TECHNICAL MEMORANDUM

INTERMEDIATE TRANSMISSION PUMP STATION DESIGN CRITERIA (TM-P-5)

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FROM: Jessamy Zagel Trisler (Parsons ES)

DATE: 20 September 1995

GENERAL

The purpose of this memorandum is to:

- present the approach used to evaluate the need for intermediate pump stations along the transmission lines from the Laguna Plant to the storage reservoirs: and
- recommend the location of any necessary intermediate pump stations.

Transmission of reclaimed water from the Laguna Plant to the storage reservoirs will require a pump station at the plant capable of pumping the water over hilly terrain to the respective reservoir sites. Use of standard pressure rated pipe, pumps, fittings and appurtenances is desirable from a cost and maintenance stand point. To limit mechanical devices to standard pressure ratings of 150 pounds per square inch (psi) (346 feet of head) the need for intermediate pump stations was evaluated. Transmission systems to each of the ten reservoir sites were evaluated. Figures 1 through 3 present an overall view of the transmission lines. The ground profile along the pipeline alignment was taken from recent USGS Quad maps. The hydraulic grade line was calculated based upon the losses in a 48-inch pipe (the inner diameter for the pipe to be specified) with a flow rate of 26 million gallons per day (mgd) and a velocity of 3.2 feet per second (fps). The flows used in this analysis are based on the present worth analysis presented in TM-P-6[1].

PUMPING ANALYSIS

The transmission line to each of the reservoir sites was evaluated using the following criteria:

- Flow: 26 mgd[1];
- Pipe Diameter: 48-inch;
- Velocity: 3.2 fps;
- C: 120;

[1] See Technical Memorandum Transport Pipeline Flowrate and Pumping Schedule Present Worth Analysis (TM-P-6).

- Head loss per 100 feet: 0.074 ft/100 ft;
- Tunnel elevations and peak ground elevations for TDH calculations as presented in Technical Memorandum TM-P-4; and
- Laguna Pump Station Elevation: 50

The ground profile of the pipeline alignment for each reservoir transmission line was taken from recent USGS Quad sheets. Elevations are with ±10 feet. Hydraulic grade lines for each reservoir were calculated using the peak ground elevation and friction loss at 0.074 ft/100 ft to determine TDH. This is a simplified approach to determine peak TDH to supply at the peak elevation. The hydraulic grade lines and ground profiles for each transmission line are presented in figures 4 through 13.

Standard pipe, pump, fitting and appurtenances are designed with a pressure rating of 150 psi. Non-standard ratings higher than 150 psi are available but are costly. If the TDH between the Laguna pump station and the peak point of the hydraulic grade line is greater than 150 psi (346 feet of head) then either an intermediate pump station or non-standard mechanical devices would be necessary. The transmission line profiles and hydraulic grade lines were evaluated to determine whether an intermediate pump station was necessary. Table 1 presents the Transmission lines evaluated, the TDH, the pressure differential between the Laguna Plant pump station and the hydraulic peak and states whether an intermediate pump station is necessary.

CONCLUSIONS AND RECOMMENDATIONS

Figures 4 through 13 and Table 1 present graphical representations of the pipeline profiles and hydraulic grade lines and tabular results of the transmission line evaluation. The hydraulic grade lines presented depict a simplified, initial hydraulic analysis. They represent a single size pipeline (48-inch diameter) transporting flow to a reservoir. The following are brief observations on the pipeline profiles and hydraulic grade lines:

- In several cases, the terminal elevation of the hydraulic grade line matches the maximum water level in the reservoir (i.e., Figures 5, 6, 7, and 9).

- Figures 7 and 9 show alignments with tunnels which bring the terminal elevation of the hydraulic grade line to that of the maximum water surface elevation in the reservoir.

- The control elevation of the hydraulic grade line for several of the reservoir routes is at an intermediate highpoint along the ground profile (i.e., Figures 4, 8, 10, 11, 12, and 13). One of these, Figure 8, includes a tunnel to avoid a highpoint. These figures also show the hydraulic grade line in the pipe at the entrance to the reservoir above the reservoir water surface elevation.

- Figures 5, 6, 7, 11, and 12 show pipeline alignments which enter the reservoir at the base of the dam, thus the difference in the ground profile's endpoint and the reservoir water surface elevation.

- Air and vacuum release valves will be sited at intermediate highpoints to reduce hydraulic transients and to prevent collapse.

To reduce the energy in the pipe at the entrance to the reservoir to a more feasible level, say 5 to 10 feet, the diameter of the pipeline downstream of the intermediate highpoint may be able to be reduced to increase the energy loss in the downstream portion of the pipeline. Further hydraulic analysis will be required during final design to determine if this is feasible, given the hydraulics of the pump-back irrigation flow conditions. In any case, energy dissipation structures must be constructed at the discharge into the reservoir to prevent erosion. Further conceptual design of the transmission pipeline is described in the KYPIPE Model Optimization for Agricultural Irrigation Systems Technical Memorandum.

All the TDHs, presented in Table 1, are less than or very close to 150 psi (or 346 feet of head $\pm$10 feet). Therefore, there is no need for an intermediate pump station for any of the transmission lines.

Table 1

Transmission Pipeline
Hydraulic Summary

Reservoir	TDH PSI (feet of head)	Intermediate P.S. Yes/No
Tolay A	134.5 (310.74)	No
Adobe Road	141.2 (326.14)	No
Lakeville	107.6 (248.51)	No
Tolay C	132.2 (305.33)	No
Sears Point	131.4 (303.55)	No
Two Rock	142.2 (328.58)	No
Bloomfield	151.3 (349.42)	No
Carroll Road	133.2 (307.80)	No
Valley Ford	133.5 (308.50)	No
Huntley	152.3 (351.71)	No

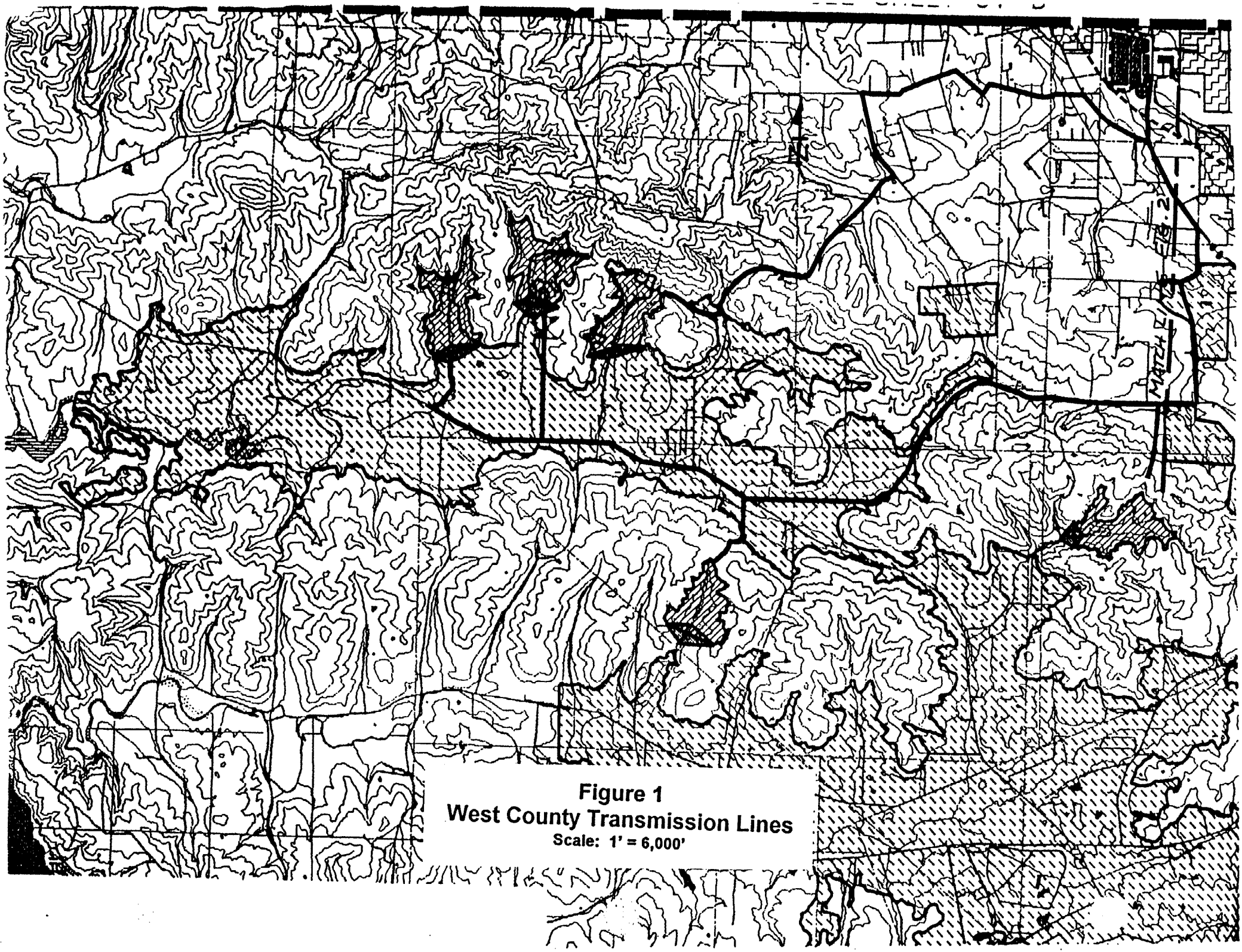

Figure 1
West County Transmission Lines
Scale: 1' = 6,000'

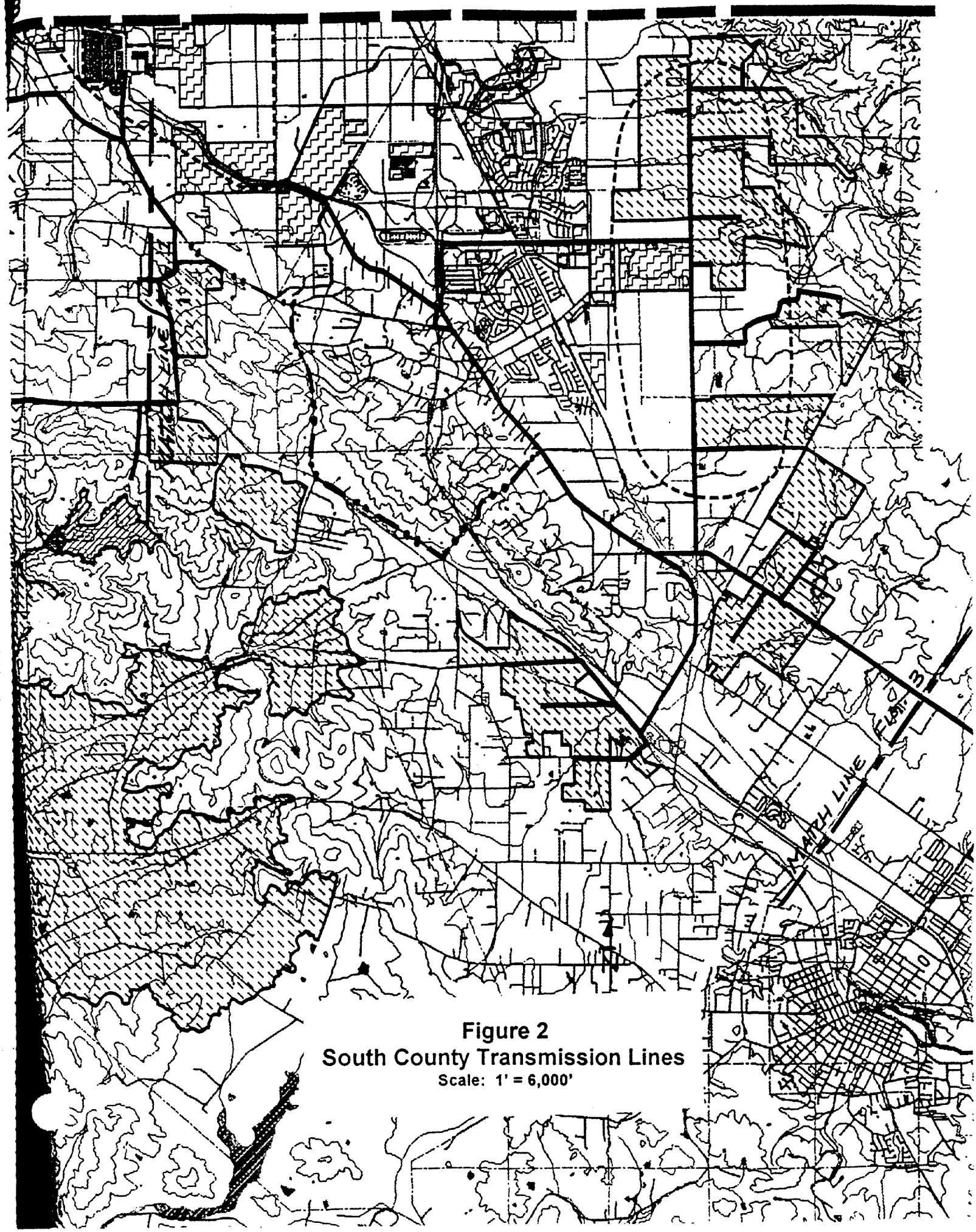

Figure 2
South County Transmission Lines
Scale: 1' = 6,000'

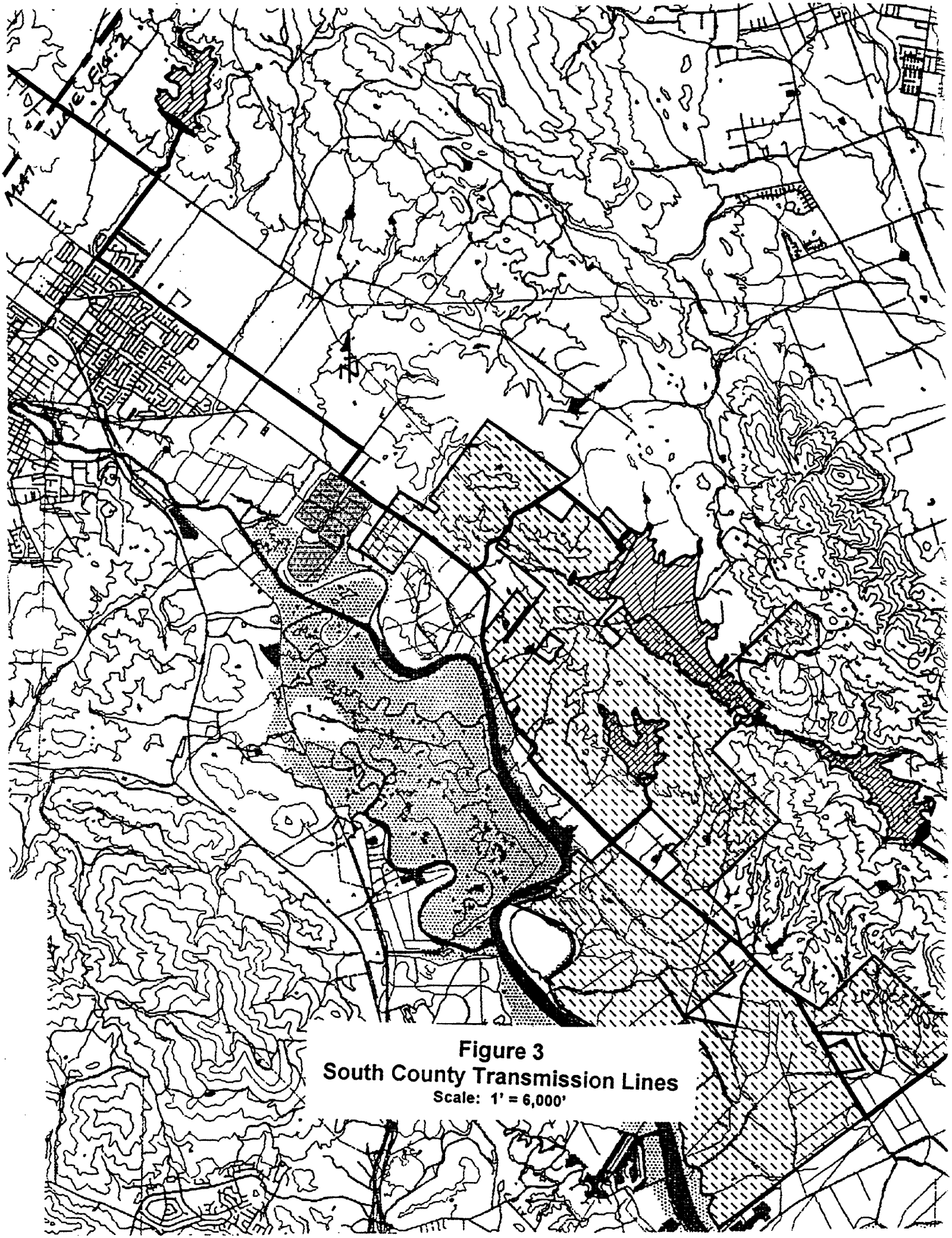

Figure 3
South County Transmission Lines
Scale: 1' = 6,000'

Figure 4

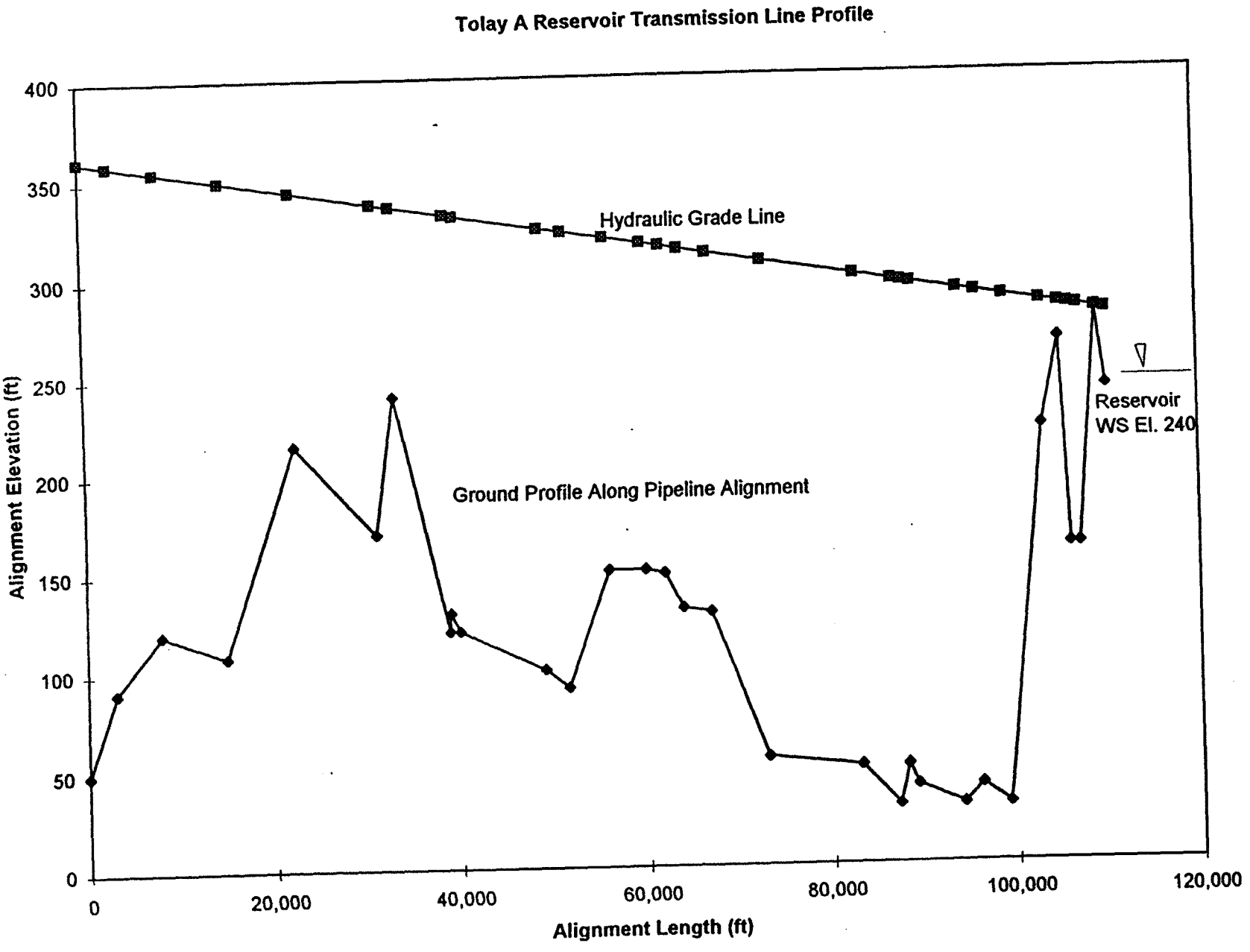

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Figure 5

Adobe Road Reservoir Transmission Line Profile

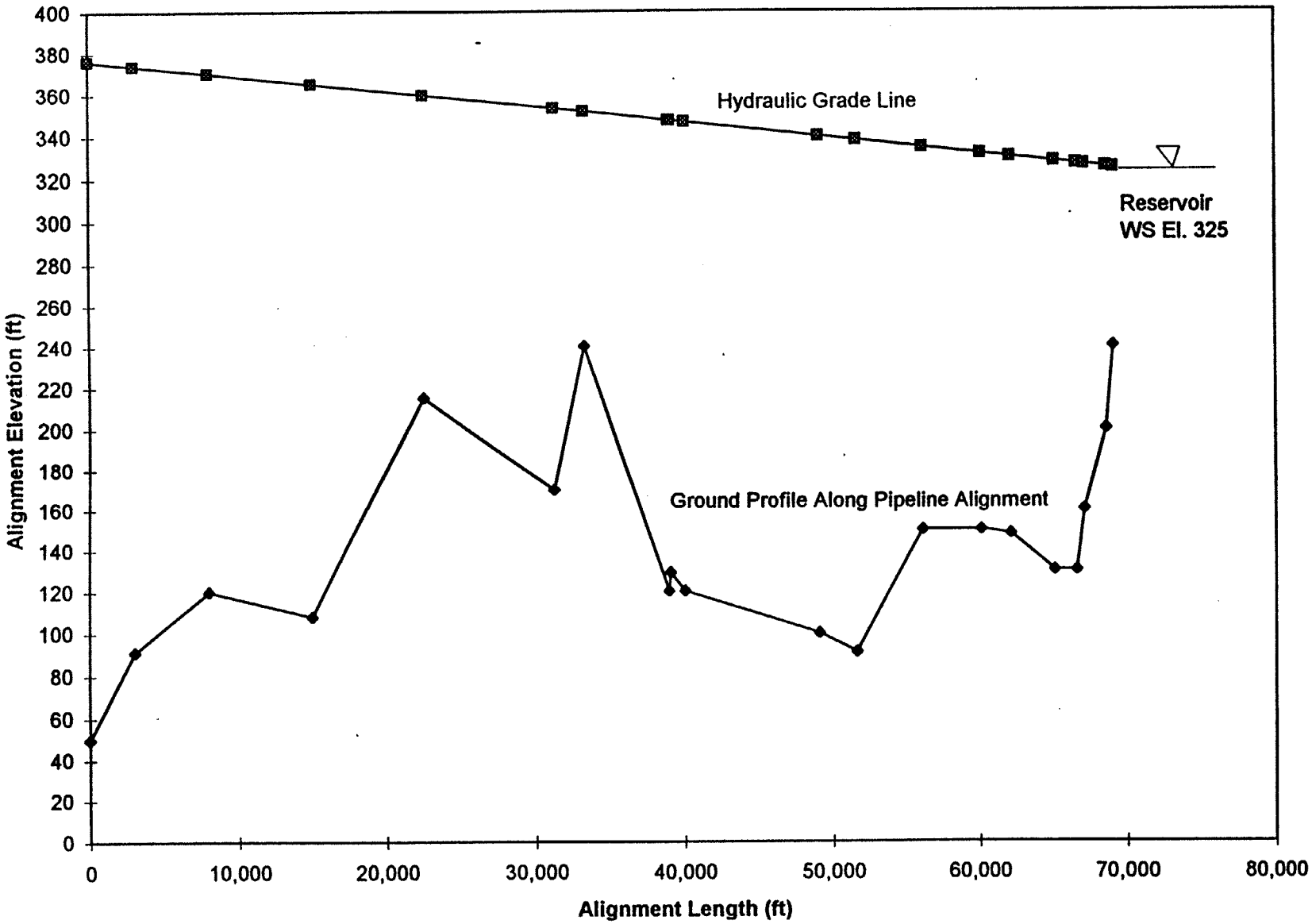

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Figure 6

Lakeville Reservoir Transmission Line Profile

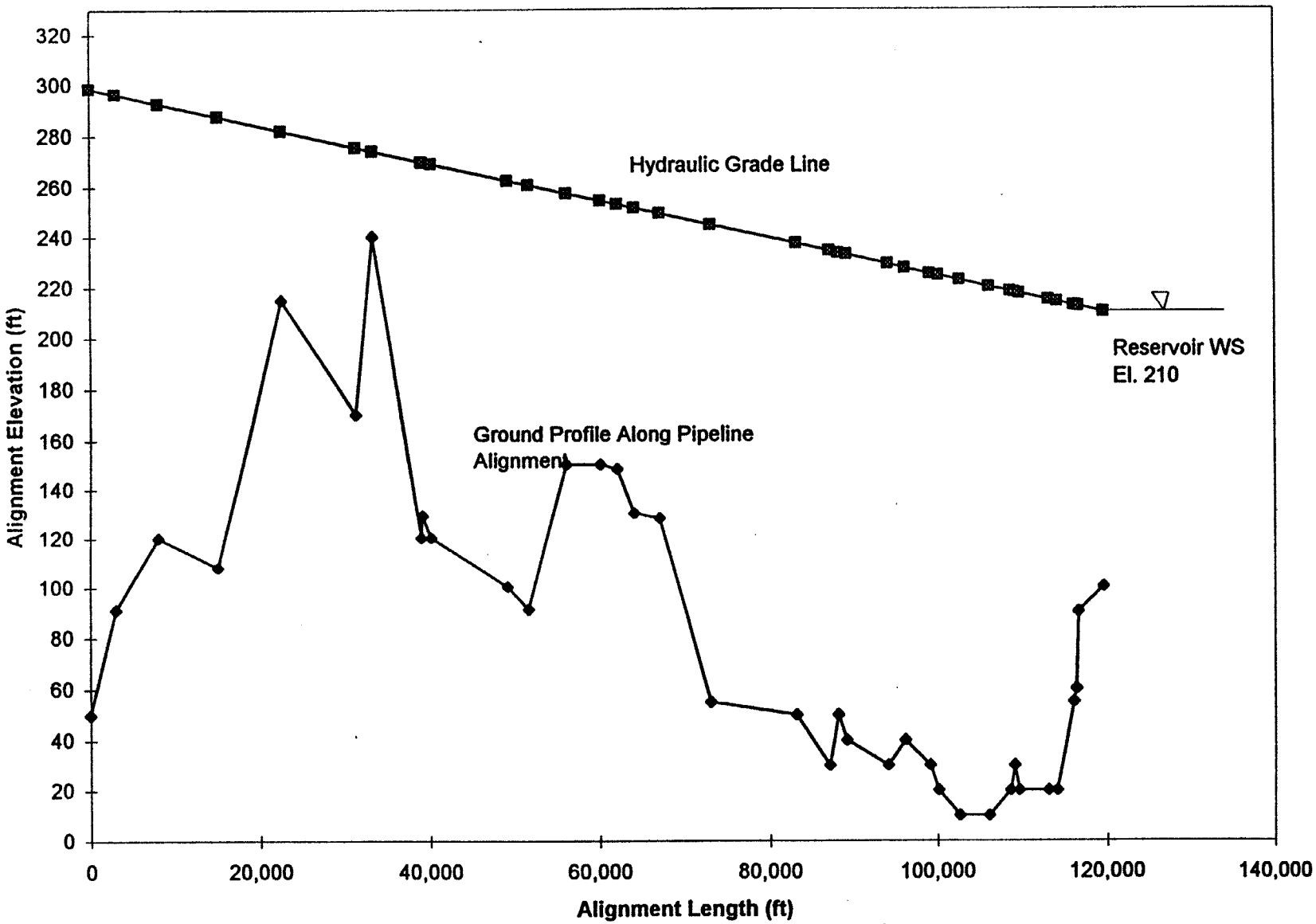

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Figure 7

Tolay C Reservoir Transmission Line Profile

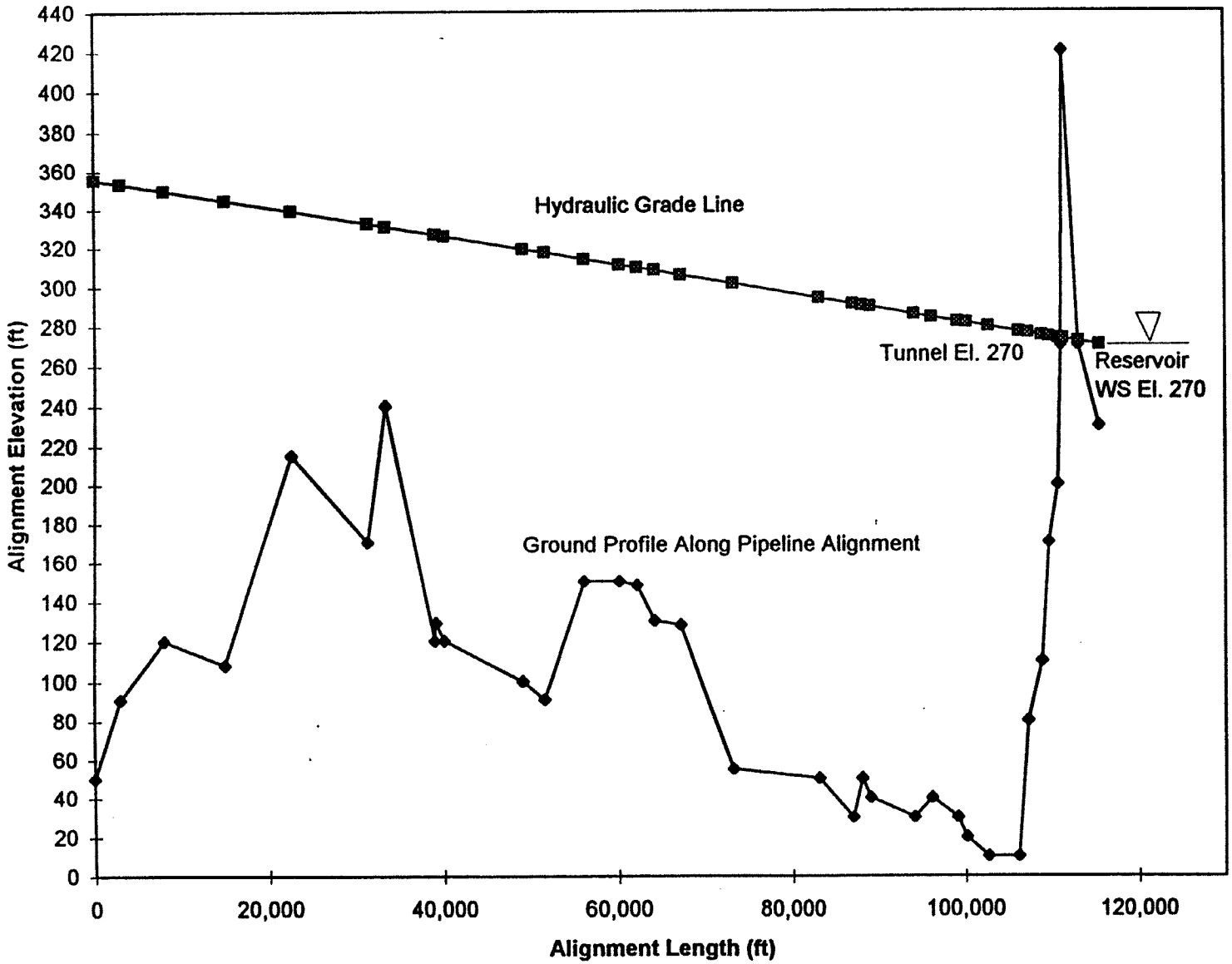

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Figure 8

Sears Point Reservoir Transmission Line Profile

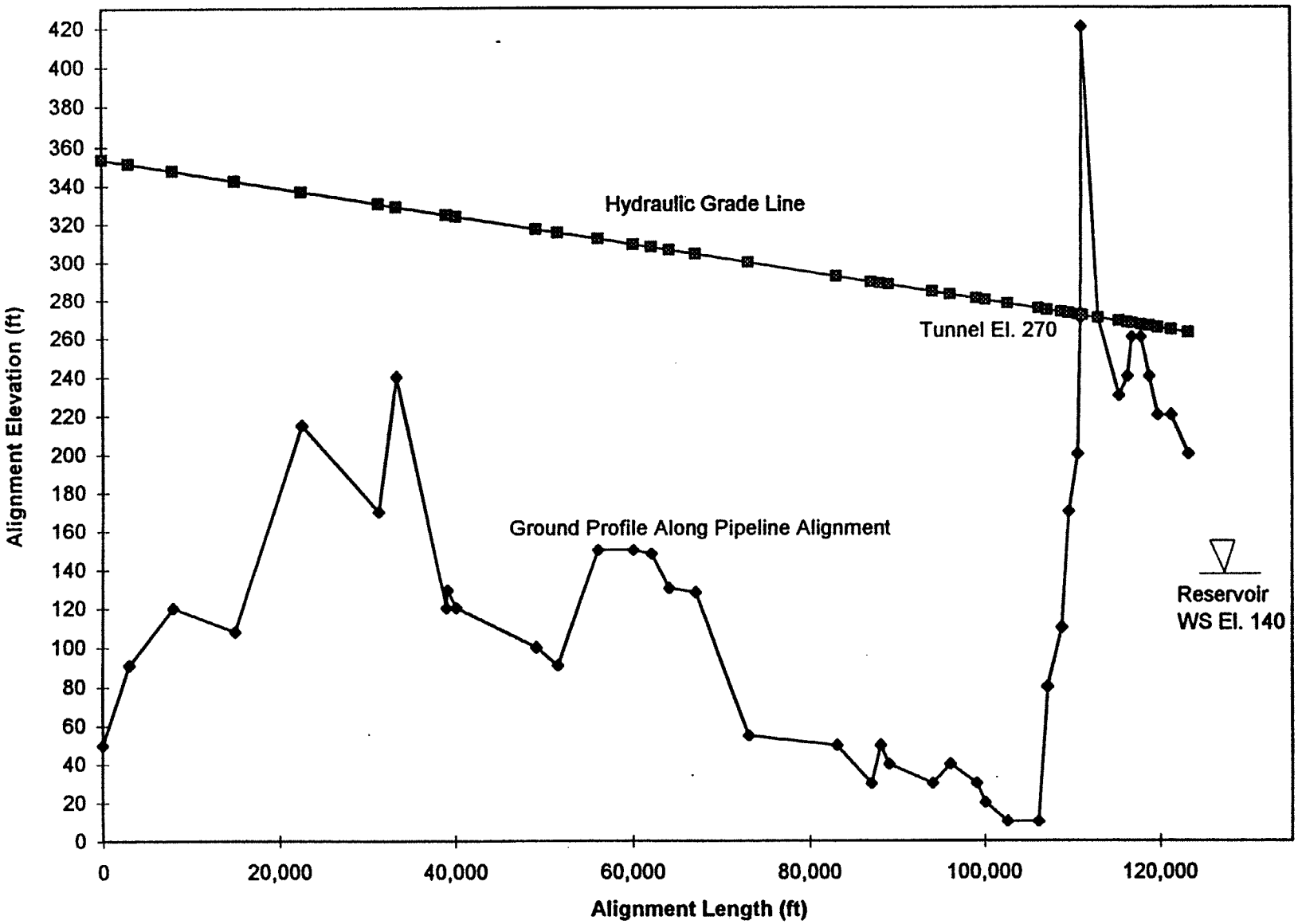

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Figure 9

Two Rock Reservoir Transmission Line Profile

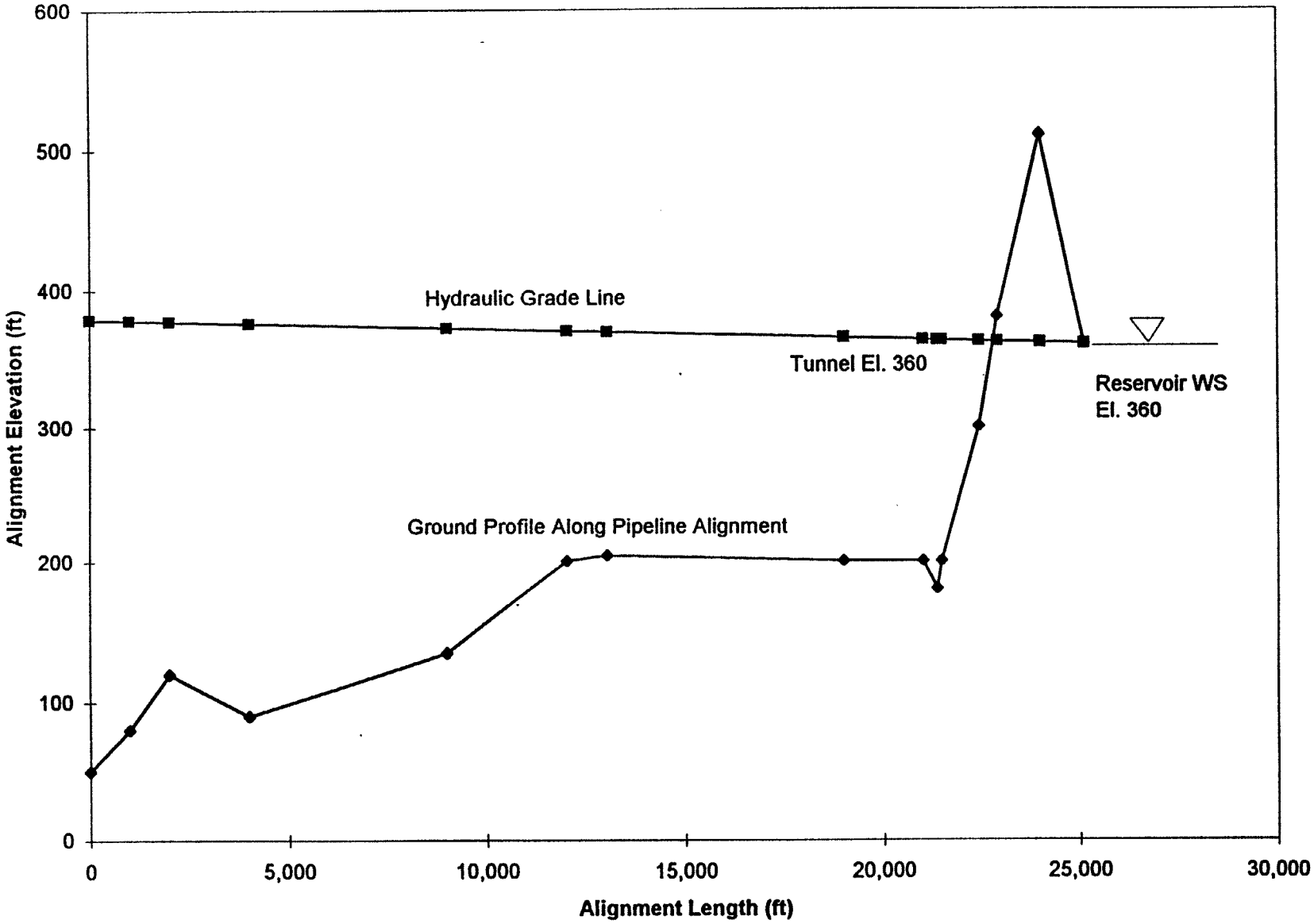

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Figure 10

Bloomfield Reservoir Transmission Line Profile

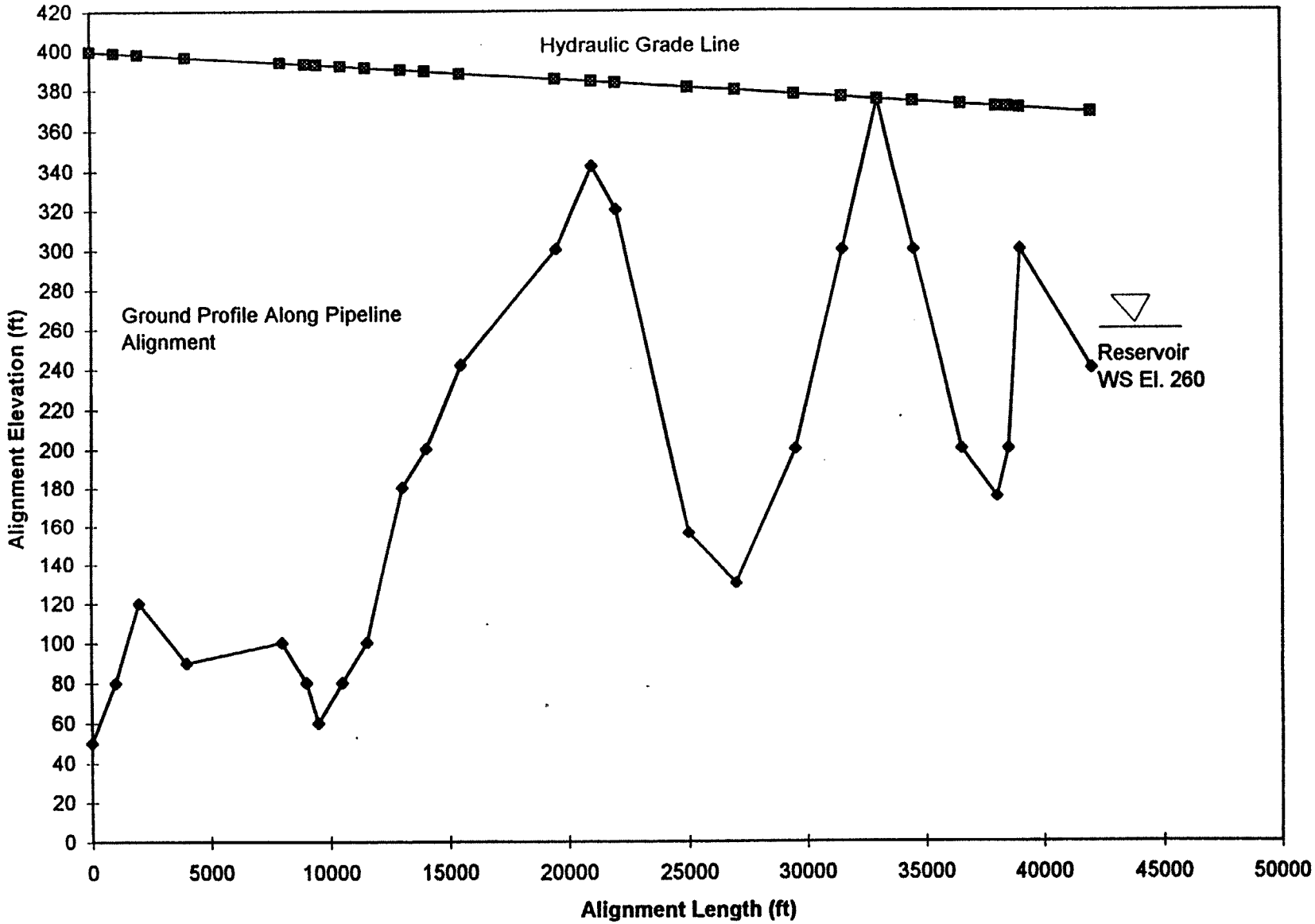

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Figure 11

Carroll Road Reservoir Transmission Line Profile

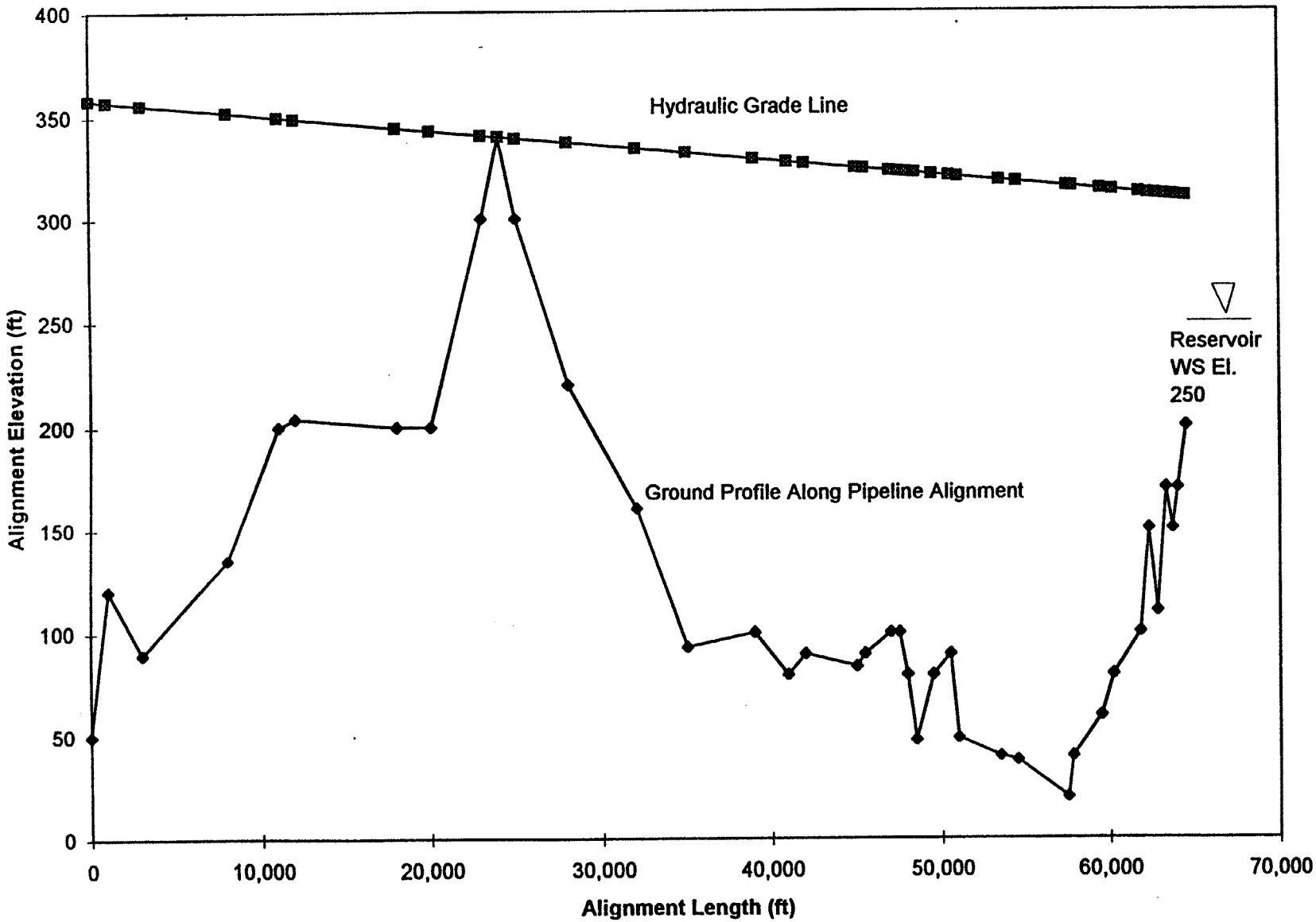

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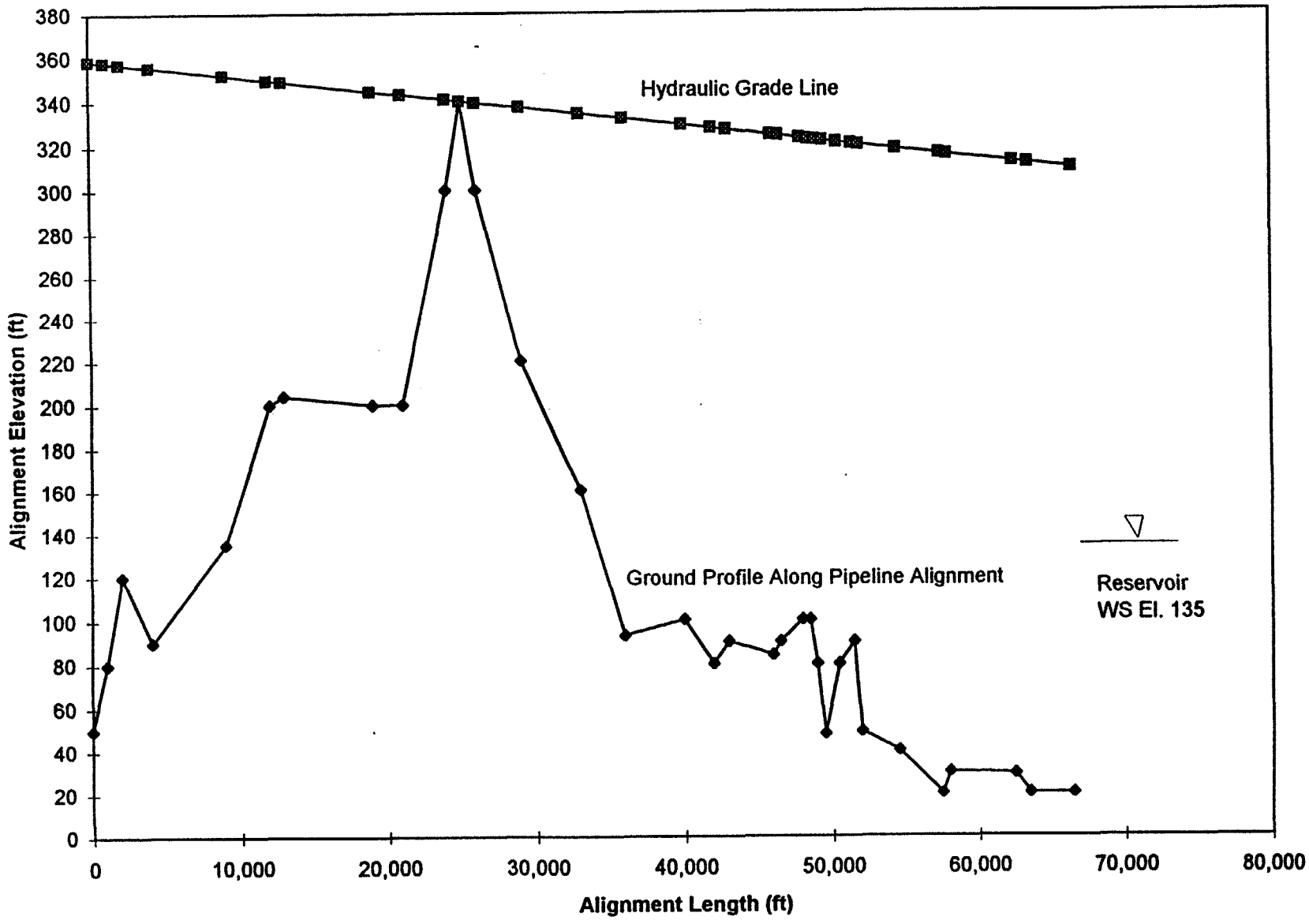
Figure 12

Valley Ford Reservoir Transmission Line Profile



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