RIVERSIDE DRIVE BANK EROSION EVALUATION

Lompoc, California

January 20, 2011

CLIENT:	City of Lompoc
PREPARED BY:	Penfield & Smith 111 East Victoria Street Santa Barbara, California 93101 (805) 963-9532
WORK ORDER NO.:	19513.01
PROJECT MANAGER:	Craig A. Steward, P.E., CFM

PURPOSE OF REPORT

As a part of the Santa Ynez River Bank Stabilization Project, the City of Lompoc requested that the project team evaluate erosion protection at the toe of the bank adjacent to Riverside Drive. The purpose of the evaluation is to determine the need and feasibility for bank stabilization along this portion of the river bank and make preliminary recommendations.

LOCATION

The area of concern is located adjacent to Riverside Drive between East Pine Avenue and East North Avenue. See Figure A.

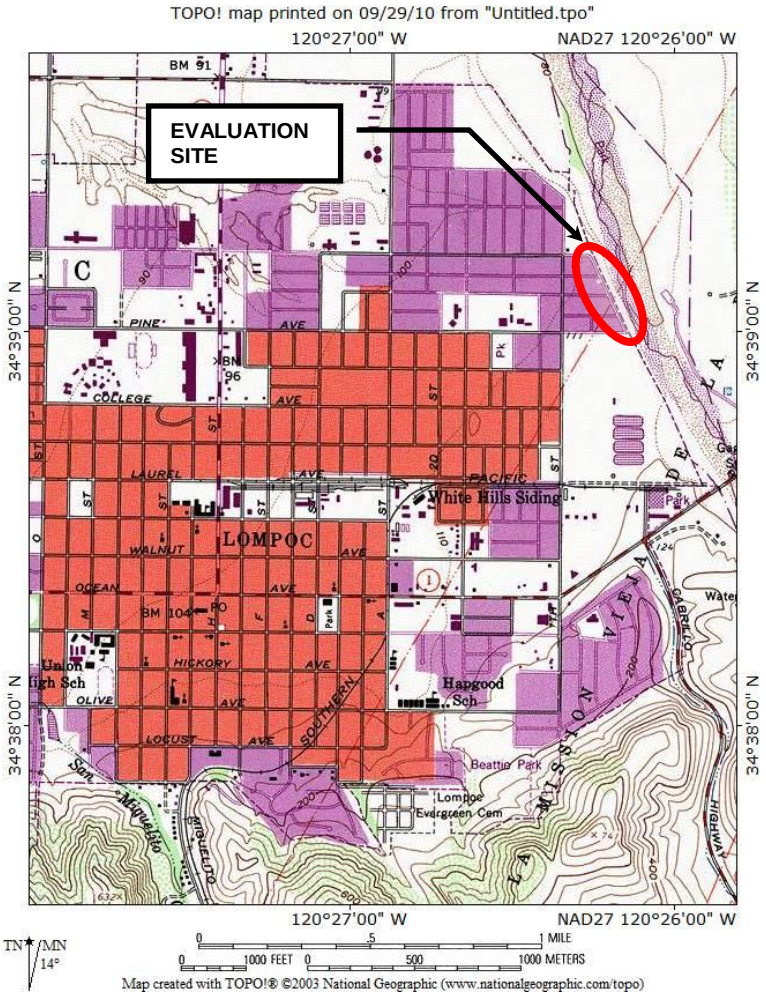


Figure A - Vicinity Map

BACKGROUND

There is a bicycle path in an open space area east of Riverside Drive between East College Avenue and East North Avenue. The open space consists of relatively level ground extending towards the river bank. The width of the level ground varies from about 200 feet near East College Avenue to about 40 feet at East Pine Avenue, to about 100 feet near East North Avenue. The river bank consists of very steep (1 horizontal : 1 vertical) or steeper slopes, covered with heavy vegetation. Much of the lower portion of the bank is covered with mature willows and other trees.

On January 25, 1969, the Santa Ynez River experienced what has been estimated by some as the highest flow on record, about 80,000 cubic feet per second. There was significant bank erosion all along the river.

Then on March 4, 1978, the Santa Ynez River experienced another very large flood, ranking in the top four flood events ever measured at this site by the U.S. Geological Survey. The peak flow rate was measured at 63,200 cubic feet per second. There was damage throughout the length of the river. In 1979, the U.S. Department of Agriculture (USDA), Soil Conservation Service prepared plans[1] to repair damage at various locations on the river. One of those locations was at the evaluation site addressed in this report. See Figure B on the following page.

[1] United States Department of Agriculture, Soil Conservation Service; Santa Ynez River Project, 216 Program, 083-047, Santa Barbara, California; May 1979.

The repair at the project evaluation site consisted of two treatments:

1. Placing about 3 feet of fill over an automobile tire bank revetment and planting that soil with grass. The toe of the slope was then planted with willows. See Figure C below.

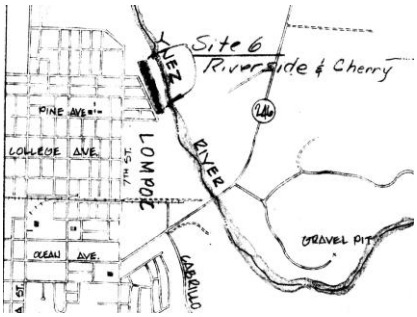


Figure B - USDA Project Location Map

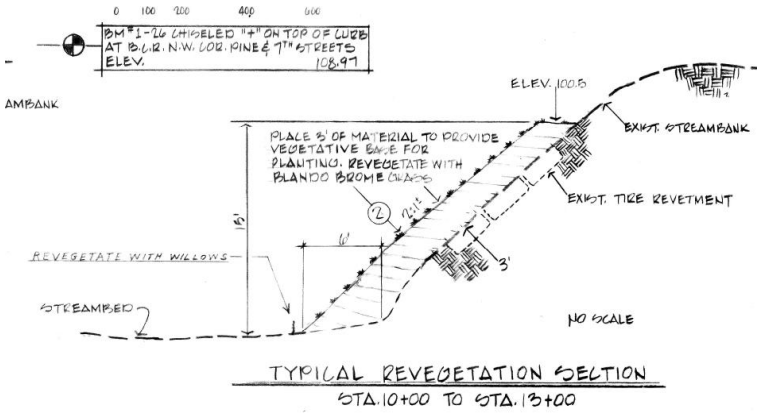


Figure C - 1979 Revegetation Detail

2. Constructing 1,000 feet of pile and cable revetment parallel to the toe of the bank. The piles were 35 feet long and constructed of pre-cast concrete and were installed every 10 feet. The top 7 feet of the pile was left exposed above the river bottom. The piles were connected together with three sets of 3/4-inch diameter wire rope (cable). Then 2" x 4" wire mesh was attached to the piles and cables. See Figure D.

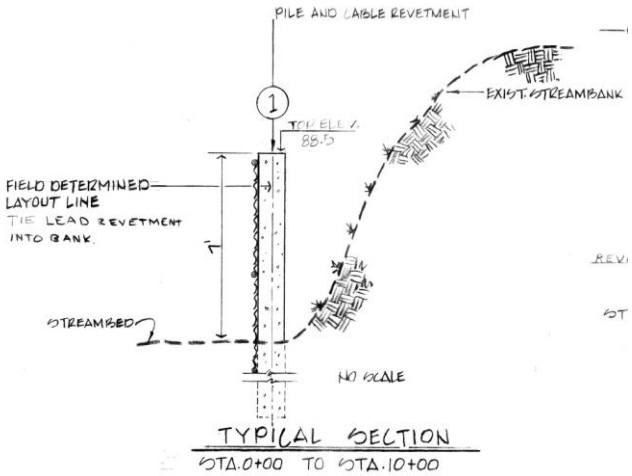


Figure D - Typical Section of 1979 Pile and Cable Revetment

In the ensuing years, the vegetation on the riverbank has filled in. See Photo 1 and Photo 2. Recently, as the City has reviewed the area, it was noted that the five piles had failed and were laying horizontally in the river bed at the upstream end of the remaining pile revetment. Additionally, the City could only identify a line of approximately 70 remaining piles (about 700 feet of pile revetment) from North Avenue to Cherry-Oak Alley. If 1,000 feet of revetment was constructed as the plans indicate, then 300 feet of this may have washed out. It is anticipated that much of the loss may have occurred at the upstream end between Cherry-Oak Alley and pine-Cherry Alley. The City has requested Penfield & Smith to evaluate:

1. The need for additional bank protection in this reach of the River.
2. The impact of losing piles at the upstream end of the revetment and whether there is a need to perform repairs.

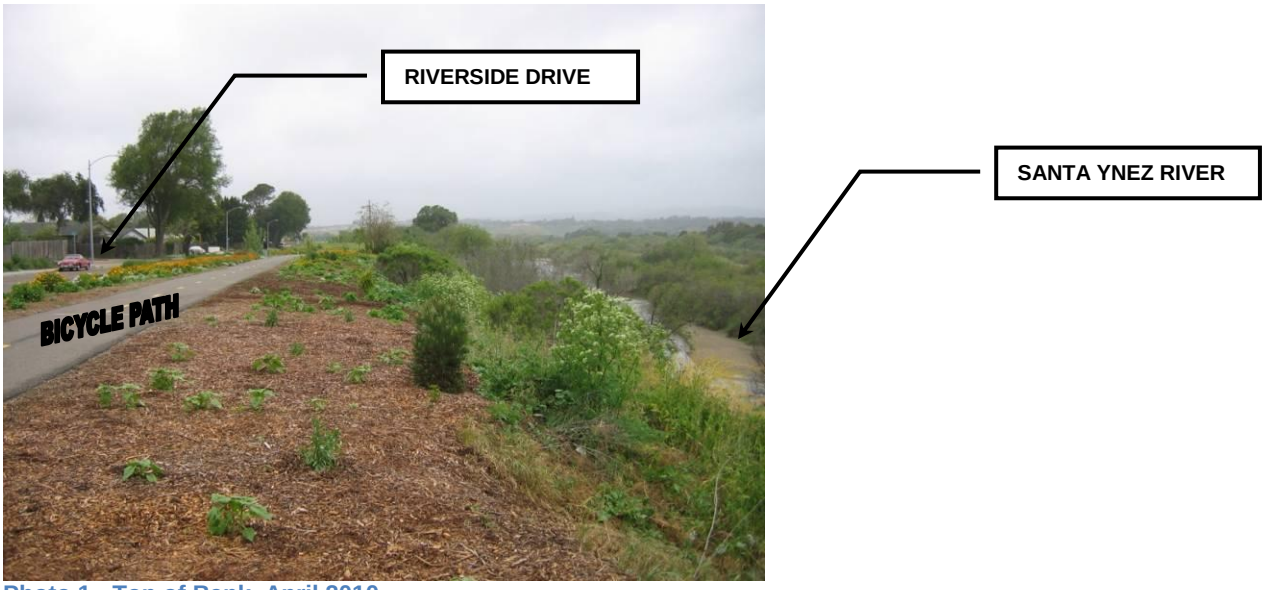


Photo 1 - Top of Bank, April 2010

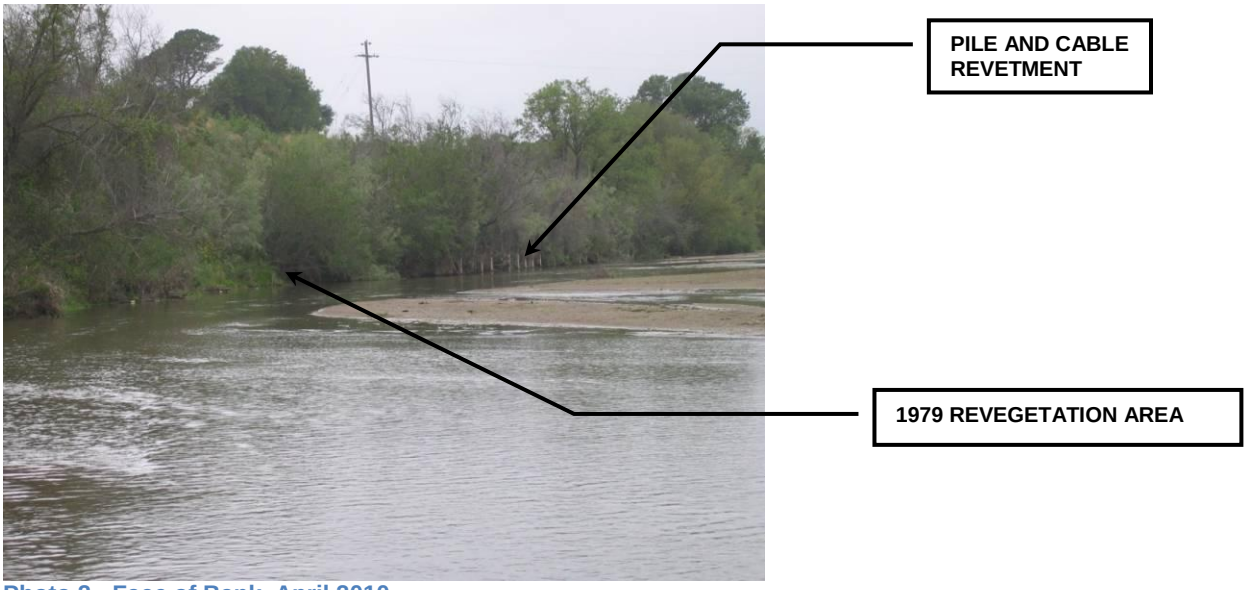


Photo 2 - Face of Bank, April 2010

METHOD OF ANALYSIS

Evaluation of the bank protection situation was approached in several ways.

1. The long-term change in bank alignment was reviewed using historical photographs.
2. A field review of the site conditions was made. Due to the river flow, a close-up investigation of the pile and cable revetment was not accomplished, but their presence is evident in the photographs. Based on the time elapsed since installation, it is assumed that the wire mesh has likely corroded and does not now contribute to the system function. However, it is likely that the cable is still in place.
3. The construction plans for the system were reviewed.
4. The project geomorphologist/geologist provided observations after field review.

In addition to these methods of evaluation, we reviewed data generated from the Santa Ynez River Bank Protection Evaluation, currently under review by the City of Lompoc. This included:

- Flow velocity and depth
- Boring logs from adjacent projects
- Historic groundwater elevations
- Neighborhood drainage patterns from the adjacent residential development

FINDINGS

Based on the review of historical photographs, it appears that this portion of the Santa Ynez River bank tends to be generally well established. The flood flows of 1969 appear to have removed a significant amount of the riverbank within the evaluation site area. However, since the flood of 1969, estimated to be between a 20-year and 50-year runoff event, the top of bank

has remained mainly in the same location, even after the significant, though smaller flood of 1978. See Photo 3.

A review of the field conditions indicated that there doesn't appear to be visible significant indications of slope erosion or ground slippage despite the very steep banks. Drainage flows from the adjacent residential development are controlled so they do not flow over the river bank but are discharged to the river away from the critical locations in a controlled manner. The bank surfaces are well vegetated with significant growth of willow at the toe of the banks. Except for the loss of piles at the upstream eand of the revetment, the pile system appears to be intact and has protected the toe from further erosion and allowed more mature trees to become established, further protecting the toe of the river bank.

Comparing the pile and cable revetment plans to the 2010 conditions we observed, it appears that there has been very little retreat of the slope. That is, the remaining portion of the pile and cable revetment still appears to be located at the toe of the bank just as shown in the 1979 plans.

Derek Booth, the project geomorphologist, observed the situation and indicated that a new installation of most structural or vegetative bank protection systems, if constructed at this location, would require the bank slopes to be graded back to a less steep condition, which would likely require moving the bicycle path. Alternatively, the bank could be completely reconstructed as an engineered slope, but this would require a level of effort and cost that is not justified by current conditions or risk. It is his opinion that disturbance of the bank in this area to enhance the current degree of bank protection would be highly disruptive to the existing vegetation and counterproductive to desired outcomes.

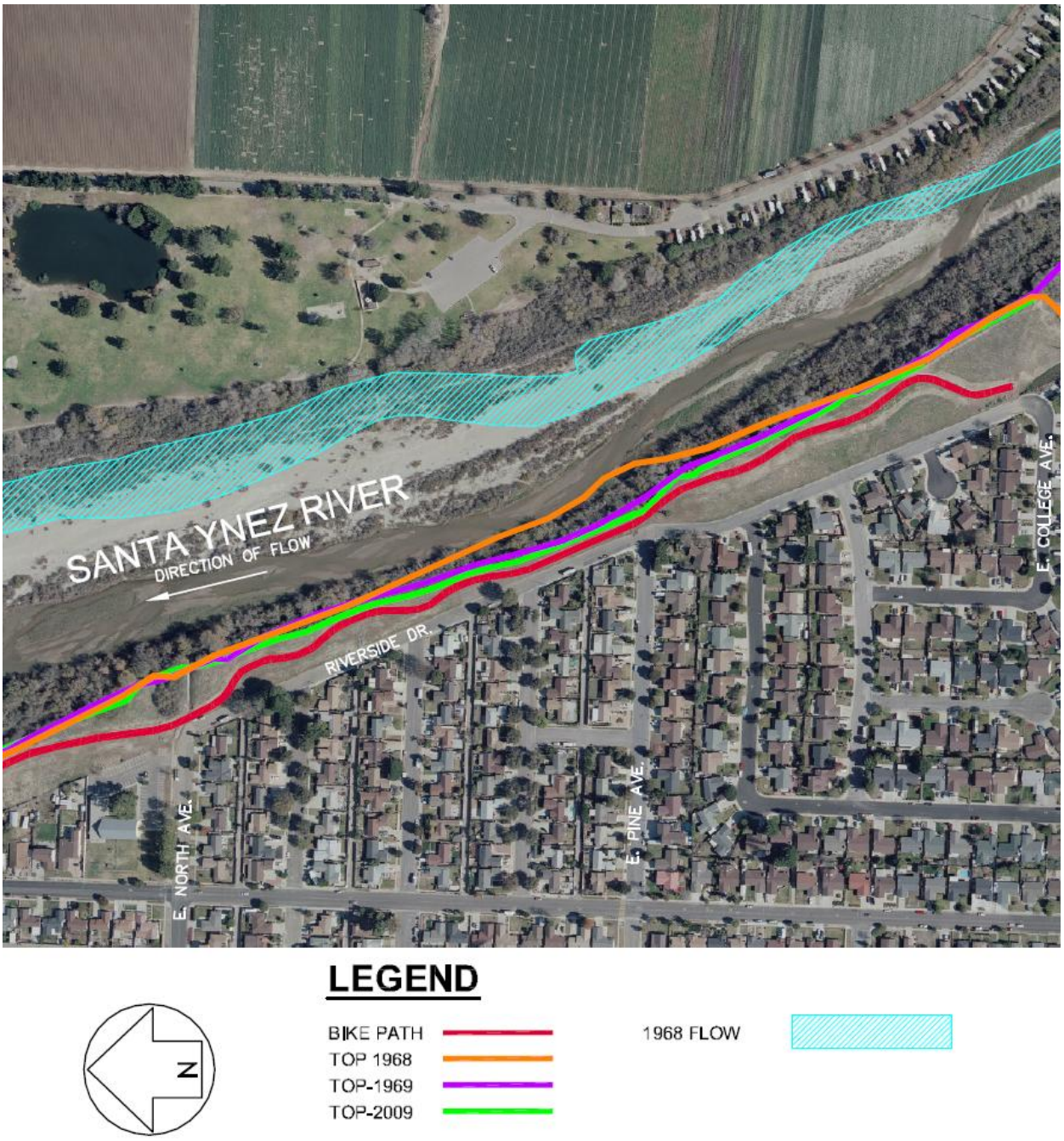


Photo 3 - Historical Photograph Analysis

Review of the water surface profile model for the evaluation site indicates that during moderate to large storm flows, the flow velocity within the main stream channel will vary from 8 feet per second to 12 feet per second. This will definitely scour and remove most unprotected vegetation, which is evident has happened in the past. The flow velocity along the banks will be much less, varying from 4 feet per second to 6 feet per second. At this flow velocity most well rooted, mature willows and other plants present at this location can survive and recover, protecting the banks at the same time.

RECOMMENDATIONS

Based on our findings and observations, we recommend that no extensive bank protection is warranted at this time. It appears that the current vegetation level on the bank and at the toe of the bank is sufficient to protect the bank from most small to moderate storm runoff events and that disturbance or grading of the existing banks would likely reduce the erosion resistance rather than enhance it.

We recommend that the vegetation on the bank and at the toe of the bank in the vicinity of Pine Avenue be monitored over time. As conditions permit or require, additional willows and other appropriate vegetation should be planted along the toe of the bank in the area not protected by the existing pile and cable revetment.

We further recommend that as conditions permit, the existing lead (most upstream) pile of the pile and cable revetment system be tied back into the bank. This may be accomplished by driving a pile or pipe into the toe of the bank and connecting the new pile or pipe to the existing lead pile with two or three strands of wire rope (cable). In addition, it would be prudent, to replace the missing 300 feet of revetment. See Figure E.

The revetment design should be modified from the original by omitting the use of the 2" x 4" wire mesh and by adding a tie-back pile and cable every 100 feet.

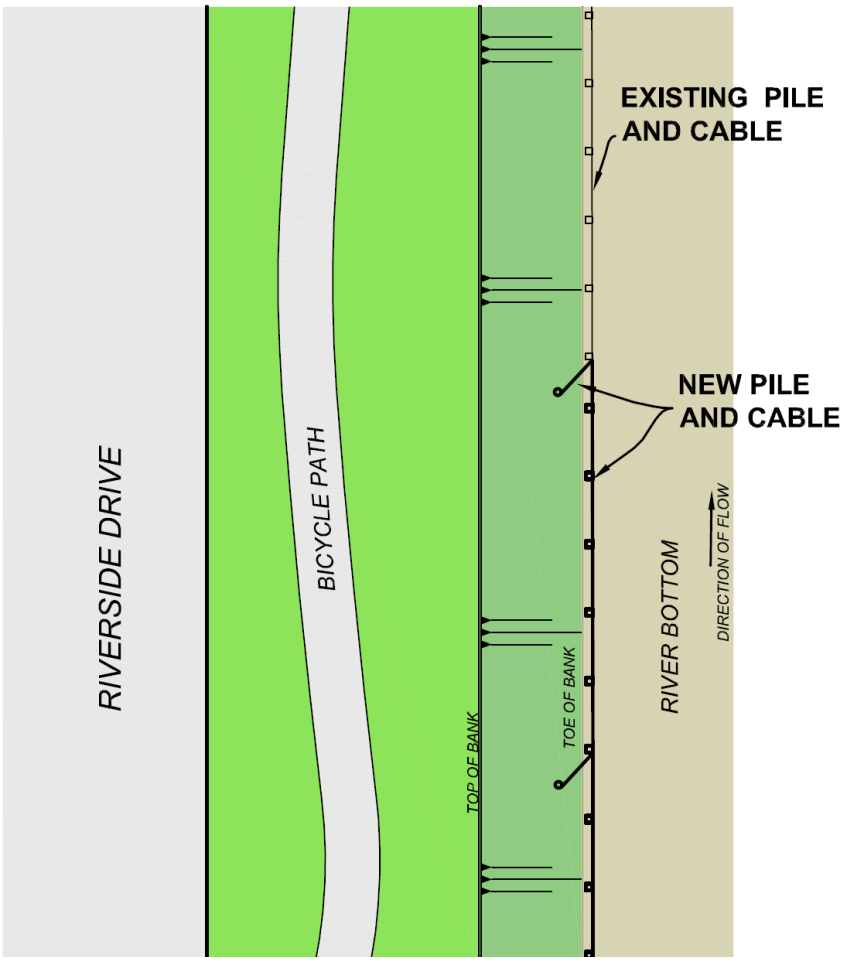
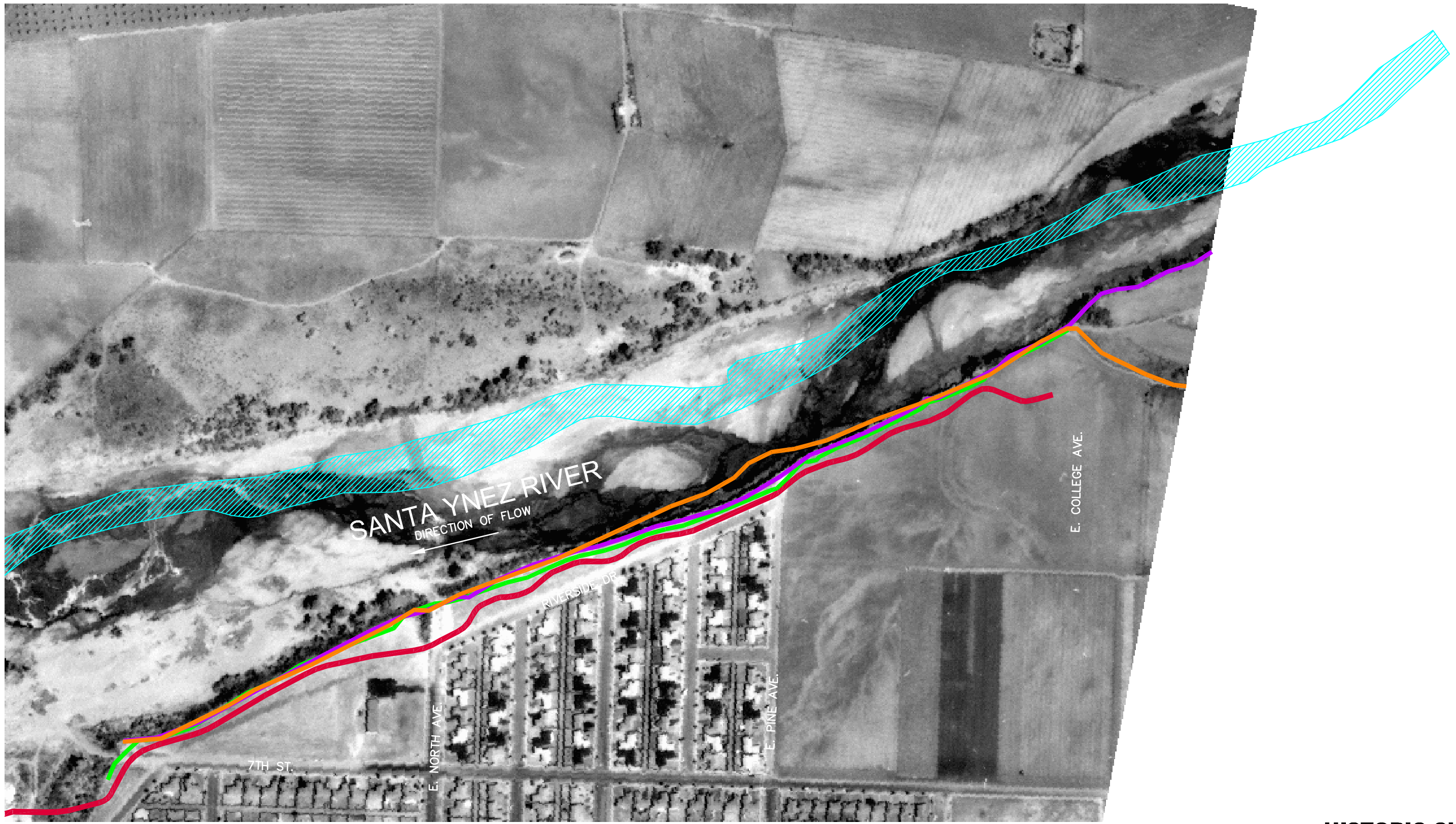


Figure E - Pile and Cable Repair Location

CALCULATIONS AND ATTACHMENTS



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1" = 200'

N

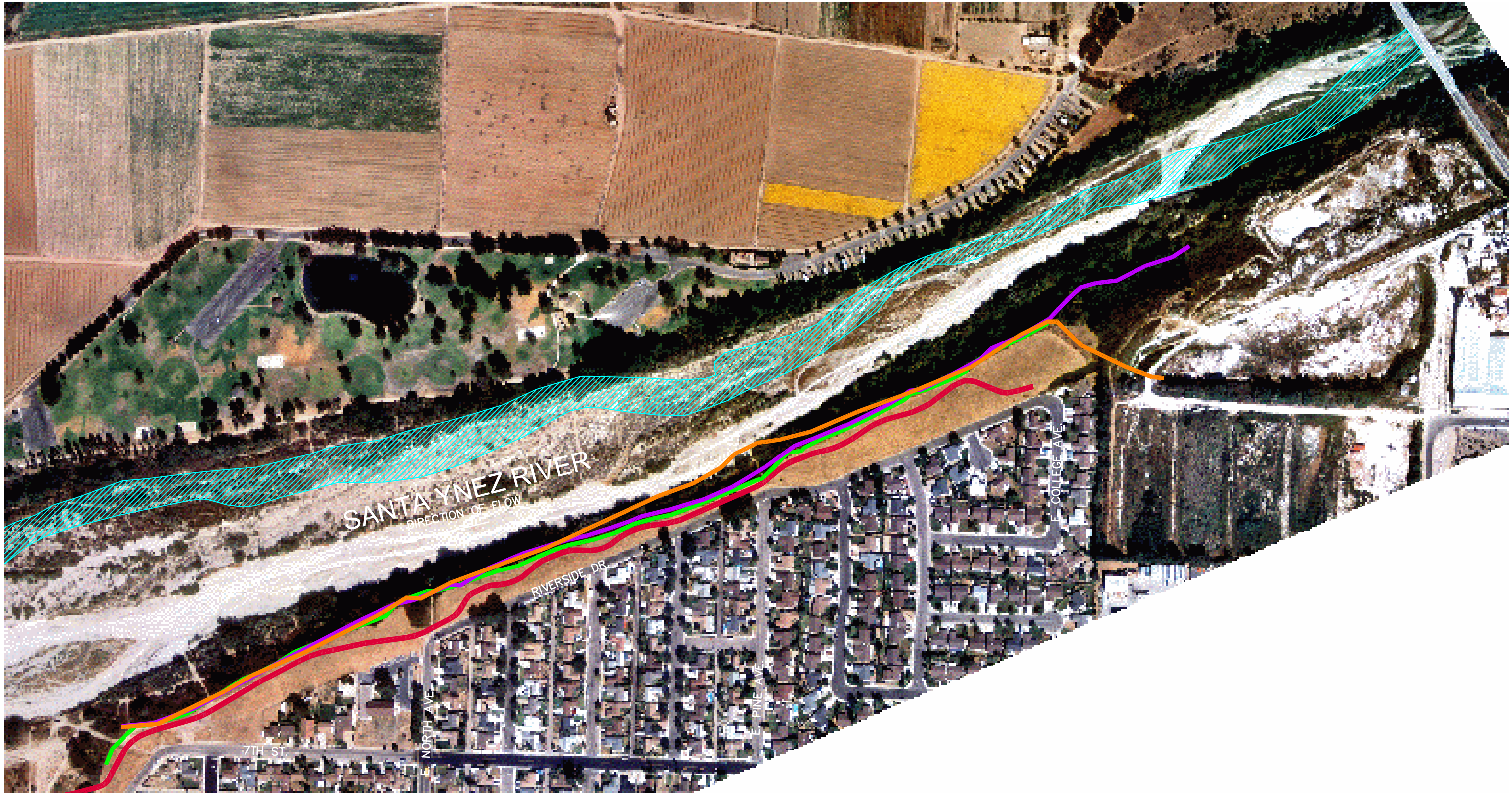
LEGEND

- BIKE PATH
- TOP 1968
- TOP-1969
- TOP-2009
- 1968 FLOW

HISTORIC CHANNEL
YEAR 1969

CITY OF LOMPOC, CALIFORNIA

1969-B



LEGEND

BIKE PATH
TOP 1968
TOP-1969
TOP-2009

1968 FLOOD

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1" = 200'

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HISTORIC CHANNEL YEAR 2000

CITY OF LOMPOC, CALIFORNIA

2000-B

SANTA YNEZ RIVER

DIRECTION OF FLOW

RIVERSIDE DR.

7TH ST.

E. NORTH AVE.

E. PINE AVE.

E. COLLEGE AVE.

LEGEND

BIKE PATH

TOP 1968

TOP-1969

TOP-2009

1968 FLOW

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1" = 200'

N

HISTORIC ERSION PROGRESS PHOTO: 2009

CITY OF LOMPOC, CALIFORNIA

2009-B