
**WATER DEMANDS AND
CONVEYANCE REQUIREMENTS,
YUBA COUNTY WATER DISTRICT**

PREPARED FOR

YUBA COUNTY WATER AGENCY

PREPARED BY

**BOOKMAN-EDMONSTON
ENGINEERING, INC.**

TABLE OF CONTENTS

SUMMARY FINDINGS	1
PREVIOUS STUDIES	4
WATER DEMAND ESTIMATES.....	7
Present Demands	7
Recent Deliveries.....	8
Forbestown Ditch Supplies.....	8
YCWD Deliveries.....	8
Future Demands.....	10
Density of Development.....	12
Potable Demand.....	14
Domestic Water Use.....	14
Commercial Use.....	14
Sources of Potable Supply.....	15
Irrigation Demand.....	15
YCWD System Demands.....	16
CONVEYANCE REQUIREMENTS.....	18
Present Conveyance Requirements.....	18
Future Conveyance Requirements.....	19

List of Tables

1	Total Present Demand Within the YCWD Service Area	2
2	Projected Total 2040 Demand Within the YCWD Service Area.....	2
3	Forbestown Ditch Projected 2040 Demand	3
4	Previous Estimates of YCWD Water Requirements.....	4
5	YCWD Water Diversions from Woodleaf Penstock.....	9
6	YCWD Diversions and Deliveries from Forbestown Ditch.....	9
7	Estimated Land Use and Population in YCWD in 2040.....	12
8	Estimated Potable Water Requirements in YCWD in 2040	15

9 Estimated Irrigation Water Requirements in YCWD in 2040 16

10 Estimated Annual and Peak Month Water Demands in YCWD in 2040..... 17

List of Figures

1 Typical Rural Residential Irrigation in YCWD (Near Oregon House)..... 11

2 Projected Future Water Demand Areas..... 13

WATER DEMANDS AND CONVEYANCE REQUIREMENTS, YUBA COUNTY WATER DISTRICT

SUMMARY FINDINGS

The Yuba County Water District (YCWD) does not currently have a large enough water supply to meet all of the water demands within the district. The YCWD has a waiting list for irrigation supply; generally, these unmet demands are located in Improvement District 1. The two main reasons for this unmet demand are (1) a contractual limitation of 3,700 acre-feet per year on the YCWD's main supply from the SFFRP to the Forbestown Ditch and (2) limitations on conveyance capacity. The YCWD agreement with the Oroville-Wyandotte Irrigation District (OWID) for water supply from the South Fork Feather River Project (SFFRP) allocates 3,700 acre-feet per year to be delivered through Forbestown Ditch. A portion of this supply is rediverted for irrigation deliveries from the Forbestown Ditch at the Costa Creek turnout. An additional supply of about 1,150 acre-feet (recorded average from 1988 to 1997) is diverted from Dry Creek under a separate YCWD water right.

Current reported losses for the Forbestown Ditch are 30 percent. For the district's irrigation conveyance, the Dobbins-Oregon House Canal (DOHC), losses are as high as 60 percent. The loss rate in the DOHC is in part due to underutilization of the canal because of limited supplies. The DOHC was constructed to carry up to 35 cubic feet per second (cfs), but because of the supply limitation, it carries only about 20 percent of this amount on average. The DOHC is a trapezoidal channel with a relatively wide bottom, which results in a high wetted surface-to-flow rate ratio, resulting in high seepage losses for these low flow conditions. With higher flows, the percentage losses would be much lower.

The estimated total present YCWD population served, irrigation acreage, and annual water demand are summarized in Table 1. The total population within the District is about 5,500 persons. Of this total, about 2,500 are located within the rural domestic service area receiving treated water from the Forbestown Treatment Plant.

The total present water demand of 17,430 acre-feet per year is only partially satisfied. Irrigation rates are limited to less than the foothill average applied water rates.

Table 1
Total Present Demand Within the YCWD Service Area

Item	Total Population or Acreage	Water Demand (acre-feet/year)	Peak Flow (cfs)
Population (Rural Domestic Service)	2,500	850 ¹	3
Irrigable Acreage	3,060	16,580 ²	55
Total		17,430	58

¹Demand based on current service area limits, which are partially supply-limited.
²Calculated from irrigable acreage, applied water requirement, and associated conveyance losses.

Table 2 shows the projected future (2040) demands for YCWD. The total population within the District in 2040 is projected to be 10,540. Because of the geography and the economic assumptions described below, 3,950 acre-feet per year is projected to be supplied for irrigation through the domestic system.

Table 2
Projected Total 2040 Demand Within the YCWD Service Area

Item	Total Population or Acreage	Water Demand (acre-feet/year)
Population	10,540	1,400
Irrigated Acreage	4,760	25,770*
Total		27,170

*Includes 3,950 acre-feet served through the rural domestic service.

For the projected future demand on the Forbestown Ditch, the population within the expanded rural domestic service area is projected to be 8,780. The irrigated acreage that could be served raw water from the Forbestown Ditch is 3,430 acres with a raw water demand of 18,560 acre-feet per year. Table 3 summarizes the year 2040 projected demands on the Forbestown Ditch.

**Table 3
Forbestown Ditch Projected 2040 Demand**

Item	Total Population or Acreage	Water Demand (acre-feet/year)	Peak Flow (cfs)
Population (Rural Domestic Service)	8,780	1,190	15
Irrigated Acreage (Rural Domestic Service)	730	3,950	60
Irrigated Acreage (Raw Water)	3,430	18,560	75
Total		23,700	75

The estimated irrigation demand is based on the assumption that the cost of water and conveyance facilities would permit its use for rural residential purposes, but would be too expensive for most types of commercial farming. In addition, this analysis has examined other factors such as terrain, proximity to conveyance facilities and trends in land use to determine the projected development of water supply demands. Earlier studies, as described in a following section, included irrigated acreage projections of 15,900 acres and 15,400 acres in 1957 and 1962, respectively, while here, projected development in 2040 is based on 4,160 acres of irrigated land.

The total Forbestown Ditch water demand under present conditions, 17,430 acre-feet per year, exceeds both the YCWD local distribution facility capacity and YCWD's contractual supply presently divertible from the SFFRP at the Woodleaf Penstock. Much of this demand is in YCWD Improvement District No. 1, which is served from the DOHC. The current capacity of the canal at its headgate on Dry Creek is only 13 cfs, and the canal has high seepage losses. Year 2040 demands are based on the assumption that these conveyance facilities would be improved. Under 2040 development conditions, some portions of the YCWD service areas would continue to rely on local supplies.

The present peak YCWD demand from the Forbestown Ditch is 16 cfs, 3 cfs for the treatment plant and 13 cfs at the Costa Creek turnout because of the present limited capacity of the DOHC. YCWD has configured its operations and constrained water delivery commitments to a peak of 12 cfs, which is the maximum delivery rate under YCWD's agreement with OWID and, reportedly, YCWD's share of the current safe delivery capacity of the Forbestown Ditch.

Criteria for evaluating alternatives for improving the conveyance capacity of the Forbestown Ditch have been based on the present and future demands and the terms and conditions of

existing agreements between YCWD and OWID. The criteria for alternatives have been determined for a range of scenarios from a minimum of present capacity to a maximum of projected future needs. The minimum flow rate for evaluating Forbestown Ditch improvements to meet present capacity is set at 24 cfs, which corresponds to the existing safe capacity of the Forbestown Ditch with an allocation of 12 cfs for YCWD and 12 cfs for OWID. The design capacity for evaluating improvements to the Forbestown Ditch to meet future needs is set at 84 cfs, the contractual allowable expansion of the ditch of 60 cfs above the current YCWD capacity of 12 cfs. The 84 cfs for future demand would be split with an allocation of 12 cfs for OWID and 72 cfs for YCWD. As summarized in Table 3, the total estimated capacity required to meet future YCWD demands is 75 cfs. Recognizing that the premises used for developing the estimate of 75 cfs are in some cases approximate, an allowance of 72 cfs for future needs is considered adequate for developing maximum conveyance criteria.

PREVIOUS STUDIES

Six previous studies of water demands in the YCWD service area were reviewed for comparison purposes and background. Results compiled in those reports include population projections, potentially irrigated acreage, and related water requirements. This section summarizes findings of those studies. A numerical summary is shown in Table 4.

Table 4
Previous Estimates of YCWD Water Requirements
(acre-feet per year)

Entity	Year	Irrigation	Domestic & Commercial	Total
Department of Water Resources Advisory Board, County of Yuba	1957	59,000	2,600	61,600
St. Maurice-Helmkamp-Musser	January 1962	53,700	4,930	58,630
CH2M Hill	July 1976	24,200	800	25,000 ¹
Bookman-Edmonston Engineering, Inc.	February 1990	25,100 ²	3,850 ³	28,950
Metcalf & Eddy, Inc.	August 1991	---	3,850 ³	---

¹Losses in the amount of 2,000 acre-feet listed in this report are additional.

²Distribution losses estimated at 7,600 acre-feet are additional.

³Dry year demands. Average annual demands estimated at 3,100 acre-feet in a September 1990 study.

County of Yuba, Department of Water Resources Advisory Board, *Analysis of Irrigation Water Needs for the Future Development of Irrigated Lands in Yuba County, California, 1957*

The YCWD section of this report indicates there are 19,875 acres of irrigable land of which 80 percent (15,900 acres) is expected to be ultimately developed, requiring 3.7 acre-feet of water per acre of developed land. The principal crops requiring irrigation were projected as 12,750 acres of clover and pasture grass, requiring about 4 acre-feet per acre, for a total of about 51,000 acre-feet. The total annual irrigation requirement was estimated to be about 59,000 acre-feet for the 15,900 acres of land expected to be developed.

The potential population was estimated to be about 10,000, resulting in about 3,500 connections. With an assumed 0.5 acre-feet for indoor use and 0.25 acre-feet for outside use at each connection, the annual domestic requirement was estimated to be about 2,600 acre-feet.

St. Maurice-Helmkamp-Musser, *Plans for Water Resources Development, Report Prepared for Yuba County Water District, January 1962*

This report developed demand estimates comparable to those presented by the Yuba County Department of Water Resources Advisory Board (1957). Lands classified as irrigable are delineated on Plate 2 of the report. Plate 2 indicates that a substantial portion of land would be served from Collins Lake and Lake Mildred.

Of the reported 22,600 acres of gross irrigable land, a net amount of about 15,400 acres or about 68 percent was estimated to have full development potential for irrigation. The most significant portion of the future irrigation demand was for nearly 11,900 acres of improved pasture at 3.7 acre-feet per acre, amounting to nearly 44,000 acre-feet. The total annual requirement at the farm headgate for the 15,400 acres of net irrigable land was estimated to be about 53,700 acre-feet, for an average of 3.5 acre-feet per acre.

Domestic water requirements listed in Table 4-6 of the report are based on 200 gallons per capita-day (gpcd) (0.224 acre-feet per person per year) and a population projection for the year 2010 of 17,100. Of the 3,830 acre-feet listed as the projected 2010 total domestic demand, 180 acre-feet for the projected Strawberry Valley population of 800 would not be supplied from the Forbestown Ditch. In addition, estimated annual water requirements for commercial uses are listed as 1,000 acre-feet, and industrial forest products requirements are listed as 100 acre-feet. The total domestic and commercial water requirement in year 2010 served from the Forbestown Ditch would be 4,750 acre-feet per year.

CH2M Hill, *Yuba County Water Agency, Water Resources and Needs, July 1976*

This report lists a net irrigable acreage at full development in YCWD totaling 11,000 acres with a total potential annual requirement (including urban demands) of 27,000 acre-feet for an average of about 2.5 acre-feet per acre. The 27,000 acre-foot annual demand is comprised of 24,200 acre-feet of irrigation and residential farm uses, 800 acre-feet of urban demand, and 2,000 acre-feet of losses.

Bookman-Edmonston Engineering, Inc., *Present and Projected Water Requirements of Districts in Yuba County, Report Prepared for Yuba County Water Agency, February 1990*

This report was prepared primarily to address the agricultural demands of water districts in Yuba County. Table A-18C of the report lists a potential 3,960 acres of irrigated pasture and 820 acres of irrigated trees in YCWD with applied requirements of 5.5 and 4.1 acre-feet per acre, respectively, for a total farm headgate annual demand of about 25,100 acre-feet. With the addition of distribution losses, the annual water requirement totals 32,700 acre-feet. The lower acreage in this report, compared to prior reports, reflects exclusion of areas now served by Browns Valley Irrigation District as well as more recent economic limitations on agribusiness development.

The estimated YCWD population listed in the report reflects upward adjustments to Department of Finance projections. The Department of Finance forecasted only a 28 percent increase in Yuba County population from the year 1990 to the year 2020, as compared to 80 and 145 percent increases in neighboring Butte and Nevada Counties, respectively. Applying an adjustment to reflect growth rates projected for these neighboring counties, the B-E report listed an estimated YCWD service area population of 5,100 in the year 1990 and about 11,000 for the year 2020. Planned dry-year usage for rural residential areas is listed as 0.35 acre-feet per capita for the YCWD. Applying the 0.35 acre-foot per capita to the 11,000 population estimate results in an estimated dry-year rural domestic demand of 3,850 acre-feet.

Bookman-Edmonston Engineering, Inc., *Report on Potable Water Requirements and Alternative Water Sources, Report Prepared for Yuba County Water Agency, September 1990*

This report was prepared to quantify potable water requirements for various communities in Yuba County and identify potential sources of supply. For YCWD, the report indicates the actual amount of water treated for potable uses in 1990 was about 0.367 acre-feet per service or about 130 gpcd. The report cited water supply shortages as the reason for the relatively low usage compared to about 250 gpcd for other similarly situated communities. This greater amount is cited as being reasonable for the average potable water requirements of the

YCWD. Applying the 250 gpcd rate to the estimated 2020 population of 11,000 yields an average annual demand of about 3,100 acre-feet.

Metcalf & Eddy, Inc., *Yuba County Water Agency Water Facilities Supply Study, Draft Report, August 1991*

This draft report was prepared to address alternative methods to treat and convey potable water supplies to communities in Yuba County. For YCWD, the report relied upon population projections and water demands developed in the previously described February 1990 and September 1990 reports prepared by B-E. Those reports indicate a YCWD dry-year demand of about 3,850 acre-feet and an average annual potable water demand of 3,100 acre-feet. The Metcalf & Eddy draft report shows the planned maximum daily demand for indoor and outdoor use should be 2.5 times greater than the average daily demand. Accordingly, the projected maximum day demand for YCWD potable water was estimated to be 10.7 cfs.

WATER DEMAND ESTIMATES

The water demand estimates described in the following sections were developed for specific areas throughout YCWD for present and future conditions. Some of the areas are expected to receive YCWD service with water conveyed from the Forbestown Ditch, while others are in isolated locations that will likely be limited to local supplies.

Rural-domestic water use estimates in previous studies have generally been based on per capita uses to reflect both indoor and outdoor use. To account for variability of terrain and water application, separate estimates were made in this study for indoor use and outside irrigation.

PRESENT DEMANDS

Present demands for water are constrained by both available supplies and conveyance capacity. That is, water use in YCWD's service area today would be greater if the supplies were adequate and conveyance capacity were not limited by either inadequate capacity or distribution losses. The SFFRP, with delivery through the Forbestown Ditch, is the primary present source of water supply for YCWD. The DOHC, operated by Improvement District No. 1, is the principal raw water distribution facility. Both the Forbestown Ditch and DOHC have capacity limitations and relatively high losses.

Recent Deliveries

Delivery of water by YCWD, as summarized from recent YCWD records, has been affected by limited supply, lack of conveyance capacity in the DOHC, conveyance restrictions in the Forbestown Ditch, and conservation imposed by drought conditions. Given these factors, the recent production records are not considered a reasonable indication of present water demands and conveyance requirements.

Forbestown Ditch Supplies

Table 5 summarizes monthly SFFRP diversions for delivery to YCWD. The contract column identifies the contractual diversion limits identified in an agreement with OWID and PG&E for diversions from the SFFRP. The maximum monthly limits are occasionally relaxed to allow for operational flexibility under certain water year conditions. The reported diversions to YCWD from the Woodleaf Penstock to the Forbestown Ditch include the Forbestown Ditch conveyance losses that OWID has assigned to YCWD. Additionally, winter deliveries are affected by runoff diverted from Oroleve Creek into the Forbestown Ditch and pulse flow operations of the Forbestown Ditch by OWID. Winter diversions from Oroleve Creek are irregular as the result of both the sporadic nature of the creek's runoff and operational practices under which creek water has occasionally not been diverted to the Forbestown Ditch. Pulse flow operation is the OWID method of choice because OWID staff believes that this method is more convenient and reduces losses in the Forbestown Ditch. Under this mode of operation, the Forbestown Ditch remains empty until YCWD terminal storage is reduced to near-minimum physical limits. An initial release of water is provide to flush the ditch, and then water is supplied to YCWD for replenishing YCWD's terminal storage. The pulse flow operation has been sporadic. YCWD staff expressed concerns about pulse flow operation, including the possibility that it results in higher losses than would occur with continued flow, and, as the result of drafting terminal storage to minimal levels, the problem of not reserving enough storage for emergencies. Also, storage fluctuations in the terminal reservoir reportedly affect YCWD's operations at the Forbestown Treatment Plant.

YCWD Deliveries

The two principal turnouts to YCWD on the Forbestown Ditch are the Costa Creek turnout for irrigation deliveries and the Forbestown Water Treatment Plant for domestic uses. Table 6 lists the annual water supplies delivered at these YCWD turnouts for irrigation and treated water service.

Table 5
YCWD Water Diversions from Woodleaf Penstock
(acre-feet)

Month	Contractual Limit	1989	1990	1991	1992	1993	1994	1995	1996	1997	Average
Jan	25	84	51	39	76	0	29	0	0	0	31
Feb	25	55	4	78	0	0	0	78	0	0	24
Mar	25	61	16	2	0	0	0	0	0	235	35
Apr	100	59	118	32	82	0	73	0	2	66	48
May	430	97	331	365	375	76	128	43	123	155	188
Jun	700	434	276	507	689	143	410	77	119	288	327
Jul	730	719	677	669	738	500	738	99	293	624	562
Aug	730	475	738	739	738	615	727	362	628	729	639
Sep	590	365	689	714	371	631	698	487	655	635	583
Oct	290	185	109	386	49	333	320	326	381	223	257
Nov	30	117	46	47	86	3	109	94	89	107	78
Dec	25	58	199	69	35	0	36	55	60	72	65
Totals	3,700	2,709	3,254	3,647	3,242	2,301	3,268	1,621	2,350	3,134	2,837

Table 6
YCWD Diversions and Deliveries from Forbestown Ditch
(acre-feet)

	1991	1992	1993	1994	1995	1996	1997	Average
Woodleaf Penstock Diversions for YCWD	3,647	3,242	2,301	3,268	1,621	2,350	3,134	2,795
Delivered at Costa Creek for Irrigation	1,965	1,697	1,165	1,745	564	1,011	1,343	1,356
Raw Supply at Forbestown Water Treatment Plant	345	378	370	452	439	473	427	412
Percent Loss	37%	36%	33%	33%	38%	37%	44%	37%

Over one-half of the 5,500 people presently residing in the YCWD service area rely on water sources other than those provided by YCWD. With about 780 active water accounts, YCWD staff estimates a present service population of about 2,500. Present domestic customers of YCWD receive treated potable water and are affected by water shortages. Due to this restricted supply, annual domestic use ranged from 310 to 473 acre-feet during the 1989 through 1997 period, which is about half the amount that would be typical of similarly situated communities. Dry-year demands for water use in the foothill and mountain communities of Butte and Plumas Counties estimated from Department of Water Resources Bulletin 166-94 *Urban Water Use in California* average about 0.34 acre-feet per person. This average includes both domestic uses and landscape irrigation. With these conditions,

the present potable water demand for YCWD, without being limited by conveyance or water availability, would be about 850 acre-feet per year. Assuming a peaking factor of 2.5, the corresponding maximum daily demand is approximately 3 cfs.

The principal irrigation demand of YCWD is located in Improvement District No. 1, which encompasses 15,100 acres in the Dobbins-Oregon House area. The DOHC conveys Forbestown Ditch supplies and unregulated flows diverted from Dry Creek near Daken Flat. As shown on the YCWD Water Rights License Map for Permit No. 1270 prepared by Kit Burton, the place of use for these flows has a gross area of 4,481 acres, of which 3,064 acres are listed as net acreage.

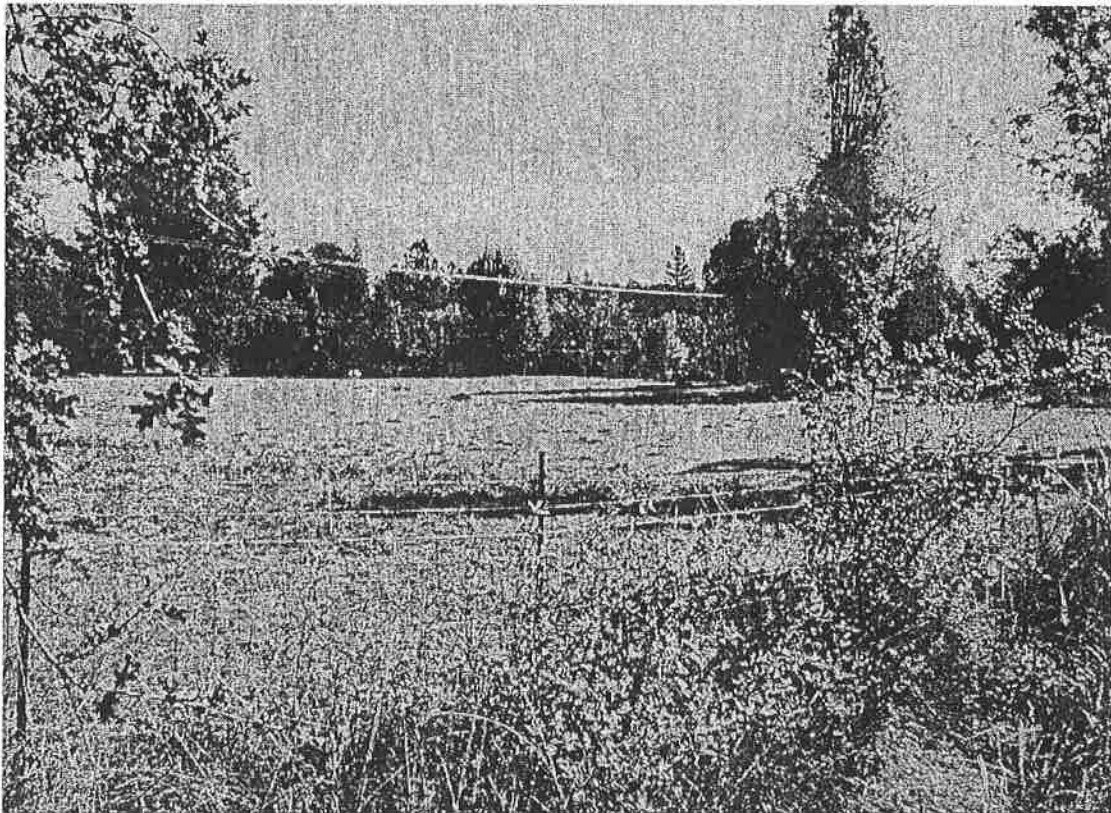
Table A-18C of the B-E (1990) report lists quantities for evapotranspiration of applied water, the weighted average of which is 3.2 acre-feet per acre. Assuming that the cost of water and use of conservation measures would cause on-farm efficiency to increase from about 61 percent, as used in Table A-18C, to 70 percent, the applied water requirement would be 4.6 acre-feet per acre. With an applied water requirement of 4.6 acre-feet per acre and an assumed conveyance/distribution loss of 15 percent, the present annual demand on 3,064 acres would be about 16,580 acre-feet from the DOHC. The conveyance requirement at the headgate of this system on Dry Creek would be 55 cfs, assuming a 20 percent monthly peak demand. These water demand and conveyance requirements exceed both the available water supply under the existing agreement with OWID and the current conveyance capacity of the DOHC and, therefore, do not correspond to present actual levels of use.

FUTURE DEMANDS

Much of the potential service area within the YCWD is presently undeveloped. Two key factors in the sparse development are (1) the lack of a local job base and the necessary long commute to jobs in other communities and (2) the lack of adequate water supplies. The future growth of irrigated agriculture for livestock fodder or food crops as an economic base in the area is unlikely because of the high cost of developing sufficient water supplies. Some existing commercial vineyard development may expand if water supplies are developed at an affordable cost. The most likely type of development would be large residential lots ranging from one to five acres suitable for a rural-domestic lifestyle. Because these types of development would generally be dependent on non-farm income, rather than commercial farming, it is reasonable to expect that the cost of water would not be as significant, a limiting factor in the use of water, if the water is available. As described below, density of development for housing and the intensity of irrigation/outdoor watering

were estimated based on this theme of development. Figure 1 is a picture of this type of residential land use. This picture shows a residence on several acres, a portion of which is irrigated pasture. Out of view of the camera at the time of the picture were a few head of cattle.

Figure 1
Typical Rural Residential Irrigation in YCWD (Near Oregon House)



This type of development is essential to the economic growth of the Yuba County foothill area. Currently, Yuba County has one of the lowest household income rates in California. The economic viability of families in Yuba County often depends on supplemental income. Small family farms, with a few head of cattle, other livestock or horse boarding, are a way for families to generate a supplemental income. In addition, small irrigated gardens or crops of a few acres provide food for the family table or fruits and vegetables for local sale. This type of rural development is currently the trend within the YCWD and provides a basis for economic development within the area. A required element of this development type is reliable, relatively inexpensive water supplies. Because groundwater is not predominant within the area, surface supplies are needed to foster this growth.

Density of Development

Estimates of demands were developed as described below for likely developable land in the areas depicted on Figure 2. Acreage and density of development for each area and the associated water duty are compiled in Tables 7 through 9. Areas suitable for development were estimated from review of USGS 7.5 minute quadrangle maps, at a scale of 1" = 2,000', based on existing indications of development, proximity to roadways, and moderate topographic relief. Fifteen community areas encompassing a gross area of about 12,740 acres were identified and outlined.

The mountainous terrain, isolated location, and probable high cost of delivering water to some of the areas shown on Figure 2 would preclude service to those areas from the Woodleaf Penstock diversion. These areas were, however, included in the analysis to estimate the total water demand for the YCWD. Based upon judgment allowances for roads, stream channels, and topographic constraints, approximate percentages of usable area were estimated to range from 40 to 80 percent with an average usable area of 67 percent. The resulting usable area is about 8,500 acres. The percentages of usable area and computation of usable area are shown on Table 7.

Table 7
Estimated Land Use and Population in YCWD in 2040

Community	Community Area (acres)			Housing/Population		
	Gross	Percent Usable	Net	Acres/Unit	Number of Units	Population at 2.5/Unit
Brownsville	1,382	70%	967	1.0	967	2,419
Challenge	371	70%	260	0.5	519	1,299
Cummings Ranch	122	70%	85	2.5	34	85
Forbestown	1,440	70%	1,008	2.5	403	1,008
Frenchtown	749	40%	300	1.0	300	749
Rackerby	96	80%	77	0.5	154	384
Sharon Valley	186	70%	130	1.0	130	326
Woodleaf	186	50%	93	1.0	93	233
Oregon House	3,251	70%	2,276	2.5	910	2,276
Subtotal (Forbestown Ditch)	7,783	---	5,196	---	3,511	8,779
Dobbins	3,118	60%	1,871	5.0	374	935
Richards Ranch	531	80%	425	10.0	42	106
Eagleville	90	60%	54	1.0	54	135
Los Verjeles	890	80%	712	40.0	18	45
Northstar	132	60%	79	1.0	79	198
Strawberry Valley	198	70%	139	1.0	139	347
YCWD Total	12,742	---	8,476	---	4,217	10,545

Figure 2 Projected Future Water Demand Areas



Average housing densities were estimated based largely on existing conditions and the size of the community. Smaller areas, those areas constrained topographically, and areas with existing, more dense indications of development ranged from 0.5 to 1 acre per household. Larger areas with less topographic relief were assigned densities ranging from 2.5 to 5 acres per household. Existing large cleared areas were assigned 10 to 40 acres per household.

The average density of development area is about 2 acres per household. With an assumed average of 2.5 persons per household, the estimated future population within the YCWD would be about 10,500 people at full development. Assumed densities and calculation of estimated full development population are listed in Table 7.

Potable Demand

Estimates of the future potable demand for YCWD have been based on indoor domestic uses and commercial uses for each community. In addition, the potable demand has been divided into two groups distinguishing the source of supply to meet that demand. The sources are treated water from YCWD and local groundwater.

Domestic Water Use

Indoor domestic use is largely unaffected by the parcel size and is primarily dependent upon family size and income. Studies by Metcalf & Eddy (1991) show indoor use for typical single-family residential developments approaches about 85 gpcd. The 85 gpcd rate for domestic indoor use in combination with the population estimates results in a total domestic demand of about 1,000 acre-feet per year, as listed in Table 8.

Commercial Use

Commercial use is typically estimated, based on population, to be about 40 gpcd. Many smaller communities can not support typical commercial development. Table 8 lists the estimated distribution of commercial water requirements for each community. For communities with a population under 100, no commercial development is expected. Communities with populations between 100 and 250 are expected to support minimal commercial development requiring 10 gpcd. Communities with populations between 250 and 1,000 are expected to require about 25 gpcd. For populations of 1,000 or more, a 40 gpcd is assumed. The resulting estimated commercial use is about 400 acre-feet per year.

Table 8
Estimated Potable Water Requirements in YCWD In 2040

Community	Population	Type of Use			Indoor Demand by Source (acre-feet/yr)		
		Domestic* (acre- feet/yr)	Commercial		YCWD Treated	Local Groundwater	Total
			(gpcd)	(acre- feet/yr)			
Brownsville	2,419	230	40	108	338	0	338
Challenge	1,299	124	40	58	182	0	182
Cummings Ranch	85	8	0	0	8	0	8
Forbestown	1,008	96	40	45	141	0	141
Frenchtown	749	71	25	21	92	0	92
Rackerby	384	37	25	11	48	0	48
Sharon Valley	326	31	25	9	40	0	40
Woodleaf	233	22	10	3	25	0	25
Oregon House	2,276	217	40	102	319	0	319
Subtotal (Forbestown Ditch)	8,779	836	--	357	1,193	--	1,193
Dobbins	935	89	25	26	0	115	115
Richards Ranch	106	10	10	1	0	11	11
Eagleville	135	13	10	2	0	15	15
Los Verjeles	45	4	0	0	0	4	4
Northstar	198	19	10	2	0	21	21
Strawberry Valley	347	33	25	10	0	43	43
YCWD Total	10,545	1,004	--	398	1,193	209	1,402

*Based on 85 gallons per capita per day.

Sources of Potable Supply

The total potable use for each community is assumed to be supplied by either treated water from YCWD or local groundwater. The assumed source of supply for each community is shown in Table 8. The total potable use is estimated as approximately 1,400 acre-feet per year, of which about 210 acre-feet would be supplied by groundwater. The remaining 1,200 acre-feet of treated water would be provided by YCWD.

Irrigation Demand

The intensity of outdoor water use and/or irrigation demand was assumed to be primarily related to parcel size. Areas assumed to have parcel sizes of 2.5 acres or more also have less topographic relief and are well suited to irrigation. Therefore, these parcels were considered to be intensely irrigated, having about 75 percent of the usable area irrigated. Smaller parcels (0.5 to 2.5 acres) would be less intensely irrigated with about 25 percent of the usable area watered. The percentages of irrigated areas and resulting irrigated acreages are

listed in Table 9. On a district-wide basis, the usable area that would be irrigation approaches 50 percent, or about 4,760 acres.

Table 9
Estimated Irrigation Water Requirements in YCWD in 2040

Community	Community Area (acres)			Irrigated Area		Irrigation Demand by Source*(acre-feet/year)			Total Demand
	Gross	Percent Usable	Net	Percent Irrigated	Acres	YCWD System		Local Ground-water	
						Treated	Raw		
Brownsville	1,382	70%	967	25%	242	1,309	0	0	1,309
Challenge	371	70%	260	25%	65	352	0	0	352
Cummings Ranch	122	70%	85	25%	21	114	0	0	114
Forbestown	1,440	70%	1,008	25%	252	1,363	0	0	1,363
Frenchtown	749	40%	300	25%	75	406	0	0	406
Rackerby	96	80%	77	25%	19	103	0	0	103
Sharon Valley	186	70%	130	25%	33	179	0	0	179
Woodleaf	186	50%	93	25%	23	124	0	0	124
Oregon House	3,251	70%	2,276	75%	1,707	0	9,235	0	9,235
Dobbins	3,118	60%	1,871	75%	1,403	0	7,594	0	7,594
Richards Ranch	531	80%	425	75%	319	0	1,726	0	1,726
Subtotal (Forbestown Ditch)	11,432	--	7,491	--	4,159	3,950	18,555	--	22,505
Eagleville	90	60%	54	25%	14	0	0	76	76
Los Verjeles	890	80%	712	75%	534	0	0	2,889	2,889
Northstar	132	60%	79	25%	20	0	0	108	108
Strawberry Valley	198	70%	139	25%	35	0	0	189	189
YCWD Total	12,742	--	8,475	--	4,762	3,950	18,555	3,262	25,767

*4.6 acre-feet per acre at farm turnouts and 15 percent conveyance loss.

As developed by B-E (1990), the applied water requirement is about 4.6 acre-feet per acre. For ultimate service from the DOHC, it is assumed that the canal will be renovated to reduce losses from the present level of 40 to 60 percent to about 15 percent. Adding distribution losses of 15 percent to the applied water requirement for all irrigation service areas indicates a total demand of about 25,800 acre-feet per year, as shown in Table 9.

YCWD System Demands

The isolated location of some of the communities shown on Figure 2 precludes feasible delivery of supplies from the Woodleaf Penstock. For similar reasons, extension of the YCWD domestic supply system to isolated locations is not considered feasible. It was assumed that areas presently supplied with irrigation supplies from Improvement District No. 1 could sustain groundwater production of sufficient quantity to meet domestic needs. However, the YCWD rural-domestic system was presumed to be extended to communities

in proximity to the existing system. Figure 2 indicates the type of water supply assumed for each community. Table 10 lists the quantities of YCWD irrigation (raw) and domestic (treated) water supplies planned for delivery to each community.

Table 10
Estimated Annual and Peak Month Water Demands in YCWD in 2040

Community	Forbestown Ditch (acre-feet/yr)			Local Sources (acre- feet/yr)	Total (acre- feet/yr)	Peak Month Rate— Forbestown Ditch Deliveries (cfs)		
	Treated	Raw	Total			Treated	Raw	Total
Brownsville ^a	1,647	0	1,647	0	1,647	4.8	0.0	4.8
Challenge ^a	534	0	534	0	534	1.5	0.0	1.5
Cummings Ranch ^a	122	0	122	0	122	0.4	0.0	0.4
Forbestown ^a	1,504	0	1,504	0	1,504	4.7	0.0	4.7
Frenchtown ^a	498	0	498	0	498	1.5	0.0	1.5
Rackerby ^a	151	0	151	0	151	0.4	0.0	0.4
Sharon Valley ^a	219	0	219	0	219	0.6	0.0	0.6
Woodleaf ^a	149	0	149	0	149	0.5	0.0	0.5
Oregon House ^b	319	9,235	9,554	0	9,554	0.6	30.0	30.6
Dobbins ^c	0	7,594	7,594	115	7,709	0.0	24.7	24.7
Richards Ranch ^c	0	1,726	1,726	11	1,737	0.0	5.6	5.6
Eagleville ^d	0	0	0	91	91	0.0	0.0	0.0
Los Verjeles ^d	0	0	0	2,893	2,893	0.0	0.0	0.0
Northstar ^d	0	0	0	129	129	0.0	0.0	0.0
Strawberry Valley ^d	0	0	0	232	232	0.0	0.0	0.0
Totals:	5,143	18,555	23,698	3,471	27,169	15.0	60.3	75.3

^aReceives YCWD treated water for all uses.

^bReceives YCWD treated water for domestic uses and YCWD raw water for irrigation.

^cUses local sources for domestic uses and receives YCWD raw water for irrigation.

^dUses local sources for all uses.

The Dobbins and Richards Ranch areas are expected to continue to receive raw-water service from the DOHC, with domestic and commercial needs served from groundwater. Because the Frenchtown and Oregon House areas are located at the terminus of the existing rural-domestic distribution system, an extension of the system would provide the logical source of potable water to these areas. Most of the irrigation demand for Oregon House is assumed to be served by the DOHC, with only negligible outdoor use being supplied through the rural-domestic system.

The communities of Northstar, Eagleville, Los Verjeles, and Strawberry Valley are expected to continue to rely on privately developed sources for all their uses. The Los Verjeles area is presently served through Dry Creek diversions at Lake Mildred. With increased YCWD deliveries to service areas tributary to Dry Creek above the Los Verjeles diversion, return

flows to Dry Creek should be available to sustain a supply to the Los Verjeles area, thereby eliminating the need for specific developments by YCWD in this area. The Woodleaf area has privately developed potable supplies plus raw water from Forbestown Ditch. Because the Woodleaf area is in proximity to the ditch and/or a likely substitute facility, a package treatment unit is assumed for future supplies for all water needs of that community.

As listed in Table 10, with distribution of the service as described above, YCWD will require about 5,140 acre-feet per year of treated water for its rural domestic system and about 18,560 acre-feet per year of raw water for irrigation. The total requirement at the Woodleaf Penstock would be about 23,700 acre-feet annually plus any conveyance losses occurring between the Woodleaf Penstock and YCWD turnouts.

CONVEYANCE REQUIREMENTS

This section of the report addresses YCWD's present and future conveyance requirements for service at the present Forbestown Ditch turnouts to YCWD. Conveyance requirements, expressed as annual quantities and peak rates, are shown in Table 10.

PRESENT CONVEYANCE REQUIREMENTS

The rural-domestic supply presently delivered at the Forbestown Water Treatment Plant serves both indoor domestic and irrigation of landscape and non-commercial farm irrigation needs. The demand for water and the respective conveyance capacity to supply the rural-domestic system is, for this analysis, considered to serve both domestic and landscape and non-commercial farm irrigation needs unless specifically identified. Four communities listed in Tables 9 and 10 are expected to use local supplies and not be served from YCWD facilities.

Peak monthly delivery of the present rural-domestic system is about 15 percent of the total annual deliveries. Additionally, YCWD records indicate peak daily treated water production ranges between 125 and 130 percent of the average daily production during peak summer months. Although these peaking requirements could be absorbed in YCWD's terminal raw water storage, this storage is also an emergency supply in case of conveyance outages. Use of this storage to absorb daily peaking would involve added risk.

The present rural-domestic water demands have been calculated from YCWD estimates of presently served population. Data on acreage of irrigation service associated with rural-

domestic water deliveries are not available to separately estimate indoor and outdoor use, as was done for future demands.

Communities with settings similar to those in YCWD, as cited in DWR Bulletin 166-94 *California Urban Water Use* for Portola and Paradise, indicate respective average peak month demands totaling 16 and 17 percent of annual usage, with occasional years up to 19 percent. A peak month at 17 percent is about twice the average monthly demand, 8.3 percent. Assuming uniform daily delivery during the peak month, a peak day-to-average day factor would be 2.0. Refining the estimate by applying the 25 percent increase experienced by YCWD for peak summer day results in a peak day-to-average day factor of 2.5. Studies by Metcalf & Eddy Inc. also utilized a peak day-to-average day factor of 2.5.

As described in the previous section titled *Water Demand Estimates*, the present water requirement of the rural-domestic service is estimated to be about 850 acre-feet per year. Applying the 2.5 peaking factor, the present rural domestic capacity requirement is 3 cfs.

Conveyance requirements for lands presently served by Improvement District No. 1 are estimated to be 55 cfs, but are presently limited to the 13 cfs diversion capability by the existing constraints in the DOHC. YCWD occasionally supplements Dry Creek flows past the Improvement District No. 1 diversion. Because this supplemental flow is not required under the water rights permits, there is no provision for such releases in either the estimated demand or conveyance requirements listed herein. If such a provision is necessary, it would additive to the 13 cfs. However, for this study, the present conveyance requirement for irrigation deliveries from the Forbestown Ditch at the Costa Creek turnout is limited to the 13 cfs capacity to correspond to the existing capacity of the DOHC.

The total conveyance capacity requirement in the Forbestown Ditch for current YCWD deliveries down to the Costa Creek turnout is 16 cfs. The delivery requirement for only rural-domestic supplies beyond that point is 3 cfs. Losses in the Forbestown Ditch would be in addition to these quantities.

FUTURE CONVEYANCE REQUIREMENTS

Under assumed full development conditions, the rural-domestic service is expected to be extended into the communities identified on Figure 2 as Frenchtown and Oregon House. Although the current Oregon House area irrigation demand is expected to continue to be served by Improvement District No. 1 facilities, domestic requirements are assumed to be delivered through the rural-domestic system. Considering this and considering that

significant portions of planned future delivery are contemplated for landscape irrigation of large parcels, the analyses shown in Tables 6, 8, and 9 distinguish between domestic and irrigation uses. Therefore, separate factors for peak month demand for indoor and irrigation uses of the rural-domestic system were utilized.

YCWD records indicate 1989-93 peak month irrigation deliveries from the Forbestown Ditch to Costa Creek averaged about 26 percent of the annual Forbestown Ditch irrigation delivery. This is not representative of the present total irrigation supply, which at times is partially supplemented by Dry Creek runoff. DWR Bulletin 113-4 *Crop Water Use in California* indicates peak monthly usage in the foothill/mountain areas of the neighboring Feather River Basin of between 19 and 21 percent of the annual application. For this study, a peak month demand is assumed to be 20 percent of the annual requirement.

As described in the *Water Demand Estimates* section, the total estimated requirements for treated water from a rural-domestic system would be about 5,140 acre-feet per year. As described above, treated domestic (indoor) use is estimated to have a peak day demand of 1.25 times the average annual daily demand. Irrigation is estimated to use 20 percent of the annual requirement in the peak month and be supplied at a uniform daily rate during the peak month. Separate unit use factors should be appropriately applied to domestic and irrigation uses.

Table 10 includes footnotes that describe the particular communities served by various combinations of local and YCWD domestic and irrigation supplies. As shown at the bottom of Table 10, the projected future peak monthly conveyance requirement to the Forbestown Water Treatment Plant for the rural-domestic system is 15 cfs. Note that peak daily demands could exceed this capacity and require occasional drafts from terminal storage. The potential draft of terminal storage and the need for an emergency reserve should be evaluated in subsequent studies.

The projected demand for YCWD raw water irrigation deliveries to Costa Creek for the Dobbins, Oregon House, and Richards Ranch areas totals about 18,560 acre-feet per year. Applying the 20 percent delivery factor results in a peak month delivery of about 3,710 acre-feet, which equates to about 60 cfs.

The total YCWD conveyance capacity requirement for future rural-domestic and irrigation demands at full development is about 75 cfs to the vicinity of Costa Creek. Conveyance beyond that point for delivery of rural-domestic supplies would be about 15 cfs.

