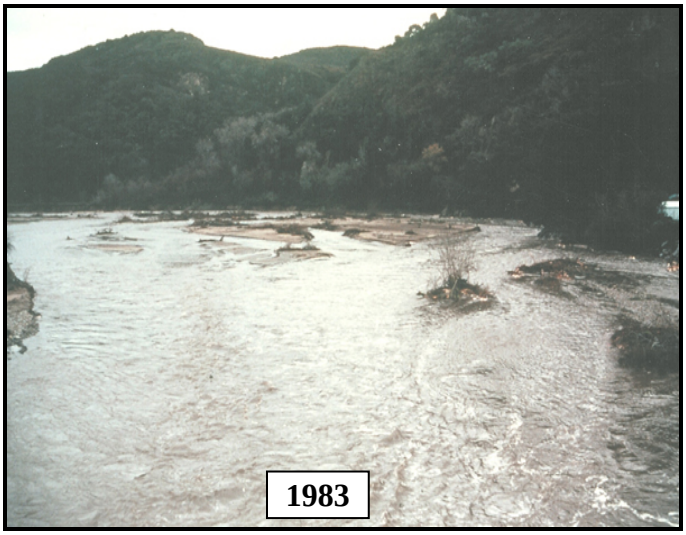
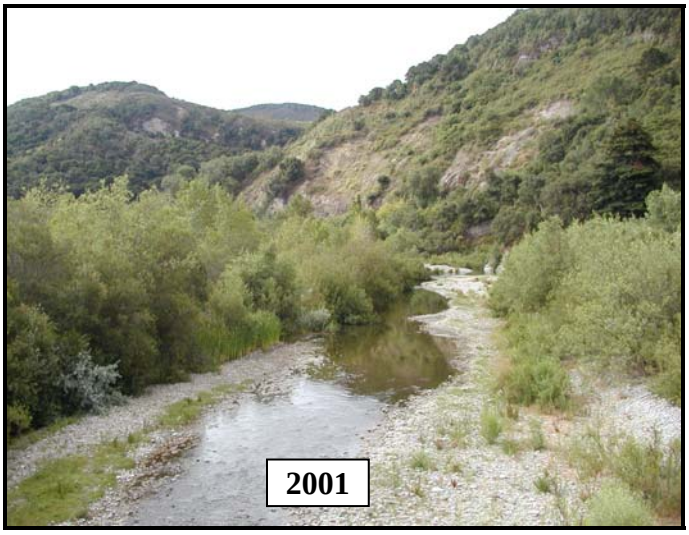
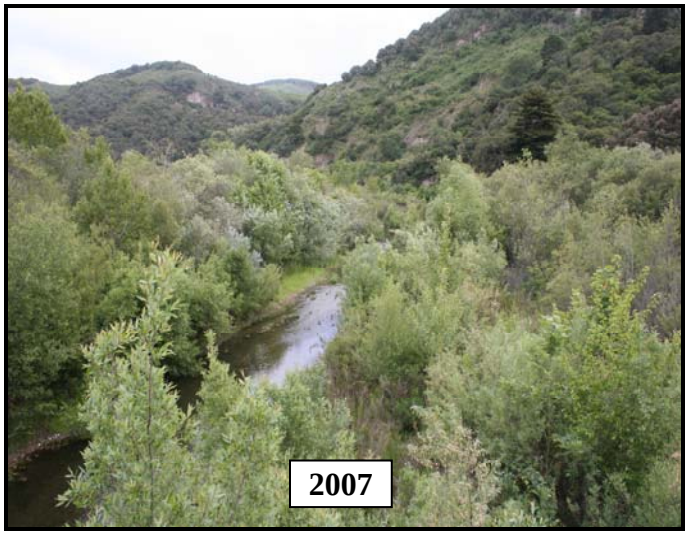
# 2007 CARMEL RIVER SURVEYS








**Views Upstream Schulte Road Bridge**

Prepared for:

**Monterey Peninsula Water Management District**
**P.O. Box 85**
**Monterey, CA 93942**

Prepared by:

**Graham Matthews & Associates**
**P.O. Box 1516**
**Weaverville, CA 96093**

**February 2008**

# ACKNOWLEDGEMENTS

Graham Matthews & Associates
Graham Matthews – Principal Investigator, Project Manager
Smokey Pittman – Senior Geomorphologist
Keith Barnard – Survey Manager
Logan Cornelius – Survey Technician II

Central Coast Surveyors:
Dave Edson, L.S.

The Gracious Landowners Who Allowed Us to Survey on Their Land:
Hacienda Carmel
Rancho Canada
Quail Lodge
Monterey Peninsula Regional Park District

MPWMD (Client):
Larry Hampson
Thomas Christiansen

# 2007 CARMEL RIVER SURVEYS
## TABLE OF CONTENTS



### LIST OF FIGURES



### APPENDICES

# 2007 CARMEL RIVER SURVEYS

## INTRODUCTION

Graham Matthews & Associates (GMA) was retained by the Monterey Peninsula Water Management District (MPWMD) to collect longitudinal thalweg (the deepest continuous line) profile data and limited cross section data from the Carmel River for use in maintaining a long-term record and comparing to the past and future data.

## SCOPE

The scope of the project included the following tasks:

1. Survey the thalweg profile from the mouth upstream to the Robinson Canyon Bridge and in the Carmel Valley Village reach
2. Survey cross sections at the main bridges passed during the profile survey
3. Tie surveys into existing (from 1995) and/or new permanent benchmarks established by Central Coast Surveyors (CCS)
4. Compare 2007 surveys with previous longitudinal profile and cross section data as available

## METHODS

Standard survey techniques were used in this project and primarily involved total station surveying equipment. Topcon GTS-802 and APL-1A robotic total stations were used for the bulk of the thalweg and cross section surveys but using conventional two-person methods. Native riparian vegetation has encroached into the stream corridor in much of the channel rendering robotic or GPS one-person surveying impractical.

The initial total station setup and backsight used benchmarks (GPS1 and GPS2) that had been established on the Via Mallorca Bridge by CCS in 1995 to get on the NAD83 California State Plane Zone 4 horizontal and NAVD88 vertical coordinate system. From there, temporary control points were established in the stream corridor and the survey crew traversed downstream, averaging approximately 300' between turning points because of the dense vegetation and meandering channel. Thalweg shots were surveyed at each slope break to define riffle crests, pools, etc and at least every 50' where the profile was relatively flat. For the sake of efficiency, very little vegetation was cleared or trimmed during the surveys, and crews instead opted to set new turning points and/or use offset methods to project points horizontally and vertically into areas that were either inaccessible or not visible to the total station. The survey progressed downstream until reaching the pipeline crossing to the Carmel Area Wastewater District treatment plant. After completing the downstream reach, crews next surveyed upstream from Via Mallorca to the Robinson Canyon Bridge. Surveys were completed in October-November 2007.

The final reach surveyed was between the Boronda and Esquiline Bridges near the Carmel Valley Little League Baseball Park. Since no known control points were found at this site, the survey crew set a 5/8" rebar near the parking lot and set up a Trimble 4700 GPS base station over it for a real time kinematic (RTK) survey. The resulting four hour file was emailed to the National Geodetic Survey's OPUS website and they provided GMA with their coordinate solution for the point. Two RTK rover units were used to generate most of the thalweg points except in areas where riparian vegetation obscured the view of satellites. The total station was used conventionally to provide those data. To verify the OPUS generated elevation, an existing NGS benchmark along Carmel Valley Road was surveyed with the RTK rover.

At each major bridge crossing along those reaches where the profile was surveyed, a cross section was also surveyed along the upstream and downstream face of the bridge. The surveys extended from the top of the left bank to the top of the right bank. No effort was spent trying to locate old cross section benchmarks or to set new ones. Most of the bridges and their respective cross sections are more or less oriented perpendicular to the stream channel but in the case of the Robinson Canyon Bridge, the cross section did not follow the bridge face since the bridge orientation is skewed.

In 1995, CCS, under contract to MPWMD, established two control points at each of six bridges over the Carmel River. During the present survey, GMA survey crews tied into those benchmarks that they could locate in order to check in and correct their positions, if necessary. The Via Mallorca points were intact but one had been disturbed, perhaps by a Hacienda Carmel crew or contractor during sidewalk reconstruction for handicapped access. We shot to an NGS benchmark on the new Highway 1 Bridge with a published elevation (estimated horizontal coordinates). Next, when surveying upstream from Via Mallorca, the crew attempted to locate 1995 control points associated with Valley Greens Bridge but only found drill holes and brass plugs where the caps had been. At the next bridge upstream (Schulte Road), the 1995 benchmarks were intact but buried under gravel alongside the road. GMA did not survey past any of the other three bridges (Don Juan, Boronda, or Rosie's) with 1995 control.

During the last week on the ground (11/12-11/16/07), GMA coordinated with Central Coast Surveyors to have them set eight new control points: two at the most downstream golf cart bridge (#5) in the Rancho Canada Golf Course; two at the Rancho San Carlos Bridge; two at the Robinson Canyon Bridge; and replace the two missing caps at the Valley Greens Bridge. Since the GMA thalweg survey had passed these bridges before the new control was set, CCS surveyed to and established coordinates for six of the temporary points GMA had set in the riverbed during our traverse, which saved us substantial time, allowing us to correct our total station survey without having to reoccupy these points. The ability to check into and adjust our total station survey to known benchmarks spread along the way was invaluable and necessary due to the large number of instrument set-ups. Where the total station derived coordinates differed from the CCS GPS coordinates, adjustments were made by dividing the difference evenly by the number of turns and applying those corrections to the control points.

Total station surveys were recorded into Husky data collectors and downloaded into AutoCAD Land Desktop Development 2007 software. The resulting electronic fieldbook

(.fbk) files were separated into control and topographic point files. Control points were adjusted where necessary to agree with CCS established control at six bridges and NGS control at the Highway 1 Bridge and then the topographic .fbk files were imported.

Once the points were in AutoCAD, the next step in generating a thalweg profile was to determine the stationing of each point along the river channel. Since the thalweg changes course frequently within the active channel, the length also changes accordingly and makes comparison of the thalweg profile over time challenging. The best method is to establish a line up the river channel, such as a channel centerline, and conform the profile stationing to that. The MPWMD hand drew a centerline based on 1986 aerial photos and set river mile stationing on that beginning at the mouth of the Carmel River and proceeding upstream. Prior thalweg profiles by GMA in 1999 and 2001 used the stationing of the bridges from that effort and adjusted surveyed points to fit that stationing between bridges. For the present effort, GMA reconstructed a "centerline" using a 2005 National Agriculture Imagery Program (NAIP) ortho photo and then "adjusted" it as necessary by shortening or lengthening curves, etc., to match the stationing generated from the 1986 photo at the bridge locations.

Once in AutoCAD, the centerline was defined as an alignment and the thalweg points were assigned stationing by projecting each point orthogonally to the centerline. Since this centerline alignment method is somewhat different than that used by GMA in 1999 and 2001, we needed to reestablish the point stationing for those surveys, so we re-imported those older surveys into AutoCAD and assigned new stationing to them. Unfortunately, we did not have access to the previous MPWMD and FIS survey data in real world coordinates so we used the stationing derived in the 2001 report, but it should be noted that the comparison is not as correct as that between the 1999, 2001 and the present data.

## RESULTS

Thalweg profile data were available in various reaches from 1978 (FIS), 1984, 1994, and 1997 from MPWMD, and 1999, 2001, and the present 2007 (Figure 1). Between the Highway 1 Bridge and Via Mallorca, the only comparison is between 1978 and 2007 and the change shows considerable degradation of 2' to 3' over time. The reach between Via Mallorca and San Carlos Bridge has been the most frequently sampled (Figure 2). Relatively little change was evident between 1978 and 1984, while by 1994, the streambed had downcut or incised appreciably (about 2' on average), the bed texture (based on the GMA staff observations and discussions with MPWMD staff) had changed as a result, with much more gravel present, and there was much greater definition of pools. However, in 1999, after major floods in 1995 and 1998 along with significant bank erosion in upstream reaches, the channel had aggraded back towards the 1978 and 1984 elevations, and in the case of a 1000-foot reach downstream of San Carlos Road, was substantially elevated above these levels. Between 1999 and 2001, the material deposited by the 1998 floods had moved out and downcutting continued through the 2007 survey to the same level or lower than the 1994 channel.

The only comparison from the data available to GMA between San Carlos Bridge and Valley Greens Drive Bridge is between 1984 and 2007 and shows general downcutting of approximately 2' until the profiles converge around Valley Greens Drive.

The reach upstream of the Schulte Road Bridge has been surveyed numerous times, including by GMA in 1999. Only data from 1997 and 1999 were available at the time this report was prepared and comparison between these surveys with the 2007 survey shows some, although less, channel lowering than in the downstream, lower gradient reaches (Figure 3). Beginning about 5000 feet upstream of Schulte Road Bridge, there is almost no difference between the present 2007 profile and that surveyed by MPWMD in 1997. Of particular interest is the reforming of several deep pools at the bridge and a short distance upstream at the weel-known bedrock outcrop. These pools are about 7-9' deeper than that surveyed in 1999 when a relatively planar bed existed post 1998 flood and upstream bank erosion.

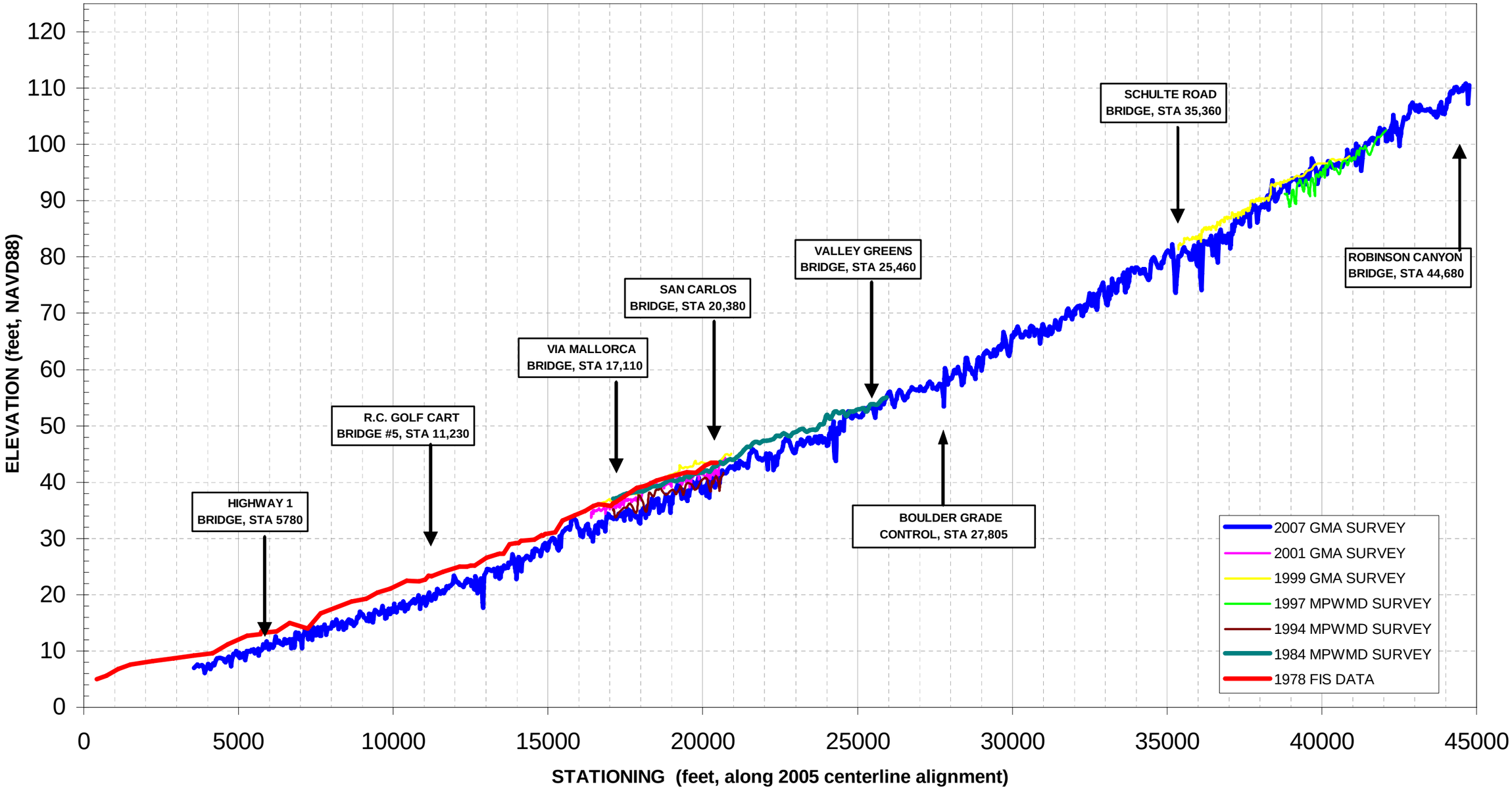
There were only three cross sections from 2001 that were comparable to those surveyed during the 2007 session. The 2001 cross sections 35 and 36 at the Via Mallorca Bridge were shifted to match the 2007 alignment and demonstrate between one and two feet of downcutting during that period, similar to that seen in the thalweg profile (Figure 4). At the San Carlos Bridge, cross section 3 from 2001 was approximately 15' downstream of the downstream face of the bridge. Similar downcutting is evident between 2001 and 2007.

## CONCLUSIONS

The present thalweg profile represents a good baseline for long-term monitoring of the lower 8 ½ miles of the Carmel River and appears to represent an incised, sediment-starved channel. The centerline developed from the 2005 aerial photos which matches the previous bridge stationing will provide a means of more accurately comparing future thalweg profiles with the present and recent past surveys. The effort fell short of the anticipated goal to carry the thalweg profile up to Klondike Creek, because of very difficult survey conditions. Surveys using RTK/GPS and/or robotic methods can be performed by one person and are therefore considerably more efficient, but the thick vegetative encroachment in and along the current channel of the Carmel River requires conventional two-person survey methods with extensive turning points (instrument set-ups) required. The establishment of new benchmarks and restoration of old benchmarks on all the major bridges in the lower section provides a good control network to assist in channel surveying for monitoring or restoration purposes using real world coordinates.

# CARMEL RIVER

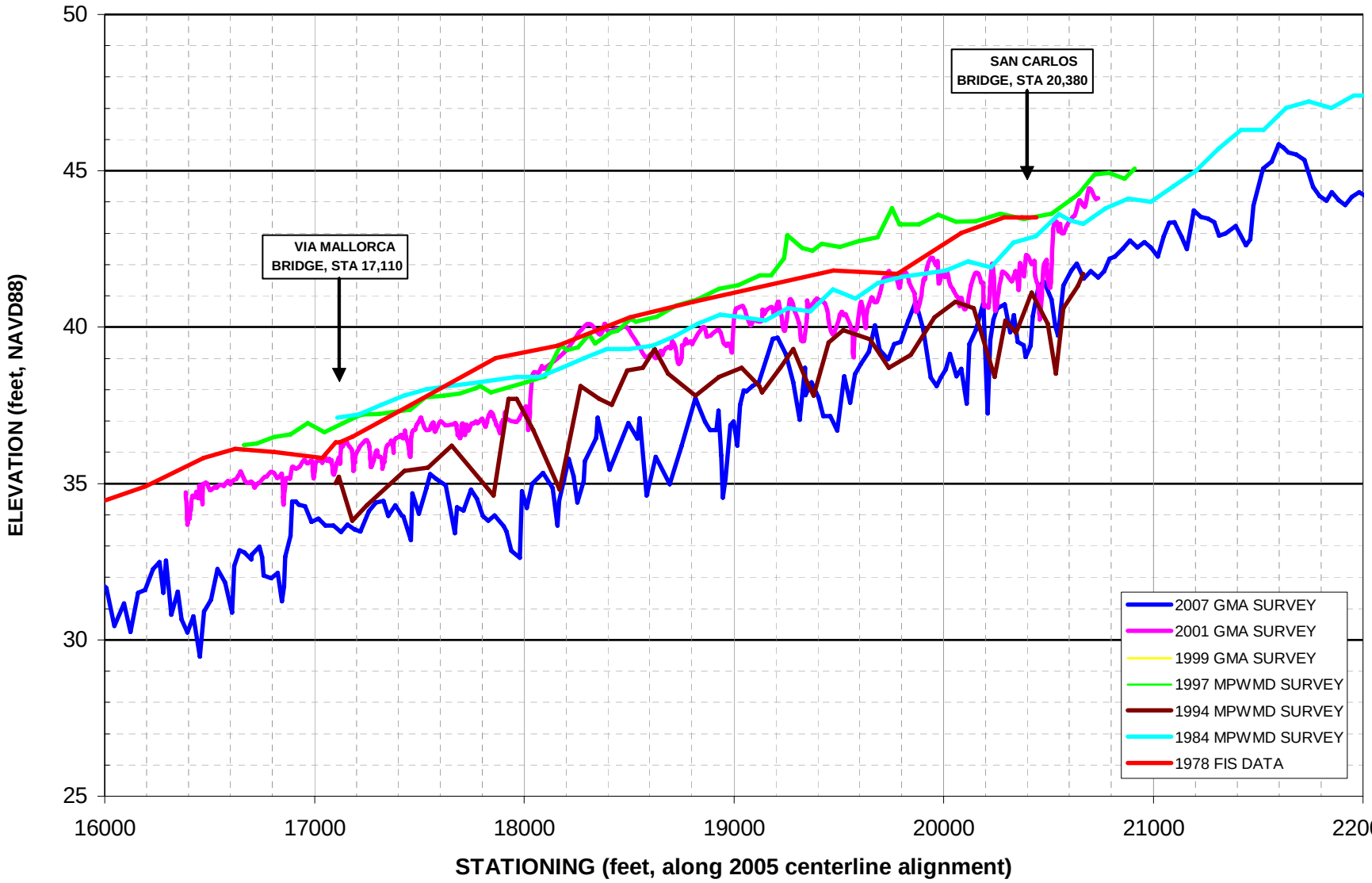
## Thalweg Profile from Mouth to Robinson Canyon Road, Various Surveys 1978-2007




| | | | |
|---|---|---|---|
| **2007 CARMEL RIVER PROFILE SURVEYS** | **MONTEREY PENINSULA WATER MANAGEMENT DISTRICT** | GMA<br>**GRAHAM MATTHEWS & ASSOCIATES**<br>Hydrology • Geomorphology • Stream Restoration<br>P.O. Box 1516 Weaverville, CA 96093-1516<br>(530) 623-0520 | **FIGURE**<br>**1** |

## CARMEL RIVER

Thalweg Profiles, Vicinity of Via Mallorca to San Carlos Road, 1978-2007




**MONTEREY PENINSULA WATER MANAGEMENT DISTRICT**

**2007 CARMEL RIVER PROFILE SURVEYS**


GMA

**GRAHAM MATTHEWS & ASSOCIATES**

Hydrology • Geomorphology • Stream Restoration

P.O. Box 1516 Weaverville, CA 96093-1516

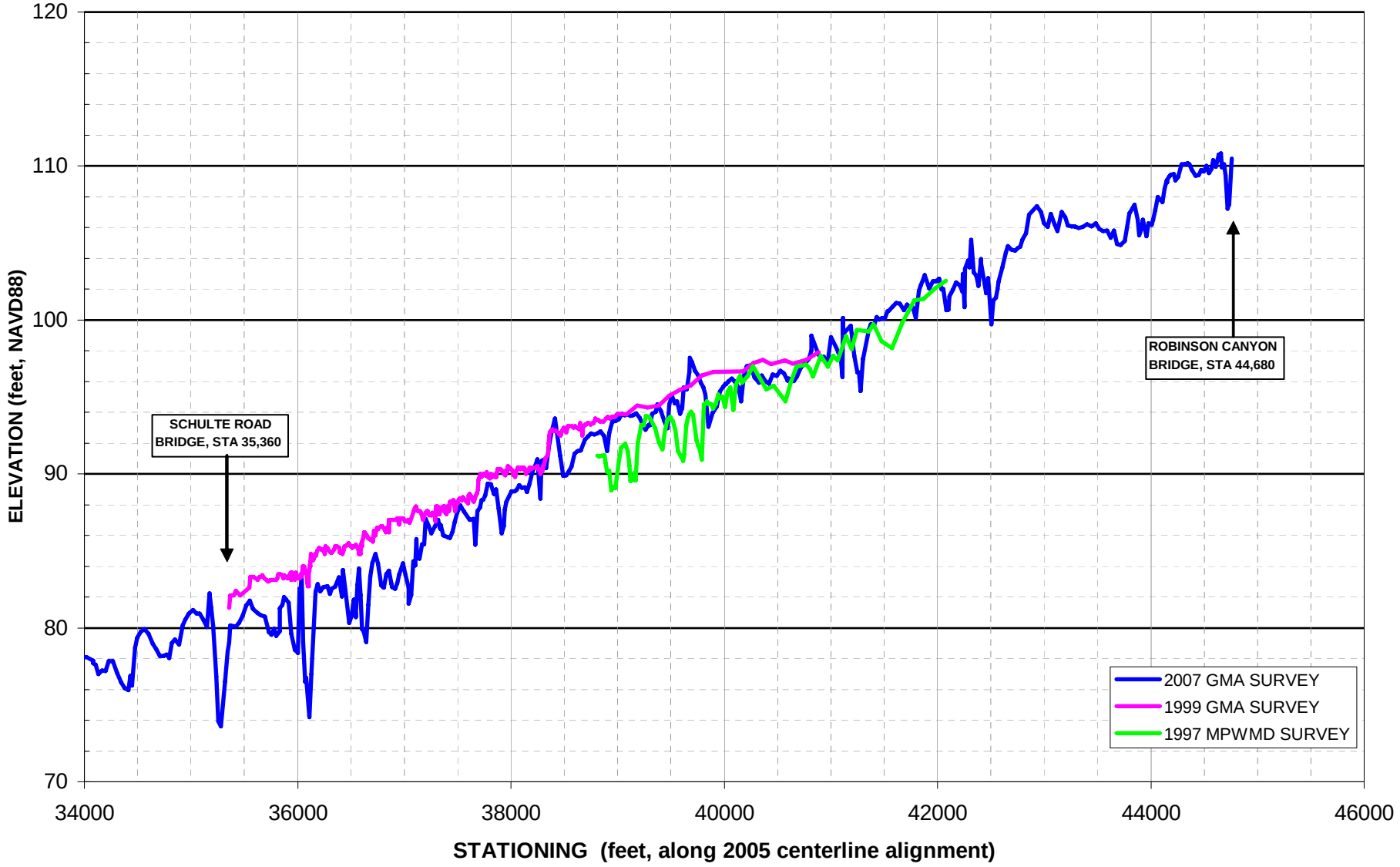
(530) 623-0520


**FIGURE**

**2**

## CARMEL RIVER

Thalweg Profile from below Schulte Road Bridge to Robinson Canyon Road Bridge, Various Surveys 1997-2007




**MONTEREY PENINSULA WATER MANAGEMENT DISTRICT**

**2007 CARMEL RIVER PROFILE SURVEYS**


GMA

**GRAHAM MATTHEWS & ASSOCIATES**

Hydrology • Geomorphology • Stream Restoration

P.O. Box 1516 Weaverville, CA 96093-1516

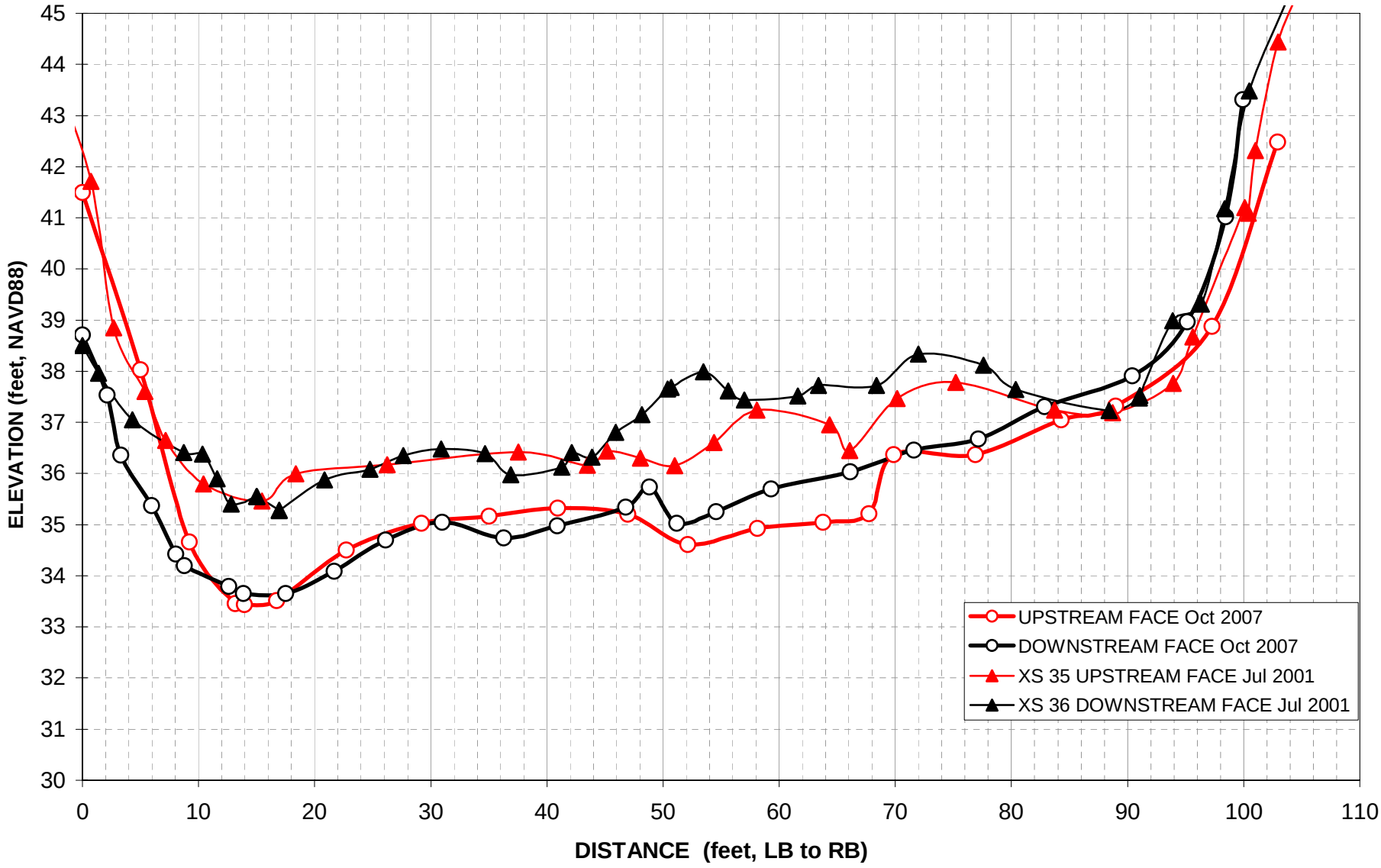
(530) 623-0520


**FIGURE**

**3**

## CARMEL RIVER

Cross Sections at Via Mallorca Bridge, 2001-2007




**MONTEREY PENINSULA WATER MANAGEMENT DISTRICT**

**2007 CARMEL RIVER PROFILE SURVEYS**


GMA

**GRAHAM MATTHEWS & ASSOCIATES**

Hydrology • Geomorphology • Stream Restoration

P.O. Box 1516 Weaverville, CA 96093-1516

(530) 623-0520


**FIGURE**

**4**

**APPENDIX A**

# SURVEY CONTROL POINTS
# ESTABLISHED WITH GPS METHODS

## LOWER CARMEL RIVER

PREPARED FOR

**GRAHAM MATTHEWS & ASSOCIATES**

**and**

**MONTEREY PENINSULA WATER MANAGEMENT DISTRICT**

By

**CENTRAL COAST SURVEYORS**

DECEMBER 2007 (EXPIRES 12/31/09)

# APPENDIX A

**Objective**:

The purpose of this project was to establish survey control points for use in subsequent surveys. This survey builds on a previous survey of twelve control points, two each at six bridge crossings, performed for the Water Management District in May of 1995. Two intervisible points have been set at each of the three addition bridge crossings along the Carmel River. A key criterion was to establish positions based on the State Plane Coordinates, allowing maximum flexibility for future use of the data, as well as suitability as Geographic Information System input data. The three new bridge locations are:

- Rancho Canada Golf Course
- Rancho San Carlos Road
- Robinson Canyon Road

In addition, it was noted that the two tablets set in 1995 at the Valley Greens crossing, set as “MPWMD GPS 3” and “MPWMD GPS 4” were sheared and missing from their shanks set in concrete. Two new tablets were modified and bonded to the concrete at these locations. Their slightly modified coordinates are reported herein.

Finally, at the Via Mallorca crossing, the tablet set as “MPWMD GPS 2” in the top of a rolled concrete curb return was noted as having been recovered from demolished concrete and recast into a new handicapped ramp installed at this curb return some three feet from its original location. The new coordinates are reported here as well.

**Methodology:**

The control points consist of 2” brass tablets with center-punch set in existing concrete. The points are numbered 101 through 108 as described on the attached tabulation. All tablets are stamped with the letters “M P W M D ”, along with their point number and year date (2007).

A Leica System 530 Global Positioning System (GPS) dual channel receiver equipped with “RTKMax” cellular telephone data modem for reception of a network-adjusted correction signal was used to establish a coordinate system congruent with the 1995 survey (California State Plane Coordinate System, Zone 4 (NAD83)).

**Conclusions:**

The attached table shows a listing of the State Plane Coordinates for all GPS-observed points, along with their orthometric height (calculated heights above sea level), expressed in feet and decimals thereof. A location description accompanies each control point. Coordinate data is also provided for key supplementary control points established and used by GMA in the course of their survey work.

## GPS CONTROL SURVEY - CARMEL RIVER - 11-16-07

| POINT ID | NORTHING | EASTING | ELEVATION | DESCRIPTOR |
|---|---|---|---|---|
| | (NAD 83 - CALIF. Z 4, FEET) | (NAD 83 - CALIF. Z 4, FEET) | (NAVD 88 DATUM, FEET) | |
| MPWMD 101 | 2091270.60 | 5711005.19 | 38.91 | BRASS TABLET IN A CART PATH INTERSECTION, APPROX. 65' NORTH OF THE NORTH END OF CART PATH BRIDGE LEADING TO THE 14TH GREEN AND 15TH TEEBOX, RANCHO CANADA WEST COURSE, 0.3' SOUTH OF THE NORTH EDGE OF A PERPENDICULAR CART PATH INTERSECTION. |
| MPWMD 102 | 2091058.78 | 5711201.90 | 36.80 | BRASS TABLET IN THE TOP OF A CONCRETE CURB, APPROX. 65' SOUTH OF THE SOUTH END OF CART PATH BRIDGE LEADING TO THE 14TH GREEN AND 15TH TEEBOX, RANCHO CANADA WEST COURSE, ON THE EASTERLY SIDE OF CART PATH 1.2' SOUTH OF THE BEGINNING OF A CONCRETE CURB. |
| MPWMD 103 | 2090915.31 | 5718497.00 | 66.58 | BRASS TABLET IN THE SOUTHEASTERLY CORNER OF A CONCRETE PAD, 8.5' SOUTH OF THE SOUTHWESTERLY CORNER OF RANCHO SAN CARLOS BRIDGE. |
| MPWMD 104 | 2090539.81 | 5718431.93 | 66.25 | BRASS TABLET IN AN ASPHALT CONCRETE DRIVEWAY APPROACH SERVING 26700 RANCH SAN CARLOS RD., APPROX 348' SOUTH OF THE RANCHO SAN CARLOS BRIDGE ALONG THE WESTERLY EDGE OF RANCHO SAN CARLOS ROAD. |
| MPWMD 105 | 2088620.39 | 5722015.24 | 83.31 | BRASS TABLET RESET OF "MPWMD GPS 3". |
| MPWMD 106 | 2088776.19 | 5722492.04 | 75.42 | BRASS TABLET RESET OF "MPWMD GPS 4". |
| MPWMD 107 | 2084936.65 | 5737273.55 | 147.38 | BRASS TABLET IN THE TOP OF AN ASPHALT CONCRETE CURB ALONG THE EASTERLY SIDE OF ROBINSON CANYON ROAD NEAR THE NORTHEASTERLY CORNER OF THE ROBINSON CANYON BRIDGE AND 1.6' NORTH OF THE BEGINNING OF THE ASPHALT CONCRETE CURB. |
| MPWMD 108 | 2084604.89 | 5737208.88 | 146.78 | BRASS TABLET IN THE TOP OF A ASPHALT CONCRETE CURB ALONG THE WESTERLY SIDE OF ROBINSON CANYON ROAD NEAR THE SOUTHWEST CORNER OF THE ROBINSON CANYON ROAD BRIDGE AND 1.3' SOUTH OF THE BEGINNING OF THE ASPHALT CONCRETE CURB. |

ALL BRASS TABLETS SET IN THIS SURVEY ARE STAMPED WITH THEIR POINT ID AND YEAR SET.

| | | | | |
|---|---|---|---|---|
| GMA CTRL 1 | 2091229.94 | 5711229.58 | 21.97 | WESTERLY SPIKE IN RIVER UPSTREAM OF RANCHO CANADA BRIDGE |
| GMA CTRL 2 | 2091295.60 | 5711391.07 | 20.84 | EASTERLY SPIKE IN RIVER UPSTREAM OF RANCHO CANADA BRIDGE |
| GMA CTRL 3 | 2091094.91 | 5718482.26 | 47.51 | SPIKE IN RIVER DOWNSTREAM OF RANCHO SAN CARLOS BRIDGE |
| GMA CTRL 4 | 2091072.91 | 5718686.57 | 42.98 | SPIKE IN RIVER UPSTREAM OF RANCHO SAN CARLOS BRIDGE |
| GMA CTRL 5 | 2088723.89 | 5722263.94 | 80.44 | CHISLED "X" ON VALLEY GREENS DR BRIDGE |
| GMA CTRL 6 | 2084713.53 | 5737232.21 | 148.86 | INK "X" ON ROBINSON CYN RD. BRIDGE |

| | | | | |
|---|---|---|---|---|
| MPWMD GPS 2 | 2091672.61 | 5715681.80 | 48.51 | NEW DATA FOR REPOSITIONED TABLET FROM 1995 SURVEY |