

Part 2 THE IMPOSSIBLE CADASTRAL SURVEY

Roger A. Frank, LS

[The previous surveyor had said it was impossible. In Part One, we left off as the JFA survey crew brainstormed ways to set corners on a rugged hillside north of Los Angeles.]

We waited for the first rains of the season to bring the fire danger in the area to an acceptable level. Then, on December 5, 2000, one of my party chiefs, Mike Ollar, and I went to the site for an initial search. We used a handheld GPS to attempt to locate the quarter corner, one-half mile west of our southwest corner. No luck, it appeared to have been washed out sometime since 1940. Our next search was for the southwest corner of our Section 24. There was a cleared trail going to within about 300 feet of the corner, so we used it to hike as close as we could, then struck out down through the dry creek bed and up the ridge, about a thirty to forty-five degree slope, chopping our way through the 10-foot high chaparral (which looks about 50-feet high when you are coming up the slope into it). Lo and behold, we found a mound of stones with an old lath right at our navigated location (**Figure 1**).

We positioned the corner using a GPS static session, again using the local CORS for control (**Figure 2**). We also found a wide spot in the forest road where our helicopter could land and which was high enough to be a good broadcast location for the RTK base, near the southeast corner of our Section 24. We set a temporary monument and tied it in to the CORS stations with static GPS. While the GPS receiver was collecting static data to position the base point, we went back to the ridge at the southeast section corner and field “digitized” the top of the ridge using kinematic GPS. This allowed me to evaluate the original topo calls at this corner to more precise locations than were available from the quad sheet.

Making Preparations

I reduced the day’s data. I found that our static GPS position on the stone corner was within seven feet of my search coordinate. Not bad for positions computed



Figure 1: 1902 stone mound at southwest corner Section 24—Old lath from 1993 survey?



Figure 2: Positioning 1902 stone corner at southwest corner of Section 24 by using GPS static baseline ties to CORS.

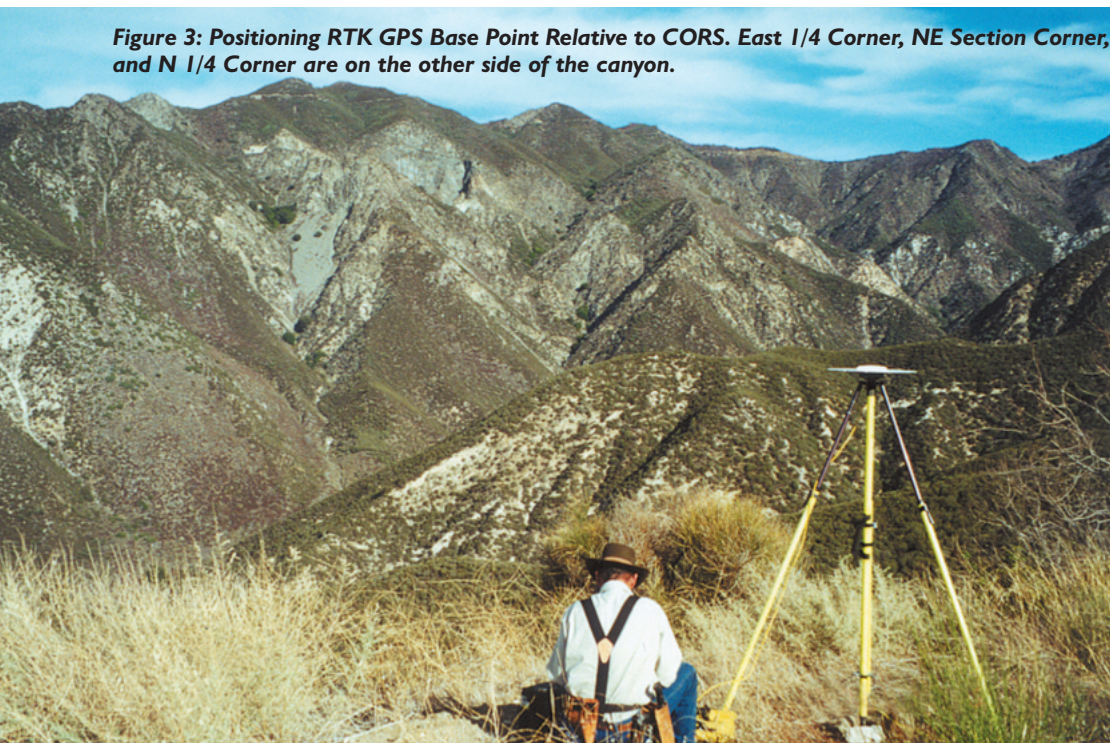


FEATURE

ed from 1902 and 1940 surveys from positions two to three miles away! Now that I knew the location of my southwest corner, I again massaged my file of record data and topo call matches to the USGS quad to upgrade my remaining search locations. I now had enough data and confidence in that data to go after some corners with full force. I set up individual corner location packages with full instructions so that I could send separate individuals to separate search locations. They would have the necessary data with them to know where to look and exactly what to look for, at least as much as I knew. I also pre-stamped brass caps with the appropriate markings for all of the sectional corners which we were going to search. These corners were very difficult to access, and I didn't want to visit any of them more than once, if possible. The plan would be for each man to be dropped off by helicopter as close as possible to his corner, navigate to the computed location using RTK GPS, locate the corner monument, set a two-inch iron pipe in place of the corner stone along with the pre-stamped brass cap, perform a static GPS session on the brass cap while he completed his description notes and digital photos, then call for the chopper—and never go back again!

I made arrangements with our helicopter company and the fuel truck to meet at the RTK base point. On December 21, 2000, three of my party chiefs and I headed out for the site along with the RTK base station equipment and three rover units. My chiefs, Mike Ollar, Mark Platt, and Steve "Buck" Backes have been working with me at Johnson-Frank for 23 years, 16 years, and 15 years, respectively. During that period, they have learned that I don't believe any survey is impossible, and I have learned that they will do whatever I ask of them to make it possible.

Figure 3: Positioning RTK GPS Base Point Relative to CORS. East 1/4 Corner, NE Section Corner, and N 1/4 Corner are on the other side of the canyon.



Of course, nothing works perfectly, and the helicopter pilot had to wait for fog to lift at his airport to get to our area. While we waited for the helicopter, Mike and Buck hoofed it about 2,000 feet down the same ridge that the base was sitting on to try to locate the south quarter corner of our section (**Figure 3**). They fought their way through the brush to the search coordinate, but could find nothing. By radio, they reported their lack of success. I then recalled that the original notes had indicated that the quarter corner was essentially due east of the section corner, while my adjustment and fit to the topo had bent that line somewhat northerly. I recalculated the search coordinate to a location straight east of the section corner which made about 30 feet of difference. The search crew went to that location and found an imbedded mound of stones matching the east-west coordinates and within a few feet north-south. They could not find any markings on the stones, but the size and location matched the original notes. They set their pipe and cap according to plan, and positioned the monument using static GPS. By that time the helicopter was on site and I sent it down to pick them up.

The Helicopter Advantage

I now had two of the corners I needed to establish my southwest quarter of the southwest quarter of our section. I still needed the other three quarter corners as a minimum. I sent Mark Platt to the west quarter corner. We watched through binoculars as the helicopter repeatedly circled the top of a small knob about 300 feet east of the quarter corner. Finally, as we watched, we saw an orange blob drop out of the helicopter. (It should be noted that Mark wears his orange safety vest at all times in the field!)

The brush was too high for the chopper to set down, so he had to jump out, from about a twelve-foot hover, then chop enough brush out of the way for the chopper to land and to allow him to retrieve his equipment. That's dedication!

Mike Ollar loaded his gear into the chopper and went for the north quarter corner. Actually the north quarter corner had not been set due to the steepness of the terrain where it fell, but a witness corner had been set on a spur ridge about 700 feet westerly. The helicopter was able to land on that spur about 50 feet from the corner location. The pilot dropped off Mike and his gear and returned to the staging area.

Next, the pilot picked up Buck and attempted to drop him at the east quarter corner, however, he was unable to land due to the brush and wind in the area. Buck



Figure 4: Corner Search Team—Alex Lugo (Fuel Truck Driver/Ferry Pilot) and Mike Zemlock (Helicopter Owner/Pilot), along with Johnson-Frank Crew—Steve “Buck” Backes, Mark Platt, Jim Frank, and Roger Frank.

then drove the forest road to a point about 2000 feet southeast of the quarter corner and chopped and crawled his way down the ridge through the brush to the area of the corner. This corner was by record a 3x3-inch stake instead of the mound of rocks described by the notes at most of the other corners. After some time searching, he was unable to locate the corner, but was able to chop enough of a hole in the brush to allow the pilot to get a skid down on the ridge in order to pick up him and his equipment.

In the meantime, Mike had located his witness corner on the north section line, re-monumented and positioned it and was ready to come back. Mark had not been able to locate the west quarter corner. I had the pilot drop me off on the knob near the west 1/4 on his way to pick up Mike on the north line. The brush was so thick that I could not find the hole that Mark had made chopping his way 300 feet down the ridge. I chopped my own trail. This corner was also called out as a 3x3 stake. It now became evident why some corners were stakes—there simply were no rocks on this slope, only decomposing granite on about a 30-40 degree slope. It had also been burned over at least once, but some years before. We made an extensive search for this important corner, mostly on hands and knees under the brush, but could find nothing. As we started back up the slope, we again couldn't follow our trail down and had to chop our way back up the hill to the landing spot.

So, at the end of our first “max-force” day, we had searched for four corners, and found, re-monumented, and positioned two, to make a total of three on the site. We weren't done, but the report of the survey being “impossible” apparently was somewhat exaggerated!

I reduced the GPS data from the day, and re-massaged my StarNet file of data that held our found corners as fixed in order to produce new search coordinates for the northwest and northeast corners of the section.

I re-estimated the total cost of the survey, then called the Dean. I told him that from the data I now had, I could tell him with good confidence where the line should be, but could not actually monument his corners without finding additional controlling corners. His disagreement with his neighbor boiled down to about 38 feet of difference in an area where there certainly appeared to be little reason to be arguing about it. He said it needed to be done, and authorized me to continue.

Without the quarter corners on the east or west, we now needed the northwest and northeast section corners. And if those weren't there, I hated to think about what we would have to do next! Again we arranged for the helicopter, and on February 6, 2001, my three chiefs and I went to the mountain.

Difficult Searches in Difficult Terrain

Mark loaded up and went to search for the northwest corner, and Buck went to the northeast (Figures 4-6). My son Jim and I went to the southeast corner to continue the search in that area. As I mentioned above, the original survey had set a witness corner on a ridge above a cliff to mark the southeast corner, but the notes had also indicated setting a small unmarked mound of rocks at the corner location down on the cliff. So, we went over the edge and down the cliff (actually about a 75 degree slope) on ropes. We searched the area, and tied-in a couple of suspicious rocks, but nothing conclusive. At the end of the day we positioned the small mound at the edge of the fire break which I had found on my first day on site—just in case.

In about three hours, Buck found his corner mound, monumented and positioned it, and called for the chopper. Mark was having trouble finding his, so I told Buck to go to the northwest corner and help Mark. It was getting late in the day and fog was beginning to roll in. The pilot was getting nervous and threatened to leave. About that time, Mark called and announced they had found a mound well-imbedded in the soil. After monumenting and positioning it, Mark and Buck returned to the staging area. They both looked like they had been dragged by horses down a very dirty road. I asked Mark how far the corner was from the computed location. The answer—“about five feet!” That shows the difficulty of the terrain and how difficult it would be to find a corner without knowing very precisely where to look!

If I could make something out of the topo or mounds at the southeast corner, I would have the control to allow me to determine the location of all of the corners of the client's property. If I ran a line “astronomic south” from the northeast section

Figure 5: Steve Backes and RTK Rover gear takeoff for search of corners on north side of section across the canyon.





Figure 6: Mark Platt and RTK Rover gear off to search for the West 1/4 Corner.



corner, it fell within two feet of a small pile of rocks we had found on the cliff face. But it didn't fit the topo calls to the top of the ridge either north or west of the corner. The mound near the firebreak could be made to fit the topo, but seemed to be about 40 feet too far south by distance from the northeast section corner. I was tempted to call the mound on the ridge the witness corner. In any case, I could now set the southeast and northeast corners of our 40-acre parcel. Those were the only corners that should take the helicopter for access, so I prepared to set those corners. I also computed new search locations for the east quarter corner based on the found northeast corner and my two possible locations for the southeast corner.

Grit, Technology, and Determination

On March 15, 2001, Mike Ollar and one of our chainmen met the helicopter back at the staging area. I told him to look for the east quarter again, although we had already searched it once. I thought that with the better locations, he might have better luck, although he was still looking for a 100-year-old stake! I had an appointment that day with another client, so I was not with the crew. About 9:00 a.m. I got cell phone call from Mike. I had given him four possible locations for the east 1/4 corner to search, all within about 30 feet of each other, and he had found the remains of the stake in a small mound of dirt under a bush within four feet of the fourth location. Even though I was about 70 miles away, I think I probably could have heard him without the phone!

With that success, I told him to go back and again look for the west quarter corner, since we now had the "exact proportion" location for that corner. Still no success. Mike and his helper set their two property corner monuments and returned.

Once I had the east quarter corner I no longer needed the southeast section corner, but lo and behold, I found that if I computed a line from the found northeast corner through the recently found east quarter corner, it ran right over the mound at the top of cliff at the edge of the firebreak. And if I continued that

line south the two chains (132 feet) and produced a position, the distance from that position to the ridge as it crossed the line running to the west matched the original topo call of three chains (198 feet) within about 20 feet. I guess that made my stone mound the witness corner that I had been looking for since my first day on the site.

On May 15, 2001, we set the final monuments for the college district's property, and shortly afterward filed the final Record of Survey with Los Angeles County. (Figures 7, 8).

In the end, by using least squares to evaluate the geometric data and quickly reevaluate when new evidence was found, along with the inclusion of all of the available records weighted appropriately for their time, the original GLO topo calls, the USGS topography, the topography on the ground, the helicopter, the RTK, and a lot of determination, we found seven of the original eight monumented corners in the survey that was previously labeled "impossible." We spent three days on the ground, and three days with helicopter support, in addition to

Figure 7: Jim Frank sets the NE Corner of the SW 1/4, SW n1/4 of Section 24 on the side of the cliff.



many hours of research, computations, reductions and analysis in the office. The clients got their 38 feet, just like I had told them many thousands of dollars earlier.

Once again, using the technologies now available to us, and properly applying them to a classic survey problem, we were able to be successful in a situation where the tried-and-true historical methods failed! Will it work every time? Most of the time, yes, but remember those Benson corners I mentioned earlier? There are others out there (or not out there)! ↓

ROGER FRANK is cofounder, current owner, and president of Johnson-Frank & Associates (JFA), located in Anaheim, California. This is his fifth article for Professional Surveyor.

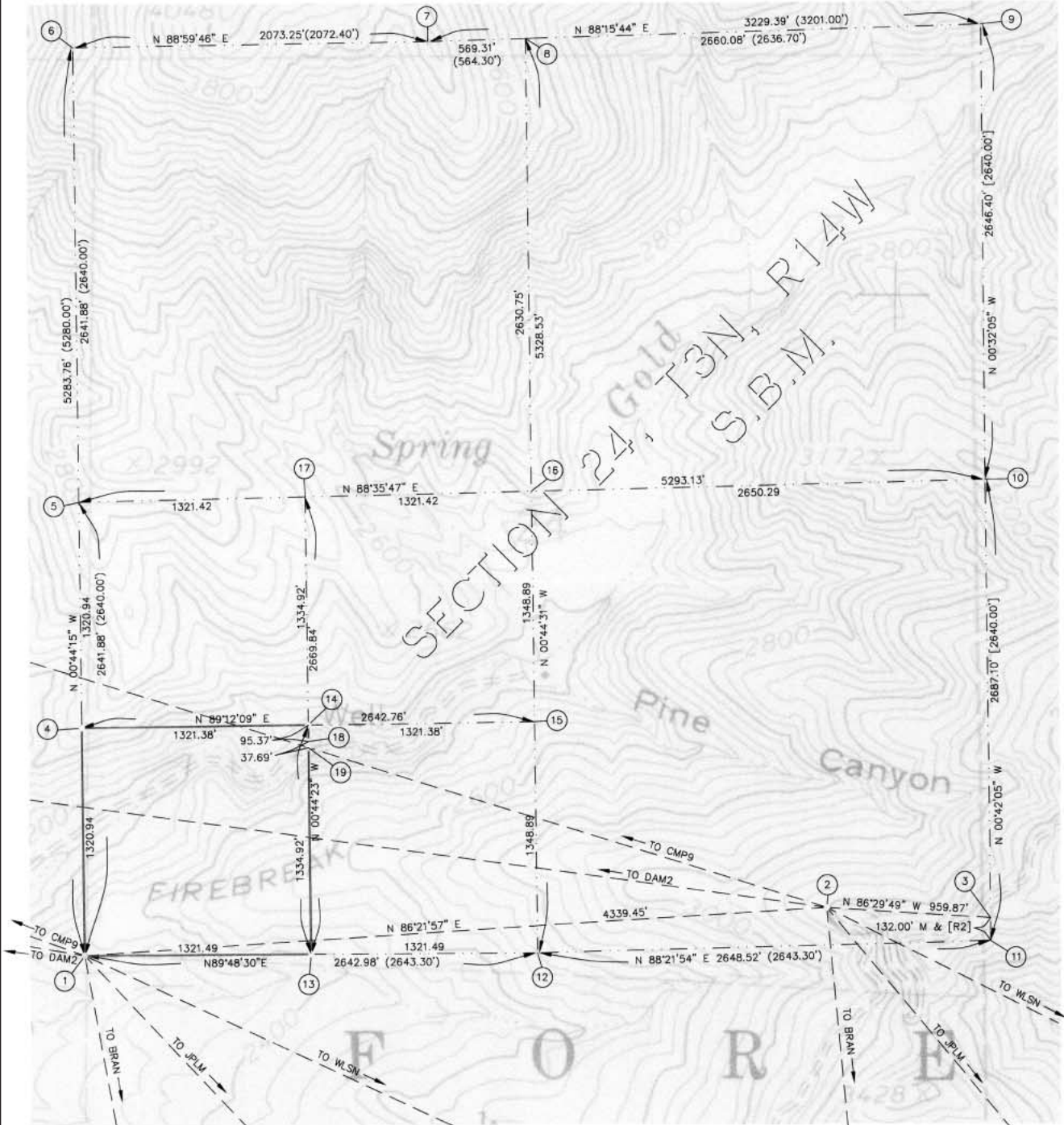
RECORD OF SURVEY

COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

BEING A SURVEY OF THE SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 24, TOWNSHIP 3 NORTH, RANGE 14 WEST, SAN BERNARDINO MERIDIAN PER THE OFFICIAL PLAT OF SAID TOWNSHIP AS APPROVED BY THE U.S. SURVEYOR GENERAL'S OFFICE, SAN FRANCISCO, CALIFORNIA, MAY 6TH, 1903.

JOHNSON-FRANK AND ASSOCIATES, INC.
 ROGER A. FRANK, PLS 4215
 SURVEYED: SEPTEMBER, 2000 - JUNE, 2001

SCALE: 1" = 400'



BACKGROUND TOPOGRAPHY FROM U.S. GEOLOGICAL SURVEY 7.5' QUADRANGLE MAP "SUNLAND, CA 1991".

Figure 8: Record of Survey showing completion of the previously labeled "Impossible" survey.