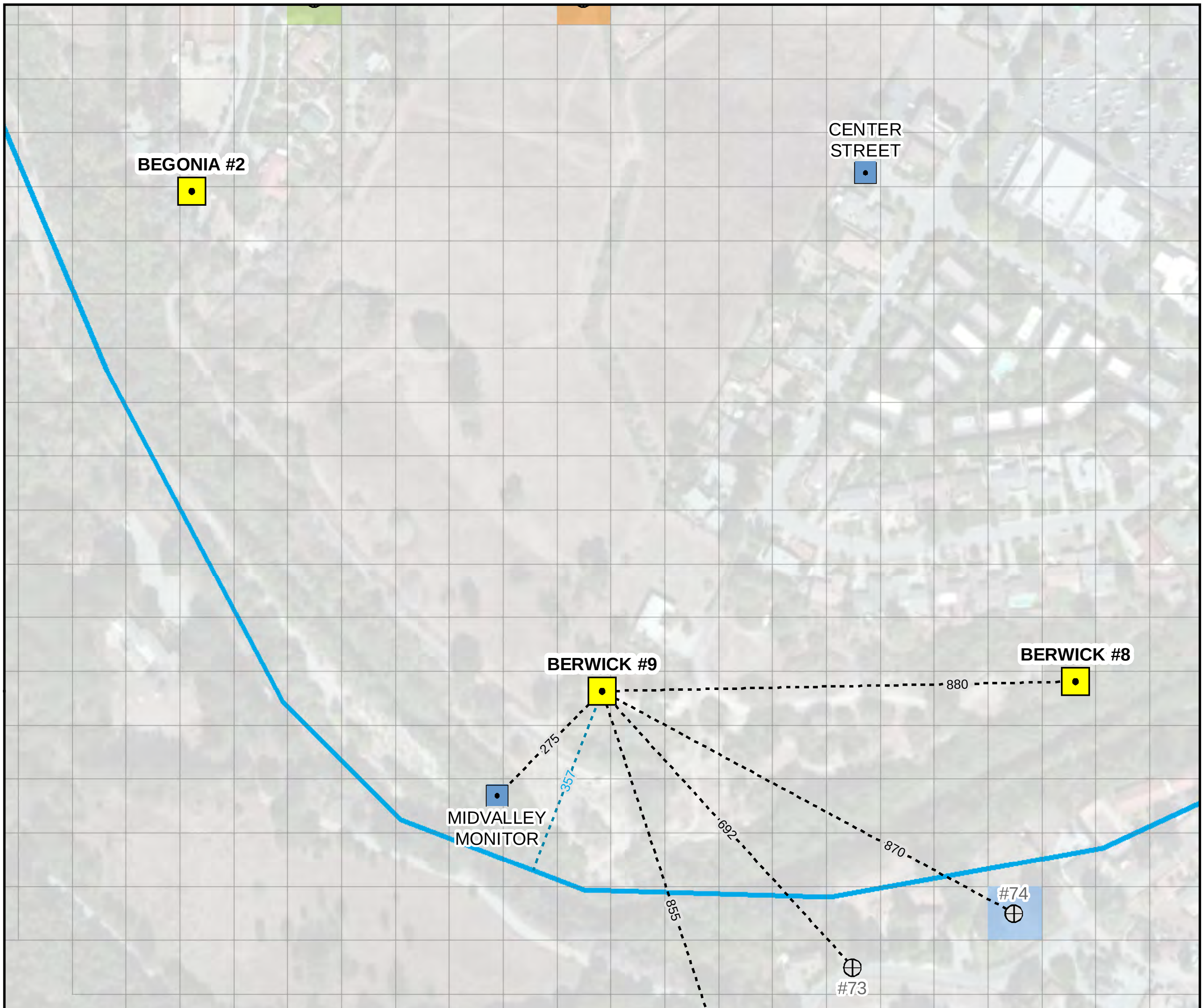

LEGEND

- CalAm Production Well
- MPWMD Monitoring Well
- Private Production Well (1 well)
- Private Production Well (2 wells)
- Distance to Wells (feet)
- Distance to River (feet)
- Carmel River

Private Pumping

(acre-feet per year)

- < 0.01
- 0.01 - 1.0
- 1.0 - 5.0
- 5.0 - 10
- 10 - 25
- > 25

NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.

N

0 150 300

Scale in Feet

FIGURE D-7

Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM BERWICK #9

WEST YOST ASSOCIATES Consulting Engineers

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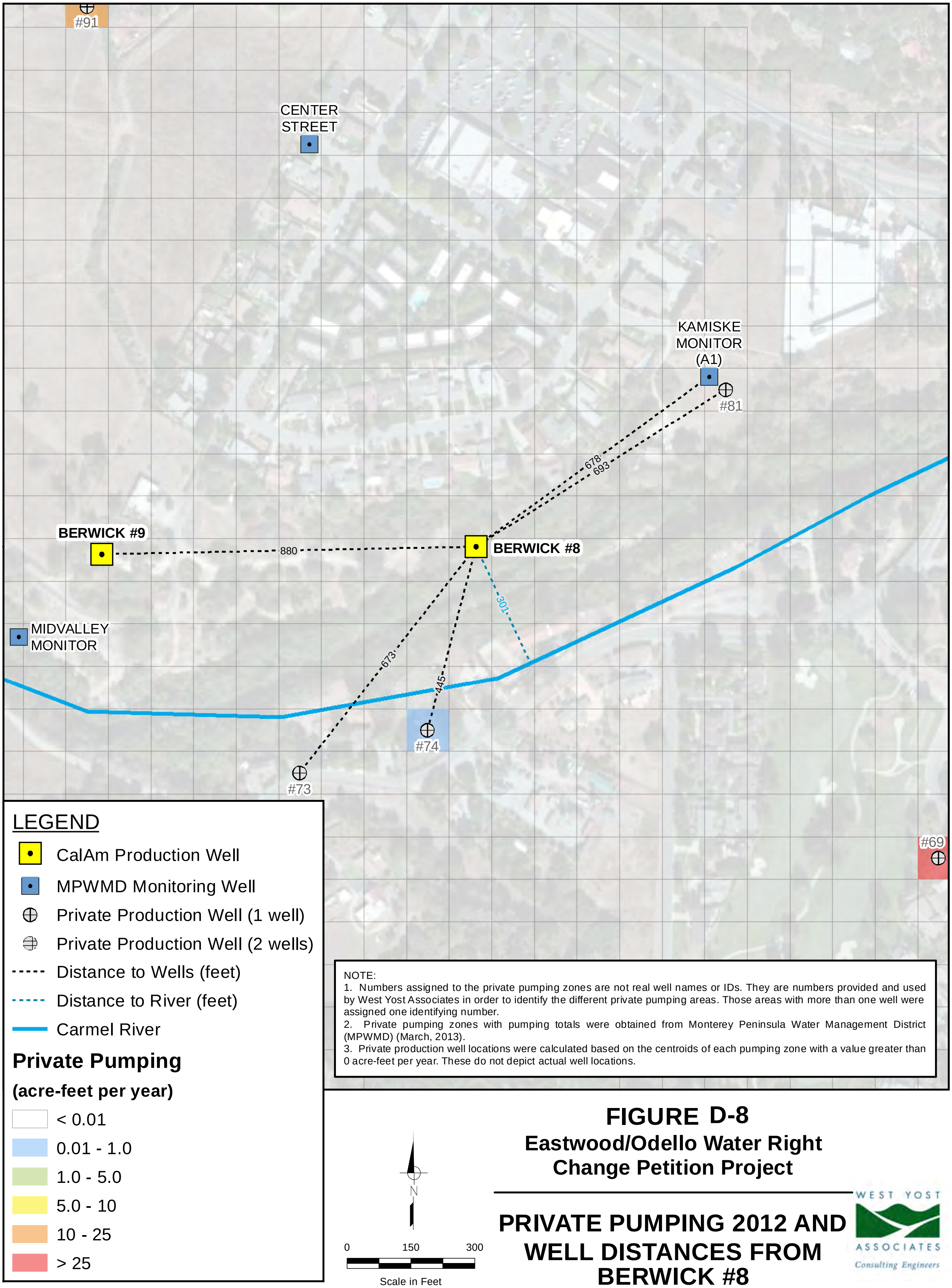


NOTE:
1. Numbers assigned to the private pumping zones are not real well names or IDs. They are numbers provided and used by West Yost Associates in order to identify the different private pumping areas. Those areas with more than one well were assigned one identifying number.
2. Private pumping zones with pumping totals were obtained from Monterey Peninsula Water Management District (MPWMD) (March, 2013).
3. Private production well locations were calculated based on the centroids of each pumping zone with a value greater than 0 acre-feet per year. These do not depict actual well locations.

FIGURE D-8

Eastwood/Odello Water Right Change Petition Project

PRIVATE PUMPING 2012 AND WELL DISTANCES FROM BERWICK #8

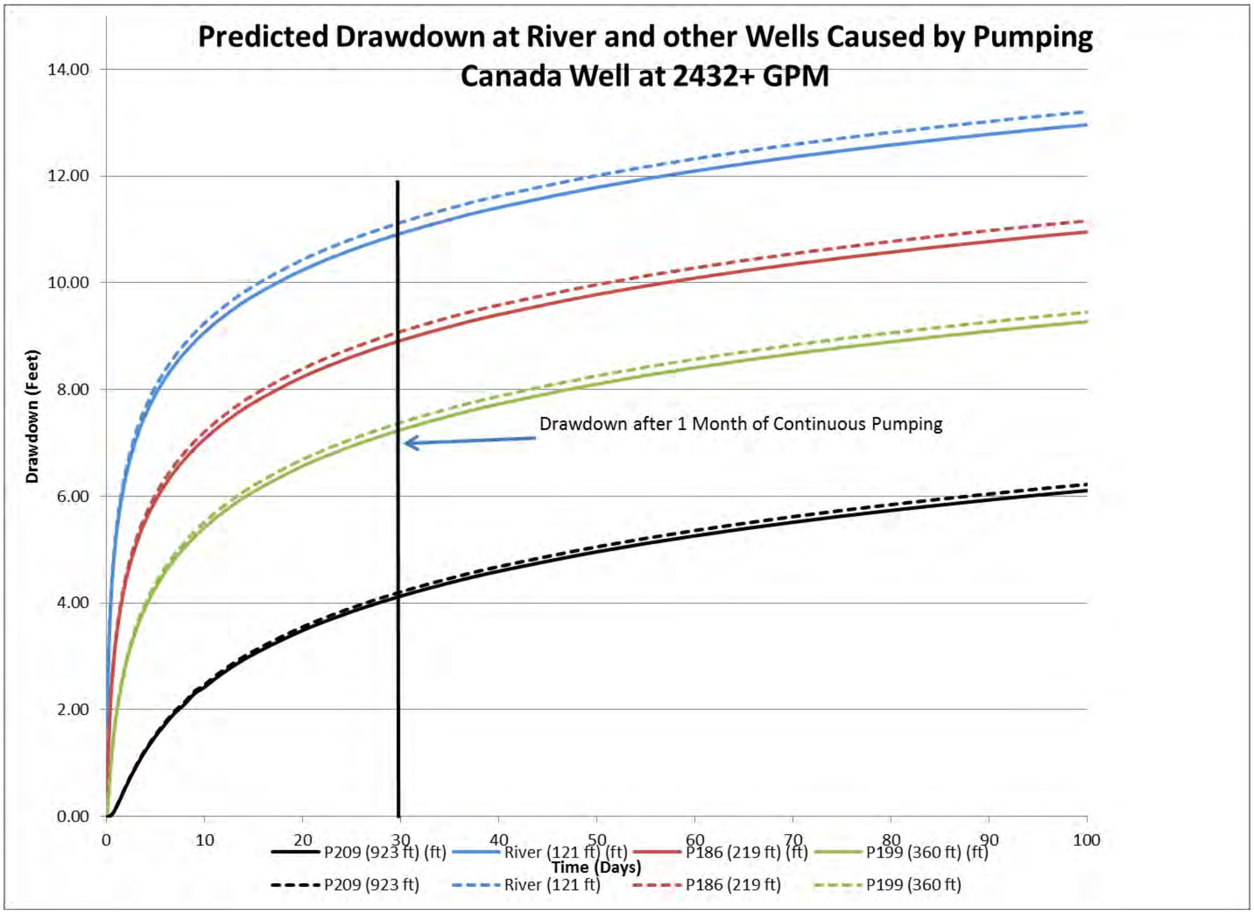
WEST YOST ASSOCIATES
Consulting Engineers

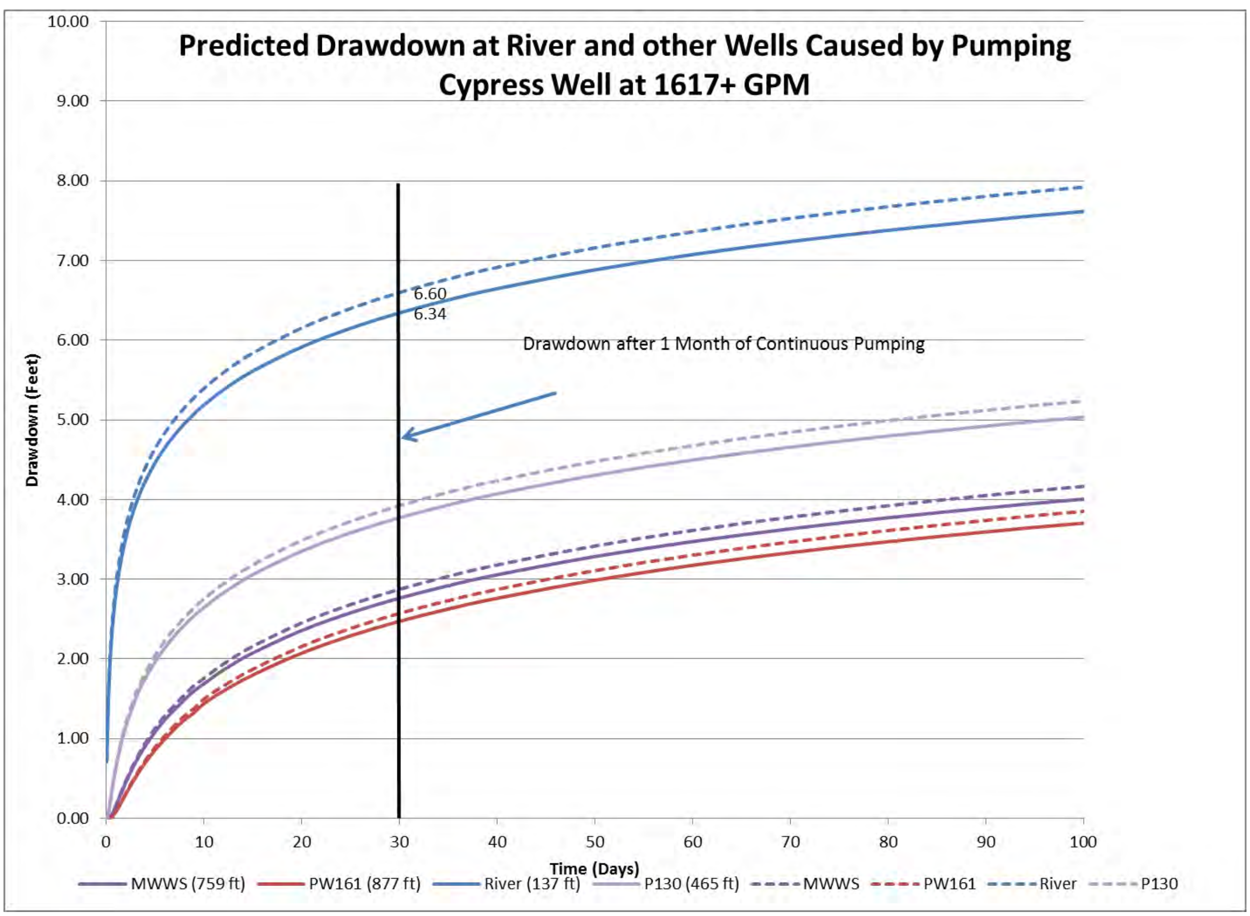
Last Saved: 6/19/2013 1:46:52 PM areimer; N:\Clients\555 Macaulay Water Resources\00-13-03 Odello Ranch GW Eval\GIS\Figures\Report Figures 20130619\FigureD_WellDistances_Pumping2012_Mapbook.mxd

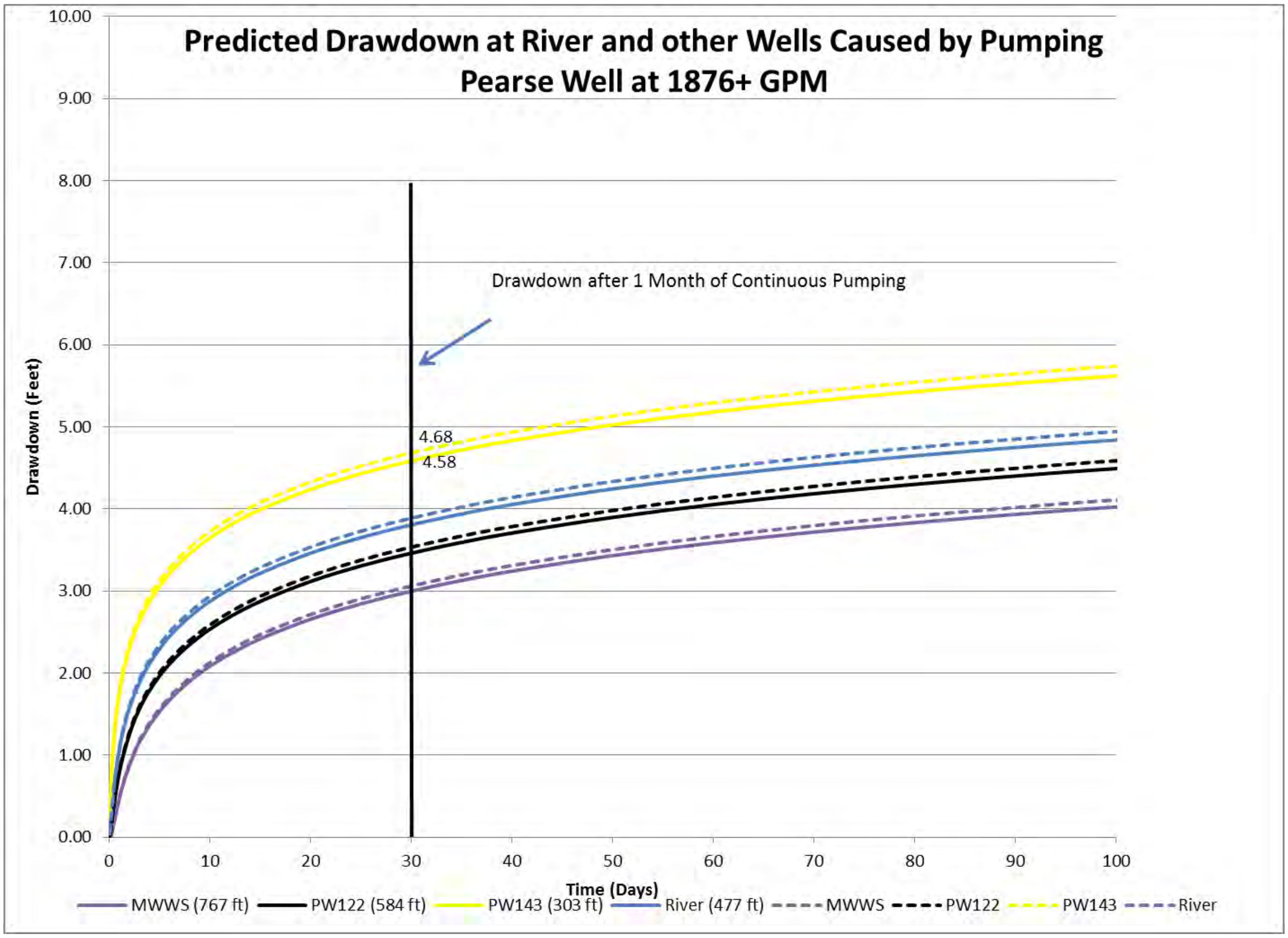
Confidential: attorney-client and work product privileges.

APPENDIX E

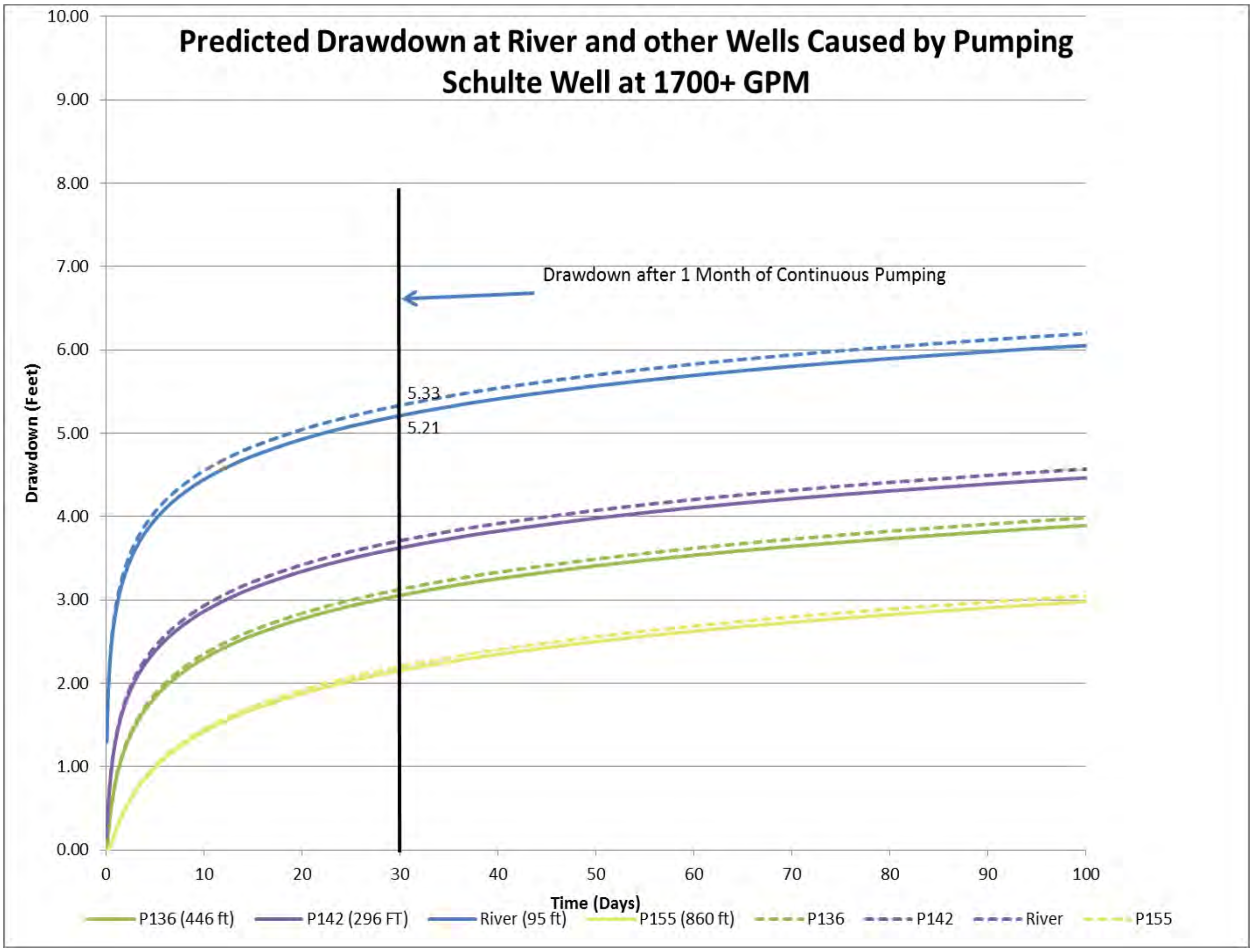
Time and Distance Drawdown Plots


Predicted Drawdown at River and other Wells Caused by Pumping Canada Well at 2432+ GPM
Drawdown (Feet)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0
10
20
30
40
50
60
70
80
90
100
Time (Days)
Drawdown after 1 Month of Continuous Pumping
P209 (923 ft) (ft)
River (121 ft) (ft)
P186 (219 ft) (ft)
P199 (360 ft) (ft)
P209 (923 ft)
River (121 ft)
P186 (219 ft)
P199 (360 ft)

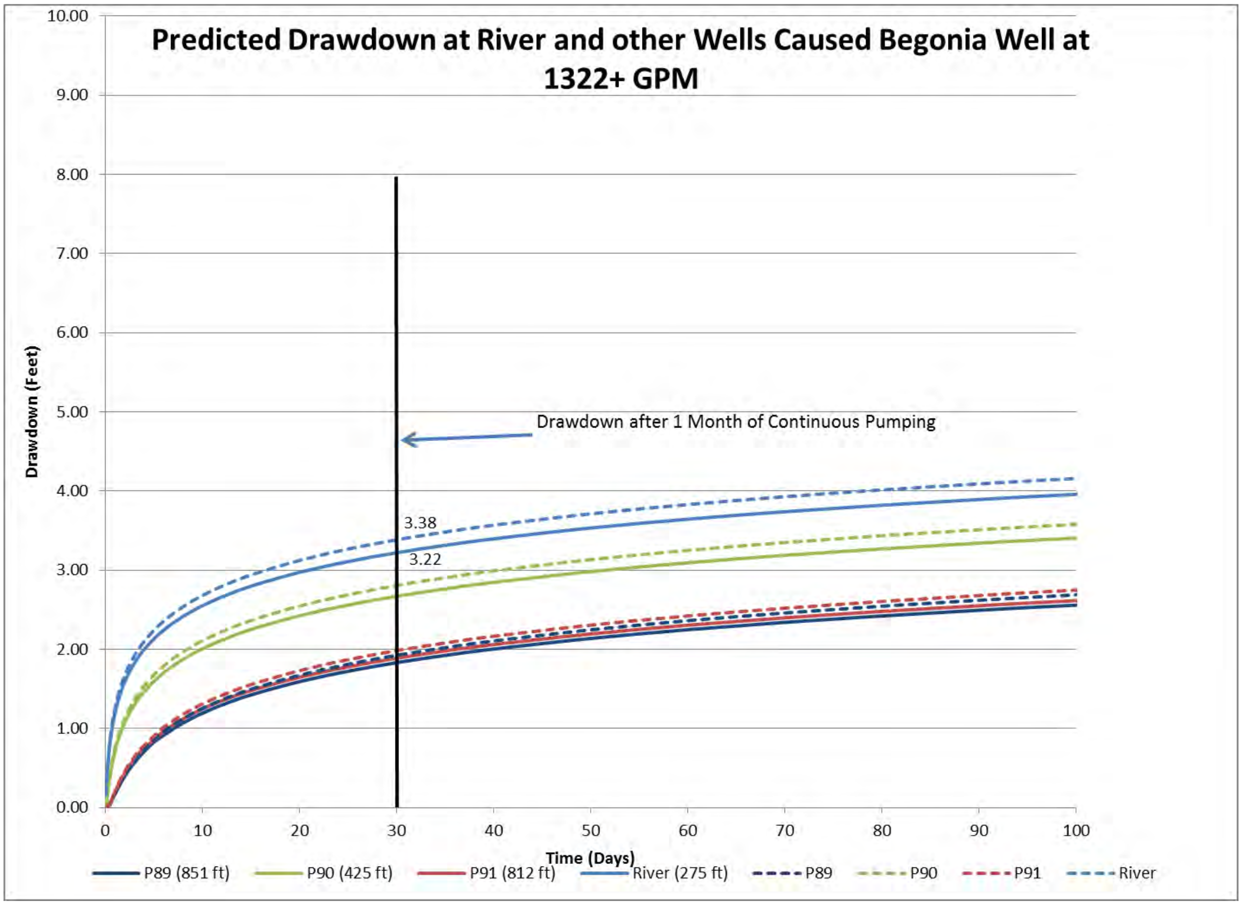

Predicted Drawdown at River and other Wells Caused by Pumping Cypress Well at 1617+ GPM
Drawdown (Feet)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0
10
20
30
40
50
60
70
80
90
100
Time (Days)
6.60
6.34
Drawdown after 1 Month of Continuous Pumping
MWWS (759 ft)
PW161 (877 ft)
River (137 ft)
P130 (465 ft)
MWWS
PW161
River
P130



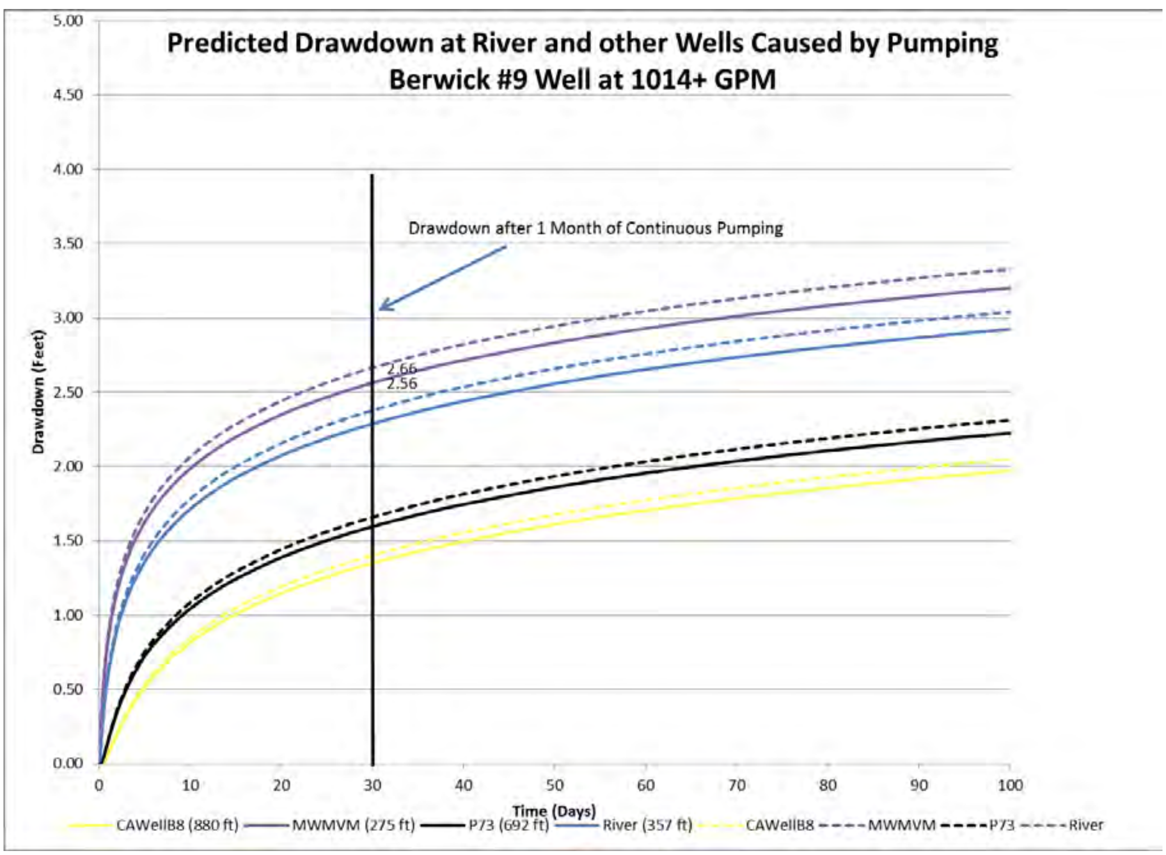
Predicted Drawdown at River and other Wells Caused by Pumping Pearse Well at 1876+ GPM
Drawdown after 1 Month of Continuous Pumping
4.68
4.58
Drawdown (Feet)
Time (Days)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0
10
20
30
40
50
60
70
80
90
100
MWWS (767 ft)
PW122 (584 ft)
PW143 (303 ft)
River (477 ft)
MWWS
PW122
PW143
River



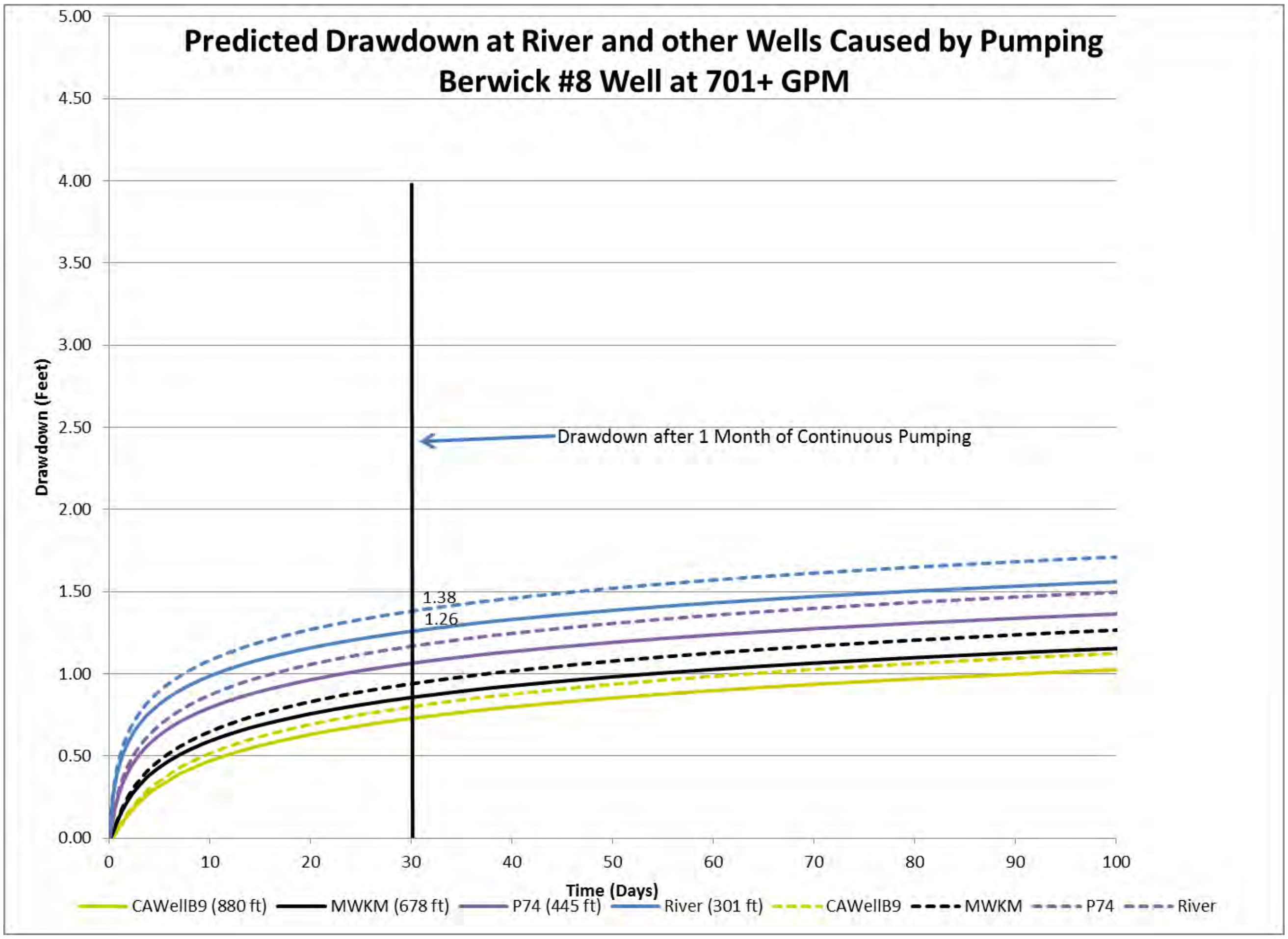
Predicted Drawdown at River and other Wells Caused by Pumping Schulte Well at 1700+ GPM
Drawdown after 1 Month of Continuous Pumping
5.33
5.21
Drawdown (Feet)
Time (Days)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0
10
20
30
40
50
60
70
80
90
100
P136 (446 ft)
P142 (296 FT)
River (95 ft)
P155 (860 ft)
P136
P142
River
P155



Predicted Drawdown at River and other Wells Caused Begonia Well at 1322+ GPM
Drawdown after 1 Month of Continuous Pumping
3.38
3.22
Drawdown (Feet)
Time (Days)
P89 (851 ft)
P90 (425 ft)
P91 (812 ft)
River (275 ft)
P89
P90
P91
River

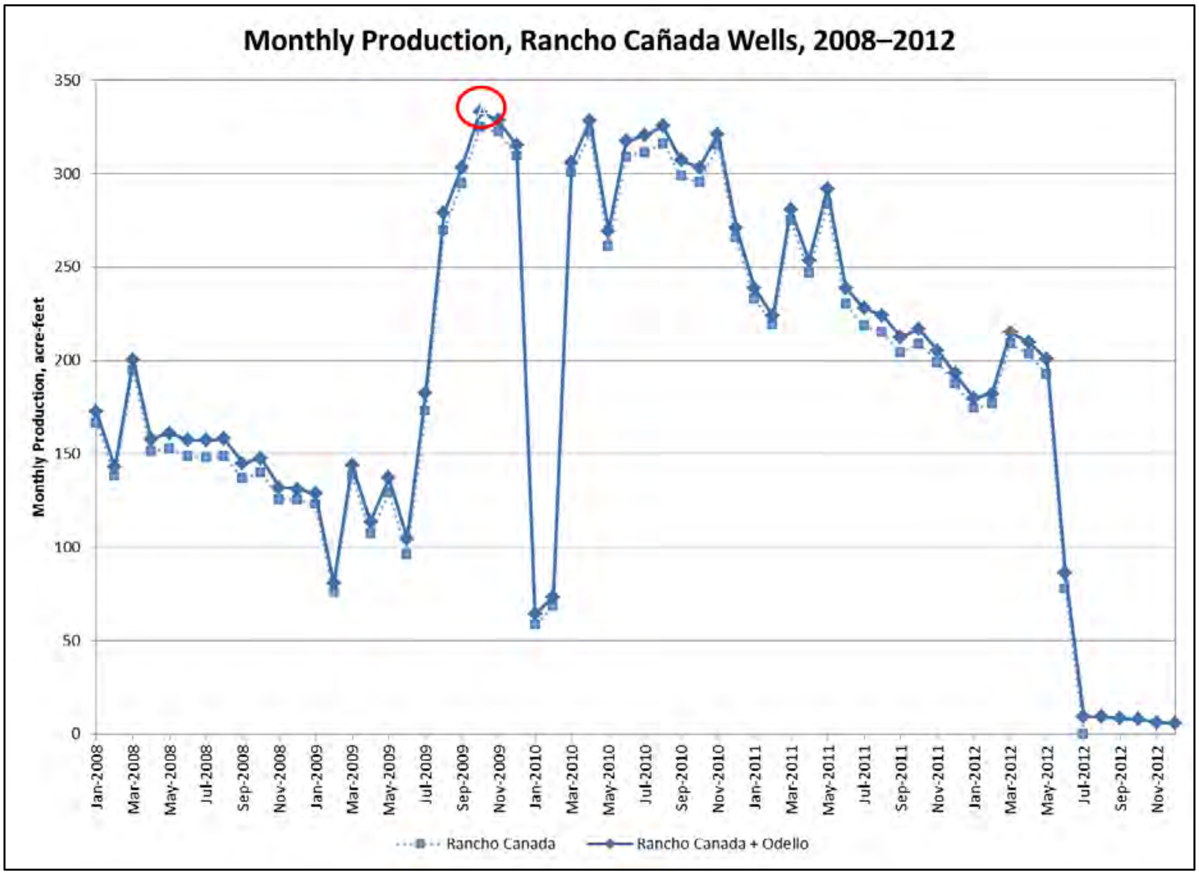


Predicted Drawdown at River and other Wells Caused by Pumping Berwick #9 Well at 1014+ GPM
Drawdown after 1 Month of Continuous Pumping
2.66
2.56
Drawdown (Feet)
Time (Days)
CAWellB8 (880 ft)
MWMVM (275 ft)
P73 (692 ft)
River (357 ft)
CAWellB8
MWMVM
P73
River

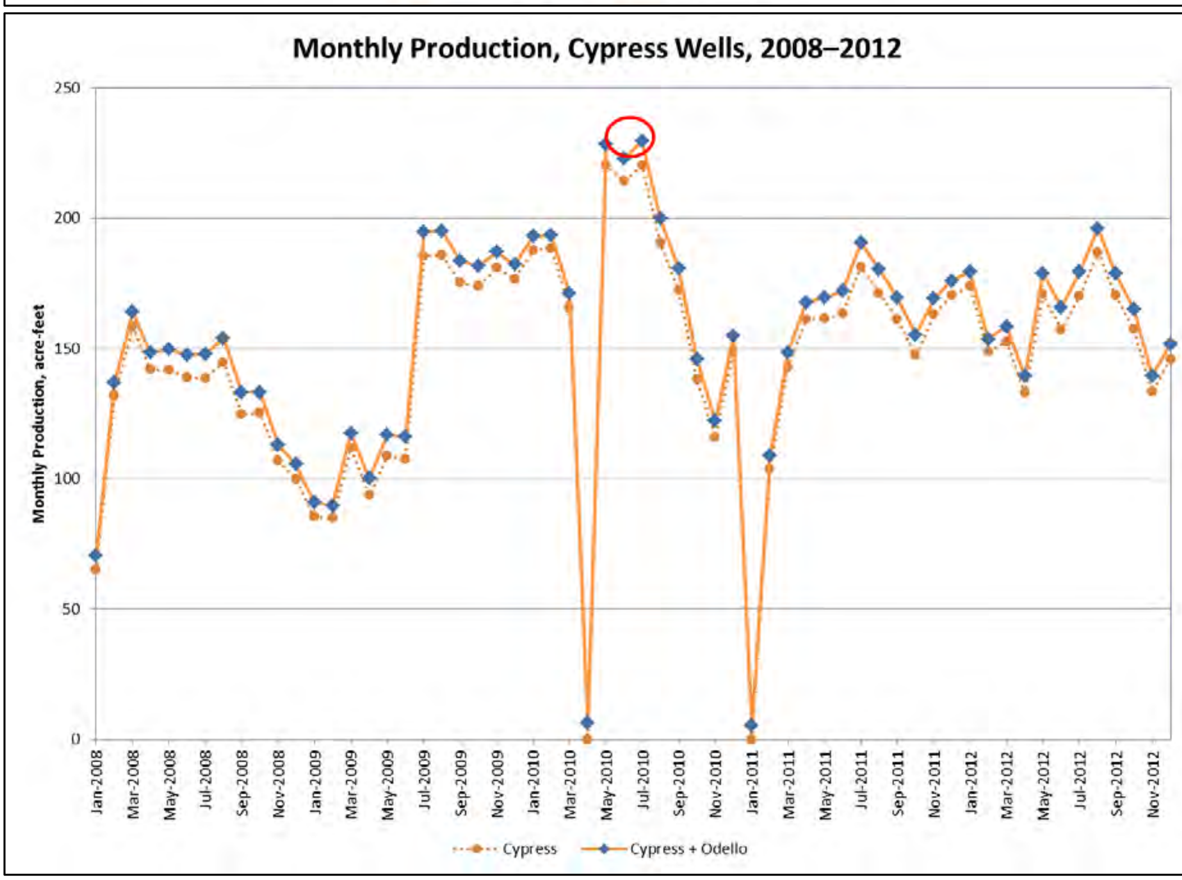

Predicted Drawdown at River and other Wells Caused by Pumping Berwick #8 Well at 701+ GPM
Drawdown (Feet)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Drawdown after 1 Month of Continuous Pumping
1.38
1.26
0
10
20
30
40
50
60
70
80
90
100
Time (Days)
CAWellB9 (880 ft)
MWKM (678 ft)
P74 (445 ft)
River (301 ft)
CAWellB9
MWKM
P74
River

APPENDIX F

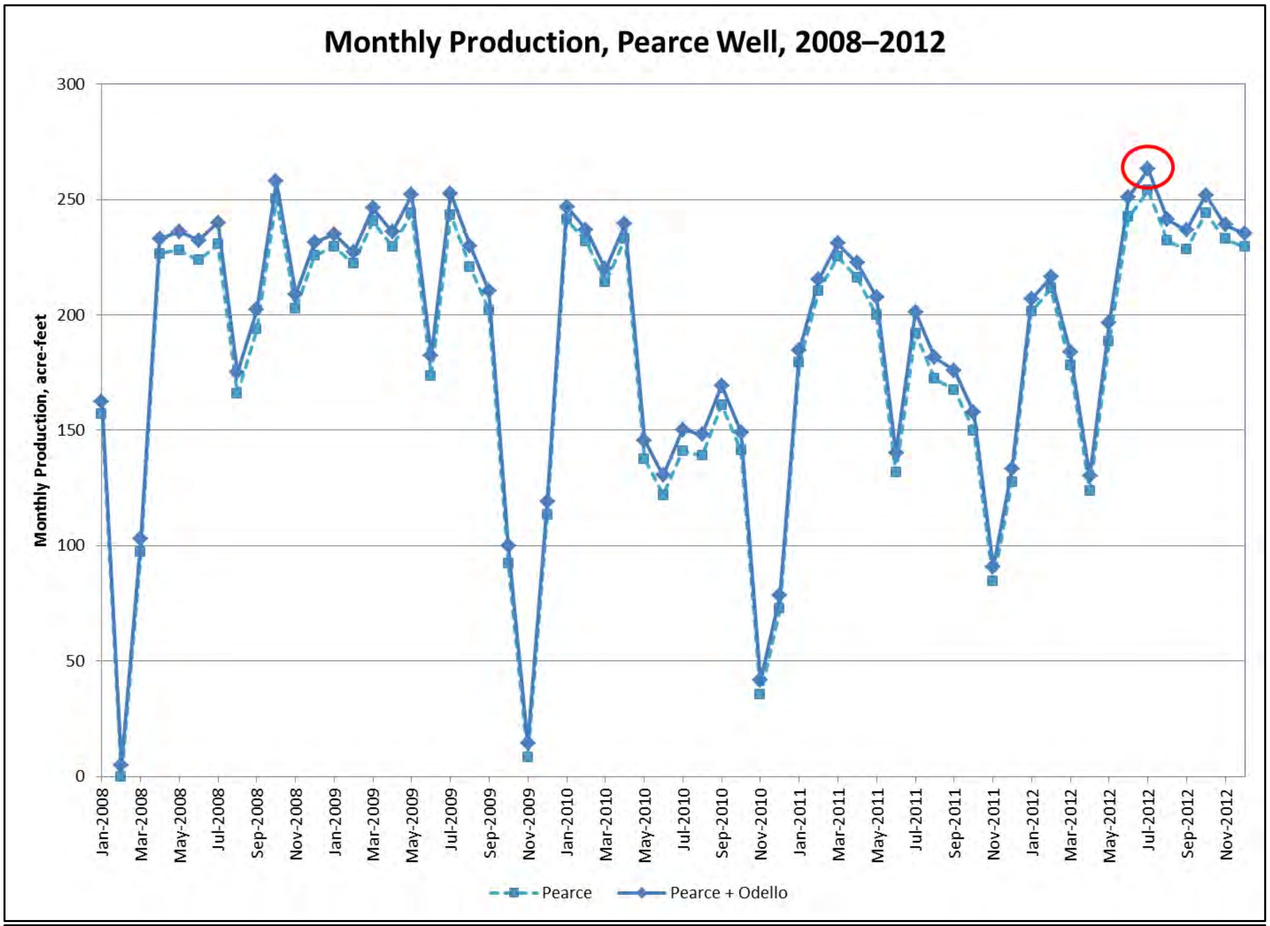
Cal-Am Pumping Plots 2008 to 2012

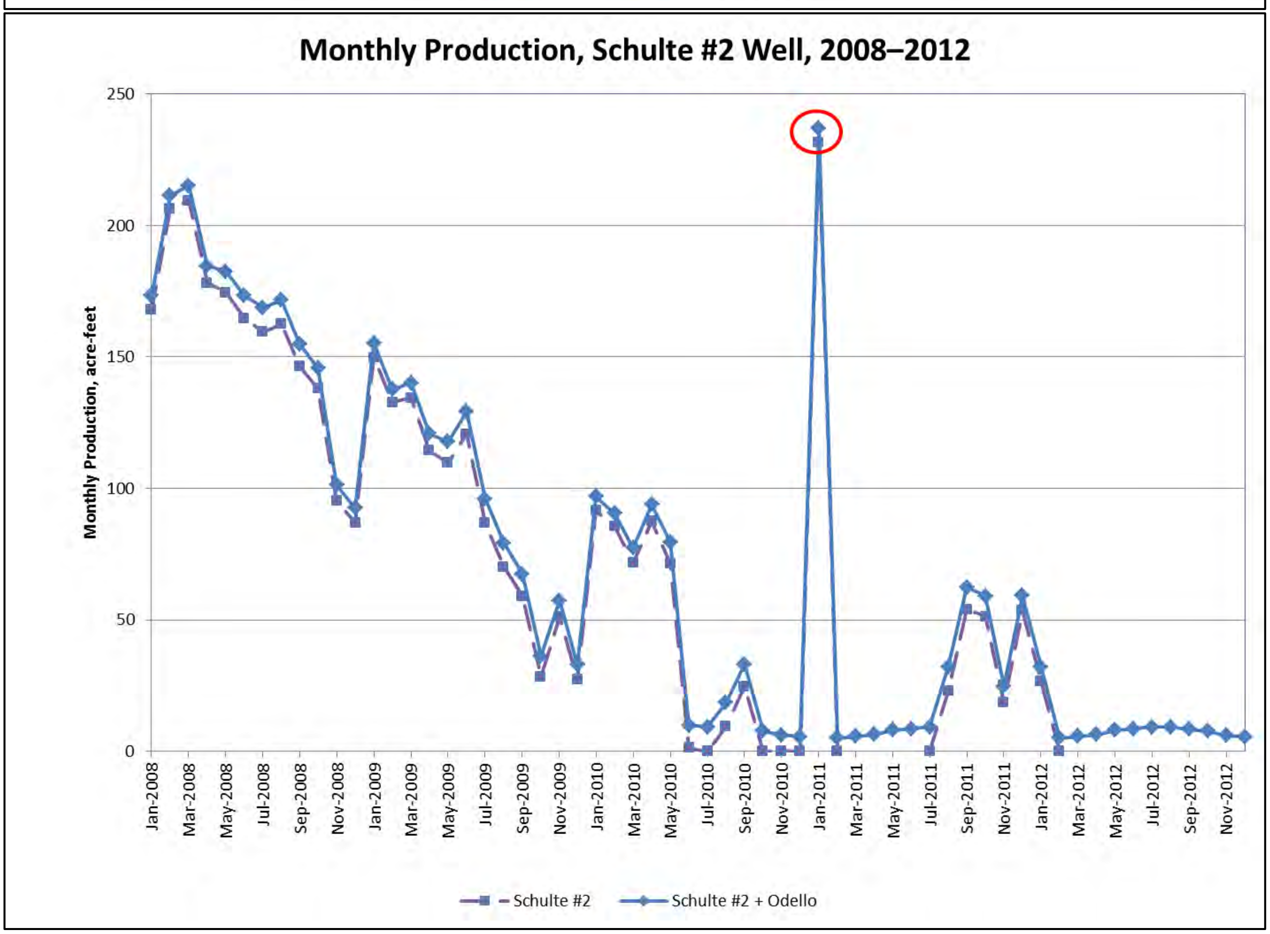


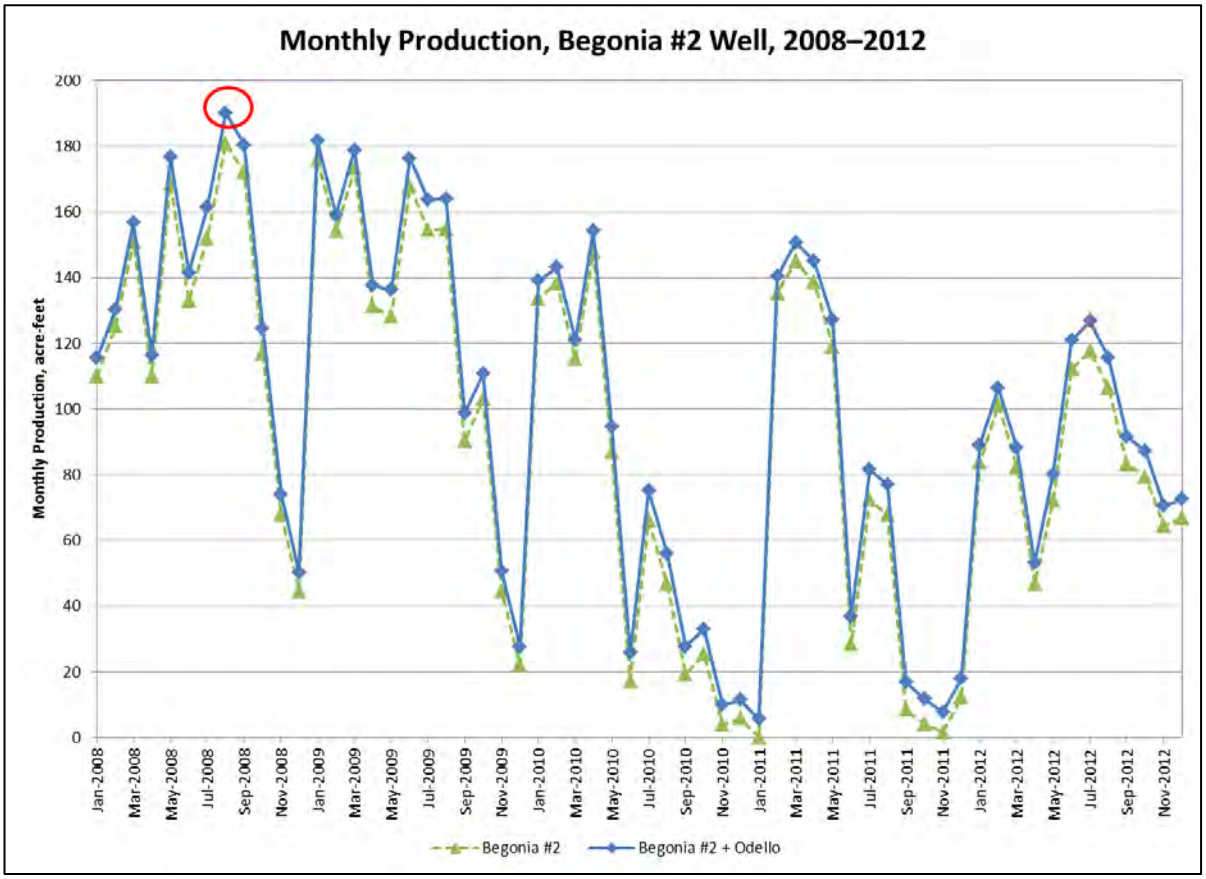
Monthly Production, Rancho Cañada Wells, 2008–2012
Monthly Production, acre-feet
Rancho Canada
Rancho Canada + Odello

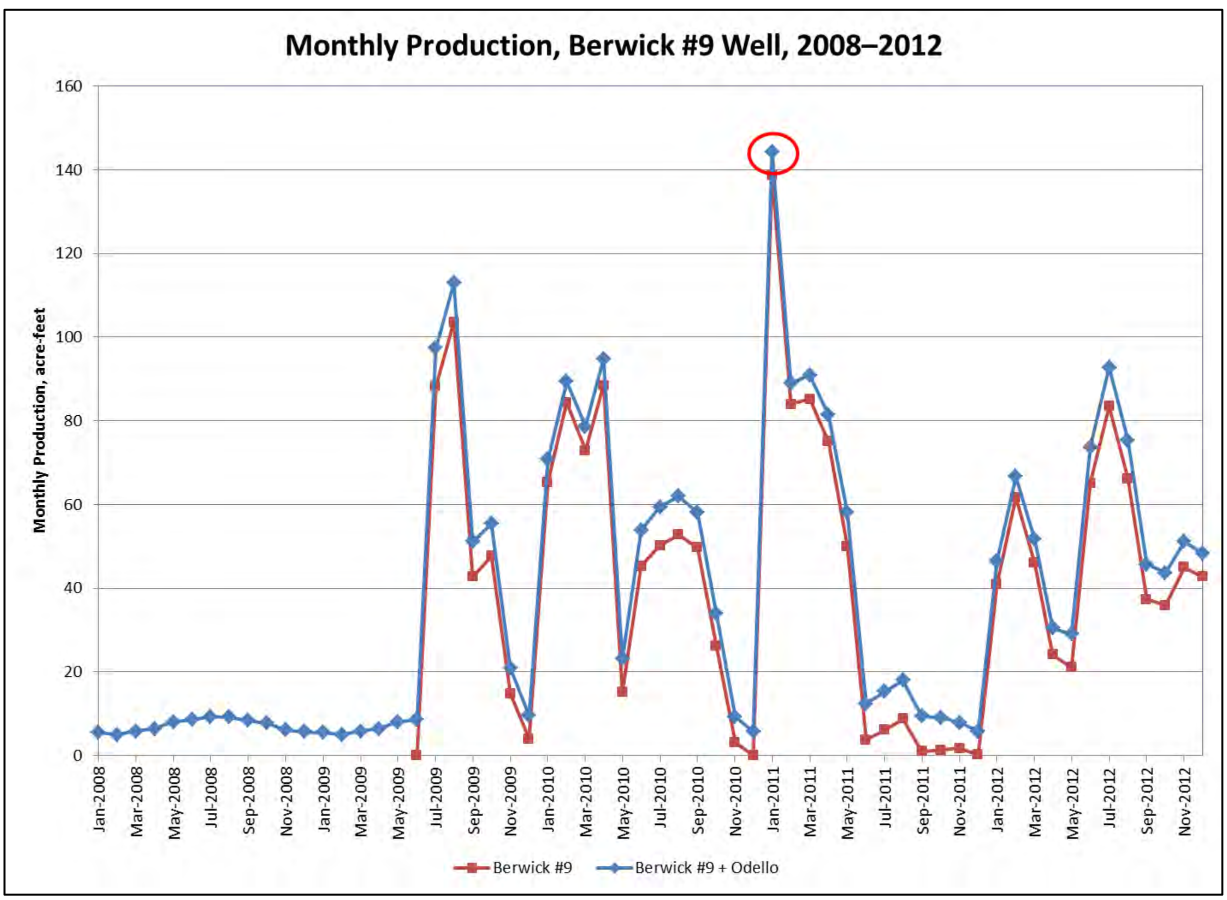


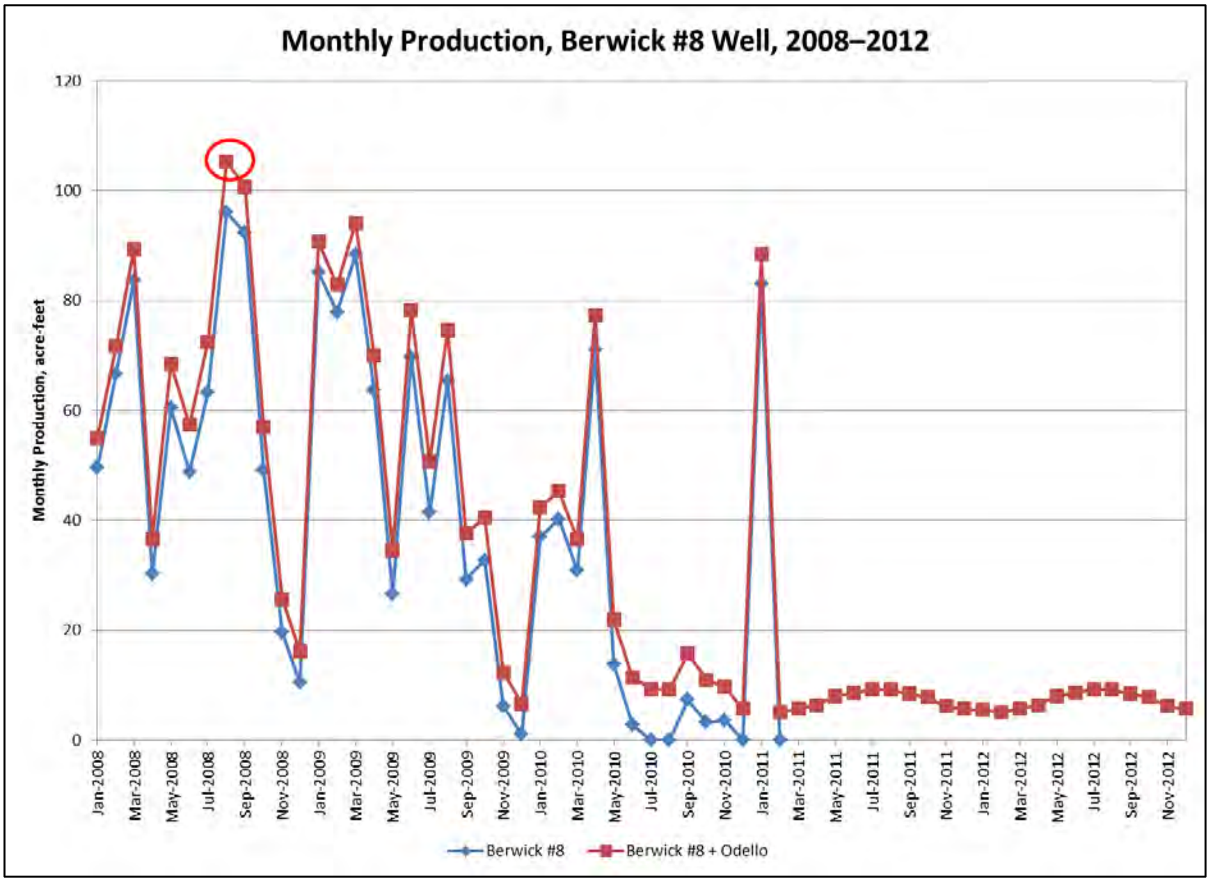
Monthly Production, Cypress Wells, 2008–2012
Monthly Production, acre-feet
Cypress
Cypress + Odello


Monthly Production, Pearce Well, 2008–2012
Monthly Production, acre-feet
300
250
200
150
100
50
0
Jan-2008
Mar-2008
May-2008
Jul-2008
Sep-2008
Nov-2008
Jan-2009
Mar-2009
May-2009
Jul-2009
Sep-2009
Nov-2009
Jan-2010
Mar-2010
May-2010
Jul-2010
Sep-2010
Nov-2010
Jan-2011
Mar-2011
May-2011
Jul-2011
Sep-2011
Nov-2011
Jan-2012
Mar-2012
May-2012
Jul-2012
Sep-2012
Nov-2012
Pearce
Pearce + Odello


Monthly Production, Schulte #2 Well, 2008–2012
Monthly Production, acre-feet
250
200
150
100
50
0
Jan-2008
Mar-2008
May-2008
Jul-2008
Sep-2008
Nov-2008
Jan-2009
Mar-2009
May-2009
Jul-2009
Sep-2009
Nov-2009
Jan-2010
Mar-2010
May-2010
Jul-2010
Sep-2010
Nov-2010
Jan-2011
Mar-2011
May-2011
Jul-2011
Sep-2011
Nov-2011
Jan-2012
Mar-2012
May-2012
Jul-2012
Sep-2012
Nov-2012
Schulte #2
Schulte #2 + Odello


Monthly Production, Begonia #2 Well, 2008–2012
Monthly Production, acre-feet
0
20
40
60
80
100
120
140
160
180
200
Jan-2008
Mar-2008
May-2008
Jul-2008
Sep-2008
Nov-2008
Jan-2009
Mar-2009
May-2009
Jul-2009
Sep-2009
Nov-2009
Jan-2010
Mar-2010
May-2010
Jul-2010
Sep-2010
Nov-2010
Jan-2011
Mar-2011
May-2011
Jul-2011
Sep-2011
Nov-2011
Jan-2012
Mar-2012
May-2012
Jul-2012
Sep-2012
Nov-2012
Begonia #2
Begonia #2 + Odello

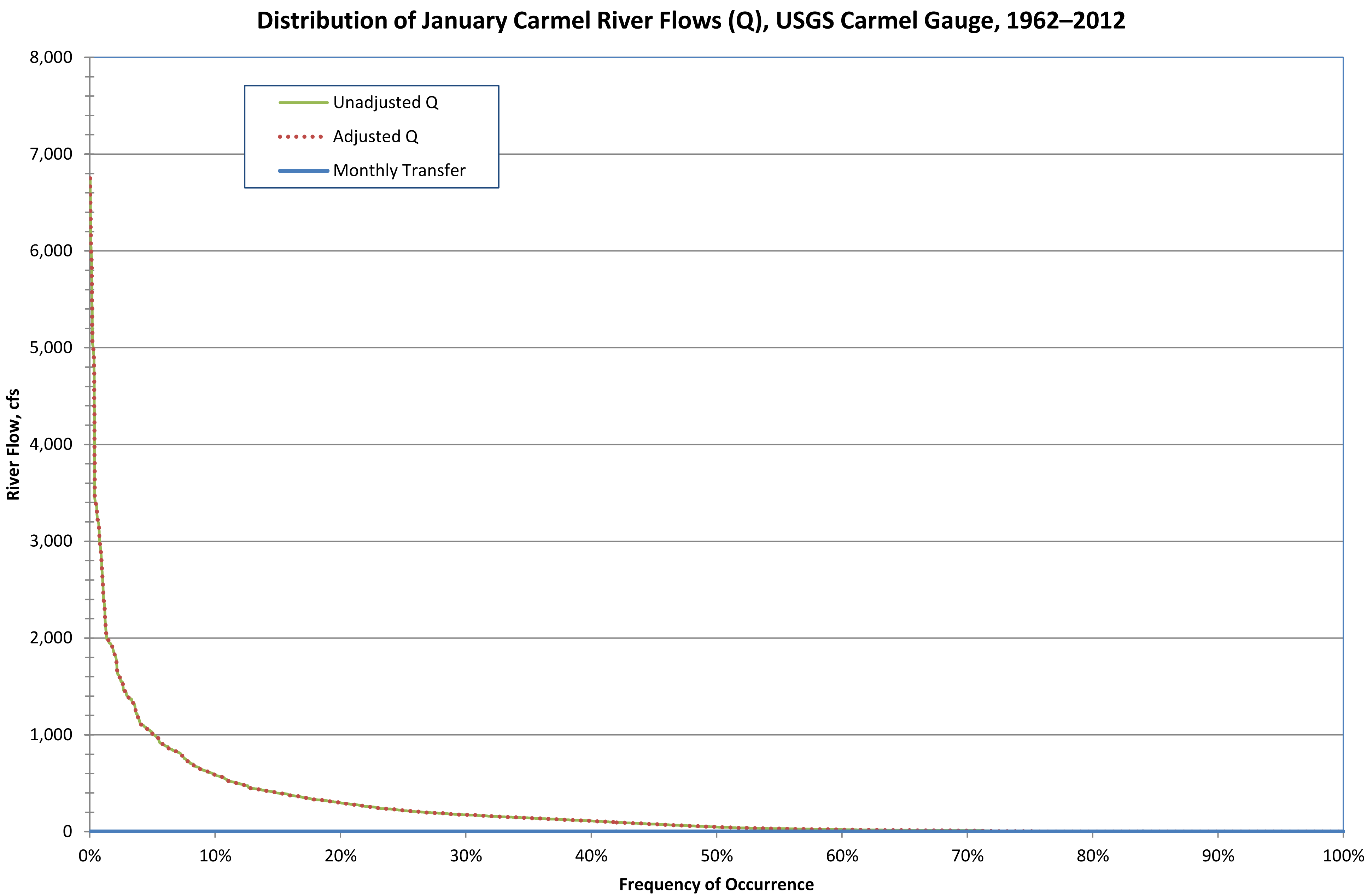

Monthly Production, Berwick #9 Well, 2008–2012
Monthly Production, acre-feet
0
20
40
60
80
100
120
140
160
Jan-2008
Mar-2008
May-2008
Jul-2008
Sep-2008
Nov-2008
Jan-2009
Mar-2009
May-2009
Jul-2009
Sep-2009
Nov-2009
Jan-2010
Mar-2010
May-2010
Jul-2010
Sep-2010
Nov-2010
Jan-2011
Mar-2011
May-2011
Jul-2011
Sep-2011
Nov-2011
Jan-2012
Mar-2012
May-2012
Jul-2012
Sep-2012
Nov-2012
Berwick #9
Berwick #9 + Odello



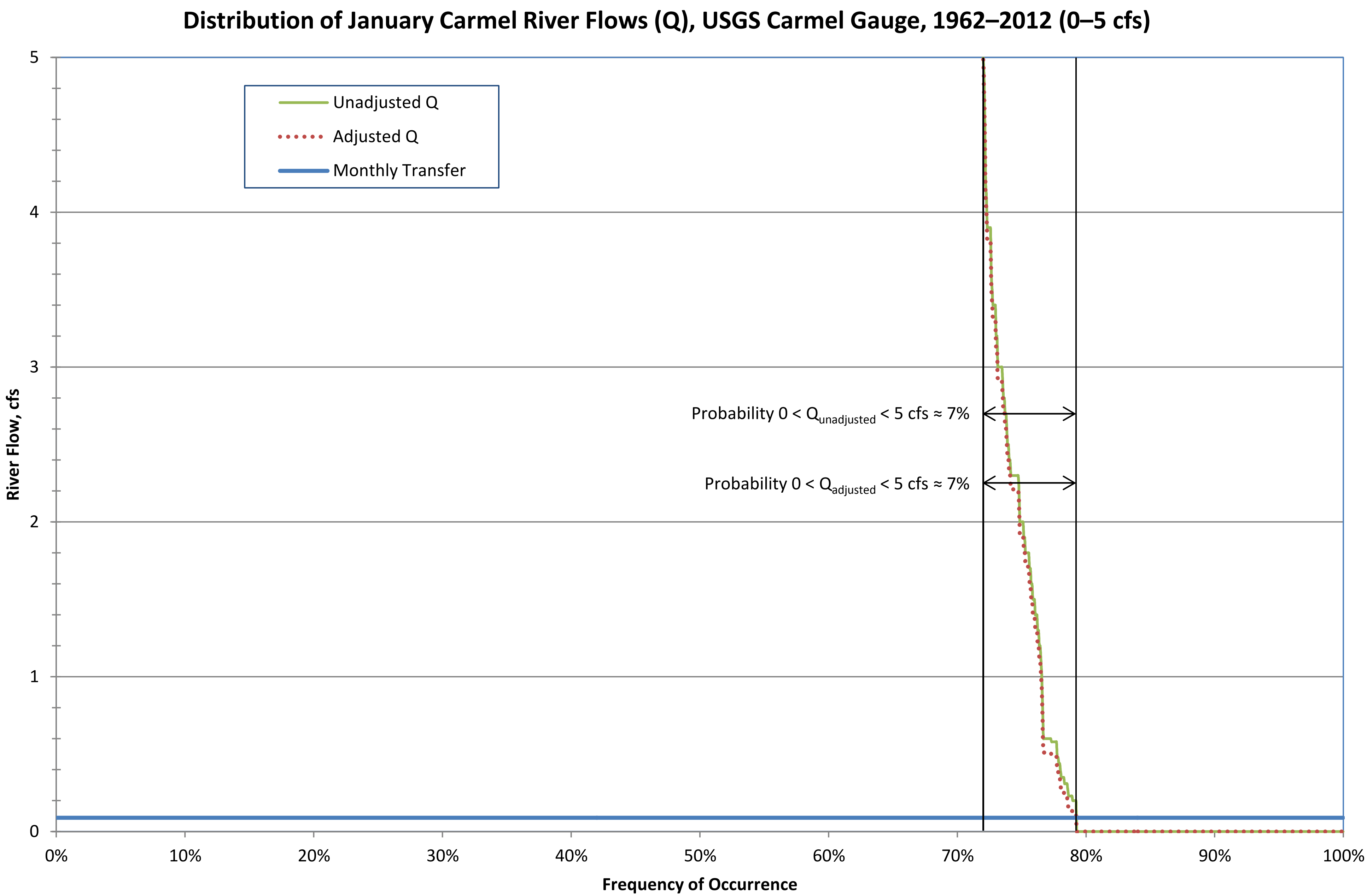
Monthly Production, Berwick #8 Well, 2008–2012
Monthly Production, acre-feet
120
100
80
60
40
20
0
Jan-2008
Mar-2008
May-2008
Jul-2008
Sep-2008
Nov-2008
Jan-2009
Mar-2009
May-2009
Jul-2009
Sep-2009
Nov-2009
Jan-2010
Mar-2010
May-2010
Jul-2010
Sep-2010
Nov-2010
Jan-2011
Mar-2011
May-2011
Jul-2011
Sep-2011
Nov-2011
Jan-2012
Mar-2012
May-2012
Jul-2012
Sep-2012
Nov-2012
Berwick #8
Berwick #8 + Odello

APPENDIX G

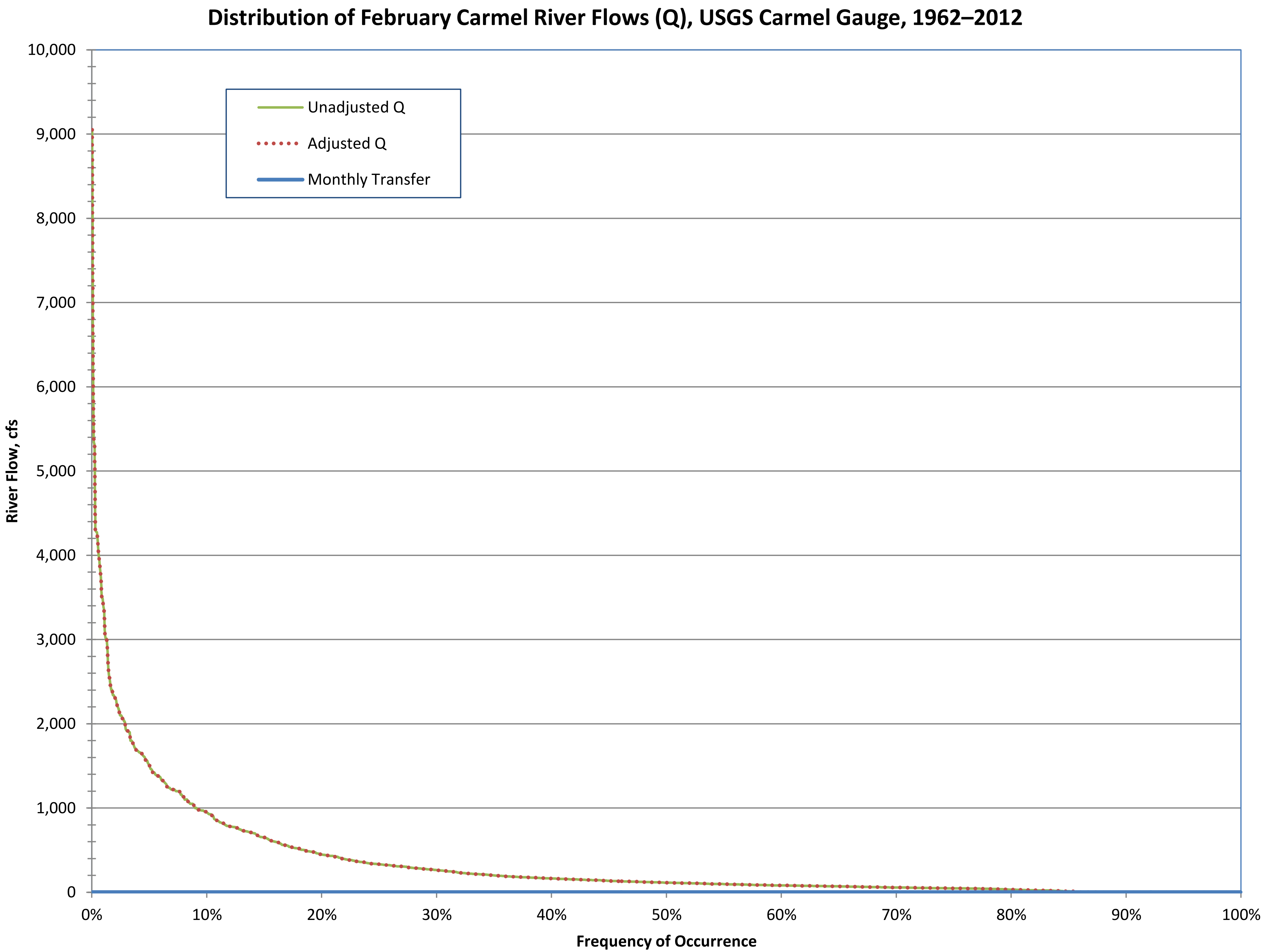
Carmel River Flow Plots



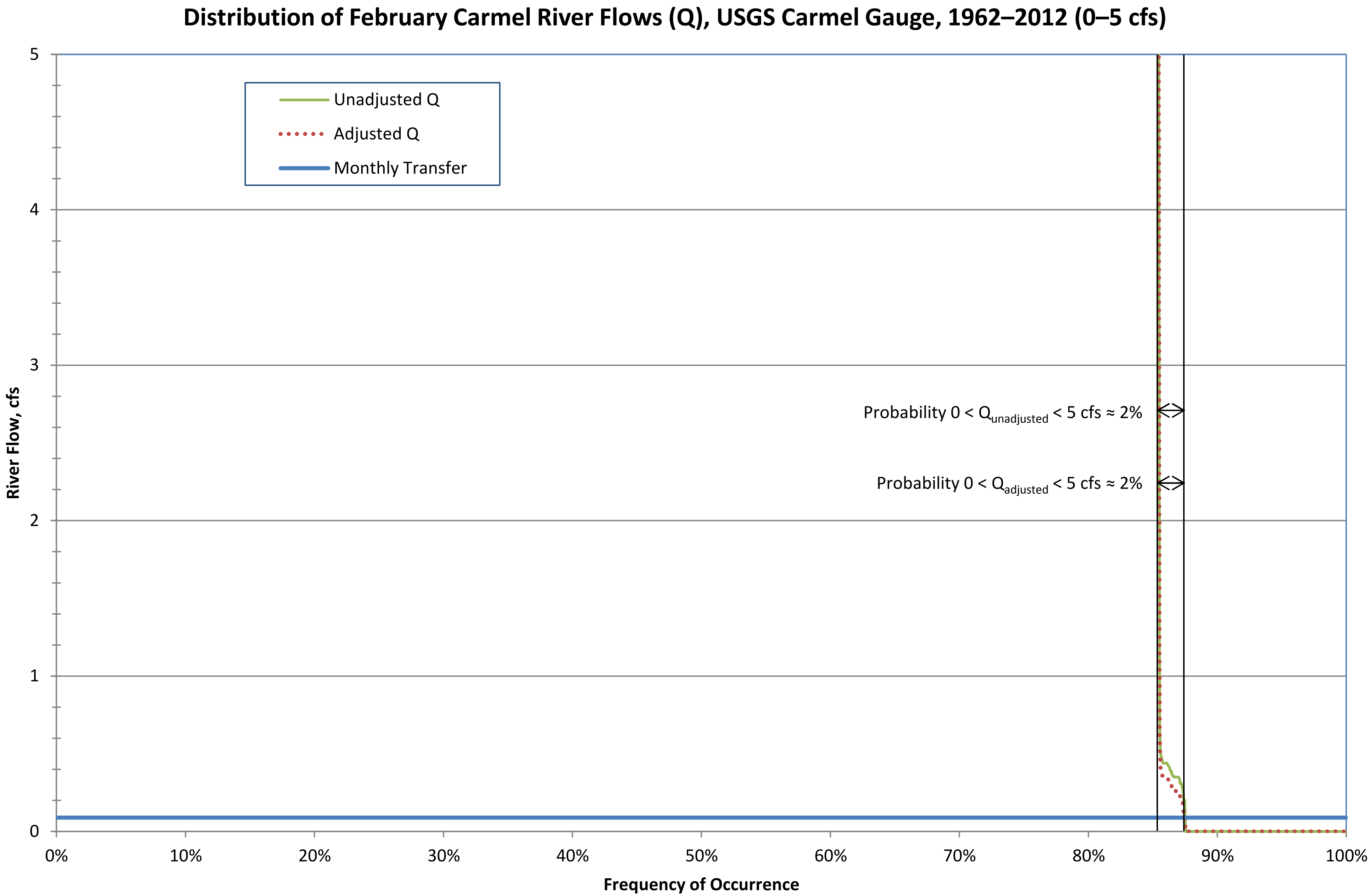
Distribution of January Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
River Flow, cfs
Unadjusted Q
Adjusted Q
Monthly Transfer
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence



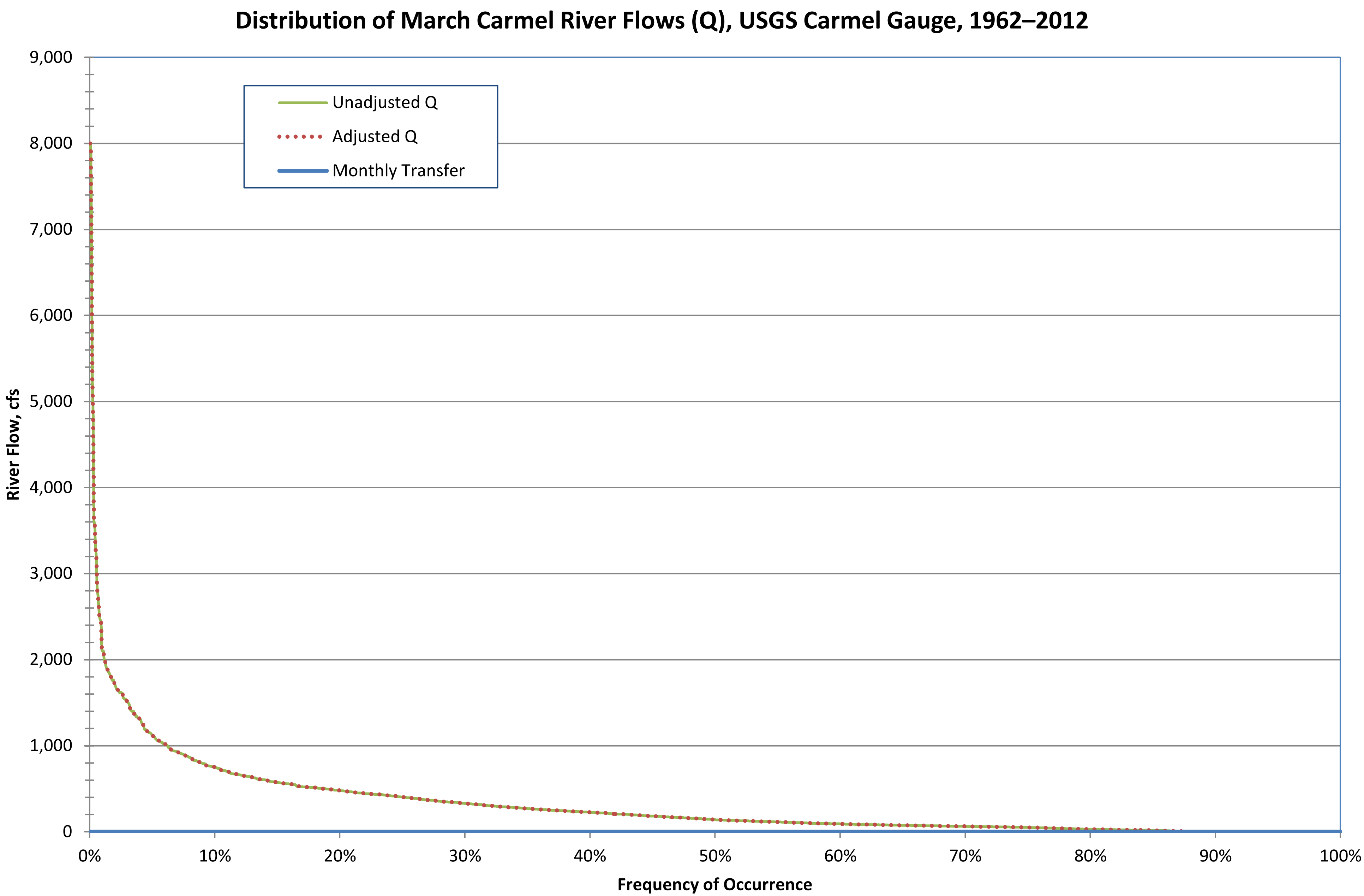
Distribution of January Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < $Q_{unadjusted}$ < 5 cfs ≈ 7%
Probability 0 < $Q_{adjusted}$ < 5 cfs ≈ 7%
River Flow, cfs
Frequency of Occurrence
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

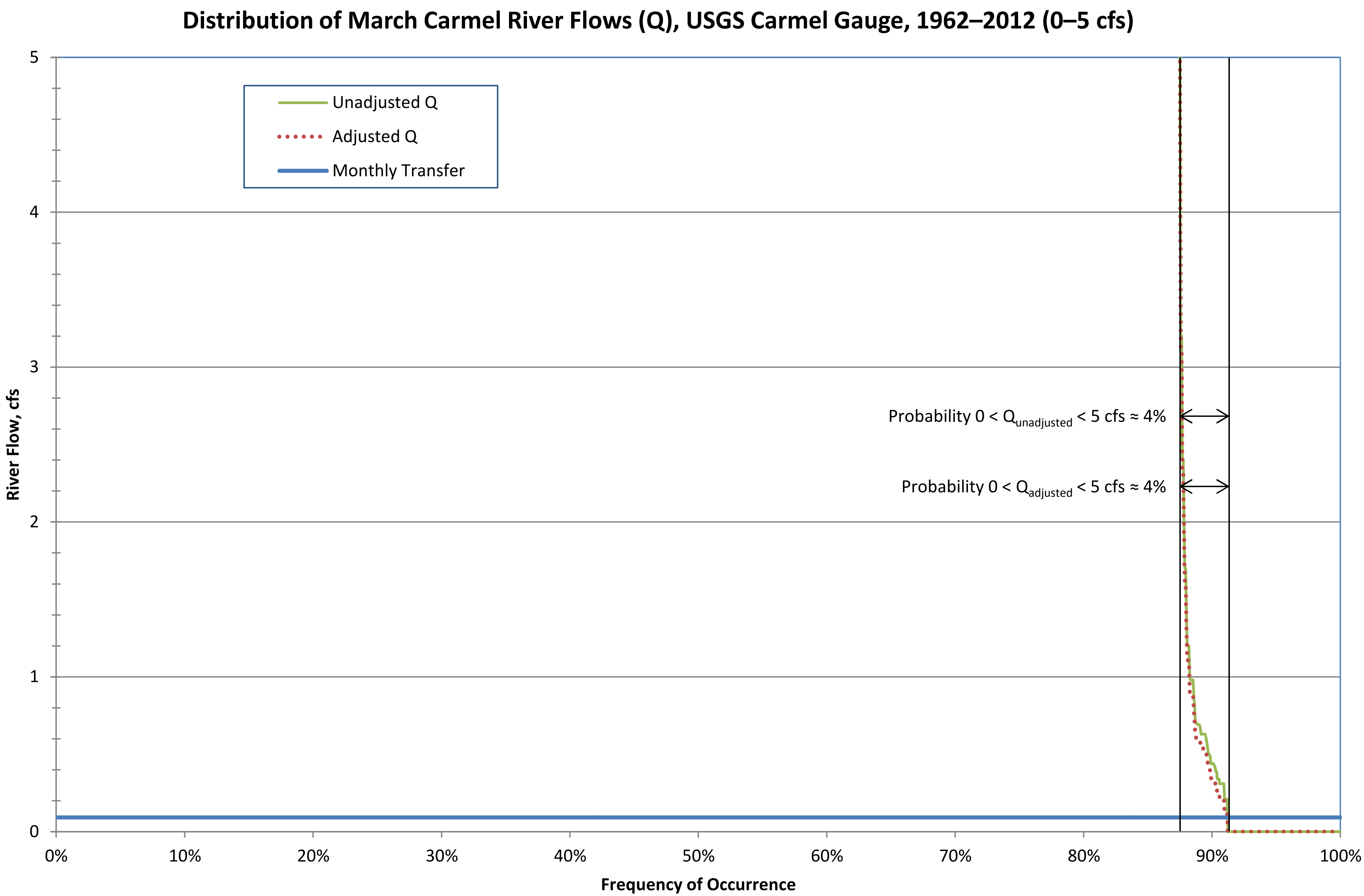


Distribution of February Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
Unadjusted Q
Adjusted Q
Monthly Transfer
River Flow, cfs
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence

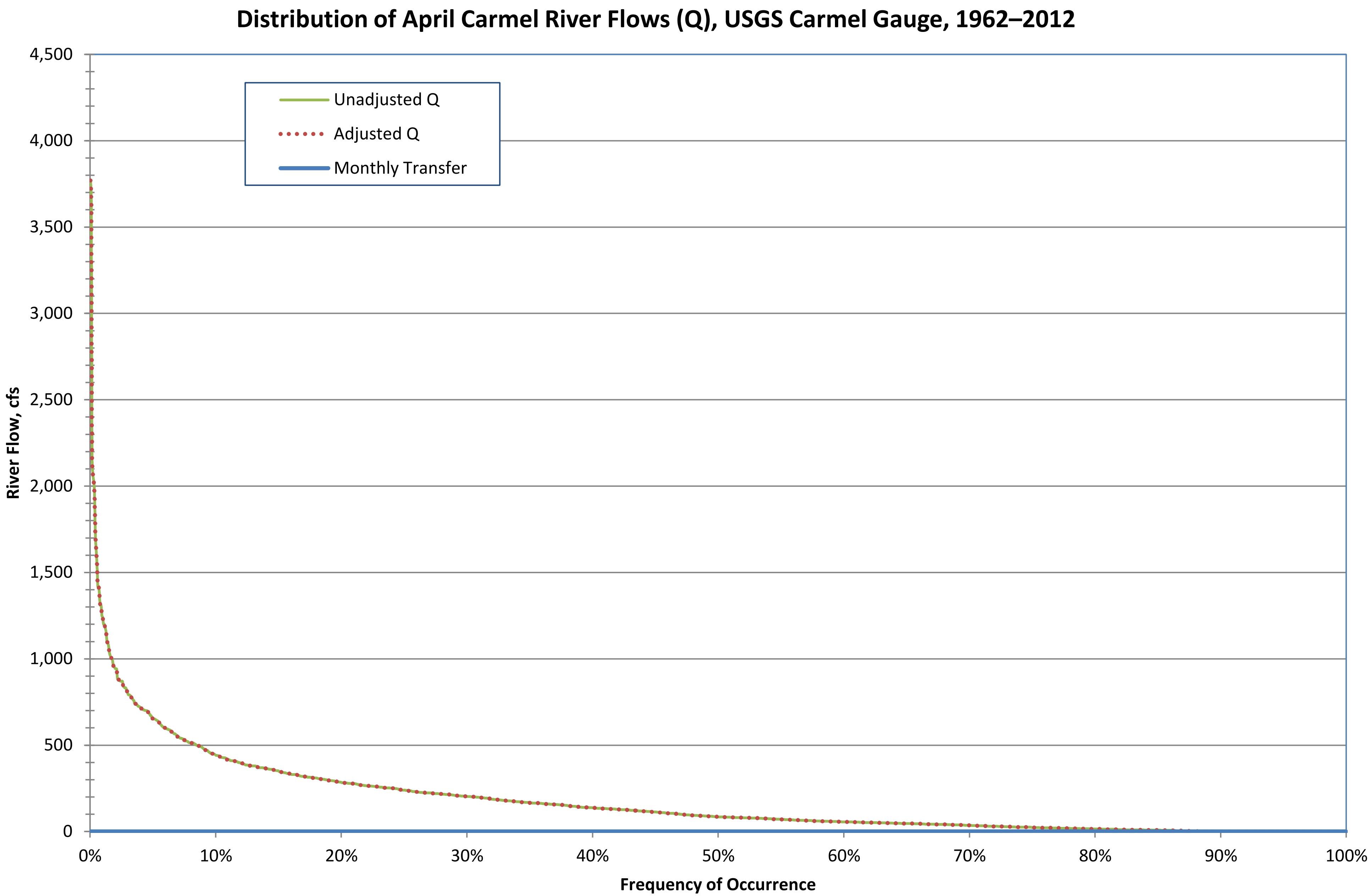


Distribution of February Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < Q_unadjusted < 5 cfs ≈ 2%
Probability 0 < Q_adjusted < 5 cfs ≈ 2%
River Flow, cfs
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence

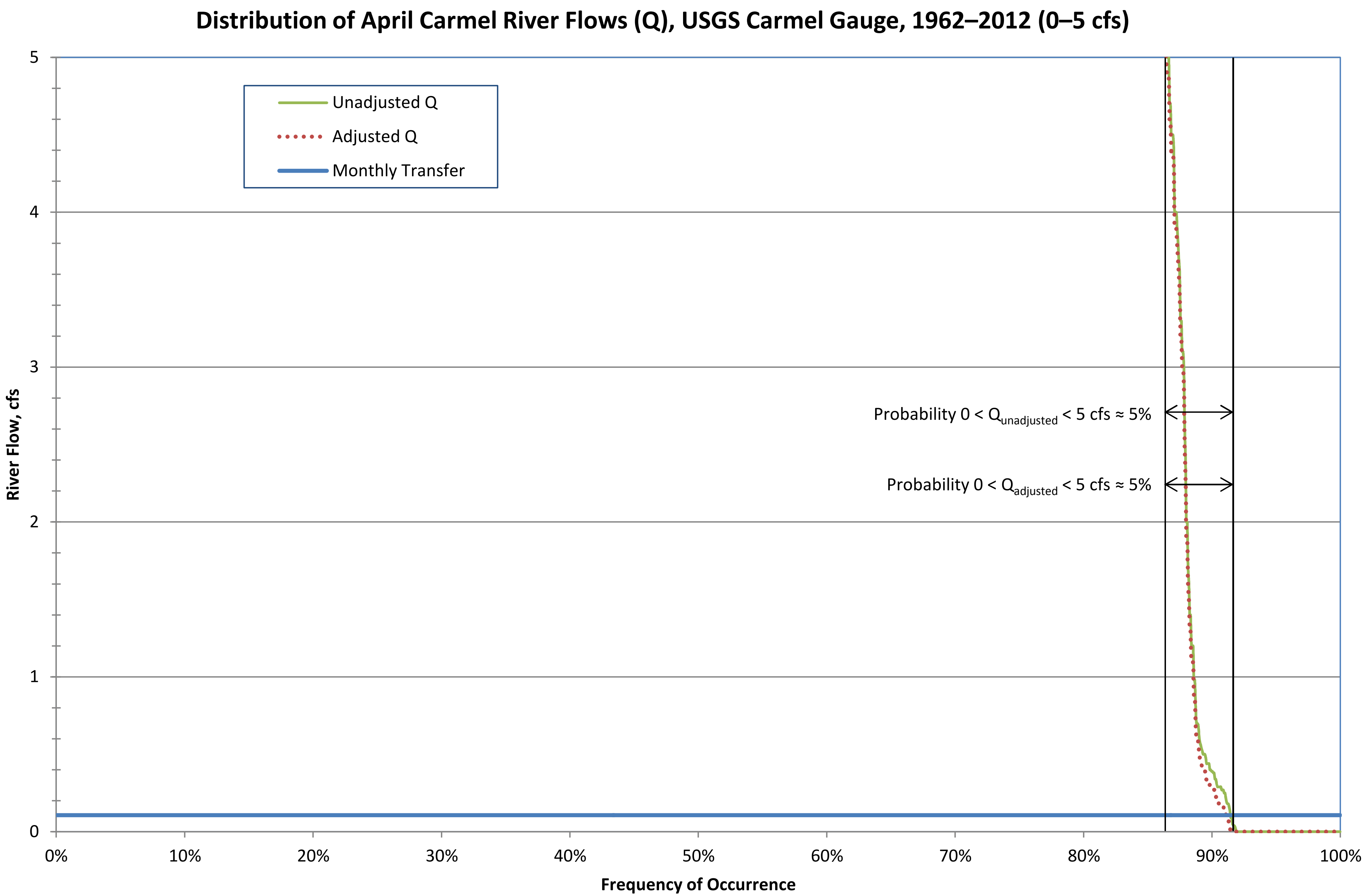

Distribution of March Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
Unadjusted Q
Adjusted Q
Monthly Transfer
River Flow, cfs
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence



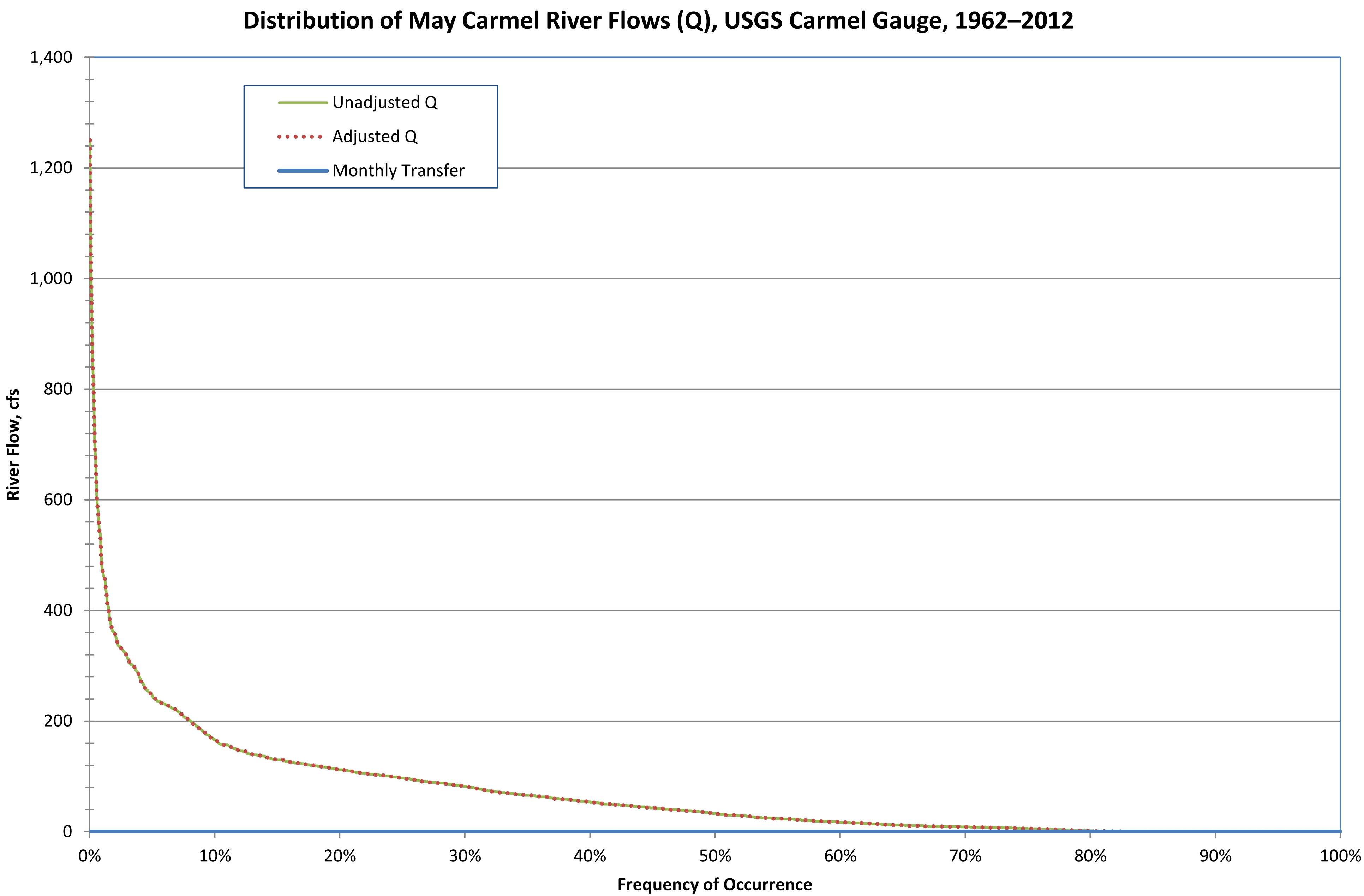
Distribution of March Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < Q_unadjusted < 5 cfs ≈ 4%
Probability 0 < Q_adjusted < 5 cfs ≈ 4%
River Flow, cfs
Frequency of Occurrence
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%



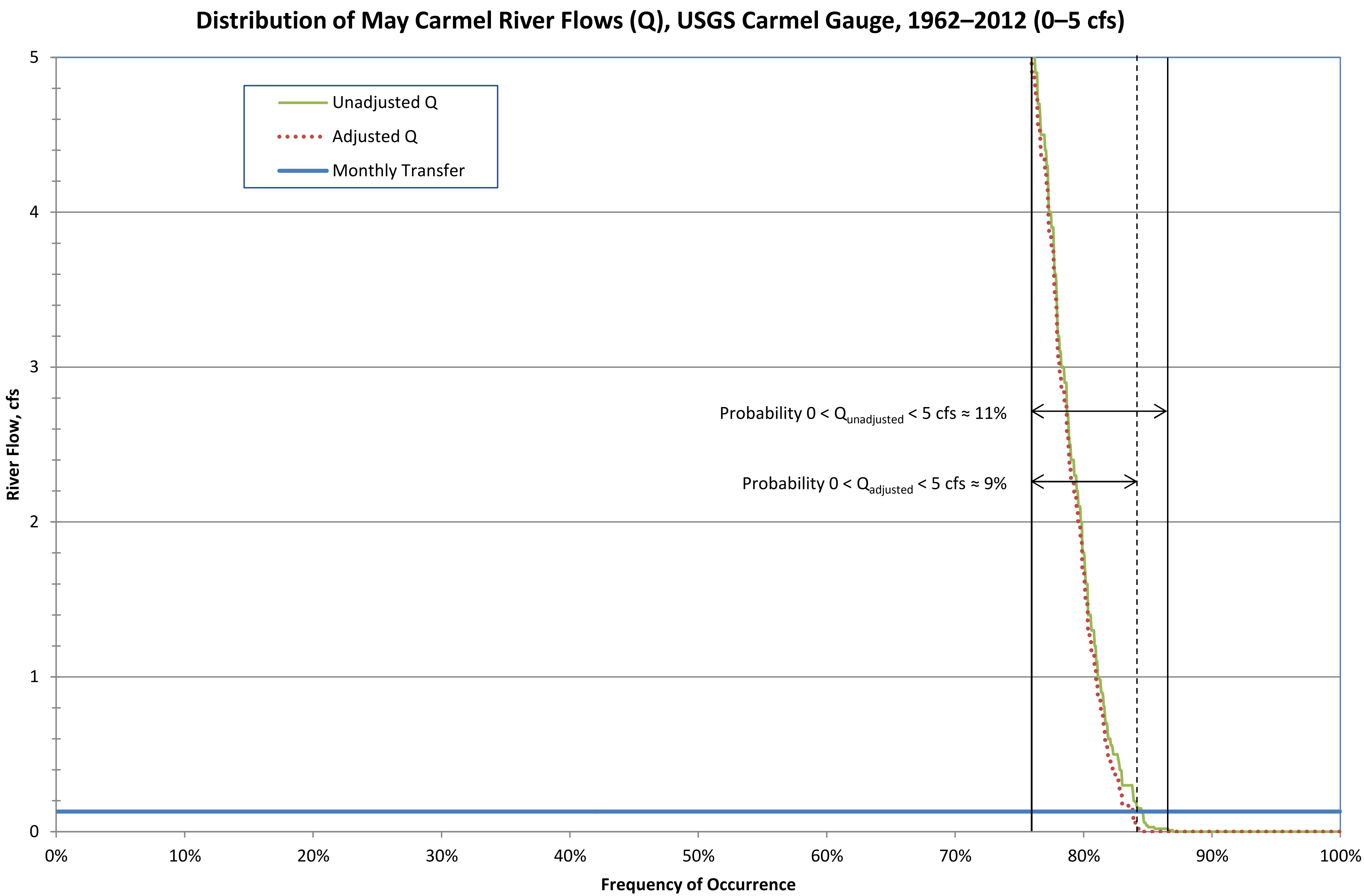
Distribution of April Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
Unadjusted Q
Adjusted Q
Monthly Transfer
River Flow, cfs
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence



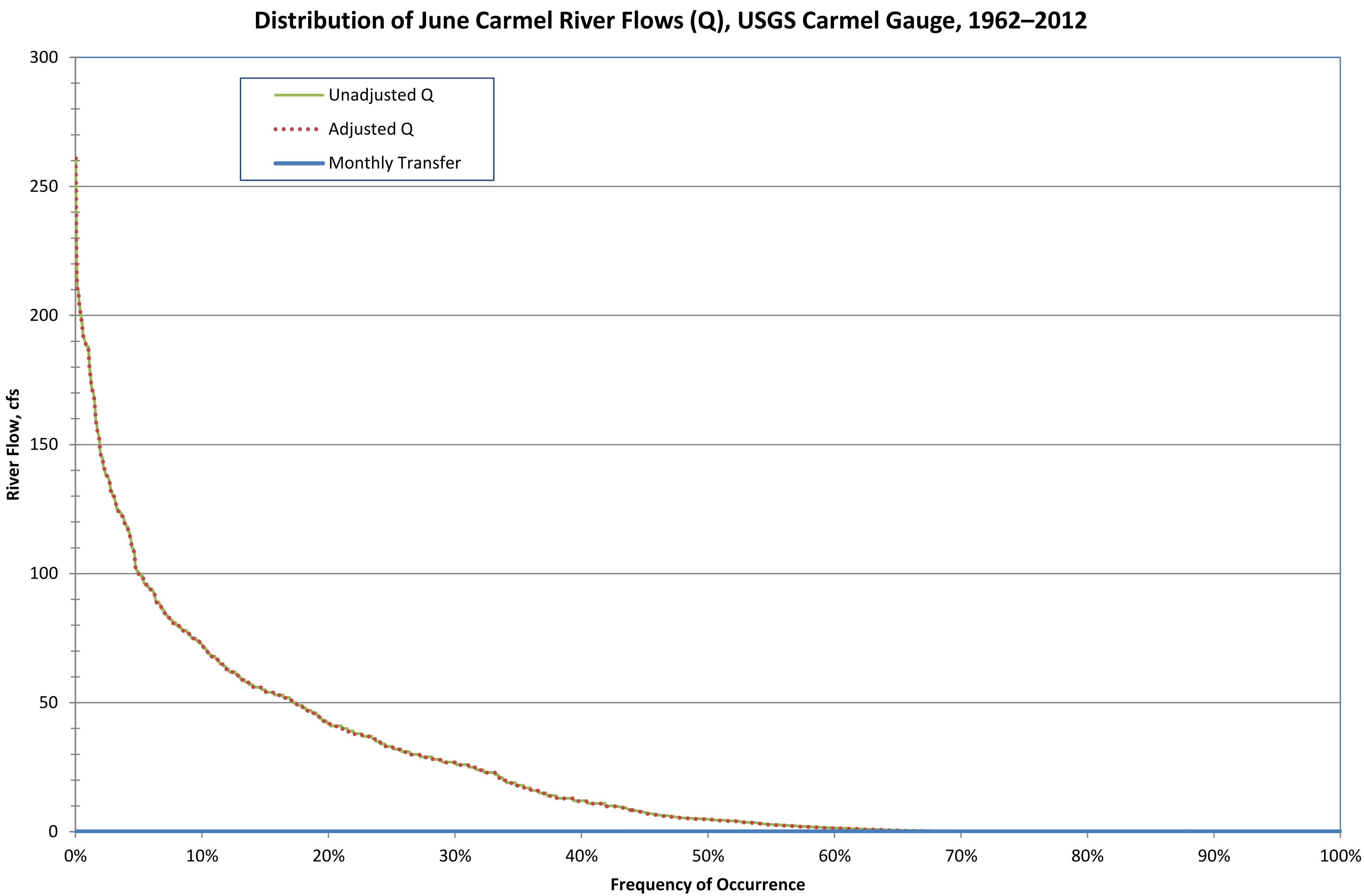
Distribution of April Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < Q_unadjusted < 5 cfs ≈ 5%
Probability 0 < Q_adjusted < 5 cfs ≈ 5%
River Flow, cfs
Frequency of Occurrence
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%



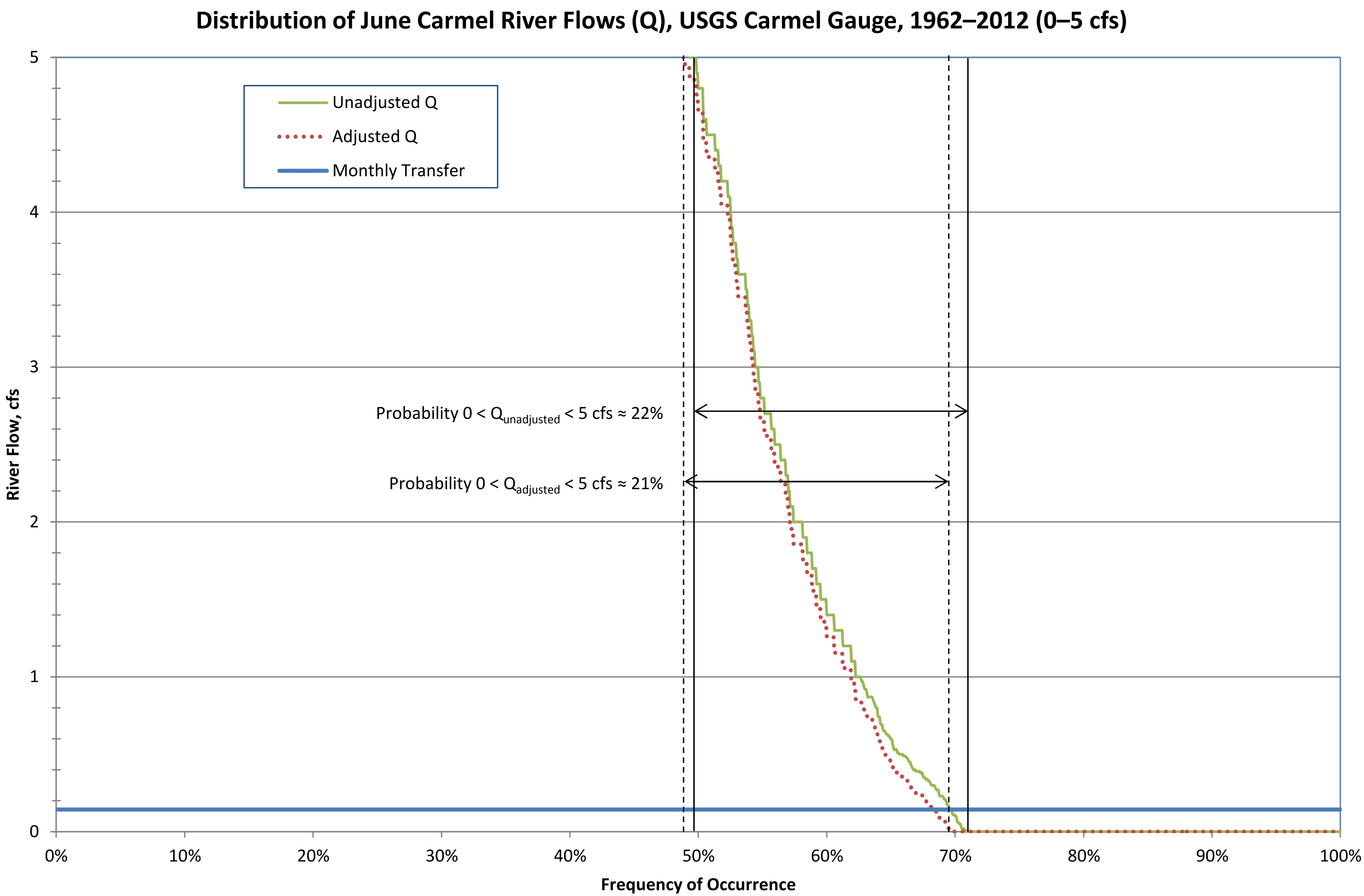
Distribution of May Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
Unadjusted Q
Adjusted Q
Monthly Transfer
River Flow, cfs
1,400
1,200
1,000
800
600
400
200
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence



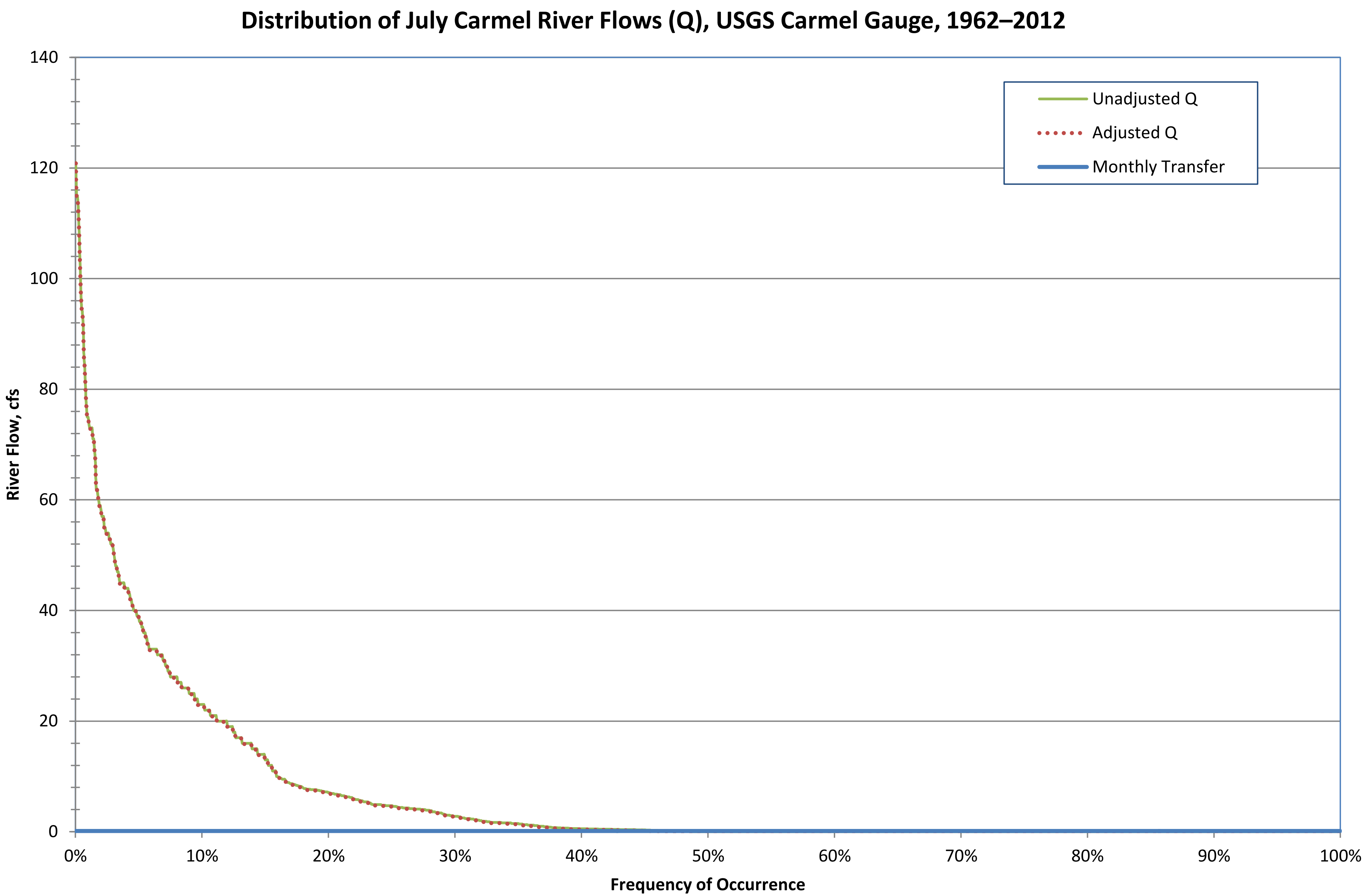
Distribution of May Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < Q_unadjusted < 5 cfs ≈ 11%
Probability 0 < Q_adjusted < 5 cfs ≈ 9%
River Flow, cfs
5
4
3
2
1
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence

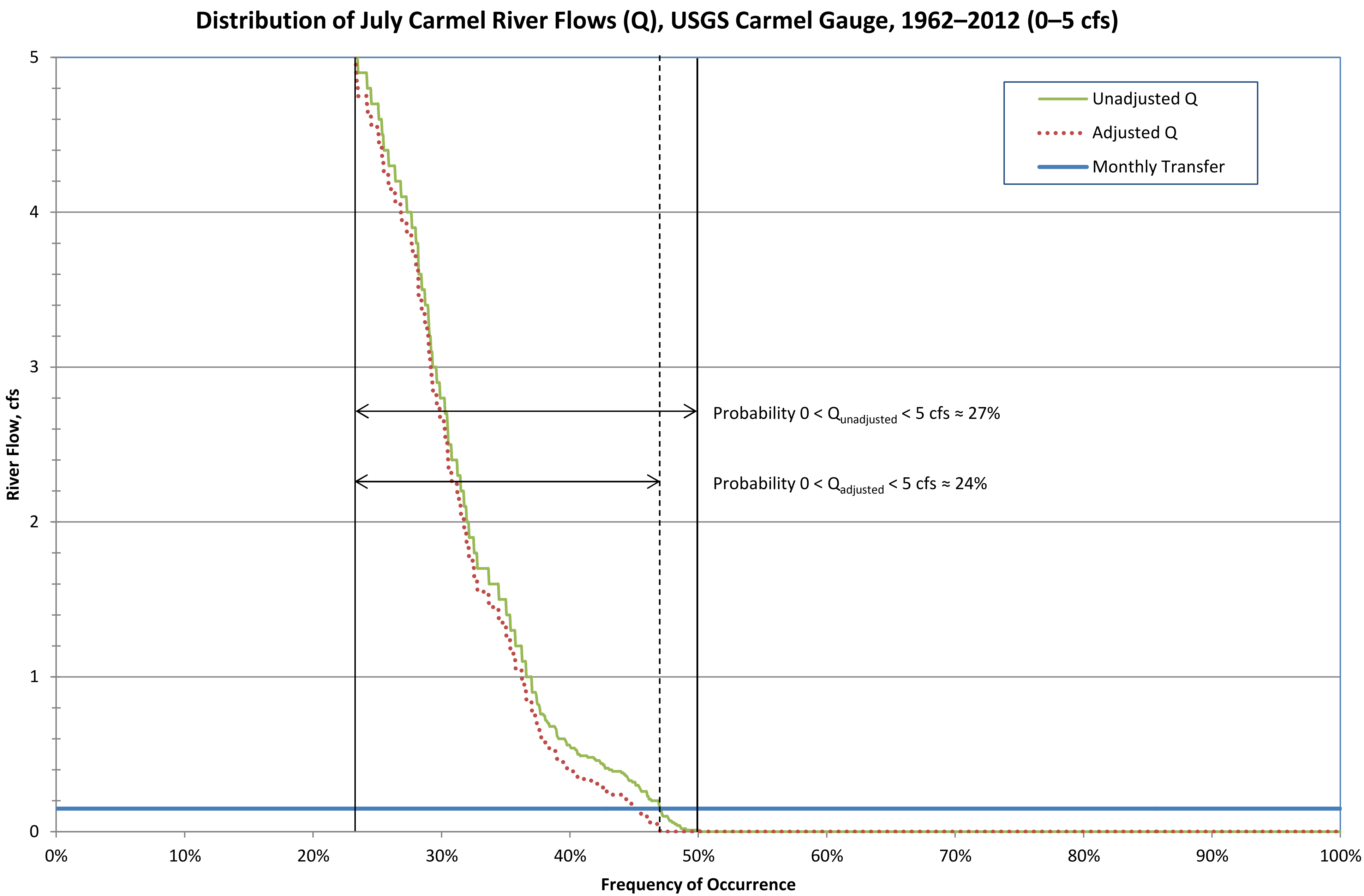


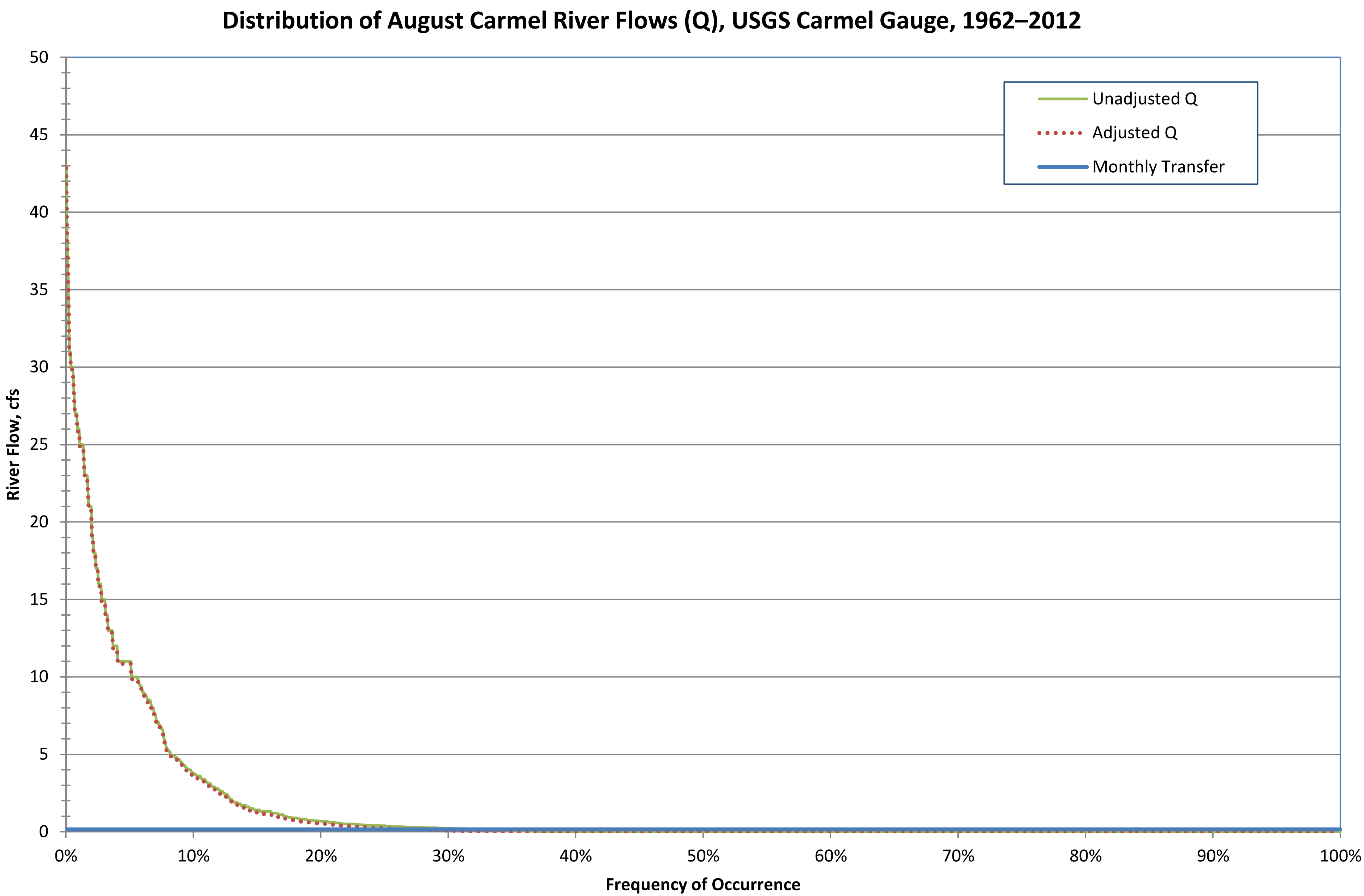
Distribution of June Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
Unadjusted Q
Adjusted Q
Monthly Transfer
River Flow, cfs
300
250
200
150
100
50
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence



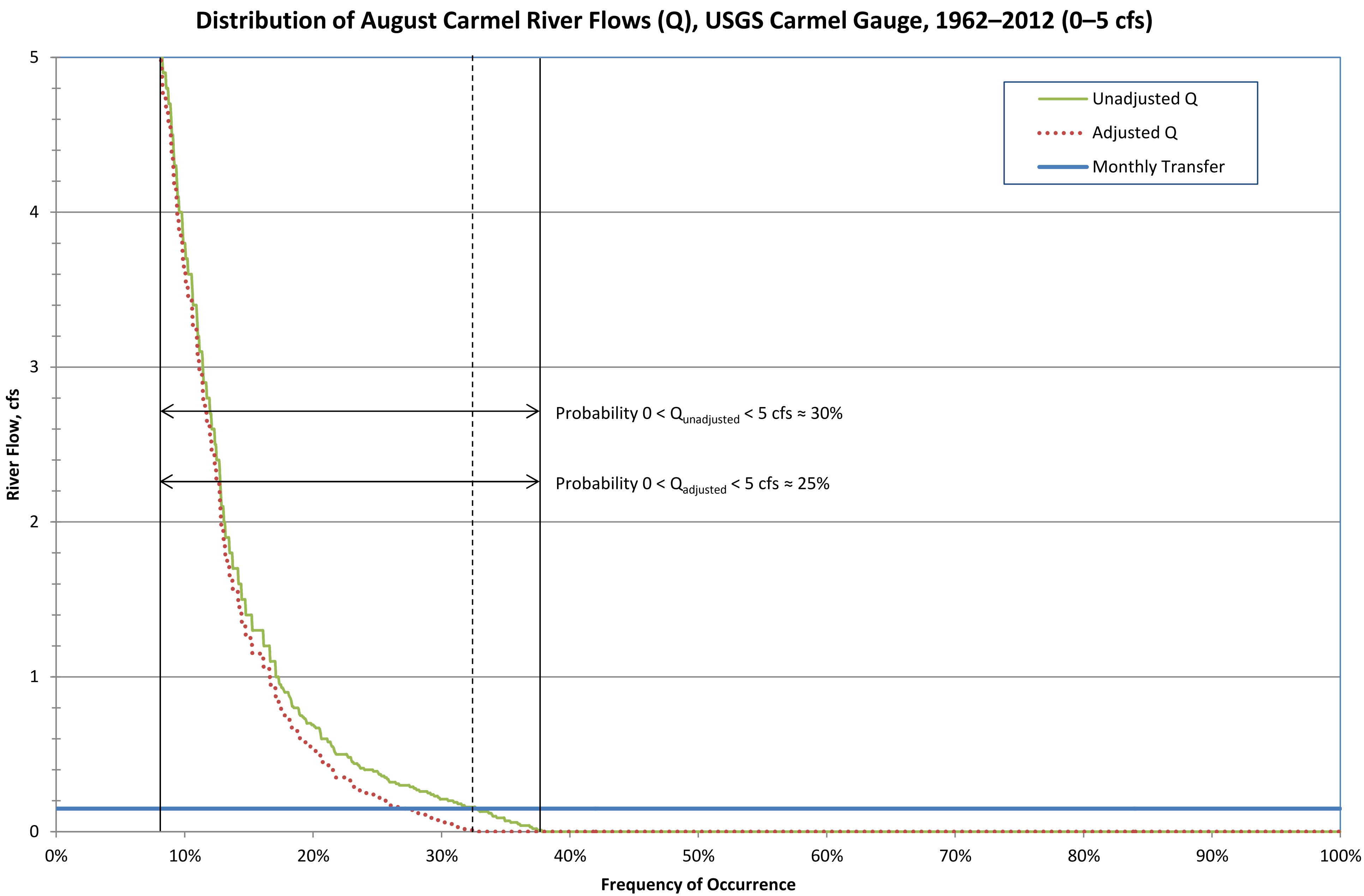
Distribution of June Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < $Q_{unadjusted}$ < 5 cfs ≈ 22%
Probability 0 < $Q_{adjusted}$ < 5 cfs ≈ 21%
River Flow, cfs
Frequency of Occurrence
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


Distribution of July Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
River Flow, cfs
Frequency of Occurrence
0
20
40
60
80
100
120
140
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Unadjusted Q
Adjusted Q
Monthly Transfer

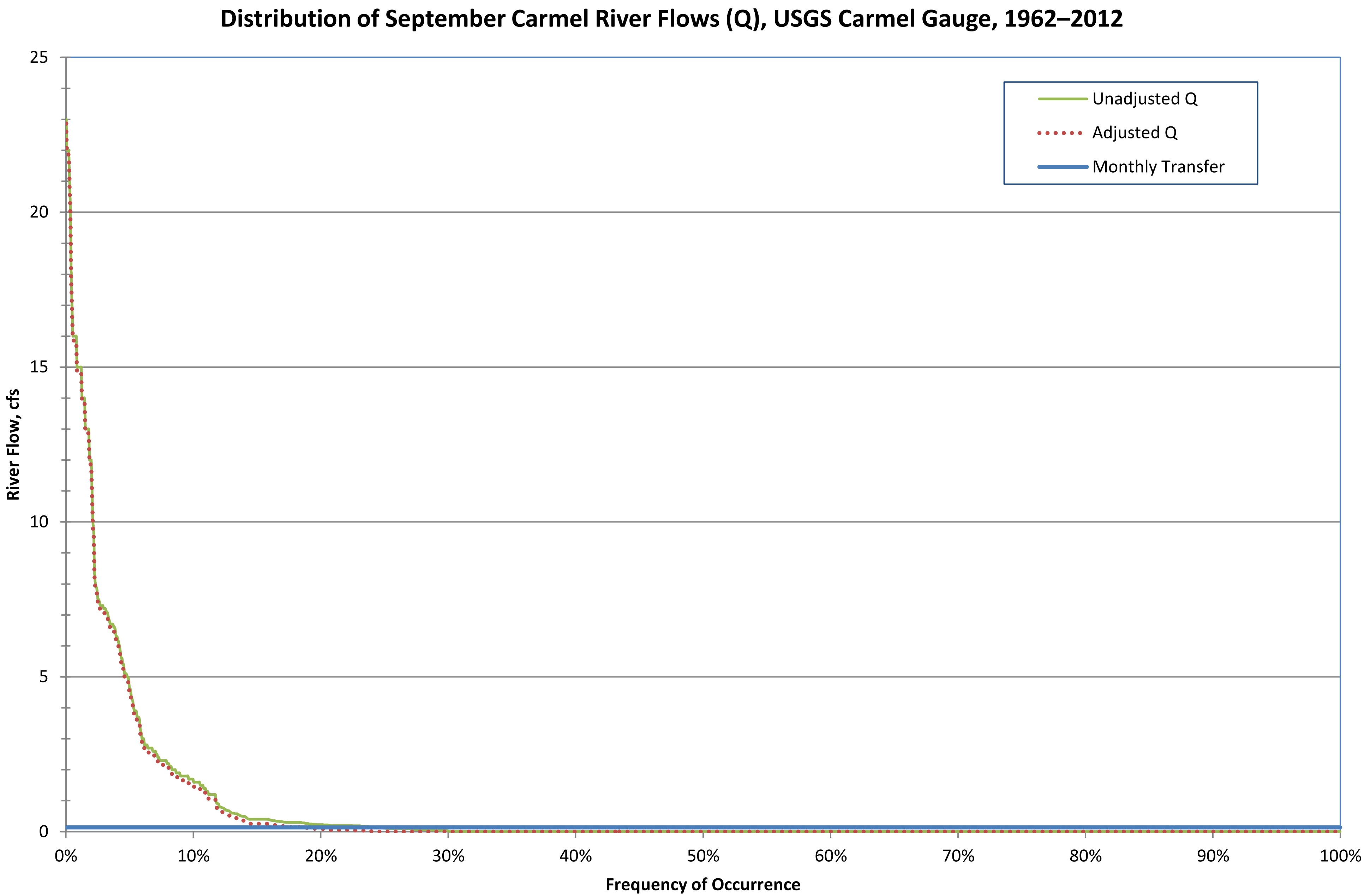

Distribution of July Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
River Flow, cfs
Frequency of Occurrence
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < Q_unadjusted < 5 cfs ≈ 27%
Probability 0 < Q_adjusted < 5 cfs ≈ 24%
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

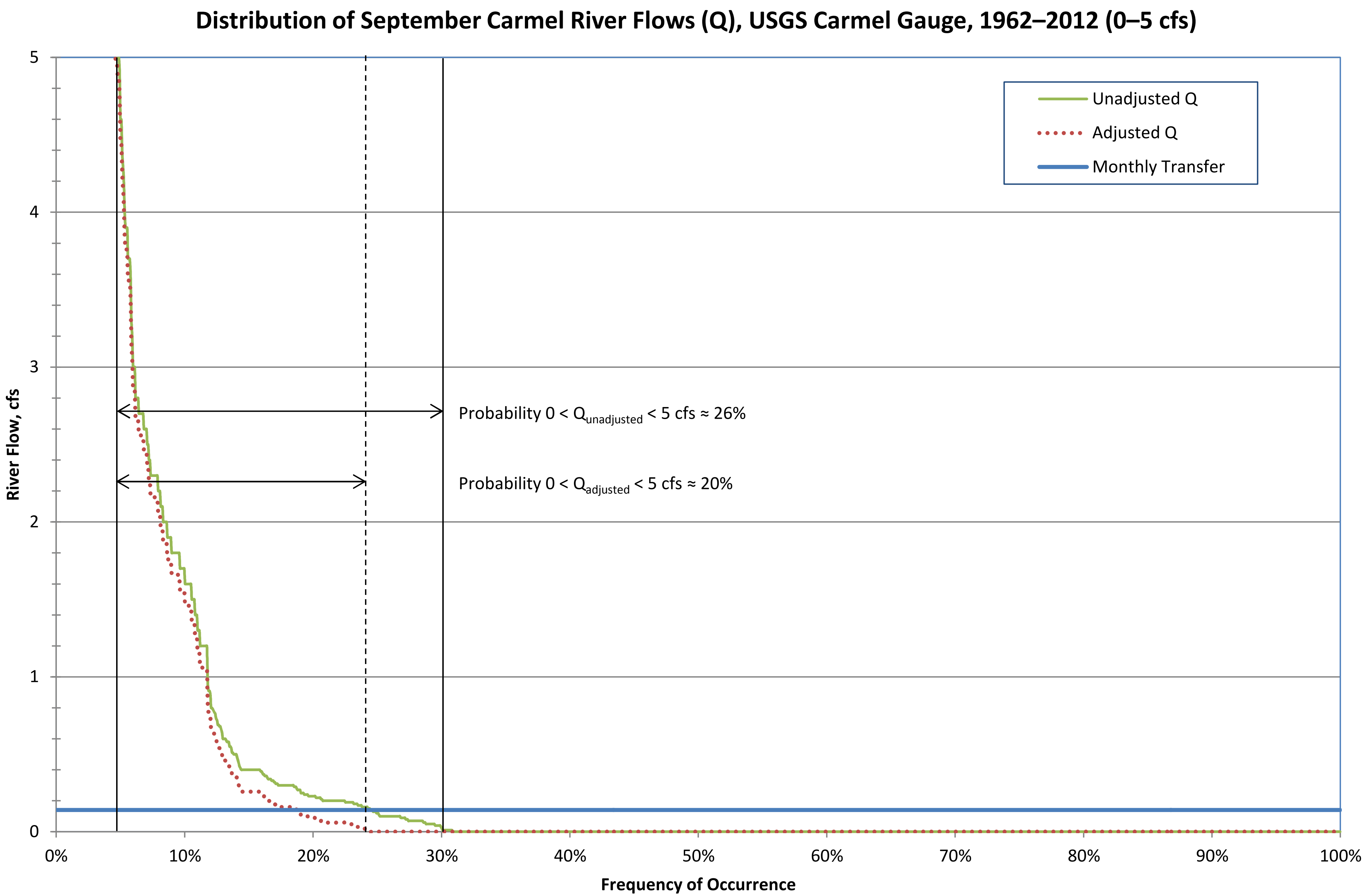


Distribution of August Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
River Flow, cfs
Frequency of Occurrence
Unadjusted Q
Adjusted Q
Monthly Transfer
0
5
10
15
20
25
30
35
40
45
50
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

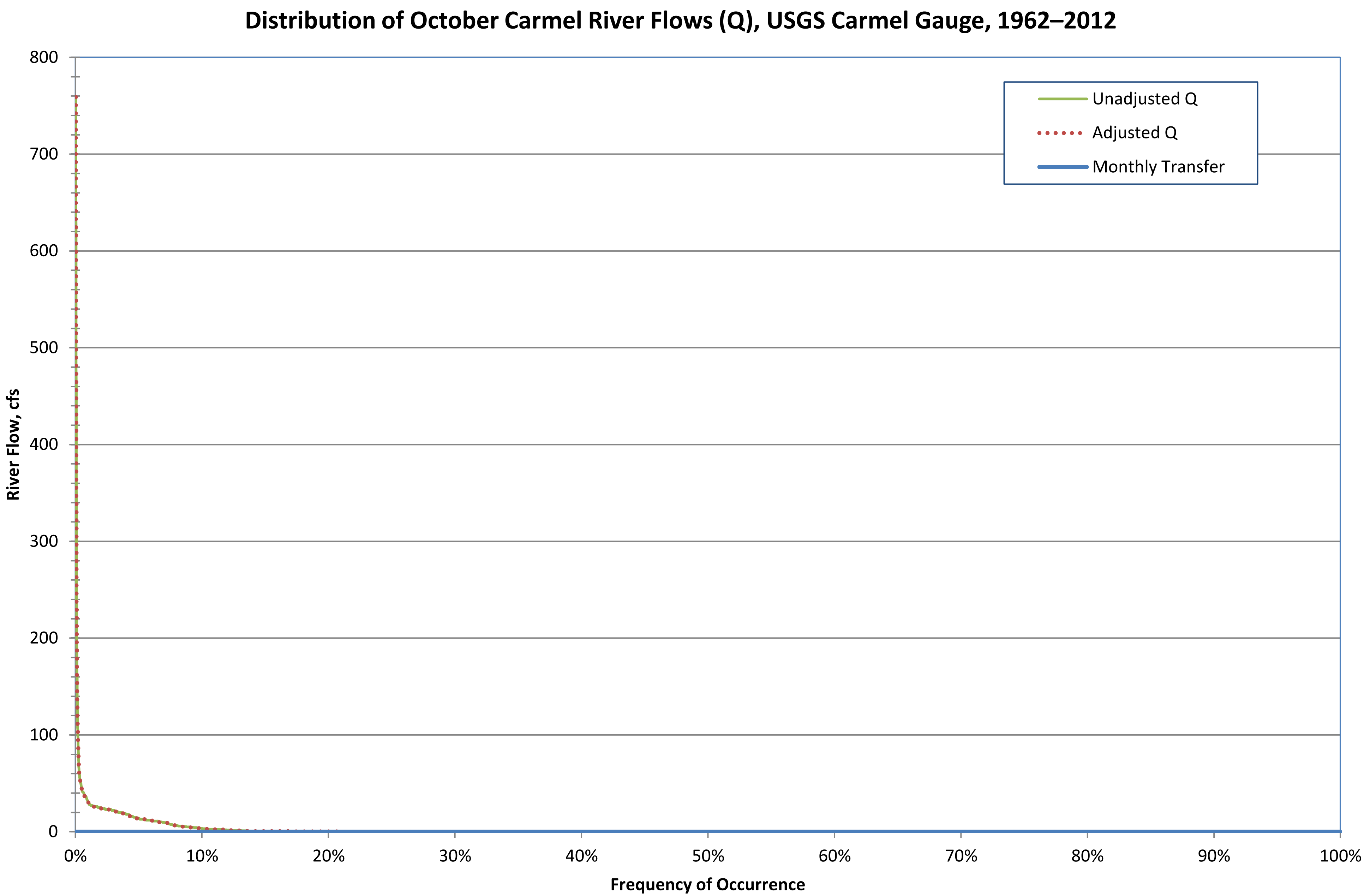


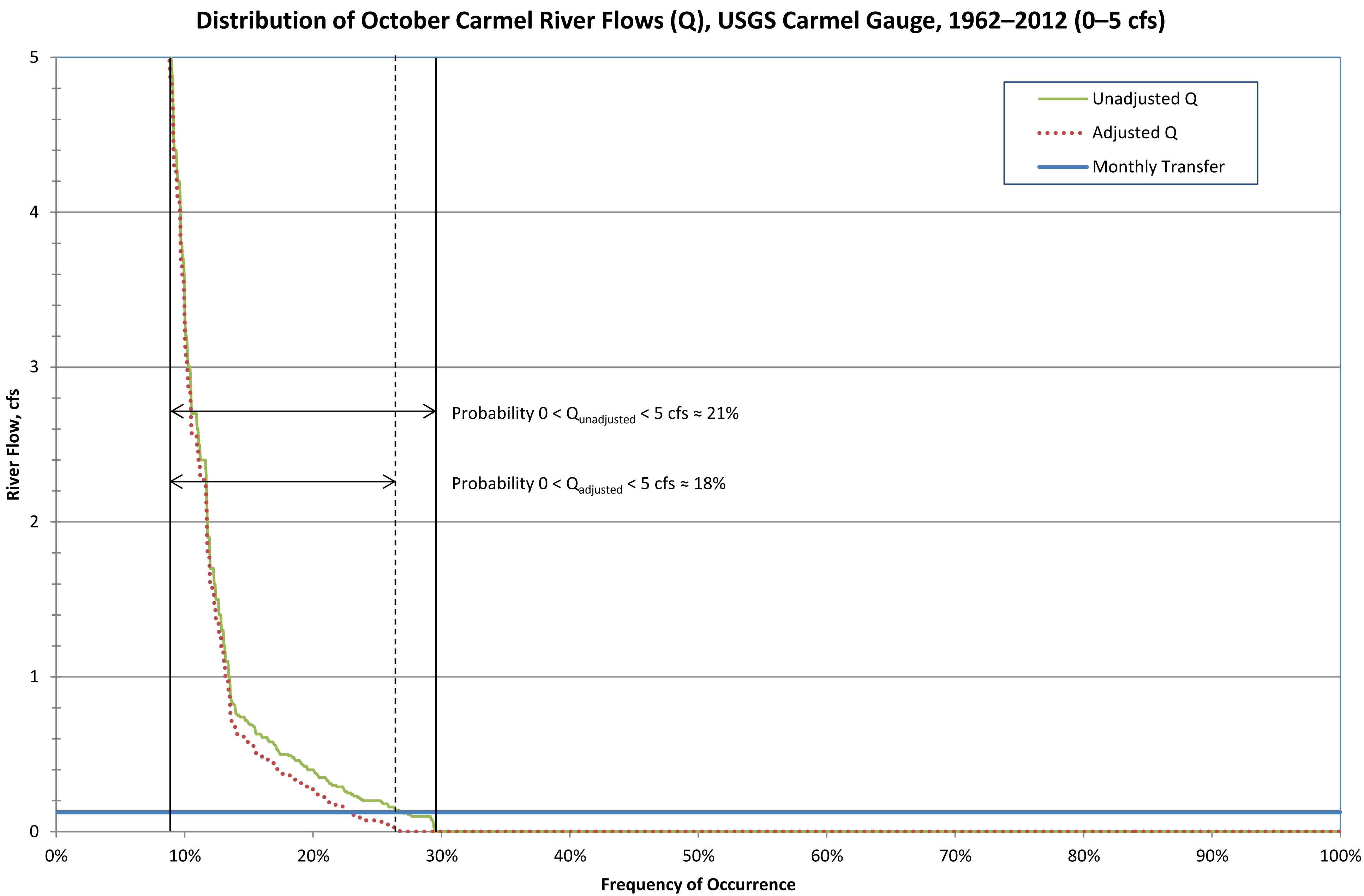
Distribution of August Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < Q_unadjusted < 5 cfs ≈ 30%
Probability 0 < Q_adjusted < 5 cfs ≈ 25%
River Flow, cfs
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence

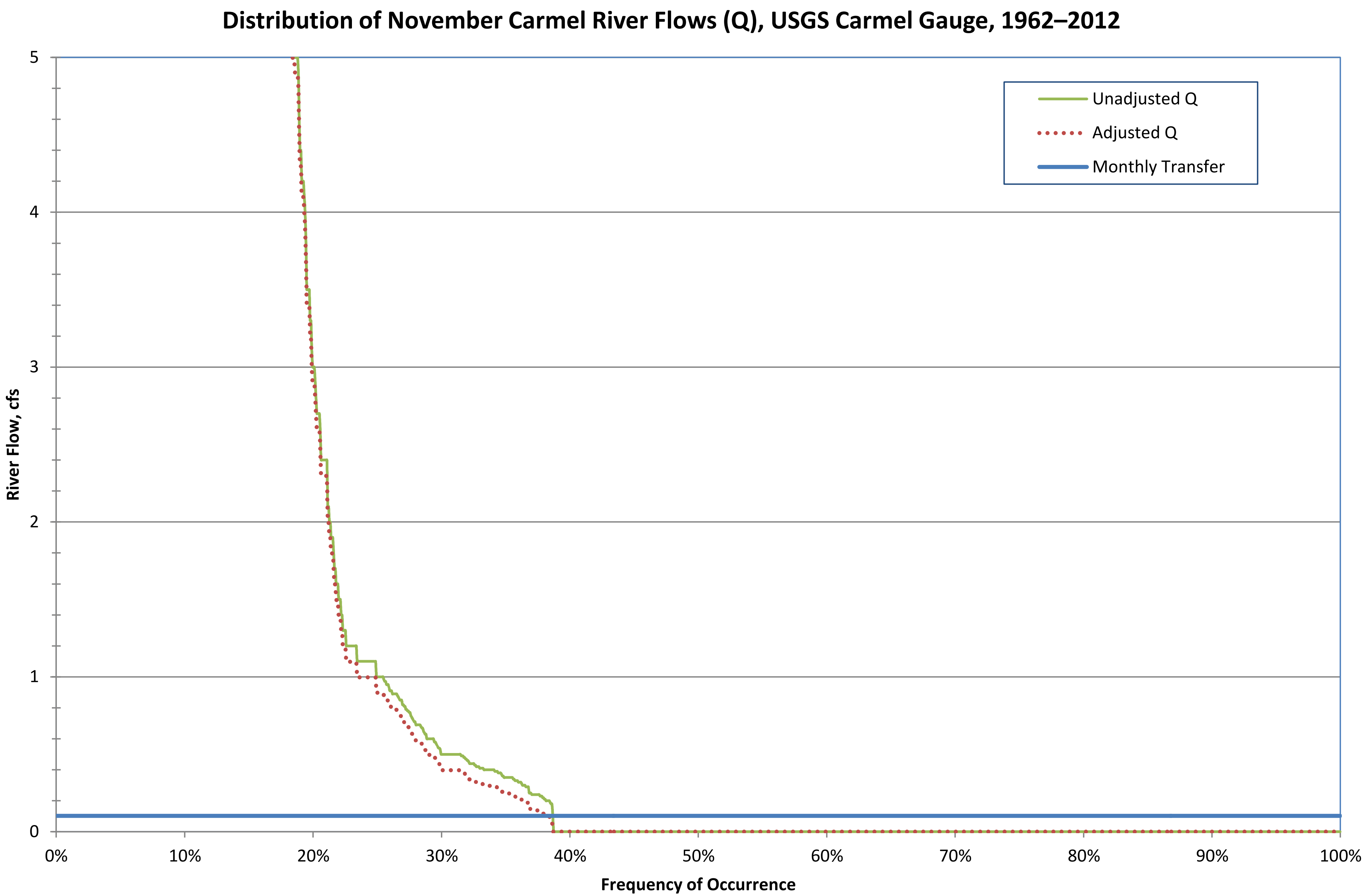

Distribution of September Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
River Flow, cfs
Frequency of Occurrence
Unadjusted Q
Adjusted Q
Monthly Transfer
0
5
10
15
20
25
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

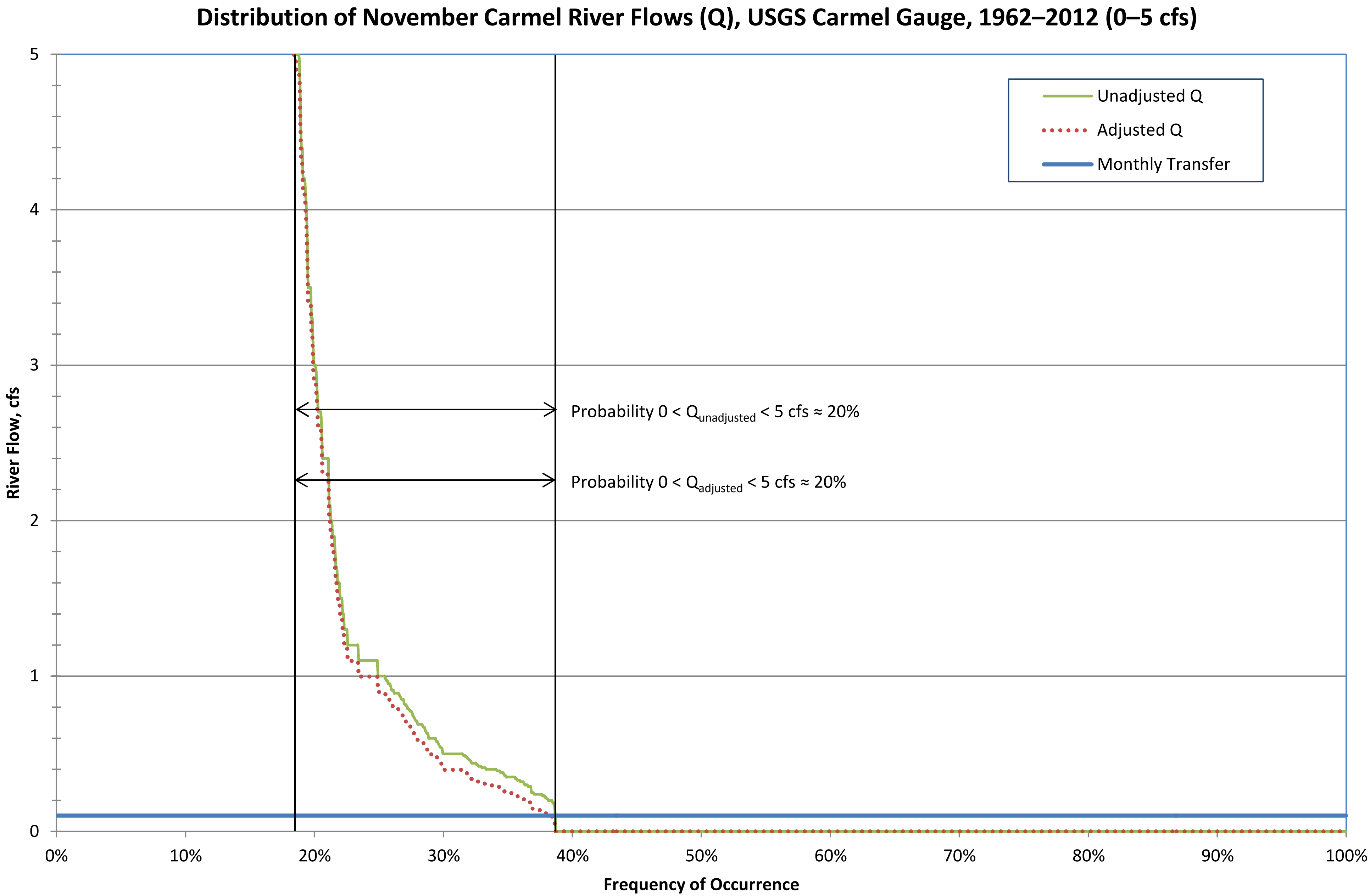


Distribution of September Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < Q_unadjusted < 5 cfs ≈ 26%
Probability 0 < Q_adjusted < 5 cfs ≈ 20%
River Flow, cfs
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence

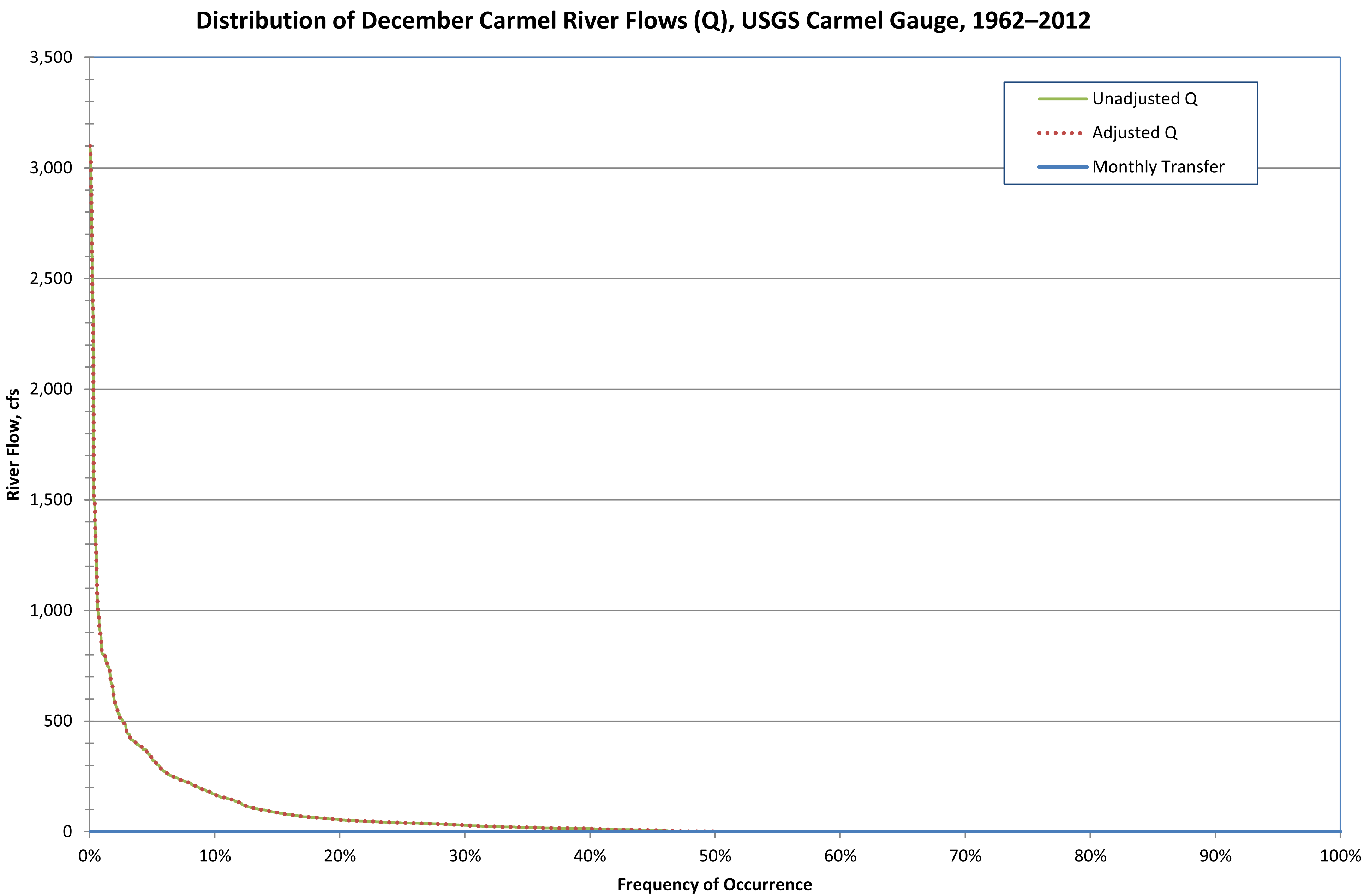

Distribution of October Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
800
700
600
500
400
300
200
100
0
River Flow, cfs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence
Unadjusted Q
Adjusted Q
Monthly Transfer

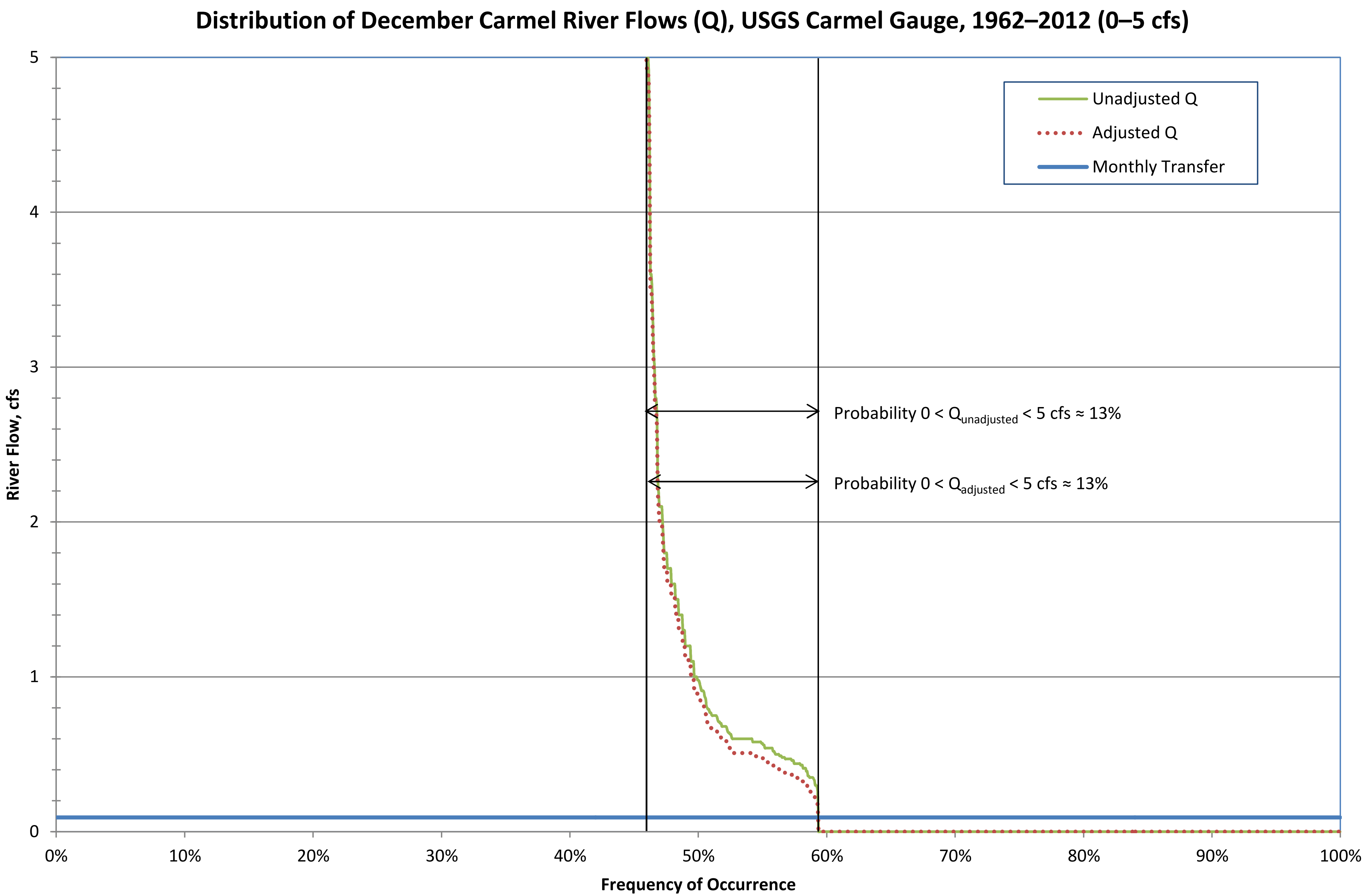

Distribution of October Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
River Flow, cfs
Frequency of Occurrence
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < Q unadjusted < 5 cfs ≈ 21%
Probability 0 < Q adjusted < 5 cfs ≈ 18%
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


Distribution of November Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
River Flow, cfs
Frequency of Occurrence
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Unadjusted Q
Adjusted Q
Monthly Transfer



Distribution of November Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < $Q_{unadjusted}$ < 5 cfs ≈ 20%
Probability 0 < $Q_{adjusted}$ < 5 cfs ≈ 20%
River Flow, cfs
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence


Distribution of December Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012
River Flow, cfs
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Frequency of Occurrence
Unadjusted Q
Adjusted Q
Monthly Transfer



Distribution of December Carmel River Flows (Q), USGS Carmel Gauge, 1962–2012 (0–5 cfs)
River Flow, cfs
Frequency of Occurrence
0
1
2
3
4
5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Unadjusted Q
Adjusted Q
Monthly Transfer
Probability 0 < $Q_{unadjusted}$ < 5 cfs ≈ 13%
Probability 0 < $Q_{adjusted}$ < 5 cfs ≈ 13%