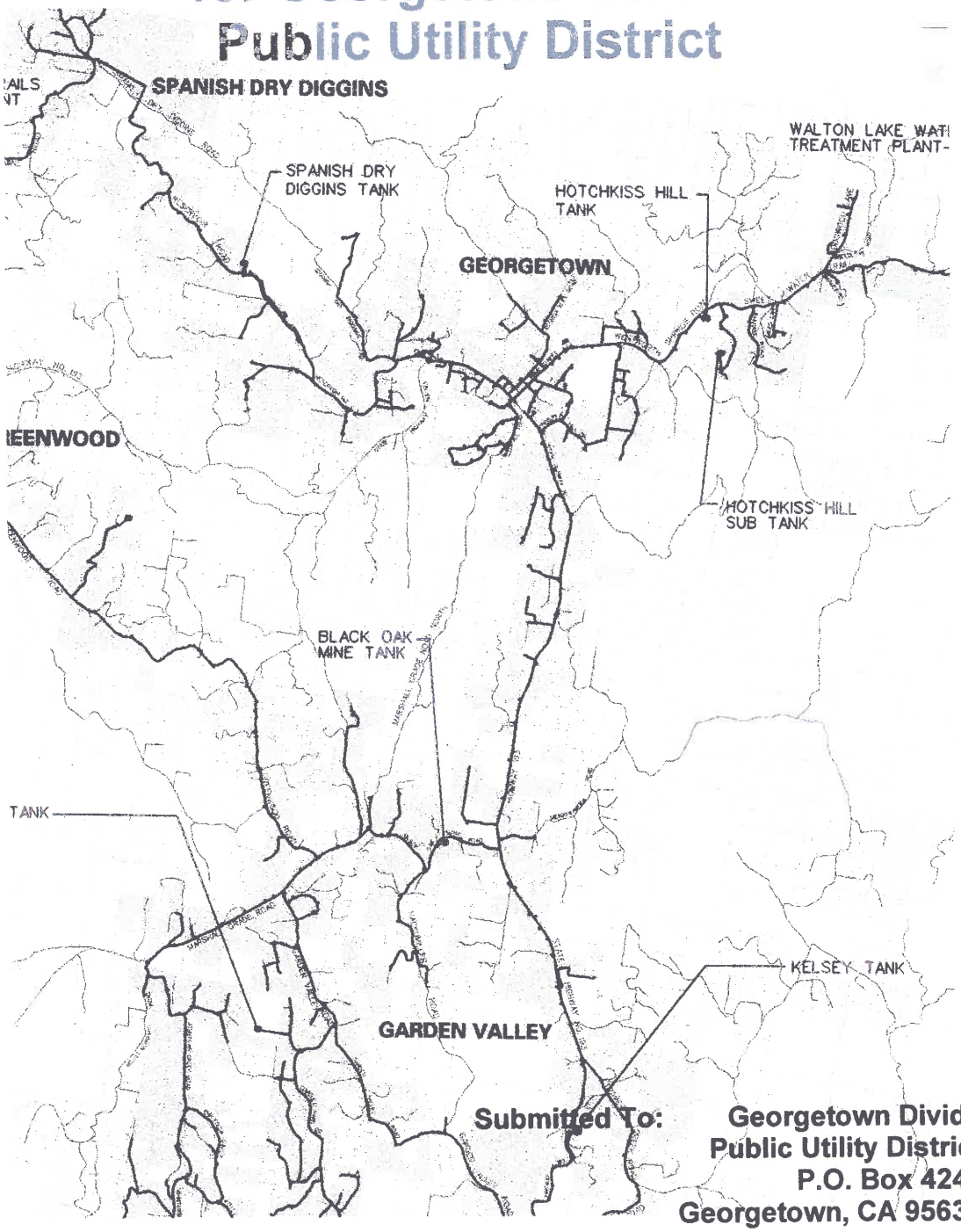
Water System Reliability Study

for Georgetown Divide Public Utility District



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WATER SYSTEM RELIABILITY STUDY FOR GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

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WATER SYSTEM RELIABILITY STUDY FOR GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

I INTRODUCTION

PURPOSE AND SCOPE

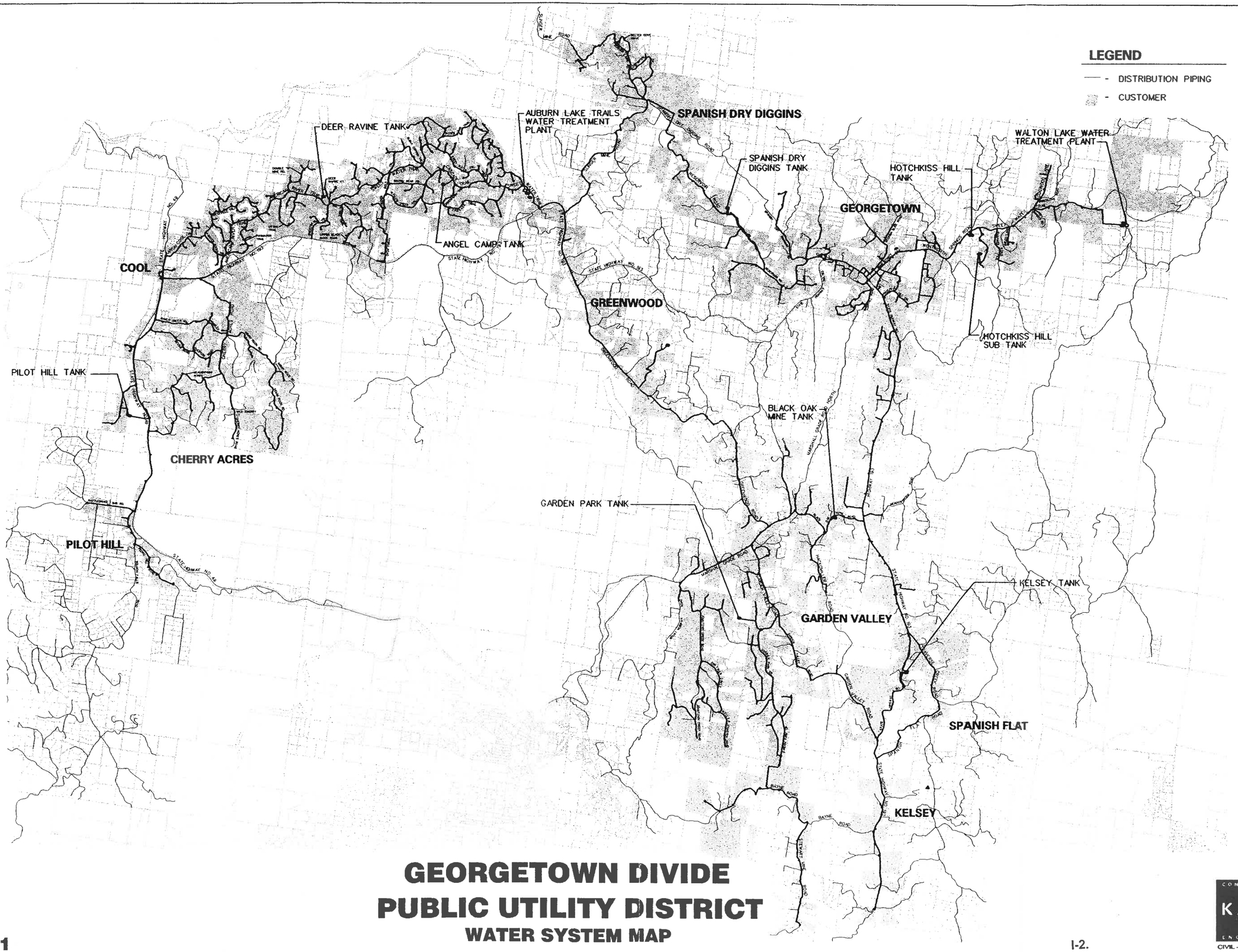
The Georgetown Divide Public Utility District (GDPUD) owns and operates raw water storage and delivery systems and treated water storage, pumping and distribution facilities which serve the El Dorado County communities of Georgetown, Cool, Pilot Hill, Auburn Lake Trails, Greenwood, Garden Valley, Kelsey and surrounding rural areas. Water is supplied from GDPUD's Stumpy Meadows Reservoir. Raw water is delivered to irrigation services and to water treatment plants through a system of open ditches and closed conduits. GDPUD water treatment plants, supplied by the GDPUD ditch system, include the Walton Lakes Water Treatment Plant and the Auburn Lake Trails Water Treatment Plant.

The scope of this Reliability Study includes the mapping and evaluation of some 70 miles of the GDPUD open ditch and raw water piped delivery network and over 200 miles of GDPUD treated water distribution facilities. The purpose of this study is to identify and prioritize repairs, upgrades and measures for both the raw water and treated water systems which should be conducted by GDPUD to reliably meet customer water demands.

This Reliability Study has been funded by a grant obtained by GDPUD from the California Department of Water Resources.

STUDY AREA LOCATION

The GDPUD water service area is located in north-central El Dorado County. The GDPUD treated water system map is presented in **Figure I-1**. The GDPUD ditch system map is presented in **Figure I-2**. The study area begins at the Pilot Creek Diversion Dam located approximately 11 miles east of Georgetown at elevation ±3780 and extends to the community of Kelsey, approximately 8 miles south of Georgetown at elevation ±2020 and to the community of Pilot Hill, approximately 12.5 miles southwest of Georgetown at elevation ±1300.



GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

WATER SYSTEM MAP

FIGURE I-1

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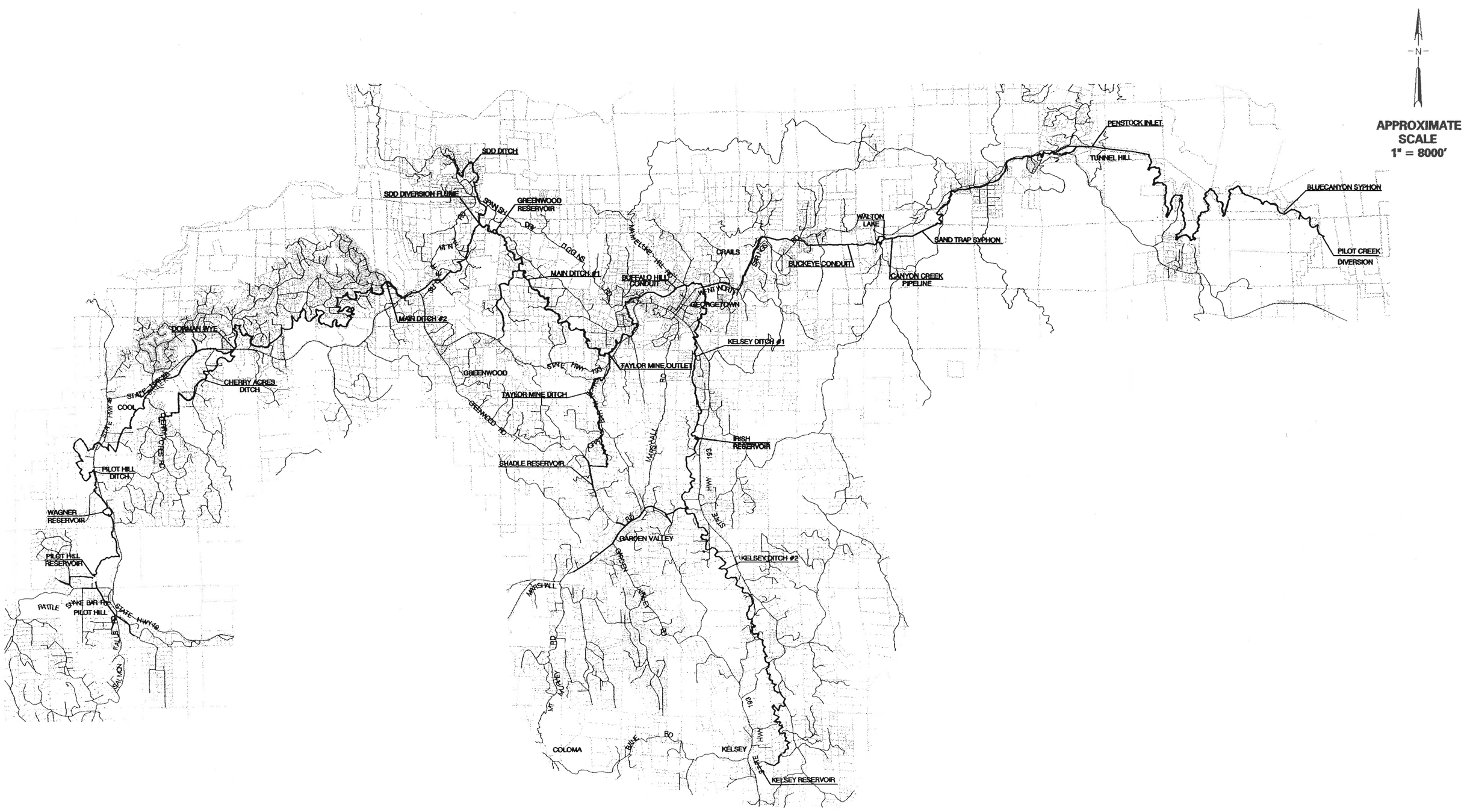

GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

DITCH WATER SYSTEM MAP

FIGURE I-2

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RELIABILITY STUDY OVERVIEW AND ORGANIZATION

This Reliability Study has been conducted as a joint effort between GDPUD engineering, management and field operations staff and KASL Consulting Engineers. GDPUD conducted the grants administration and project management. Public reports and presentations were provided during the course of this study by GDPUD staff and by KASL to advise the GDPUD Board of Directors and the public of the progress of this study. Specific tasks conducted by KASL for this Reliability Study included:

- System Inventory / Data Collection
- Water Demand Projections
- Performance and Design Standards
- Systems Analysis
- Alternative Feasibility Analysis
- Reliability Study Report

Findings and Recommendations of this Reliability Study Report are summarized in Section II of this report and are also included in the GDPUD Ditch System Maps and Treated Water Network Reliability Exhibits which are submitted as exhibit attachments to this Reliability Study.

System Inventory and Data Collection (Section III)

GDPUD raw water and treated water delivery, pipeline and distribution facilities were mapped using Global Positioning System (GPS) technology. The results of this mapping effort are summarized in Section III. GPS gathered coordinates and elevations were mapped at 1" = 400 scale. The system mapping conducted for the raw water and treated water systems were prepared compatible with countywide Geographic Information System (GIS) maps prepared by El Dorado County. Coordinating the GPS system mapping horizontal control used for this Reliability Study with the GIS control system used by El Dorado County allowed the location and alignment of GDPUD raw water and treated water facilities to be "layered onto" the road and parcel base maps prepared by El Dorado County. The raw water and treated water system maps prepared for GDPUD for the Reliability Study are discussed in Section III and are submitted as exhibit attachments.

Water Demands (Section IV)

This Reliability Study uses GDPUD water demand data available for the period of 1996 through 2001. Water demand information available for some 3000 domestic water services and provided in two-month demand (meter reading) increments were evaluated and quantified. Presented in Section IV of this study are the results of this analysis. GIS information available from El Dorado County including land use descriptions and zoning codes were applied to each parcel to identify GDPUD services by land use and by acreage. Average day demands and maximum day demands were then calculated

by land use category. Land Use categories included residential small acreage, residential medium acreage, residential large acreage, agricultural, commercial, industrial and public use. Demands were also identified by GDPUD region and zone. For the purpose of this Reliability Study the GDPUD treated water distribution service area was divided into three regions:

- Garden Valley / Kelsey
- Walton Lakes / Georgetown / Spanish Dry Diggins
- Auburn Lake Trails / Cool / Pilot Hill

As further described in Section IV these regions have been further divided into some 24 pressure zone sub-regions.

Water demands of the raw water delivery and distribution system have also been divided into three sections. These correspond to the principal ditch segments of the GDPUD raw water system which are:

- Upcountry Ditch
- Main Ditch / Pilot Hill Ditch
- Kelsey Ditch

Raw water demands and ditch design flows for each segment were determined from GDPUD raw water meter data collected at the Tunnel Hill Measuring Flume and the Buckeye Measuring Flume and from water treatment plant demands at Walton Lakes and Auburn Lake Trails.

Performance and Design Criteria (Section V)

As part of the scope of this Reliability Study, improvement standards have been prepared for GDPUD water treatment, storage, distribution and service facilities. Recommended improvement standards together with standard drawings have been submitted to GDPUD. Recommended GDPUD Water System Improvement Standards are summarized in Section V. These are compared to EID and PCWA Improvement Standards.

Design and performance criteria for the raw water ditch conveyance system and for raw water conveyance structures (culverts, pipelines, etc.) are also presented in Section V.

System Analysis (Section VI)

The raw water conveyance system was analyzed in the field with GDPUD ditch system operators. Findings, the performance of specific ditch systems and the history of repairs and maintenance were then reviewed with GDPUD engineering operations staff. Each section of the open conveyance ditch system was "pre-marked" ahead of GPS survey crews. Previous ditch repairs, known or suspected loss areas, high

maintenance segments, low freeboard areas, ditch segments which had been lined or replaced with closed conduits, ditch structures and ditch appurtenances, were identified in the field so that the location and limits of these features could be included in the raw water system mapping.

After the initial raw water system mapping was conducted, a field check of the mapped ditch segments was performed. Each of the ditch sections was again reviewed in the field with the ditch operators. The significance and conditions of previous repair areas, the significance of known or suspected loss areas, areas of known or suspected instability and the accuracy of the initial mapping effort was checked. Corrections to the raw water system maps were made to more accurately reflect the ditch system improvements and conditions. Revised ditch system maps were also submitted to GDPUD engineering and operations staff for review.

Open channel flow analysis was conducted for each segment of the open ditch. With ditch slope and typical ditch cross section determined in the field the capacity of each ditch segment to carry design flows with at least the minimum freeboard allowance was determined. The capacity of each closed conduit and the capacity of each culvert crossing was also checked. Details of these calculations and capacity determinations are included in Section VI. Recommended raw water conveyance measures to improve system reliability are discussed in Section VII.

To evaluate the treated water transmission and distribution system WaterCad distribution system modeling software developed by Haestad Methods was used. The GDPUD water distribution systems were created from the field mapping conducted as part of the system inventory and data acquisition task and from available GDPUD water system improvement plans. Once the water system networks were created from the field mapping, pipe diameters, junctions and system parameters (water storage tank and water surface elevations, pump characteristics, PRV settings, normally open and closed valves, etc.) were reviewed with GDPUD staff. The network models developed for the Walton Lakes System and the Auburn Lake Trails System were then calibrated. Steady static pressure readings were conducted in the field and compared to pressure readings predicted by the network models for demands typical of the period that field measurements were taken. Adjustments to the models were then made to accurately reflect measured field conditions. Fire hydrant flow tests were then performed throughout the Auburn Lake Trails and Walton Lakes Systems. Actual fire hydrant flows and pressures were compared to results predicted by the network models. Adjustments, as necessary, were made to pipe roughness and network system parameters. Fire hydrant tests were repeated until close correlation between actual and predicted results were achieved. Once the GDPUD treated water networks were accurately modeled and calibrated the ability of the existing distribution systems to reliably meet existing maximum day demands, maximum day plus a 5% increase in demands, maximum day plus a 10% increase in demands and maximum day plus fire flow demands were tested. The result of this analysis is included in Section VI. Recommended treated water system measures to improve system reliability are described in Section VIII.

Ditch System Reliability Measures (Section VII)

Measures recommended to enhance ditch system reliability and performance are described in Section VII of this Reliability Study. These were reviewed with GDPUD staff and prioritized. Ditch system modifications proposed for public health and safety are assigned the highest priority. Measures which increase system reliability and help ensure the supply for raw water to GDPUD water treatment plants are assigned a higher priority than modifications proposed downstream of water treatment supply intakes. Measures designed to ensure the continued delivery of existing raw water flows and to reduce conveyance losses are assigned a higher priority than measures suggested to enhance capacity.

Treated Water System Reliability Measures (Section VIII)

Measures recommended to enhance the treated water system reliability and performance are described in Section VIII of this Reliability Study. System improvements to reliably meet maximum day demands and to reliably meet maximum day plus fire flow demands were evaluated using the WaterCad network analysis. Water distribution system loops to provide alternative or enhanced water delivery paths, replacement of critical water mains with larger diameter pipe or with parallel mains and the replacement of old pipe section which have poor hydraulic sections with new, smooth, pipe are typical of network alternatives considered to improve system reliability. The benefits realized with each alternative were compared on the basis of costs, feasibility and performance. Recommended reliability measures, together with the prioritization of improvements were reviewed with GDPUD staff.

ACKNOWLEDGEMENTS

As previously noted this Reliability Study was conducted as a joint effort of the Georgetown Divide Public Utility District and KASL Consulting Engineers. KASL gratefully acknowledges GDPUD management, engineering and field operations personnel for their valuable assistance and participation in this study including:

Henry White	-	General Manager
Steven Gau	-	Operations Manager
Pete Hereford	-	Supervisor / Distribution
Don Schwagel	-	Ditch Superintendent
John Simons	-	Ditch Superintendent
Jack Bohn	-	Ditch Superintendent
Kelly Kawashima	-	Administrative Assistant
Delores Barron	-	Administrative Assistant
Marie Davis	-	Past General Manager

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II SUMMARY

The findings and recommendations of the GDPUD Network Reliability Study are summarized in this section.

PURPOSE

The purpose of this Study is to identify and prioritize repairs, upgrades and measures to ensure that GDPUD raw water and treated water distribution and storage networks reliably meet customer demands. This Reliability Study shall serve as the basis for the implementation of cost effective raw water and treated water improvements. It is intended that this Study assist GDPUD in developing a Capital Improvements Program so that reliability measures can be budgeted and scheduled. It is intended that this Study serve as the basis for low interest construction loans and water system improvement grant applications available from State and Federal agencies.

The analysis and recommendations presented herein help prioritize the completion of remedial work. Design and operational criteria and system demands are developed so that GDPUD engineering and operations staff can effectively proceed with structural and non-structural upgrades and repairs and effectively utilize available maintenance and improvement funds. This Study also provides the necessary network model development, demands and criteria to help GDPUD staff evaluate proposed extensions or modifications to the existing distribution systems.

SCOPE

The scope of this Reliability Study includes the mapping and evaluation of approximately 70 miles of the GDPUD raw water delivery and raw water storage network and approximately 200 miles of the GDPUD treated water pumping, storage and distribution system. The scope of this Study does not include evaluation of the Stumpy Meadows Reservoir and does not include evaluation of the Walton Lakes Water Treatment Plant or the Auburn Lake Trails Water Treatment Plant.

SYSTEMS INVENTORY AND MAPPING

To effectively evaluate the condition and performance of both the raw water and treated water systems, inventory and mapping of existing distribution and storage facilities was conducted. Both the raw water and treated water networks were mapped using GPS technology. Mapping was conducted at 1" = 400' scale. A survey control network was established within and around the GDPUD service area. This network permitted mapping accuracy to ±1 foot, both horizontal and vertical. The GPS mapping

conducted for this Study takes advantage of the GIS mapping recently conducted by El Dorado County. GPS-gathered data was best fit to the County's parcel and roadway mapping.

Reduced size, GDPUD treated water system maps (21 sheets) completed for this Study are included in the Appendix. Network maps are prepared for storage and distribution systems served by the Auburn Lake Trails (ALT) Water Treatment Plant and by the Walton Lakes (WL) Water Treatment Plant. The treated water distribution system mapping completed for this Study includes pipe alignment, size and junctions, water storage tank elevations, pump station operating characteristics and pressure reducing valve set points. The system mapping conducted for the GDPUD treated water systems is a compilation of field surveys, as-builts, water system improvement plans and GDPUD-supplied operations information. The water system maps, prepared so that computer network modeling and analysis could be conducted, also provide a valuable data and inventory resource tool for GDPUD engineering and operations staff.

Reduced size, GDPUD raw water system maps (22 sheets) completed for this Study are included in the Appendix. Ditch system maps are prepared for the Upcountry (UC), Main / Pilot Hill (PH) and Kelsey (K) ditch systems. The raw water system maps include the location, alignment, slope and capacity of each raw water ditch and pipeline segment. The location and limits of existing ditch system improvements (piped sections, lining, culverts, wastegates, structures) are shown. Highlighted on the maps are priority repair areas recommended as part of this Study. The raw water mapping provides an accurate inventory of the main ditches, lateral ditches and irrigation pipelines. Similar to the treated water system mapping, raw water system maps were best fit to the El Dorado County parcel and road base maps. Full size and half size reduction ditch system maps prepared for this Study have been provided to GDPUD. While the ditch system maps were prepared to evaluate the performance and condition of the raw water delivery system they also serve as a valuable resource for the ongoing operation and maintenance of the GDPUD raw water system.

WATER SYSTEM DEMANDS

For the purpose of this Study GDPUD treated water system demands were determined by region, by pressure zone and by land use. A summary of demand results for residential land uses, by region, is as follows:

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GDPUD Average Day and Maximum Day Residential Water Demands (gallons per day / unit) by Region

Land Use	Garden Valley / Kelsey		Walton Lakes, Georgetown, Spanish Dry Diggins		ALT / Cool / Pilot Hill	
	Avg. Day	Max. Day	Avg. Day	Max. Day	Avg. Day	Max. Day
Small Acreage Residential	295	750	360	915	435	1045
Medium Acreage Residential	425	1070	390	990	510	1225
Large Acreage Residential	475	1200	450	1140	550	1320

The average and maximum day residential water demands presented above compare well with El Dorado Irrigation District Standard Water Demands for the EID Central Region.

Water demand findings for residential, agricultural, commercial, industrial and public land uses and for each of the 24 pressure zones identified for the GDPUD water service area are presented in Tables IV-1, IV-2 and IV-3 of this Study. Average day and maximum day water demand findings were used to calibrate the network model and to conduct the system analysis.

Ditch design flows are also presented in Section IV. A summary of peak summer time ditch flows, by segment is as follows:

GDPUD DITCH DESIGN FLOWS

GDPUD Ditch Section	Design Flows (cfs)
Upcountry	
Above Tunnel Hill	32 to 35
Tunnel Hill to Walton Lakes	32 to 35
Walton Lakes to Crails	27 to 30

Main / Pilot Hill		
Main Ditch No. 1	16 to 20	640 mI
Main Ditch No. 2	12.5 to 16.5	500 mI
Pilot Hill Ditch	3 to 12	120 mI
Kelsey		
Kelsey Ditch No. 1	8 to 10	320 mI
Kelsey Ditch No. 2	3 to 8	120 mI
Spanish Dry Diggins	2 to 3	80 mI
Taylor Mine	3 to 5	120 mI
Cherry Acres	2 to 3	80 mI

In Section IV ditch design flows are further segmented into specific ditch segments. Ditch design flows are compared to ditch capacity determinations.

PERFORMANCE AND DESIGN CRITERIA

Prior to the preparation of this Reliability Study, GDPUD had no formally defined performance and operation criteria for either the treated water or the raw water system. Recommended Water System Improvement Standards have been prepared as part of this Study and submitted to the District. Performance and design criteria included in these Standards for treated water system demands, fire flows, treated water storage, transmission mains and design pressures are presented in Section V. These include:

RECOMMENDED PERFORMANCE AND DESIGN CRITERIA

Fire flows:	500 gpm per hydrant for Single Family and Duplex Residential land use areas Min. 20 psi delivery pressure
Treated Water Storage:	Min. Capacity, 250,000 gallons
Fire Storage Reserve:	4 hours of design fire flow
System Peaking Storage:	20% of the total daily fire flow
Emergency Storage:	Min. of 4 hours under maximum day demands
Transmission Main Size:	Min. 8-inch diameter mains to deliver max. day demands at less than 10 ft/sec.

Transmission Main Material:	PVC C-900 or C 905, CL 150 / 200 or DIP CL 200 min.
Design Pressures:	Not less than 35 psi and not more than 115 psi at the meter
Min. Pipe Cover:	3 feet
Raw Water Storage:	Not less than 50 ac-ft available to Walton Lakes and Auburn Lake Trails Water Treatment Plants
Ditch System Culvert and Pipe Criteria:	Per Table V-2
Min. Allowable Ditch Freeboard:	1 to 2 feet for Upcountry Ditch; 6 inches to 1 foot for other GDPUD ditches

SYSTEMS ANALYSIS

Treated Water

Treated water distribution models were developed for both the Auburn Lake Trails water system and the Walton Lakes treated water system. The network models were calibrated to ensure that model results accurately simulate actual conditions. With the assistance of local fire departments static pressure calibrations and flow test calibrations were completed for both systems.

Maximum Day Demands

Under maximum day demands, systems analysis using the Auburn Lake Trails model identified 9 pipe junctions, demand or fire hydrant nodes with pressures below the 35 psi minimum criteria. Within the Walton Lakes system, network analysis identified a total of 7 pipe junctions, demand or fire hydrant nodes with pressures below 35 psi during maximum day demand conditions.

Maximum Day Plus Fire Flows

Both the Auburn Lake Trails and Walton Lakes distribution systems were evaluated under maximum day plus 500 gpm fire flow conditions. Within the Auburn Lake Trails service area maximum day plus fire flow design criteria could not be met at 11 hydrant locations (out of 275 total). Under these test conditions either the minimum required flow could not be delivered with a minimum of 20 psi residual at the hydrant or the fire flow plus maximum day demands caused unacceptably low pressures somewhere in the system.

There are approximately 250 fire hydrants within the Walton Lakes system. Maximum day demands plus a 500 gpm fire flow was evaluated at each hydrant. At some 60 hydrant locations either the residual pressure at the hydrant dropped below 20 psi or unacceptably low pressures occurred somewhere within the distribution zone during the simulated test condition.

Storage Tank Capacities

Within the Auburn Lake Trails system, the Deer Ravine Tank is under capacity. With the Walton Lakes system, the Garden Park and Hotchkiss Hill Sub Tanks are under capacity.

Ditch System

Based on the analysis of field conditions, system performance, capacity and design criteria, the following segments of the ditch system include features which require priority reliability improvement measures.

LOCATION OF DITCH PRIORITY RELIABILITY MEASURES

Ditch	Segment
Upcountry Ditch (6 locations)	▪ Structure #1 to Structure #2 ▪ Structure #2 to Structure #3 ▪ Structure #3 to Structure #4 ▪ Structure #5 to Structure #6 ▪ Balderstan Wastegate to Sand Trap Siphon ▪ Buckeye Conduit to Shroeder Conduit
Main Ditch #1 (7 locations)	▪ Buffalo Hills Conduit to Spanish Dry Diggins Rd. ▪ Spanish Dry Diggins Rd. to Taylor Mine Outlet ▪ Taylor Mine Outlet to Cabin Wastegate ▪ Cabin Wastegate to Growlersberg Wastegate ▪ Growlersberg Wastegate to Summers Wastegate ▪ Summers Wastegate to Spools Wastegate ▪ Spools Wastegate to Jackass Wastegate
Main Ditch #2 (3 locations)	▪ Blue Heron Falls to Kaiser Siphon ▪ Kaiser Siphon to ALT Water Treatment Plant ▪ Willow Creek Wastegate to Baldridge Wastegate

Pilot Hill Ditch (4 locations)	▪ Doman Wye to Knickerbocker Creek ▪ Lovejoy Wastegate to Nagle Wastegate ▪ Nagle Wastegate to Capecroft Wastegate ▪ Wagner Reservoir to Wagner Reservoir Wastegate
Kelsey Ditch # 1 (4 locations)	▪ The Crails to St. James Wastegate ▪ St. James Wastegate to State Highway 193 ▪ Forest View Dr. Falls to Irish Res. Wastegate ▪ Stark Wastegate to Kelsey Reservoir

Priority reliability measures on the Upcountry Ditch typically include replacement of unstable ditch sections with piping. Priority measures on the Main / Pilot Hill Ditch typically include repair of sections with cribwalls and berm improvements. Priority measures on the Kelsey Ditch typically include gunnite lining of high loss areas. Specific reliability measures recommended for each segment of the ditch system are included in Section VII of this Study.

Raw Water Storage

Currently raw water storage capacity upstream of the GDPUD Water Treatment plants is approximately 33.9 ac-ft. A minimum of 50 ac-ft is recommended. Construction of new raw water storage reservoirs was evaluated. Expansion of existing raw water storage ponds was also evaluated and recommended as follows:

GDPUD RAW WATER STORAGE

Reservoir	Existing Capacity (ac-ft)	Expanded Capacity (ac-ft)
Walton Lakes	14.0	24.7
Greenwood	14.3	24.4
Auburn Lake Trails	5.6	9.6
Totals	33.9	58.7

DITCH SYSTEM RELIABILITY MEASURES

Priority ditch system reliability measures recommended for the ditch system are summarized in **Table II-1** of this Study. These are also highlighted on the Ditch System Maps included in the Appendix of this Study. It is recommended that these measures be conducted over the next 5 years. Estimated costs are projected ahead to the mid point of the 2003 – 2008 implementation period. Maintenance, access and second

priority reliability measures are also identified for this Study. These are itemized in Table VII-2 of this study but are not repeated in this Summary. "Second-tier" measures include SCADA instrumentation and control systems for the ditch flows and reservoir levels and the purchase of a second narrow track excavator.

TREATED WATER RELIABILITY IMPROVEMENTS

Priority treated water system reliability measures are summarized in **Table II-2** for Auburn Lake Trails and in **Table II-3** for Walton Lakes. These tables are also included in Section VIII of this Study. Treated water reliability measures are assigned a priority of 1 to 4. It is recommended that the first priority measures be completed over the next five years with the second, third and fourth priority measures completed within a 5 to 10, 10 to 15 and 15 to 20 year schedule. Highest priority Auburn Lake Trails system improvements include:

- ALT 1B — Supply Greenwood Road from Walton Lakes
- ALT 4A1 — Replace treated water golf course supply with raw water supply
- ALT 9 — Construct second Deer Ravine Tank (600,000 gallon capacity)

Highest priority Walton Lakes measures include:

- WL 2 — Fain Lane Line Extension
- WL 4B — Remove Quiet Place Check Valve
- WL 3A — Bayne Road Line Extension
- WL 15 — Whitney Creek Pressure Reducing Station
- WL 20 — Garden Park Line Replacement
- WL 21 — Hancock Road Tank Tie

Water treatment system reliability measures for both Auburn Lake Trails and for Walton Lakes are included as Exhibit attachments to this Study. These have been placed in the back pocket of this Study.

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TABLE II-1

SUMMARY OF PRIORITY RELIABILITY MEASURE RECOMMENDATIONS GDPUD DITCH SYSTEM

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Upcountry Ditch	Structure #1 to Structure #2 (UC-5)	• Construct retaining walls / slope stabilization for downslope levee at "the Narrows" • Widen access road from 6 feet to 10 feet • Replace 250 feet of open ditch with 48" pipe	$548,000
Upcountry Ditch	Structure #2 to Structure #3 (UC-4)	• Provide 1 foot of additional freeboard for 400 feet of ditch	$72,000
Upcountry Ditch	Structure #3 to Structure #4 (UC-4)	• Replace 500 LF of ditch with 48" pipe	$305,000
Upcountry Ditch	Structure #5 to Structure #6 (UC-4)	• Replace 500 LF of ditch with 48" pipe	$305,000
Upcountry Ditch	Balderston Wastegate to Sand Trap Siphon (UC-2)	• Provide 1 foot of additional freeboard, 1000 feet of lined and unlined section of ditch	$111,000
Upcountry Ditch	Walton Lake (UC-2)	• Dredge Walton Lake to restore holding capacity to approx. 25.0 acre-feet • Provide bypass piping during dredging	$496,000
Upcountry Ditch	Buckeye Conduit to Shroeder Conduit (PH-7)	• Provide 1 foot of additional freeboard for approximately 1100 feet of lined ditch	$85,000
		Subtotal, Upcountry Ditch	$1,922,000

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TABLE II-1 (cont.)

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Main / Pilot Hill Ditch (Main Ditch #1)	Buffalo Hills Conduit to Spanish Dry Diggins Rd. (PH-7)	• Provide 6 inches of additional freeboard for approximately 500 feet of unlined ditch	$60,000
Main / Pilot Hill Ditch (Main Ditch #1)	Spanish Dry Diggins Rd. to Taylor Mine Outlet (PH-7)	• Gunnite line approximately 2500 feet of ditch or improve ditch with crib walls and 6" of additional freeboard	$305,000
Main / Pilot Hill Ditch (Main Ditch #1)	Taylor Mine Outlet to Cabin Wastegate (PH-7)	• Construct crib wall improvements at 3 locations • Replace 500 feet of deteriorated lining with new lining • Provide 6 inches of additional freeboard, 500 feet of ditch • Replace Cabin Wastegate	$186,000
Main / Pilot Hill Ditch (Main Ditch #1)	Cabin Wastegate to Growlersberg Wastegate (PH-7)	• Replace 1800 feet of lined ditch with new lining	$200,000
Main / Pilot Hill Ditch (Main Ditch #1)	Growlersberg Wastegate to Summers Wastegate (PH-7)	• Provide crib wall repairs at 3 locations	$11,000
Main / Pilot Hill Ditch (Main Ditch #1)	Summers Wastegate to Spools Wastegate (PH-7)	• Repair 600 feet of ditch with crib walls and 6 inches of additional freeboard	$93,000
Main / Pilot Hill Ditch (Main Ditch #1)	Spools Wastegate to Jackass Wastegate (PH-5)	• Provide crib wall repairs at 2 locations	$7,500

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TABLE II-1 (cont.)

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Main / Pilot Hill Ditch (Main Ditch #1)	Jackass Wastegate to Greenwood Reservoir (PH-5)	• Dredge Greenwood Reservoir to provide capacity of ±24.4ac-ft	$416,000
Main / Pilot Hill Ditch (Main Ditch #2)	Blue Heron Falls to Kaiser Siphon (PH-5)	• Gunnite line 600 feet of existing ditch	$84,000
Main / Pilot Hill Ditch (Main Ditch #2)	Kaiser Siphon to ALT Water Treatment Plant (PH-4)	• Dredge ALT raw water storage reservoir to provide capacity of ±9.6 ac-ft • Provide bypass piping during dredging	$198,000
Main / Pilot Hill Ditch (Main Ditch #2)	Willow Creek Wastegate to Baldridge Wastegate (PH-4)	• Repair with crib walls, 5 ditch sections damaged by cattle • Place 3000 lineal feet of cattle control fencing	$80,000
Main Ditch / Pilot Hill Ditch (Pilot Hill Ditch)	Doman Wye to Knickerbocker Creek (PH-3)	• Remove and replace 2-18" CMP and 24" STL culverts with 42x29 CMPA or 36" CMP	$22,000
Main Ditch / Pilot Hill Ditch (Pilot Hill Ditch)	Lovejoy Wastegate to Nagle Wastegate (PH-2)	• Gunnite line approximately 400 feet of ditch • Replace Nagle Wastegate	$81,000
Main Ditch / Pilot Hill Ditch (Pilot Hill Ditch)	Nagle Wastegate to Capecroft Wastegate (PH-2)	• Provide crib wall; repair, ±50 feet in length, one location	$4,000
Main Ditch / Pilot Hill Ditch (Pilot Hill Ditch)	Wagner Reservoir to Wagner Reservoir Wastegate (PH-1)	• Gunnite line ±250 foot ditch section	$28,000
		Subtotal, Main / Pilot Hill Ditch	$1,775,500

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TABLE II-1 (cont.)

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Kelsey Ditch (Kelsey Ditch #1)	The Crails to St. James Wastegate (K-4)	• Remove and replace 2-15" PVC pipes at two locations; total ±800 lineal feet, replace with min. 30" pipe or 42"x29" CMPA • Place trash racks (Grizzlies) at upstream end of new pipes	$136,000
Kelsey Ditch (Kelsey Ditch #1)	St. James Wastegate to State Highway 193 (K-4)	• Remove and replace 18" CMP culvert, replace with 42"x29" CMPA or 42" CMP	$8,000
Kelsey Ditch (Kelsey Ditch #1)	Forest View Dr. Falls to Irish Res. Wastegate (K-3)	• Gunnite line approximately 600 lineal feet of ditch	$75,000
Kelsey Ditch (Kelsey Ditch #2)	Black Oak Siphon to Dukes Wastegate (K-2)	• Gunnite line approximately 400 lineal feet of ditch	$51,000
Kelsey Ditch (Kelsey Ditch #2)	Dukes Wastegate to State Highway 193 (K-2)	• Gunnite line approximately 1000 lineal feet of ditch (total two locations)	$125,000
Kelsey Ditch (Kelsey Ditch #2)	Mellows Wastegate to Kelsey Flume (K-1)	• Gunnite line approximately 800 lineal feet of ditch (total two locations)	$95,000
Kelsey Ditch (Kelsey Ditch #2)	Kelsey Flume to Stork Wastegate (K-1)	▪ Gunnite line approximately 400 lineal feet of ditch	$48,000

TABLE II-1 (cont.)

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Kelsey Ditch (Kelsey Ditch #2)	Stork Wastegate to Kelsey Reservoir (K-1)	• Gunnite line approximately 800 lineal feet of ditch (total two locations) • Reconstruct Stork Wastegate	$120,000
		Subtotal, Kelsey Ditch	$563,000
		Estimated Total, All Priority Measures	$4,260,500

(1) Refer to Ditch System Map Sheets included in the Appendix of this Study
(2) Costs are based on ENRCC = 7000 projected for mid-point of 2003 – 2008 Priority Measure Schedule

GDPUD WATER SYTEM RELIABILITY MEASURES

AUBURN LAKE TRAILS SERVICE AREA

CONSULTING KASL ENGINEERS

7777 Greenback Ln #104
Citrus Heights, CA 95610
Tel 916/722-1800
Fax 916-722-4595
"We take engineering personally"

SUMMARY OF COSTS

6-Nov-02

	3% PER YEAR INCREASE, ENR-CCI	6,481	6,800	7,880	9,140	10,600
Measure #	**Description**	**Amount**	**Priority**			
			1	**2**	**3**	**4**
ALT-1A	GREENWOOD RD FEED FROM WL	$ 308,000	$ 324,000			
ALT-1B	GREENWOOD RD MAIN REPLACEMENT	$ 833,000				$ 1,363,000
ALT-2	ANGEL CAMP CT. BOOSTER PUMP	$ 102,000			$ 144,000	
ALT-3	HIGHWAY 193 CROSS TIE-BRINKS LN REPLACE	$ 267,000			$ 377,000	
ALT-4A	GRAVITY RAW WATER FOR GOLF COURSE	$ 413,000	$ 434,000			
ALT-4B	DIGGER TREE CT TO WESTVIEW TRL TIE	$ 40,000		$ 49,000		
ALT-5	INDIAN ROCK ROAD MAIN REPLACEMENT	$ 66,000			$ 94,000	
ALT-6	CHERRY ACRE ROAD PRV-CROSS TIE	$ 160,000		$ 195,000		
ALT-7	CATECROFT ROAD MAIN REPLACEMENT	$ 209,000			$ 295,000	
ALT-8A	HWY 49-PILOT HILL LOOP	$ 387,000				$ 633,000
ALT-8B	SALMON FALLS ROAD MAIN REPLACEMENT	$ 514,000			$ 725,000	
ALT-9	SECOND DEER RAVINE TANK, 0.6 MG	$ 1,965,000	$ 2,062,000			
ALT-10	CHERRY HILLS TANK, 0.4 MG	$ 787,000			$ 1,110,000	
	TOTAL, CURRENT COSTS	**$ 6,051,000**				
	PROJECTED FUTURE COSTS		**$ 2,820,000**	**$ 244,000**	**$ 2,745,000**	**$ 1,996,000**

Table II-2 Summary

GDPUD WATER SYSTEM RELIABILITY MEASURES

WALTON LAKES SERVICE AREA

CONSULTING KASL ENGINEERS

7777 Greenback Ln #104
Citrus Heights, CA 95610
Tel 916/722-1800
Fax 916-722-4595
"We take engineering personally"

SUMMARY OF COSTS

6-Nov-02

	3% PER YEAR INCREASE, ENR-CCI	6,481	6,800	7,880	9,140	10,600
Measure #	**Description**	**Amount**	**Priority**			
			1	**2**	**3**	**4**
WL-1	CITABRIA LN LOOP TIE	$ 92,000		$ 112,000		
WL-2	FAIN LANE EXTENSION	$ 364,000	$ 382,000			
WL-3	BUFFALO HILL RD LINE REPLACEMENT	$ 96,000			$ 136,000	
WL-4 A	QUIET PLACE LOOP TIE	$ 59,000				$ 97,000
WL-4 B	QUIET PLACE REMOVE CHECK VALVE	$ 5,000	$ 6,000			
WL-5	HOLLOWAY DR LINE REPLACEMENT	$ 74,000			$ 105,000	
WL-6	LONGVIEW LANE LINE REPLACEMENT	$ 270,000			$ 381,000	
WL-7	RESERVOIR RD, SDD, HWY 193 REPLACEMENTS	$ 917,000		$ 1,115,000		
WL-8	SILENT MEADOW LN LINE REPLACEMENT	$ 127,000			$ 180,000	
WL-9	SANROMO ROAD LINE REPLACEMENT	$ 531,000				$ 869,000
WL-10	BLACK OAK MINE RD PROPOSED IMPROVEMENT	$ 59,000				$ 97,000
WL-11	GREENWOOD ROAD MAIN REPLACEMENT	$ 208,000		$ 253,000		
WL-12	TRAVERSE CREEK RD. LINE REPLACEMENT	$ 454,000				$ 743,000
WL-13A	BAYNE ROAD LINE EXTENSION	$ 405,000	$ 425,000			
WL-13B	BAYNE ROAD TANK	$ 1,350,000		$ 1,642,000		
WL-14	LAZY BROOK TRAIL LINE REPLACEMENT	$ 128,000				$ 210,000
WL-15	WHITNEY CT. PRESSURE REDUCING STATION	$ 108,000	$ 114,000			
WL-16	OAK LANE LINE REPLACEMENT	$ 151,000			$ 213,000	
WL-17	SHASTA RD. LINE REPLACEMENT	$ 109,000				$ 179,000
WL-18	TALMALPAIS RD. LINE REPLACEMENT	$ 110,000			$ 156,000	
WL-19	PIKES PEAK CIR. LINE REPLACEMENT	$ 64,000			$ 91,000	
WL-20	GARDEN PARK LINE REPLACEMENT	$ 97,000	$ 102,000			
WL-21	HANCOCK ROAD TANK TIE	$ 113,000	$ 119,000			
WL-22	GARDEN PARK TANK PROPOSED IMPROVEMENTS	$ 836,000		$ 1,017,000		
WL-23	HOTCHKISS HILL SUB TANK ADDITION	$ 444,000			$ 627,000	
WL-24	TRAVERSE CREEK RD. BOOSTER PUMPS	$ 62,000			$ 88,000	
WL-25	CHRYSLER CIR & ROLLER COASTER REPLACEMENT	$ 570,000				$ 933,000
	TOTAL, CURRENT COSTS	**$ 7,803,000**				
	PROJECTED FUTURE COSTS		**$ 1,148,000**	**$ 4,139,000**	**$ 1,977,000**	**$ 3,128,000**

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III INVENTORY / DATA COLLECTION

In this section of the Reliability Study the mapping of existing GDPUD raw water and treated water systems is summarized.

GPS MAPPING AND CONTROL

The scope of this task included accurate mapping of existing GDPUD raw water and treated water facilities using GPS technology. GPS-gathered coordinates and elevations were mapped at 1" = 400 scale for both the raw water and treated water systems. The base maps prepared for the GDPUD facilities as part of this task were, for the most part, compatible with the countywide GIS mapping conducted by El Dorado County. The GPS-gathered information was "best fit" to the parcel and roadway GIS mapping conducted by the County and with few exceptions, good agreement between the GPS data compiled for this project and the County's base maps was obtained.

To obtain accurate longitude, latitude and elevation data for each data point five control points were established within and around the GDPUD service area. With the location and elevations of these base control points established the GPS data collected at each point along the ditch or along GDPUD treated water mains was calibrated using Real Time Kinetic (RTK) surveys. A horizontal and vertical accuracy of $\pm$1 foot was obtained using this control system. Supplemental field surveys were conducted in areas where adequate GPS coverage could not be obtained. This occurred in areas of dense tree cover and in areas along the GDPUD ditch where topography prevented adequate satellite access. Over 5000 data points were collected in the raw water and treated water mapping effort.

DISTRICT SUPPLIED DATA

Field data was supplemented by GDPUD supplied improvement plans available for the treated water and raw water delivery systems. GDPUD improvement plans were used to determine the material, age and size of treated water main improvements (valves, hydrants, pipelines, PRV's, tanks, etc.).

The alignment and location of raw water conduits were plotted on the raw water ditch system map. The location of physical facilities, valves, pipeline inlets and outlets, etc. were determined in the field to verify that the improvement plans accurately reflected as-built conditions.

DISTRICT MAPPING ASSISTANCE

Ditch system appurtenances important to the mapping of existing GDPUD facilities were pre-marked. GDPUD ditch superintendents together with KASL engineering staff "flagged" the location of ditch structures, ditch culverts, lined sections, cribwalls, old repairs, low berms, fence crossings, waste gates and flumes. The location

and limits of these facilities were then included in the ditch system mapping. In addition, GDPUD ditch superintendents identified the location and alignment of raw water pipelines constructed to serve GDPUD irrigation customers remote from the ditch system. The location and alignment of the ditch pipeline appurtenances have also been included in the raw water mapping effort.

GDPUD treated water system appurtenances shown on District-supplied maps were located in the field. Where valves, hydrants, PRV's and tanks shown on District maps could not be located GDPUD staff provided assistance to KASL engineering and surveying crews to determine as-built locations. GDPUD treated water base maps include information on tank elevations, normal and minimum water levels, booster pump operating characteristics and the normal operating range of pressure reducing valves. This District-supplied information was needed to complete the network modeling of the treated water systems.

TREATED WATER SYSTEM MAPPING

GDPUD treated water system maps (21 sheets) prepared for this Reliability Study are included in the appendix of this report. Over 200 miles of treated water pipelines are mapped. Treated water improvements served by the Auburn Lake Trails (ALT) Water Treatment Plant are shown on the "ALT" plan sheets. These improvements include the ALT treated water booster pumps, Angels Camp Tank, Deer Ravine Tank and Pilot Hill Tank. The ALT water treatment plant has a capacity of 2.3 MGD. Maximum day deliveries as high as 2.2 MGD have been recorded. The ALT water system maps and GPS data were imported into the WaterCad model to conduct the ALT network analysis. As further discussed in Section VI, the ALT network model developed from this mapping effort includes some 28 PRV's, over 850 pipeline segments and over 650 demand, pipeline junction and fire hydrant nodes.

Treated water improvements served by the Walton Lakes (WL) Water Treatment Plant are shown on the "WL" plan sheets. WL treated water network improvements include the Walton Lake Tank, Hotchkiss Hill Tanks, Black Oak Mine Tank, Spanish Dry Diggins Tank, Garden Park Tank and Kelsey Tank. The capacity of the WL Water Treatment Plant is 2.3 MGD. A maximum day production of 1.8 MGD has been recorded for this facility. The WL water system maps and GPS data were imported into the WaterCad model to conduct the WL network analysis. The WL network model includes over 20 PRV's, over 800 pipeline segments and over 800 demand, pipeline junction and fire hydrant nodes. The WL system includes the community of Georgetown and the older portions of the GDPUD service area. Facilities of the WL treated water distribution system are, in general, older than the ALT system. As further discussed herein more extensive measures are needed to improve the reliability of the WL system than the newer ALT system.

RAW WATER SYSTEM MAPPING

GDPUD raw water system maps (total 23 sheets) prepared for this Reliability Study are also presented in the appendix. The GDPUD ditch system is divided into 3 distinct segments; the Upcountry Ditch, the Main / Pilot Hill Ditch System and the Kelsey Ditch.

The Upcountry Ditch System encompasses some 16.4 miles of open ditch and raw water conduits and includes the Buckeye Conduit, Canyon Creek Conduit, Sand Trap Siphon, Tunnel Hill, Bacon Canyon Pipe, Pilot Creek Pipeline, Buckeye Flume and Tunnel Hill Flume. The Upcountry Ditch is divided nearly equally into segments upstream of the Tunnel Hill Outlet (±8.12 miles) and downstream of the Tunnel Hill Outlet (±8.12 miles). The Upcountry Ditch begins at the Pilot Creek Diversion Dam and is the main supply line for the GDPUD system. All of the water which is delivered to the GDPUD Water Treatment Plants and all of the water which eventually reaches GDPUD irrigation services must be conveyed via the Upcountry Ditch. The Walton Lakes Water Treatment Plant is located downstream of the Canyon Creek Conduit and upstream of the Buckeye Conduit. Over the years several miles of open ditch segments within the Upcountry Ditch System have been replaced with closed conduits. Approximately 47% of the total Upcountry conveyance system is now piped.

The Main / Pilot Hill Ditch System including Main Ditch No. 1, Main Ditch No. 2, Pilot Hill Ditch and the Spanish Dry Diggins Ditch totals approximately 28.2 miles in length. Water is delivered to the Auburn Lake Trails Water Treatment Plant via the Main / Pilot Hill Ditch System. Not included in the above total is approximately 1 mile of Knickerbocker Creek. Downstream of Dorman Wye and the Cherry Acres Ditch Diversion, the Pilot Hill Ditch flows into and "shares" the Knickerbocker Creek Channel. The Pilot Hill Ditch is then diverted from Knickerbocker Creek upstream of Cherry Acres Road. There are approximately 4 miles of pipeline which are tributary to the Main / Pilot Hill Ditch. These include the Croft, Pilot Hill Estates and Pilot Hill pipelines.

The Kelsey Ditch System including Kelsey Ditch No. 1, Kelsey Ditch No. 2 and the Taylor Mine Ditch encompasses some 15.6 miles. Tributary to the Kelsey Ditch are the Kelsey, Cunningham, Garden Valley, Greenwood and Greenwood Road pipelines. These pipelines add approximately 6 miles to the Kelsey raw water delivery system.

The features, performance, capacities and suggested reliability improvements for each of the GDPUD ditches are described in Section VI of this Study.

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IV WATER SYSTEM DEMANDS

Domestic water system demands and design flows in the GDPUD ditch system are summarized in this section of the Reliability Study.

DOMESTIC WATER SYSTEM DEMANDS

Domestic water demand history was obtained from GDPUD for some 3100 domestic water customers. Demand data available for the period from 1996 through 2001 was evaluated. Water system demands in the form of 2 month meter readings were first reduced to average day demands for each period and then to annual average demand for the 6-year data period. Water service customers were identified by assessors parcel number. With GIS information available from El Dorado County, the acreage, land use code and zoning code of each GDPUD water service customer was determined. Water service customers in older sections of the GDPUD service area have different water service demands than GDPUD customers located in newer developments. Residential parcels with small acreages have different demands than residential parcels with larger acreage. Customers served by the Walton Lakes Water Treatment Plant have different maximum day demand characteristics than customers served by the Auburn Lake trails Water Treatment Plant. To accurately model the demand characteristics of the GDPUD service area and to efficiently apply these demands to the network modeling, domestic water system demands were calculated by region, by pressure zones within each region and by land use.

Water Demands by Region

The GDPUD service area was first divided into regions. For this Reliability Study these regions have been identified as:

- Garden Valley / Kelsey Region
- Walton Lakes / Georgetown / Spanish Dry Diggins Region
- Auburn Lake Trails / Cool / Pilot Hill Region

The Garden Valley / Kelsey Region and the Walton Lakes/ Georgetown/ Spanish Dry Diggins Region are served by the Walton Lakes Water Treatment Plant. The Auburn Lake Trails / Cool / Pilot Hill Region is served by the Auburn Lake Trails Water Treatment Plant.

Garden Valley / Kelsey

Located in the southeast portion of the GDPUD service area this region encompasses some 20,000 acres. Approximately 815 parcels are now served by GDPUD in this region.

Pressure zones within each region were defined by a water storage tank, booster pump or a pressure reducing station. As part of the network modeling task, demands within each pressure zone were specifically assigned based on the water demands calculated from the GDPUD demand data. Pressure zones identified for the Garden Valley / Kelsey Region are as follows:

- Kelsey
- Garden Park
- Marshall Grade
- Water Willow
- Irish Lane
- Traverse Creek
- Garden Valley

Average day and maximum day domestic water demands are presented later in this section by region, by pressure zone and by land use. Average day and maximum day domestic demands for residential parcels in the Garden Valley / Kelsey Region were determined to be:

Average Day and Maximum Day
Domestic Water Demands
Garden Valley / Kelsey Region

Land Use	Avg. Day Demand (gpd / parcel)	Max. Day Demand (gpd / parcel)
Small Ac. Residential	295	750
Medium Ac. Residential	425	1070
Large Ac. Residential	475	1200

Maximum day demands were determined from maximum day treatment plant flow records. From the Walton Lakes Treatment Plant the maximum day factor was calculated at 2.54 times the average day demand.

As further discussed in this Reliability Study, average day water demands are included in the systems analysis for the purpose of conducting calibration runs. Maximum day water demands are used to evaluate system reliability. Each of the GDPUD regions and pressure zones are evaluated in Section VI of this Study under maximum day demands and under maximum day plus fire flow demand criteria.

Walton Lake / Georgetown / Spanish Dry Diggins

This region is located in the central and northeastern portion of the GDPUD Service Area. It encompasses some 17,850 acres, approximately 835 GDPUD service parcels and 8 pressure zones. For the purpose of this Study, pressure zones have been designated as:

- Fools Canyon
- Walton Lake
- Hotchkiss Hill
- Georgetown East
- Georgetown West
- Spanish Dry Diggins Tank
- Spanish Dry Diggins South
- Spanish Dry Diggins North

Each of these zones has been evaluated separately as part of the Walton Lakes / Georgetown / Spanish Dry Diggins Region. Domestic water demands by land use for each of these zones are also presented later in this section of this Reliability Study. As discussed above each of these zones is defined by a reservoir, tank or pressure reducing station. In general, average day and maximum day residential land use water demands for this region are summarized as follows:

Average Day and Maximum Day
Domestic Water Demands
Walton Lakes / Georgetown / Spanish Dry Diggins Region

Land Use	Avg. Day Demand (gpd / parcel)	Max. Day Demand (gpd / parcel)
Small Ac. Residential	360	915
Medium Ac. Residential	390	990
Large Ac. Residential	450	1140

Auburn Lake Trails / Cool / Pilot Hill Region

This region is served by the Auburn Lake Trails Water Treatment Plant. It currently encompasses some 32,900 acres and some 1435 service parcels. For this Study nine pressure zones have been identified in this region. These are:

- Black Ridge
- ALT East / Greenwood

- ALT Central
- Indian Rock
- ALT West
- Cool / Cherry Acres
- Meadowview
- EXT 82A
- Old Pilot Hill

Demand summaries for each of the land uses in each of these pressure zones are presented later in this section of this Reliability Study. In general, average day and maximum day residential land use domestic water demands for this region can be summarized as follows:

Average Day and Maximum Day
Water Demands
Auburn Lake Trails / Cool / Pilot Hill Region

Land Use	Avg. Day Demand (gpd / parcel)	Max. Day Demand (gpd / parcel)
Small Ac. Residential	435	1045
Medium Ac. Residential	510	1225
Large Ac. Residential	550	1320

For this region the maximum day factor applied was 2.40 based on Auburn Lake Trails Water Treatment Plant production records available for the period of 1996 to the present.

Comparison of GDPUD and EID Residential Water Demands

To evaluate the water demand findings determined for this Reliability Study and presented herein a comparison of GDPUD demands, by region, to El Dorado Irrigation District (EID) residential demand standards was conducted.

EID Standard Water Demands in effect for the EID "Central Region" are used for this comparison since this EID region (which includes the communities of Lotus, Coloma, Diamond Springs, Pleasant Valley, Placerville) most closely matches the characteristics of the GDPUD service area.

A summary comparison of average annual GDPUD demands and EID Standards is as follows:

Summary Comparison of EID Central Water Demand Studies and GDPUD Average Day Residential Water Demands

Land Use	EID Central Avg. Annual Demand Standards (gpd / unit)	GDPUD Avg. Annual Demand Results by Region (gpd / unit)		
		Garden Valley/ Kelsey	Walton Lakes/ Georgetown	ALT / Cool/ Pilot Hill
Small Acreage Residential	375	295	360	435
Medium Acreage Residential	550	425	390	510
Large Acreage Residential	880	475	450	550

A summary comparison of EID maximum day residential demand standards and GDPUD Service Area findings is as follows:

Summary Comparison of EID Central Water Demand Studies and GDPUD Maximum Day Residential Water Demands

Land Use	EID Central Max. Day Demand Standards (gpd / unit)	GDPUD Max. Day Demand Results by Region (gpd / unit)		
		Garden Valley/ Kelsey	Walton Lakes/ Georgetown	ALT / Cool/ Pilot Hill
Small Acreage Residential	750	750	915	1045
Medium Acreage Residential	1100	1070	990	1225
Large Acreage Residential	1760	1200	1140	1320

As presented above there is good correlation between the average annual and maximum day water demand findings for residential parcels within the GDPUD Service Area and the water demand standards in effect for the EID Central Zone.

Water Demands by Land Use

For each region and for each pressure zone within the GDPUD service area water demands by land use were determined. As previously discussed, land use data by parcel was available from the El Dorado County GIS database. From this database parcel acreage, use description, use codes and land use ones were determined by parcel. Water demands for each GDPUD region and pressure zone were determined, by land use, as follows:

- Small Acreage Residential (less than 1 acre)
- Medium Acreage Residential (1 to 5 acres)
- Large Acreage Residential (over 5 acres)
- High Density Residential (apts., mobile home parks, condominiums)
- Agricultural
- Commercial
- Industrial
- Public Use

The domestic water demand findings of this Reliability Study are summarized by region, pressure zone and land use in **Table IV-1** for the Garden / Kelsey Region, in Table **IV-2** for the Walton Lakes / Georgetown / Spanish Dry Diggins Region and in Table **IV-3** for the Auburn Lake Trails / Cool / Pilot Hill Region.

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TABLE IV-1
GDPUD DOMESTIC WATER DEMAND SUMMARY
GARDEN VALLEY / KELSEY REGION

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS (1)
Pressure Zone: Kelsey				
Residential				
- Small Acreage (< 1 acre)	280	140-430	710	7
- Medium Acreage (1-5acres)	360	100-950	910	28
- Large Acreage (>5 acres)	400	100-1300	1020	27
- High Density	2720	2720	6910	1
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	100	100	250	1
Unknown	---	---	---	---
Pressure Zone: Garden Park				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	440	100-2330	1120	172
- Large Acreage (>5 acres)	440	100-1600	1120	19
- High Density	---	---	---	---
Agricultural	750	200-1140	1910	4
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	---	---
Pressure Zone: Marshall Grade				
Residential				
- Small Acreage (< 1 acre)	320	320	810	1
- Medium Acreage (1-5acres)	540	140-1900	1370	90
- Large Acreage (>5 acres)	640	120-4640	1630	76
- High Density	---	---	---	---
Agricultural	310	160-560	790	5
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	--	---

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TABLE IV-1 (cont.)

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS [1]
Pressure Zone: Water Willow				
Residential				
- Small Acreage (< 1 acre)	200	200	510	1
- Medium Acreage (1-5acres)	480	110-1290	1220	42
- Large Acreage (>5 acres)	430	110-2060	1090	14
- High Density	---	---	---	---
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	---	---
Pressure Zone: Irish Lane				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	400	400	1020	1
- Large Acreage (>5 acres)	420	190-830	1070	5
- High Density	---	---	---	---
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	---	---
Pressure Zone: Traverse Creek				
Residential				
- Small Acreage (< 1 acre)	230	130-320	580	7
- Medium Acreage (1-5acres)	370	100-1970	940	46
- Large Acreage (>5 acres)	520	110-3010	1320	42
- High Density	---	---	---	---
Agricultural	470	250-750	1190	3
Commercial	---	---	---	---
Industrial	830	830	2110	1
Public Use	600	600	1520	1
Unknown	---	---	---	---

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TABLE IV-1 (cont.)

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS [1]
Pressure Zone: Garden Valley				
Residential				
- Small Acreage (< 1 acre)	430	120-1220	1090	13
- Medium Acreage (1-5acres)	360	100-1470	910	92
- Large Acreage (>5 acres)	460	110-1340	1170	48
- High Density	---	---	---	---
Agricultural	480	120-760	1220	3
Commercial	420	120-910	1070	7
Industrial	---	---	---	---
Public Use	210	210	530	1
Unknown	8940	820-17050	22710	2

760 parcels

Notes:

(1) Parcels within very low demand data (100 gpd or less) were not included in average day demand determinations

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TABLE IV-2
GDPUD DOMESTIC WATER
DEMAND SUMMARY
WALTON LAKE / GEORGETOWN / SPANISH
DRY DIGGINS REGION

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS (1)
Pressure Zone: Fools Canyon				
Residential				
- Small Acreage (< 1 acre)	460	1190-850	1170	3
- Medium Acreage (1-5acres)	480	120-1270	1220	39
- Large Acreage (>5 acres)	610	230-2040	1550	15
- High Density	---	---	---	---
Agricultural	360	360	910	1
Commercial	400	400	1020	1
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	300	300	790	1
Pressure Zone: Walton Lake				
Residential				
- Small Acreage (< 1 acre)	280	120-530	710	21
- Medium Acreage (1-5acres)	300	120-750	760	49
- Large Acreage (>5 acres)	300	120-730	760	20
- High Density	7400	7400	18800	1
Agricultural	950	950	2410	1
Commercial	520	520	1320	1
Industrial	---	---	---	---
Public Use	1830	590-3070	4650	2
Unknown	230	230	580	1
Pressure Zone: Hotchkiss Hill				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	280	100-640	710	6
- Large Acreage (>5 acres)	290	290	740	1
- High Density	---	---	---	---
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	--	---

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TABLE IV-2 (cont.)

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS [1]
Pressure Zone: Georgetown East				
Residential				
- Small Acreage (< 1 acre)	350	100-1580	890	25
- Medium Acreage (1-5acres)	390	110-1110	990	67
- Large Acreage (>5 acres)	490	140-1950	1240	19
- High Density	600	450-750	1520	2
Agricultural	4720	380-9050	11990	2
Commercial	220	220	560	1
Industrial	670	620-730	1700	2
Public Use	2170	420-3910	5510	2
Unknown	230	230	580	1
Pressure Zone: Georgetown West				
Residential				
- Small Acreage (< 1 acre)	350	100-1430	890	103
- Medium Acreage (1-5acres)	370	100-1600	990	180
- Large Acreage (>5 acres)	440	110-1420	1120	40
- High Density	610	250-1630	1550	5
Agricultural	340	100-750	860	5
Commercial	730	150-5030	1850	23
Industrial	1220	1220	3100	1
Public Use	470	250-680	1190	2
Unknown	4200	140-23640	10670	6
Pressure Zone: Spanish Dry Diggins Tank				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	480	170-780	1220	2
- Large Acreage (>5 acres)	480	120-1350	1220	17
- High Density	---	---	---	---
Agricultural	340	190-590	860	3
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	---	---

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TABLE IV-2 (cont.)

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS [1]
Pressure Zone: Spanish Dry Diggins South				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	350	350-130-920	890	1
- Large Acreage (>5 acres)	440	---	1120	3
- High Density	---	---	---	---
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	---	---
Pressure Zone: Spanish Dry Diggins North				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	460	120-1680	1190	84
- Large Acreage (>5 acres)	540	110-3570	1370	23
- High Density	---	111	---	---
Agricultural	10	10	30	1
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	600	600	1520	1

787 parcels

Notes:

(1) Parcels with very low consumption data (100 gpd or less) were not included in average day demand determinations

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TABLE IV-3
GDPUD DOMESTIC WATER
DEMAND SUMMARY
AUBURN LAKE TRAILS / COOL / PILOT HILL

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS (1)
Pressure Zone: Black Ridge				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	---	---	---	---
- Large Acreage (>5 acres)	410	140-990	980	8
- High Density	---	---	---	---
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	---	---
			7840 gpd	
Pressure Zone: Alt East Greenwood				
Residential				
- Small Acreage (< 1 acre)	370	100-1140	890	171
- Medium Acreage (1-5acres)	420	100-1550	1010	270
- Large Acreage (>5 acres)	540	100-2660	1300	81
- High Density	640	460-820	1540	2
Agricultural	460	460	1100	1
Commercial	420	160-1000	1010	6
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	610	140-4640	1460	19
Pressure Zone: Alt Central				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	420	110-2030	1010	85
- Large Acreage (>5 acres)	510	150-960	1220	12
- High Density	---	---	---	---
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	140	140	340	1

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TABLE IV-3 (cont.)

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS [1]
Pressure Zone: Indian Rock				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	450	160-980	1080	7
- Large Acreage (>5 acres)	460	240-1030	1100	4
- High Density	---	---	---	---
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	520	520	1250	1

7560
4400
1250
13,210 gpd

Pressure Zone: Alt West				
Residential				
- Small Acreage (< 1 acre)	450	110-2090	1080	119
- Medium Acreage (1-5acres)	430	130-1210	1030	89
- Large Acreage (>5 acres)	420	100-880	1010	10
- High Density	---	---	---	---
Agricultural	660	660	1580	1
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	260	260	620	1
Unknown	370	890	300-450	2

128,520
91,670
10,100
1580
620
740
223,290

Pressure Zone: Cool / Cherry Acres				
Residential				
- Small Acreage (< 1 acre)	430	100-1140	1030	127
- Medium Acreage (1-5acres)	560	100-2530	1340	131
- Large Acreage (>5 acres)	770	240-2580	1850	29
- High Density	1400	1400	3360	1
Agricultural	1260	230-4860	3020	6
Commercial	2700	1380-4410	6480	3
Industrial	0	0	0	1
Public Use	6260	6260	15020	1
Unknown	610	140-1430	1460	10

130,810
175,540
53,650
3240
18,120
19,440
15020
14,600
430,640

Pressure Zone: Meadowview				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	610	220-1440	1460	23
- Large Acreage (>5 acres)	650	100-1990	1560	32
- High Density	---	---	---	---
Agricultural	---	---	---	---
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	---	---	---	---

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TABLE IV-3 (cont.)

LAND USE	AVE DAY (GPD)	RANGE (GPD)	MAX DAY (GPD)	# of PARCELS [1]
Pressure Zone: Ext 82A				
Residential				
- Small Acreage (< 1 acre)	---	---	---	---
- Medium Acreage (1-5acres)	490	160-1500	1180	11
- Large Acreage (>5 acres)	650	210-2820	1560	19
- High Density	---	---	---	---
Agricultural	140	140	340	1
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	---	---	---	---
Unknown	500	230-820	1200	3
Pressure Zone: Old Pilot Hill				
Residential				
- Small Acreage (< 1 acre)	490	270-940	1180	5
- Medium Acreage (1-5acres)	680	100-2010	1630	29
- Large Acreage (>5 acres)	540	180-1830	1300	15
- High Density	3260	690-7650	7820	3
Agricultural	240	240	580	1
Commercial	---	---	---	---
Industrial	---	---	---	---
Public Use	1960	1960	4700	1
Unknown	---	---	---	---

1342

Notes:

(1) Parcels with very low demand data (100 gpd or less) were not included in average day demand calculations.

Deer Ravine - Max Day (in pond) 685,000 gpd

DITCH DESIGN FLOWS

GDPUD measures releases from Stumpy Meadows Reservoir and measures ditch flows at measuring flumes located near the outlet from Tunnel Hill and at the outlet from Buckeye Conduit. Flows measured below Tunnel Hill most accurately reflect water conveyed in the GDPUD ditch system. These flows include water diverted from Pilot Creek at the Pilot Creek Diversion Dam and side water that is captured at the Bacon Creek Diversion Dam and at structures 1 through 7 located upstream of Tunnel Hill. In spring and early summer the District is normally permitted to collect sidewater from Bacon Creek Diversion Dam and from Structures 1 through 7. To maintain flows in Pilot Creek, restrictions are imposed on GDPUD from collecting sidewater during summer and fall months. In 2002, for example, GDPUD was not permitted to collect sidewater from structures 3 through 7 after August 1. Summertime flow measured at the Tunnel Hill outlet typically vary from 29 to 33 cfs. Since 1996, GDPUD has recorded flow measurements at the Tunnel Hill outlet. To date, the maximum daily flow recorded at this location is approximately 35 cfs.

The measuring flume at the Buckeye Conduit outlet is located downstream of Walton Lakes and reflects diversions to the Walton Lakes Water Treatment Plant. The maximum rated capacity of the Walton Lake Water Treatment Plant is 2.3 MGD (3.55 cfs). According to plant operating data, the maximum day water production at Walton Lake was approximately 1.8 MGD (2.8 cfs). Summer time flows measured at the Buckeye Outlet typically range from 24 to 26 cfs. These measured flows are consistent with the Tunnel Hill flow measurements less the summer time water treatment demands at Walton Lake Treatment Plant. Since 1966, maximum daily flows up to approximately 30 cfs have been recorded at the Buckeye Outlet.

Downstream of the Buckeye and Schroeder Conduits, flows are diverted to Main Ditch #1 and to Kelsey Ditch #1. The District does not currently maintain flow measuring facilities at this diversion point (known as "the Crails"). Based on operating experience approximately 1/3 of the flow delivered from the Buckeye Conduit is diverted to the Kelsey Ditch with approximately 2/3 of the flow diverted to the Main Ditch. For the purposes of this Reliability Study and consistent with the ditch flow data available a current design flow of 8 to 10 cfs is assigned to the upper section of the Kelsey Ditch System and a current design flow of 18 to 20 cfs is assigned to the upper section of the Main Ditch #1.

Water is diverted from the Main Ditch System to serve the Auburn Lake Trails (ALT) Water Treatment Plant. Downstream of this diversion point, water flows via the GDPUD ditch system to irrigation and raw water sources in Cool, Pilot Hill and Cherry Acres. The Kelsey Ditch System serves irrigation and raw water demands along Highway 193, Greenwood Road, Garden Valley and Kelsey.

A summary of raw water ditch design flows is presented in **Table IV-4**. In Section VI, the capacity of each section of the GDPUD ditch system shall be evaluated with respect to these current design flows. Current design flows presented in Table IV-4 provide a 10% to 15% range to allow for short term surges, changes in the flow released at Stumpy Meadows and entering the Pilot Creek Diversion Dam, the capture of sidewater at locations such as the Bacon Creek Diversion Dam, Upcountry Structures #1 through #7 and the miscellaneous capture of flows throughout the ditch system.

The range of ditch flows presented in Table IV-4 allows for diversion and losses along the ditch system. Main Ditch / Pilot Hill Ditch design flows take into account releases to the Taylor Mine Ditch, the ALT Water Treatment Plant, Cherry Acres Ditch and the Pilot Hill Estates and Pilot Hill Pipelines. The ALT Water Treatment Plant has a maximum rated capacity of approximately 2.3 MGD. The maximum day production recorded for this plant is approximately 2.2 MGD (3.40 cfs). Ditch design flows presented herein for Main Ditch No. 2 and the Pilot Hill Ditch downstream of the ALT Water Treatment Plant take into account these water treatment plant demands. Kelsey Ditch design flows take into account diversions to the Garden Valley and Greenwood Pipelines and other demands such as the Cunningham Pipeline.

Ditch design flows must also provide for losses due to leaks, evapotranspiration, and evaporation. Under normal operating conditions, net losses in the Upcountry Ditch Section are relatively small. Losses due to evapotranspiration, evaporation and leaks are offset with inflows from the Bacon Creek Diversion Dam and sidewater structures #1 through #7. The daily ditch flows recorded at the Tunnel Hill measuring flume are comparable to the ditch flows recorded upstream at the Pilot Creek Diversion Point. When Walton Lakes Water Treatment Plant demands are taken into account the daily ditch flows measured at the Buckeye Flume compare reasonably well with the ditch flows measured at Tunnel Hill. Flows into the Buckeye conduit are also regulated by changes in storage at Walton Lake.

Ditch flows are estimated but not measured with a flow metering device in either the Main Ditch / Pilot Hill Ditch or the Kelsey Ditch. Losses in these ditch systems must therefore be estimated. Based on operating experience and typical ditch performance the net loss in ditch flows in the Main / Pilot Hill Ditch and Kelsey Ditch Systems are estimated at 25% of the total design flows. For the Main Ditch / Pilot Hill Ditch System, a 5 cfs loss is included in the ditch design flows. For the Kelsey Ditch a 2.5 cfs loss is included in the ditch design flows.

The ability of existing GDPUD ditch, culvert and piped sections to reliably convey the design flows presented in Table IV-4 is discussed in Section VI of this Study.

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TABLE IV-4

GDPUD
RAW WATER DITCH
DESIGN FLOWS

GDPUD Ditch Section	Current Design Flows (cfs)
Upcountry Ditch	
Pilot Creek Div. Dam to Tunnel Hill Outlet	32 to 35
Tunnel Hill Outlet To Walton Lake Water Treatment Plant	32 to 35
Walton Lake Water Treatment Plant to The Crails	27 to 30
Main / Pilot Hill Ditch	
Main Ditch No. 1, Crails to Taylor Mine Ditch	18 to 20
Main Ditch No. 1, Taylor Mine Ditch to Greenwood / Spanish Dry Diggins Ditch	16 to 17.5
Main Ditch No. 2, Spanish Dry Diggins Ditch to ALT Water Treatment Plant	15 to 16.5
Main Ditch No. 2 ALT Water Treatment Plant To Cherry Acres Ditch	12.5 to 14
Pilot Hill Ditch, Cherry Acres Ditch to Nagle Wastegate	8 to 12

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TABLE IV-4 (cont.)

GDPUD
RAW WATER DITCH
DESIGN FLOWS

GDPUD Ditch Section	Current Design Flows (cfs)
Pilot Hill Ditch, Nagle Wastegate to Wagner Res.	5 to 8
Pilot Hill Ditch, Wagner Res. to Pilot Hill Res.	3 to 5
Kelsey Ditch	
Kelsey Ditch No. 1, Crails to Black Oak Mine Siphon / Garden Valley Pipeline	8 to 10
Kelsey Ditch No. 2, Garden Valley Pipeline to Chicken Flat Wastegate	5 to 8
Kelsey Ditch No. 2, Chicken Flat Wastegate to Kelsey Reservoir	3 to 5
Spanish Dry Diggins Ditch	2 to 3
Taylor Mine Ditch	3 to 5
Cherry Acres Ditch	2 to 3
Garden Valley / Greenwood Pipeline	2 to 3
Pilot Hill Pipeline	2 to 3
Pilot Hill Estates Pipeline	1 to 2
Greenwood Road Pipeline	1 to 2

V PERFORMANCE AND DESIGN CRITERIA

In this section of this Reliability Study recommended improvement standards are presented for GDPUD treated water storage and distribution facilities. Design criteria and improvement standards are also presented for the GDPUD raw water ditch system.

DESIGN CRITERIA – TREATED WATER SYSTEMS

As part of the scope of this Reliability Study, recommended water system Improvement Standards have been submitted to GDPUD. Performance and design criteria included within these Improvement Standards are summarized herein.

Regulatory Standards

Compliance with the following regulatory standards, including all updates and changes, should be included in the design of GDPUD treated water systems.

- United Stated Public Health Service (USPHS) Drinking Water standards and the Environmental Public Agency (EPA) Standards.
- California Safe Drinking Water Act, Laws and Standards of the state of California, Department of health Services, Public Water Supply Branch.
- The Porter-Cologne Water Quality Control Act and the California Regional Water Quality control Board, Central valley Region
- Ordinances of the County of El Dorado
- Uniform Fire Code and Local Fire Ordinances

Domestic Water System Demands

For new single family residential developments, it is recommended that average daily water demands be based on the following:

Design Population per Living Unit

- Developments of 100 living units and less; 3.5 persons per unit
- Developments of greater than 100 living units; 3.0 persons per unit

Average Per Capita Daily Flow Requirement

- Forested, Residential Developments (approximately above 3,000 ft. elevation), 200 gallons per person per day.
- Urban and Non-forested Residential Developments (approximately below 3,000 ft. elevation), 250 gallons per person per day.

These average daily demand values are consistent with the water demand findings included in Section IV of this Reliability Study.

Commercial and Industrial Uses

Since water demands for commercial and industrial uses vary widely, design demands should be based on the specific flow requirements of the proposed developments.

Schools

The larger demand, as determined from one of the two following methods, should be assumed for schools.

- The entire school area shall be assumed a single family zoning with minimum sized lots assumed.
- Flow shall be based on ultimate design student population plus administration, teaching and operating personnel.

Maximum Day Demands

Maximum day demands should be determined by multiplying average day demands by a factor of 2.0. this multiplier is consistent with the maximum day demand findings included in Section IV of this Reliability Study.

Peak Hourly Demands

Peak hourly demands should be determined by multiplying average day demands by a factor of 3.0

Fire Flows

The fire protection district with jurisdiction (El Dorado County Fire Protection District, Garden Valley Fire Department, Georgetown Fire Protection District, California Department of Forestry, etc.) should set fire flow requirements. In the absence of requirements from the local or county fire protection district, the following minimum design requirements are recommended:

- Single Family and Duplex Residential – 500 gpm from a single hydrant
- Townhouse, Apartment, Multiple Residential units – 1000 gpm from two hydrants
- Commercial and Industrial – based on Uniform Building Code Standards but not less than 1500 gpm from two hydrants

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Treated Water Storage

Water storage tank capacity should be at least equal to the sum of the fire storage reservation, plus allowance for system peaking plus allowance for emergency reserve. The minimum storage tank capacity should be 250,000 gallons

Fire Storage Reservation

The fire storage reservation should be no less than the product of the minimum design fire flow and the design fire duration. The minimum design fire duration should be four (4) hours but may be increased by the fire protection district with jurisdiction. In residential areas the minimum fire storage reservation should be 120,000 gallons.

System Peaking Storage

Water storage tanks should provide not less than twenty (20) percent of the total maximum daily flows assuming a 24-hour pumping rate. Per 100 residential units, each with a maximum day demand of 1500 gallons per unit per day, the system peaking storage provided should be not less than 30,000 gallons.

Emergency Storage

Water storage tanks should provide emergency storage capacity in excess of fire storage and system peaking storage requirements. Emergency storage equivalent to a four hour demand under maximum day demands is recommended as the emergency storage reservation. Per 100 residential units, emergency storage equivalent to 25,000 gallons is recommended.

Treated Water Storage Transmission Mains

Recommended water storage transmission main design criteria and performance standards are as follows:

Pipe Material

- PVC C-900 or C-905, CL 150/200
- DIP CL 200 minimum

Pipe Size

- 8 inch diameter minimum
- Transmission main should be sized to deliver maximum daily demands at velocities not greater than 10 feet per second

Pressure

Transmission mains should be suitable for working pressures as high as 200 psi

Minimum Cover

3 feet minimum cover is recommended for water transmission mains

Treated Water Distribution Lines

Pipe Material

It is recommended that treated water distribution lines be constructed of the same material as the transmission mains; either PVC C-900 or C-905, CL 150/200 or DIP, CL 200 minimum.

Pipe Size

An 8-inch diameter minimum size is recommended for distribution lines, however, for short (less than 500 foot long) dead end water mains, a 6-inch diameter main may be adequate if not more than one fire hydrant is supplied from this distribution line.

Flow Data

Distribution lines should be sized to deliver the larger of:

- Maximum hourly flows or
- Maximum day demands plus fire flows

Distribution lines should be sized to deliver the design flow rate at velocities not greater than 10 feet per second.

Design Pressures

For municipal service the allowable working pressure within the distribution system should not exceed 150 psi under maximum day demand conditions. The minimum service pressure should not be below 35 psi at the meter and the maximum service pressure should not exceed 115 psi at the meter. The distribution system should be sized to provide fire flows plus maximum day demands at not less than 20 psi.

Main Line Valves, Blow-Off Assemblies and Air Release Valves

Main line valves should be installed at not more than 1800 foot intervals on transmission mains. Air release valves should be installed at all pipeline summits at 1,500 – 3,000 foot intervals and at both ends of long horizontal runs of pipe. Pipeline

blow-offs should be installed at all major low points. Whenever practical, a fire hydrant should be used for blow-off valves. A summary of recommended treated water standards and design criteria is presented in **Table V-1**. A performance comparison of proposed GDPUD standards and existing EID and PCWA standards is also presented in Table V-1.

DESIGN CRITERIA – RAW WATER SYSTEMS

Raw Water Storage

The storage of raw water is a high priority public health and systems control safety feature of the GDPUD ditch water system. Raw water storage located upstream of the Walton Lake Water Treatment Plant and the ALT Water Treatment Plant should provide adequate storage to meet treated water demands should a ditch failure occur. Based on GDPUD repair records, ditch failures upstream of Tunnel Hill have occurred which have reduced or temporarily eliminated the flow of raw water into downstream ditch sections for periods of up to 10 days. Upcountry Ditch failures are much more likely to occur during winter rain and snow periods than during the summer. For the purpose of this Reliability Study, existing and proposed GDPUD raw water storage reservoirs upstream of water treatment plants shall be evaluated with respect to a winter time ditch failure period of 15 to 20 days.

Planned ditch system repairs are typically conducted after the irrigation season ends in October, and weather permitting, may continue until mid November. For the purpose of this study it shall be assumed that any planned ditch repair work which requires more than 2 weeks (14 days) to repair will include provisions for bypassing the ditch flow with temporary piping and pumping facilities during longer repair periods.

GDPUD water treatment plant production records for Walton Lakes and for ALT for the period of 1994 – 2002 indicate that for the 5 month period of November through March Walton Lake WTP now produces an average of 0.38 million gallons per day (MGD) of treated water. Similarly, "winter" month treated water demands at ALT average 0.40 MGD. During the October and early November ditch maintenance periods, average daily water demands at Walton Lakes are currently 0.56 MGD. At ALT, water demands in October - November are typically 0.62 MGD.

To meet average daily winter time emergency ditch failure conditions, the raw water storage upstream of Walton Lakes equivalent to the average daily demands at Walton Lakes and Auburn Lake trails over a 15 to 20 (winter) day period should be provided. This storage demand is equivalent to 11.7 to 15.6 MG or 36 to 48 acre-feet. To meet the winter time emergency storage demands upstream of ALT, raw water storage equivalent to 6 to 8 MGD (18.5 to 25 acre-feet) should be provided. To permit fall maintenance work, it is recommended that raw water storage upstream of Walton Lakes equivalent to 16.5 MG or 50.8 acre-feet be available. To meet fall maintenance criteria upstream of ALT, 8.7 MG or 26.7 acre-feet of raw water storage should be available.

TABLE V-1
RECOMMENDED GDPUD DESIGN CRITERIA AND PERFORMANCE STANDARDS

IMPROVEMENT STANDARD COMPARISON TABLE – WATER DESIGN CRITERIA

GDPUDSPEC SECTION	DESIGN ITEM	RECOMMENDED GDPUD STANDARDS (2002)	PCWA STANDARDS (1993)	EID STANDARDS (1993)
SECTION 1002- REGULATORY STDS.	Agency Compliance	1. United States Public Health Service (USPHS) drinking water stds (DWS) 2. Environmental Public Agency (EPA) stds. 3. California Safe Drinking Water Act, 4. Department of Health Services 5. Porter-Cologne Water Quality Control Act 6. California Regional Water Quality Control Board 7. Ordinances of the County of El Dorado 8. Uniform Fire Code and Local Fire Ordinances	1. Laws and Stds. Of the State of California, Department of Public Health relating to Domestic Water Supply 2. Standards of Minimum Requirements for Safe Practice in the Production and Delivery of Water for Domestic Use 3. Title 17, Chapter V, Sections 7583-7622, California Administrative Code, regarding cross-connections 4. All applicable Ordinances, Rules and Regulations for all local agencies, cities, fire districts, etc…	1. Ordinances, requirements and applicable stds. Of governmental Agencies having jurisdiction within the Districts service area shall be Observed. 2. Uniform Plumbing Code 3. Municipal Code of the County of El Dorado 4. Road encroachment regulations of County of El Dorado 5. CALTRANS Std. Specifications 6. Regulations and Policy's adopted by board of directors of El Dorado Irrigation District
SECTION 1005- CALCULATIONS	Hydraulic Analysis	Computer Analysis Required for Proposed distribution system w/either Haested Methods or EPANET software	Shall be supplied to Agency upon request	Water System analysis shall be performed taking into consideration both existing and future development.
	Formulas	Use Hazen-Williams Formula	NA	Use Hazen-Williams Formula
	C - Values	For new system Use C-value of 140 or per manufacturer, whichever is lower. For existing system use C-value of 120	NA	Size (inches) / Existing Main / Proposed Main 4&6 / 100 / 110 8&10 / 110 / 120 12-18 / 115 / 130 Note: C-values have accounted for minor losses.
SECTION 1006 – MUNICIPAL FLOW	Design Population per Living Unit	3.0-3.5	NA	NA
	Avg Per Capita daily flow	200-250 gal/day	NA	NA
	Avg. Daily Flow (ADF)	(Sum of Design Pop.) x (Avg per capita daily flow)	NA	See Table 3-1: Mean Annual Water Demands Based on Land use Category and Geographic Region around District. Average Day Demand (ADD) - 160-922 gal/dwelling unit/day
	Max Daily Flow/Peak Daily	2 x ADF	- Use 1.5 gpm per connection for new medium to high density land use w/ 5/8"x3/4" meters. - Use 3.0gpm for large lot projects of 1-acre or more per lot - For Commercial/Industrial contact Engineering Department	2.5xADD gpm for – Low Density Residential (Western Region) 2.0x ADD - Medium/High Density Residential Commercial and Industrial 1.5xADD-Multiple Family 4.5xADD- Parks, Schools, Golf Courses
	Max Hourly Flow/ Peak Hour	3 x ADF	NA	5.0xADD-Low Density Residential 4.5xADD-Medium/High Density (Western & Central Region) 3.5xADD- Medium/High Density (Eastern Region) 2.5xADD-Multiple Family Mobile Home, Commercial/Industrial 4.5xADD-Parks, Schools, Golf Courses
SECTION 1007- FIRE FLOW	Fire Flow	500 gpm –Single Family 1000gpm-Townhouse 1500 gpm-Commercial Industrial-As determined by Fire protection district	Local Fire Protection Authority to Determine: -Max allowable velocity=7.0ft/sec -Residual Pressure at Peak Day+Fire must be greater than 20 psi	Fire District governs Fire Flow Requirements
SECTION 1008 SOURCE	Water Quality	EPA Drinking Water Act & State and County Health Departments	NA	NA
	Testing	Public Health Service Chemical Tests (including Heavy Metals), dissolved O_2, turbidity, temperature, bacteriological (including fecal coliform), pH, organics, radioactivity, pesticides, herbicides, etc…	NA	NA

TABLE V-1
RECOMMENDED GDPUD DESIGN CRITERIA AND PERFORMANCE STANDARDS

IMPROVEMENT STANDARD COMPARISON TABLE – WATER DESIGN CRITERIA

GDPUDSPEC SECTION	DESIGN ITEM	RECOMMENDED GDPUD STANDARDS (2002)	PCWA STANDARDS (1993)	EID STANDARDS (1993)
	Reliability	Geologic, Hydrological, and Meteorological to prove adequate supply in driest years on record	NA	NA
SECTION 1009 TREATMENT PLANT AND PUMPING STATION DESIGN	Pumping Units	100% Redundancy, Shall provide Max day design flow w/largest pump out of service	NA	NA
	Facilities	Paved Access, Lighting, and fencing, Toilet and Sink,	NA	NA
	Treatment Requirements	Must Meet DOHS Stds.	NA	NA
	Chlorinating	Gas or Liquid; Not less than 30 min. contact time @ max day & DOHS requirements	NA	NA
	Chlorinating Analyzer	7-Day, Programmable Circular chart recorder alarmed to stop production	NA	NA
	Turbidity	Recorded continuously and alarmed to stop production	NA	NA
	SCADA	Compatible w/ district	NA	NA
	Flow Meter	7-day, programmable circular chart recorder	NA	NA
	Electrical	Auxiliary power required - Monitor status of auxiliary power generation equip.	NA	NA
	Design Flow	Max Daily Flow- or Max Hourly w/ Fire (if no storage)	NA	NA
SECTION 1010 STORAGE FACILITIES	Storage Facility Capacity	Sum of Fire Storage reservation + system peaking + emergency reserve Min=250,000 gal	NA	NA
	Fire Storage Reservation (FSR)	Fire Flow * Duration Min duration is 4 hours	NA	NA
	System Peaking Storage (SPS)	20% of total maximum daily flows	NA	NA
	Emergency Storage (ES)	4-hour duration w/ Max daily flow	NA	NA
	Over-Flow Piping	Sized to pass max incoming flow rate w/4" of Head	NA	NA
SECTION 1011 TRANSMISSION MAINS	Pipe Material	C-900/C-905, PVC CL 150/200 or DIP CL 200	PVC, Ductile Iron, or Steel Pipe w/ minimum pressure rating of 150psi	12" and smaller – PVC, AWWA C900 CL150/200 or Ductile Iron larger than 12" – Ductile Iron CL 250, 300, 350
	Design Flow Rate	Max Daily Flow	Max Daily + Fire Flow	Higher of the two: 1. Peak Hour 2. Max Day + Fire
	Velocity	Max 10 fps	7 fps	10fps
	Minimum Diameter	8"	12"	6"
	Design Pressure	Min=Required Flow to Storage facility, Max=200psi	35 psi Min and 100 psi Max for service connection Minimum peak hour pressure = 30psi Minimum during periods of coincident peak day and fire flow shall not be less than 20 psi. Services w/ 80psi or more should have pressure regulator set to 60psi max. Services w/25psi should have individual hydropneumatic tank maintained by owner.	Max=150psi, Min=40psi, Min Emergency=20psi w/ half full reservoir
	Minimum Cover	3-feet	30"	3-feet in unpaved areas, 30" from subgrade to top of pipe in paved areas 60" in areas above the 5000' elevation
	Locator Wire	For all non-metallic pipe No. 12AWG copper wire Type UF insulation: Looped inside valves/vaults/risers: Grounded @ end of pipe run	No.10 gage insulated copper wire complete w/ epoxy splice kit, 6" over all pipe Provide Continuity Testing before final approval	No. 10 A.W.G. Insulated copper wire - installed on non-metallic pipe and non-bonded pipe

TABLE V-1
RECOMMENDED GDPUD DESIGN CRITERIA AND PERFORMANCE STANDARDS

IMPROVEMENT STANDARD COMPARISON TABLE – WATER DESIGN CRITERIA

GDPUDSPEC SECTION	DESIGN ITEM	RECOMMENDED GDPUD STANDARDS (2002)	PCWA STANDARDS (1993)	EID STANDARDS (1993)
SECTION 1011 TRANSMISSION MAINS	Valves, Blow-offs, and Air Release	Valves spaced 1/per 1800lf, ARV's at end of lines and every 1500-3000 ft, BO's fire hydrant valve preferred	BO's:Required @ low spots and dead ends, fire hydrant maybe substituted for BOV, locate in street 3' from curb and gutter, design BO for 2.5fps velocity: for 8" & 10" use min 4" BOV, for 12" and larger use 6" BOV, 2"BOV @ end of line for future service 4"BOV shall be above ground wharf type & 6"BOV shall be fire hydrant ARV's: Combination air/vacuum release valves (AVRV) at all high points and every 1000' on flat runs and between valved sections of pipe - 1"AVRV on lines up to 12" - 2"AVRV for lines 14-18" - 3" AVRV for lines 20 to 30" for lines larger than 30" shall be as directed by agency or engineer For In-line valves see distribution main	ARV"s: Required at all significant high points BO's: Required at low spots and at dead-ends of lines 2" and 4" assemblies or fire hydrant acceptable Sizing criteria provided: 6"-2"BO, 8"-4"BO, 10"-4"BO, 12"-4"BO, larger than 12" special design. Valves: In-line valves required at a minimum of every 1000' of pipe Except for lines 10" and larger, where valves shall be @ intervals of 100 ft. per inch of pipeline diameter. - Valves shall be the same nominal size as pipeline - Valves shall be able to handle high static pressures - 12" and smaller shall be resilient seated gate valves 12" and larger shall be butterfly valves
SECTION 1012 DISTRIBUTION MAINS	Pipe Material	C-900/C-905, PVC CL 150/200 or DIP CL 200	PVC, Ductile Iron, or Steel Pipe w/ minimum pressure rating of 150psi	12" and smaller – PVC, AWWA C900 CL150/200 or Ductile Iron larger than 12" – Ductile Iron CL 250, 300, 350
	Service Mains	NA	- 5/8", ¾", and 1" meters shall be served w/ 1" service piping - 1" shall be copper or polyethylene - 1.5-2" shall be copper or PVC: 2" and larger shall have buried GV @ main - 3"- PVC - Place near property lines (not in driveways)	1-2" polyethylene tubing CTS, AWWA C901 3" and greater – PVC Schedule 40
	Easements	See Section 600 - minimum width shall be 15' for lines less than 12" or 3 times the depth of line, whichever is greater - pipe location – prefer centerline of easement - Etc… (see section 600)	NA	Shall be accessible by conventional maintenance vehicles traveling over all weather relatively level surfaces. Width – for 18" in DIA. 20' Wide Pipe Location – 5' offsets from easement centerline Easement Location – On one property and not obstructed by walls, trees or permanent improvements unless otherwise approved Easement Provisions-Exclusive, non-exclusive, and or irrevocable offer of easement dedication
	Horizontal & Vertical Curves	NA	Joints laid in accordance w/ manufacturers recommendations	PVC: Deflection of joints not allowed, can bend pipe to the following minimum radius': 4"-190', 6"-200', 8"-250', 10"&12"-fittings required DIP: Max deflection for MJ joints 6-12" -4° or 260 ft radius, 14-18" - 3° or 345 ft. radius.
	Design Flow Rate	Higher of the following 2: 1. Max Hourly Flow Rate 2. Fire Flow Demand + Max Daily Flow	Design Q=Peak Day + Fire	Higher of the two: 1. Peak Hour Max Day + Fire
	Velocity	Max velocity not to exceed 10fps	7 fps	10 fps
	Design Pressure	Not to exceed 150psi Municipal Service Pressure Min=35psi Max=115psi Min w/Fire Flow=20psi	35 psi Min and 100 psi Max for service connection Minimum peak hour pressure = 30psi Minimum during periods of coincident peak day and fire flow shall not be less than 20 psi. Services w/ 80psi or more should have pressure regulator set to 60psi max. Services w/25psi should have individual hydropneumatic tank maintained by owner.	Max=150psi, Min=40psi, Min Emergency=20psi w/ half-full reservoir.

TABLE V-1
RECOMMENDED GDPUD DESIGN CRITERIA AND PERFORMANCE STANDARDS

IMPROVEMENT STANDARD COMPARISON TABLE – WATER DESIGN CRITERIA

GDPUDSPEC SECTION	DESIGN ITEM	RECOMMENDED GDPUD STANDARDS (2002)	PCWA STANDARDS (1993)	EID STANDARDS (1993)
SECTION 1012 DISTRIBUTION MAINS	Min Line Size	6-inches to 8-inch	6"	6": 4-inches if cul-de-sac w/ no more than 8-3/4" services, no longer than 500 feet, and no fire hydrant connections
	In-Line Valves	Distribution System shall have sufficient number of valves such that no single shut down will result in removing from service more than 500 feet of pipe in school, commercial, industrial, or multiple family dwelling areas, or greater than 900 feet in other districts. - No more than 2 fire hydrants out of service - Locate valves in street intersections or on prolongation property lines	Design distribution system w/ enough valves that no single shut-down will result close down more than 1000 feet of transmission line or 500' in other areas. No more than 2-fire hydrants removed from service at once. - 10" and smaller shall be gate valve type - 12" and larger shall be butterfly type - 16" and larger valve shall have min 2" bypass - locate valves in street intersections or property lines - 3-valve min on tees - 4-valve min on crosses - All valves shall be flanged - See More Detail for all valves Section 1.4	In-line valves required at a minimum of every 1000' of pipe Except for lines 10" and larger, where valves shall be @ intervals of 100 ft. per inch of pipeline diameter. - Valves shall be the same nominal size as pipeline - Valves shall be able to handle high static pressures - 12" and smaller shall be resilient seated gate valves - 12" and larger shall be butterfly valves
	Water Meters	Required on all services	5/8"x3/4" to 2": - Shall be in conformance w/ AWWA C700 - Manufactured by Sensus, Schlumberger or equal - Positive Displacement: rotating disc or oscillating piston - Etc… see section 1.4.9.1 3" and Larger - Shall be in conformance w/ AWWA C702 - Manufactured by Sensus or equal - Must have bypass piping: 3"w/2"bypass, 4"w/2", 6" w/4", 8"w/4"	Required on each new single family dwelling unit -No service line less than 1" Dia. -No meter smaller than ¾" -Polyethelene service tubing shall be min 160psi -Positive-displacement piston or disc-type Meter Sizing and Type Table 3-9 provided Service line sizing Table 3-11 and Head loss Tables also provided Table 3-10 and 3-12.
	ARV's/BO's	ARV's: Required at significant high points, Sizing criteria provided BO's: Fire hydrants preferred, dead end runs and low spots, capable of draining pipe in 2 to 4 hours, over 10" requires specially designed BO assembly.	BO's: Required @ low spots and dead ends, fire hydrant maybe substituted for BOV, locate in street 3' from curb and gutter, design BO for 2.5fps velocity: for 8" & 10" use min 4" BOV, for 12" and larger use 6" BOV, 2"BOV @ end of line for future service 4"BOV shall be above ground wharf type & 6"BOV shall be fire hydrant ARV's: Combination air/vacuum release valves (AVRV) at all high points and every 1000' on flat runs and between valved sections of pipe - 1"AVRV on lines up to 12" - 2"AVRV for lines 14-18" - 3" AVRV for lines 20 to 30" - for lines larger than 30" shall be as directed by agency or engineer	ARV's: Required at all significant high points BO's: Required at low spots and at dead-ends of lines 2" and 4" assemblies or fire hydrant acceptable Sizing criteria provided: 6"-2"BO, 8"-4"BO, 10"-4"BO, 12"-4"BO, larger than 12" special design.
	Minimum Cover	3-feet	30"	3-feet in unpaved areas, 30" from subgrade to top of pipe in paved areas 60" in areas above the 5000' elevation
	Locator Wire	For all non-metallic pipe No. 12AWG copper wire Type UF insulation: Looped inside valves/vaults/risers: Grounded @ end of pipe run	No.10 gage insulated copper wire complete w/ epoxy splice kit, 6" over all pipe Provide Continuity Testing before final approval	No. 10 A.W.G. Insulated copper wire - installed on non-metallic pipe and non-bonded pipe
	Separation	10' from parallel sewers and 12" higher	1. 24" min. separation from water line unless sewer 2. 10' min from sewers 3. Crossing-minimum 1' clearance-all sewer crossings shall conform to California State Health department regulations 4. Written application to district to install facilities in common trench.	Per California Code of Regulations: 1. 10 feet from sewers (if less, see Dwg W07) 2. Crossing- minimum 1 foot clearance 4. No common trenches allowed 5. 25' from cesspools, septic tanks, leach fields and seepage pits.

TABLE V-1
RECOMMENDED GDPUD DESIGN CRITERIA AND PERFORMANCE STANDARDS

IMPROVEMENT STANDARD COMPARISON TABLE – WATER DESIGN CRITERIA

GDPUDSPEC SECTION	DESIGN ITEM	RECOMMENDED GDPUD STANDARDS (2002)	PCWA STANDARDS (1993)	EID STANDARDS (1993)
SECTION 1012 DISTRIBUTION MAINS	Line Location	6' from ROW CL or easement of 15'	3' from lip of gutter	5' from Edge of Pavement or 3' from lip of gutter:
SECTION 1013 FIRE PROTECTION	Hydrant Type	Dry Barrel w/2-hose one pumper outlet types and 6" Riser pipe	Dry or Wet Barrel per detail SA016 and 0017 Min Dia=Looped 6" feed or 8" feed min.	Dry barrel type w/ 4.5" and 2-21/2" hose nozzles
	Spacing	Single Family: not to exceed 500 feet Townhouse/Commercial/Industrial: not to exceed 300 feet	Per direction of local Fire District	Per direction of local Fire District
SECTION 1016 CREEK CROSSINGS	Material Requirement	DIP under full creek width plus 10 feet either side	NA	NA
	Encasement/Other Specifics	Concrete Encasement Required	NA	- Concrete Encasement w/ reinforcement (per detail W25)- Protect Pipe 10-feet beyond top of banks - Pipelines to cross upstream of hydraulic structures (i.e. bridges, culverts, etc.) - Cross perpendicular to flow line of creek

A summary of recommended raw water storage based on current demands, historic failures and ditch maintenance is as follows:

GDPUD
RAW WATER EMERGENCY AND MAINTENANCE
STORAGE CRITERIA
TO MEET EXISTING TREATED
WATER DEMANDS

Location	Ditch Failure Storage [1] (ac-ft)	Ditch Repair Storage [2] (ac-ft)	Recommended Min. Raw Water Storage (ac-ft)
Upstream of Walton Lakes & ALT Water Treatment Plant	36 to 48	51	50
Upstream of ALT Water Treatment Plant	18.5 to 25	26.7	25

(1) Based on a ditch failure resulting in no supply for a 15 to 20 day period during winter months.
(2) Based on a 2 week ditch repair project conducted between Oct. 1 - Nov. 15.

In Section VI of this Study, existing raw water storage capacities are evaluated with respect to the above criteria. Currently, raw water storage upstream of the Walton Lake Water Treatment Plant is limited to the Walton Lakes Reservoir. Raw water storage upstream of the ALT Water Treatment Plant is now provided at Greenwood Reservoir and at the Auburn Lake Trails Water Treatment Plant Reservoir.

Downstream of GDPUD water treatment plants, raw water storage is used to respond to fluctuations in daily irrigation demands. These raw water storage ponds may also be used to sustain demands during those periods during the irrigation season when ditch sections must be temporarily shut down for maintenance or repair.

Ditch Structures

Ditch structures include culverts, piped sections, and wastegates. Adequate culvert capacity is critical since in many locations culverts have been placed which are undersized or of inappropriate pipe material. In **Table V-2** is presented culvert recommendations based on an average ditch slope and hydraulic grade level of 0.002 ft./ft. (0.2%) and a Mannings "N" roughness co-efficient of 0.024. Corrugated metal pipe arches (CMPA) are recommended for culverts. As an alternative to CMPA, corrugated metal pipe (CMP) or high density polyethylene (HDPE) pipe may be used. The CMPA structure is preferred because the lower profile of the "squash pipe" is a better fit for the trapezoidal ditch section. Recommended minimum "round" culvert structures (CMP or HDPE) are also presented in Table V-2.

In Section VI of this Study culverts which have been placed within the GDPUD ditch system shall be compared to the CMPA and CMP recommendations presented in Table V-2. Future culverts which are proposed within the ditch at proposed driveways and new roadway crossings should be placed consistent with the recommendations presented in Table V-2.

Culverts should be constructed with tapered (smooth) inlet and outlet sections. Concrete, cobble or sack-crete should be placed at the upstream end. Culverts should be furnished with flared end sections for both upstream and downstream sections.

Recommended ditch repairs may include replacement of unstable or inadequate ditch sections with piped sections. For gravity flow pipelines, a number of pipe options are available including HDPE pipe, pre-cast concrete, concrete cylinder, lined and coated ductile iron and coated steel pipe. For the purpose of this study, HDPE or concrete pipe with a Mannings "N" of 0.015 is assumed. Piped sections with capacities adequate to meet design ditch flow for the various segments of the GDPUD ditch system are also presented in Table V-2.

Piped sections should be constructed with tapered inlet and outlet sections which are concrete or gunnite lined. A concrete headwall with a debris rack ("grizzley") should be installed at the piped inlet.

While the ditch serves mainly to deliver water to GDPUD customers, it also acts as a drain gutter which collects runoff and discharges this flow to controlled locations. Discharge points, or "wastegates", have been constructed at periodic locations along the ditch. In upper ditch sections sidewater collection structures #1 through #7 are also designed to serve as wastegates for the release of excess flow. In other ditch locations separate structures are provided to waste or discharge excess winter runoff. Structures #1 through #7 located in the Upcountry Ditch Section are constructed of reinforced concrete with metal slide gates. These have been in service for at least 40 years. A few of the wastegates below Tunnel Hill are also concrete construction however, most of

TABLE V-2

CULVERT AND PIPE CRITERIA FOR GDPUD DITCH SECTIONS

GDPUD Ditch Section	Design Flow (cfs)	Recommended Min. CMPA [1] (span x rise, in.)	Recommended Min. Culvert Size (in) CMP or HDPE [2]	Recommended Min. Pipe Size (in.) [3] HDPE or Concrete
Upcountry Ditch				
Pilot Creek Div. Dam to Tunnel Hill Outlet	35	71 x 47	54	48
Tunnel Hill Outlet To Walton Lake Water Treatment Plant	35	71 x 47	54	48
Walton Lake Water Treatment Plant to The Crails	30	66 x 51	54	42
Main / Pilot Hill Ditch				
Main Ditch No. 1, Crails to Taylor Mine Ditch	20	60 x 46	48	42
Main Ditch No. 1, Taylor Mine Ditch to Spanish Dry Diggins	17.5	57 x 38	48	36

TABLE V-2 (cont.)

CULVERT AND PIPE CRITERIA FOR GDPUD DITCH SECTIONS

GDPUD Ditch Section	Design Flow (cfs)	Recommended Min. CMPA [1] (span x rise, in.)	Recommended Min. Culvert Size (in) CMP or HDPE [2]	Recommended Min. Pipe Size (in.) [3] HDPE or Concrete
Main Ditch No. 2, Spanish Dry Diggins Ditch to ALT Water Treatment Plant	16.5	57 x 38	48	36
Main Ditch No. 2 ALT to Cherry Acres Ditch	14	49 x 33	42	36
Pilot Hill Ditch, Cherry Acres Ditch to Nagle Wastegate	12	49 x 33	42	36
Pilot Hill Ditch, Nagle Wastegate to Wagner Res.	8	35 x 24	36	30
Pilot Hill Ditch, Wagner Res. to Pilot Hill Res.	5	35 x 24	36	24

TABLE V-2 (cont.)

CULVERT AND PIPE CRITERIA FOR GDPUD DITCH SECTIONS

GDPUD Ditch Section	Design Flow (cfs)	Recommended Min. CMPA [1] (span x rise)	Recommended Min. Culvert Size (in) CMP or HDPE [2]	Recommended Min. Pipe Size (in.) [3] HDPE or Concrete
Kelsey Ditch				
Kelsey Ditch No. 1, Crails to Black Oak Mine Siphon	10	42 x 29	42	30
Kelsey Ditch No. 2, Black Oak Mine to Chicken Flat Wastegate	8	35 x 24	36	24
Kelsey Ditch No. 2, Chicken Flat Wastegate to Kelsey Reservoir	5	35 x 24	36	24

(1) Slope = 0.002
N = 0.024
Pipe Flow 50% to 75% Fill

(2) Slope = 0.002
N = 0.025
Pipe Flow = 50% to 75% Fill

(3) Slope = 0.002
N = 0.015
Pipe Flow 50% to 75% Fill

the wastegates within the GDPUD System are constructed with wood. These require replacement every 10 to 15 years.

Where wastegates have been constructed in intervals of 3500 to 5000 feet, adequate control of runoff flows has typically been provided. In areas where the wastegate interval exceeds this spacing the ditch operators have difficulty in keeping runoff contained in the ditch until the next wastegate release point. Where runoff flows exceed ditch capacity damage to the ditch section can occur. Where construction equipment access is possible it is recommended that new and replacement wastegates be constructed of concrete. Alternative concrete and metal (slide) wastegate configurations are presented in **Figures V-1 and V-2**.

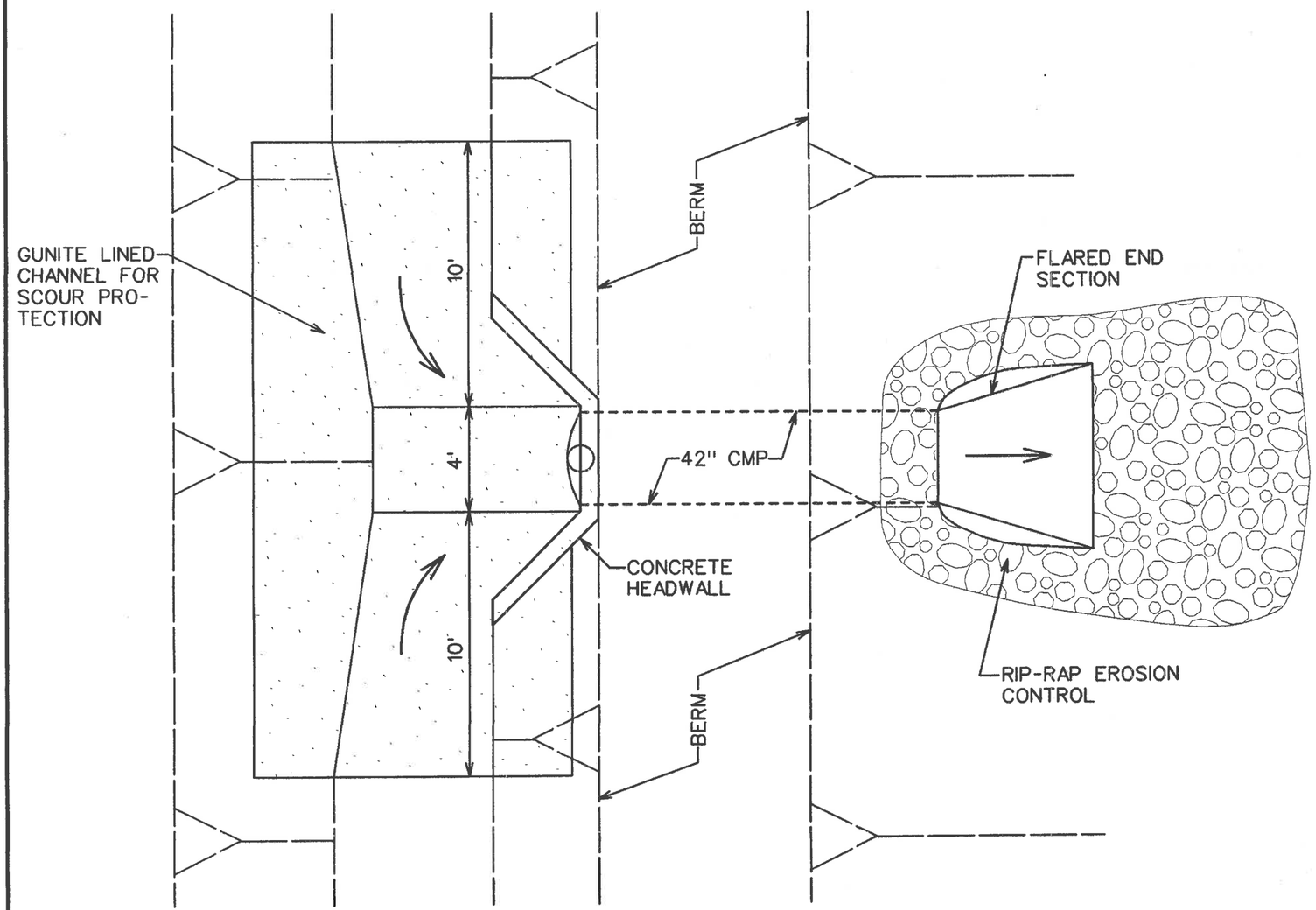
Ditch Section

The ditch section geometry impacts the flow characteristics, the ease of operation and maintenance, capacity and access. While it is recognized that there are few segments within the GDPUD ditch system which meet all of the characteristics of the design ditch presented in **Figure V-3**, when ditch maintenance and ditch repairs are conducted it is important that reconstruction efforts be directed to achieving the design ditch section as a goal. Ditch section criteria includes freeboard, minimum bottom width and side slopes.

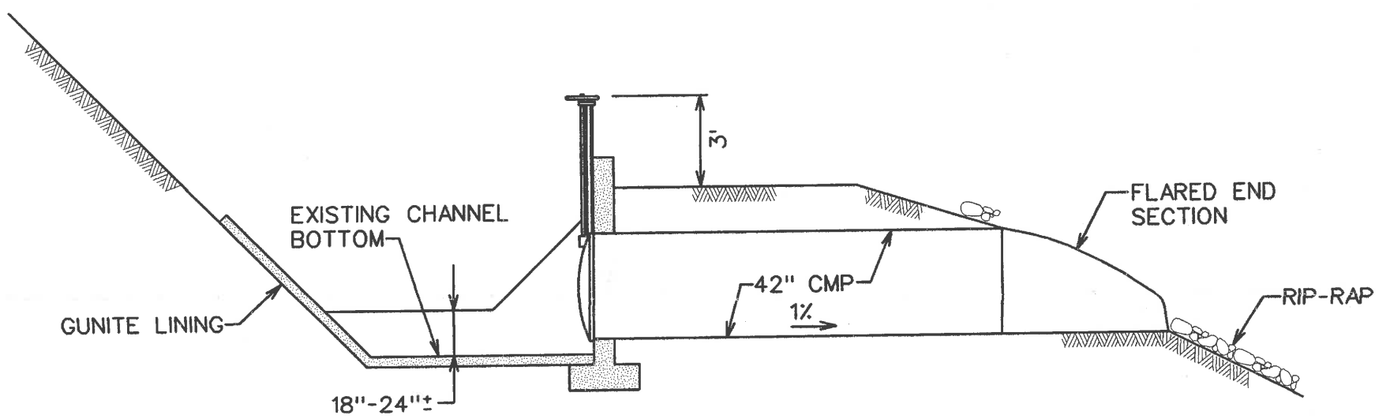
Freeboard

The design capacity of the GDPUD ditch system is evaluated in Section VI, in part, on the basis of allowable freeboard, or "clearance" between the normal maximum operating water level in the ditch and the top of the ditch section. Operating the ditch above these levels typically results in increased losses. Upper sections of the ditch are irregular and are compromised by roots and burrowing animals. Allowable freeboard provides for backwater at inlets to culverts and pipes without over-topping the ditch section.

The allowable freeboard recommended to be included in the reconstruction and repair of GDPUD ditch sections and included in the analysis of existing system ditch capacity is as follows:



PLAN

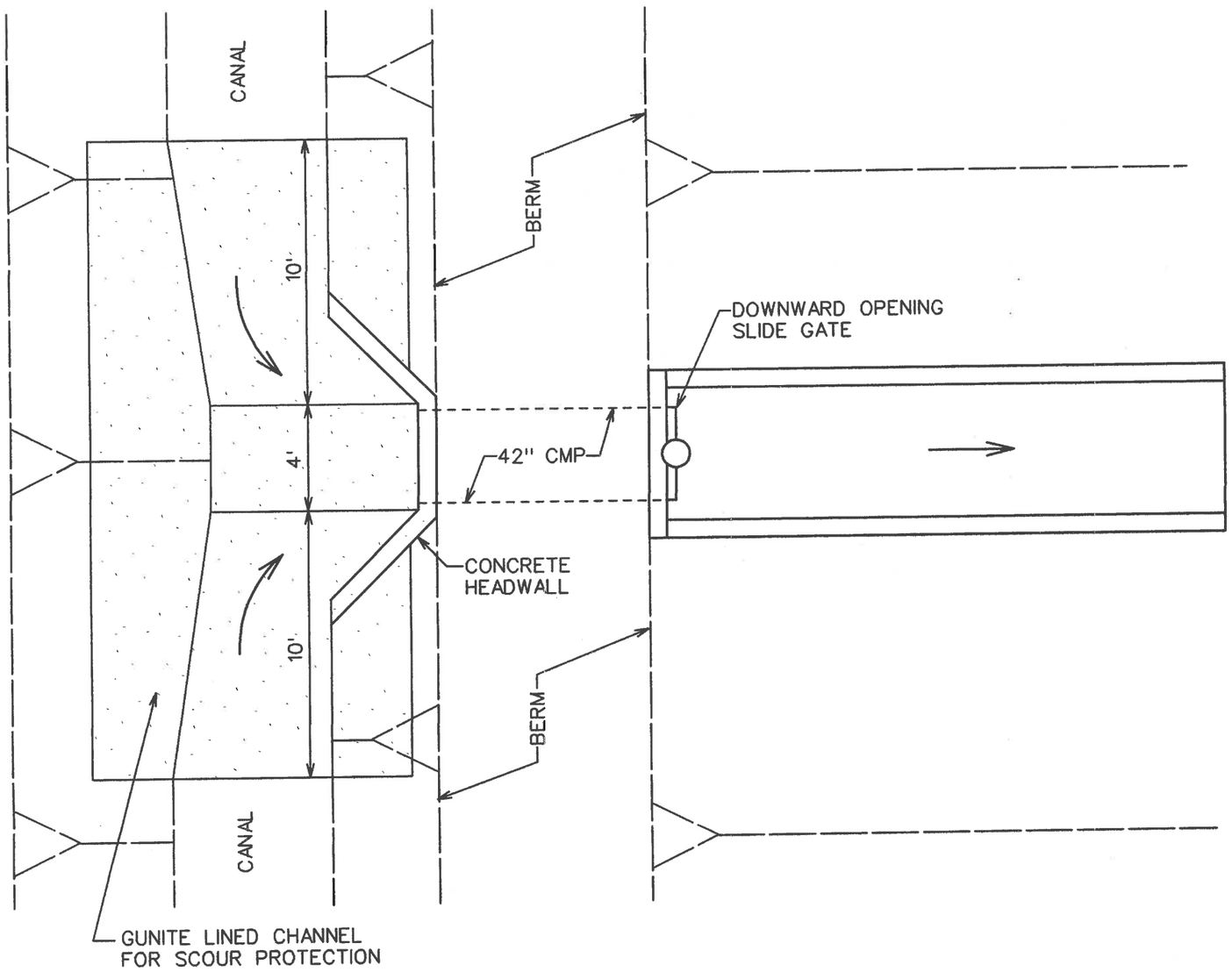


SECTION

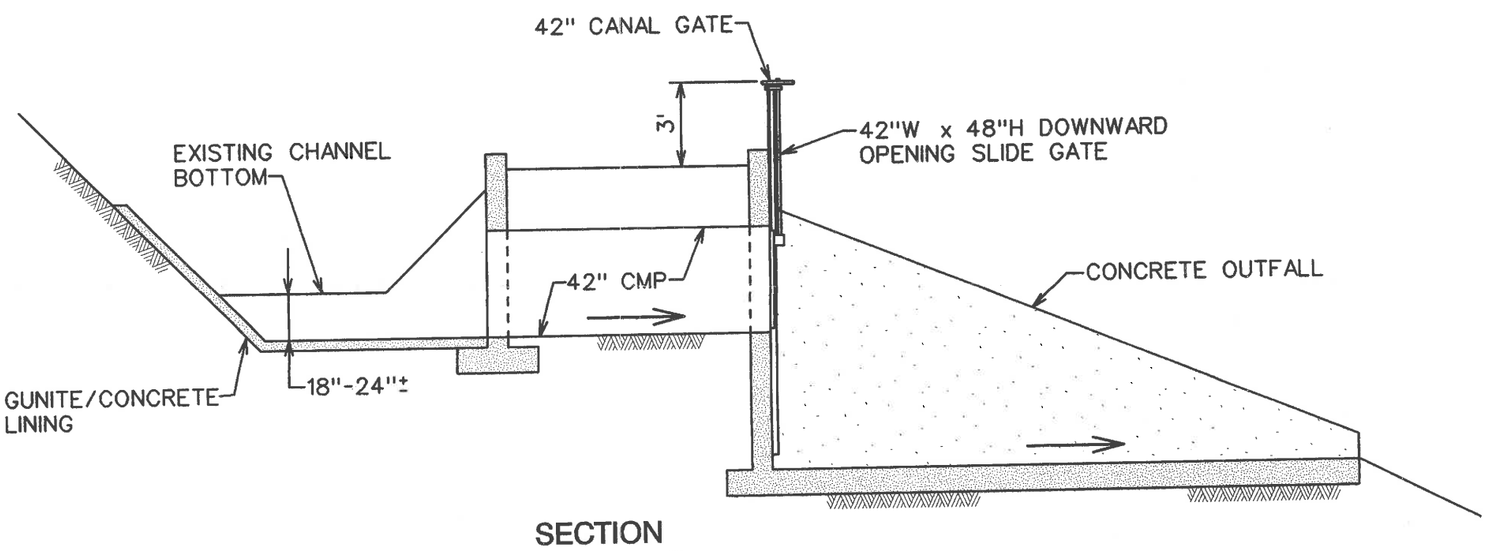
WASTE GATE WITH CANAL GATE

SCALE: 1"=5'

FIGURE V-1



PLAN

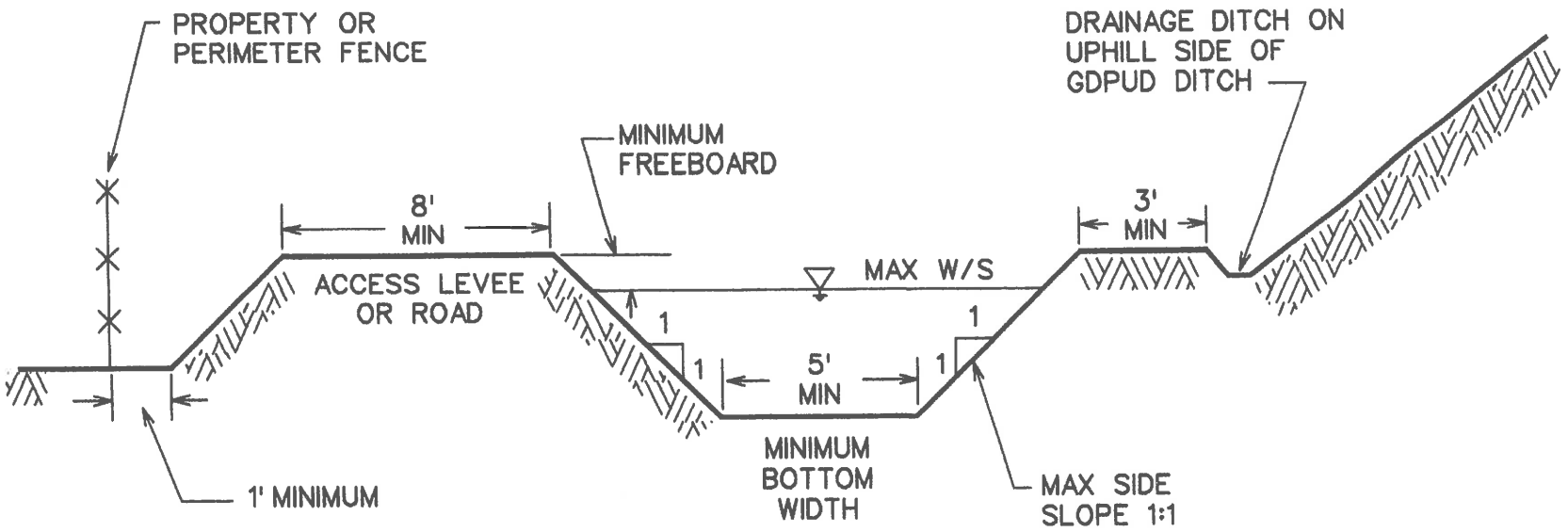


SECTION

WASTE GATE WITH ADJUSTABLE OVERFLOW WEIR

SCALE: 1"=5'

FIGURE V-2



GDPUD DESIGN DITCH SECTION

NO SCALE

ALLOWABLE FREEBOARD

UPCOUNTRY DITCH	
U/S OF TUNNEL HILL	2 FT
TUNNEL HILL OUTLET TO THE CRAILS	1 FT
MAIN DITCH No. 1	
THE CRAILS TO GREENWOOD/SDD	0.5-1* FT
MAIN DITCH No. 2	
GREENWOOD/SDD TO DORMAN SIPHON	0.5-1* FT
PILOT HILL DITCH	
DORMAN SIPHON TO PILOT HILL RES	0.5 FT
KELSEY DITCH No. 1	
THE CRAILS TO BLACK OAK MINE	1 FT
KELSEY DITCH No. 2	
BLACK OAK MINE TO KELSEY RES	0.5 FT
TAYLOR MINE DITCH	1 FT
CHERRY ACRES DITCH	1 FT
SPANISH DRY DIGGINS DITCH	0.5 FT

*WHERE POSSIBLE, A 1 FOOT MINIMUM FREEBOARD SECTION SHOULD BE PROVIDED IN MAIN DITCH No. 1 AND MAIN DITCH No. 2

FIGURE V-3

GDPUD
RAW WATER DITCH MINIMUM
ALLOWABLE FREEBOARD CRITERIA

GDPUD Ditch Sections	Minimum Allowable Freeboard (ft.)
Upcountry Ditch, Upstream of Tunnel Hill	2
Upcountry Ditch, Tunnel Hill Outlet to The Crails	1
Main Ditch No. 1 The Crails to Greenwood / SDD	0.5 to 1*
Main Ditch No. 2 Greenwood / SDD to Dorman Siphon	0.5 to 1*
Pilot Hill Ditch Dorman Siphon to Pilot Hill Res.	0.5
Kelsey Ditch No. 1 The Crails to Black Oak Mine	1.0
Kelsey Ditch No. 2 Black Oak Mine to Kelsey Res.	0.5
Taylor Mine Ditch	1.0
Cherry Acres Ditch	1.0
Spanish Dry Diggins Ditch	0.5

* Where possible, a 1 foot minimum freeboard section should be provided in Main Ditch No. 1 and Main Ditch No. 2.

Minimum Bottom Width and Side Slopes

To allow access for the District maintenance equipment a minimum ditch bottom width of 5 feet should be maintained. This ditch section criteria should be achievable in all areas of the GDPUD raw water ditch system except for the lower sections of the Kelsey Ditch (Kelsey Ditch No. 2 downstream of the Chicken Flat Wastegate) and at the

downstream ends of the smaller distribution ditches; Spanish Dry Diggins, Taylor Mine and Cherry Acres.

Wherever possible a ditch side slope of 1:1, or flatter, should be provided for unlined ditch sections. Ditches located in rocky sections may be constructed with steeper side slopes.

Access and Access Control

For maintenance access a ditch levee width of not less than 8 feet wide should be provided on one side of the ditch. Wherever possible diversion ditches should be provided on the upstream side of the ditch to divert runoff to specific discharge points (wastegates, culverts, drainage swales).

To allow continued operation and maintenance of the ditch system, property fences which cross the ditch section should be installed with a minimum 8-foot wide metal or prefabricated gate. Gates may be secured with GDPUD approved locks. Property line and livestock fences should not be permitted within the ditch section to the maintained toe of the ditch levee. Minimum recommended fence clearances are shown in Figure V-3.

The District should install access control fences outside the toe of the levee slope as necessary to prevent livestock from accessing the ditch section. Without appropriate fencing livestock damage the ditch section, creating losses and increased ditch maintenance costs. Control of livestock access to the ditch is particularly critical in ditch conveyance areas upstream of the Walton Lakes and Auburn Lake Trails Water Treatment Plants.

CONSULTING
KASL
ENGINEERS

VI SYSTEMS ANALYSIS

In this section of the Reliability Study the hydraulic network modeling used to simulate the GDPUD treated water systems and the field measurements and hydraulic calculations used to evaluate the GDPUD raw water systems are described. Systems analysis findings are summarized.

TREATED WATER SYSTEM

Network Model

The WaterCad water distribution modeling software developed by Haestad Methods was used to analyze the GDPUD treated water distribution and storage systems. Using this software network models were developed for both the Auburn Lake Trails treated water system and the Walton Lakes treated water system. Network distribution models are mathematical representations of real physical systems. The WaterCad models permit the input of actual physical characteristics as well as loading conditions and boundary information. Field files created from the GPS mapping of the distribution system were input to the WaterCad models. The GPS data provided the actual locations, alignments and elevations of treated water pipes, valves and appurtenances. Water distribution maps created from the field information and used in the network modeling are appended to this report.

Average annual and maximum day water demands determined for each pressure zone served by the Auburn Lake Trails and Walton Lakes systems were also input to the models. Demands were placed at pipe junctions and demand nodes. Fire flows were evaluated at each fire hydrant. Average day and maximum day demands were assigned to pipe junctions and demand nodes consistent with the demand data determined for each pressure zone. By determining the demands (or loading) within each pressure zone loading conditions included in the models reflected actual demands on the Auburn Lake Trails and Walton Lakes systems.

Treated water pipe diameters and pipe material information was available from GDPUD improvement plans. Physical data together with pipe roughness coefficients appropriate for the age and the material of the pipe were input to the models.

Model Development and Review

Water distribution system maps developed for the network models were reviewed with GDPUD staff. Operating data for tanks, PRV's and pump stations was obtained from GDPUD. This information provided the boundary data which must also be included in the network models to produce accurate simulation results.

Model Calibration

Calibration testing of network models ensures that the results provided by the model bear close resemblance to reality. Calibration involves making corrections and adjustments to the model until observed pressures and flow rates are in reasonable agreement with computer-predicted performance over a wide range of operating conditions. Network calibration guidelines published by the American Water Works Association (AWWA) were used in this study. For planning studies AWWA suggests that at least 10% of the system nodes be tested for static pressure and that the pressure readings at these nodes be within 5 psi of the pressures predicted by the network model. For flow test calibrations the network model should predict flows within 10% of the actual values and within 5 psi of the actual pressure.

Static Pressure Calibration Test Results

Static pressure readings at fire hydrants were available for the study area from the El Dorado County Fire Protection District, the Garden Valley Fire Department and the Georgetown Fire Protection District. These pressure tests were conducted by the fire districts in either 2000 or 2001. Assuming average day demands, the network models were checked for pressures predicted at selected fire hydrant nodes. Static readings were within 5 psi of the predicted results at some 70 hydrant nodes checked within the Auburn Lake Trails system and were within the 5 psi criteria for some 40 hydrant locations checked within the Walton Lakes system. To further confirm these static pressure results, static pressure readings were conducted in November 2001 and January 2002 by KASL engineering staff for the Auburn Lake Trails system. Some 50 static pressure tests were conducted. The actual water system demands were determined for the days that static pressure tests were taken. The network model demands were then adjusted to closely approximate actual demands. Static pressures predicted by the model were within the 5 psi tolerance for all of the Auburn Lake Trails static pressures measured in the field.

Similarly, in February and March 2002 some 70 fire hydrant locations were tested for static pressure within the Walton Lakes system. Again, actual water demands for the dates that static pressure tests were conducted were determined with GDPUD. The Walton Lakes network model was run with demands adjusted to closely approximate the actual demands for the test days. Static pressures predicted by the model were within the 5 psi tolerance for all of the Walton Lakes static pressure test locations.

Flow Test Calibration Results

A total of 21 Auburn Lake Trails system fire hydrants were flow tested by KASL Consulting Engineers and the El Dorado County Fire Protection District in November 2001 and February 2002. Seven hydrants flow tested in November 2001 were re-tested in February 2002. Eighteen (18) of the 21 hydrant flow tests were within 5 psi of the

measured residual pressure and within 10% of the measured flows predicted by the network model. Fire hydrant flow test results were provided to GDPUD staff. Poorly operating pressure reducing valve(s) or a partially closed valve(s) are possible reasons that measured results at the three hydrants did not closely match the pressures and flows predicted by the network model.

A total of 16 Walton Lakes system hydrants were flow tested by KASL Consulting Engineers in February 2002. Follow up fire hydrant flow tests were conducted in March 2002. KASL was assisted by the Garden Valley Fire Department and the Georgetown Fire Protection District in the completion of these tests. For all but one of the 16 fire hydrants tested the actual pressures and flows measured were within 5 psi of the pressure and within 10% of the flow predicted by the network model.

Auburn Lake Trails and Walton Lake static pressure and fire hydrant flow test results were provided to GDPUD. Based on the results of both the static pressure and fire flow field tests it was determined that the Auburn Lake Trails and the Walton Lakes network models were adequately calibrated and produce results which closely approximate actual conditions within these systems. Systems analysis using the calibrated models was then initiated.

Model Results – Maximum Day Demands

Auburn Lake Trails Distribution System

In **Figure VI-1** is summarized the network analysis results for maximum day demand conditions within the Auburn Lake Trails system. Maximum day demands were evaluated at ±650 pipe junctions (J-nodes), demand nodes (D-nodes), and fire hydrant (FH-nodes) locations within the Auburn Lake Trails distribution system. Water treatment plant operations were included in the model. Maximum day demands were distributed through the ±850 pipelines, 3 tanks, water treatment plant, pump stations and 28 PRV's that comprise the Auburn Lake Trails system. As discussed in Section V of this Reliability Study distribution pressures should be between 35 psi and 150 psi. Reliability measures were evaluated for pressures which fell below 35 psi.

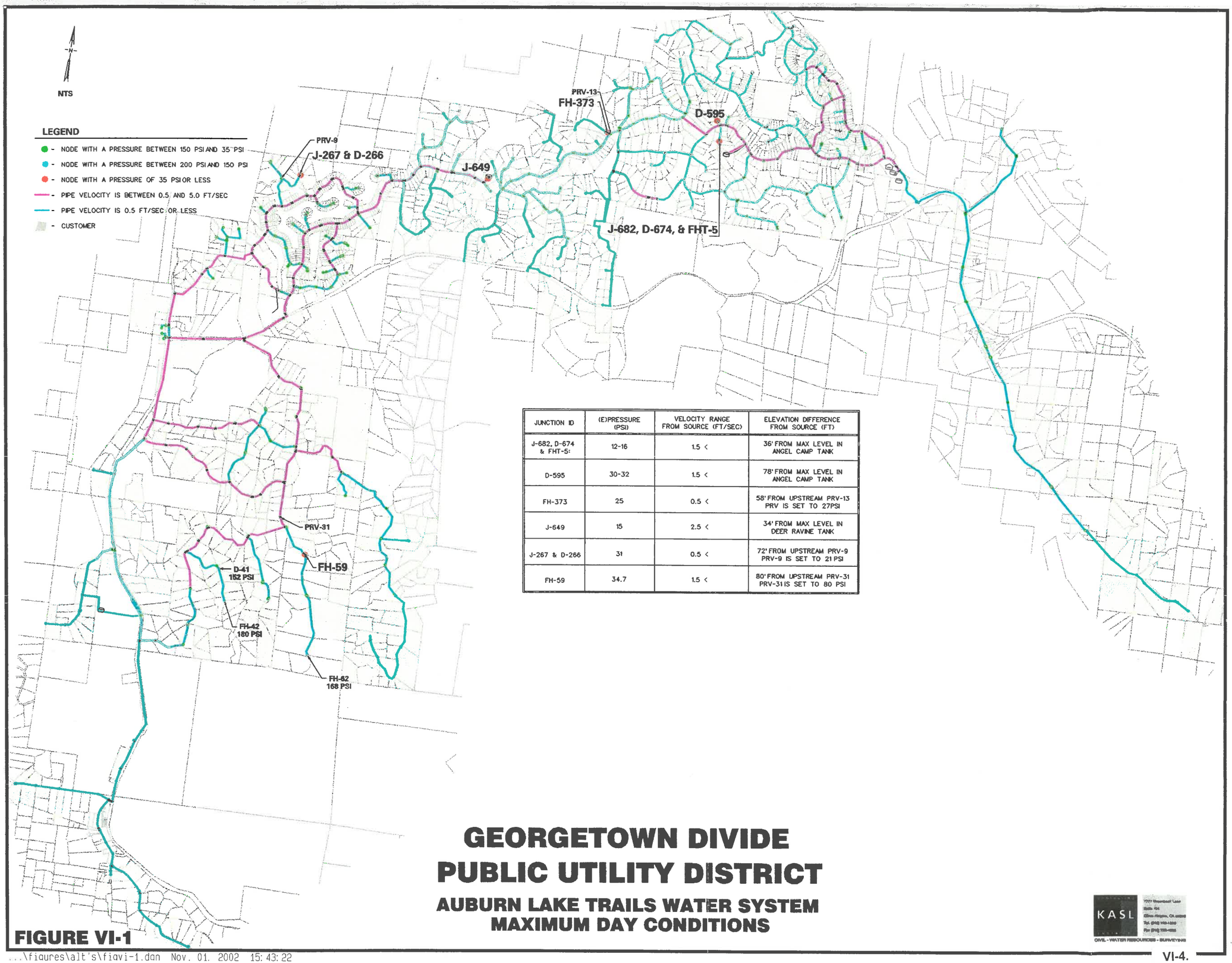
Under maximum day demand conditions, there were 9 nodes found that operate below 35 psi. The locations of these nodes are highlighted in Figure VI-1. Three of these nodes; J-682, D-674 and FHT-5 are located on Angels Camp Court near Angels Camp Tank. Under maximum day demands operating pressures at these nodes range from 12 to 16 psi. The elevation at these nodes is within 36 feet of the high water elevation at Angels Camp Tank.

Node D-595 is located on Hotchkiss Court opposite Cascade Trail from Angels Camp Court. This node is within 78 feet of the high water elevation at Angels Camp Tank and operates between 30 and 32 psi. To improve the pressures at these locations either a booster pump and pressure tank are needed to serve properties in close proximity to the Angels Camp Tank or the operating level at the tank must be raised.

NTS

LEGEND

- NODE WITH A PRESSURE BETWEEN 150 PSI AND 35 PSI
- NODE WITH A PRESSURE BETWEEN 200 PSI AND 150 PSI
- NODE WITH A PRESSURE OF 35 PSI OR LESS
- PIPE VELOCITY IS BETWEEN 0.5 AND 5.0 FT/SEC
- PIPE VELOCITY IS 0.5 FT/SEC OR LESS
- CUSTOMER



JUNCTION ID	(E)PRESSURE (PSI)	VELOCITY RANGE FROM SOURCE (FT/SEC)	ELEVATION DIFFERENCE FROM SOURCE (FT)
J-682, D-674 & FHT-5:	12-16	1.5 <	36' FROM MAX LEVEL IN ANGEL CAMP TANK
D-595	30-32	1.5 <	78' FROM MAX LEVEL IN ANGEL CAMP TANK
FH-373	25	0.5 <	58' FROM UPSTREAM PRV-13 PRV IS SET TO 27PSI
J-649	15	2.5 <	34' FROM MAX LEVEL IN DEER RAVINE TANK
J-267 & D-266	31	0.5 <	72' FROM UPSTREAM PRV-9 PRV-9 IS SET TO 21 PSI
FH-59	34.7	1.5 <	80' FROM UPSTREAM PRV-31 PRV-31 IS SET TO 80 PSI

GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

AUBURN LAKE TRAILS WATER SYSTEM MAXIMUM DAY CONDITIONS

FIGURE VI-1

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The pump at the water treatment plant could also be increased in head with an altitude valve placed at the Angels Camp Tank. With this alternative the existing inlet / outlet piping configuration at the tank would also need to be changed or else water would be "trapped" in the tank.

At FH 373 the existing maximum day demand pressure is 25 psi. This hydrant is located near the intersection of Big Nugget Trail and Sweetwater Trail. The pressures at this location are controlled by PRV-13 which is set to open at 27 psi. The downstream affects of increasing the operating set point at this PRV to 37 psi were evaluated. It was determined that this option caused unacceptably high pressures in other areas of the distribution system.

According to the network model results, Node J-649 operates at 15 psi under maximum day demands. This node is located on American River Trail between Wagon Wheel Court and Sweetwater Trail. The elevation at this node is within 34 feet of the maximum water level in Deer Ravine Tank. Either a booster pump station is needed to serve properties in close proximity to the tank or the operating level at Deer Ravine Tank must be raised to improve operating conditions.

Nodes J-267 and D-266 are located on Brown Bar Court downstream of PRV-9 which is located near the intersection of Shirt Tail Trail and Brown Bar Court. Maximum day operating pressures of 31 psi are predicted by the network model at these nodes. PRV-9 is set to open at 21 psi. The downstream affects of increasing the set point of this PRV to 25 psi must be evaluated with respect to other nodes downstream of PRV-9 which may be "over-pressurized" by increasing the PRV set point.

FH-59 is located in Cherry Acres near the intersection of Cherry Acres Road and Cherry Acres Circle. This hydrant is located downstream of PRV-31 which is set to open at 80 psi. High pressures at D-41 (152 psi) and FH-42 (180 psi) were also found below PRV-31. Increasing the set point at PRV-31 to improve pressure at FH-59 is not a good alternative considering the high pressures which already exist downstream of this valve.

Improvements recommended to improve ALT systems reliability under maximum day demands are described in Section VIII of this Study.

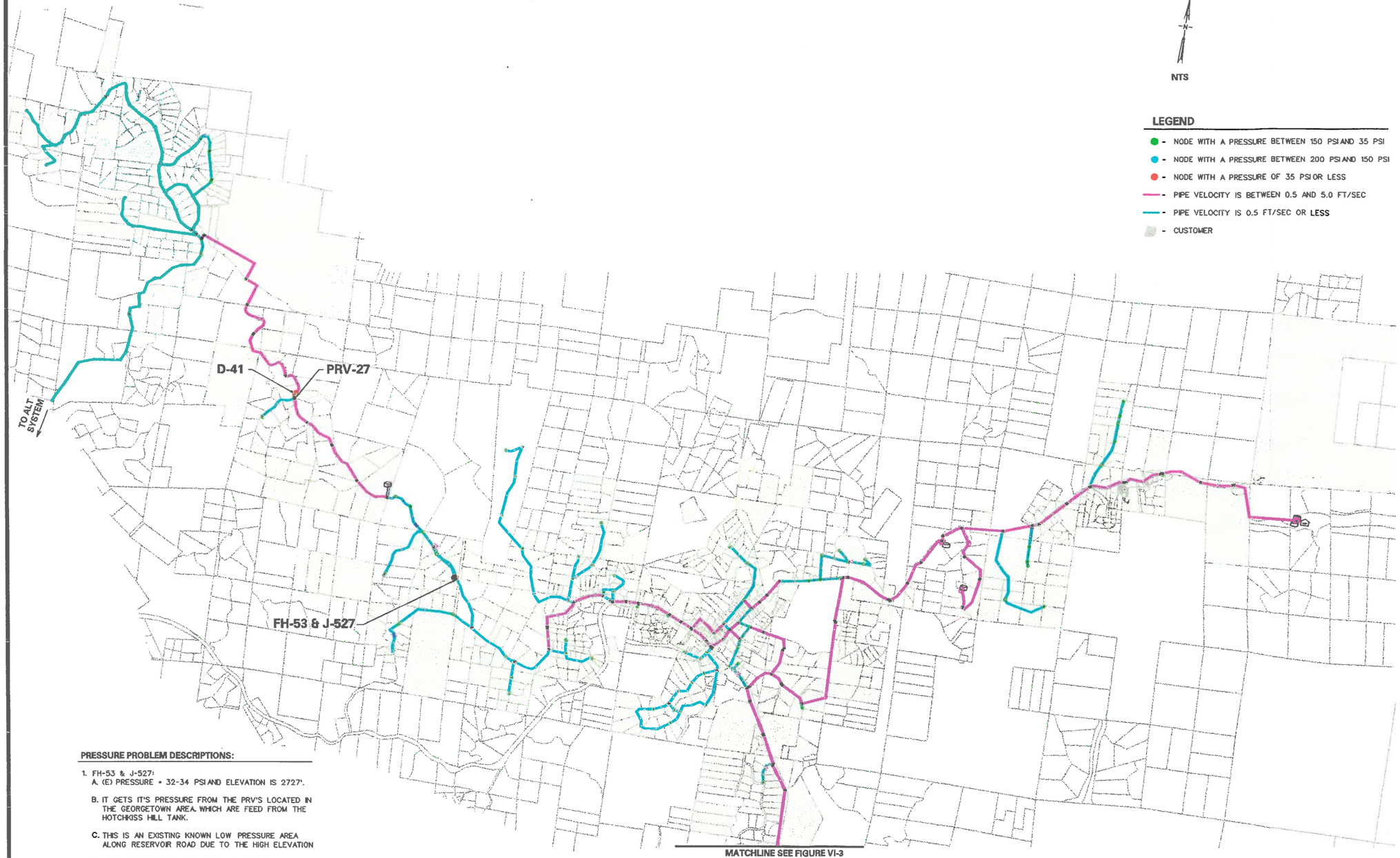
Walton Lakes Distribution System

In **Figure VI-2 and VI-3** are summarized the network analysis results for maximum day demand conditions with the Walton Lakes treated water system. The Walton Lakes Treatment Plant was included in the model. Similar to the analysis conducted for Auburn Lake Trails, maximum day demands were evaluated at the ±700 pipe junctions, junction demand nodes and fire hydrant locations within the Walton Lakes system. The low pressure nodes found typically occur in the higher elevation areas of the system.

NTS

LEGEND

- NODE WITH A PRESSURE BETWEEN 150 PSI AND 35 PSI
- NODE WITH A PRESSURE BETWEEN 200 PSI AND 150 PSI
- NODE WITH A PRESSURE OF 35 PSI OR LESS
- PIPE VELOCITY IS BETWEEN 0.5 AND 5.0 FT/SEC
- PIPE VELOCITY IS 0.5 FT/SEC OR LESS
- CUSTOMER



PRESSURE PROBLEM DESCRIPTIONS:

1. FH-53 & J-527:
   A. (E) PRESSURE = 32-34 PSI AND ELEVATION IS 2727'.
   B. IT GETS IT'S PRESSURE FROM THE PRV'S LOCATED IN THE GEORGETOWN AREA. WHICH ARE FEED FROM THE HOTCHKISS HILL TANK.
   C. THIS IS AN EXISTING KNOWN LOW PRESSURE AREA ALONG RESERVOIR ROAD DUE TO THE HIGH ELEVATION
   D. VERY LITTLE HEAD LOSS DUE TOO VELOCITY.

2. D-41:
   A. (E) PRESSURE = 34 PSI AND ELEVATION IS 2548'.
   B. IT GETS IT'S PRESSURE FROM PRV-27 THAT'S SET AT 35 PSI AND FEED FROM THE SDD TANK

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WALTON LAKES WATER SYSTEM
MAXIMUM DAY CONDITIONS

FIGURE VI-2

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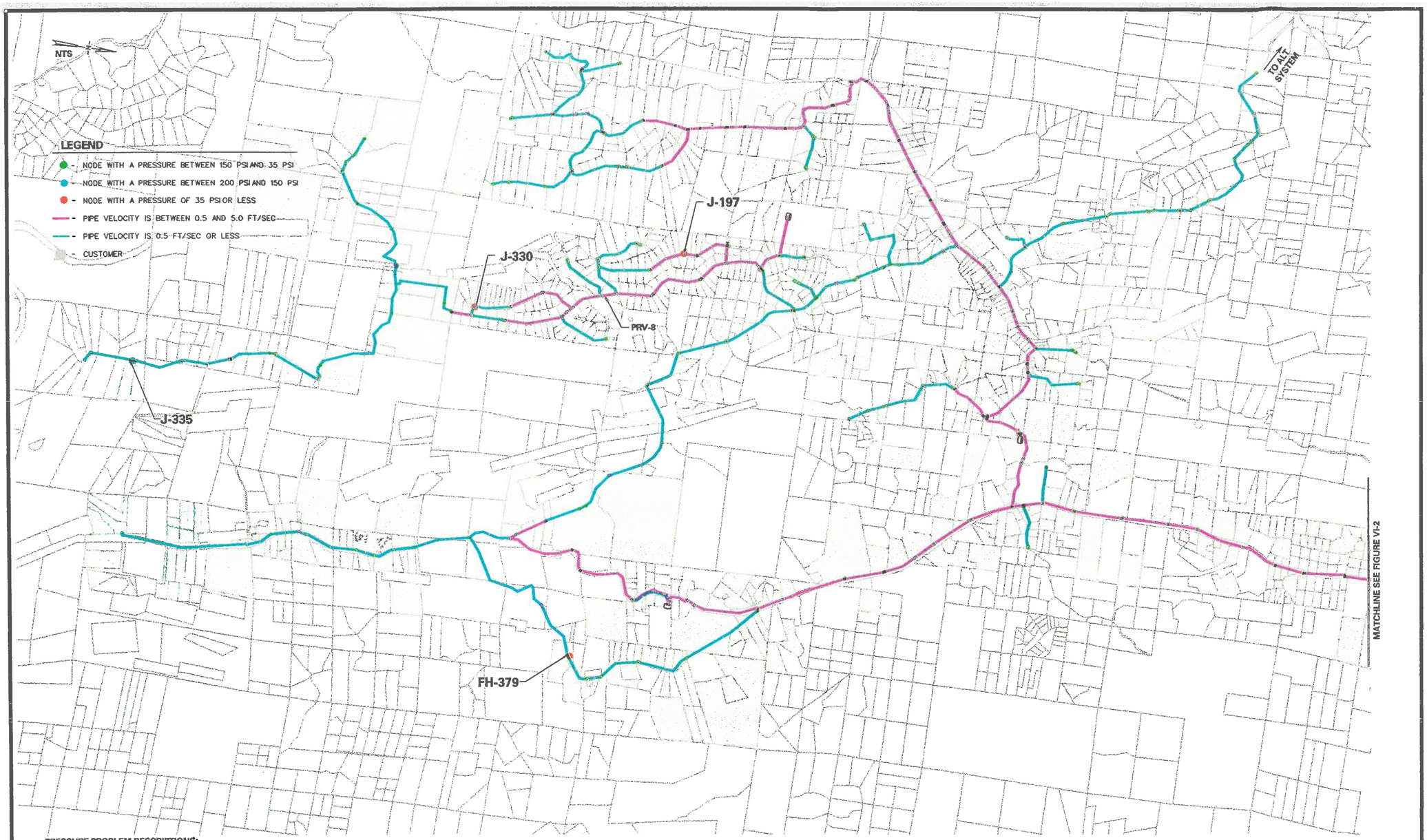

PRESSURE PROBLEM DESCRIPTIONS:

1. J-330:
   A. (E) PRESSURE = 34 PSI AND ELEVATION IS 1925'.
   B. IT GETS IT'S PRESSURE FROM PRV-8 WHICH IS SET TO A 2006 HGL.
   C. THIS IS A HIGH ELEVATED AREA.
   D. VERY LITTLE HEAD LOSS DUE TOO VELOCITY.
2. J-197:
   A. (E) PRESSURE = 33 PSI AND ELEVATION IS 2095'.
   B. IT GETS IT'S PRESSURE FROM THE GARDEN PARK TANK HGL= 2182'
   C. THIS IS A HIGH ELEVATED AREA.
   D. VERY LITTLE HEAD LOSS DUE TO VELOCITY.
3. FH-379:
   A. (E) PRESSURE = 32 PSI AND ELEVATION IS 2417'.
   B. IT GETS IT'S PRESSURE FROM THE PRESSURE SUSTAINING VALVE AT THE KELSEY TANK SET TO AN HGL OF 2482'
   C. THIS IS A HIGH ELEVATED AREA.
   D. VERY LITTLE HEAD LOSS DUE TO VELOCITY.
4. J-335:
   A. (E) PRESSURE = 29 PSI AND ELEVATION IS 1934'.
   B. IT GETS IT'S PRESSURE FROM PRV-8 SET TO AN HGL OF 2006
   C. THIS IS A HIGH ELEVATED AREA AND EXTREMELY DISTANT FROM THE PRESSURE SOURCE.
   D. VERY LITTLE HEAD LOSS DUE TO VELOCITY.

GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

WALTON LAKES WATER SYSTEM
MAXIMUM DAY CONDITIONS

FIGURE VI-3

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Fire Hydrant 53 (FH-53) and Junction Node J-527 shown in Figure VI-2 are high elevation nodes located along Reservoir Road in the Georgetown West Zone. This is a known low pressure area which is served by pressure created from the Hotchkiss Hill Tank. Pressures in Georgetown West are inspected by several PRV valves. The cost of installing a booster pump and pressure tank at the Spanish Dry Diggins Tank together with a separate "high pressure line" to serve the low pressure zone along Reservoir Road was also evaluated.

Demand Node D-41 is located in the Spanish Dry Diggins Pressure Zone. Pressures at this node are controlled by the setting of PRV-27. The impacts of adjusting the setting at PRV-27 can be evaluated with the network model. Low pressures at D-41 could be resolved by a booster pump and pressure tank at the Spanish Dry Diggins (SDD) Tank together with a high pressure line parallel to the existing low pressure line which is served by the SDD tank.

Nodes D-41, FH-53 and J-527 are in close proximity to the Greenwood Reservoir. If a new treatment plant with a clearwell tank at ± elevation 2450 was located at the Greenwood Reservoir adequate pressure would be available to correct these low pressure nodes.

Low pressure nodes J-330, J-197 and J-335 shown in Figure VI-3 are located in the Garden Park Zone. Node J-330 is located on Pikes Peak Circle and is served by the Garden Park Tank and PRV-8. Node J-335 is located at the extreme southern end of the system on Stewart Mine Road. It is also served by the Garden Park Tank with pressures controlled by PRV-8. There is a significant range in elevations downstream of PRV-8. Increasing the setting at this PRV to serve the higher elevation nodes could result in unacceptably high pressures at the low elevation nodes. Separate high pressure and low pressure mains were evaluated for this area, as well as connection to the existing main in State Highway 193 which is served by the higher elevation Kelsey Tank.

J-197 is located on McKinley Court at elevation 2095 and is served by the Garden Park Tank HGL of 2182. While a booster pump and pressure tank would resolve this low pressure problem this solution is not considered cost effective.

FH-379 is located in the Traverse Creek Zone and is served by the pressure sustaining valve located at the Kelsey Tank. This is the only low pressure node identified for the Kelsey Tank service area. A booster pump and pressure tank would not be cost effective to resolve this low pressure area.

Improvements recommended to improve Walton Lakes system reliability under maximum day demands are presented in Section VIII of this Study.

Model Results – Maximum Day Demands Increased by 5%; Maximum Day Demands Increased by 10%

After completing the system analysis with maximum day demands, the Auburn Lake Trails and the Walton Lakes systems were evaluated with maximum day demands increased by 5% and with maximum day demands increased by 10%. No additional low pressure nodes were identified in either the Auburn Lake Trails system or in the Walton Lakes system with these percentage increases in maximum day demands.

Model Results – Maximum Day Demands Plus 500 GPM Fire Flow

Auburn Lake Trails

In **Figure VI-4** is presented a summary of "failed" fire hydrant test locations within the ALT system under maximum day demands plus 500 gpm fire flow. With maximum day demands already included in the modeled demands, delivery of a 500 gpm fire flow was tested at each of the ±275 fire hydrants within the ALT system. At a minimum, a 500 gpm fire flow with a 20 psi residual pressure is needed to satisfy the minimum operating criteria. In addition, positive pressures must be maintained throughout the ALT distribution system with maximum day plus fire flow demands. Maximum day demand plus fire flows at 11 locations within ALT failed to meet this criteria.

Test fire hydrant 5 (FHT-5) is located on Angels Camp Court within close proximity to Angel Camp Tank. Low pressures at this hydrant were previously discussed under maximum day demands.

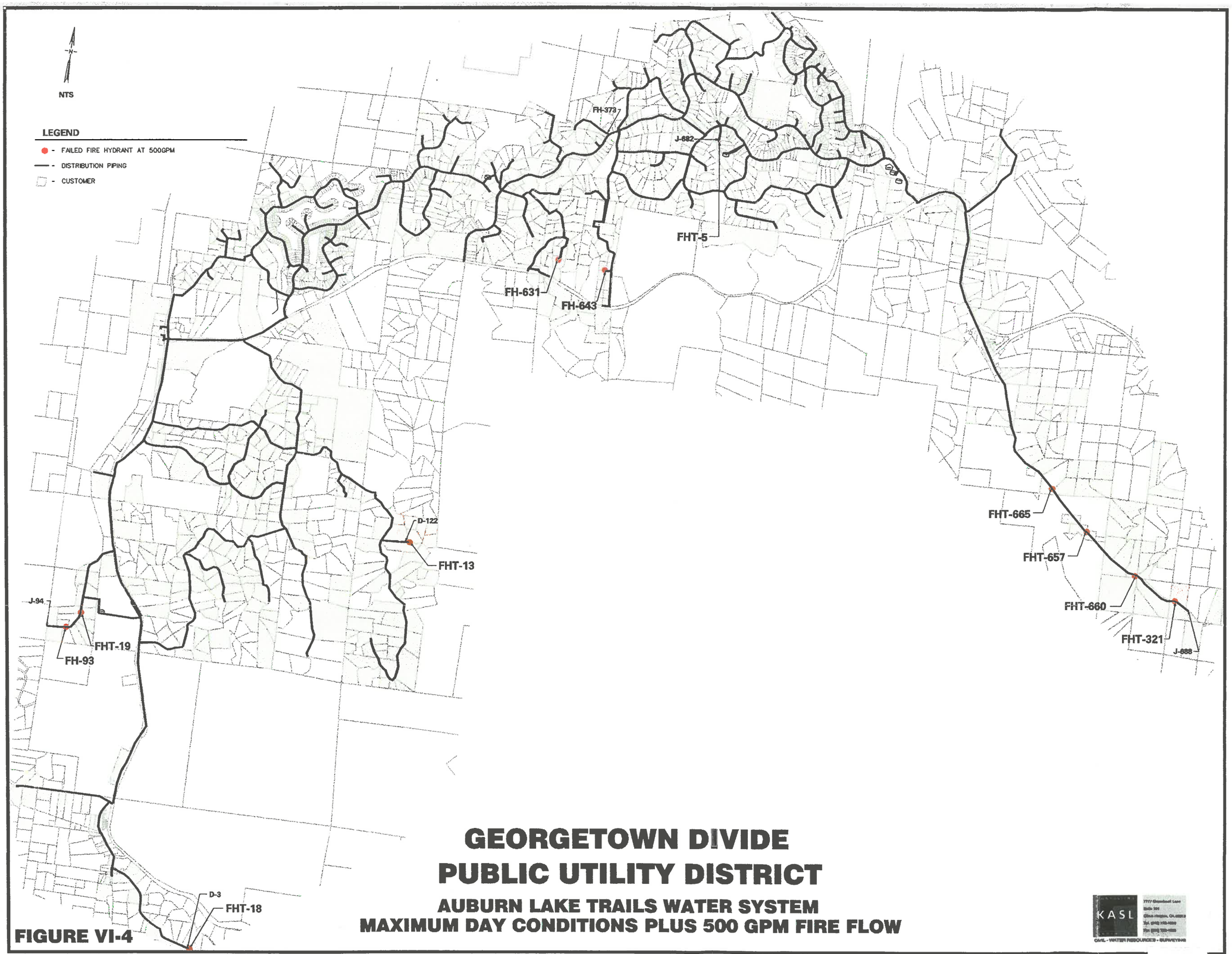
Four of the "failed" ALT hydrants, FH-321, 660, 657 and 665 are located along Greenwood Road and are fed by a single, non-looping, 6-inch diameter main. With a 500 gpm fire flow to FH-321 some 1200 feet of the 8" diameter Greenwood Road main has flow velocities of 5 to 6.5 feet per sec. To avoid high friction head losses, flow velocities within supply pipelines should be maintained at 5 ft. / sec. or less. To improve pressures to the Greenwood Road hydrants the Greenwood Road main must be increased in size or be served by the higher pressures available from the Walton Lakes Plant. Conditions along Greenwood Road would improve with the relocation of the ALT Treatment Plant to Greenwood Reservoir.

Fire hydrant 631 (FH-631) is located at the end of Brinks Lane south of Upper Black Rock Road. This hydrant is fed by 6" diameter mains located on Lois Lane and Brinks Lane with pipe velocities in excess of 6.5 feet / sec. These pipes are connected to the 6-inch diameter main located in Upper Black Rock Road. Replacing these small diameter mains with minimum 8-inch diameter mains or connecting the mains which terminate on Upper Black Rock Road, Sweetwater Trail and Tegra Road with a main along State Highway 193 would improve maximum day and maximum day plus fire flow pressures to acceptable levels.

NTS

LEGEND

- FAILED FIRE HYDRANT AT 500GPM
- DISTRIBUTION PIPING
- CUSTOMER



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AUBURN LAKE TRAILS WATER SYSTEM
MAXIMUM DAY CONDITIONS PLUS 500 GPM FIRE FLOW

FIGURE VI-4

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Fire hydrant 643 (FH-643) is also located in the Upper Black Rock Road / Tegra Road area. With maximum day plus 500 gpm flows at FH-643 high velocities occur at the two 4-inch diameter mains which connect the pipeline in Tegra Road with the pipeline in Hidden Gold Trail. The main in Hidden Gold Trail south of Brown Bear Trail could also be replaced with a larger main. Again, connecting the Tegra Road, Upper Black Rock and Sweetwater Trail mains with a new main along Highway 193 would result in acceptable pressures under maximum day plus fire flow conditions.

Fire hydrant 93 (FH-93) and test fire hydrant 19 (FHT-19) are located on Capecroft Lane in the western end of the ALT System, west of the Pilot Hill Tank. Pipeline velocities above 5 feet per second occur in the 6-inch diameter Capecroft Lane main west of State Highway 49 when 500 gpm fire flows are delivered to FH-93.

Test fire hydrant 13 (FHT-13) is located in Cherry Acres east of Indian Rock Road. When fire flows are delivered to this hydrant, pipe velocities in excess of 5 ft. / sec. occur in ± 6000 feet of the 6-inch diameter Indian Rock Road main. Either this main must be increased in size or the Indian Rock Road connected to the main in Cherry Acres Road to improve fire hydrant flows and pressures.

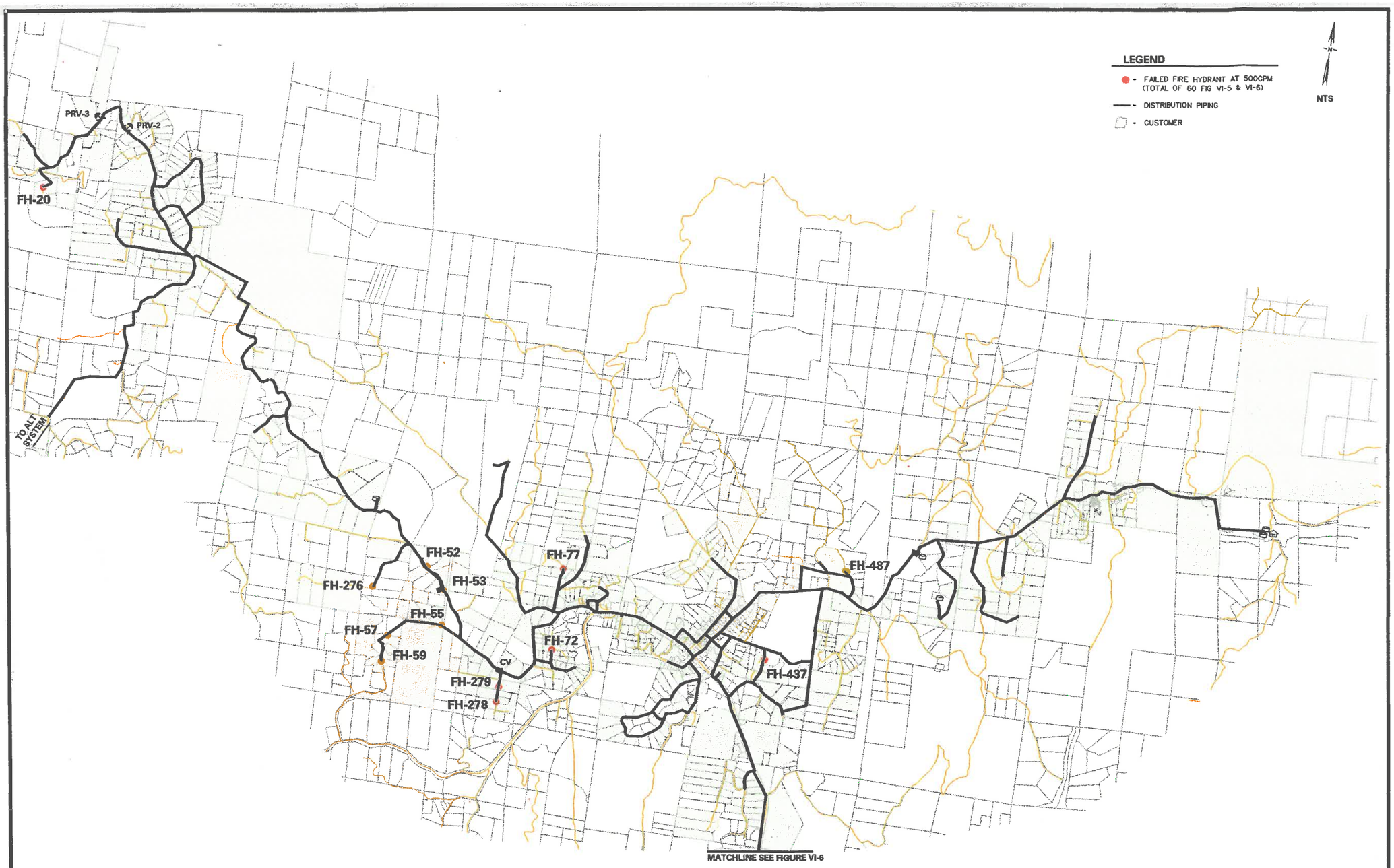
FHT-18 is located in Pilot Hill at the southwest limit of the ALT System. When 500 gpm are delivered to this location pipe velocities in excess of 5 ft / sec. occur in ±6000 feet of 6-inch diameter main on Pilot Hill Road and Meadow Craft Lane. To improve the performance of hydrants in the area, existing mains in Salmon Falls Road, Pilot Hill Road and Meadow Craft Lane must be improved to 8-inch diameter or a parallel main placed on State Highway 49 south of Rattlesnake Bar Road.

ALT system improvements recommended to improve reliability under maximum day plus fire flow demands are presented in Section VIII of this Study.

Walton Lakes

There are some 250 fire hydrants within the Walton Lakes system. A maximum day plus 500 gpm fire flow was evaluated at each hydrant. At some 60 Walton Lakes system hydrant locations either a residual pressure of 20 psi could not be maintained or pressures within the distribution zone dropped below zero with a hydrant flowing at 500 gpm. Conditions are not described herein for each failed case. System conditions and limitations common to "multiple" or "area" failure are summarized in this study. In **Figure VI-5** and **Figure VI-6** is presented a summary of hydrant locations which did not meet the system reliability criteria.

Fire hydrant 107 (FH-107) is located on Greenwood Road near Greybar Mine Road. With maximum day demands and a 500 gpm fire flow at FH 107 pipe velocities between 5 and 6.5 feet per second are predicted for some 7500 feet of 6" water main constructed in Greenwood Road north of Marshall Grade Road. With fire flow demands at FH 107, three nodes located near this hydrant (±1500 feet) would experience



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WALTON LAKE WATER SYSTEM
MAXIMUM DAY CONDITIONS PLUS 500 GPM FIRE FLOW

FIGURE VI-5

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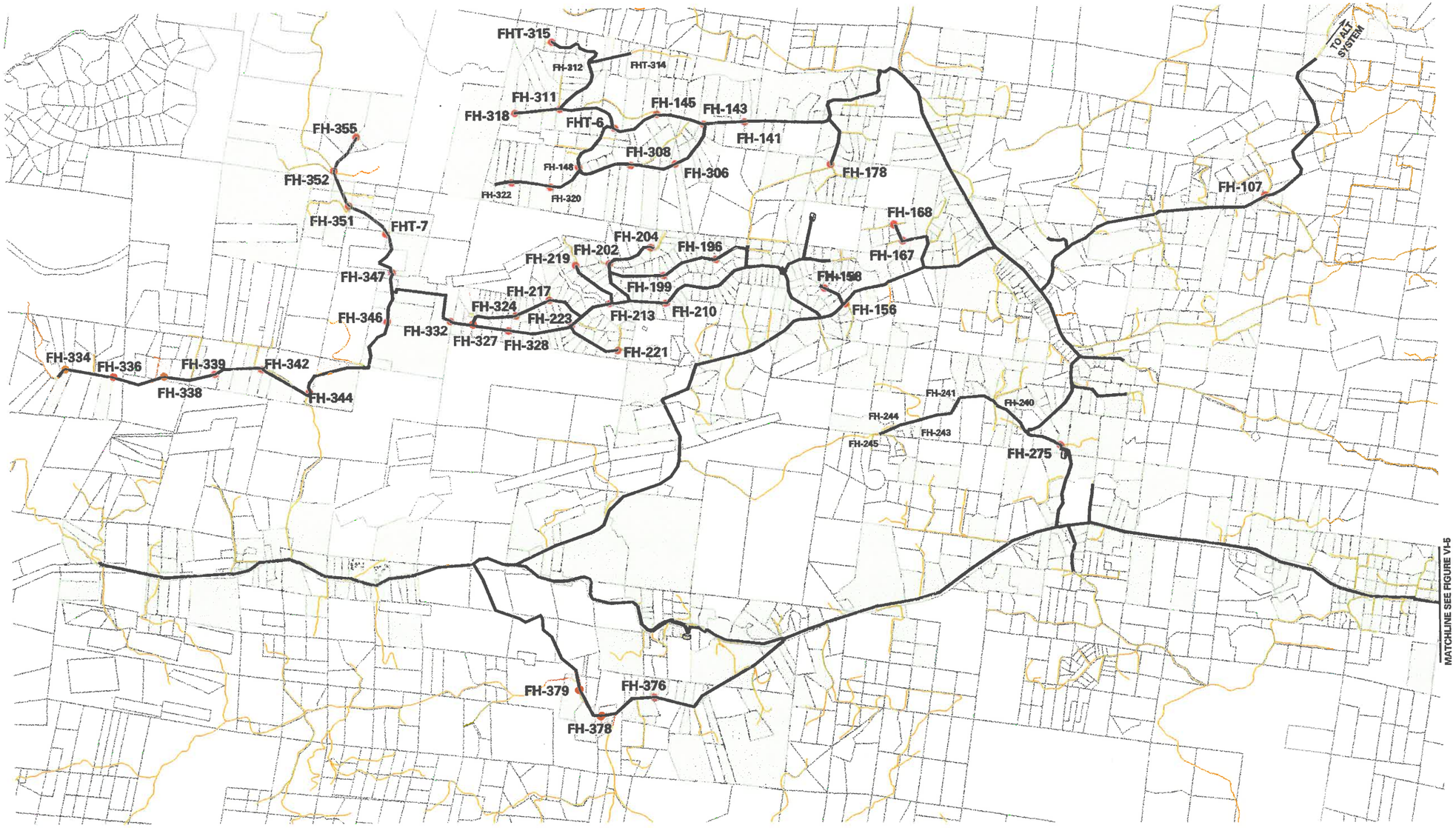
LEGEND

- FAILED FIRE HYDRANT AT 500GPM (TOTAL OF 60 FIG VI-5 & VI-6)
- DISTRIBUTION PIPING
- CUSTOMER

NTS



GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

WALTON LAKE WATER SYSTEM
MAXIMUM DAY CONDITIONS PLUS 500 GPM FIRE FLOW

FIGURE VI-6

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pressures below 35 psi. To correct this deficiency either the 6" diameter Greenwood main must be replaced with a larger diameter pipeline or the Greenwood Road area must be served by two points of supply. This could be accomplished with the new treatment plant sited at Greenwood Reservoir with service from the Sliger Mine Road and an 8" diameter water main constructed in Greenwood Road north of this location.

Failed conditions found at fire hydrant 336 (FH-336) are representative of similar failures predicted at FH-334, FH-338, FH-339, FH-342 and FH-344, FH-346, FH-347, FH-351, FH-352, FH-355 and FHT-7 all located on Stewart Mine Road or Bayne Road. With a 500 gpm flow at FH-336, the WaterCad model identified some 21 nodes with negative pressures. These negative pressures were predicted at locations along Stewart Mine Road, Bayne Road, Pikes Peak Drive and Garden Park Drive. High velocities were also predicted in pipelines on Garden Park Drive and on Pikes Peak Drive.

With widespread failures a number of system improvements were evaluated to correct these system deficiencies. These included:

1.) Replace the 4 inch mains located in Pikes Peak Drive and in Garden Park Drive with larger (min. 8 inch diameter) pipelines.
2.) Replace the 6 inch diameter connection located between Pikes Peak Drive and Bayne Road with larger (min. 8 inch diameter) pipeline.
3.) Provide a second "source" of supply to this area by connecting the main at Stewart Mine Road and Bayne Road with a new main on Bayne Road east to State Highway 193. This connection would allow the Stewart Mine Road / Bayne Road parcels to be served by both the Garden Park Tank and the Kelsey Tank. A PRV would be needed with the second source of supply to allow the higher pressure Kelsey tank system to feed the lower pressure Garden Park Tank system.
4.) Replumb the Garden Park Tank with separate inlet and outlet piping and an altitude valve on the Garden Park Tank. This will allow the Garden Park Tank to better serve the Garden Park area and improve the efficiency of the water supply system.

The failed conditions found at fire hydrant 322 (FH-322) are representative of similar failures predicted at FHT-6, FH-141, FH-143, FH-145, FH-148, FH-306, FH-308 and FH-320 all located in the Roller Coaster Drive, Chrysler Circle, Johnston Creek Road area. With a 500 gpm fire flow at FH-322, the WaterCad Model predicted 10 nodes with negative pressures and determined that pipelines located in Johnston Creek Road, Chrysler Circle and Roller Coaster Road would deliver flows with velocities in excess of 5 ft. / sec.

To correct these deficiencies alternative improvements include:

1.) Replace 6" main in Johnston Creek Road with minimum 8" diameter main.
2.) Replace 4" mains in Chrysler Circle and in Roller Coaster Road with minimum 8" diameter mains.
3.) Provide alternative "source" of supply for this area by providing a connection to mains located in Garden Park Drive or in Bayne Road. Water distribution mains in Garden Park Drive and in Bayne Road must also be increased in size to at least 8-inch diameter for these improvements to be effective.

The failed conditions found at fire hydrant 315 (FH-315) are believed to be representative of similar failures predicted at FH-311, FH-312, FH-314 and FH-318, all located in the Lazy Brook Trail and Lynx Ridge service areas. Predicted conditions with fire hydrant flows at FH- 315 include 7 nodes with negative pressures and 14 nodes with pressures less than 35 psi.

To correct these deficiencies possible improvements include:

1.) Replace 4 inch diameter main in Lazy Brook Trail with minimum 8 inch diameter main.
2.) Replace 6 inch diameter main located in Lazy Brook Trail with minimum 8 inch diameter main.
3.) Implement improvements described above for FH-322.

The failed conditions evaluated for fire hydrant 379 (FH-379) are representative of similar failures predicted at FH-378 also located along Traverse Creek Road. With fire flows at FH-379, high pipe velocities are predicted for some 6500 feet of pipeline in Traverse Creek Road east of Highway 193. Negative pressures are predicted at two nodes. Pressures below 35 psi are predicted at two nodes located along Traverse Creek Road. Improvements evaluated to correct these deficiencies included:

1.) Replace the 6" diameter pipe in Traverse Creek Road / Spanish Flat Road with a minimum 8" diameter pipeline.
2.) Install booster pumps.

The failed condition identified by the network model for fire hydrant 168 (FH-168), located on Superior Court is also representative of a similar failure predicted at FH-167. With a fire flow at FH-168 negative node pressures are predicted at two locations with high pipeline velocities anticipated in the 4" & 6" diameter mains located on Garden Valley Road, Oak Lane, Towzen Drive and Superior Court. To correct deficiencies these pipelines should be replaced with minimum 8 inch diameter pipelines.

Fire hydrant 158 (FH-158) is located in Whitney Court west of Garden Valley Road. Fire flows tested at this location result in high pipeline velocities in over 10,000 feet of 6" diameter main constructed in Garden Valley Road. Existing pipelines must be

replaced with larger diameter mains. Replacing a normally closed valve with a PRV shall also be evaluated.

Fire hydrant 20 (FH-20) is the only predicted failed condition in the Walton Lakes System, west of the Spanish Dry Diggins Tank. Maximum day plus fire flow conditions at this location result in high pipeline velocities in the Sliger Mine Road main west and north of Edgewater Drive. The Sliger Mine Road main downstream of Edgewater Drive is 6 inches in diameter. To correct this deficiency this main should be replaced with a minimum 8-inch diameter pipeline.

The failure predicted at fire hydrant 57 (FH-57), Longview Drive, is believed representative of similar failures predicted at FH-52, 53, 55, 59 and 276. All of these hydrants are located along Reservoir Road, Silent Meadow Road and Longview Lane south and east of Spanish Dry Diggins Tank. Fire flows at FH-57 result in negative pressures at 3 nodes and pressures of 35 psi or less at 10 nodes. The water main in Longview Drive is 6 inch diameter. Replacement with an 8 inch diameter main was evaluated.

Failed fire hydrant 72 (FH-72) is located at Quiet Plane and Lasita Way. Mains which serve the hydrant are 6 inch diameter and pipeline velocities exceed 5 ft. / sec. under fire flow demands. Looping the 6 inch Quiet Place main back to the main in Reservoir Road and replacing the Reservoir Road main with a minimum 8 inch diameter main was evaluated to resolve this deficiency. The benefits of removing an existing check valve located in Reservoir Road shall be evaluated.

Failures at fire hydrant 437 (FH-437) are isolated to the area near Harkness St. and Birch Hill Court. Placement of an 8-inch main to connect the main at Harkness with the 12-inch main located along Fain Lane would resolve this isolated deficiency.

High velocities in the 6 inch diameter mains located in Eaton Road and Veterans Way and low pressures at 4 nodes are predicted with maximum day demands plus fire flows to fire hydrant 487 (FH-487). Replacement of the 6 inch diameter mains in Eaton and Veterans with an 8 inch main and the looping of these mains back to the Wentworth Springs Road mains via Citabra Lane would resolve this deficiency.

System reliability measures recommended to correct maximum day and maximum day plus fire flow deficiencies in both the ALT and Walton Lakes systems are summarized in Section VIII.

Water Storage Tank Capacities

Existing GDPUD water storage tanks were evaluated with respect to the storage tank performance and design criteria recommendations presented in Section V. To meet the Fire Storage Reservation (FSR), System Peaking Storage (SPS) and Emergency Storage (ES) requirements presented in Section V the following Auburn Lake Trails tank volumes are required:

Comparison of Auburn Lake Trails System Storage Tank Volumes with Recommended Design Criteria

Tank	Recommended Min. Volume, (FSR + SPS + ES) gallons	Storage Volume Provided, gallons	Notes
Angels Camp	420,600	500,000	Tank is adequately sized
Deer Ravine	596,100	250,000	Tank is undersized.
Pilot Hill	165,000	470,000	Tank is oversized

Similarly, a capacity analysis of Walton Lakes system tanks is as follows:

Comparison of Walton Lakes Storage Tanks with Recommended Design Criteria

Tank	Recommended Min. Volume, (FSR + SPS + ES) gallons	Storage Volume Provided, gallons	Notes
Hotchkiss Hill	377,300	500,000	Tank is adequately sized
Spanish Dry Diggins	183,900	200,000	Tank is adequately sized
Black Oak Mine	269,000	300,000	Tank is adequately sized
Garden Park	285,000	200,000	Tank is undersized
Kelsey	169,600	214,000	Tank is adequately sized
Walton Lakes Clearwells	361,410	600,000	Tanks are adequately sized
Hotchkiss Hill Sub Tank	121,600	60,000	Tank is undersized

As summarized above, the Deer Ravine Tank and the Garden Park Tank are inadequately sized. The Hotchkiss Hill Sub tank, while undersized, serves a limited area and therefore the capacity limits at this location are less significant than at the Deer Ravine Tank and the Garden Park Tank.

Extended Period Simulations

To confirm the evaluation of existing tank capacities presented above, extended period maximum day demand simulations were conducted for each GDPUD tank. With the network models, extended period simulations allow evaluation of tank levels over a 24 hour maximum day period. Predicted tank levels can be compared to the levels (volumes) that should be available in the tank for fire storage reserve, emergency storage and system peaking storage. Under maximum day demands tank levels may drop into the system peaking storage (SPS) but should not fall below the level reserved for fire and emergency storage (FSR + ES).

A summary of the extended period simulation results for each GDPUD tank is as follows:

Angels Camp Tank Tank levels fall within the SPS limits but do not drop below minimum ES + FSR requirements. The Angels Camp Tank is adequately sized.

Deer Ravine Tank Adequate volume is not provided for FSR + ES. This tank always operates below the minimum FSR + ES requirement. The Deer Ravine Tank is undersized.

Pilot Hill Tank Under maximum day conditions, the minimum hydraulic grade line is well above the FSR + ES + SPS level. The Pilot Hill Tank has more than adequate capacity.

Hotchkiss Hill Tank Tank levels operate within SPS levels under maximum day demands but do not drop below minimum FSR + ES requirements. The Hotchkiss Hill Tank is adequately sized.

Spanish Dry Diggins Tank levels do not drop below minimum FSR + ES requirements. The Spanish Dry Diggins Tank is adequately sized.

Black Oak Mine Tank level drops to minimum FSR + ES requirement. The volume of the Black Oak Mine Tank is marginally adequate.

Kelsey Tank Tank levels are well above the minimum FSR + ES requirement. The Kelsey Tank has adequate volume.

Garden Park Under maximum day demands, levels in the Garden Park Tank almost drop to the FSR limit and are below the FSR + ES minimum requirement. The Garden Park Tank does not have adequate storage volume.

Hotchkiss Hill Sub Tank Adequate volume is not provided in this tank to meet minimum fire flow requirements.

In Section VIII of this study recommended storage tank improvements are proposed at Deer Ravine and Garden Park to improve system reliability.

DITCH SYSTEM

The GDPUD raw water ditch system was evaluated in this Reliability Study on the basis of performance, condition and capacity. The performance and condition of each segment of the ditch system were reviewed in the field with GDPUD ditch operators. High maintenance areas, high loss areas, previous repair areas, lined and piped sections were mapped. These features are included in the ditch system maps presented in the Appendix of this study.

Ditch flowline elevations and cross sections were measured throughout the GDPUD system. The capacity of each ditch section was determined using open channel flow equations, ditch slope, cross sectional area and assumed "roughness" (Mannings "N" coefficients). Minimum allowable freeboards, as presented in Section V of this study, were also applied to determine ditch segment capacities. The capacity of culverts placed in the ditch and the capacity of piped segments were determined based on partially full pipe flow, the available pipe slope, Mannings "N" appropriate for the culvert or pipe material and the depth of flow through the culvert or pipe. Allowable head loss was assumed to be one-half of the available freeboard.

A summary of ditch, culvert and piped segment capacities is presented in the Appendix of this study. The capacity of each segment of the GDPUD ditch system with respect to the design flows presented in Section V is summarized in **Figure VI-7**. Figure VI-7 (14 sheets) is presented at the end of this section of this Reliability Study. Based on the ditch design criteria and ditch design flows recommended in this study, adequate ditch capacity is available in all segments of the ditch system with the exception of:

- Upcountry Ditch, Balderston Wastegate to Sand Trap Siphon
- Upcountry Ditch, Buckeye Conduit to Shroeder Conduit
- Main Ditch #1, Spanish Dry Diggins Road to Spools Wastegate
- Kelsey Ditch #1, Forest View Drive to Irish Reservoir Wastegate
- Kelsey Ditch #2, Irish Reservoir Wastegate to Twin Pine Siphon

Upcountry Ditch

Pilot Creek Pipeline

Findings: The Pilot Creek Pipeline is a 48 inch diameter concrete pipe constructed some 3900 lineal feet from the Pilot Creek Diversion Dam to the Bacon Canyon Pipe. Adequate capacity is available. The pipeline does not normally require maintenance except for the periodic checking and maintenance of vent structures. The ditch operator also needs to access the Pilot Creek Diversion Dam along this route. There is no vehicle access available along this section of the pipeline.

Recommendations: An all-weather vehicle access, a minimum of 10 feet wide, is needed along the Pilot Creek Pipeline to maintain the operation of the pipeline and to access the Pilot Creek Diversion Dam.

Bacon Creek Pipeline

Findings: The Bacon Creek Pipeline is a 48 inch diameter concrete pipe constructed some 3000 feet in length. The pipeline begins at the connection of the 12-inch diameter Bacon Creek Pipeline and ends with the first open ditch section of the Upcountry Ditch. In 1993 GDPUD extended this pipeline some 1800 feet to improve system reliability. The section of the ditch replaced with pipe was susceptible to slides and unstable soils conditions. Limited vehicle access is available along the Bacon Canyon Pipeline.

Recommendations: Improved all-weather vehicle access is needed along approximately 1500 feet of the Bacon Canyon Pipeline.

Bacon Canyon Pipeline to Structure #1

Findings: This section of the Upcountry Ditch has adequate capacity to meet design flows. The existing ditch section has a capacity of approximately 35.9 cfs. Immediately upstream of Structure #1 an 860 lineal foot section of the ditch has been replaced with a 48 inch diameter Corrugated Metal Pipe. Future pipe replacements for this section of the ditch should be 48 inch diameter concrete, HDPE or similar. Future culverts placed in this section of the ditch should be 71 x 47 CMPA or 54" CMP.

Structure #1 to Structure #2

Findings: Within this reach there are 7 sections of pipelines varying in length from 80 to approximately 2250 feet. Ditch sections have been repaired with pipeline in 1993 and again in 2000. The ditch capacity meets with design flow criteria only when the allowable freeboard is reduced to 1.5 feet. A portion of this segment includes "The Narrows". This is an abandoned section of ditch levee approximately 250 lineal feet in length. During the past 10 years the levee roadway has been reduced from

approximately 10 feet in width to less than 6 feet in width with slope failures occurring on the downhill side of the ditch and access road. Since this section of the access road is no longer safe for vehicle travel, GDPUD have created a temporary bypass road around The Narrows using old logging trails located above the ditch section.

Previous ditch repairs using 48" concrete pipe provide adequate conveyance capacity. Pipeline repairs using 48" CMP represent restrictions to flow. Future ditch replacement in this section should use 48" concrete or HDPE pipe. Future culverts should be 71 x 47 CMPA or 54" CMP.

Recommendations: Provide roadway stabilization at the "Narrows" using retaining walls or gabions. Replace the ±250 foot long open ditch section with 48" concrete or HDPE pipe. Because of its importance to the continued supply of water to the rest of the GDPUD system this is a priority repair item.

Structure #2 to Structure #3

Findings: Similar to the previous reach, the segment between Structure #2 and Structure #3 includes several ditch sections which have been replaced with pipeline. According to the Ditch Operator sections of this ditch were replaced with pipe in the 1970's. A repair with pipe replacement was also completed in 2000. Piped sections are concrete, composite or CMP. Adequate conveyance capacity is available with the concrete and composite pipes. The 48" diameter CMP pipes represent restriction to flow and should not be used for future pipe repairs in this section of ditch.

Adequate capacity is available with the existing ditch section and slope except for a ±400 foot long section of ditch located approximately 400 feet upstream of Structure #3. Freeboard improvements which would raise the road levee section by approximately 1 foot are needed in this area.

This segment of the ditch is located below an area known as "The Landing". In 2002 significant logging activity was observed in this area. The logging activity together with slides that have been observed below the ditch and recent repairs to replace unstable ditch sections suggests that additional ditch replacement with piping will be warranted. It is recommended that the District plan on replacing that ±800 foot long section of ditch located approximately 1800 feet upstream of Structure #3.

Recommendations: Provide additional freeboard for approximately 400 feet of existing ditch. Replace approximately 800 feet of ditch with 48" concrete or HDPE pipe.

Structure #3 to Structure #4

Findings: This is a short (±2200 foot long) segment. Most of this segment is open ditch. Downstream of Structure #3 a 100-foot long 48" diameter CMP was placed as a ditch repair in 2000. Immediately downstream of this repair there exists a ±500 foot long section of ditch which appears to be unstable. Saturated levee conditions

have been observed and this segment of ditch is located in a known slide area. Immediately upstream of Structure #4 there also exists a known slide area above the open ditch.

Recommendations: The ±500 foot long unstable ditch section located immediately downstream of Structure #3 should be replaced with a 48" diameter concrete or HDPE pipe as a priority repair. The District should also schedule for replacement the ±500 foot section of ditch located immediately upstream of Structure #4.

Structure #4 to Structure #5

Findings: In response to slide damage in this segment ditch sections were replaced with pipe in 1986 and 1997. The District also replaced a section of unstable ditch with the "Big Cut". While the Big Cut eliminated a problem area of the ditch and reduced the overall ditch length the new ditch section constructed did not include adequate access. Maintenance, especially ditch cleaning and vegetation removal along the levee is restricted along the Big Cut because of poor access.

Recommendations: Widen the Big Cut area to provide for a minimum 8 foot wide ditch access road along one side.

Structure #5 to Structure #6

Findings: This reach of the GDPUD Upcountry Ditch is mostly open ditch. There is one, ±50-foot long 48" CMP placed approximately 300 feet downstream of Structure #5. The CMP is under capacity. An unstable ditch section has been identified approximately 400 feet downstream of Structure #5. This is a priority repair area. Slides were observed above the ditch in this area during the 1986 storms however, no ditch sections were piped in this segment at that time.

Recommendations: Replace the 48" CMP and a section of ditch approximately 400 feet downstream of this CMP with a 48" diameter concrete or HDPE pipe. This work should be considered a priority repair by the District.

Structure #6 to Structure #7

Findings: Portions of this section of ditch are lined and there is one, 30-foot long section of 42" diameter concrete pipe. According to the Ditch Operator the segment between Structure #6 and Structure #7 is stable with no obvious problem areas. Capacity slightly exceeds the design flow in this reach.

Structure #7 to Tunnel Hill

Findings: Most of this segment consists of a 36-inch concrete pipe. Slopes are good (±1% compared to slopes of 0.2% or less for most of the Upcountry Ditch System) and adequate capacities are available in both the piped and open ditch sections.

Tunnel Hill

Findings: Access to the Tunnel Hill section of the ditch was not available for this study. No findings or recommendations are presented for this segment of the Upcountry system.

Penstock Inlet / Penstock Bypass to Tree House Lane

Findings: Beginning at the Tunnel Hill Outlet this section of the Upcountry Ditch falls rapidly along the Penstock Bypass Ditch to the crossing of Wentworth Springs Road. Slopes continue to be moderate from Wentworth Springs Road to Tree House Lane. With the moderate slopes and ditch sections available ditch capacities are adequate in this segment. This Tunnel Hill Flow Measuring Flume is located downstream of Wentworth Springs Road. Approximately 200 feet of lined ditch has been placed near the flume. Gauge readings at the flume are recorded manually.

Maintenance access along the ditch is adequate upstream of Homewood Drive. Between Homewood Drive and Tree House Lane, access is poor. Heavy vegetation growth has occurred within the ditch and along levee sections in the ±2600-foot long ditch segment between Homewood Drive and Tree House Lane.

Culverts ranging in size from 36" to 48" diameter have been placed for driveway and roadway crossings in this area. Because of the moderate to steep ditch slopes available these have not resulted in significant restrictions to flow. Future culvert crossings should be not less than 66 x 51 CMPA or 54" CMP.

Recommendations: Provide minimum 8-foot wide access for ditch maintenance and vegetation clearing from Homewood Drive to Tree House Lane (2600 feet). Install continuous flow monitoring and recording equipment at the Tunnel Hill Measuring Flume.

Tree House Lane to Balderston Wastegate

Findings: This is a moderately sloping ditch section with adequate ditch cross sections. Adequate capacity is available provided that the ditch can be kept clear of vegetation. Access is particularly poor upstream and downstream of Rock Creek Road and upstream and downstream of Mt. Cedar Road. To provide clearing and maintenance improved access should be provided in these areas. This section crosses numerous property lines with fences and no access gates. There are a number of

culverts placed in this section for driveway and road crossings. These are either 48" CMP or 57 x 38 CMPA. With the ditch slope available these structures have adequate capacity.

Recommendations: Provide improved ditch maintenance with minimum 8-foot access one side. Replace cross fences with access gates. Future culverts placed in this area should be not smaller than 57" x 38" CMPA or 48" CMP.

Balderston Wastegate to Sand Trap Siphon

Findings: The capacity of this section of the ditch is limited by available freeboard. During summertime operations, ditch flows were observed within a few inches of the top of the ditch. This was observed in both lined and unlined sections.

Recommendations: Provide 1 foot of additional freeboard along low freeboard areas located downstream of Balderston Road to the Sand Trap Siphon. This section is approximately 3300 feet in length. It is estimated that freeboard improvements are needed for approximately 1000 feet of ditch in this area.

Sand Trap Siphon / Canyon Creek Conduit

Findings: These are 30-inch diameter concrete pipes which were constructed by the District to replace high maintenance ditch sections. The Sand Trap Siphon is approximately 2500 feet in length. The Canyon Creek Conduit is approximately 2300 feet long. With the hydraulic grade line along these pipe routes adequate capacity is available to provide design flows. The pipelines do not require extensive maintenance, however, vegetation must be cleared to maintain to access to pipeline appurtenances including air release valves and blow off valves. Immediately upstream of the Sand Trap Siphon there exists a potential raw water reservoir site with capacity of 7 to 10 acre-feet. The benefits of developing this site for raw water storage will be evaluated later in this section of this study.

Recommendations: Maintain access along pipeline routes for periodic inspection and maintenance of pipeline appurtenances.

Buckeye Conduit

Findings: The Buckeye Conduit is a 30 inch concrete cylinder pipe constructed from the Walton Lake Outlet and extending some 10,300 feet to the outlet at the Buckeye hydroelectric power plant. With the hydraulic grade lines available, adequate capacity is provided in this pipeline to meet design flows. In general, this pipeline is constructed along property lines and along easement areas. Long reaches are inaccessible for periodic inspection and for maintenance of pipe appurtenances.

Recommendations: Provide and maintain access along pipeline routes for periodic maintenance and inspection.

Buckeye Conduit to Schroeder Conduit

Findings: This section includes the Buckeye Flow Measuring Flume. Similar to the Tunnel Hill Flume daily gauge readings are recorded by hand at this location. The existing ditch is lined in the vicinity of the flume. In 1999 gunite lining was also completed upstream of the Wentworth Springs Road crossing. The capacity of the ditch is limited by available freeboard and slope. To improve capacity an additional 1 foot of freeboard is needed along approximately 1500 feet of ditch beginning approximately 1100 feet upstream of the Wentworth Springs Road crossing. The 36" CMP constructed for the ditch crossing at Wentworth Springs Road is under-sized. Future culverts and road crossings provided in this segment of the ditch should be 66 x 51 CMPA or 54" CMP.

Recommendations: Provide continuous monitoring and recording of the flow measurements at the Buckeye Measuring Flume. Provide an additional 1 foot of freeboard for approximately 1100 feet of existing ditch.

Schroeder Conduit

Findings: The Schroeder Conduit consists of some 3235 lineal feet of 36 inch diameter concrete cylinder pipe. The pipeline parallels Wentworth Springs Road from Hotchkiss Hill Road to the discharge of the conduit at the Crails. With the available hydraulic grade lines and this pipe diameter and material, adequate capacity is provided to meet design flows. While pipe access can, typically, be achieved from Wentworth Springs Road, clearing is needed to periodically inspect and maintain pipe appurtenances including blow off valves and air relief valves.

Recommendations: Provide clearing and maintain access along pipeline routes for periodic pipe inspection and maintenance.

Main / Pilot Hill Ditch

Main Ditch No. 1, Crails to Buffalo Hills Conduit

Findings: This section of Main Ditch No. 1 has moderate slopes and adequate capacity to meet design flows. It is located in a heavily vegetated area with no maintenance access provided. At the Crails flow from the Upcountry District is diverted to the Main Ditch and to the Kelsey Ditch. Flows are estimated but not measured. There is a potential raw water storage site located along this reach of the ditch. This site is located on land owned by the GDPUD which once served as a raw water storage reservoir for a water treatment plant at Georgetown. The benefits of constructing a raw water storage reservoir in this location will be discussed later in this section of this Reliability Study.

Recommendations: Provide minimum 8-foot wide access and vegetation clearing for 1000 foot section located downstream of Crails. Provide measuring flume or flow meter to measure flow to the Main Ditch. Alternatively, a flow measuring device could be provided on the Kelsey Ditch with the difference in flows measured at Buckeye and measured at Kelsey assumed for the flow to the Main Ditch.

Buffalo Hills Conduit (Illinois Canyon Pipe)

Findings: This is a 24" diameter ductile iron pipe approximately 4900 feet in length. The pipe size, material and hydraulic grade line available provide adequate capacity to deliver design flows. Similar to other pipelines constructed by the District to replace ditch sections, this pipeline is located along property lines and easement areas. Access is needed to provide periodic pipeline inspection of maintenance of pipeline appurtenances.

Recommendations: Provide and maintain access along pipeline route for periodic pipe inspection and maintenance.

Buffalo Hills Conduit to Spanish Dry Diggins Road

Findings: Approximately 1300 lineal feet of the ditch is gunnite-lined. The condition of this lining ranges from fair to good. A 500-foot section upstream of Spanish Dry Diggins Road was lined in 2001 but has limited available freeboard. This section cannot provide 6" to 12" of freeboard at design flows.

Recommendations: A minimum of 6 inches of additional freeboard should be provided so that the ditch in this area can operate with a depth of approximately 1-1/2 feet with 1 foot of freeboard. A bottom ditch width of 7 feet is recommended. This is a priority repair area to allow continued delivery of raw water to the ALT Treatment Plant and to GDPUD irrigation services.

Spanish Dry Diggins Road to Taylor Mine Outlet

Findings: This section of the Main Ditch is constructed at very flat slopes (less than 0.2%). This condition together with the limited freeboard available has resulted in numerous crib wall repairs and low freeboard areas along 2500 feet of this segment of the ditch beginning at Spanish Dry Diggins Road and continuing to Lasita Place. With the present ditch section and minimal slopes, design flows cannot be conveyed with 6" to 12" of freeboard.

Downstream of Lasita Place there are two additional isolated crib wall repair areas. In addition, at approximately midway between Lasita Place and the Taylor Mine Outlet there exists an undersized CMP culvert which is a restriction to flow and capacity.

Recommendations: The existing ditch segment between Spanish Dry Diggins and Lasita Place should be gunnite-lined. A minimum ditch section with a 7-foot wide

bottom width and a minimum depth of 2-1/2 feet is recommended. This would allow a flow depth of 18 inches with 12 inches of freeboard. This is a priority repair. New crib wall sections, each ±40 feet in length, should be installed to replace the two old crib wall sections downstream of Lasita Place. New driveway and roadway crossings in this section of the ditch should be installed with a 60 x 46 CMPA or a 48" CMP.

Taylor Mine Outlet (and Flume) to Cabin Wastegate

Findings: This section of the Main Ditch is also constructed with very flat (< .2%) slopes. The existing ditch section together with the flat slopes does not permit the ditch to carry design flow with at least 6" to 12" of freeboard. While the first 2000 feet of this segment has been lined the last 500 feet of lining is in poor condition with large holes and cracks. This lining should be replaced. From the end of the existing lining to the Cabin Wastegate there are previous crib wall repairs. Typically, the ditch at Cabin Wastegate operates with less than 6 inches of freeboard. The Cabin Wastegate is scheduled to be replaced.

Recommendations: Approximately 500 feet of the existing lined section should be replaced with new lining from approximately 1500 to approximately 2000 feet downstream of the Taylor Mine Outlet. Construct 3 sections of crib wall approximately 40 feet long each, at three locations within 600 feet (upstream) of Cabin Wastegate. Provide freeboard improvements from the end of the lined section to Cabin Wastegate. This is a priority repair item. Construct enhanced ditch with minimum 6-foot bottom width and minimum 2 foot 9 inches deep section to provide not less than 12 inches of freeboard and 1 foot 9 inches of operating depth at design flows. Replace Cabin Wastegate.

Cabin Wastegate to Growlersberg Wastegate

Findings: This segment of the Main Ditch is lined, however much of the lining is old (over 20 years) and in poor condition. Ditch slopes are very flat. The existing ditch section together with the flat slopes are not adequate to carry design flows with adequate freeboard. There are a number of low freeboard and repair areas in this segment which were identified during field investigations.

Recommendations: Remove and replace existing lining with a new lined section for the 1800 foot segment between the Cabin Wastegate and the Growlersberg Wastegate. The minimum ditch section should include a 6 foot wide bottom and a 2 foot 9 inch depth (1 - 9 inch water operating depth) or a 7 foot bottom with a 2 foot 3 inch depth (1 - 3 inch water operating depth). This is a priority repair item. The fence at Growlersberg must be replaced with an access gate and security lock.

Growlersberg Wastegate to Summers Wastegate

Findings: The ditch is piped through a portion of the Growlersberg Conservation Camp. Downstream of the piped section there are three areas which require crib wall

repair and replacement. Further downstream there is an old lined section which was constructed with expansion joints. The construction method used has extended the useful life of the lining since it is still providing good service. While this section of ditch was constructed with relatively flat slopes lack of adequate freeboard can be permitted in this area since the ditch lining is in good condition. Downstream of a falls section (and immediately upstream of the Summers Wastegate and Flume) there is also a ±600 foot long section of lining. This lining was placed in 1991 and is in fair to good condition.

Recommendations: Provide crib wall repair or replacement to three, ±40 foot long sections.

Summers Wastegate to Spools Wastegate

Findings: Within 600 feet (downstream) of Summers Wastegate field investigations identified 5 repair areas. The existing ditch section and the flat slopes also do not permit the ditch segment to convey design flows with adequate freeboard. Upstream of Silent Meadow Lane leaks were observed through an old lined section. Downstream of Silent Meadow Lane there is also a lined section which is constructed with very flat slopes. This section can not convey design flow with adequate freeboard.

Recommendations: Beginning at Summers Wastegate repair the first 600 feet of ditch with crib walls and increased freeboard. This is a priority repair. The final ditch section should include not less than a 7-foot bottom width and not less than a 2 foot, 3 inch depth. Replace old lining with a new lined section for ±3200 lineal feet upstream of Spools Wastegate. New lined section should provide not less than 6 feet of bottom width and not less than 2-1/2 feet of depth.

Spools Wastegate to Jackass Wastegate

Findings: Three repair areas are identified in this segment of the ditch. Two are located in unlined areas and one is located in an area which was lined approximately 20 years ago. This segment continues to be flat with slopes less than 0.2%. With the section available and the flat gradient, this section of the ditch can not convey design flows with adequate freeboard.

Recommendations: Replace lined section for approximately 600 feet downstream of Spools Wastegate. Final lined section should provide not less than a 5 foot bottom width with not less than 2-1/2 feet of depth. Provide crib wall repairs at two locations, 40 feet in length and 100 feet in length. Replace 900-foot long lined section downstream of Cougar Lane. Provide levee improvements for approximately 1000 feet of ditch between lined sections.

Jackass Wastegate to Greenwood Reservoir

Findings: This segment has improved slope and capacity. Two repair areas each approximately 100 feet in length were identified downstream of Falstaff Road. The

Jackass Wastegate was re-constructed with reinforced concrete sidewalls and steel gates in 1977.

Greenwood Reservoir is a critical raw water storage reservoir of the GDPUD system. Reservoir capacity and modifications to increase capacity are discussed later in this section of this study.

Recommendations: Two ditch sections, each ±100 feet in length should be repaired with crib wall construction. Recommendations regarding Greenwood Reservoir are included under "Raw Water Storage".

Greenwood Reservoir to SDD Diversion Flume

Findings: This is a lined section which is in fair to good condition. Ditch capacities are limited by slope and section but there are no known repair areas or known leaks in this segment. To convey design flows, the ditch must operate with limited freeboard.

Recommendations: Freeboard enhancement may be needed in this segment of the ditch in the future.

SDD Diversion Flume to Blue Heron Way Falls

Findings: The ditch falls rapidly through this segment. Because of the elevation difference available this ditch section has capacity well in excess of design flows. No significant leaks or losses are known to occur in this segment. There is significant vegetation growth in this area which should be cleaned to maintain access.

Recommendations: Conduct vegetation removal to maintain access along the ditch.

Blue Heron Way Falls to Kaiser Siphon

Findings: Ditch slopes in the area are also well above the minimum required to maintain flows. There are, however, numerous fence crossings on the ditch which hinder operator access. Low berm area and old crib wall repair areas were identified from 500 to 1500 feet downstream of Blue Heron Way. Upstream of the Kaiser Wastegate and the Kaiser Siphon are two significant repair areas which extend some 600 feet along the ditch.

Recommendations: Replace fence crossings with GDPUD approved gates in 7 locations. Provide ditch lining 500 feet to 1500 feet downstream of Blue Heron Way. Lined sections should be constructed with bottom width not less than 5 feet and a ditch depth not less than 2 feet. Provide ditch lining 200 to 800 feet upstream of Kaiser Wastegate and Siphon. Minimum finished ditch section should be the same as

described above for the lined section below Blue Heron Way. This is a priority repair area.

Kaiser Pipeline and Kaiser Siphon

Findings: The Kaiser Pipeline is a 24 inch diameter Reinforced Plastic Mortar (RPM) pipe (Techite) placed by the District in the early 1970's. This pipeline connects to the Kaiser Siphon, a 24-inch diameter steel pipeline placed prior to the upstream pipeline. The two piped sections convey raw water some 4200 feet from the Kaiser Wastegate across State Highway 193. Hydraulic gradient and pipe diameter are adequate to convey 25 cfs which exceeds the design flows. Access along the pipeline must be maintained to permit periodic inspection and maintenance of system blowoffs, air relief valves and drains. According to District records portions of the pipeline which cross State Highway 193 to the discharge are Techite. Maintenance on the Kaiser Pipeline / Kaiser Siphon has been limited to replacing one section of the steel pipeline with plastic pipe.

Recommendations: While this conduit has provided reliable service, periodic repairs should be anticipated in the future. At a minimum, access along the pipeline and vegetation clearing must be maintained. The Kaiser Pipeline has been in place since the early 1970's. Replacement of this critical pipeline element with HDPE, pressure rated plastic (PVC 905) or concrete pipe should be included in the District's long term planning.

Kaiser Siphon to Ford Siphon

Findings: This is a short section of open ditch. There is adequate fall and ditch cross section to convey design flows. There are no known leaks or repair areas in this section of the ditch.

Ford Siphon

Findings: This is a ±250 foot long section of 36-inch diameter concrete pipe. Raw water flows are conveyed back across State Highway 193 to Auburn Lake Trails with this conduit. The Ford Siphon includes a drain / blowoff which must be periodically maintained.

Recommendations: Maintenance access to the drain / blowoff must be maintained for periodic access and repair.

Ford Siphon to ALT Water Treatment Plant

Findings: This section includes lined areas and a 30-inch diameter concrete pipe constructed under Rita Court. The capacities of the open ditch and piped section are adequate to convey design flows. Existing ditch lining is in good to very good condition. Access is hindered by two fence crossings.

Recommendations: Replace existing fence crossings with GDPUD approved gates.

ALT Water Treatment Plant to Campground Wastegate

Findings: The ALT Water Treatment Plant raw water storage reservoir is an important feature of the ditch supply system. Recommendations to improve capacity are included in this section of this Reliability Study. There is a metering flume on the ditch downstream of the ALT Plant. The flume is currently not used. Most of the ditch along this segment is unlined. Lined sections which have been constructed are rated fair to good, with some sections rated very good. Ditch slopes are relatively flat (±0.2%) but with the cross section provided, adequate capacity is available to convey design flows. There are numerous culverts placed for roadway and driveway crossings. These are typically 48" or 54" CMP, 57 x 38 CMPA or 49 x 33 CMPA. These are adequate to provide conveyance without restricting ditch flow. There are a number of fence crossings in this area. Those without gates should be replaced with GDPUD approved gates. Significant drainage flows enter the ditch at a point approximately 900 feet upstream of the second crossing of Cascade Lake Trails.

Recommendations: A metering device should be installed downstream of the ALT Water Treatment Plant. Install at the existing metering flume or replace the existing flume with a meter which continuously monitors and records flow. Replace ditch fence crossings with gates. If new culverts are placed for driveways or road crossings, they should be 49 x 33 or 57 x 38 CMPA. The ditch segment between the ALT Treatment Plant and the ALT Campground Wastegate is 13,000 feet in length. This is too long to provide adequate flow control during winter periods. It is recommended that a new wastegate be installed at the drainage inlet area located approximately 1000 feet upstream of Cascade Trail. It is recognized that permits from regulatory agencies are required to implement this feature. Provide improved access along the ditch in the vicinity of the ALT Campground. Vegetation clearing and levee widening from ±1500 feet downstream of the ALT Campground is recommended.

Campground Wastegate to Willow Creek Wastegate

Findings: This is another relatively flat section, however, adequate section and slope and capacity are available to meet design flows. Similar to the previous section there are isolated sections of lined ditch. Lined sections within 2500 feet (downstream) of Campground Wastegate are in fair to good condition. Approximately 1 mile downstream of the Campground Wastegate is an older lined section (20 to 25 years) which is in poor condition and should be replaced. This lined area is located approximately 500 to 1500 feet upstream of an area where the ditch parallels Cascade Trail. Excessive drainage flow enters the ditch in this area. Approximately 1500 feet upstream of the Willow Creek Wastegate the ditch crosses through cattle pasture land. There are numerous areas within the pasture in which cattle have damaged the ditch. Fencing is needed in this area to control access. The Campground Wastegate and the

Willows Creek Wastegate are separated by a distance of some 9600 feet. Approximately 800 feet upstream of the Willow Creek Wastegate is an area which receives excessive drainage flows.

Recommendations: It is recommended that a new wastegate be constructed in the drainage area below Cascade Trail. Construct lined ditch improvements upstream of the new wastegate some 1800 feet to replace old lining in poor condition. The lined ditch should provide a section with a minimum bottom width of 5 feet and a ditch depth not less than 2-1/2 feet. New culverts placed in this area should not be smaller than 49 x 33 CMPA or 48" CMP. Place livestock fence to control cattle access to the ditch. Approximately 1500 feet of livestock fencing is required upstream of Willow Creek Wastegate. Provide ditch lining approximately 800 feet upstream of the Willow Creek Wastegate in the area which receives widespread drainage inflow. Continue the lining to Willow Creek Wastegate.

Willow Creek Wastegate to Baldridge Wastegate

Findings: Downstream of the Willow Creek Wastegate is another area which receives widespread drainage flows. Drainage seeps upstream and downstream of the ditch were observed for a distance of some 500 feet. It is suspected that this wet area near the Willow Creek Wastegate is a high loss area. Approximately 900 feet downstream of the Willow Creek Wastegate the ditch again crosses cattle pasture area. Along the next 3000 feet there are several locations where cattle have damaged the levee sections creating low berm areas and ditch losses.

Recommendations: Downstream of the Willow Creek Wastegate provide ditch lining in the unstable saturated discharge areas. Construct some 3000 lineal feet of livestock control fencing where the ditch crosses pasture land. Repair with crib walls 5 locations each ±40 feet in length which have been damaged by cattle. Place GDPUD approved gates at existing fence crossings. If new culverts are placed in this ditch segment they should be 49 x 33 CMPA or larger.

Baldridge Wastegate to Bogus Wastegate

Findings: This section includes the Baldridge Pipe and several lined ditch sections. This existing piped, lined and unlined sections have adequate slope section and capacity to convey design flows. Lined sections are in fair to good condition. No repair or significant loss areas were identified in this segment. There are several fences which cross the ditch section. These should be replaced with GDPUD approved gates. Downstream of Upper Black Rock Road the ditch parallels pasture land separated from the ditch by fencing but which releases significant drainage into the ditch. This section of the ditch is currently lined.

Recommendations: Provide GDPUD approved gates at 8 cross fences located along this segment of this ditch. New culverts placed in the segment should be 49 x 33 CMPA or larger.

Bogus Wastegate to Dorman Wye

Findings: This section of the ditch has moderate slopes. The existing slope and ditch section provide capacity in excess of design flows.

Pilot Hill Ditch

Dorman Wye to Knickerbocker Creek

Findings: At Dorman Wye ditch flows are divided between the Cherry Acres Ditch and the Pilot Hill Ditch. Downstream of the Dorman Wye the Pilot Hill Ditch crosses State Highway 193 again with two, 18 inch CMP culverts. It is believed that one of these culverts is blocked. There is a 24-inch diameter steel culvert located at a driveway crossing downstream of this location. There is heavy vegetation growth along this segment of the ditch.

Recommendations: Replace two existing 18" CMP culverts at State Highway 193 and the 2 inch steel pipe located downstream of this location with a 42 x 29 CMPA or a 36" CMP. Remove vegetation and provide maintenance access along ditch.

Knickerbocker Creek to Pear Orchard Wastegate

Findings: There is adequate capacity in this ditch segment to convey design flows. No repair or loss areas were identified. This segment of the ditch, typical of much of the Pilot Hill Ditch, is hindered by vegetation growth.

Recommendations: Provide minimum 8 foot wide access for ditch inspection and control of vegetation. New culverts placed in the segment should be minimum 42 x 29 CMPA or 36" CMP. Install GDPUD approved gates at existing fence crossings.

Pear Orchard Wastegate to Therekel Wastegate

Findings: Adequate capacity is available in this segment to convey design flows. One repair area was identified.

Recommendations: Provide minimum 8 foot wide access for ditch inspection and control of vegetation. New culverts placed in this segment should be minimum 42 x 29 CMPA or 36" CMP. Conduct repairs with 40 foot section of crib wall improvements.

Therekel Wastegate to State Highway 49

Findings: This section is characterized by numerous cross fences and poor access. Adequate capacity is available in this segment to convey design flows,

however, poor access does not allow proper maintenance and the cleaning of vegetation. Two, 18" culverts have been placed for ditch flows at Grand Fir Circle.

Recommendations: Provide minimum 8-foot wide areas for ditch inspection and control of vegetation. Place GDPUD approved access gates to replace cross fences at 18 locations along this segment. Replace the two, 18 inch culverts at Grand Fir Circle with minimum 42 x 29 CMPA or 36" CMP.

State Highway 49 to Lovejoy Wastegate

Findings: This is a short ditch segment with adequate capacity to convey design flows. Vegetation clearing and adequate maintenance access needed especially in the vicinity of the Lovejoy Wastegate.

Recommendations: Provide minimum 8-foot wide clearing for access and vegetation control. New culverts placed in this segment should be 42 x 29 CMPA or 36" CMP, minimum.

Lovejoy Wastegate to Nagle Wastegate

Findings: This is a flat section of ditch with limited capacity. However available capacity does exceed design flows in this lower section of the Pilot Hill Ditch System. West of Northside School there is a ±500 foot long repair area. Saturated and unstable conditions make repairs with cribwalls unsuitable. The Nagle Wastegate, an old wastegate of wood construction, is scheduled to be rebuilt in 2002.

Recommendations: Provide minimum 8 foot clearance for access and vegetation clearing. New culverts placed in this segment should be minimum 42 x 29 CMPA or 36" CMP. Repair 500 foot long ditch segment west of Northside School with ditch lining. Reconstruct Nagle Wastegate as a reinforced concrete structure with metal slide gates.

Nagle Wastegate to Capecroft Wastegate

Findings: GDPUD staff have recently completed ditch improvements in this area. A wooden flume was reconstructed and a culvert replaced in this area in 2002. Ditch slopes are flat in this segment and capacities are limited but exceed current design flows for this lower section of the Pilot Hill Ditch. One repair area was identified approximately 250 to 300 feet downstream of Nagle Wastegate.

Recommendations: Provide cribwall repair for approximately 50 feet of leaking ditch sections 250 to 300 feet downstream of Nagle Wastegate.

Capecroft Wastegate to Wagner Reservoir

Findings: There are several fences which cross the ditch downstream of Capecroft Lane. These hinder access and impede maintenance. The ditch flows parallel to State Highway 49 for some 1200 feet before discharging to Wagner Reservoir. This section is heavily choked with vegetation. The ditch is constructed with adequate slope in this area.

Recommendations: Replace cross fences with minimum 8-foot wide gates installed with GDPUD approved locks. Clear vegetation growth along ditch. Maintain clearance by providing adequate access along the ditch.

Wagner Reservoir to Wagner Reservoir Wastegate

Findings: Wagner Reservoir is a GDPUD regulatory reservoir which helps control flows in the lower Pilot Hill Ditch system. The operators report no significant deficiencies with the reservoir. It appears to be adequately sized. Downstream of the reservoir ditch access is limited. There is a significant loss area located approximately 1000 feet downstream of the Wagner Reservoir and approximately 200 feet upstream of the Wagner Wastegate. The District has attempted to repair this section with cribwalls.

Recommendations: Wagner Reservoir should be periodically checked for siltation. Conduct maintenance dredging as required. Monitor and repair, as necessary, Wagner Reservoir outlet gates. Provide vegetation clearing and maintenance access for ditch section downstream of the reservoir. Construct approximately 250 feet of ditch lining to repair leaking sections upstream of Wagner Wastegate.

Wagner Wastegate to Bayley House Wastegate

Findings: Ditch slopes in this section are good and there are fewer obstructions to access. GDPUD crews are able to periodically clear and maintain this area with the narrow track excavators and crews. Three repair areas, each ±50 to 100 feet in length were identified.

Recommendations: Conduct cribwall repairs at three locations, each ±50 to 100 feet in length.

Bayley House Wastegate to Pilot Hill Reservoir

Findings: This is the last open ditch section of the Pilot Hill System. Slopes and capacities are adequate. Except for the area immediately upstream of Pilot Hill Reservoir, maintenance access is available.

Recommendations: Replace fence crossing upstream of Pilot Hill Reservoir with minimum 8-foot wide gate and GDPUD approved lock.

Kelsey Ditch System

The Crails to St. James Wastegate

Findings: This segment of the Kelsey Ditch passes through and adjacent to GDPUD school and recreation areas. Most of this segment has already been lined or piped. Lined sections are in good condition. At two locations totaling some 800 feet the ditch has been replaced with two, 15-inch diameter PVC pipes. These pipes are not large enough to carry the ditch design flows and are frequently clogged with debris. Play and sports equipment from the school and park areas float down the canal and become lodged in these small diameter pipes.

Recommendations: The two segments which were previously improved with the small diameter pipe should be replaced with minimum 30 inch diameter HDPE or concrete pipes or a 42" x 29" CMPA section. Typical of all piped sections on the ditch the piped inlets should be constructed with trash racks (grizzlies).

St. James Wastegate to State Highway 193

Findings: Upstream of Prospect Hill Drive this segment of the ditch is lined. Approximately 100 lineal feet of this lining has been damaged, however, and should be replaced. Downstream of Prospect Hill Drive there are 4 fence crossings which inhibit access and maintenance. The capacity of this segment of the ditch is adequate to carry design flows except for an 18-inch CMP culvert which has been placed at a crossing some 400 feet downstream of Prospect Hill Drive.

Recommendations: Replace with new lining approximately 100 feet of ditch located upstream of Prospect Hill Drive. Replace fence crossings with minimum 8-foot wide gates and GDPUD approved locks. Replace the 18-inch CMP culvert with a 42" x 29" CMPA or 42" CMP.

State Highway 193 to (Forest View Drive) Falls

Findings: This segment is not lined but is constructed with adequate slope and capacity. Existing culverts placed in the ditch are of adequate capacity to carry the design flows. One fence crossing and one repair area were identified within this segment.

Recommendations: Replace fence crossing with minimum 8-foot wide gates and GDPUD approved locks. Provide ±100 feet of cribwall and freeboard improvements at ditch repair area located approximately 600 feet downstream of State Highway 193 crossing.

Falls to Irish Reservoir Wastegate

Findings: Downstream of the Florallan Road crossing there is a ±600 foot long segment of ditch which has known leaks. Ditch soils in this area are more sandy and loamy than clay. Leaks surface several feet below the ditch. Cribwall repairs in the material and in the section of ditch have not been successful. Downstream of the Hope Mountain Road crossing there is a known repair area. This segment of this ditch has been fenced off by property owners and access is difficult. Adjacent to Shamrock Lane there exists approximately 150 feet of low berm area which impacts the capacity of this segment.

Recommendations: Approximately 600 feet of existing ditch located downstream of Florallan Road should be gunnite-lined. It is recommended that the lined section should be at least 5 feet, 6 inches wide with a minimum depth of 2 feet. This is a known loss area and a priority repair. The low freeboard area located along Shamrock Lane should also be improved with a ditch section not less than 5 feet, 6 inches wide and not less than 2 feet deep. Approximately 100 feet of cribwall and berm improvements are recommended for the repair area located downstream of Hope Mountain Road. Existing fence crossings at 6 locations should be replaced with minimum 8-foot wide gates and GDPUD approved locks.

Kelsey Ditch No. 2

Irish Reservoir Wastegate to Twin Pines Siphon

Findings: Most of this segment is unlined. There are several low berm areas located 1500 to 3000 feet downstream of Irish Reservoir which impact ditch capacity. This segment of the ditch crosses through pastureland. To prevent the ditch from damage, fences are needed along the ditch with gunnite-lined sections provided at cattle crossings. To protect the ditch, GDPUD has previously placed cribwalls at cattle crossings. After these have been placed the cattle create a new crossing and damage a new section of ditch upstream or downstream of the cribwall repairs. A ±400 foot long repair area was identified beginning 200 feet downstream of Irish Reservoir.

Recommendations: Approximately 1500 feet of cattle access control fencing is recommended for this segment. At four locations, each approximately 100 feet in length, the existing unlined ditch should be constructed with a gunnite-lined section to provide controlled cattle crossings. A 400-foot section of unlined ditch beginning approximately 200 feet downstream of Irish Reservoir should be lined. The lined section should be constructed with not less than a 5 foot, 6 inch wide bottom width and a 2 foot depth or, alternatively, a 6 foot, 6 inch wide bottom with not less than an 18-inch depth. There are 10 fence crossings in this segment which should be replaced with minimum 8-foot wide gates and GDPUD approved locks.

The last ±2000 feet of ditch upstream of the Twin Pines Siphon is lined. Of this lined segment approximately 1200 feet is in poor condition and should be repaired or replaced. Existing seeps surface below this lined section of the ditch.

Irish Reservoir is a shallow regulating reservoir with little capacity. Maintenance dredging of this reservoir is recommended.

Twin Pines Siphon to Black Oaks Siphon

Findings: This segment includes the 24-inch diameter Twin Pine Siphon and an older lined section upstream of the Black Oaks Siphon. Upstream of the Black Oaks Siphon is the Clark Hill Wastegate and the discharge to the Greenwood Road and the Garden Valley pipelines.

Recommendations: The ±600-foot long section of lined ditch located between the siphons is in poor to fair condition. This lined section should be scheduled for repair and / or replacement. There are two fence crossings in this ditch segment which should be replaced with minimum 8-foot wide gates and GDPUD approved locks.

Black Oaks Siphon to Dukes Wastegate

Findings: Immediately downstream of Black Oaks Siphon some 300 feet of ditch was gunnite-lined in 2001 to control leaks. The remainder of this ditch segment is unlined with numerous fence crossings. Three repair areas were identified within this reach. The most significant of these is located approximately 1200 feet upstream of Dukes Wastegate. The Cunningham pipe begins approximately 400 feet upstream of the ditch crossing of Fair Pines Lane.

Recommendations: Repair with gunnite lining approximately 400 lineal feet of ditch located approximately 1200 feet upstream of Dukes Wastegate. This is a known leak and a priority repair area.

Provide gunnite-lined ditch repairs for two other, ±400 foot long segments, one located downstream of Happy Trails Lane and one located upstream of Fair Pines Lane. Replace fence crossings in 11 locations with minimum 8-foot wide gates and GDPUD approved locks.

Dukes Wastegate to State Highway 193

Findings: A total of 7 repair areas were identified for the reach of the Kelsey No. 2 ditch. Two of these segments with a total length of some 1000 feet are known loss areas. Repairs in this segment of the ditch must be conducted with lining. Cribwall repairs have proven ineffective as the soil is sandy and loamy with relatively high permeability rates. The previously lined sections in the segment are in fair to good condition.

Recommendations: Provide, as a priority repair, ditch lining for some 1000 feet of unlined ditch with known and observed leaks. Schedule for repair the lining of an additional 5 areas with a total length of 1500 feet. There is a 120-foot length section of 15-inch PVC placed in the ditch approximately 800 feet upstream of the State Highway 193 crossing. This small diameter PVC pipe is a maintenance problem and restricts ditch capacity. It should be replaced with a minimum 24-inch diameter HDPE or concrete pipe, a 36-inch CMP or a 35" x 24" CMPA. There are two other short segments (±30 feet long) of 18-inch steel and 18" CMP / 20" steel pipe placed at driveway crossings. These should also be replaced with 35" x 24" CMPA or 36" CMP.

State Highway 193 to Chicken Flat Wastegate

Findings: Nearly all of this ditch segment has been replaced with 15 inch PVC low pressure, (irrigation Class 100) pipe. The plastic pipe was placed in the ditch section and partially covered. Typically, minimum cover suggested for this pipe is 30 inches.

Since this pipe was not placed with adequate bedding, backfill and cover and since some sections of the pipe are exposed, pipe sections have been damaged by traffic, debris and UV degradation. Because this segment is located at the lower end of Kelsey Ditch No. 2 design flows are lower and the capacity of the 15 inch pipe matches or nearly matches design flows.

Recommendations: While the 15-inch PVC pipe provides adequate capacity the District should schedule replacement of this pipe with 24" diameter HDPE or 36" diameter CMP. A repair area is located near the downstream limit of the 15 inch PVC pipe. This existing open ditch section should be replaced with gunnite lining or extension of the piping improvements. As outlined above piping options include a 24" HDPE, 36" CMP or 35" x 24" CMPA.

Chicken Flat Wastegate to Mellows Wastegate

Findings: This ditch segment provides adequate service and capacity.

Mellows Wastegate to Kelsey Flume

Findings: Two significant loss areas were identified for this segment of the Kelsey No. 2 ditch. The first is located immediately downstream of Mellows Wastegate. The second is located approximately 1200 feet upstream of the Kelsey Siphon. Three low berm repair areas were also noted. Previous repairs in this segment of this ditch have typically consisted of gunnite lining or the replacement of ditch sections with piping.

Recommendations: Gunnite line approximately 800 feet of ditch (total two locations) at the two known loss areas for this segment. These are priority repairs. The three low berm areas could be repaired by providing a minimum ditch bottom width of 3-1/2 feet and a ditch depth of two feet.

Kelsey Flume Siphon to Stork Wastegate

Findings: Three repair areas were identified in this reach. Two are located within 400 feet of the outlet of the Kelsey Flume Siphon. These are not as significant as the repair area located approximately 200 feet upstream of Stork Wastegate. This is a known loss area.

Recommendations: Gunnite line approximately 400 feet of ditch upstream of Stork Wastegate. Schedule for ditch lining an additional 400 feet of ditch located 200 to 600 feet downstream of the Kelsey Siphon outlet.

Stork Wastegate to Kelsey Reservoir

Findings: The existing Stork Wastegate is of wood construction and has exceeded its useful life. It should be replaced with a new reinforced concrete facility with steel wastegates. Two ditch repair areas were identified in this last Kelsey Ditch No. 2 segment. These are known loss areas. There is a ±200 foot section of 15 inch diameter PVC partially exposed pipe which was placed in the ditch approximately 1200 feet downstream of the Stork Wastegate.

Recommendations: Gunnite line approximately 800 feet of ditch to repair the known loss areas. These are priority repairs. Replacement of the Stork Wastegate with a reinforced concrete facility should also be conducted as a priority repair. The District should schedule replacement of the exposed 15 inch PVC pipe with a buried 18 inch HDPE pipe or 24 inch CMP or a 28" x 20" CMPA.

Spanish Dry Diggins Ditch

Spanish Dry Diggins Flume to End

Findings: This is a minor ditch of the GDPUD ditch system. Most of the old ditch sections have been replaced with 15" to 24" pipe. The exiting piped and open ditch sections, in general, provide adequate capacity and service. Two repair areas were identified. One is located approximately 400 feet upstream of the Shelter Cove Drive crossing and is located approximately 200 feet downstream of Shelter Cove Drive.

Recommendations: Since most of the repairs and improvements to the Spanish Dry Diggins Ditch have been accomplished by piping ditch sections it is recommended that the repair located upstream of Shelter Cove Drive be completed with approximately 100 feet of 18" HDPE, 24" CMP or 28 x 20 CMPA. Similarly it is recommended that the repair downstream of Shelter Cove Drive be completed with 200 feet of 18" HDPE, 24" CMP or 28 x 20 CMPA.

Taylor Mine Ditch

Taylor Mine Outlet to Stradle Reservoir

Findings: Similar to Spanish Dry Diggins Ditch, Taylor Mine Ditch is also a minor ditch of the GDPUD system. Similar to Spanish Dry Diggins, Taylor Mine Ditch is tributary to the Main / Pilot Hill Ditch System and serves only irrigation water customers. Approximately 2/3 of the Taylor Mine Ditch has already been piped or lined. Capacity is adequate. Existing wastegates are in good condition. One low berm area was identified. There are 8 fence crossings on this ditch segment.

Recommendations: There are a number of different pipe materials and sizes which have been used on the Taylor Mine Ditch. It is recommended that future pipe installations use 18" HDPE, 24" CMP or 28 x 20 CMPA. The low berm area located downstream of the last Graybar Mine Road crossing should be replaced with a ±100 foot long piped section. Replace the 8 fence crossings of the ditch with a minimum 8-foot wide gate and GDPUD approved lock.

Cherry Acres Ditch

Dorman Wye to End

Findings: Similar to the Taylor Mine and Spanish Dry Diggins ditches, the Cherry Acres Ditch is a minor ditch tributary to the Main / Pilot Hill Ditch network. The Cherry Acres Ditch serves only irrigation customers. Adequate capacity is available to meet demands. Culvert and piped sections are adequately sized. There is one section of 14" diameter steel pipe which, because of slope, has adequate capacity, but because of limited diameter and condition should be replaced. There are 21 fence crossings on the Cherry Acres ditch. Because of poor access, maintenance of the Cherry Acres Ditch is difficult. Vegetation growth is particularly heavy along the first ±2500 feet of the ditch beginning at Dorman Wye. Four repair areas were identified. These are of limited scope and could be corrected with piping or cribwalls. GDPUD has previously lined approximately 2000 feet of the Cherry Acres Ditch with satisfactory results.

Recommendations: Replace the ±200-foot long section of 14" diameter steel pipe located upstream of Cramer Court with an 18" HDPE, 24" CMP or 28 x 20 CMPA pipe. Provide ±40-foot long cribwall repairs and berm improvements at two locations upstream of Cramer Court, one location downstream of Cramer Road and one location upstream of Wawona Way. Replace the 21 fence crossings with minimum 8-foot wide gates and GDPUD approved locks.

Raw Water Storage

Existing Storage Capacity

In the event of a ditch failure and during periods of ditch maintenance GDPUD must rely on the raw water storage provided by the Walton Lakes, Greenwood and Auburn Lake Trails Reservoirs to supply the Auburn Lake Trails and the Walton Lakes Water Treatment Plants (WTP). In Section V of this Study raw water storage criteria to meet emergency and maintenance conditions was developed. Not less than 50 acre-feet of raw water storage should be provided upstream of the water treatment plants with not less than 25 acre-feet provided upstream of the Walton Lakes WTP and not less than 25 acre feet provided upstream of the Auburn Lake Trails WTP. Based on existing reservoir surface areas, normal operating depth, estimated useable depths and the siltation which has likely occurred in all three reservoirs, the estimated current available capacity of each reservoir is as follows:

EXISTING RAW WATER STORAGE CAPACITY AVAILABLE

Reservoir	Approx. Surface Area (ft^2)	Approx. Max. Useable Depth (ft.)	Approx. Average Useable Depth (ft.)	Approx. Storage Capacity (ac-ft)
Walton Lakes	215,000	8.5	2.8	14.0
Greenwood	250,000	7.5	2.5	14.3
Auburn Lake Trails	105,000	7.0	2.3	5.6
			Estimated Total (ac-ft)	33.9

Additional raw water storage could be developed by constructing new raw water storage reservoirs or by improving the capacity of existing reservoirs.

Construction of New Raw Water Storage Reservoirs

Ideally raw water storage should be provided along the raw water supply ditch upstream of both the Walton Lakes and the Auburn Lake Trails Water Treatment Plants. Using this criteria, raw water storage would be available to serve both plants. Storage should be provided downstream of Tunnel Hill since the ditch sections upstream of Tunnel Hill are most susceptible to major failures and long term outages. The best

apparent site for a new reservoir upstream of Walton Lakes is located along Balderston Road near the inlet to the Sand Trap Siphon. A relatively level and open site in the vicinity of the ditch section replaced by the Sand Trap Siphon was evaluated. It was estimated that a reservoir with a surface area of approximately 60,000 square feet could be reasonably developed at this location. With a useable storage depth of up to 10 feet a raw water storage reservoir of approximately 7 to 10 acre-feet could be developed at this site. Based on cost, site acquisition, environmental and operations criteria it was determined that development of a new raw water storage reservoir at this location was not a good alternative.

A potential raw water storage site is located on GDPUD-owned property (APN 061-140-37) near the beginning of the Main / Pilot Hill Ditch System. This site is located north and east of Beam Field and encompasses the old Georgetown Reservoir. Preliminary topographic surveys were conducted of this site and it was determined that a reservoir with a storage capacity of approximately 19.8 acre-feet could be developed at this location. While this site could be developed at reasonable construction costs and with no acquisition costs its location downstream of Walton Lakes limits its value to supplementary storage for Auburn Lake Trails. Should the District construct a new water treatment plant with expanded capacity at Greenwood Reservoir, additional raw water storage at the Georgetown site would be of greater benefit.

Expansion of Existing Raw Water Storage Capacity

Increasing the useable depth of Walton Lakes from approximately 8-1/2 feet to approximately 10 feet could increase the available storage at this site from approximately 14.0 acre-feet to approximately 24.7 acre-feet. Similarly, increasing the available storage capacity of Greenwood Reservoir from approximately 14.3 acre-feet to approximately 24.4 acre-feet could be accomplished by increasing the useable water storage depth from 7-1/2 feet to 8-1/2 feet. The useable water storage depth at the Auburn Lake Trails Reservoir could also be increased to approximately 8 feet and storage capacity increased to approximately 9.6 acre-feet. In 1980, GDPUD conducted limited sediment removal from Walton Lakes. At that time approximately 4000 yd^3 (2.5 ac-ft) of sediment was removed from Walton Lakes. This work was conducted on a limited budget basis. After 20 years this amount of sediment together with additional dredging and excavation could be conducted to expand the existing capacity of this reservoir.

The estimated expanded capacity of the existing reservoirs is as follows:

EXPANDED RAW WATER STORAGE CAPACITY AVAILABLE

Reservoir	Approx. Surface Area (ft^2)	Approx. Max. Useable Depth (ft.)	Approx. Avg. Useable Depth (ft)	Approx. Storage Capacity (ac-ft)
Walton Lakes	215,000	10.0	5.0	24.7
Greenwood	250,000	8.5	4.25	24.4
Auburn Lake Trails	105,000	8.0	4.0	9.6
			Estimated Total (ac-ft)	58.7

The raw water storage that would be available from these expanded reservoirs would satisfy emergency and maintenance storage criteria developed for this Study.

GDPUD Ditch System Capacities and Design Flows
Up Country Ditch System
Pilot Creek Diversion to Structure #3

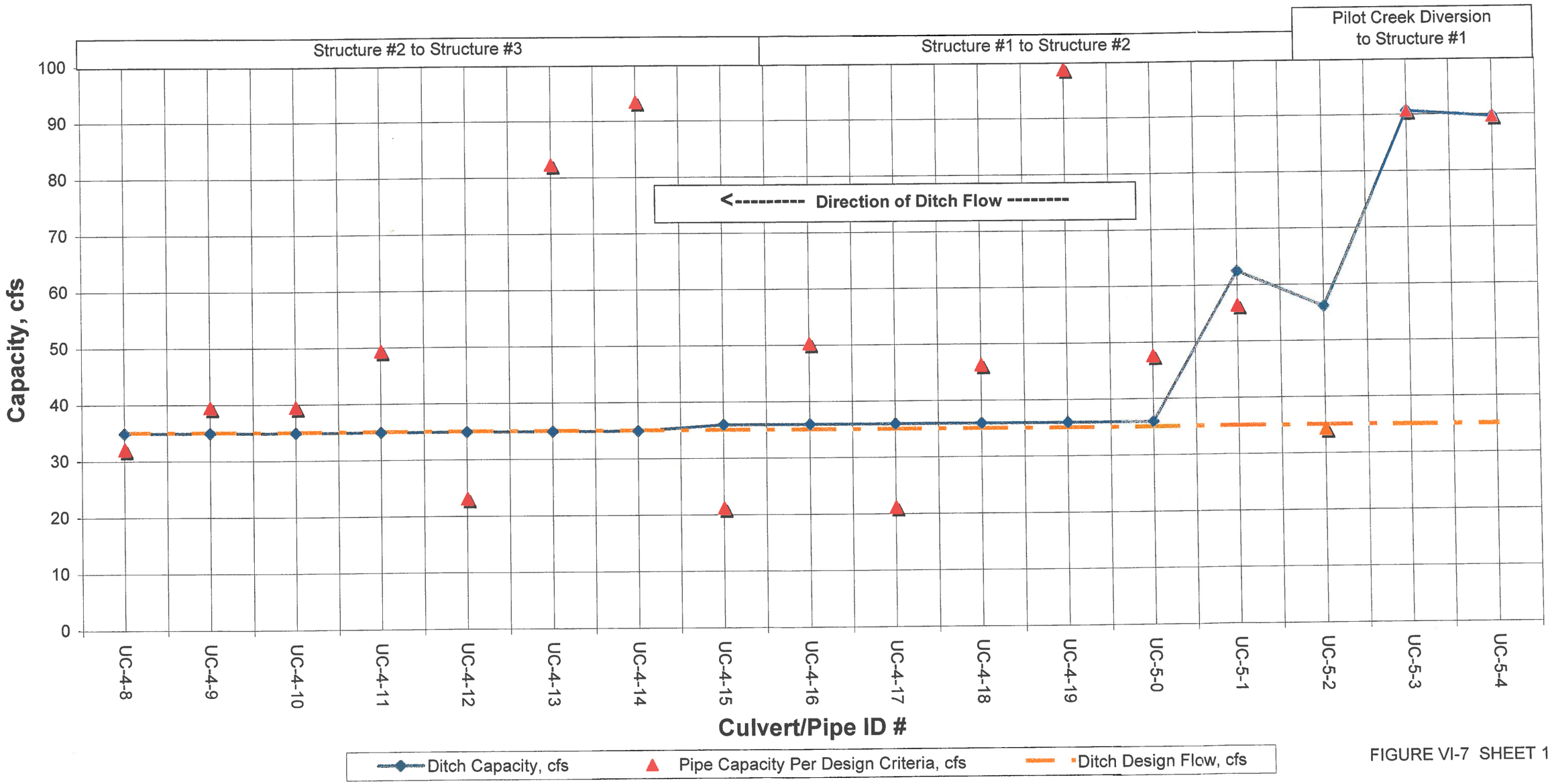

FIGURE VI-7 SHEET 1

GDPUD Ditch System Capacities and Design Flows
Up Country Ditch System
Structure #3 to Tunnel Hill Inlet

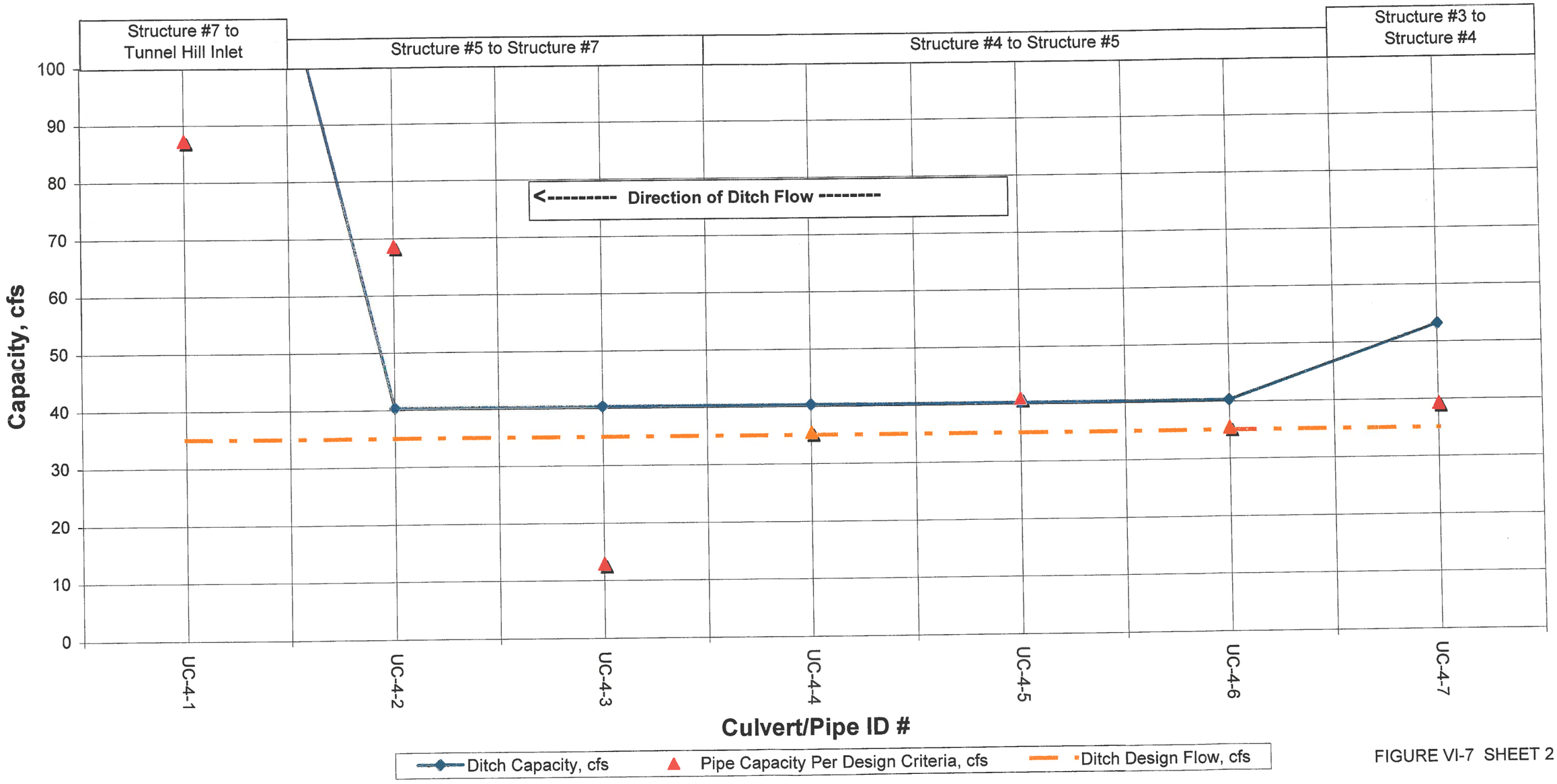

FIGURE VI-7 SHEET 2

GDPUD Ditch System Capacities and Design Flows
Up Country Ditch System
Penstock Inlet to Balderston Wastegate

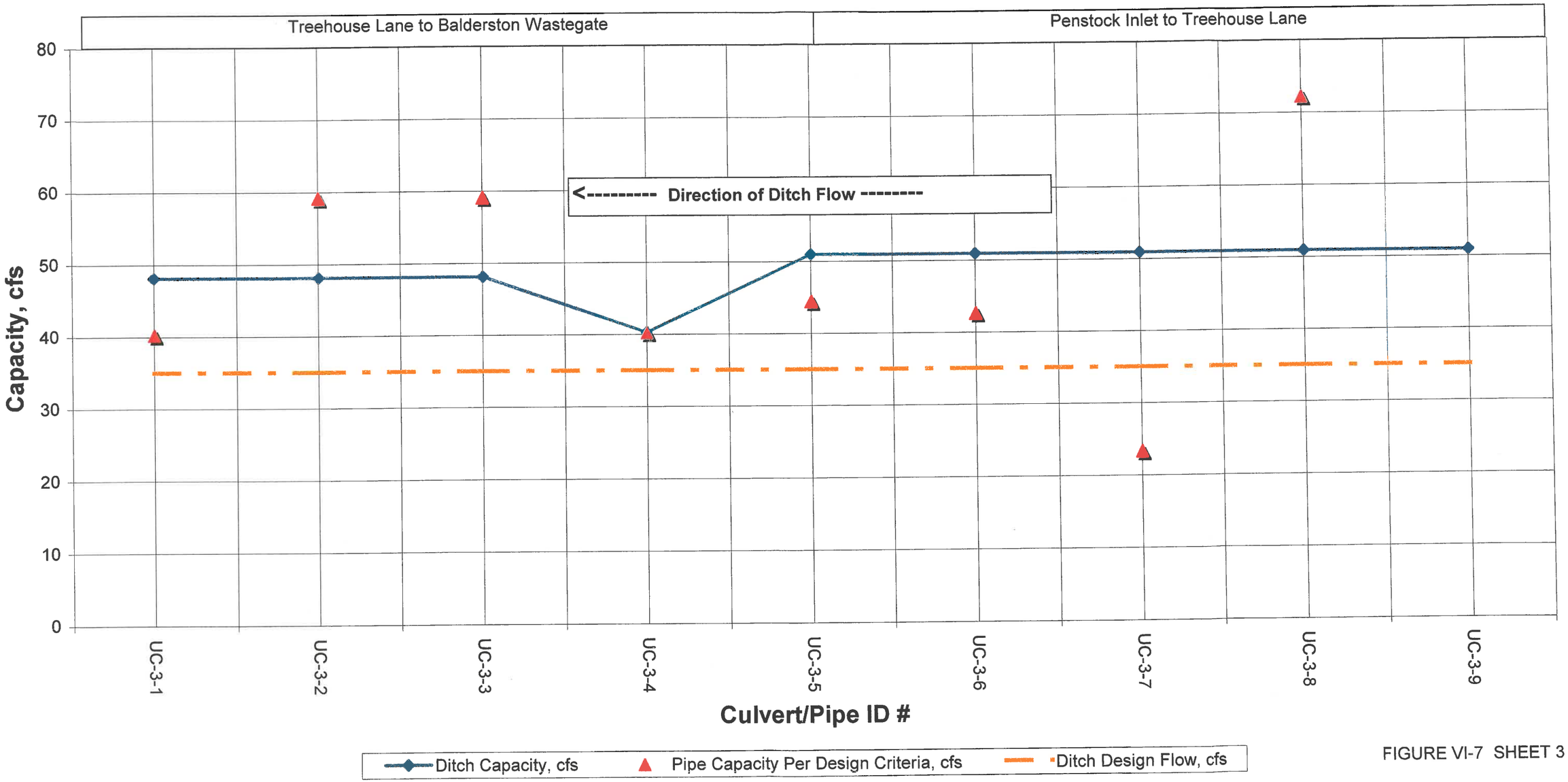

FIGURE VI-7 SHEET 3

GDPUD Ditch System Capacities and Design Flows
Up Country Ditch System
Balderston Wastegate to the Crails

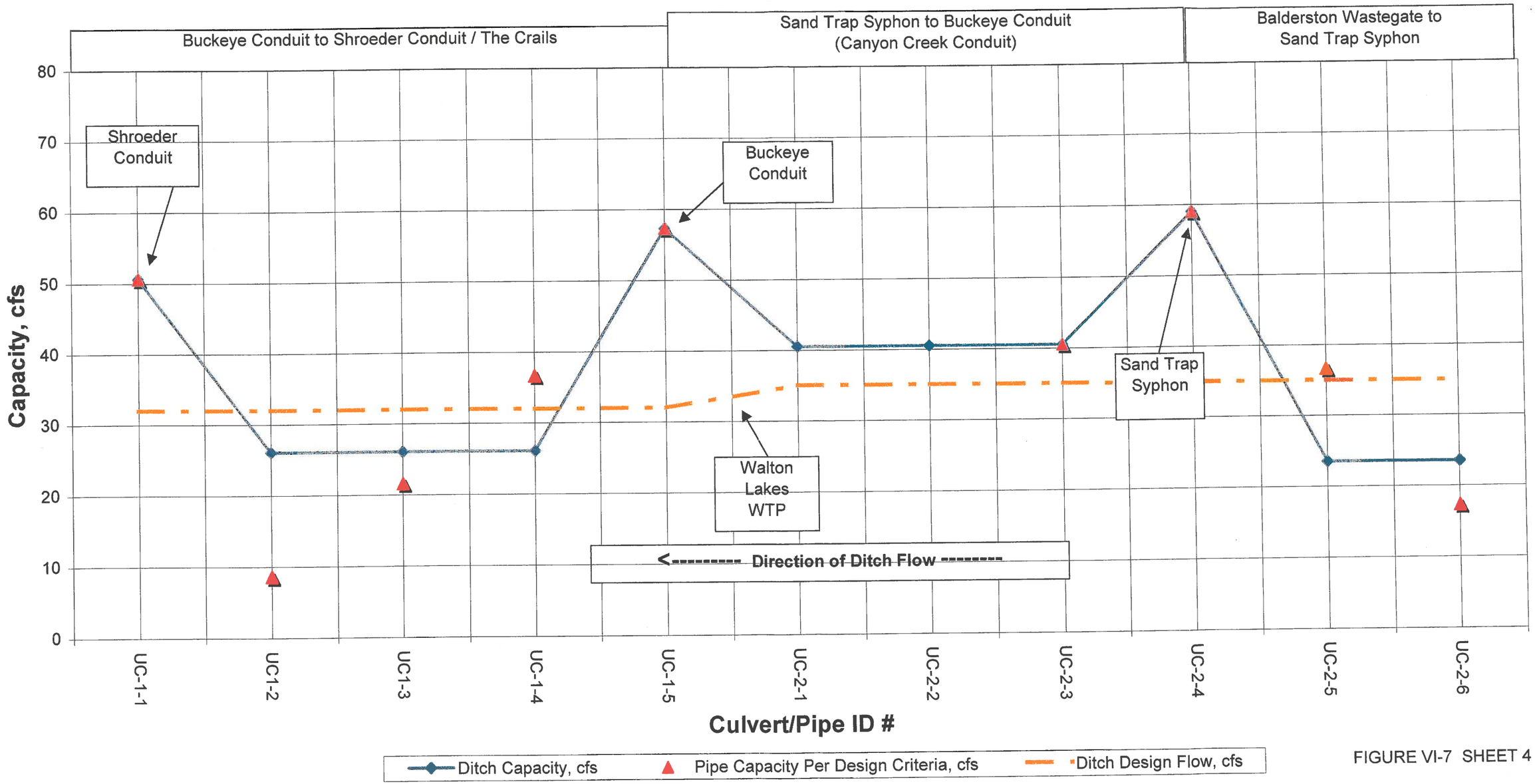

FIGURE VI-7 SHEET 4

GDPUD Ditch System Capacities and Design Flows
Main/Pilot Hill Ditch System
Main Ditch #1

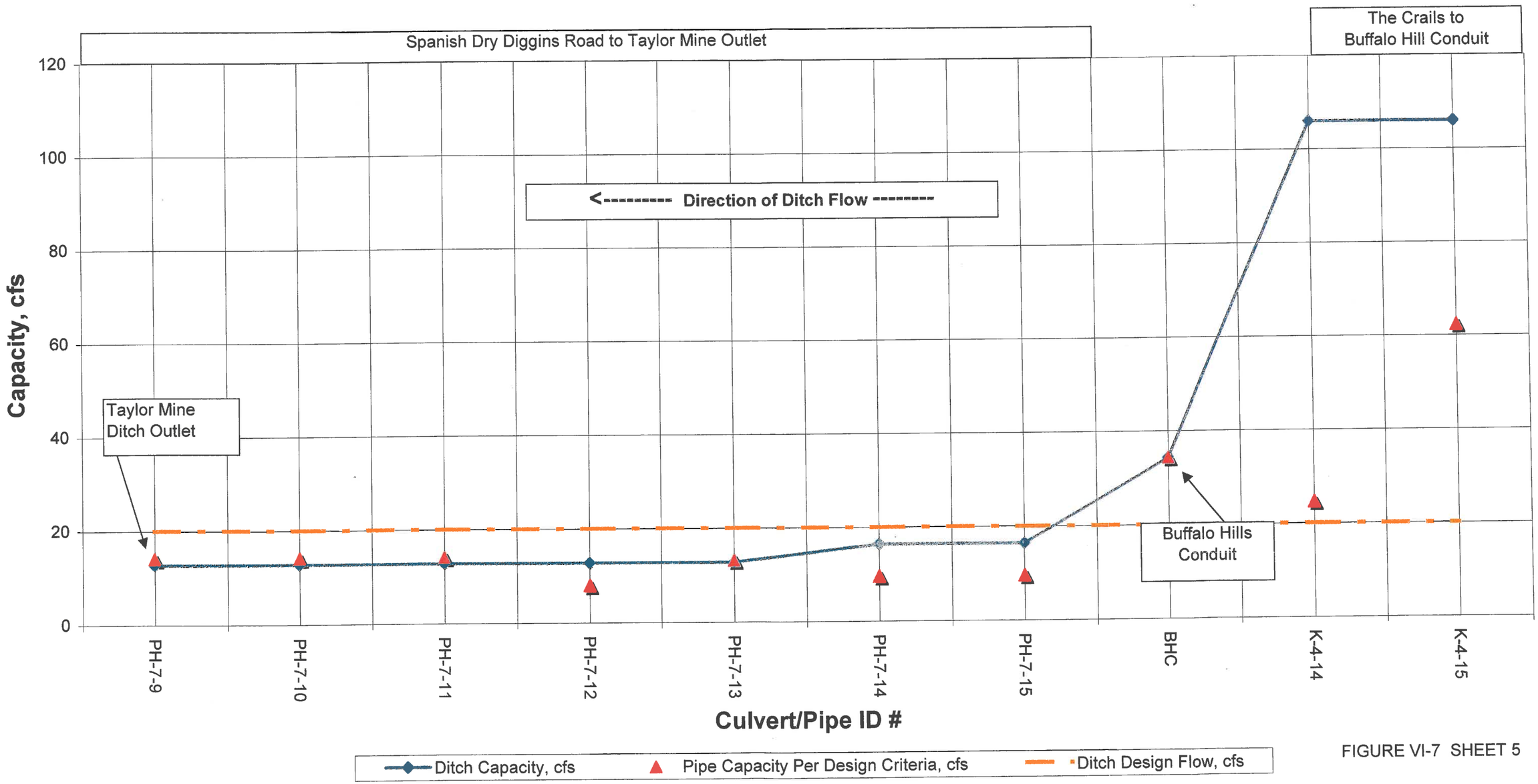

FIGURE VI-7 SHEET 5

GDPUD Ditch System Capacities and Design Flows
Main/Pilot Hill Ditch System
Main Ditch #1
Taylor Mine Outlet to SDD Diversion Flume

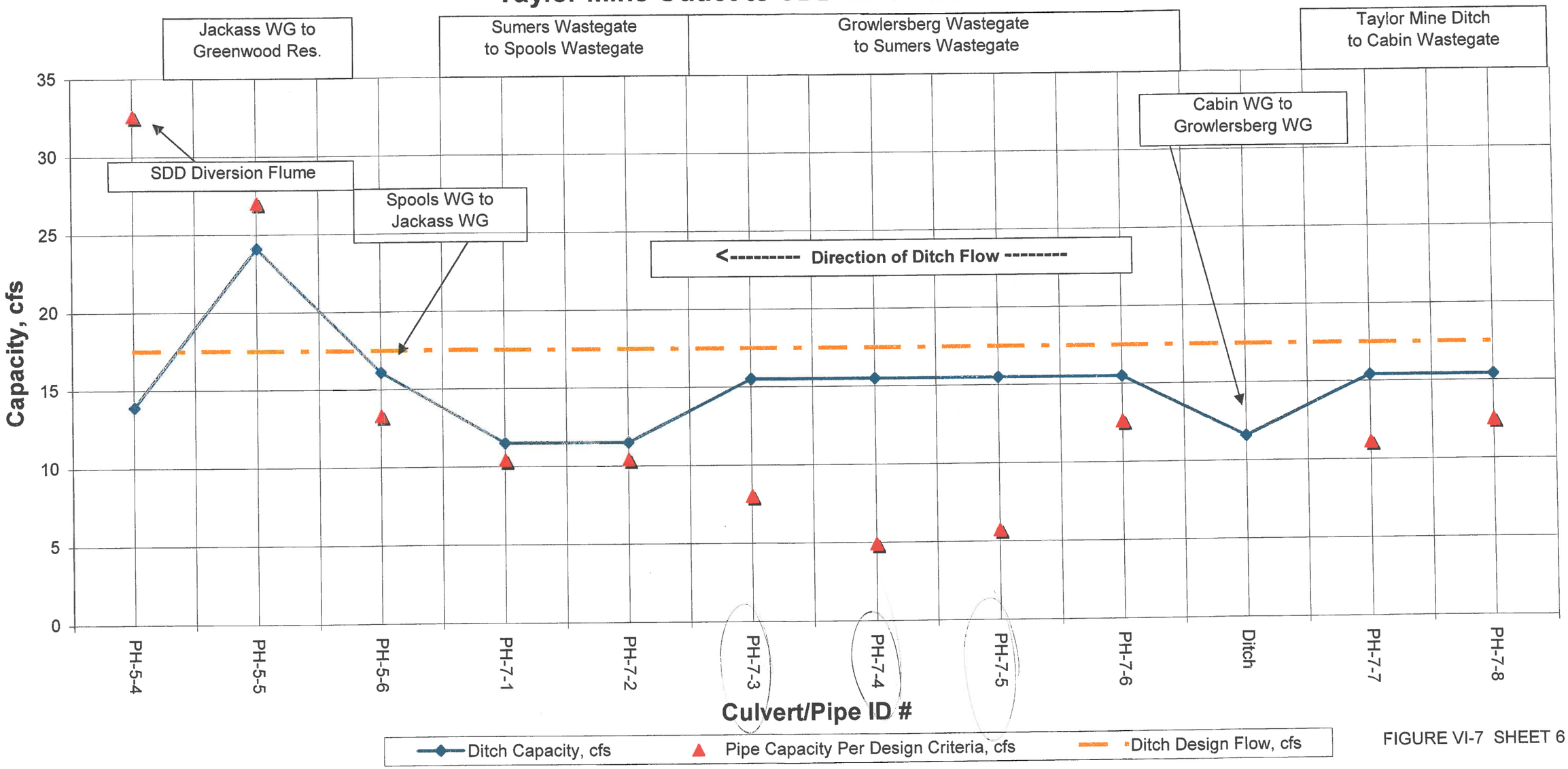

FIGURE VI-7 SHEET 6

GDPUD Ditch System Capacities and Design Flows
Main/Pilot Hill Ditch System
Main Ditch #2
Spanish Dry Diggins Diversion Flume to Dorman Wye

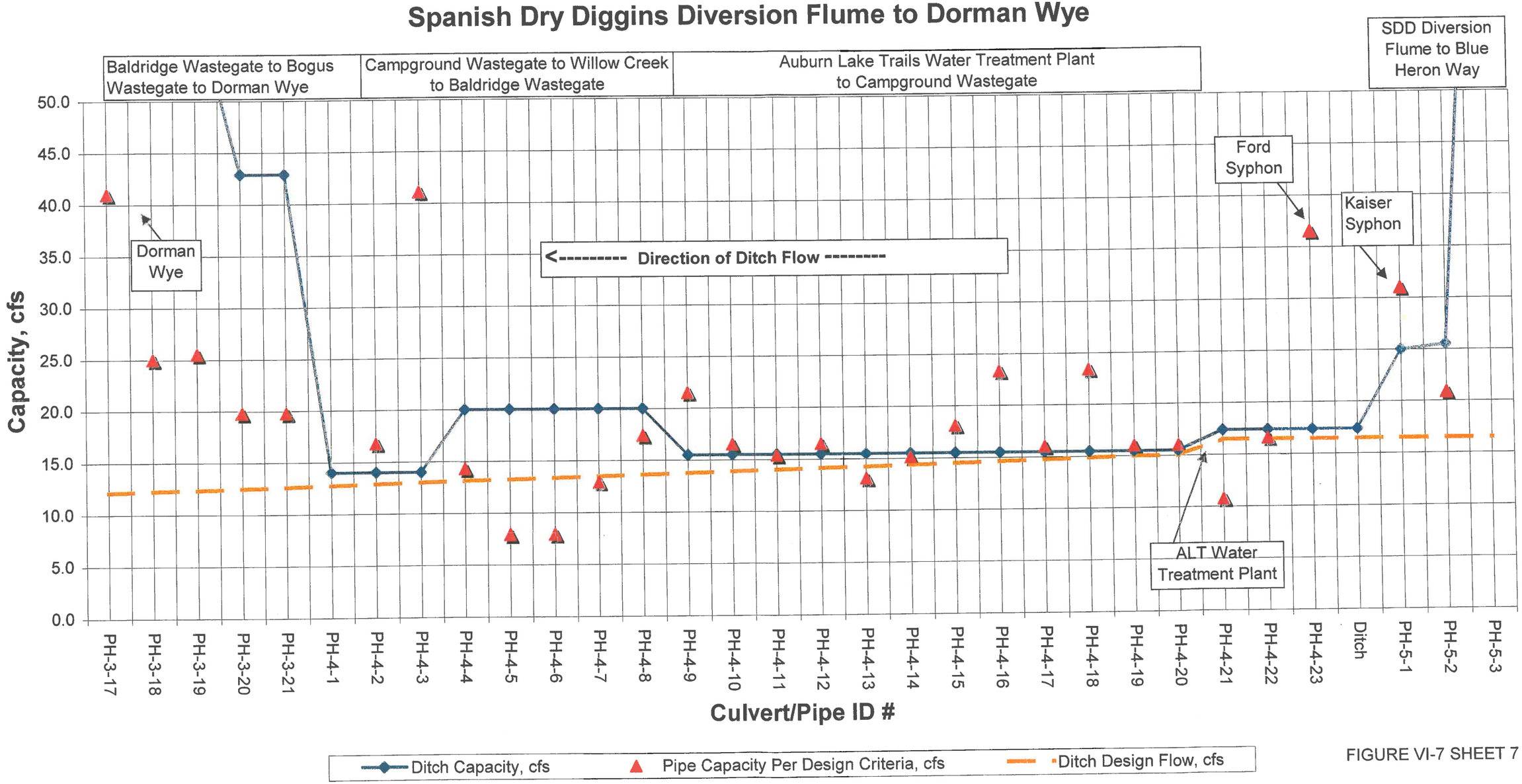

FIGURE VI-7 SHEET 7

GDPUD Ditch System Capacities and Design Flows
Main/Pilot Hill Ditch System
Pilot Hill Ditch
Dorman Wye to the Pilot Hill Reservoir

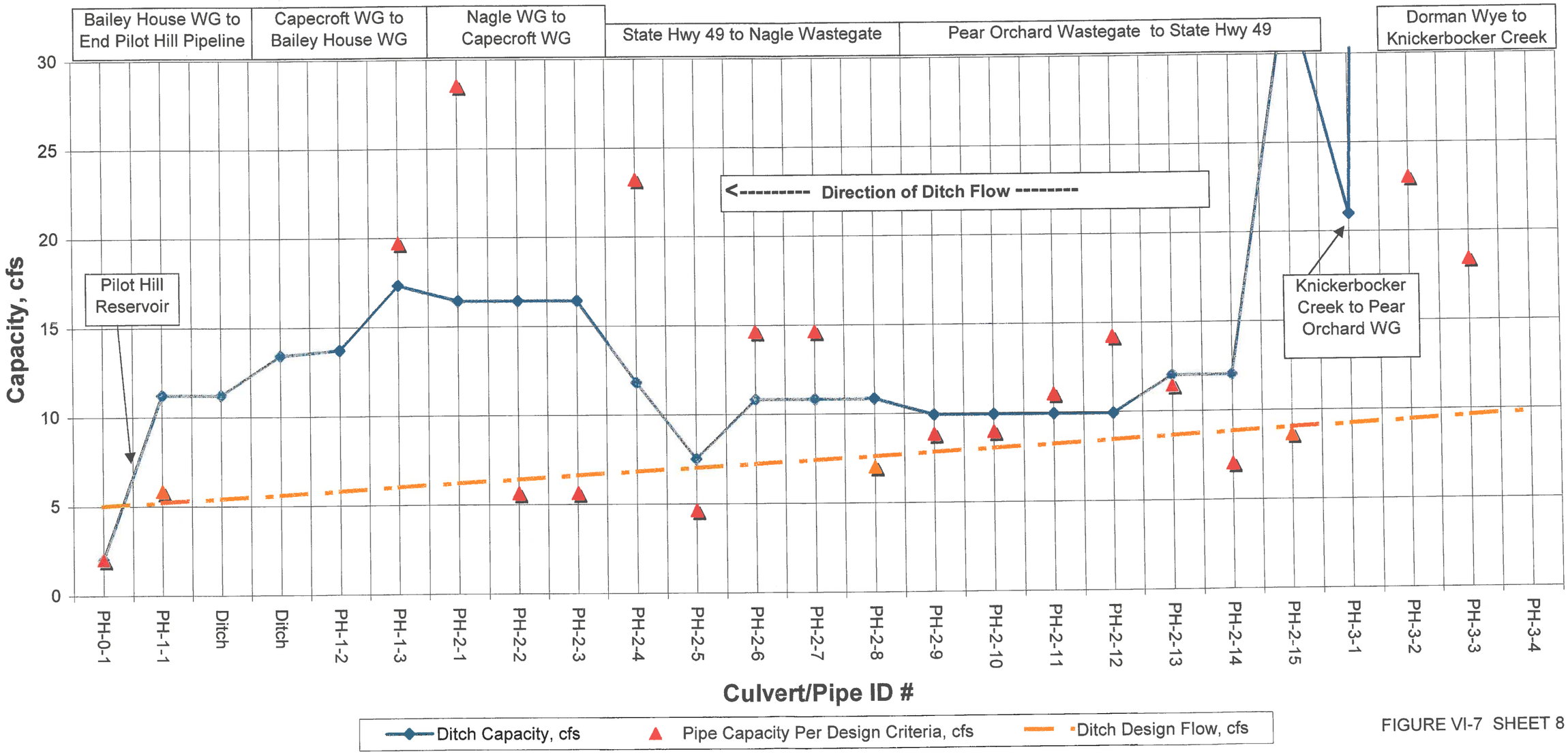

FIGURE VI-7 SHEET 8

GDPUD Ditch System Capacities and Design Flows
Main/Pilot Hill Ditch System
Spanish Dry Diggins Ditch
SDD Diversion Flume to End SDD Ditch

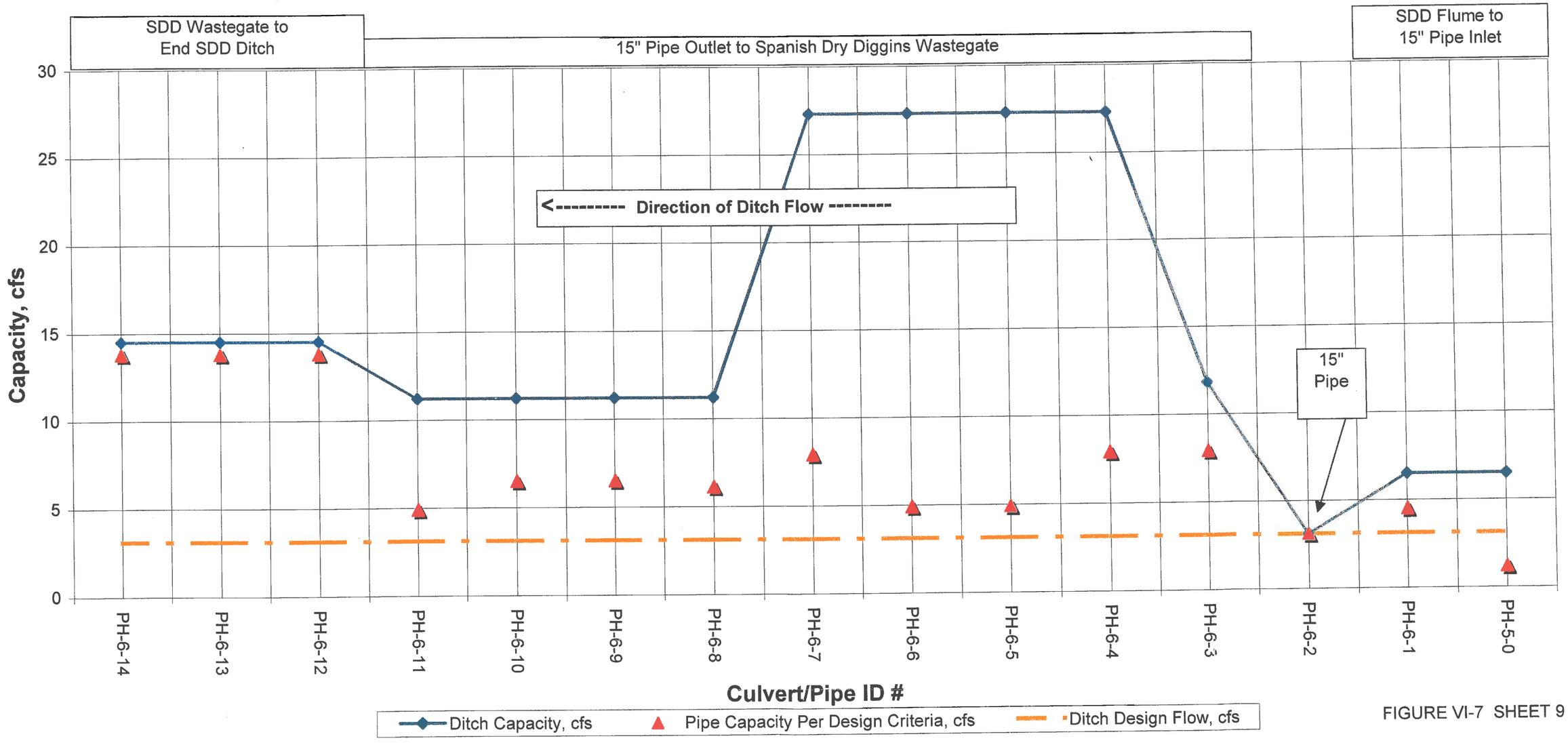

FIGURE VI-7 SHEET 9

GDPUD Ditch System Capacities and Design Flows
Main/Pilot Hill Ditch System
Cherry Acres Ditch
Dorman Wye to End of Cherry Acres Ditch

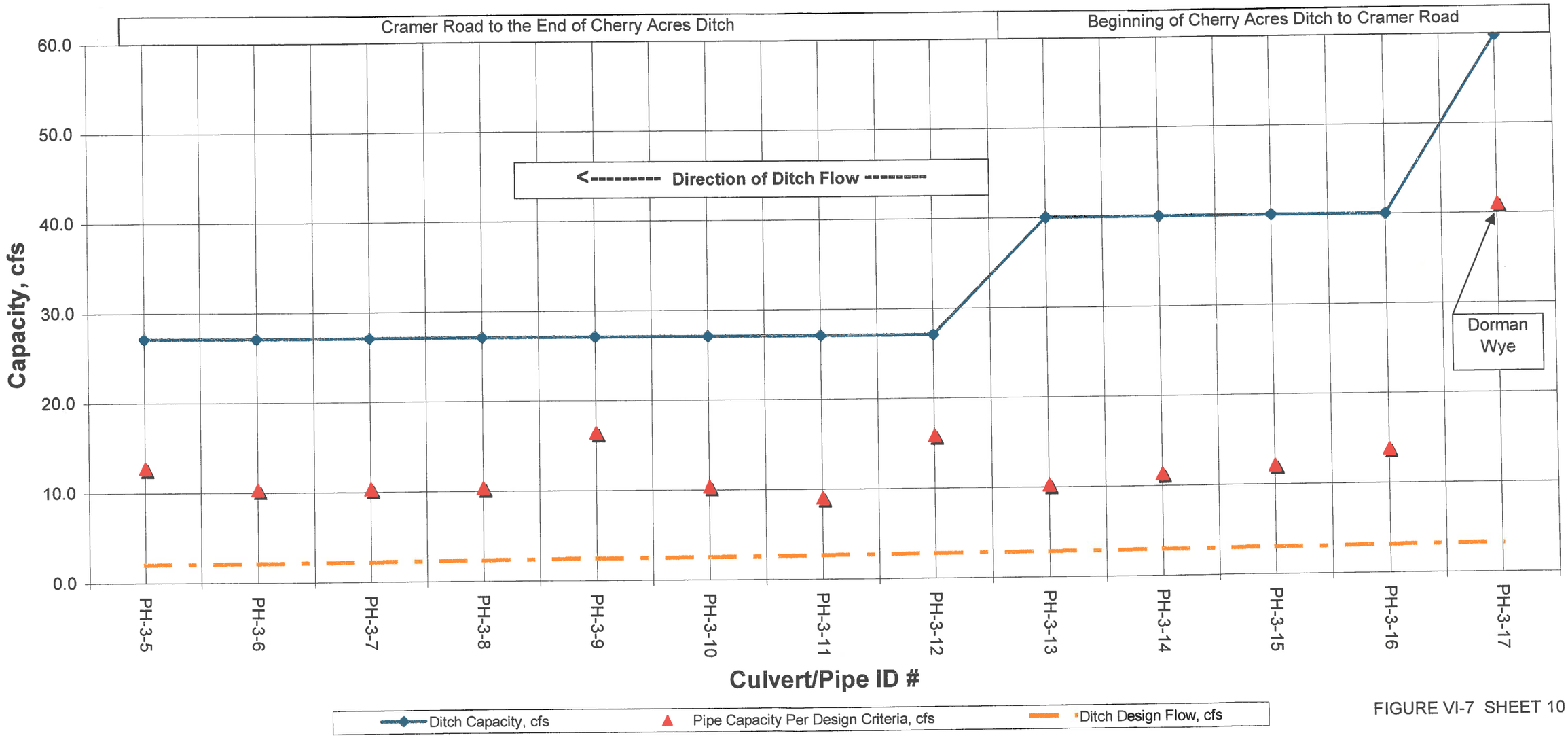

FIGURE VI-7 SHEET 10

GDPUD Ditch System Capacities and Design Flows
Kelsey Ditch System
Kelsey Ditch #1
The Crails to Irish Reservoir Wastegate

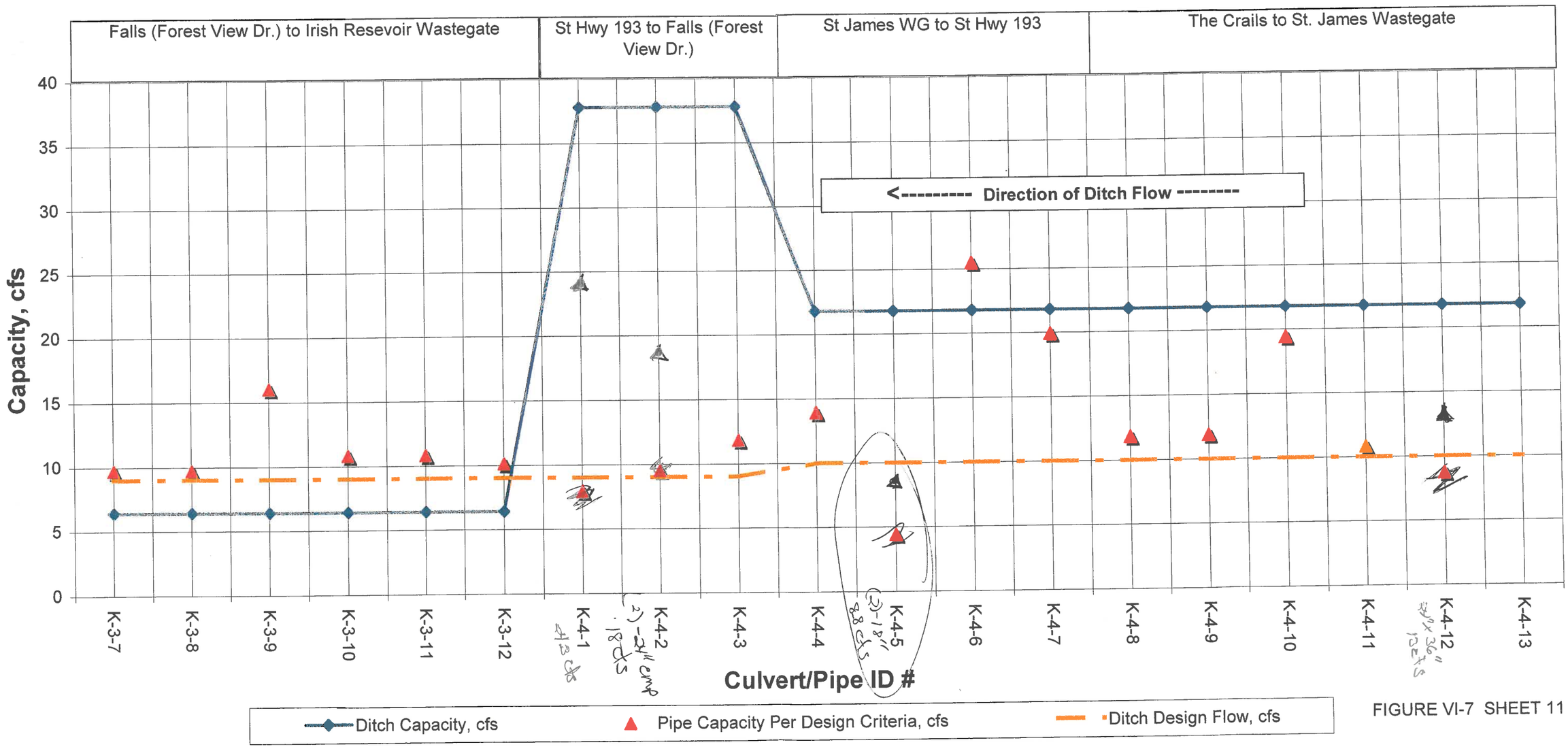

FIGURE VI-7 SHEET 11

GDPUD Ditch System Capacities and Design Flows
Kelsey Ditch System
Upper Kelsey Ditch #2
Irish Reservoir Wastegate to Chicken Flat Wastegate

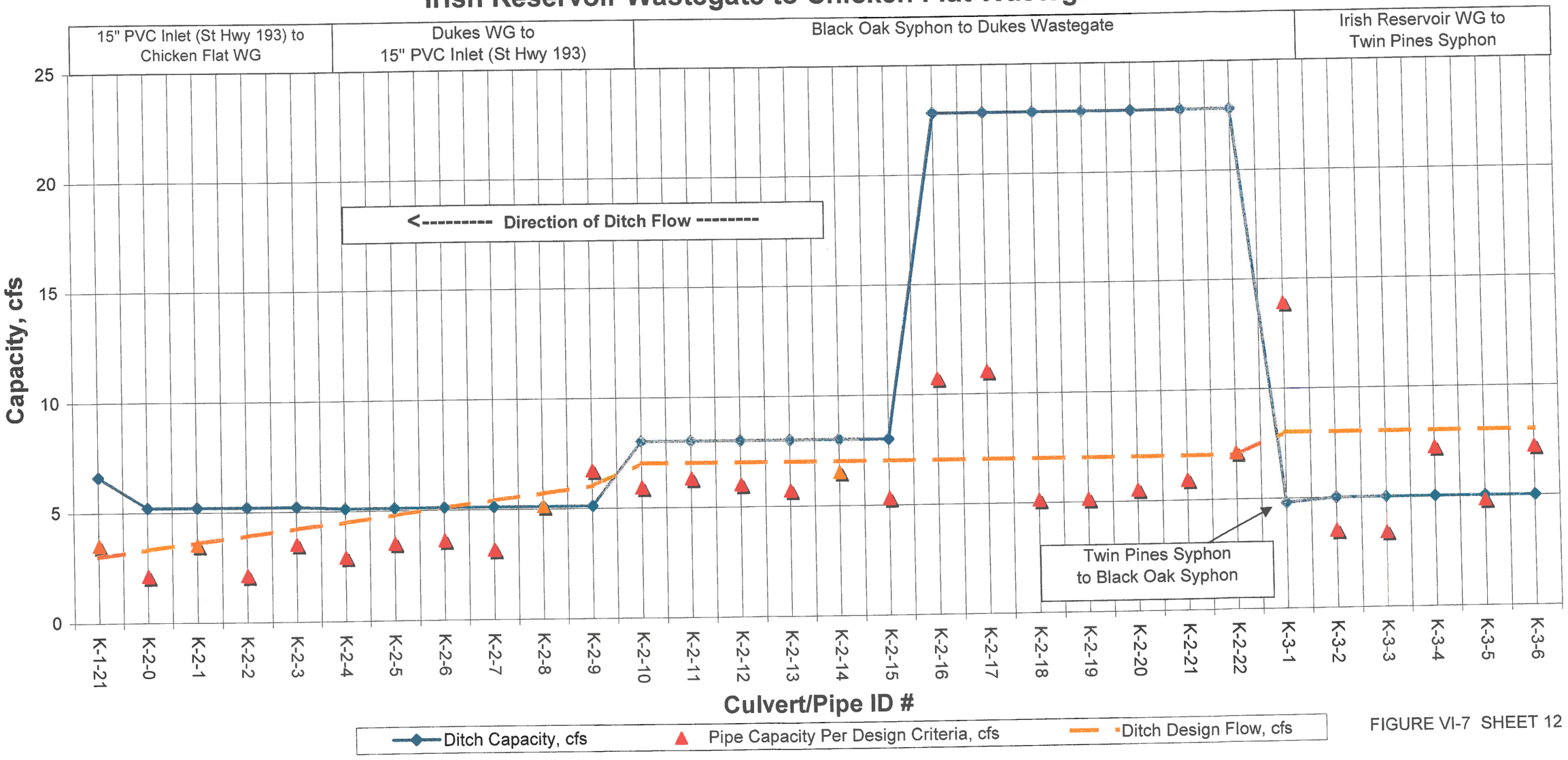

FIGURE VI-7 SHEET 12

GDPUD Ditch System Capacities and Design Flows
Kelsey Ditch System
Lower Kelsey Ditch #2
Chicken Flat Wastegate to Kelsey Reservoir

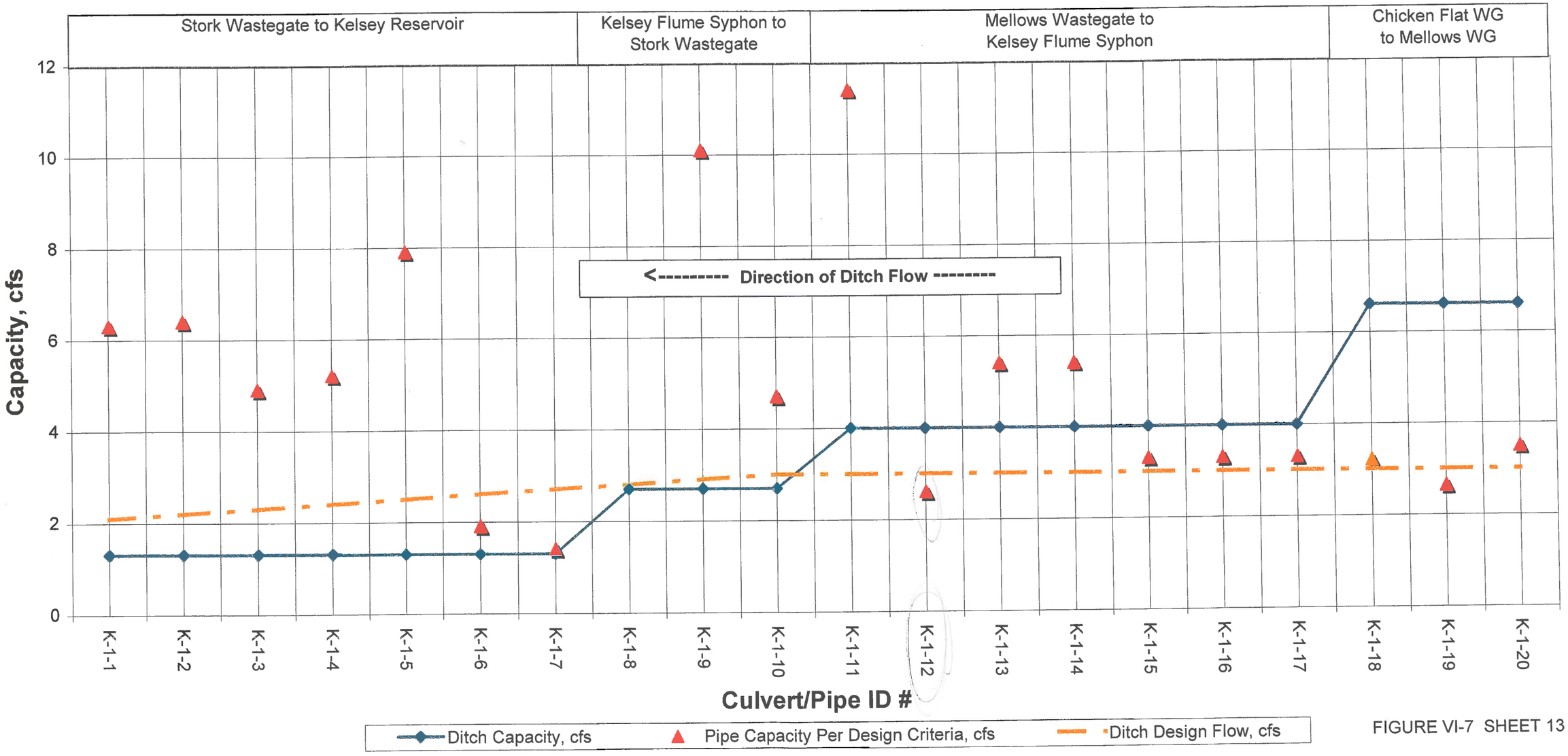

FIGURE VI-7 SHEET 13

GDPUD Ditch System Capacities and Design Flows
Kelsey Ditch System
Taylor Mine Ditch
Taylor Mine Outlet to End Greenwood Road Pipeline

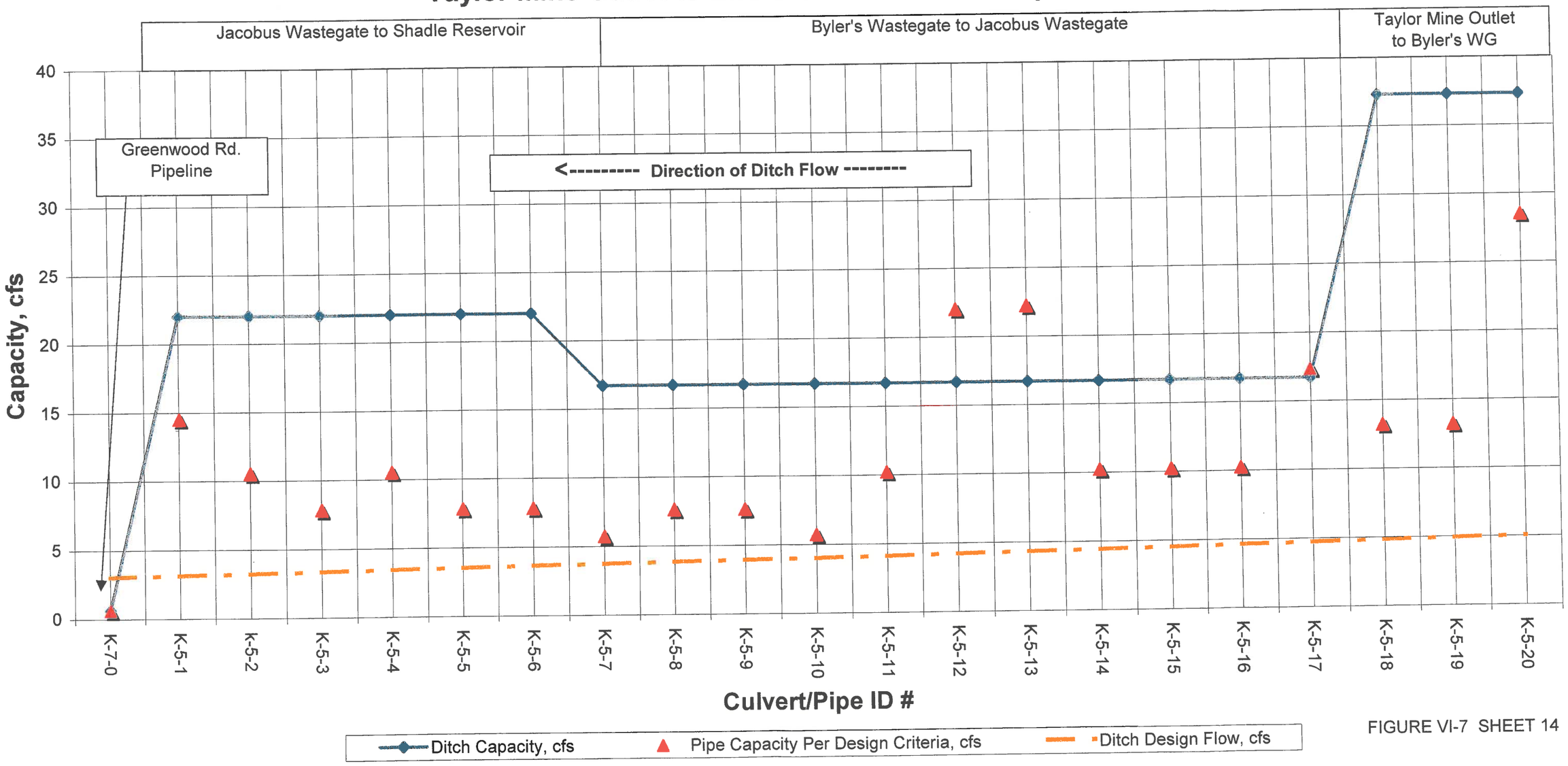

FIGURE VI-7 SHEET 14

CONSULTING
KASL
ENGINEERS

VII RECOMMENDED DITCH SYSTEM RELIABILITY MEASURES

In this section of the Reliability Study measures recommended to improve ditch system reliability are presented and prioritized.

PRIORITY RELIABILITY MEASURES

Priority ditch system reliability measures are summarized in **Table VII-1**. Priority measures are identified by ditch segment and are cross-referenced to the raw water (ditch) maps presented in the Appendix of this Study. Priority repair areas are highlighted on the ditch system maps. Measures to improve the stability of Upcountry and Main / Pilot Hill Ditch improvements upstream of the Walton Lakes and Auburn Lake Trails water treatment plants have been assigned a higher priority than measures discussed in Section VI of this Study to improve ditch facilities downstream of treatment plant raw water supply points Ditch stability and loss reduction measures have been assigned a higher priority than ditch capacity improvements.

Enlargement of the raw water storage facilities at Walton Lakes, Greenwood and Auburn Lake Trails to meet emergency and maintenance supply criteria are high priority reliability measures. Replacement of unstable sections of the Upcountry Ditch system with piping are high priority measures. Repair of Main / Pilot Hill Ditch Systems upstream of the Auburn Lake Trails Water Treatment Plant with gunnite lining and cribwalls to control leaks and to reliably deliver design flows are assigned a high priority. Reduction of losses at known leak areas are assigned a high priority. These loss reduction measures include repairs along the Kelsey Ditch System as well as repairs on the Upcountry Ditch and Main / Pilot Hill Ditch

Implementation Schedule and Estimated Costs

It is recommended that the priority reliability measures presented in Table VII-1 be scheduled for implementation over the next 5 years (2003 – 2008). The estimated costs presented in Table VII-1 assume that current unit costs would be inflated, on average, to projected 2005 - 2006 costs. This would be the approximate midpoint of the recommended 5-year implementation period. Current costs are projected ahead using Engineering News Construction Costs (ENRCC) indices. The current (late 2002) ENRCC applicable to Northern California is approximately 6500. An ENRCC index of 7000 is used to estimate projected costs.

The total estimated cost of the priority ditch system reliability measures is $4,260,500. Priority Upcountry Ditch costs are estimated at $1,922,000, or 45% of this total. Main / Pilot Hill Ditch costs are estimated at $1,775,000 (42%) and Kelsey Ditch costs are estimated at $563,000 (13%).

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TABLE VII-1

SUMMARY OF PRIORITY RELIABILITY MEASURE RECOMMENDATIONS
GDPUD DITCH SYSTEM

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Upcountry Ditch	Structure #1 to Structure #2 (UC-5)	• Construct retaining walls / slope stabilization for downslope levee at "the Narrows" • Widen access road from 6 feet to 10 feet • Replace 250 feet of open ditch with 48" pipe	$548,000
Upcountry Ditch	Structure #2 to Structure #3 (UC-4)	• Provide 1 foot of additional freeboard for 400 feet of ditch	$72,000
Upcountry Ditch	Structure #3 to Structure #4 (UC-4)	• Replace 500 LF of ditch with 48" pipe	$305,000
Upcountry Ditch	Structure #5 to Structure #6 (UC-4)	• Replace 500 LF of ditch with 48" pipe	$305,000
Upcountry Ditch	Balderston Wastegate to Sand Trap Siphon (UC-2)	• Provide 1 foot of additional freeboard, 1000 feet of lined and unlined section of ditch	$111,000
Upcountry Ditch	Walton Lake (UC-2)	• Dredge Walton Lake to restore holding capacity to approx. 25.0 acre-feet • Provide bypass piping during dredging	$496,000
Upcountry Ditch	Buckeye Conduit to Shroeder Conduit (PH-7)	• Provide 1 foot of additional freeboard for approximately 1100 feet of lined ditch	$85,000
		Subtotal, Upcountry Ditch	$1,922,000

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TABLE VII-1 (cont.)

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Main / Pilot Hill Ditch (Main Ditch #1)	Buffalo Hills Conduit to Spanish Dry Diggins Rd. (PH-7)	• Provide 6 inches of additional freeboard for approximately 500 feet of unlined ditch	$60,000
Main / Pilot Hill Ditch (Main Ditch #1)	Spanish Dry Diggins Rd. to Taylor Mine Outlet (PH-7)	• Gunnite line approximately 2500 feet of ditch or improve ditch with crib walls and 6" of additional freeboard	$305,000
Main / Pilot Hill Ditch (Main Ditch #1)	Taylor Mine Outlet to Cabin Wastegate (PH-7)	• Construct crib wall improvements at 3 locations • Replace 500 feet of deteriorated lining with new lining • Provide 6 inches of additional freeboard, 500 feet of ditch • Replace Cabin Wastegate	$186,000
Main / Pilot Hill Ditch (Main Ditch #1)	Cabin Wastegate to Growlersberg Wastegate (PH-7)	• Replace 1800 feet of lined ditch with new lining	$200,000
Main / Pilot Hill Ditch (Main Ditch #1)	Growlersberg Wastegate to Summers Wastegate (PH-7)	• Provide crib wall repairs at 3 locations	$11,000
Main / Pilot Hill Ditch (Main Ditch #1)	Summers Wastegate to Spools Wastegate (PH-7)	• Repair 600 feet of ditch with crib walls and 6 inches of additional freeboard	$93,000
Main / Pilot Hill Ditch (Main Ditch #1)	Spools Wastegate to Jackass Wastegate (PH-5)	• Provide crib wall repairs at 2 locations	$7,500

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TABLE VII-1 (cont.)

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Main / Pilot Hill Ditch (Main Ditch #1)	Jackass Wastegate to Greenwood Reservoir (PH-5)	• Dredge Greenwood Reservoir to provide capacity of ±24.4ac-ft	$416,000
Main / Pilot Hill Ditch (Main Ditch #2)	Blue Heron Falls to Kaiser Siphon (PH-5)	• Gunnite line 600 feet of existing ditch	$84,000
Main / Pilot Hill Ditch (Main Ditch #2)	Kaiser Siphon to ALT Water Treatment Plant (PH-4)	• Dredge ALT raw water storage reservoir to provide capacity of ±9.6 ac-ft • Provide bypass piping during dredging	$198,000
Main / Pilot Hill Ditch (Main Ditch #2)	Willow Creek Wastegate to Baldridge Wastegate (PH-4)	• Repair with crib walls, 5 ditch sections damaged by cattle • Place 3000 lineal feet of cattle control fencing	$80,000
Main Ditch / Pilot Hill Ditch (Pilot Hill Ditch)	Doman Wye to Knickerbocker Creek (PH-3)	• Remove and replace 2-18" CMP and 24" STL culverts with 42x29 CMPA or 36" CMP	$22,000
Main Ditch / Pilot Hill Ditch (Pilot Hill Ditch)	Lovejoy Wastegate to Nagle Wastegate (PH-2)	• Gunnite line approximately 400 feet of ditch • Replace Nagle Wastegate	$81,000
Main Ditch / Pilot Hill Ditch (Pilot Hill Ditch)	Nagle Wastegate to Capecroft Wastegate (PH-2)	• Provide crib wall; repair, ±50 feet in length, one location	$4,000
Main Ditch / Pilot Hill Ditch (Pilot Hill Ditch)	Wagner Reservoir to Wagner Reservoir Wastegate (PH-1)	• Gunnite line ±250 foot ditch section	$28,000
		Subtotal, Main / Pilot Hill Ditch	$1,775,500

TABLE VII-1 (cont.)

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Kelsey Ditch (Kelsey Ditch #1)	The Crails to St. James Wastegate (K-4)	• Remove and replace 2-15" PVC pipes at two locations; total ±800 lineal feet, replace with min. 30" pipe or 42"x29" CMPA • Place trash racks (Grizzlies) at upstream end of new pipes	$136,000
Kelsey Ditch (Kelsey Ditch #1)	St. James Wastegate to State Highway 193 (K-4)	• Remove and replace 18" CMP culvert, replace with 42"x29" CMPA or 42" CMP	$8,000
Kelsey Ditch (Kelsey Ditch #1)	Forest View Dr. Falls to Irish Res. Wastegate (K-3)	• Gunnite line approximately 600 lineal feet of ditch	$75,000
Kelsey Ditch (Kelsey Ditch #2)	Black Oak Siphon to Dukes Wastegate (K-2)	• Gunnite line approximately 400 lineal feet of ditch	$51,000
Kelsey Ditch (Kelsey Ditch #2)	Dukes Wastegate to State Highway 193 (K-2)	• Gunnite line approximately 1000 lineal feet of ditch (total two locations)	$125,000
Kelsey Ditch (Kelsey Ditch #2)	Mellows Wastegate to Kelsey Flume (K-1)	• Gunnite line approximately 800 lineal feet of ditch (total two locations)	$95,000
Kelsey Ditch (Kelsey Ditch #2)	Kelsey Flume to Stork Wastegate (K-1)	▪ Gunnite line approximately 400 lineal feet of ditch	$48,000

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TABLE VII-1 (cont.)

Ditch System	Segment (Map Sheet #) [1]	Description	Estimated Cost [2]
Kelsey Ditch (Kelsey Ditch #2)	Stork Wastegate to Kelsey Reservoir (K-1)	• Gunnite line approximately 800 lineal feet of ditch (total two locations) • Reconstruct Stork Wastegate	$120,000
		Subtotal, Kelsey Ditch	$563,000
		Estimated Total, All Priority Measures	$4,260,500

(1) Refer to Ditch System Map Sheets included in the Appendix of this Study
(2) Costs are based on ENRCC = 7000 projected for mid-point of 2003 – 2008 Priority Measure Schedule

MAINTENANCE, ACCESS AND SECOND PRIORITY RELIABILITY MEASURES

Maintenance, access and second priority reliability measures are presented in **Table VII-2**. Included are reliability recommendations discussed in Section VI which are not already listed in Table VII-1. Access measures to improve operations and to keep maintenance problems from escalating into reliability issues are included in this "second-tier" of reliability measures. Replacement of additional Upcountry Ditch segments with piped improvements are included in this group of measures. Replacement of cross fences with access gates is proposed. The installation of additional flow monitoring and flow measuring equipment is included in this group of measures.

Second priority measures recommended in Table VII-2 include minor cribwall repair, ditch lining and piping on the Main / Pilot Hill Ditch downstream of the Auburn Lake Trails Water Treatment Plant, on the Kelsey Ditch and on the Taylor Mine, Spanish Dry Diggins and Cherry Acres ditches.

Second priority measures include replacement or repair of existing ditch lining in poor condition and the repair or replacement of GDPUD waste gates in place throughout the GDPUD ditch system. Wood-constructed waste gates equipped with stop logs should be replaced with reinforced concrete structures equipped with metal slide or canal gates. New waste gates proposed at two locations on Main Ditch No. 2 downstream of the Auburn Lake Trails Water Treatment Plant are proposed.

Second priority measures include the replacement of selected undersized culverts and the replacement of small diameter, partially exposed PVC pipe located in the Kelsey Ditch system. Second priority measures include the construction of access control fencing in selected areas of the Main / Pilot Hill and Kelsey ditches.

Schedule and Estimated Costs

It is recommended that the maintenance access and second priority reliability measures recommended herein be scheduled over the next 20-year period. An ENRCCI index of 8000 is assumed. This would provide a ±25% inflation of current costs.

As presented in Table VII-2 the total estimated cost of these second-tier measures is $7,029,000. Of this total approximately $1,787,000 is estimated for the Upcountry Ditch (25% of total), $3,534,000 is estimated for the Main / Pilot Hill Ditch (50% of total) and $1,308,000 is estimated for the Kelsey Ditch (19% of total). Estimated Cherry Acres Ditch and Spanish Dry Diggins Ditch costs are included in the Main / Pilot Hill Ditch total. Taylor Mine Ditch measures are included in the Kelsey Ditch total. Costs associated with ditch system maintenance equipment (small track excavators) and SCADA control systems ($400,000) are applicable to all the GDPUD ditch systems. These costs are included in the total cost estimate but not the Ditch subtotals.

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TABLE VII-2

SUMMARY OF MAINTENANCE, ACCESS, AND SECOND PRIORITY RELIABILITY MEASURE RECOMMENDATIONS GDPUD DITCH SYSTEM

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Upcountry Ditch	Bacon Creek Pipeline (UC-5)	• Improve access along ±1,500 linear feet of pipeline to provide a 10-foot wide all-weather vehicle access road	$314,000
Upcountry Ditch	Structure #1 to Structure #2 (UC-4)	• Provide 1 foot of additional freeboard, ±200 ft of unlined section of ditch	$12,000
Upcountry Ditch	Structure #2 to Structure #3 (UC-4)	• Replace ±800 feet of ditch with 48" concrete or HDPE pipe	$492,000
Upcountry Ditch	Structure #3 to Structure #4 (UC-4)	• Schedule to replace ±500 feet of ditch with 48" concrete or HDPE pipe	$349,000
Upcountry Ditch	Structure #4 to Structure #5 (UC-4)	• Widen the Big Cut area to provide an 8-foot wide ditch access road along one side of ditch	$123,000
Upcountry Ditch	Penstock Inlet/Bypass to Tree House Lane (UC-3)	• Provide improved ditch maintenance with minimum 8-foot access on one side (±2600 ft) • Replace cross fences with access gates and locks (±5 locations) • Install continuous flow monitoring and recording equipment at the Tunnel Hill Measuring Flume	$177,000

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TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Upcountry Ditch	Tree House Lane to Balderston Wastegate (UC-3)	• Provide improved ditch maintenance with minimum 8-foot access on one side (±5600 ft) • Replace cross fences with access gates and locks (±10 locations)	$209,000
Upcountry Ditch	Sand Trap Siphon Canyon Creek Conduit (UC-2)	• Maintain access along pipeline routes for maintenance and inspection (± 5000 ft.)	($10,000 / year) [3]
Upcountry Ditch	Buckeye Conduit (UC-2)	• Maintain access along pipeline route for maintenance and inspection (±10,000 ft.)	($20,000 / year) [3]
Upcountry Ditch	Buckeye Conduit to Schroeder Conduit (UC-1)	• Replace 36" CMP at Wentworth Springs Road with 66"x51" CMPA or 54" CMP • Provide continuous flow monitoring and recording equipment at the Buckeye Measuring Flume.	$49,000
Upcountry Ditch	Schroeder Conduit (UC-1)	• Maintain access along pipeline route for maintenance and inspection (± 3250 ft.)	($6,500 / year) [3]
Main / Pilot Hill Ditch (Main Ditch #1)	The Crails to Buffalo Hills Conduit (K-4)	• Provide ditch maintenance and vegetation clearing with minimum 8-foot access on one side ditch, 1000 feet • Provide measuring flume and flow meter to measure flow to the Main Ditch	$80,000

TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Main / Pilot Hill Ditch (Main Ditch #1)	Buffalo Hills Conduit (PH-7)	• Maintain access along pipeline route for maintenance and inspection (± 4900 ft.)	($9,800 / year) [3]
Main / Pilot Hill Ditch (Main Ditch #1)	Spanish Dry Diggins Rd. to Taylor Mine Outlet (PH-7)	• Construct two new ±40 foot crib wall sections to replace old crib wall sections	$10,000
Main / Pilot Hill Ditch (Main Ditch #1)	Cabin Wastegate to Growlersberg Wastegate (PH-7)	• Replace fence crossing with GDPUD approved gate and lock	$6,000
Main / Pilot Hill Ditch (Main Ditch #1)	Summers Wastegate to Spools Wastegate (PH-5)	• Replace ±3200 linear feet of old lining for with new lining	$414,000
Main / Pilot Hill Ditch (Main Ditch #1)	Spools Wastegate to Jackass Wastegate (PH-5)	• Replace ±1500 linear feet of old lining for with new lining (2 locations) • Provide berm improvements for approximately 1000 feet of ditch between lined sections.	$243,000
Main / Pilot Hill Ditch (Main Ditch #1)	Jackass Wastegate to Greenwood Reservoir (PH-5)	• Repair ±200 feet of ditch section with crib wall construction (2 locations)	$20,000
Main / Pilot Hill Ditch (Main Ditch #2)	SDD Diversion Flume to Blue Heron Way Falls (PH-5)	• Conduct vegetation removal to maintain access along the ditch (±3300 ft.)	($6,600 [3] / year)

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TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Main / Pilot Hill Ditch (Main Ditch #2)	Blue Heron Way Falls to Kaiser Siphon (PH-5)	• Replace fence crossings with GDPUD approved gates (7 locations) • Gunnite line approximately 500 feet of existing ditch	$103,000
Main / Pilot Hill Ditch (Main Ditch #2)	Kaiser Pipeline and Kaiser Siphon (PH-5)	• Maintain access and vegetation clearing along pipeline and siphon route for maintenance and inspection (± 4150 ft.) • Replace pipeline segment with HDPE, pressure rated plastic (PVC 905) or concrete pipe	$203,000 ($8,300 / year) [3]
Main / Pilot Hill Ditch (Main Ditch #2)	Ford Siphon to ALT Water Treatment Plant (PH-4)	• Replace existing fence crossings with GDPUD approved gates (3 locations)	$11,000
Main / Pilot Hill Ditch (Main Ditch #2)	ALT Water Treatment Plant to Campground Wastegate (PH-4)	• Replace existing fence crossings with GDPUD approved gates (±5 locations) • Install flow metering device downstream of ALT Water Treatment Plant • Construct new wastegate • Improve access along the ditch in the vicinity of the ALT Campground • Provide vegetation clearing and levee widening from ±1500 feet downstream of the ALT Campground	$172,000

TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Main / Pilot Hill Ditch (Main Ditch #2)	Campground Wastegate to Willow Creek Wastegate (PH-4)	• Replace existing fence crossings with GDPUD approved gates (±3 locations) • Construct new wastegate • Construct lined ditch improvements ±1800 feet • Place ±1500 feet of livestock fencing • Gunnite line approximately 800 feet of ditch	$433,000
Main / Pilot Hill Ditch (Main Ditch #2)	Willow Creek Wastegate to Baldridge Wastegate (PH-4)	• Replace existing fence crossings with GDPUD approved gates and locks (±5 locations) • Gunnite line approximately 500 feet of ditch	$83,000
Main / Pilot Hill Ditch (Main Ditch #2)	Baldridge Wastegate to Bogus Wastegate (PH-3)	• Replace 8 existing fence crossings with GDPUD approved gates	$30,000
Main / Pilot Hill Ditch (Pilot Hill Ditch)	Dorman Wye to Knickerbocker Creek (PH-3)	• Provide access and vegetation clearing along ditch (±3300 ft.)	$162,000
Main / Pilot Hill Ditch (Pilot Hill Ditch)	Knickerbocker Creek to Pear Orchard Wastegate (PH-3)	• Provide 8 foot access and vegetation clearing along ditch (±1950 ft.) • Replace existing fence crossings with GDPUD approved gates (±3 locations)	$107,000

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TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Main / Pilot Hill Ditch (Pilot Hill Ditch)	Pear Orchard Wastegate to Therekel Wastegate (PH-2)	• Provide an 8-foot access and vegetation clearing along ditch (±2900 ft.) • Conduct repairs with a 40-foot section of crib wall improvements	$93,000
Pilot Hill Ditch	Therekel Wastegate to State Hwy 49 (PH-2)	• Provide an 8 foot access and vegetation clearing along ditch (±5,300 ft.) • Replace 10 existing fence crossings with GDPUD approved gates • Replace two 18" culverts with minimum 42"x29" CMPA or 36" CMP	$304,000
Pilot Hill Ditch	State Hwy 49 to Lovejoy Wastegate (PH-2)	• Provide an 8 foot access and vegetation clearing along ditch (±1100 ft.) • Replace existing fence crossings with GDPUD approved gates and locks (2 locations)	$41,000
Pilot Hill Ditch	Lovejoy Wastegate to Nagle Wastegate (PH-2)	• Provide an 8 foot access and vegetation clearing along ditch (±5400 ft.) • Replace existing fence crossings with GDPUD approved gates and locks (2 locations)	$174,000
Pilot Hill Ditch	Capecroft Wastegate to Wagner Reservoir (PH-2)	• Provide an 8 foot access and vegetation clearing along ditch (±2200 ft.) • Replace fence crossings with approved gates and locks (±3 locations)	$119,000

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TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Pilot Hill Ditch	Wagner Reservoir to Wagner Reservoir Wastegate (PH-1)	• Provide an 8 foot access and vegetation for ditch section downstream of reservoir (±1300 ft.) • Dredge reservoir as necessary • Monitor and repair reservoir outlet gates as necessary	$156,000
Pilot Hill Ditch	Wagner Reservoir Wastegate to Bayley House Wastegate (PH-1)	• Construct 3 crib wall repairs, each ±50 to ±100 feet in length	$22,000
Pilot Hill Ditch	Bayley House Wastegate to Pilot Hill Reservoir (PH-1)	• Replace existing fence crossing with 8-foot wide minimum GDPUD approved gate and lock	$4,000
Kelsey Ditch	St. James Wastegate to State Hwy 49 (K-4)	• Replace existing fence crossings with 8-foot wide minimum GDPUD approved gates and locks (±4 locations) • Replace old lining with 100 lineal feet of gunnite lining	$30,000
Kelsey Ditch	State Hwy 49 to (Forrest View Dr.) Falls (K-4)	• Replace existing fence crossing with 8-foot wide minimum GDPUD approved gate and lock (one location) • Provide ±100 feet of cribwall and berm improvements	$14,000

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TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Kelsey Ditch	(Forrest View Dr.) Falls to Irish Res. Wastegate (K-3)	• Improve low freeboard condition for ±250 feet of ditch section • Provide ±100 feet of cribwall and berm improvements • Replace existing fence crossings with 8-foot wide minimum GDPUD approved gates and locks (6 locations)	$44,000
Kelsey Ditch	Irish Res. Wastegate to Twin Pines Siphon (K-3)	• Place ±1500 lineal feet of cattle control fencing • Gunnite line approximately 800 feet of ditch (total 5 locations including 4 cattle crossings) • Replace 1200 feet of lined ditch with new lining • Conduct maintenance and silt removal at Irish Reservoir • Replace existing fence crossings with GDPUD approved 8-foot wide minimum gates and locks (10 locations)	$302,000
Kelsey Ditch	Twin Pines Siphon to Black Oaks Siphon (K-3)	• Repair or replace 600 feet of lined ditch • Replace fence crossings with GDPUD approved 8-foot wide minimum gates and locks (2 locations)	$44,000

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TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Kelsey Ditch	Black Oaks Siphon to Dukes Wastegate (K-2)	• Repair ±800 gunnite-lined ditch sections (2 locations) • Replace existing fence crossings with GDPUD approved 8-foot wide minimum gates and locks (11 locations)	$90,000
Kelsey Ditch	Dukes Wastegate to State Hwy 193 (K-2)	• Repair ±1500 gunnite-lined ditch sections (5 locations) • Remove and replace ±120 feet of 15" PVC pipe, replace with a 24" HDPE, 36" CMP, or 35"x24" CMPA • Replace an 18" and 18"/20" steel culverts, replace with 35"x24" CMPA or 36" CMP	$115,000
Kelsey Ditch	State Hwy 193 to Chicken Flat Wastegate (K-2/K-1)	• Replace exposed sections of 15" PVC with 24" HDPE or 36" CMP (±2000 feet) • Replace ±150 feet of open ditch with gunnite-lined ditch or extend piping improvements with 24" HDPE, 36" CMP, or 35"x24" CMPA	$269,000
Kelsey Ditch	Mellows Wastegate to Kelsey Flume (K-1)	• Repair ±200 feet of low berm areas along ditch (total three locations)	$10,000
Kelsey Ditch	Kelsey Flume Siphon to Stork Wastegate (K-1)	• Gunnite line approximately 800 lineal feet of ditch (total two locations)	$99,000

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TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Kelsey Ditch	Stork Wastegate to Kelsey Reservoir (K-1)	• Replace ±200 feet of exposed sections of 15" PVC with a buried 18" HDPE, 24" CMP or 28"x20" CMPA	$31,000
Spanish Dry Diggins Ditch	SDD Flume to End (PH-6)	• Replace ±300 feet of ditch with 18" HDPE, 24" CMP, or 28"x20" CMPA (total two locations)	$46,000
Taylor Mine Ditch	Taylor Mine Outlet to Shadle Reservoir (K-5)	• Replace ±100 of low berm area ditch with piped section • Replace existing 8 fence crossings with GDPUD approved 8-foot wide minimum gates and locks	$45,000
Overall	Overall	• Purchase a second excavator (Takeuchi Model TB 135 Compact Excavator)	$50,000
Overall	Overall	• Install SCADA remote transmitting units (RTU's) at four flow meter locations • Install monitoring equipment (pressure transducers or ultrasonic sensors) and SCADA RTU's at 3 reservoirs • Furnish automatic control valves or weirs at Stumpy Meadows and at Walton Lakes • Install Central Processing Unit for SCADA receiving station at GDPUD	$350,000

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TABLE VII-2 (cont.)

Ditch System	Segment (Plan Sheet #) [1]	Description	Estimated Cost [2]
Upcountry Ditch	Overall	• Replace wastegates with new reinforced concrete wastegates (2 locations)	$62,000
Pilot Hill Ditch	Overall	• Replace wastegates and flumes with new reinforced concrete structures (15 locations)	$498,000
Kelsey Ditch	Overall	• Replace wastegates with new reinforced concrete wastegates (7 locations)	$215,000
		Estimated Total, Maintenance, Access and Second Priority Measures [3]	$7,029,000

Subtotal, Upcountry Ditch	=	$1,787,000 (25% of total)
Subtotal, Main / Pilot Hill Ditch [4]	=	$3,534,000 (50% of total)
Subtotal, Kelsey Ditch [5]	=	$1,308,000 (19% of total)
Subtotal, Other Items	=	$ 400,000 (6% of total)

(1) Refer to Ditch System Map Sheets included in the Appendix of this Study
(2) Costs are based on ENRCC = 8000
(3) Total does not include annual maintenance costs
(4) Cherry Acres and Spanish dDy Diggins costs included with Main / Pilot Hill Ditch
(5) Taylor Mine Ditch costs included with Kelsey Ditch

SCADA Instrumentation and Control

Currently releases from Stumpy Meadows are manually controlled. Levels in Walton Lakes are used to judge whether releases at Stumpy Meadows should be increased or decreased. There is a lag time of several hours between adjustments made at the Stumpy Meadows discharge structure and measurable changes in the levels of Walton Lakes. Flows from the Walton Lakes Reservoir are also manually controlled. An increase or decrease in the flow released from Walton Lakes is based on observed levels in downstream reservoirs (Greenwood, Auburn Lake Trails, Wagner, Pilot Hill, Kelsey), seasonal demands and operator experience. Ideally, releases from Walton Lakes are maintained at rates which meet treatment plant and irrigation customer demands without spills (overflows) at the downstream regulating reservoirs. Again, there are several hours of lag time between the adjustments made at Auburn Lake Trails and changes in the levels of downstream regulating reservoirs.

To improve system reliability and control, automatic flow metering and recording equipment is proposed in this Reliability Study at the existing Stumpy Meadows, Tunnel Hill and Buckeye measuring flumes. Furthermore, a new flow measuring device, with automatic flow metering and recording equipment is proposed downstream of the Crails (either on the Main / Pilot Hill Ditch or on the Kelsey Ditch). It is recommended that flow data from these metering devices be transmitted, via SCADA, to a central receiving station located at GDPUD offices in Georgetown. To provide automatic control of flows released from Stumpy Meadows and from Walton Lakes it is recommended that water surface elevations at the Walton Lakes Reservoir and water surface elevations at one reservoir on the Kelsey Ditch System (e.g. Kelsey Reservoir) and one reservoir on the Main / Pilot Hill Ditch System (e.g. Auburn Lake Trails, Wagner or Pilot Hill Reservoir) also be continuously monitored. Reservoir levels would be monitored by ultrasonic units or pressure transducers with limits which would maintain reservoirs between acceptable high and acceptable low levels. The reservoir level information would also be transmitted, by SCADA, to GDPUD central offices at Georgetown. A central processing unit (CPU) located at Georgetown would then process the flow and level information received from the remote transmitters (RTU's) and convert this information to signals which are transmitted to automatic control valves (or weirs) located at Stumpy Meadows and at Walton Lakes. The control signals would automatically actuate the position of the release valves or weirs to increase or decrease the releases from Stumpy Meadows and from Walton Lakes. Flows measured at the Buckeye flume would provide feedback control for the Walton Lakes releases. Flows measured at either the Stumpy Meadows or the Tunnel Hill flumes would provide feedback control for the Stumpy Meadows releases. A sudden decrease in flows measured at Tunnel Hill could be used to alert the operators of problems (ditch failure) in the Upcountry system. The estimated cost to install automatic control valves at Stumpy Meadows and Walton Lakes together with level control monitors, level and flow remote transmitting units (7 total) and a central processing unit is estimated at $350,000.

Ditch Maintenance Equipment

Currently the District owns and operates one narrow track (compact) excavator. It is recommended that during the next few years the District purchase a second excavator. The existing excavator is in demand by all three ditch superintendents. One unit can not meet all of the existing or projected demands. The existing excavator has been extremely beneficial in improving ditch maintenance and operations. With the replacement of cross fences with access gates, additional areas of the ditch will be available for maintenance by the excavator.

A Takeuchi Model TB 135 Compact Excavator similar to the unit now owned by GDPUD currently retails at approximately $40,000. Assuming purchase of a second unit within the next 5 years, $50,000 has been included in the proposed maintenance, access and second priority measure cost estimate.

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VIII RECOMMENDED TREATED SYSTEM RELIABILITY MEASURES

In this section of the Reliability Study recommended measures to improve the reliability of the treated water system are summarized. The GDPUD distribution system is divided into two major service areas. Treated water customers are served either from the Walton Lakes Water Treatment Plant or the Auburn Lake Trails Water Treatment Plant.

The reliability measures recommended will improve the distribution systems so that they deliver maximum day demands and a minimum of 500 gallons per minute (gpm) fire flow to any one fire hydrant.

Under maximum day demands the ability of the existing Auburn Lake Trails and Walton Lake networks to maintain pressures within acceptable limits has been evaluated by the network modeling. Reliability measures recommended herein are proposed to resolve low-pressure deficiencies under these conditions. Network modeling has also been used to evaluate the capacity of each system to deliver not less than 500 gpm to each hydrant together with maximum day demands. Reliability measures identified herein are proposed to resolve the low flow or low-pressure deficiencies which occur under maximum day plus fire flow conditions. Low pressure and inadequate fire flows are indicators of system deficiencies. Correction measures address the cause, not just the deficiency indicated by the model.

The following reliability measures are not ranked in any particular order. Prioritization of reliability measures and a summary of costs are presented later in this section of the study.

AUBURN LAKE TRAILS TREATED WATER SYSTEM

ALT-1A Greenwood Road Feed from Walton Lake

This reliability measure would the remove the Greenwood Road area that is now being served by the Auburn Lake Trails (ALT) treatment plant and allow the area to be served from the Walton Lake treatment plant. The ALT treatment plant is at capacity during maximum days. This measure would remove some of the demand currently on the ALT treatment plant and shift it to the Walton Lake treatment plant which has more available capacity than the ALT treatment plant.

The measure includes the installation of 2,900 feet of 8-inch diameter pipe to replace existing 6-inch pipe between Blackridge Road and junction 688. This measure also includes the installation of a pressure reducing station just north of Blackridge Road. Approximately 1,900 feet of pipe on Blackridge Road would be replaced with a higher pressure rated pipe. The existing pump station serving the upper portion of

Blackridge could be eliminated because the pressure would be increased on Blackridge Road. The switch over to the Walton Lake system would be completed by closing a main line valve on Highway 193 south of Sliger Mine Road and opening a normally closed valve near junction 688.

ALT-1B Greenwood Road Main Replacement

This reliability measure would allow the Greenwood Road service area to remain on the ALT distribution system and increase the fire flow to the hydrants along the road. The measure would require the replacement of the existing 6-inch water line from Slinger Mine Road to Junction 688 with approximately 14,500 feet of 8-inch minimum water line. Included would be the installation of additional fire hydrants to improve the fire protection for the area.

ALT-2 Angel Camp Court Booster Pump

The fire hydrant on Angel Camp is only 36 feet lower than the high water level of the Angel Camp Tank. When the tank is full the pressure at the hydrant is only 15 psi and as the level in the tank lowers the pressure at the hydrant is reduced. To correct this problem this measure recommends installing a booster pump for the line serving Angel Camp Court. The booster pump would be of sufficient size to allow a minimum fire flow of 500 gpm during the maximum day demand.

ALT-3 Highway 193 Cross Tie-Brinks Line Replacement

The fire hydrants on Brinks Lane and Bud's Alley cannot provide 500 gpm during maximum day demands. Both of the hydrants are located on long dead-end lines. These lines were extended from the ALT subdivision south to serve lots outside of ALT. The dead-end lines can be connected with measure ALT-3. Looping the dead-ends provides two directions of supply. The measure would install approximately 4,500 feet of 8-inch main, valves and additional fire hydrants.

ALT-4 Gravity Raw Water for Golf Course

The ALT golf course is irrigated with treated domestic water. Under maximum day conditions, the golf course requires 250,000 gallons per day. At maximum day demands the ALT water treatment plant is at approximately 95% of its maximum capacity. The golf course is using treated domestic to water the course that could be used to serve approximately 250 single family dwelling units at 1,000 gallons per day.

This reliability measure would replace the treated water being used to irrigate the golf course with untreated ditch irrigation water. This measure would install 6,800 feet of 6-inch water line from a diversion point at the ditch just upstream of the Dorman Wye, then westerly along Highway 193 and then northwesterly to a pond on the golf course.

ALT-5 Indian Rock Road Main Replacement

A long dead-end 6-inch line serves the fire hydrant on White Horse Road from Indian Rock Road. The existing line is not adequate to provide 500-gpm fire flow during the maximum day demand. This reliability measure would replace approximately 1,200 feet of 6-inch main with 8-inch main water line.

ALT-6 Cherry Acre Road PRV-Cross Tie

The fire hydrant ant the end of Cherry Acre Road is located on one of the longest dead-end lines in either the Walton Lake or Auburn Lake Trails systems. Instead of replacing the water line in Indian Rock Road with a main larger enough to provide adequate flows, it would be more economical to connect the Indian Rock Road dead-end with the Cherry Acres dead-end. Both of these dead-ends are at the southern end of the Cherry Acres area. Connecting them together would provide a looped system and a second feed source for each.

The reliability measure would install 2,400 feet of 8-inch main together with a pressure reducing station, pressure relief station and related valving.

ALT-7 Capecroft Road Main Replacement

The fire hydrants on Capecroft Road are old style wharf hydrants. The main serving the area is not adequate to supply maximum day demands plus 500 gpm fire flows. The existing fire hydrants are widely spaced and would not provide adequate fire protection. The reliability measure would replace the existing 6-inch main with 8-inch diameter water main and add fire hydrants for adequate fire protection.

ALT-8A Highway 49-Pilot Hill Loop

The Pilot Hill service area is located in the southwest corner of the ALT service area. Pilot Hill is served by a main that dead-ends in Pilot Hill. It is not practical at this time to loop the line that provides water to Pilot Hill but it would be practical to loop the main service in Pilot Hill. Reliability measure 8A provides a loop to the service main in Pilot Hill. A single main would still serve the new looped service mains from the north along Highway 49 to the intersection of Highway 49 and Meadow View Road.

The measure would install approximately 7,500 feet, valves and fire hydrants south along Highway 49 from the Rattlesnake Bar Road intersection to then cross-country to Meadow Croft Lane. This reliability measure would encounter fewer existing buried utilities than the proposed measure ALT-8B.

ALT-8B Salmon Falls Road Main Replacement

This reliability measure would provide the same level of service as ALT-8A except that the distribution system within Pilot Hill would not be a looped system. The measure would replace the existing distribution main with approximately 7,200 feet of 8-inch diameter main, valves and additional fire hydrants. This measure would be a more difficult to install than ALT-8A because water services would have to be maintained as construction proceeded.

ALT-9 Second Deer Ravine

The existing Deer Ravine Tank is 250,000-gallon capacity. The tank was probably of adequate size to serve the western ALT system when it was installed. Because the ALT system has been extended west to Cool, southerly to the Cherry Hills, Indian Rock and Meadow View areas and southerly to the Pilot Hill area the tank is no longer of adequate size to serve the maximum day demand and have any reserve for fire flows or emergency storage. During a maximum day in 2001, approximately 595,000 gallons was served through the tank.

Reliability measure ALT-9 proposed to install a second tank at Deer Ravine. The tank would be a minimum of 600,000 gallons to provide for maximum day demand, fire and emergency storage.

ALT-10 Cherry Hills Tank

This reliability measure would provide water storage for the Cherry Acres, Indian Rock and Meadow View areas that not rely on the storage at Deer Ravine. The measure would install a 400,000-gallon capacity tank in the Cherry Hills area.

Reliability Measures Estimated Costs and Priorities

Reliability measure costs are estimated and summarized. This cost summary is shown on **Table VIII-1.** Cost estimates were first prepared based on current costs. Reliability measures were separated into four priorities. Each priority period represents approximately a five-year period. Current costs were inflated for future costs using the Engineering News Record – Construction Cost Index (ENR-CCI). The Engineering News Record established the Construction Cost Index in 1913 to track labor and material costs in 20 large cities. The index is updated every three months and historical data is available.

The reliability measures were prioritized based on what measure would result in the best improvement to the distribution system. Issues considered in establishing priorities included:

GDPUD WATER SYTEM RELIABILITY MEASURES

AUBURN LAKE TRAILS SERVICE AREA

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"We take engineering personally"

SUMMARY OF COSTS

6-Nov-02

	3% PER YEAR INCREASE, ENR-CCI	6,481	6,800	7,880	9,140	10,600
Measure #	Description	Amount	Priority			
			1	2	3	4
ALT-1A	GREENWOOD RD FEED FROM WL	$ 308,000	$ 324,000			
ALT-1B	GREENWOOD RD MAIN REPLACEMENT	$ 833,000				$ 1,363,000
ALT-2	ANGEL CAMP CT. BOOSTER PUMP	$ 102,000			$ 144,000	
ALT-3	HIGHWAY 193 CROSS TIE-BRINKS LN REPLACE	$ 267,000			$ 377,000	
ALT-4A	GRAVITY RAW WATER FOR GOLF COURSE	$ 413,000	$ 434,000			
ALT-4B	DIGGER TREE CT TO WESTVIEW TRL TIE	$ 40,000		$ 49,000		
ALT-5	INDIAN ROCK ROAD MAIN REPLACEMENT	$ 66,000			$ 94,000	
ALT-6	CHERRY ACRE ROAD PRV-CROSS TIE	$ 160,000		$ 195,000		
ALT-7	CATECROFT ROAD MAIN REPLACEMENT	$ 209,000			$ 295,000	
ALT-8A	HWY 49-PILOT HILL LOOP	$ 387,000				$ 633,000
ALT-8B	SALMON FALLS ROAD MAIN REPLACEMENT	$ 514,000			$ 725,000	
ALT-9	SECOND DEER RAVINE TANK, 0.6 MG	$ 1,965,000	$ 2,062,000			
ALT-10	CHERRY HILLS TANK, 0.4 MG	$ 787,000			$ 1,110,000	
	TOTAL, CURRENT COSTS	**$ 6,051,000**				
	PROJECTED FUTURE COSTS		**$ 2,820,000**	**$ 244,000**	**$ 2,745,000**	**$ 1,996,000**

1. Looping of dead-ends, where possible.
2. Additional storage, for peak day, fire flows and emergencies
3. Conservation of treated water.

The current cost estimates shown on Table VIII-1 were based on an ENR-CCI value of 6,481. To estimate future cost were increased by three percent per year to the midpoint of each five-year priority period. The future ENR-CCI index was then used to estimate reliability measure future costs.

The Auburn Lake Trails reliability measures recommended herein are graphically represented on system maps included in the back pockets of this study. The map for the Auburn Lake Trails system is titled Figure 1, Auburn Lake Trails - Reliability Improvements.

WALTON LAKES TREATED WATER SYSTEM

WL-1 Citabria Lane

The fire hydrant at the North end or Citabria Lane will not flow 500 gpm during a maximum day because a long single line feeds it from Wentworth Spring Road, along Tiger Lane and Veterans Way to Citabria Lane. This WL-1 reliability measure will loop the line by installing approximately 1,200 feet of 8-inch water line from Wentworth Springs Road along Citabria Lane with connection to the existing main feeding the hydrant.

WL-2 Fain Lane Extension

This reliability measure would create multiple loops for the water distribution system serving the Georgetown Townsite, provide a second by-pass around the Georgetown Townsite and correct the flow to a hydrant located south of Harkness Street. The reliability measure would install approximately 1,600 feet of 8-inch main from Fain Lane westerly to Harkness Street and 3,300 feet of 12 inch main extending from the existing 12 inch pipe on Fain Lane southerly then westerly to Highway 193 to connect with the existing main just north of Cedar Drive.

WL-3 Buffalo Hill Road Line Replacement

The fire hydrant at the end of the Buffalo Hill Court water line will not flow 500 gpm during maximum day. 6-inch and 4-inch mains serve the fire hydrant. The WL-3 reliability measure would replace the line along Buffalo Hill Road and Buffalo Hill Court with new 8-inch main approximately 1,500 feet in length. Additional fire hydrants are proposed to improve the fire service in the area.

WL-4A & 4B Quiet Place

The fire hydrant near the intersection of Quiet Place and Lasita Way will not flow 500 gpm during maximum day demands. Reliability measure 4B would remove the check valve in Reservoir Road near Holloway Drive that prevents water in the Reservoir Tank from flowing easterly on Reservoir Road. Reliability measure 4A would install approximately 900 feet for 8-inch main from the intersection of Quiet Place and Lasita Way north along Quiet Place and connect to the existing 10-inch main in Reservoir Road creating a loop.

WL-5 Holloway Drive Line Replacement

The two hydrants on Holloway Drive do not flow 500 gpm during maximum day demands because the hydrants are served with a 4-inch main that is not large enough to supply the needed flow. The WL-5 reliability measure includes the replacement of the 4-inch main on Holloway Drive with 8-inch main to the last hydrant; a distance of approximately 1,000 feet. To ensure the flow the recommendations discussed in WL-7 would also need to be completed.

WL-6 Longview Lane Line Replacement

The hydrants along Longview Lane, which is served from Reservoir Road, will not provide 500 gpm during maximum day. Because it is not economical or practical to loop the main on Longview Lane the main would need to be increased in size to provide 500 gpm during maximum day demand. This reliability measure would include the installation of approximately 4,000 feet of 8-inch minimum. GDPUD should consider installation of a 10-inch main if Longview Lane is to be extended.

WL-7 Reservoir Road, Spanish Dry Diggings, Hwy 193 Line Replacement

Measure WL-7 is one of the more extensive and expensive reliability measures recommended for Walton Lakes. This measure would improve service and fire flows from the four-way stop at Main Street and Highway 193, westerly along Highway 193 to Spanish Dry Diggins Road and Reservoir Road. The reliability measure would include:

1. Enlarging the existing 6-inch pipe to 10-inch along Reservoir Road between Longview Lane and Spanish Dry Diggins Road.
2. Enlarging the existing 8-inch main along Spanish Dry Diggins to 10-inch between Reservoir Road and Highway 193.
3. Enlarging the existing 8-inch main to 10-inch along highway 193 between Spanish Dry Diggins Road and Main Street.
4. Looping along Highway 193 between South Street and Main Street with and 8-inch water line.

This measure would include the installation of approximately 10,500 feet of 10-inch pipe and 850 feet of 8-inch pipe with additional valves and fire hydrants.

WL-8 Silent Meadow Lane Line Replacement

The existing line installed in Silent Meadow Lane is 4-inches in diameter and is not adequate to deliver 500 gpm plus maximum day demand. The WL-8 measure would replace the existing 4-inch pipe with 8-inch pipe to correct the flow deficiency. The measure includes the installation of approximately 2,200 feet of new 8-inch main together with additional valves and fire hydrants.

WL-9 Sanromo Road Line Replacement

Because of the long dead-end on Sliger Mine Road in the northwest corner of the system, the distribution system cannot deliver 500 gpm fire flow to the end of Sanromo Road. The WL-9 reliability measure would replace approximately 8,200 feet of existing 6-inch pipe with 8-inch pipe and provide valves and additional fire hydrants. Looping the system to improve flows is not a practical option for this alternative.

WL-10 Black Oak Mine Road Proposed Reliability Measure

The fire hydrant near the Black Oak Mine Road tank cannot deliver 500 gpm at 20 psi primarily because the hydrant is only 35 feet lower than the high water level of the tank. The highest pressure at the fire hydrant is only 15 psi when the tank is full and then drops as the tank water elevation lowers. This reliability measure would install a new 8-inch line approximately 200 feet directly from the tank outlet main to the hydrant and construct a fire booster pump station that would supply a minimum of 500 gpm to the hydrant when flow is sensed at the hydrant lateral.

WL-11 Greenwood Road Main Replacement

To improve the flow along Greenwood Road sufficiently to allow the fire hydrant at the intersection of Greenwood Road and Conifer Lane to flow at 500 gpm during maximum day would require the upgrading of the existing pipe along Greenwood Road from Marshall Road to Esperanza Lane. A 10-inch diameter main is recommended. The measure would install approximately 2,600 feet of 10-inch main, valves and additional hydrants.

WL-12 Traverse Creek Road Line Replacement

Fire hydrants in the middle of the Traverse Creek Road loop are not capable of providing 500 gpm during maximum day. While the line is looped the length of 6-inch main causes too much resistance to flow during maximum day demands. To correct this deficiency it would be necessary to replace a portion the existing water line serving

Traverse Creek Road. The reliability measure would replace approximately 6,300 feet of 6-inch main with new 8-inch main together with valves and additional fire hydrants.

The WL-12 reliability measure is required to implement measure WL-24, which would install a booster pump on this line.

WL-13A Bayne Road Line Extension

The suggested Bayne Road proposed reliability measures provides the greatest single system benefit of any measures recommended for the Walton Lake distribution system. The Bayne Road reliability measure would tie together two extremely long dead-end distribution lines of the Walton Lake system and provide a loop for the southern end of the distribution system. The reliability measure would improve the fire flow capabilities of some 21 hydrants. The reliability measure would construct an 8-inch main from Highway 193 along Bayne Road to the intersection of Stewart Mine Road. The reliability measure would provide stub outs for a future tank(s) located just off Bayne Road (see WL-13B). The reliability measure would install approximately 5,500 feet of 8-inch main together with valves, fire hydrants, pressure reducing station and pressure relief station. The reliability measure should also acquire the tank sites for the future tanks.

WL-13B Bayne Road Tank

This reliability measure would further strengthen the southern end of the Walton Lake distribution system by installing a tank(s) near the intersection of Bayne Road and Highway 193. The south end of the Walton Lake distribution system does not have local storage for backup in the event of a line break along Highway 193. The installation of a tank(s) would make the southern end of the distribution system less vulnerable to upstream line breaks. It would also provide much needed storage in the southern end of the system. The reliability measure would install one 500,000-gallon tank with provisions for a second tank sometime in the future. Pipe and valves would be included to connect to the Bayne Road reliability measure, WL-13A.

WL-14 Lazy Brook Trail Proposed Reliability Measures

The fire hydrant at the end of Lazy Brook Trail cannot deliver 500 gpm during maximum day demand. To correct this problem it is recommended that the existing water line along Lazy Brook Trail be replaced from Lynx Ridge Road to the end of the existing water main. The reliability measure would install approximately 2,200 feet of 8-inch main, valves and additional fire hydrants to improve fire protection for the area.

WL-15 Whitney Court Proposed Reliability Measures

The Whitney Court reliability measures include the replacement of a normally closed valve on Green Valley Road just north of Whitney Court with a pressure reducing station. This valve is normally closed and prevents water from being delivered south on Green Valley Road from Marshal Road. The water that is delivered to the Whitney Court area is delivered from the south end of Green Valley Road from Highway 193. The installation of a pressure reducing valve would allow for a looped delivery to the Whitney Court area. In addition the existing 4-inch water line cannot deliver the 500-gpm fire flow. This line would be replaced with approximately 1,100 feet of 8-inch main.

The installation of the pressure reducing station will greatly improve the water service to the Garden Park Drive area.

WL-16 Oak Lane Proposed Reliability Measures

The existing 4-inch water line serving Oak Lane is too small to deliver the needed 500 gpm fire flows during maximum day demands. The solution would be to replace the existing water line with approximately 2,600 feet of 8-inch water main.

WL-17 Shasta Road Line Replacement

The water line installed on Shasta Road is a 4-inch line and is too small to deliver the maximum daily flow and 500 gpm fire flow. The reliability measure would replace the existing line with approximately 1,700 feet of 8-inch main, valves and additional hydrants for fire protection. Also recommended as part of this reliability measure is the completion of measure WL-13 and the pressure reducing station recommended in WL-15.

WL-18 Tamalpais Road Line Replacement

The existing 4-inch line serving Tamalpais Road is too small to deliver the needed maximum day demand and the 500 gpm fire flow. The reliability measure would replace the existing line with approximately 1,700 feet of 8-inch main and install new fire hydrants. Reliability measure WL-13 or WL-20 and the pressure reducing station of WL-15 should be completed in advance of or at the same time as this measure.

WL-19 Pikes Peak Circle Line Replacement

The mains in Pikes Peak Circle do not have adequate capacity to provide fire flows. The measure would replace approximately 1,000 feet of 4-inch main from the intersection of Pikes Peak Circle and Garden Valley Road south toward Bayne Road with an 8-inch diameter main. To complete the water supply WL-19 measure the

proposed measure WL-13 would also need to be installed. The pressure reducing station portion of WL-15 would need to be installed for WL-19 to be effective.

WL-20 Garden Park Line Replacement

There are six fire hydrants in the Garden Park area that cannot deliver the 500 gpm fire flow during maximum day. The water supply to this area of the distribution system could be greatly improved by providing a second source of water from the Garden Park tank. The reliability measure would include installing a new 8-inch main from the Garden Park tank and tying into the distribution system on Hancock Road. This would provide a two-source supply from the Garden Park tank. The measure would install approximately 1,700 feet of 8-inch main together with valves and additional fire hydrants. The pressure reduction station portion of WL-15 would also need to be completed to improve this water supply measure.

WL-21 Hancock Road – Garden Park Tank Tie

This measure is similar to WL-20 but would deliver water from the Garden Park tank to the Johntown Creek Road area via a tie at the westerly end of Hancock Road. The Johntown Creek Road area is served by a single source from Marshall Road. The area is vulnerable to outages caused by a line break as far upstream as the intersection of Marshall Road and Garden Valley Road. This measure would include the installation of approximately 1,700 feet of 8-inch main from the Garden Park tank easterly to Bee Hive Court and along Bee Hive Court to the intersection of Hancock Road. Additional hydrants would also be installed.

WL-22 Garden Park Tank Addition

This measure includes installation of an additional 250,000-gallon tank next to the existing Garden Park Tank. This reliability measure would bolster the fire flow storage and emergency storage for the area. If the WL-21 reliability measure is completed additional storage would also be needed for the Johntown Creek Road service area. Minor piping and valving would be needed for this reliability measure. A fire hydrant would be installed near the tank to provide a drafting point for fire truck pumpers.

WL-23 Hotchkiss Hill Subdivision Tank Addition

The Hotchkiss Hill Subdivision tank is not adequate to provide fire flow and emergency storage. The tank should be replaced with a minimum tank of 250,000-gallons to provide the storage needed. The tank would probably need to occupy the existing site because the area is limited in size and available tank sites.

WL-24 Traverse Creek Road Booster Pump

For the most southerly fire hydrant on Traverse Creek Road to deliver 500 gpm during maximum day demand a fire flow booster pump needs to be installed. In addition, the WL-12 reliability measure (Traverse Creek Road Line Replacement) needs to be completed to provide adequate supply water for the booster pump.

WL-25 Chrysler Circle and Roller Coaster Replacements

The Chrysler Circle and Roller Coaster Road distribution system consists of 4-inch diameter water mains. These mains are not large enough to deliver maximum day demands and 500 gpm fire flows. The reliability measure would replace these distribution mains with approximately 9,100 feet of 8-inch mains, valves and add several fire hydrants. To be effective this reliability measure would need to be made after the WL-21 reliability measure.

Reliability Measures Estimated Costs and Priorities

Walton Lakes reliability measure costs are estimated and summarized. This cost summary is shown on **Table VIII-2.** Cost estimates were first prepared based on current costs. Reliability measures were separated into four priorities. Each priority period represents approximately a five-year period. Current costs were inflated for future costs using the Engineering News Record – Construction Cost Index (ENR-CCI). The Engineering News Record established the Construction Cost Index in 1913 to track labor and material costs in 20 large cities. The index is updated every three months and historical data is available.

The reliability measures were prioritized based on what measure would result in the best improvement to the distribution system. Issues considered in establishing priorities included:

1. Looping of dead-ends, where possible.
2. Additional storage, for peak day, fire flows and emergencies
3. Conservation of treated water.

The current cost estimates shown on Table VIII-2 were based on an ENR-CCI value of 6,481. To estimate future costs, current costs were increased by three percent per year to the midpoint of each five-year priority period. The future ENR-CCI index was then used to estimate reliability measure future costs.

The Walton Lake reliability measures recommended herein are graphically represented on system maps included in the back pockets of this study. The map for the Walton Lakes system is entitled Figure 2, Walton Lakes - Reliability Improvements 1 of 2 and Figure 3, Walton Lakes – Reliability Improvements 2 of 2.

GDPUD WATER SYSTEM RELIABILITY MEASURES

WALTON LAKES SERVICE AREA

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"We take engineering personally"

SUMMARY OF COSTS 6-Nov-02

	3% PER YEAR INCREASE, ENR-CCI	6,481	6,800	7,880	9,140	10,600
Measure #	**Description**	**Amount**	**Priority**			
			1	**2**	**3**	**4**
WL-1	CITABRIA LN LOOP TIE	$ 92,000		$ 112,000		
WL-2	FAIN LANE EXTENSION	$ 364,000	$ 382,000			
WL-3	BUFFALO HILL RD LINE REPLACEMENT	$ 96,000			$ 136,000	
WL-4 A	QUIET PLACE LOOP TIE	$ 59,000				$ 97,000
WL-4 B	QUIET PLACE REMOVE CHECK VALVE	$ 5,000	$ 6,000			
WL-5	HOLLOWAY DR LINE REPLACEMENT	$ 74,000			$ 105,000	
WL-6	LONGVIEW LANE LINE REPLACEMENT	$ 270,000			$ 381,000	
WL-7	RESERVOIR RD, SDD, HWY 193 REPLACEMENTS	$ 917,000		$ 1,115,000		
WL-8	SILENT MEADOW LN LINE REPLACEMENT	$ 127,000			$ 180,000	
WL-9	SANROMO ROAD LINE REPLACEMENT	$ 531,000				$ 869,000
WL-10	BLACK OAK MINE RD PROPOSED IMPROVEMENT	$ 59,000				$ 97,000
WL-11	GREENWOOD ROAD MAIN REPLACEMENT	$ 208,000		$ 253,000		
WL-12	TRAVERSE CREEK RD. LINE REPLACEMENT	$ 454,000				$ 743,000
WL-13A	BAYNE ROAD LINE EXTENSION	$ 405,000	$ 425,000			
WL-13B	BAYNE ROAD TANK	$ 1,350,000		$ 1,642,000		
WL-14	LAZY BROOK TRAIL LINE REPLACEMENT	$ 128,000				$ 210,000
WL-15	WHITNEY CT. PRESSURE REDUCING STATION	$ 108,000	$ 114,000			
WL-16	OAK LANE LINE REPLACEMENT	$ 151,000			$ 213,000	
WL-17	SHASTA RD. LINE REPLACEMENT	$ 109,000				$ 179,000
WL-18	TALMALPAIS RD. LINE REPLACEMENT	$ 110,000			$ 156,000	
WL-19	PIKES PEAK CIR. LINE REPLACEMENT	$ 64,000			$ 91,000	
WL-20	GARDEN PARK LINE REPLACEMENT	$ 97,000	$ 102,000			
WL-21	HANCOCK ROAD TANK TIE	$ 113,000	$ 119,000			
WL-22	GARDEN PARK TANK PROPOSED IMPROVEMENTS	$ 836,000		$ 1,017,000		
WL-23	HOTCHKISS HILL SUB TANK ADDITION	$ 444,000			$ 627,000	
WL-24	TRAVERSE CREEK RD. BOOSTER PUMPS	$ 62,000			$ 88,000	
WL-25	CHRYSLER CIR & ROLLER COASTER REPLACEMENT	$ 570,000				$ 933,000
	TOTAL, CURRENT COSTS	**$ 7,803,000**				
	PROJECTED FUTURE COSTS		**$ 1,148,000**	**$ 4,139,000**	**$ 1,977,000**	**$ 3,128,000**

Table VIII-2

Summary

LEGEND

- FAILED FIRE HYDRANT AT 500GPM (TOTAL OF 68 FIG 3 & 4)
- DISTRIBUTION PIPING
- CUSTOMER
- NEW MAIN
- REMOVE AND REPLACE MAIN

SCALE: 1"=1000'

WL-25: CHRYSLER CIRCLE PROPOSED IMPROVEMENT

TO ALLOW THESE 5 HYDRANTS TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. CONSTRUCT WL-21 IMPROVEMENT.
2. ENLARGE CHRYSLER CIR FROM 4" TO 8".
3. ENLARGE ROLLER COASTER RD. FROM 4" TO 8".

OTHER SUGGESTED IMPROVEMENTS
1. LOOP FROM BAYNE RD OR GARDEN PARK RD TO ROLLER COASTER RD.
2. REPLACE CLOSED VALVE W/PRV-1 (ALT. WL-15)

WL-14: LAZY BROOK TRL PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. ENLARGE (E) 4" TO 8". SEE HIGHLIGHTED MAINS.

OTHER SUGGESTED IMPROVEMENTS INCLUDE:
1. ENLARGE (E) 6" TO 8" ALONG LAZY BROOK TRL BETWEEN LYNX RIDGE RD. TO JOHNTOWN CREEK RD.
2. REPLACE CLOSED VALVE W/PRV-1

WL-21: HANCOCK RD. PROPOSED IMPROVEMENT

TO ALLOW THESE 7 HYDRANTS TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. CONNECT GARDEN PARK TANK TO HANCOCK RD.

OTHER SUGGESTED IMPROVEMENTS
1. ENLARGE MAIN DOWN ENTIRE JOHNTOWN CREEK RD FROM 6" TO 8"
2. ENLARGE MAIN ALONG MARSHALL RD. TO 10" DIAMETER
3. REPLACE CLOSED VALVE W/PRV-1 (ALT. WL-15)

WL-18: TAMALPAIS RD. PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. ENLARGE (E) 4" TO 8" ALONG TAMALPAIS RD. SEE HIGHLIGHTED MAINS.
2. EITHER IMPROVEMENT WL-13 OR WL-20.

OTHER SUGGESTED IMPROVEMENTS INCLUDE:
1. REPLACE CLOSED VALVE W/PRV-1

WL-22: GARDEN PARK TANK PROPOSED IMPROVEMENT

ADD AN ADDITIONAL 250,000 GALLON CAPACITY TANK AT THE GARDEN PARK

TO ALT SYSTEM

WL-16: OAK LANE PROPOSED IMPROVEMENT

TO ALLOW THESE 2 HYDRANTS TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. ENLARGE (E) 4" TO 8". SEE HIGHLIGHTED MAINS.

WL-13: BAYNE RD. PROPOSED IMPROVEMENT

TO ALLOW THESE 21 HYDRANTS TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. LOOP AN 8" MAIN ALONG BAYNE RD. AND INSTALL A PRV NEAR HW 193 AND BAYNE RD (SET TO APPROXIMATELY 40 PSI) SEE HIGHLIGHTED MAIN.

OTHER SUGGESTED IMPROVEMENTS INCLUDE:
1. ENLARGING ALONG STATE HWY 193 FROM A 6" TO AN 8" BETWEEN BAYNE RD. AND GARDEN VALLEY RD.
2. ENLARGE THE MAIN BETWEEN GARDEN PARK AND BAYNE RD. TO 8".
3. REPLACE CLOSED VALVE W/PRV-1
4. INSTALL TANK
   a. PROVIDES HYDRAULIC BREAK FOR LOWER PRESSURE ZONE.
   b. BENEFITS AS ADDITIONAL STORAGE CAPACITY FOR LONG DURATION FIRES AND AROUND BAYNE RD/STEWART MINE AREA AS WELL AS SOUTHERN AREA OF GARDEN PARK

PRV-1

FH-156

WL-11: GREENWOOD RD. PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. ENLARGE (E) 6" MAIN ALONG GREENWOOD RD. BETWEEN ESPERANZA LN AND MARSHALL RD. FROM 6" TO 10". SEE HIGHLIGHTED MAIN.

OTHER SUGGESTED IMPROVMENTS INCLUDE:
1. ENLARGING GREENWOOD RD. MAIN TO 10" FOR POTENTIAL GREENWOOD WATER TREATMENT PLANT OPTION.

WL-15: WHITNEY CT. PROPOSED IMPROVEMENT

TO ALLOW THESE TWO HYDRANTS TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. ENLARGE (E) 4" TO 8". SEE HIGHLIGHTED MAINS.
2. REPLACE CLOSED VALVE W/ PRV-1 AND SET TO 110 PSI.

OTHER SUGGESTED IMPROVEMENTS INCLUDE:
1. ENLARGING GARDEN VALLEY MAIN FROM 6" TO 8".

WL-10: BLACK OAK MINE RD. PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
A. HYDRANT PROBLEM DUE TO ELEVATION (ONLY 35FT BELOW HIGH WATER LEVEL IN BLACK OAK MINE TANK). IMPROVEMENT WOULD REQUIRE A BOOSTER PUMP.

WL-19: PIKES PEAK CIRC PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. ENLARGE (E) 4" TO 8" ALONG GARDEN PARK DR. SOUTH OF PIKES PEAK CIR. SEE HIGHLIGHTED MAINS.
2. COMPLETE WL-13 IMPROVEMENT

OTHER SUGGESTED IMPROVEMENTS INCLUDE:
1. ENLARGING PIKES PEAK CIR. WITH AN 8" MAIN.
2. ENLARGING (E) 6" MAIN BETWEEN GARDEN PARK RD. AND BAYNE RD. WITH AN 8" MAIN.
3. ENLARGE (E) 6" MAIN ALONG BAYNE RD TO 8".
4. ENLARGING GARDEN PARK MAIN FROM 6" TO 8".
5. REPLACE CLOSED VALVE W/PRV-1.

WL-20: GARDEN PARK PROPOSED IMPROVEMENT

TO ALLOW THESE 6 HYDRANTS TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. LOOP GARDEN PARK TANK TO MC KINNEY CT. SEE HIGHLIGHTED MAIN.

OTHER SUGGESTED IMPROVEMENTS INCLUDE:
1. ENLARGE GARDEN PARK MAIN FROM 6" TO 8".
2. REPLACE CLOSED VALVE W/PRV-1

WL-17: SHASTA RD. PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. ENLARGE (E) 4" TO 8" ALONG SHASTA RD. SEE HIGHLIGHTED MAINS.
2. EITHER IMPROVEMENT WL-13 OR WL-20

OTHER SUGGESTED IMPROVMENTS INCLUDE:
1. REPLACE CLOSED VALVE W/PRV-1
2. REPLACE GARDEN PARK 6" W/AN 8".

MATCHLINE SEE FIGURE 2

WL-24: TRAVERSE CREEK RD. 2 PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:
1. INSTALL A BOOSTER PUMP

WL-12: TRAVERSE CREEK RD. PROPOSED IMPROVEMENT

TO ALLOW THESE HYDRANTS TO FLOW 500 GPM DURING A MAX DAY DO ONE OF THE FOLLOWING:
A. ENLARGE (E) 6" MAIN ALONG TRAVERSE CREEK RD. BETWEEN HWY 193 AND SPANISH FLAT RD. FROM 6" TO 8". SEE HIGHLIGHTED MAIN.

B. INSTALL WL-24 IMPROVMENT

GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

WALTON LAKE WATER SYSTEM
PROPOSED NETWORK RELIABILITY IMPROVEMENTS FOR MAX DAY PLUS FIRE

FIGURE 3

CONSULTING KASL ENGINEERS
7777 Greenback Lane
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Tel. (916) 722-1800
Fax (916) 722-4595
CIVIL - WATER RESOURCES - SURVEYING

WL-9: SANROMO RD PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:

1. ENLARGE (E) 6" TO 8" DOWNSTREAM OF EDGEWATER DRIVE (SEE HIGHLIGHTED LINE).

WL-7: RESERVOIR RD PROPOSED IMPROVEMENT

TO ALLOW THESE TWO FIRE HYDRANTS TO FLOW 500 GPM ON A MAX DAY DO THE FOLLOWING:

1. ENLARGE (E) 6" PIPE TO 10" ALONG RESERVOIR RD. BETWEEN LONGVIEW LN. AND SPANISH DRY DIGGINS. SEE HIGHLIGHTED LINE
2. ENLARGE (E) 8" MAIN ALONG SPANISH DRY DIGGINS, TO 10" BETWEEN RESERVOIR RD AND HWY 193. SEE HIGHLIGHTED LINE.
3. ENLARGE (E)8" MAIN TO A 10" MAIN ALONG STATE HWY 193 BETWEEN MAIN ST. AND SPANISH DRY DIGGINS RD. SEE HIGHLIGHTED LINE.
4. LOOP ALONG STATE HWY 193 BETWEEN SOUTH ST. AND MAIN ST. W/AN 8" LINE. SEE HIGHLIGHTED LINE

WL-3: BUFFALO HILL RD PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:

1. ENLARGE (E) 6&4 INCH TO 8". SEE HIGHLIGHTED MAIN.

WL-1: CITABRIA LANE PROPOSED IMPROVEMENT

TO ALLOW THIS FIRE HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:

1. LOOP 8" PIPE ALONG CITABRIA LANE TO BETWEEN VETERANS AND WENTWORTH SPRINGS RD. SEE HIGHLIGHTED MAIN.

WL-8: SILENT MEADOW LN. PROPOSED IMPROVEMENT

TO ALLOW THIS FIRE HYDRANT TO FLOW 500 GPM ON A MAX DAY DO THE FOLLOWING:

1. ENLARGE (E) 4" TO 8". SEE HIGHLIGHTED MAINS.

WL-6: LONGVIEW LN PROPOSED IMPROVEMENT

TO ALLOW THESE THREE FIRE HYDRANTS TO FLOW 500 GPM ON A MAX DAY DO THE FOLLOWING:

1. ENLARGE (E) 4" TO 8". SEE HIGHLIGHTED MAINS.

WL-23: HOTCHKISS HILL SUB TANK PROPOSED IMPROVEMENT

EXISTING TANK IS 60,000 GAL. MINIMUM REQUIRED SIZE PER STDS. IS 125,000 GAL.

WL-2: FAIN LANE PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO ONE OF THE FOLLOWING:

1. CONNECT 12" LINE FROM FAIN LN TO HWY 193. THIS ALSO PROVIDES A REDUNDANCY LOOP AROUND GEORGETOWN.
2. LOOP 8" PIPE ALONG PARCELS. SEE HIGHLIGHTED MAIN.

WL-5: HOLLOWAY DR. PROPOSED IMPROVEMENT

TO ALLOW THESE TWO HYDRANTS TO FLOW 500GPM DURING A MAX DAY DO THE FOLLOWING:

1. ENLARGE (E) 4" TO 8". SEE HIGHLIGHTED MAINS.
2. DO WL-7 IMPROVEMENTS ITEMS 1-3

WL-4: QUIET PLACE PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO ONE OF THE FOLLOWING:

A. REMOVE IN LINE CHECK VALVE NEAR RESERVOIR RD AND HOLLOWAY DRIVE.
B. LOOP 8" MAIN BACK TO RESERVOIR RD. SEE HIGHLIGHTED MAIN

TO ALT SYSTEM

CV

PRV-1

MATCHLINE SEE FIGURE 2

LEGEND

- FAILED FIRE HYDRANT AT 500GPM (TOTAL OF 68 FIG 3 & 4)
- DISTRIBUTION PIPING
- CUSTOMER
- NEW MAIN
- REMOVE AND REPLACE MAIN

N

SCALE: 1"=1000'

GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

WALTON LAKE WATER SYSTEM
PROPOSED NETWORK RELIABILITY IMPROVEMENTS FOR MAX DAY PLUS FIRE

FIGURE 2

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~N~

SCALE: 1"=1000'

LEGEND

- ● - FAILED FIRE HYDRANT AT 500GPM (TOTAL OF 68 FIG 3 & 4)
- — - DISTRIBUTION PIPING
- ▒ - CUSTOMER
- ▬ - NEW MAIN
- ▬ - REMOVE AND REPLACE MAIN
- — - IRRIGATION WATER MAIN

NOTES:

1. FH-273 AND FH-132 WERE TWO ADDITIONAL FIRE HYDRANTS THAT FAILED BECAUSE MAX DAY DEMAND INCREASED FROM 2.1MGD 2000 TO 2.24MGD IN 2001.

ALT-9: DEER RAVINE TANK PROPOSED IMPROVEMENT

(E) TANK IS 250,000 GALLONS AND SERVES APPROXIMATELY 595,000 GALLONS DURING THE 2001 MAX DAY CONDITION.

A. ENLARGE EXISITING TANK

B. INSTALL A NEW TANK TO SERVE CHERRY ACRES AREA.

FH-273
SEE NOTE 1

6" IRRG

6" IRRG

(E) DITCH

(E) DITCH

8" OR 10"

PRV-1

PRV-2

PRV-3

PRV-4

FH-132
SEE NOTE 1

8"

8"

8"

8"

8"

ALT-2: ANGEL CAMP CT. PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:

1. HYDRANT PROBLEM DUE TO ELEVATION (ONLY 36FT BELOW HIGH WATER LEVEL IN ANGEL CAMP TANK). IMPROVEMENT WOULD REQUIRE A BOOSTER PUMP.

ALT-3: HWY 193 PROPOSED IMPROVEMENT

TO ALLOW THESE TWO HYDRANTS TO FLOW 500 GPM DURNING A MAX DAY, DO THE FOLLOWING:

1. LOOP 8" PIPE ALONG STATE HWY 193 BETWEEN FH-631 AND FH-643. ENLARGE BRINKS LN. FROM 4" TO 8" DIAMETER. SEE HIGHLIGHTED MAINS. MAY CONSIDER INSTALLING A 10" OR 12" LINE IN HWY 193 FOR FUTURE MAIN ALONG HWY 193 BETWEEN CHERRY ACRES AND SWEETWATER.

ALT-4: GOLF COURSE SUPPLY PROPOSED IMPROVEMENT

CHANGE SOURCE OF GOLF COURSE DEMAND.

A. REMOVE GOLF COURSE FROM TREATED WATER LINE BY SUPPLYING WITH RAW WATER FROM GDPUD DITCH SYSTEM.

B. CONSTRUCT 8" LOOP LINE FROM THE END OF DIGGER TREE COURT TO WESTVILLE TRAIL.

IMPROVEMENTS WILL ALLOW FH-273 TO FLOW 500 GPM DURING A MAX DAY.

ALT-10: CHERRY ACRES TANK PROPOSED IMPROVEMENT

A. INSTALL A MINIMUM 250,000 GALLON TANK IN ONE OF THE FOLLOWING LOCATIONS.
1. HUMMINGBIRD LANE-REQUIRES 3 PRV'S (PRV-2, PRV-3, PRV-4)
2. CHERRY ACRES RD.-REQUIRES 1 PRV (PRV-1)

THIS ALTERNATIVE PROVIDES SOME ADDITIONAL RELIEF TO THE DEER RAVINE TANK BUT REDUCES TURN-OVER IN THE PILOT HILL TANK.

ALT-5: INDIAN ROCK RD. PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:

1. ENLARGE (E) LATERAL FROM 6" TO 8" OFF OF INDIAN ROCK RD. SEE HIGHLIGHTED MAIN.

ALT-6: CHERRY ACRE RD. PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO ONE OF THE FOLLOWING:

1. LOOP 8" PIPE BETWEEN EXISTING PARCELS TO LOOP CHERRY ACRES RD. WITH INDIAN ROCK RD. THIS LOOP WILL REQUIRE A NEW PRV TO SEPARATE EXT2A AND MEADOWVIEW PRESSURE ZONES. SEE HIGHLIGHTED MAINS.

ALT-7: CATECROFT RD. PROPOSED IMPROVEMENT

TO ALLOW THESE HYDRANTS TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:

1. ENLARGE (E) 6" LINE DOWN CATECROFT RD. TO AN 8" LINE. SEE HIGHLIGHTED MAIN.

ALT-8: SALMON FALLS RD. PROPOSED IMPROVEMENT

TO ALLOW THIS HYDRANT TO FLOW 500 GPM DURING A MAX DAY DO THE FOLLOWING:

A. LOOP AN 8" DIA. MAIN DOWN 49.

B. ENLARGE (E) 6" LINE DOWN SALMON FALLS RD. AND PEDRO HILL RD. TO AN 8" LINE. SEE HIGHLIGHTED MAIN.

8"

8"

ALT-1: GREENWOOD RD. PROPOSED IMPROVEMENT

TO ALLOW THESE 4-HYDRANTS TO FLOW 500GPM DURING A MAX DAY, DO ONE OF THE FOLLOWING:

A. FEED FROM WALTON LAKES
1. CLOSE VALVE AT HWY 193 AND SLIGER MINE RD.
2. REPLACE 2900 LINEAR FEET OF (E) 6" WITH 8" DI CLASS 250.
3. INSTALL PRV JUST NORTH OF INT. OF GREENWOOD AND BLACKRIDGE RD.
4. CAN ABANDON (E) PUMP STATION ON BLACKRIDGE RD.
5. REPLACE 1900 LF OF PIPE ALONG BLACKRIDGE (TO HIGHER PRESSURE).

B. GREENWOOD LINE REPLACEMENT - BLACKRIDGE RD TO SLIGER RD.

8" OR 10"

8" OR 10"

8" OR 10"

FHT-665

FHT-657

FHT-660

FHT-321

J-688

GEORGETOWN DIVIDE PUBLIC UTILITY DISTRICT

AUBURN LAKE TRAILS WATER SYSTEM

PROPOSED NETWORK RELIABILITY IMPROVEMENTS FOR MAX DAY PLUS FIRE

FIGURE 1

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