

ROSENBERG ASSOCIATES

CIVIL ENGINEERS, DESIGNERS & LAND SURVEYORS

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August 13, 1990

Reed Mathis
St. George/Santa Clara Irrigation Co.
142 West 100 South
St. George, Utah 84770

**SUBJECT: SANTA CLARA RIVER DISTRIBUTION SYSTEM,
UTAH POWER & LIGHT CO. CANAL EVALUATION**

Dear Reed,

Pursuant to your request, Rosenberg Associates has completed this evaluation of the subject canal in regards to amount of water currently being lost between the diversion near Baker Reservoir and the return near Gunlock in Washington County. This is based on recent field investigations and measurements of the canal, a preliminary investigation of the canal made in July-August, 1988, discussions with Mr. Rod Leavitt, Water Commissioner and several of the water users and upon review of a report prepared by Utah Power and Light dated June 28, 1990.

Photographs of the canal have been included with brief descriptions and locations noted.

Diversion to Veyo Plant

The Utah Power and Light canal begins at a concrete diversion upstream from Baker Reservoir. The canal consists of unlined earthen canal, concrete lined canal and short sections of steel pipeline. A 3' parshall flume is located approximately 6,500 feet downstream from the diversion near the Baker Reservoir Campground.

The section of the canal between the diversion and the parshall flume flows across a steep hillside through very thick vegetation and is primarily accessible only by foot. The overbanks along the open canal are covered with lush vegetation which spill into the canal itself routinely. Large willow roots, fallen trees and other debris was observed in the canal. The canal showed no sign of recent cleaning or removal of the vegetation immediately adjacent to the canal. On July 13, 1990 approximately 5.1 cfs was measured at the 3' parshall flume, although the canal was flowing approximately 1/5 of its rated capacity, the water surface level was high and it is anticipated that a substantial amount of water would be lost over the banks if the full flow was being diverted.

Seventeen (17) leaks were documented between the diversion and the flume on July 13, 1990. These leaks ranged from minor leaking joints on the pipeline to major leaks through the canal bottom which surface on the downhill side and accumulate. All of the leaks were either

plainly visible or could be easily heard running substantial amounts of water down the slope. This water is either absorbed into the ground, lost by plant transpiration or evaporation or runs downstream into Baker Reservoir.

From the flume the canal runs for approximately 16,500 feet near the top of a lava ledge around several side canyons to the Brookside area and then across several fields and subdivisions to the entrance to the Veyo Power Generating Station Penstock. This canal appears to be in a similar condition to the reach above the flume. Numerous leaks were heard and observed in this reach. Immediately upstream from the entrance, the canal runs very wide and flat. The canal is unlined and several very large leaks were observed on the downhill side. Meadow grasses and a wetland-like environment was observed downstream from the canal while the upstream bank was a typical dry pinion-juniper environment. It was obvious that the water leaking from the canal and seeping through the ground below the canal has caused these very distinct vegetation changes to occur. Sections of the canal near the entrance to the penstock appeared to have been cleaned within recent years, but the hard to access, upstream portion of this reach showed no signs of recent maintenance.

The penstock feeds the Veyo Power Plant and discharges from the plant into an earthen canal and diversion where additional water diverted from the River below Baker Reservoir is added in. A 3' flume measures the release from Baker Reservoir upstream, but no flume measures the water being diverted from the river into the power canal. The combined canal flow is measured by a 3' flume immediately downstream from the convergence.

Veyo Plant to Upper Sand Cove Reservoir

From the Veyo Plant the canal flows approximately 3,600 feet along the canyon hillside to the first Veyo Users diversion and the entrance to a siphon across the River. It consists primarily of unlined earthen canal with several short steel pipe sections and a short section of concrete lined canal. Six (6) leaks and seeps were observed in this reach. The largest of which occurred only 1,800 feet downstream from the Veyo Plant and within sight of the plant access road. This leak was flowing directly into the River appearing to more than double the flow downstream. Near the exit of the second steel pipe section, debris was clogging the canal and causing a 2' head increase in the canal (see photo). The debris was collected on a very large willow root and sediment indicating that the canal had not been maintained recently. Downstream from the clog the canal was a very wide and accessible by a gravel road. This section of the canal showed recent signs of maintenance and cleaning and was not inundated with roots or debris.

It appears that where a backhoe can get into the canal itself or access the canal freely, the canal is being maintained. During these reaches the canal showed few signs of leaking and only small historical seeps were observed. However when the canal goes around a rock outcropping or along a steep canyon wall or through very thick vegetation, any thing which restricts easy access the canal is not being adequately maintained and the large leaks are occurring.

The first Veyo diversion was diverting 1 cfs according to a 3' parshall flume near the diversion. The balance of flow was entering a 1000 foot long 4' diameter steel pipe siphon which carries flow across the river canyon. A pipe seam leak on the south side of the river was observed spraying water 25' into the air. Substantial vegetation growth near the leak indicated that it has been leaking for some time. From the siphon the canal is a wide earthen canal which is accessible from the south side. This segment of the canal appeared to be in

good condition with the leaks primarily occurring near the four turnouts serving pasture and alfalfa fields downstream from the canal. The turnouts were equipped with slide gates and small parshall flumes except for one which consisted of an open pipe connecting the canal and a well irrigated alfalfa field. A small quantity of water was flowing freely through the pipe and irrigating this field. Again it was noted that where the canal is easily accessible with a backhoe that maintenance was occurring although no very recent cleaning or dredging activities were observed. In total 14 leaks and seeps were observed between the siphon entrance and Highway 18 occurring primarily at the turnouts and difficult to access points of the system during a very low flow period (less than 1 cfs on August 8, 1990). During periods of high flow the number of leaks and the amount of water leaking would be expected to increase dramatically.

A new 3' parshall flume measures the canal flow at Highway 18. From this point the canal flows approximately 9,500 feet around the volcano through an earthen canal to Upper Sand Cove Reservoir. Two (2) major leaks and thirty-three (33) minor leaks and seeps were observed in this reach during a period of low flow (less than 1 cfs on August 8, 1990). The vegetation along the canal is evidence of many of the seep locations. Meadow grasses and willows are visible on the downstream side while vegetation is limited to sagebrush and dry grasses on the uphill side separated by the canal itself. During high flows the losses through this reach would appear to be much higher by the areas where water has flowed historically and vegetation appears downslope from the canal.

Upper Sand Cove Reservoir to the Gunlock Plant

From Upper Sand Cove Reservoir the canal is piped approximately 14,200 feet through a steel pipeline to the Sand Cove Power Plant. Several leaking pipe seams were observed in this reach. From the plant the flow returns to an open earth lined canal flowing approximately 3,900 feet into Lower Sand Cove Reservoir. From Lower Sand Cove Reservoir flow is piped to the Gunlock Power Plant and discharged to an earthen canal which returns to the Santa Clara River above Gunlock Reservoir. A 3' parshall flume measures flow returning to the river.

The canal flows downstream can be regulated by the two reservoirs causing some problems in determining what amount of flow is being stored for future release and what is being lost in the system. Since there is no constant monitoring device on the canal downstream no record of when stored water is released is available.

The pipeline is in relatively good condition with only a few leaks noticed. Several of the leaks were on the steep sections above the plants which are difficult to access with welding equipment.

Conclusions

The Utah Power and Light Canal is obviously losing water to the numerous leaks, seeps, plant transpiration and evaporation which is occurring along its reach between the Baker Reservoir Diversion and the Gunlock Power Plant. While it is expected that some seepage, evaporation and transpiration losses will occur from an open canal with the amount of unlined length that this one has, it appears that the amount of losses occurring due to the major leaks alone is significant.

The open canal appears to function properly where it is maintained in good condition. Several reaches were noted to be in relatively good condition and the number of active leaks was reduced significantly from those reaches in an unmaintained state. The maintained reaches of the canal were in areas where the canal was accessible by a backhoe or similar equipment making maintenance operations easier. In the reaches where the canal is inaccessible by backhoe the canal was in primarily very poor condition with vegetation within the banks and debris clogging flow in the canal and causing overflow to occur under peak flow conditions. These areas are also where the substantial leaks are occurring.

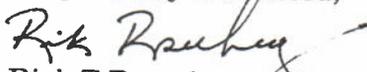
The Utah Power and Light Report concluded that much of the lost water in the upper reaches of the ditch returns to the river and is rediverted for use downstream but this does not account for the additional water being made in the river from springs. This also does not eliminate the need for routine maintenance of the canal in these areas.

The majority of leaks appear to be repairable. This process will require additional effort on the part of Utah Power and Light personnel because of the remoteness and the fact that some reaches are accessible only by foot. It would appear to be more feasible to pipe the canal through these areas in lieu of the routine maintenance required to keep vegetation cleared and leaks plugged. Because the water is being used to generate power and the more water passing through the plants the more power is generated and the more revenues are made, it would appear that Utah Power and Light would try to maximize canal flow by minimizing losses from the system.

Note: On August 7, 1990 Utah Power and Light diverted the entire flow from the canal above Baker Reservoir. A small flow was diverted into the canal at the Veyo Plant and the majority of it was being taken by the Veyo users. On August 8, 1990 Utah Power and Light personnel were observed cleaning the canal near Highway 18 with a small backhoe. Additional personnel were observed repairing pipeline leaks below Upper Sand Cove Reservoir at the same time. These actions are the only times during our inspection of the system that UP & L personnel were observed working on the canal.

If additional information or data is required please contact this office. We appreciate the opportunity of working with the irrigation company on this matter.

Respectfully Submitted,


Rick T Rosenberg, P.E.
Rosenberg Associates

cc. Gerald Stoker

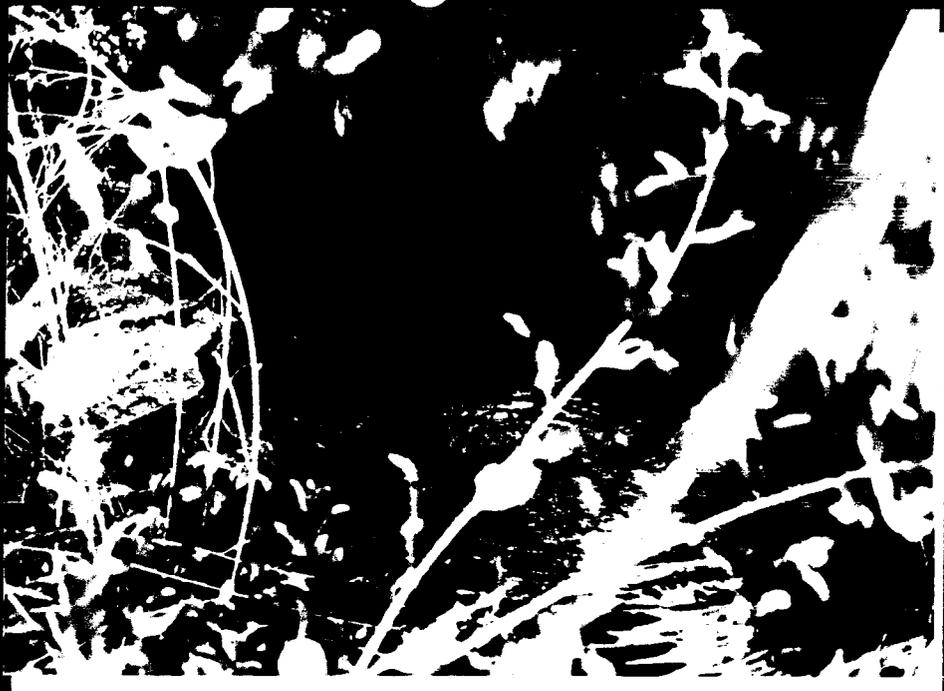


Figure 1. Pipe leak below canal diversion near Baker Reservoir (7/13/90)



Figure 2. Un-maintained earthen ditch vegetation near Baker Reservoir (7/13/90)



Figure 3. Vegetation in ditch and uncontrolled on banks, turnout weir near Baker Res. (7/13/90)



Figure 4. Thick vegetation, brush and trees on banks, deadfall across canal near Baker Res. (7/13/90)



5. Earthen ditch with flow diverted - Note vegetation in bottom and thick overgrowth on banks (8/8/90)



6. Earthen canal above Veyo Plant penstock intake note bank vegetation (8/8/90)

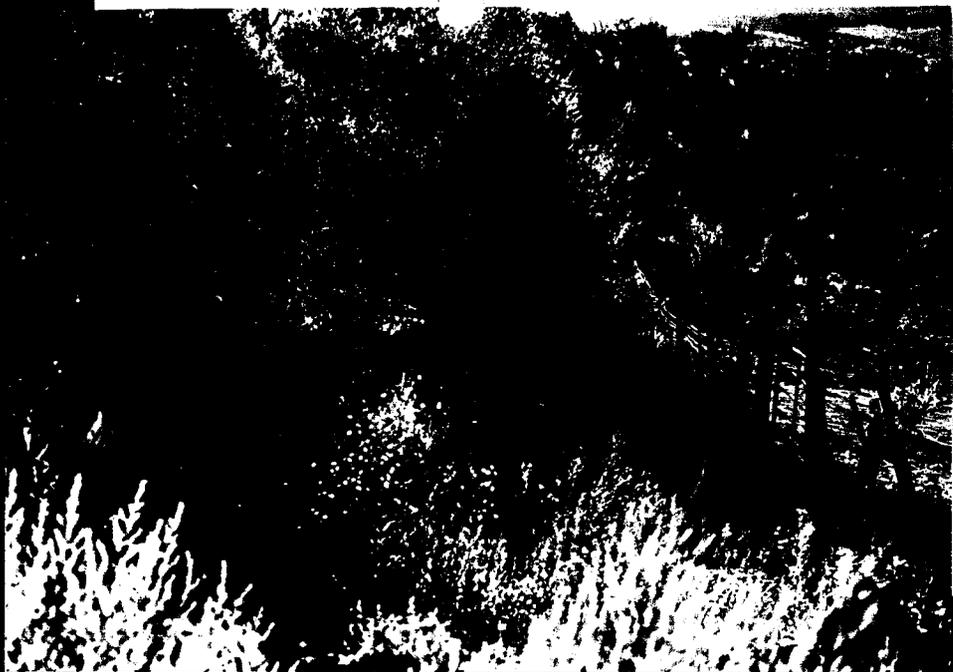


Figure 7. Vegetation below ditch caused by leakage
Near Veyo Plant Penstock intake (8/8/90)



Figure 8. Canal above Veyo Plant Penstock intake -
Note vegetation above ditch compared to
vegetation below ditch (8/8/90)

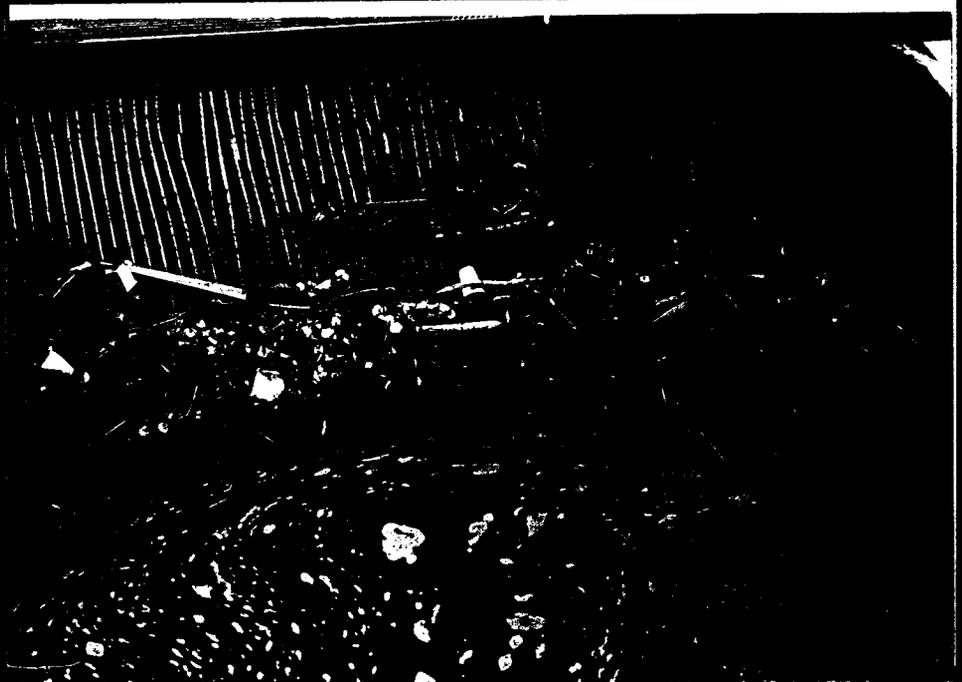


Figure 9. Veyo Plant penstock entrance - note built up debris on trash rack (8/8/90)

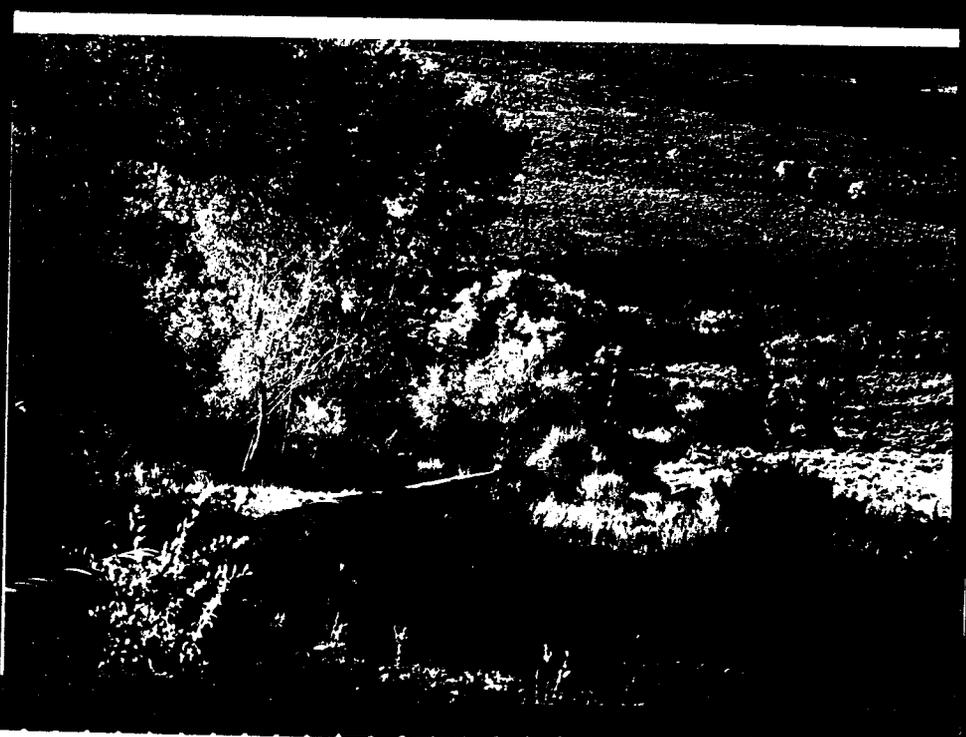


Figure 10. Veyo Plant Penstock (8/8/90)

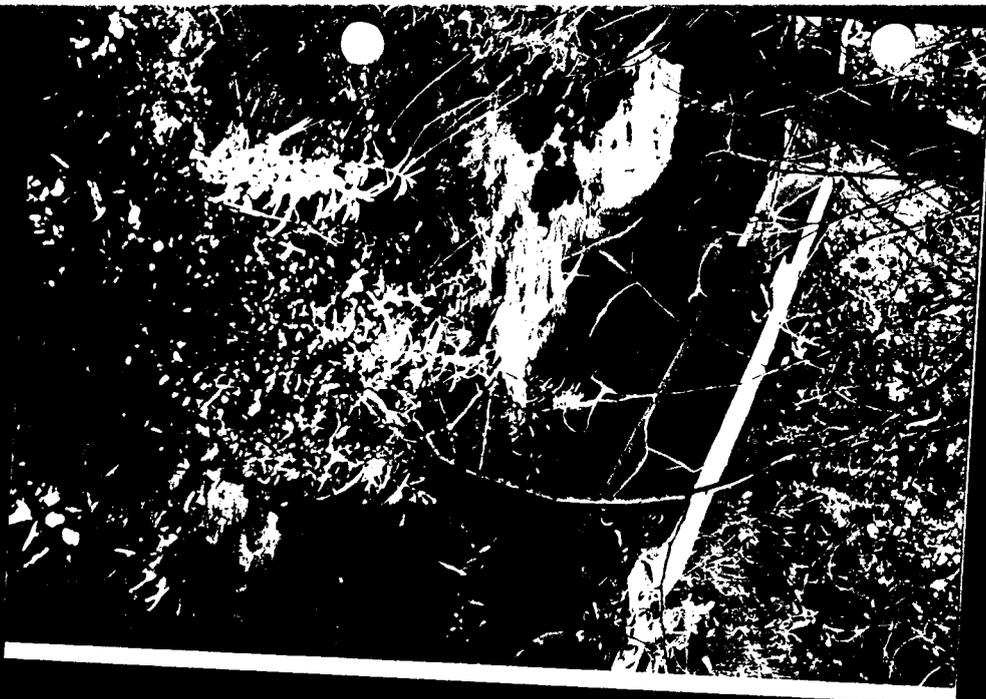


Figure 11. Clogged ditch below Veyo Plant causing 2' head drop under low flow conditions large leak noted below canal. (8/8/90)



Figure 12. Leak below clogged ditch shown in Figure 11. Note pipe installed by property owner for access through leak flow (8/8/90)



Figure 13. Canal below Veyo Plant near an access road for maintenance (8/8/90).

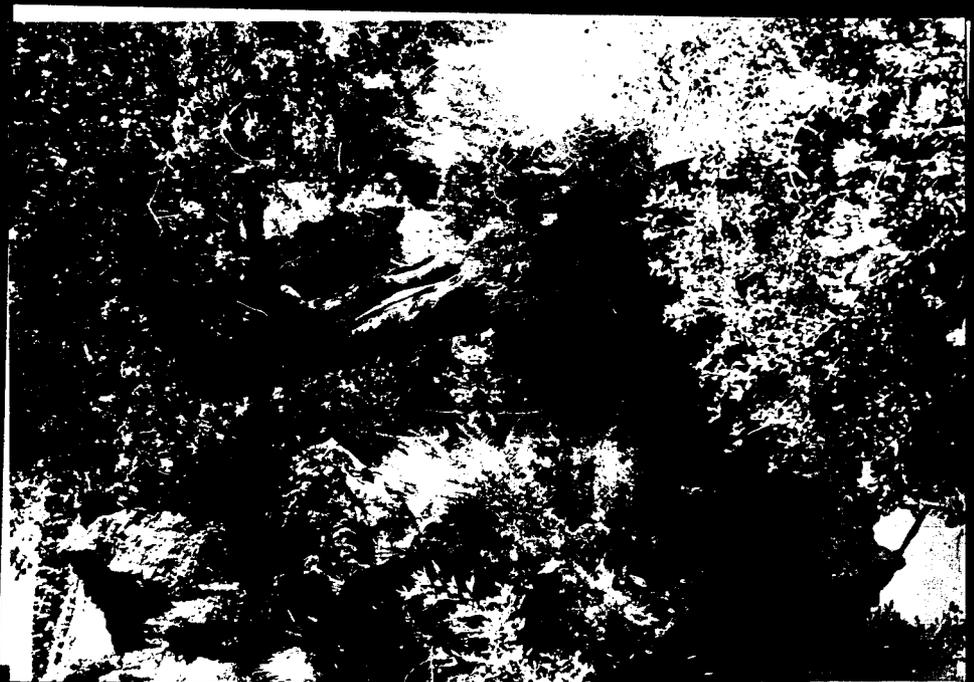


Figure 14. Canal below Veyo Plant in a difficult access area - note vegetation growth concrete was was leaking below (8/8/90)



Figure 15. Siphon line at Santa Clara River - note flow in river caused by springs and canal leaks in \approx 5000' of stream (8/8/90)



Figure 16. Leak in siphon line south of river - note moss growth on pipe and adjacent vegetation growth (8/8/90).



Figure 17. Canal below siphon - note bank vegetation difference upstream vs. downstream (8/8/90)

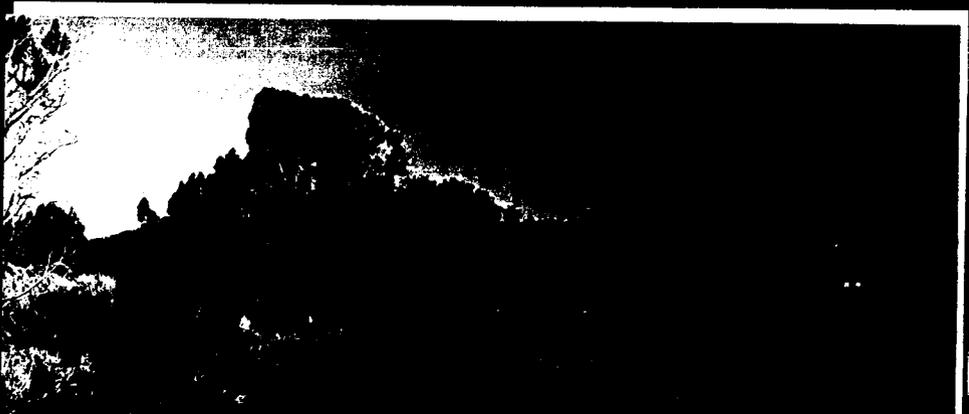


Figure 18. Canal east of Veyo - note thick vegetation on banks and bottom during very low flow conditions, < 1.5 cfs (3/8/90)



Figure 19. Canal near Bailin property. Leaking diversion is feeding green alfalfa field in background. (8/8/90)



Figure 20. Canal south of Bailin property. Maintenance has been completed in past years (8/8/90)



Figure 21. Upstream from leaking canal crossing of dry wash Southeast of Bailin property (8/8/90)

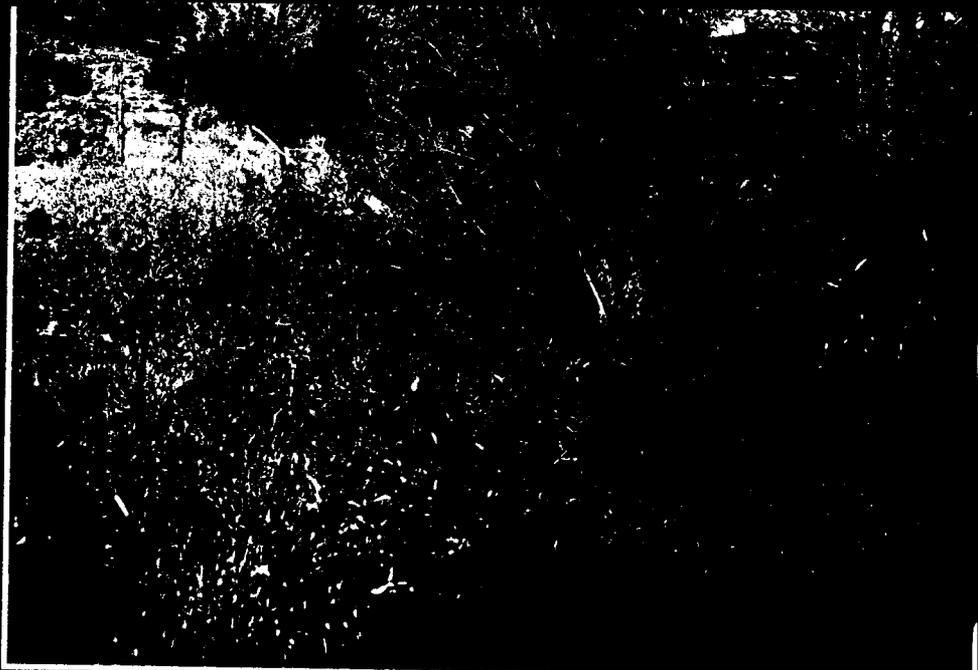


Figure 22. Downstream from leaking canal crossing - same as 21 - notice difference in vegetation. (8/8/90)



Figure 23. UP & L personnel cleaning ditch west of Highway 18 (8/8/90).



Figure 24. UP & L personnel cleaning ditch west of Highway 18 - notice difference between before and after conditions (8/8/90)

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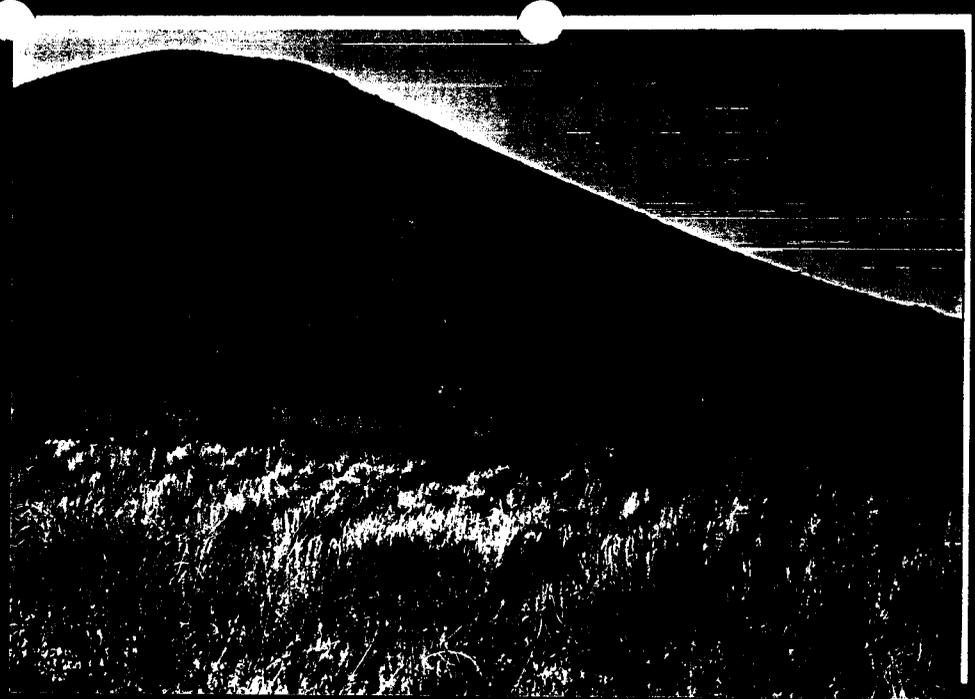
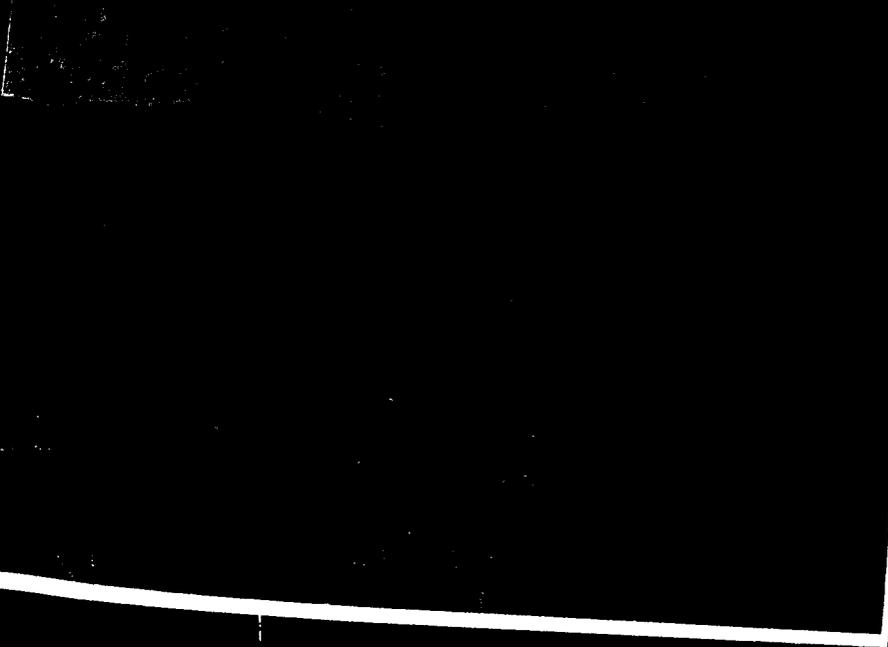


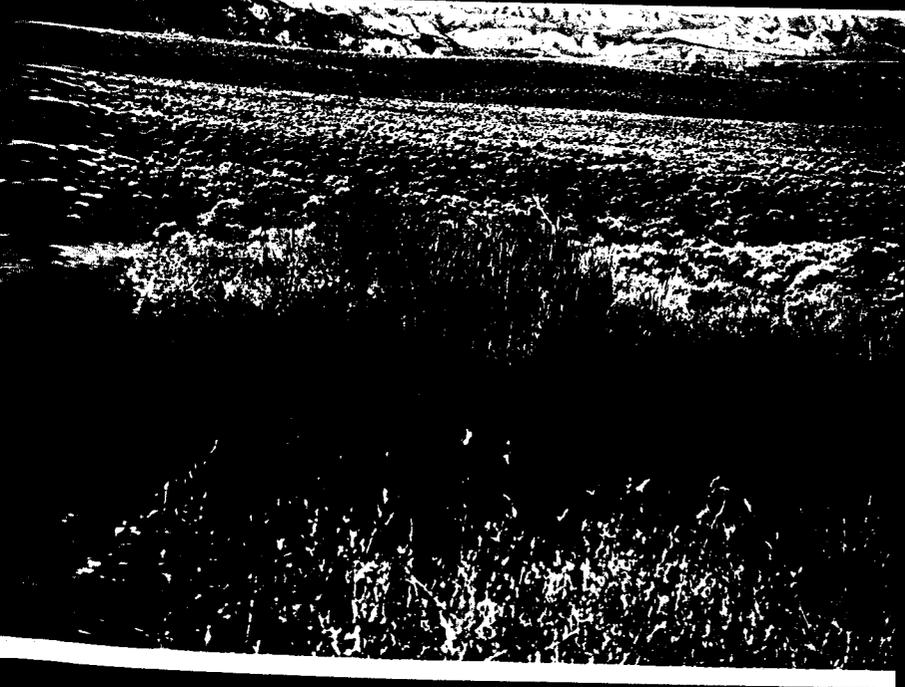
Figure 25. Vegetation along canal on north slope of volcano (8/8/90)



Figure 26. Vegetation in canal and on banks near volcano (8/8/90)



-- 27. Wetland vegetation below canal caused by seepage and leaks (8/8/90)



-- Meadow grasses and wetland vegetation below canal caused by seepage & leaks (8/8/90)

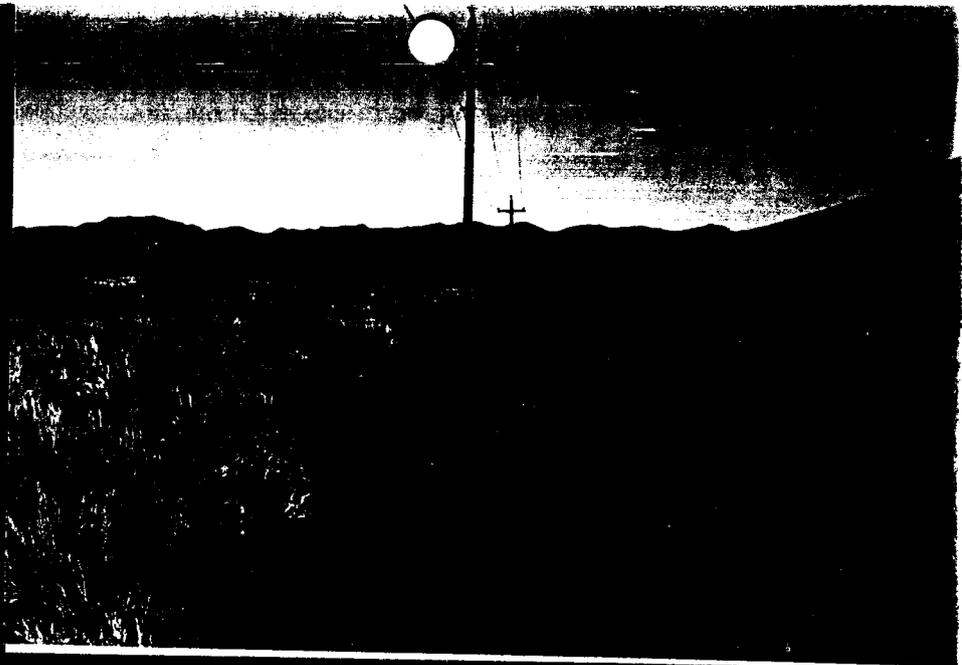


Figure 29. Vegetation along canal east of volcano
(8/8/90)



Figure 30. Meadow grasses adjacent to canal near
Upper Sand Cove Reservoir (8/8/90)



Figure 31. Vegetation on banks above Upper Sand Cove Reservoir (8/8/90).

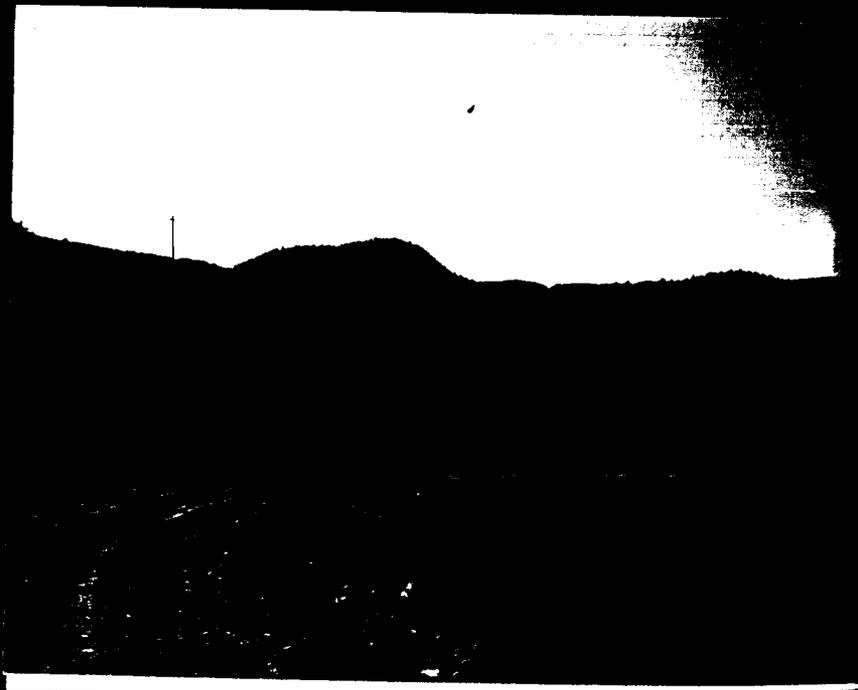


Figure 32. Penstock above Sand Cove Plant - note leak in center of photo (8/8/90)