CITY OF RIVERSIDE
BENCHMARK INFORMATION

HISTORY

The early history of the City of Riverside is one of land divisions centered around agriculture and a well planned town of wide streets set amidst this agricultural backdrop. The City's founders realized that the success of the City and agriculture depended on water and worked to establish a network of canals and ditches that relied mostly on gravity to deliver the water from intakes and wells located along the Santa Ana River in the vicinity of Colton, San Bernardino and Loma Linda. To provide for gravity flow over these distances and within the local groves a precise and consistent vertical datum was required.

With this background and the desire to provide for the orderly expansion and improvement of streets the Board of Trustees of the City of Riverside on December 2, 1889 adopted Ordinance Number 105 setting the datum plane for the City of Riverside at an Elevation of 841.771 feet at a metal bolt in the granite foundation course of the Loring Building adjacent to the City Hall entrance. The point is not evident today and the basis of the datum, while close to sea level, was not referenced. The ordinance further stipulated the grade for the curb returns and side slope for the sidewalks.

The ordinance was superseded on July 23, 1929 by Ordinance 551, adopting the datum of the United States Department of the Interior Geological Survey adjustment entitled "Southern California Preliminary Adjustment of 1928". This being the initial release of what then was is referred to as the "North American Vertical Datum of 1929". (NAVD 29)

1970 ADJUSTMENT OF THE 1929 NATIONAL GEODETIC VERTICAL DATUM. (NGVD)

The next update to this datum occurred with the Southern California Cooperative Leveling Program that was performed during the late 1960's. This project involved local agencies throughout Southern California performing First Order Leveling under the direction of the United States Environmental Science Services Administration, Coast and Geodetic Survey. That adjustment was completed in 1970.

It was during that project that the City of Riverside, a participant in the leveling cooperative project, established the framework for the benchmark network currently in use. Marks were set at various locations and First Order Levels were run. These level circuits were tied to marks within the cooperative leveling project and adjusted by the Riverside County Flood Control and Water Conservation District. The City of Riverside network was published January 1971 and remains the backbone of the benchmarks published by the City of Riverside.

In 1973 the national datum was re-titled the National Geodetic Vertical Datum of 1929. (NGVD 29). Since that time most of the elevations within the Riverside area have been referred to as based upon the 1970 adjustment of the 1929 National Geodetic Vertical Datum. (NGVD)

NATIONAL GEODETIC VERTICAL DATUM OF 1988 (NGVD 88)

In 1993 the National Geodetic Survey, released the 1988 Adjustment now known as NGVD 88. That adjustment combined existing and new precise levels, high precision GPS positioning, modernized computer analysis, and only one tidal benchmark to establish a new vertical framework.

In August, 2008 the Federal Emergency Management Agency FEMA released updated Flood Insurance Rate Maps (FIRM) tied to the 1988 datum.

CITY OF RIVERSIDE 1929 to 1988 DATUM CONVERSION

Since the release of the NGVD 88 datum in the City of Riverside Public Works Department, City Engineering Division, Survey and Land Records Section had been reviewing options for converting the existing City Benchmark Network to the NGVD 1988.

One option that was considered was to use the National Geodetic Survey Program "VERTCON" to convert the existing benchmarks and then publish the estimated value generated by the program. Another option was to attempt to re-input all the actual 1960's era leveling data and readjusting that network to published 1988 benchmark values.

While both options had their merits the Survey and Land Records Section chose to take a middle approach.

1988 RE-ADJUSTMENT PROCESS

Research of NGVD1988 Datum Benchmarks

City Survey staff using the National Geodetic Survey Web Site downloaded all 1988 Datum Data Sheets in and around the City of Riverside. Each Datasheet was then reviewed and only those data sheets that included 1988 values developed from a re-adjustment or from new level runs were kept. All these values and marks were then added to the City Benchmark network.

NGVD 1988 Datum vs. City Datum

City Survey staff then compared the NGS 1988 locations with those of the existing City Network. Comparisons were developed between points that were identical to existing marks in the City network. In addition City Staff developed a list of NGS 1988 marks that were in close proximity to marks in the City network. City staff then performed 3rd order levels to between these points. Levels were run in both directions and only performed between marks that could be leveled in 3 or fewer turns.

Combining all these marks the City was able to determine differences between the City Benchmark Datum and NAVD datum at 27 points across the City. While most were concentrated along the BNSF Railroad running north-south through the City there were also points along Van Buren Blvd at both the East and West ends of the City. A map showing the distribution of the control locations is shown in Figure A.

Adjustment

Adjustment took place using the off the shelf Trimble Navigation TGO Elevation Adjustment process. All City benchmarks were added and the control values for all 27 locations were input. The software then developed a sloped plane that best approximated the 27 control values. The adjustment results, control values, adjusted values, and residuals are shown in Table B. A PDF document showing this as well as all the adjusted values is also available on this web page.

Publishing of Adjusted Values

Each of the adjusted values have been added to the existing benchmark listings found here on the City Web page. In addition all the marks retrieved from the NGS Web Site have also been added. Be sure to note that only NGVD published value are shown for the control marks. Adjusted values are shown for the remaining City Network marks.

BENCHMARK DESIGNATIONS

Other than the addition of adjusted NAVD 88 values to the City Benchmark Listing the following method of how to interpret the City Benchmark designations still applies.

The City of Riverside Benchmark listing incorporates new and existing marks. Like the 1971 City Benchmark Book all U.S.C.& G.S. points retain the designations established by the County of Riverside and are held as first order.

The benchmark designations used within the City of Riverside as part of the 1970 adjustment were based upon an alpha and numeric grid that encompassed the City of Riverside. The alpha values increased in a northerly direction and the numeric increased in an easterly direction. These became the first two digits of the marks designation and are followed by a dash and a different letter for each mark.

Current designations have abandoned this “grid” convention and instead simply begin with the grid designation of the beginning mark and advance the letter designation through available letters until reaching a closing mark. If enough letters are not available, a different grid designation is used for the first new mark. While all the original City designations have been held there are some differences.

The most significant difference is with reset marks. With this edition all original marks, including destroyed marks, were input and given their original designation. Those marks noted as resets of a previous mark and given the same designation followed by the notation “Reset” have been given new designations. In the body of the description it notes the former mark designation, ie: “Formerly G2-C RESET”. This was done for the purpose of maintaining the integrity of the original level circuits and reducing confusion should the City decide at sometime in the future to re-input and re-adjust the entire network to new constraints or the North American Vertical Datum of 1988.

This edition continues with the addition of a fourth digit to all City benchmark designations. This digit designates the general accuracy of the mark. A few receive a number “1” as the fourth digit due mainly to their shared designations with U.S.C.&G.S. marks. All of the points established by the City, leveled using first order equipment and procedures, and then adjusted by Riverside County Flood Control receive a “2” designation. This is mainly due to the type of mark used and the uncertainty of its stability.

The remaining City points receive a “3” designation for the fourth digit. These points were leveled since the release of the 1971 City Level Net. They were leveled using a standard Wild NI-2 level and Philadelphia Rod. All were leveled in both directions or from existing mark to existing mark and the runs then closed and adjusted. The accuracy of these levels has been very good. Adjusted differences between benchmarks have never exceeded 0.02 feet from the measured difference and have only approached this tolerance in terrain with considerable relief.

Some of the marks have been re-leveled and re-adjusted. These marks have received a new value corresponding with the leveling date. The original value remains for comparison. This has occurred where re-leveling indicated some kind of settlement, or values between existing marks did not match current measured differences. Re-leveling was extended through additional existing marks until satisfactory values and closures were obtained.

The City of Riverside has not regularly maintained benchmarks for some years. New marks are established as required for City construction projects. These circuits are closed, adjusted, and entered. Destroyed marks are noted when discovered by the City Field Crew or reported by private surveyors. Marks are perpetuated when there imminent destruction is reported.

The addition of second and third tracks to the A.T.& S.F. and U.P. railroad lines for Metrolink service has resulted in the destruction of many of the original first order United States Coast and Geodetic Survey Benchmarks. Those that have been confirmed destroyed are noted in this addition. Many others may be destroyed but have not been reported. Please do not rely upon these marks to be present unless they have been shown as recently recovered within their description.

FIGURE A
Control Value Distribution

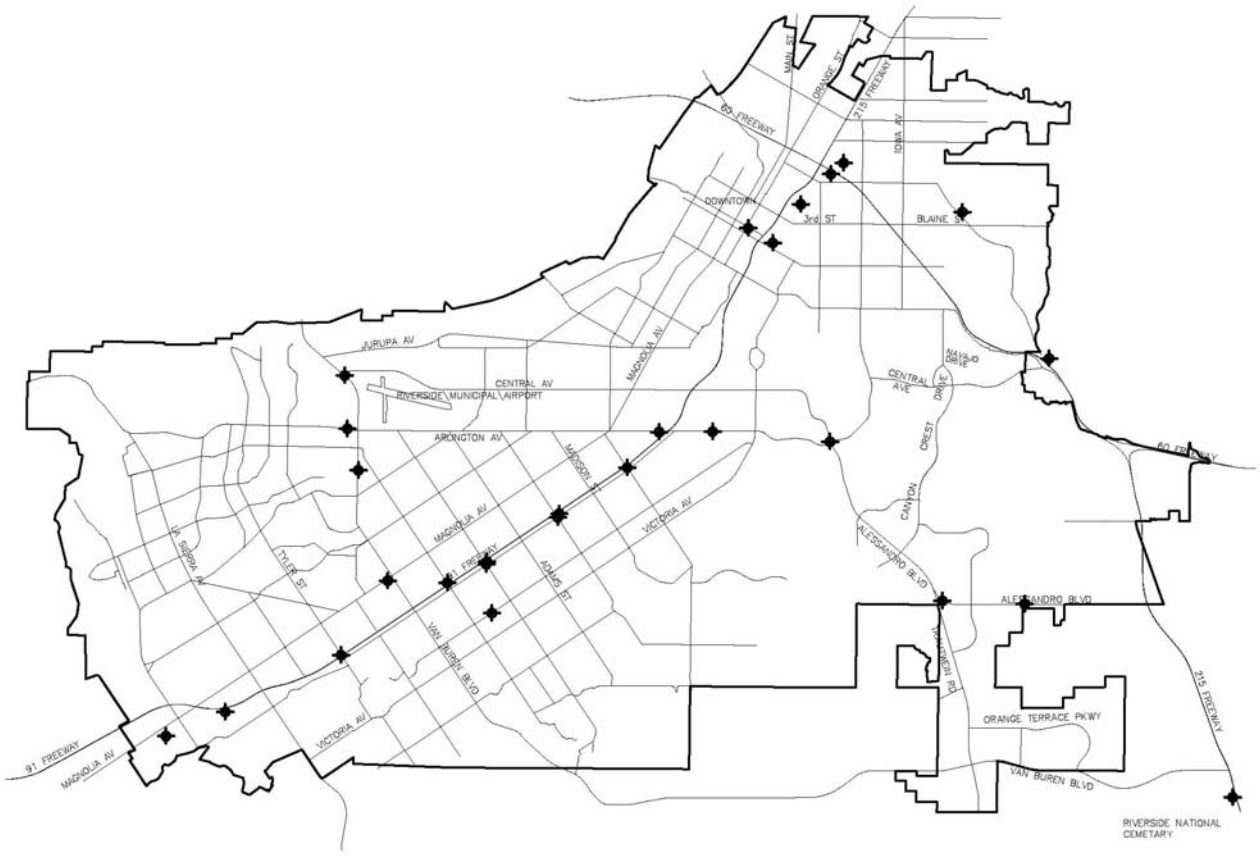

TABLE B

ADJUSTMENT PARAMETERS

Correction constant 2.453sft
Origin North 2280308.200sft Slope North-1.300ppm
Origin East 6198407.000sft Slope East 0.610ppm

B.M. I.D.	NGVD 29	DATUM DIFF	ADJUSTED NAVD 88	NAVD 88 Control Value	Adjustment Residual
600-43-68	1532.700	2.503	1535.203	1535.160	0.043
600-50-68	1369.902	2.460	1372.362	1372.380	-0.018
600-53-68	1077.842	2.444	1080.286	1080.310	-0.024
601-07-68	881.881	2.436	884.317	884.370	-0.053
601-08-68	879.883	2.436	882.319	882.360	-0.041
601-09-68	880.471	2.437	882.908	882.700	0.208
601-10-68	877.295	2.440	879.735	879.740	-0.005
601-16-68	866.370	2.453	868.823	868.840	-0.017
601-19-68	837.656	2.454	840.110	840.090	0.02
601-21-68	810.933	2.455	813.388	813.370	0.018
601-22-68	821.737	2.455	824.192	824.170	0.022
601-25-68	756.665	2.457	759.122	759.120	0.002
601-29-68	722.010	2.457	724.467	724.480	-0.013
601-30-69	697.682	2.457	700.139	700.150	-0.011
E5-I3	855.989	2.459	858.448	858.449	-0.001
F4-A1	810.933	2.455	813.388	813.370	0.018
F4-G1	788.349	2.453	790.802	790.820	-0.018
F5-C1	837.656	2.454	840.110	840.035	0.075
F8-H3	1622.303	2.479	1624.782	1624.840	-0.058
G3-K3	739.275	2.442	741.717	741.705	0.012
G3-V3	732.818	2.438	735.256	735.283	-0.027
G6-H2	889.160	2.453	891.613	891.610	0.003
G6-M3	851.147	2.451	853.598	853.597	0.001
G7-F3	1135.110	2.458	1137.568	1137.570	-0.002
GPS-68	1610.288	2.476	1612.764	1612.810	-0.046
H3-F3	741.229	2.434	743.663	743.710	-0.047
Z-1-RESET	857.615	2.437	860.052	860.090	-0.038