Maui County Water Use and Development Plan

DWS Finance and System Economics

Draft

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I. Introduction

This chapter (Finance and System Economics Chapter) is one component of a comprehensive update of the Maui County Water Use & Development Plan (WUDP). The purpose of this chapter is to characterize the current financial status and economics of the Maui Department of Water Supply (DWS) systems for purposes of developing a long term water use and development plan.

This initial draft of the water demand chapter is intended for the purpose of review by the DWS and each WUDP Water Advisory Committee (WAC). It is expected that the scope and content of the chapter may change based on comments and recommendations by the DWS and each WAC in the course of the WUDP process.

This chapter is divided into two main sections: “DWS Finance” and “DWS System Economics”. This distinction reflects the fact that, in long term resource planning, revenues and expenses are treated somewhat differently than conventional financial accounting practice.

In the first section the revenues, expenses and financial status of the DWS are presented from a fiscal perspective. This perspective is characterized by the standardized accounting conventions used in the financial statements in DWS Annual Reports. The purpose of the financial statements is to provide an accurate picture of the financial status of the DWS at a particular time and period (one fiscal year). The financial statements are prepared using standardized accounting conventions for balance, operating and cash flow statements and schedules of plant, cumulative depreciation and debt instruments.

In the second section the costs of the DWS systems are presented in a format used in resource planning economic analysis. Resource planning analysis focuses on long term (twenty to thirty year) comparisons of resource characteristics. In this context costs are summarized differently from the fiscal accounting approach. In this section and in later chapters costs and revenues are characterized using several conventions such as fixed and variable costs, short and long term marginal costs, capital carrying charges and revenue requirements summarized as net present values.

II. DWS Finance

This section describes the financial reporting and status of the Department of Water Supply. Information is provided from the DWS annual reports and from a recent revenue requirements analysis performed for the DWS. The process of establishing the Department’s rates and associated issues are discussed.

Overview

The powers, duties and functions of the Department of Water Supply are defined by the Charter of Maui County. As amended in the year 2002, the Charter specifies that the DWS is a regular department of the county government with a Board of Water Supply serving in an advisory

capacity.[1] As a county department, the budget, rates and fees of the DWS are ultimately determined by the County Council as part of the County's annual budget approval process.

Although the DWS is a department of the county government, the finances of the DWS remain substantially separate from the general finances of the county government. The Charter specifies that

> The revenues of the department of water supply shall be kept in a separate fund and shall be such as to make the department of water supply self-supporting, provided that the council may issue general obligation bonds on behalf of the department of water supply and may provide capital improvement appropriations for the department of water supply. [Charter of Maui County, Chapter 11, p.26]

Since the DWS is specified by the Charter to be self-supporting, its funds derive from the rates and fees charged to its customers for the provision of water services. These rates and fees must be reviewed periodically and changed as necessary to provide sufficient (but not excessive) funds to pay for the Department's expenses. There are several important aspects to determining appropriate rates and fees by the Department. Rates and fees must be set to (1) provide an appropriate amount of revenues to fund the Department's expenses, (2) fairly allocate the Department's costs to various classes and categories of users and (3) provide appropriate incentives to users to encourage responsible water use practices. The process and issues associated with establishing rates and fees are discussed in more detail below.

DWS Financial Statements

The finances of the Department of Water Supply are reported in its Annual Reports. Finances are planned, implemented and reported on a July-to-June fiscal year basis.[2] The Annual Reports include independent auditors' reports that include financial statements prepared according to standard accounting conventions. The reports include balance, income and cash flow statements and schedules of plant assets, accumulated depreciation and debt obligations. These financial statements are prepared in accordance with accounting standards applicable for publicly owned utilities.

Balance Sheet

The "Statement of Net Assets" in the DWS Annual Report is the balance sheet. It presents a snapshot of the balances of assets and liabilities of the DWS as of the last day of the fiscal year.

Liquid assets and liabilities are divided into "restricted" and "unrestricted" categories. Restricted assets are amounts in funds that are reserved for specific purposes such as Water Use Development Fees, funds held specifically for source and storage improvements and certain contributions in aid of construction.

Assets include everything that the DWS owns or is entitled to, including cash, investments, receivables, inventories of materials and supplies, property, "plant" and equipment. All assets

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[1] Prior to the Charter amendments made in the year 2002 the Department of Water Supply was a semi-autonomous agency under the jurisdiction and authority of the Board of Water Supply. The rates charged by the Department for water service have been subject to approval by the County Council both prior to and since the 2002 Charter amendments.

[2] Each fiscal year begins on the first day of July of the "previous-numbered" calendar year. For example, the 2006 fiscal year begins on July 1, 2005 and extends through June 30, 2006.

are stated in terms of “book” value which is the actual original capitalized cost less any accumulated depreciation.

Liabilities include all amounts owed by or ultimately collectable from the DWS. This includes outstanding bonds, payable accounts and contracts, vacation pay and customer deposits and advances.

The net assets of the DWS are the amount by which its assets exceed its liabilities.

Summary of DWS Statement of Net Assets
(Balance Sheet)
Summarized from DWS Annual Reports for Fiscal Years 2003 & 2004

	2004	2003	2002
Current Assets (Cash, investments, receivables, supplies)			
Restricted	$7,801,245	$14,100,060	$10,974,527
Unrestricted	27,180,265	27,925,369	27,027,044
Property, Plant and Equipment	387,991,299	375,566,990	364,816,581
Accumulated Depreciation	(124,238,711)	(114,961,014)	(105,588,225)
Deferred Charges	218,630	165,763	206,564
Total Assets	308,952,728	302,797,168	297,436,491
Current Liabilities (Payables, accrued vacation pay, claims, deposits)			
Payable from Restricted Assets	807,004	924,761	860,374
Payable from Unrestricted Assets	5,875,935	8,227,962	7,502,427
Noncurrent Liabilities (Bonds and notes payable, capital advances)	37,999,149	40,029,607	43,557,195
Total Liabilities	44,682,088	49,182,330	51,919,996
Net Assets			
Capital assets (net of related debt)	224,173,320	218,472,859	213,709,825
Restricted assets	17,207,807	12,511,079	9,101,465
Unrestricted assets	22,889,513	22,630,900	22,705,205
Total Net Assets	$264,270,640	$253,614,838	$245,516,495

Income Statement

The “Statements of Revenues, Expenses and Changes in Net Assets” in the DWS Annual Report is the “income statement.” This statement shows the summed revenues and expenses for the fiscal year period.

One accounting convention worth noting is that actual capital expenditures made during the fiscal year are not directly reported in the income statement. Capital expenditures are reported using the accounting convention of depreciation. Capital expenditures are posted as expenses distributed over a number of future years representing the accounting “life” of the assets for which the expenditures are made. Depreciation is reported as an expense in the income statement and represents the distributed proportion of the capital expenditures made in the fiscal year and previous years. Proceeds from bond issues and expenditures made to repay principal on long term debt liabilities are not directly reported in this statement. The treatment of capital expenditures is a fundamental difference between the income statement and the cash flow statement described further below.

Summary of DWS Statement of Revenues, Expenses and Changes in Net Assets (Income Statement)

Summarized from DWS Annual Reports for Fiscal Years 2003 & 2004

	2004	2003	2002
OPERATING REVENUE (primarily revenue from water bills to customers)	$27,735,311	$ 28,608,492	27,350,431
OPERATING EXPENSES (costs of operations, excluding capital costs but including depreciation)	29,591,991	28,795,546	26,842,012
OPERATING INCOME (LOSS)	(1,856,680)	(187,054)	508,419
NON-OPERATING REVENUE (EXPENSES) (interest income / expense and debt amortization)	(1,351,275)	(1,542,983)	(403,936)
INCOME (LOSS) BEFORE CONTRIBUTIONS	(3,207,955)	(1,730,037)	104,483
CAPITAL CONTRIBUTIONS (Water System Development Fees, source and storage assessments, federal and state funds)	13,863,757	9,828,380	5,574,219
RESTATEMENT OF ASSETS (one time adjustment)			(2,227,710)
CHANGE IN NET ASSETS (as restated)	10,655,802	8,098,343	3,450,992
NET ASSETS, BEGINNING OF YEAR	253,614,838	245,516,495	242,065,503
NET ASSETS, END OF YEAR	264,270,640	253,614,838	245,516,495

Cash Flow Statement

The cash flow statement reports the net summed transactions of cash for the fiscal year.

Although both the income statement and the cash flow statement report revenues and expenses for the fiscal year these statements differ in several important respects. First, whereas the income statement includes everything of value within the scope of revenues and expenses (including receivables, payables, intangibles, entitlements and future liabilities), the cash flow statement reports only cash transactions made during the fiscal year. Second, the income statement reports capital expenditures using the convention of depreciation whereas the cash flow statement reports actual proceeds from bond issues and actual expenditures made against principal on debt instruments. Depreciation is not a cash transaction and is not reported in this statement. Third, in summary, whereas the netted results of the income statement are posted as changes between the beginning and end of year entries in the balance sheet, the netted results of the cash flow statement represent changes between the beginning and end of year balances of cash accounts, funds, investments and debt liabilities.

Summary of DWS Cash Flow Statement

Summarized from DWS Annual Reports for Fiscal Years 2003 & 2004

	2004	2003	2002
Cash Flow from Operating Activities			
Cash received from customers	$28,682,106	$27,778,484	$28,183,823
Cash paid to suppliers and employees	(20,004,940)	(18,942,934)	(18,004,414)
Refunds for construction advances	(429,403)	(442,346)	(428,666)
Receipts for construction advances	24,179	823,810	83,884
Interest paid (non-capitalized)	(1,927,389)	(2,205,229)	(1,516,070)
Net cash from operating activities	6,344,553	7,011,785	8,318,557
Cash Flows from Capital Financing Activities			
Acquisition of capital assets	(8,384,699)	(7,430,211)	(7,051,589)
Payment of principal on debt instruments	(11,685,210)	(6,771,360)	(3,619,599)
Principal from bond issue	7,945,000	2,947,453	
Cash contributions in aid of construction	9,055,137	650,520	3,050,871
Net cash used in capital financing activities	(3,069,772)	(4,748,698)	(7,620,317)
Cash Flows from Investing Activities			
Decrease (Increase) in investments	(7,448,184)	160,509	(11,370,432)
Interest received from investments	651,134	702,494	1,136,708

Net cash used in investing activities	(6,797,050)	863,003	(10,233,724)
Net Increase (Decrease) in Cash	(3,522,269)	3,126,090	(9,535,484)
Cash and Equivalents, Beginning of Year	4,326,152	1,200,062	10,735,546
Cash and Equivalents, End of Year	$803,883	$4,326,152	$1,200,062

Annual Report Notes and Schedules

The financial statements in the DWS Annual Reports are accompanied by several explanatory notes and schedules. These important components of the Annual Reports elucidate the balance sheet, income and cash flow statements summarized above. Schedules are provided which reconcile differences between cash and operating reporting formats, identify components of restricted and unrestricted capital funds, identify schedules of bond and note liabilities and plant assets and accumulated depreciation. These notes and schedules are not reproduced here but should be recognized as essential components of the annual report financial statements.

Components of DWS Revenues and Expenses

Several components of DWS revenues and expenses are described below. All of the components described below are included in the DWS financial statements as elements of the balance sheet, income statement, cash flow statement and associated schedules according to conventional accounting practices. The discussion below, however, summarizes these components in a format which is different in some respects from the format used in the DWS Annual Reports.

Revenues and Sources of Funds

The revenues and sources of funds of the DWS are identified in several different formats in separate parts of the annual report financial statements. For clarity, these are summarized and discussed contiguously below.

The revenues and sources of funds for the DWS include the following:

- Charges to customers for providing water services
- Water system development fees charged to customers for new water meter accounts.[3]
- Fees and “in-kind” contributions from land developers
- Fees from the county for water services for fire protection
- Interest on investment instruments

These revenues and sources of funds are discussed individually below.

[3] The term “meter” or “water meter” is commonly used to refer to an “account” or “service” with the DWS. The DWS charges fees for establishing new water service accounts but does not charge fees to customers for installing new water metering devices (hardware) when this might be necessary.

Charges to Customers for Provision of Water Services

Rates charged to customers for the provision of water delivery services include bi-monthly service charges based on meter size and bi-monthly water delivery charges based on the metered volume of water consumption. Money received from these charges is posted as "Water Sales" and included in "Operating Revenue" in the DWS financial statements.

Water Service Charges

Schedule A

Effective as of Fiscal Year =>	1998	1999	2000	2001	2002	2006
General Rates						
0 - 10,000 Gallons	$1.17	$1.23	$1.29	$1.35	$1.42	$1.42
10,001 - 25,000 Gals	1.57	1.65	1.73	1.82	1.91	2.16
Over 25,000 Gals	1.85	1.94	2.04	2.14	2.25	2.54
Agricultural Rates						
0 - 10,000 Gallons	$1.17	$1.23	$1.29	$1.35	$1.42	$1.42
10,001 - 25,000 Gals	1.57	1.65	1.73	1.82	1.91	2.16
Over 25,000 Gals	0.63	0.66	0.69	0.72	0.76	0.80
Non-Potable Agricultural Rates						
0 - 10,000 Gallons	$0.63	$0.66	$0.69	$0.72	$0.76	$0.80
10,001 - 25,000 Gals	0.63	0.66	0.69	0.72	0.76	0.80
Over 25,000 Gals	0.63	0.66	0.69	0.72	0.76	0.80

Water Service Charges

Schedule B

Effective Dates	Thru FY2005	FY2006
Size of Meter	Per Meter Per Month	
5/8	$5.60	$6.50
3/4	$7.00	$8.50
1	$11.50	$14.00
1 1/2	$22.00	$27.00
2	$30.00	$37.00
3	$60.00	$74.00
4	$110.00	$138.00
6	$195.00	$245.00
8	$300.00	$375.00

Water System Development Fees

The DWS charges Water Use Development Fees for providing new water service accounts. The fee schedule, as established by the DWS rules is identified below.

Water System Development Fee

Effective July 29, 2002

Meter Size	Total Fee
5/8	$6,030
3/4	$8,442
1	$15,678
1 1/2	$34,974
2	$61,506
3	$138,690
4	$247,230
6	$555,966
8	$987,714
10	$1,543,680
12	$2,222,658

The current DWS Water Use and Development Fees became effective in July 2002. The magnitude of the fees is based loosely on the dual purpose of the fees: to provide funds for expansion of the DWS water system and to charge new customers for a prorated portion of the costs of the existing water system.[4] The fees are broken down into several components so that they may be applied in component part where applicable where new customers or developers may provide in-kind contributions to source, storage or transmission infrastructure.

Water Use and Development Fees collected by the DWS are Restricted funds held until they are used for water system expansion. Funds that are not immediately expended are invested in short term instruments held by the county treasury.

Fees and In-Kind Contributions from Land Developers

Improvements to the DWS water system are sometimes required in order to provide water service for new land development or to meet fire flow requirements for new construction on developed land. In these circumstances developers or landowners may be required to provide the necessary improvements. Improvements can include expansion of DWS source, storage or

[4] Although the magnitude of the fees is based on an analysis of the "value" of the investment by prior existing customers in the existing water system and was conceived as a fair value to "buy in" to the water system, the fees do not represent any purchase of ownership or equity in the water system. The fees simply entitle a new customer to receive water service according to the rules and conventions of the DWS.

transmission capacities. Improvements installed by developers or landowners must be made according to the specifications of the DWS and are ultimately dedicated to the DWS. Improvements are credited towards (but sometimes can exceed) required Water Use Development Fees.

Fees for Fire Protection

The DWS provides hydrants, standpipes and mains and other improvements sufficient to meet county fire protection requirements. In many instances the size of transmission and distribution piping is determined in part by fire flow requirements. The DWS charges the county for a portion of the costs of providing these services.

Interest on Cash and Investment Balances

Unspent balances of revenues collected by the DWS are kept in several funds invested in short term insured liquid instruments maintained by the county treasury. Interest earned on these accounts is a source of revenue to the DWS.

Expenses

DWS expenses can be summarized according to various methods of categorization. In accordance with accounting standards the financial statements in the DWS Annual Report format summarize expenses as operating and non-operating expenses.

Operating expenses as characterized in the financial statements are illustrated in the table below. Note that the operating expenses portrayed below include depreciation. Depreciation is an accounting convention that is not an actual expenditure made in the fiscal year. This method of categorization does not explicitly identify direct expenditures for capital improvements that are made from capital funds, including expenditure of water system development fees or principal from debt instruments.

OPERATING EXPENSES

From DWS Annual Report: Statements of Revenues, Expensesand Changes in Net Assets

	FY2004	FY2003	FY2002
Operating Expenses			
Power and Pumping	$6,330,620	$6,080,126	$5,640,248
Administrative and general	4,362,066	4,068,662	4,231,950
Transmission and distribution	4,261,657	3,963,691	3,682,644
Purification	4,033,453	4,117,090	3,618,025
Customers' accounting and collecting	858,798	851,940	745,880
Source of Supply	312,195	283,396	201,225
Depreciation	9,433,202	9,430,641	8,722,040
Total Operating Expenses	**$29,591,991**	**$28,795,546**	**$26,842,012**

Non-operating expenses are comprised primarily of interest expense with minor other expenses. Amortization of debt expense listed as a non-operating expense but is only a minor component and does not represent the primary repayment of principal of bond instruments (this is represented by depreciation posted as an operating expense.)

NON-OPERATING EXPENSES			
From DWS Annual Report: Statements of Revenues, Expensesand Changes in Net Assets			
	FY2004	FY2003	FY2002
Non - Operating Expenses			
Interest expense-net of capitalized intere	($1,913,133)	($2,325,384)	($1,689,757)
Amortization of Debt Expense	($57,447)	($40,801)	($45,299)
Other expesnses	($33,111)	($34,343)	($18,824)
Total Operating Expenses	**($2,003,691)**	**($2,400,528)**	**($1,753,880)**

DWS expenses are comprised of the following components:

- Operating costs of providing water services to is customers
- Expenses for interest and repayment of funds borrowed to pay for water system improvements
- Direct expenses for water system expansion and improvements

Expenses are addressed in some detail in an economic context (rather than an accounting context) in the section below “DWS System Economics”.

Rates and Ratemaking Issues

The Department of Water Supply is a “self-supporting” agency. The rates and fees charged by the Department provide almost all of its revenues and must be sufficient to provide sufficient funds to provide necessary services. The rates and fees charged by the Department are reviewed periodically. When it is necessary or appropriate to change the rates or fees a proposal is drafted by the Department, reviewed by the Board of Water Supply and transmitted to the Mayor for transmittal and approval by the County Council.

There is no particular method for deriving rates or fees specified by the county’s Charter or Code. Rates and fees are ultimately determined at the discretion of the County Council on a case by case basis. From an analytical standpoint, the process used by the DWS in proposing rates and fees essentially follows a conventional utility ratemaking approach. This approach consists of the following general steps:

- Determination of Revenue Requirements
  - examine historical consumption and expenses
  - determine future consumption, capital improvements and expenses
  - determine the amount of revenue necessary to provide from rates / fees
- Rate Design
  - Identify objectives and policies to be incorporated in rate design
    - Regarding the allocation of costs to classes or categories of users
    - Regarding rate structure

- Perform studies of cost of service, costs by function or classification as necessary
- Determine rate design to implement identified objectives and policies

- Determination of Proposed Rate Schedule (tariffs)

These steps are discussed below.

Revenue Requirements

The first step in reviewing or establishing reasonable rates is to determine the amount of revenue necessary to provide necessary funds for the Department. This typically involves several steps.

Historical expenses and water consumption patterns are examined. Future water consumption, capital improvements and expenses are estimated for several upcoming years. The amount of revenue that is necessary to meet projected expenses is estimated using an income statement and/or cash flow statement approach.

Annual statements for several future years are prepared assuming the level of revenue that would be generated at existing rates. The statements are examined to determine whether existing rates will result in sufficient or excessive revenues to cover expenses. Several indices are examined including end-of-year cash flow balances and some standard debt coverage ratios. Alternate assumptions regarding funding capital improvements can be examined including different capitalization or borrowing strategies. If existing rates are not sufficient then appropriate alternate rate levels can be examined to determine the level of rates that is necessary and appropriate.

Increases in revenue requirements do not necessarily mean that increases in rates are necessary. The need for rates to increase is determined by the ***relationship*** between the growth in revenues and the growth in expenditures. For example, usually both water consumption and expenses will grow from year to year. If there is sufficient growth in water consumption (and hence water revenues) to cover increases in expenses, a rate increase would not be necessary.

There are many inter-related factors that affect the need to adjust rates. In typical circumstances, for example, the following factors could be expected to change from year to year:

- Water consumption would tend to increase with the general growth in population and economy. Increased water consumption results in increased revenues even at existing rates. In some years water consumption does not increase due to annual variations in weather (when it rains more, less water is used) and short-term economic cycles.

- Expenses would tend to increase. Total expenses tend to increase with increased water consumption, system expansion and inflation.

- Capitalization and debt levels are likely to increase or decrease. Expenses associated with financing system assets are likely to change, both in terms of accounting measures and actual cash flows.
    - Existing plant assets are depreciated. New plant assets may be acquired.
    - Existing debt obligations are retired. New debt obligations may be acquired.
    - Debt may be refinanced.

- Interest rates may change, affecting expenses of short term borrowing and revenues from investment instruments.
- Account balances in special funds may increase or decrease due to the magnitude and timing of collection of fees reserved for system expansion and actual expenditures for system expansion.
- Capital improvement program expenditures can change substantially from year to year both in terms of encumbrance and expenditure.

A revenue requirements analysis takes all of these factors into consideration to determine whether existing rates will be sufficient and appropriate for the anticipated circumstances of coming years. Once it is determined what overall level of revenue requirements will be necessary and appropriate a rate structure and schedules can be designed to recover the appropriate revenues.

Rate Design

Once it is determined what amount of revenues needs to be collected from water users it must be determined what rates and fees should be charged, how these rates and fees should be allocated to various types and classes of users and how the fees should be structured. The way that rates are allocated and structured is referred to as rate design.

There are many possible components to rate designs. For example, rates could be equal for all users or, alternatively, various user "classes" could be established with separate rates and/or rate structures. Rates could be charged according to any (or some combination) of various user characteristics including size of meter, use class, total amount of water consumed, peak water consumption, location (water district, zone, altitude, etc.) or conservation classification. Special rates could be offered to specific types of users such as agricultural users, senior citizens or low-income users. Rates could be varied according to wet or drought conditions. Rates could be adjusted automatically to account for changes in electricity costs for pumping water.

Current Rate Design

The DWS rate design is characterized by the following attributes:

- Customers are billed bi-monthly.
- Three rate classes are defined: general users, agricultural potable water users and agricultural non-potable users.
- There is a bimonthly service charge that is graduated by meter size. Larger meters are charged higher bi-monthly charges.
- There is a volumetric water charge determined by metered water consumption. Volumetric charges are different for each rate class. Agricultural rates are substantially subsidized by general users.
- Volumetric water charges for potable water are differentiated by "inclining blocks." For the first ten thousand gallons of water consumed (first block) a lower rate is charged than for subsequent increasingly more expensive blocks.
- A substantial one-time Water System Development Fee is charged for each new water service installation. This fee is graduated by meter size (based on meter orifice area equivalents).

Rate Design Objectives

There are several objectives in determining the allocation and structure of rates. Three important considerations are fairness, incentives and revenue stability.

Fairness

It is clear that rates should be fair to customers. It is less clear exactly how fairness should be determined.[5] Should rates be the same for all customers? Should rates be differentiated to reflect the actual different costs to serve each customer (or class or group or location of customers)? Should the uses or purposes for which a customer uses water be considered? Should the customer's size or income or use patterns be considered?

Incentives

The allocation and structure of rates provide substantial economic signals (incentives) to customers that affect water consumption levels and patterns. Simply the fact that water consumption is metered and customers are billed according to water consumption provides an incentive for customers to monitor and limit the amount of water use. The inclining block rate structure of the existing DWS rates accentuates this incentive since changes in the amount of water consumption affect the most expensive component of the water rate structure (the highest applicable block).

Incentives can be a deliberate or merely an incidental component of rate design. Regardless of intent, however, it should be clearly recognized that all rate designs provide various incentives to customers. An important consideration in rate design is to structure rates in a way that provide reasonable incentives that encourage customers to use water responsibly.

Rate incentives can be general or can be specifically targeted. For example, if water production is more expensive during summer months or during drought conditions, rates could be structured to charge more for water during these periods in order to encourage water conservation during these periods.

Revenue Stability

An ultimate purpose of rates is to provide the revenues necessary to operate the DWS and provide water services to its customers. The amount of revenues collected as well as the amount of revenues needed are dependent upon several factors that can vary substantially from year to year. One consideration in rate design is the extent to which revenues remain sufficient to meet expenses during possible contingencies.

One important variable is weather. Typically, more water is consumed (and correspondingly more revenue is collected) in the drier summer months than in the wetter winter months. Similarly during drought periods more water is consumed and more revenues are collected than during dry conditions. Since water production costs also tend to be higher during drought conditions, the increased revenue from increased consumption collected under these conditions is helpful to balance the increased production costs. To the extent that marginal water production costs in drought conditions are higher than rates, however, the increased revenues from increased consumption during droughts may not be sufficient to compensate for the

[5] Regarding how rates are applied after they have been established there is a straightforward standard: there should be no unfair discrimination in rates within a rate class. In other words, rates need to be applied consistently without making exceptions for some customers in preference to others within a defined rate class. Regarding how rates are designed, however, the concept of fairness is more complex and subjective.

increased production costs. This circumstance is true for the Upcountry DWS water system in some locations and under certain conditions.

Another variable is inflation and cost escalation. Of particular importance is the cost of electricity. Electricity is a significant cost in water production, treatment and transmission and is quite variable from year to year. One consideration in rate design is the ability to index rates on some measure of inflation and/or electricity price in order to make revenues more commensurate with expenses as conditions change from year to year.

Rate Design Strategies

There are several rate design strategies used to address rate design objectives.

- ESTABLISHING RATE CLASSES Rate classes can be designated in order to use rate designs that specifically target separate types of customers. Each customer class is designated according to some defining customer characteristics. The existing DWS rate structure differentiates between agricultural users and all other users. Definition of more specific rate classes is being considered.

- FIXED AND VARIABLE CHARGES The current DWS rate design includes both a fixed bi-monthly service charge graduated according to meter size and a variable volumetric water charge based on metered consumption. From a "cost of service" perspective (see next topic below) this reflects the fact that some types of costs are the "result" of each water service (billing costs, metering and distribution costs) and other costs are result from the amount of water consumed (pumping, treatment, storage, transmission). Providing a fixed component in the rate design allocates costs (at least some extent) according to fixed versus variable costs of providing service. It also provides a component of revenue stability.

- COST OF SERVICE PRICING One approach to allocating costs between classes of customers and designing rate structures is to price water according to the cost of providing water service. If one class of customers is more expensive to serve this approach would allocate more cost to that class. In volumetric terms (cost per volume of water served), smaller customers tend to be more expensive to serve than larger customers, rural customers more expensive than urban customers and higher altitude customers more expensive than lower altitude customers. An advantage to cost of service pricing is that it is based on underlying system economics. Cost of service pricing tends to send "true" price signals to customers that reflect, to the extent possible, the actual costs of providing water service. These price signals, however, may be at odds with other rate design objectives. For example, *allocation* according to cost of service tends to increase residential rates compared to large customer rates. Designing *rate structure* according to cost of service tends to make rates cheaper per unit with increasing consumption (declining block) which is the opposite of the "conservation" objective inherent in the inclining block structure of existing DWS rates.

- BLOCK PRICING Rates can be differentiated according to blocks of consumption. The first "block" of water can cost one amount and subsequent blocks can have different prices. Block pricing can be "declining" with each subsequent block having a lower unit price the previous block. A declining block structure typically expresses a cost of service approach to pricing. Block pricing can be "inclining" with each subsequent block costing more than the previous block. An inclining block structure can express several objectives including providing a conservation incentive and providing the benefits of a "lifeline" rate (discussed below). One disadvantage of inclining block pricing is that it

tends to increase revenue volatility because fluctuations in consumption occur in the highest applicable block which accentuates the variability of revenues.

• LIFELINE RATES Lifeline rates provide lower prices to certain customers for the first block of water consumption. The objective is to provide some basic amount of water to meet essential needs at a low rate so that it is affordable to low income customers. The existing DWS inclining block rate structure provides some attributes of a lifeline rate because the first block of water is less expensive than subsequent blocks.

• SEASONAL OR DROUGHT RATES Water consumption is higher during drier summer months and during droughts. This results in correspondingly higher revenues but, depending upon the economics of water production, these additional revenues may not sufficiently compensate for the higher water production costs that may occur during these drier periods. If a fiscal or planning objective is to encourage water conservation during droughts or dry seasons a higher price for water during these periods is a means to provide this incentive to customers and provide the utility with revenues to cover corresponding higher production costs.

• INDEXED RATES Rates can be indexed as a means to automatically respond to factors that affect utility costs. Rates can be indexed to a consumer price index to follow inflation. Rates can be indexed to electricity price or cost to account for this substantial component of utility costs.[6] In Hawaii, where electricity is produced primarily from highly volatile petroleum sources and where the electric utilities pass this volatility straight through to its customers by way of a fuel price adjustment clause, an electricity price adjustment mechanism for water rates merits consideration.

• CONSERVATION RATES One mechanism to encourage customers to use water efficiently or reduce water consumption generally is by rate design. The existing DWS inclining block rate structure encourages conservation by making water bills more sensitive to water consumption volume since the effective "marginal" price is in the highest cost applicable block. The concept of what constitutes a conservation rate can be elusive. Any rate structure that results in a higher bill as a result of higher consumption encourages conservation at least to some extent. This is true even of a declining block rate structure. A conservation rate usually refers to a rate structure that accentuates the extent to which the customer's bill increases with increased consumption. Rates that have inclining volumetric charges or that put a large proportion of costs in the volumetric portion of the bill have the strongest conservation effect.

It should be clear that these rate design strategies are interrelated. The extent to which a rate block structure is "inclining" or "declining", for example, depends upon the relationship of the fixed and variable component of the rate. A substantial fixed monthly charge has a similar effect on a customer's total bill as a declining block volumetric rate (the average unit cost of water tends to go down with increased consumption).

DWS Financial Status

The DWS recently conducted an extensive review of its financial status and the adequacy of its rates to provide sufficient revenues. A consultant was retained to perform a detailed revenue

[6] Rates can be indexed either to electricity prices or it can be indexed to electricity expenses. These alternatives have substantial differences in how the adjustment is administered and how the adjustment affects revenues.

requirements analysis and cost of service study and make recommendations regarding adjustments to the DWS water rates. The results of this analysis are published in the "2004 Water Rate Study Draft Report, February 2005 by R.W. Beck, Inc.

A Water Rate Stakeholders Committee was convened to participate in the review and recommendation of DWS rates. The Committee made several recommendations regarding the finances of the DWS including a recommendation to increase DWS water rates by an average of 12%. Part of the rate increase supports the Committee's recommendation to fund an accelerated Capital Improvement Program Implementation Plan. Part of the rate increase supports the finding of the rate study consultant indicating that a rate increase was necessary to support the operation expenses of the DWS.

The Water Rate Stakeholders Committee recommended that rate design should move towards customer class based rates but that this should be considered only after further analysis is completed. The Committee recommended a rate increase based on the existing DWS rate design.

The recommendations of the committee were endorsed by the Board of Water Supply and were sent to the Mayor and then the County Council for consideration and approval. The County Council approved the rate increase recommendations. It is expected that further consideration will be made to the rate design issues at a future time after further analysis by the DWS and its consultants. The new DWS water rates will take effect on July 1, 2005.

Based on the revenue requirements analysis conducted as part of the rate study and the corresponding increase in water rates the DWS should have sufficient revenues for its operations and an accelerated CIP implementation plan. It is expected that the rates of the DWS will be reviewed each year by the County Council as part of the county budget approval process.

III. DWS System Economics

This section examines water system production costs from several specific "perspectives" used in water resource planning. These may differ from the accounting perspectives addressed above in several respects. Resource planning economics examines the relative costs of various resource options or strategies. It is important in this context to carefully differentiate between which costs are "fixed" and which are "variable" with respect to the implementation of alternate resource options. Several distinctions and conventions used in resource planning are identified and discussed. Using these conventions an analysis of the water production costs of the existing DWS systems is presented.

Water Production Costs

Types of Water Production Costs

Resource planning requires an examination and comparison of the economics of different resource options, measures and strategies. This exercise requires some careful attention to how costs are characterized and categorized. Basically, comparative resource analysis looks at the overall economics of resources "on the margin." The focus is on the ***differences*** between the ***projected life cycle*** costs of various resources. This is a different perspective than the "accounting" perspective addressed in the sections above which looks at summed operating expenses and cash flows for an ***annual period***.

Several conventions are used in resource planning economics. These are identified and discussed below. First a distinction between operating and capital costs is identified. Second, a distinction between variable and fixed costs is discussed. Third, the concepts of short run and long run marginal costs are defined. In a following section these conventions are incorporated in an analysis of the water production costs of existing DWS systems and pressure zones.

Operating vs Capital Costs

In resource planning economics, capital costs represent the costs of purchasing, building or installing a project. Operating costs represent the operating the project on an ongoing basis.

There is a difference between resource planning economics and accounting practice regarding the treatment of capital costs. In the resource planning perspective the ongoing costs of paying for the capital costs of a project (interest and depreciation) are not considered operating costs. These cost streams associated with the capital cost of a project are carefully accounted for in resource planning economics but they are not included in summaries of operating costs. The costs of financing capital projects are ultimately summarized and categorized as capital costs. This is a different treatment than the accounting perspective which (1) includes depreciation as a book expense that is posted to operating expenses and (2) includes interest on the debt-financed portion of capital projects as a component of non-operating expenses on the income statement.

The resource planning economics treatment of capital and operating costs simplifies the exercise of comparing various candidate resource options. It also simplifies the distinctions between variable and fixed costs and the definitions of marginal costs that are discussed below.

Variable vs Fixed Costs

Some of the costs of DWS operations increase when the volume of water that must be served increases. The amount of electricity used in pumping, for example, increases with increases in the amount of water that is pumped. Likewise, these costs will decrease with decreased water production. The costs that change with respect to the amount of water production are ***variable*** costs.

Some types of costs do not change with respect to the amount of water production. The amount of rent paid by the DWS for its administrative offices, for example, does not change in response to the amount of water production. Costs that do not change with respect to the amount of water production are termed ***fixed*** costs.

Capital costs of existing projects are fixed costs. Regardless of whether water production may increase or decrease, the capital costs (including associated interest and depreciation) will

remain unchanged.

Operating costs include both variable and fixed components. It is clear enough that some general types of operating costs are variable (such as electricity) and some are fixed (such as administrative costs). It is also true that each category of costs for each part of the DWS system includes both fixed and variable components. Electricity costs, for example, clearly vary with respect to the volume of water produced but electricity costs are composed of both fixed and variable components. The monthly electric customer service charges, for example, do not change with respect to differences in electricity consumption.

For purposes of resource planning economics, operating costs are divided into fixed operating costs and variable operating costs. As discussed below, the distinction between fixed and variable operating costs depends in part upon the particular context for which the costs are applied.

Short Run vs Long Run Marginal Costs

The distinction between variable costs and fixed costs is simple and intuitive in principle. In application, however, this initial simplicity is complicated by several considerations. The conventions of short run marginal costs and long run marginal costs address these considerations explicitly.

First, there is a consideration of the magnitude and duration of changes in water production that are being considered. For example, in response to a small one-time change in the amount of water that is produced it might be expected that electricity costs might change because pumps would not have to run as long, even if the difference is relatively small. For a small one-time change in consumption, however, it would not be expected that maintenance or labor costs would change or that the life of pumps or motors would be effected. On the other hand, some actions might be considered in resource analysis that could have large impacts on the amount of water produced by the water system or on specific parts of the water system. In response to a large and continuous change in the amount of water production for all or parts of the water system, it could be expected that equipment wear, maintenance and associated labor costs could be affected. In summary, the scale and duration of changes in consumption affect the scope of which types of costs are variable and which are fixed.

Second, there is a consideration of the time scale of the resource analysis and whether changes in the operation of the system or the timing or type of new resources that might be added to the system is considered. As discussed above, it is clear enough that the capital costs of existing projects are fixed costs. In the long run, however, large and continuous changes in the amount of water demand may affect the timing or even the type of new projects. In this case the capital costs of new projects may be “variable”.

Third, in resource planning analyses it is not only the total amount of water production that is required of the system that is considered. The costs of operating a water system are the sum of the costs of operating all of its components. The concept of fixed vs variable costs applies to each component of the system as well as the system as a whole. Long term resource planning includes the consideration of many different types of resources and resource operation strategies. The addition of an economical resource may affect the volume of water produced by other less economical resources. Thus the fixed and variable costs of each resource are important to determine not only with respect to changes in the total amount of water production for the system but also in the context of changes in the resource mix or system operation strategies.

To address these considerations two common resource planning economics conventions are defined. Both are expressed in terms of "marginal costs." Marginal costs are the incremental ***change in costs*** that result from an incremental ***change in production***. Marginal costs are expressed in terms of a ratio of these terms: change in costs per change in production.

Short run marginal costs are the immediate change in costs that results from a small change in production. Short run marginal costs can apply to a total system or to individual system components.

Long run marginal costs are the long term change in costs that result from a substantial change in production considered over a long enough period of time to consider impacts on future capital projects and system operations. Long run marginal costs apply to the analysis of a system, not to individual system components.

The difference between short run and long run marginal costs is in the size and duration of the change in production that is considered and in whether changes to the makeup and operation of the system are considered.

AverageCosts by DWS District

Average costs to deliver water on the DWS systems were estimated for each DWS district. These costs are shown in the table below.

DWS Water System Cost by District

$ / kgal (production basis) Fiscal Year 2003

	Central	Upcountry	W.Maui Lahaina	E.Maui Hana	Molokai	DWS Total
Water production electricity and chemicals	$0.38	$0.88	$0.42	$0.55	$0.63	$0.49
Water production direct and allocated labor costs	$0.41	$0.48	$0.35	$4.39	$1.31	$0.47
Other operating costs allocated by district	$0.47	$0.54	$0.45	$1.66	$0.74	$0.50
TOTAL OPERATING COSTS	**$1.26**	**$1.90**	**$1.22**	**$6.60**	**$2.68**	**$1.46**
Capital Costs allocated by district	$0.32	$0.89	$0.46	$2.76	$0.90	$0.48
TOTAL ALLOCATED DISTRICT COST	**$1.58**	**$2.79**	**$1.68**	**$9.36**	**$3.58**	**$1.94**

The costs shown above were derived with some adjustments from the *2004 Water Rate Study Draft Report* (Rate Study) prepared for the Maui DWS by R.W.Beck, February 2005. All costs shown here are expressed as costs per thousand gallons of water *production.* The Rate Study reports most unit costs denominated by *metered consumption*. The information above should be considered approximate. The disbursement of costs to the cost categories and the allocation of costs between the districts incorporate substantial subjective estimation.

Short Run Marginal Costs of Water by Pressure Zone

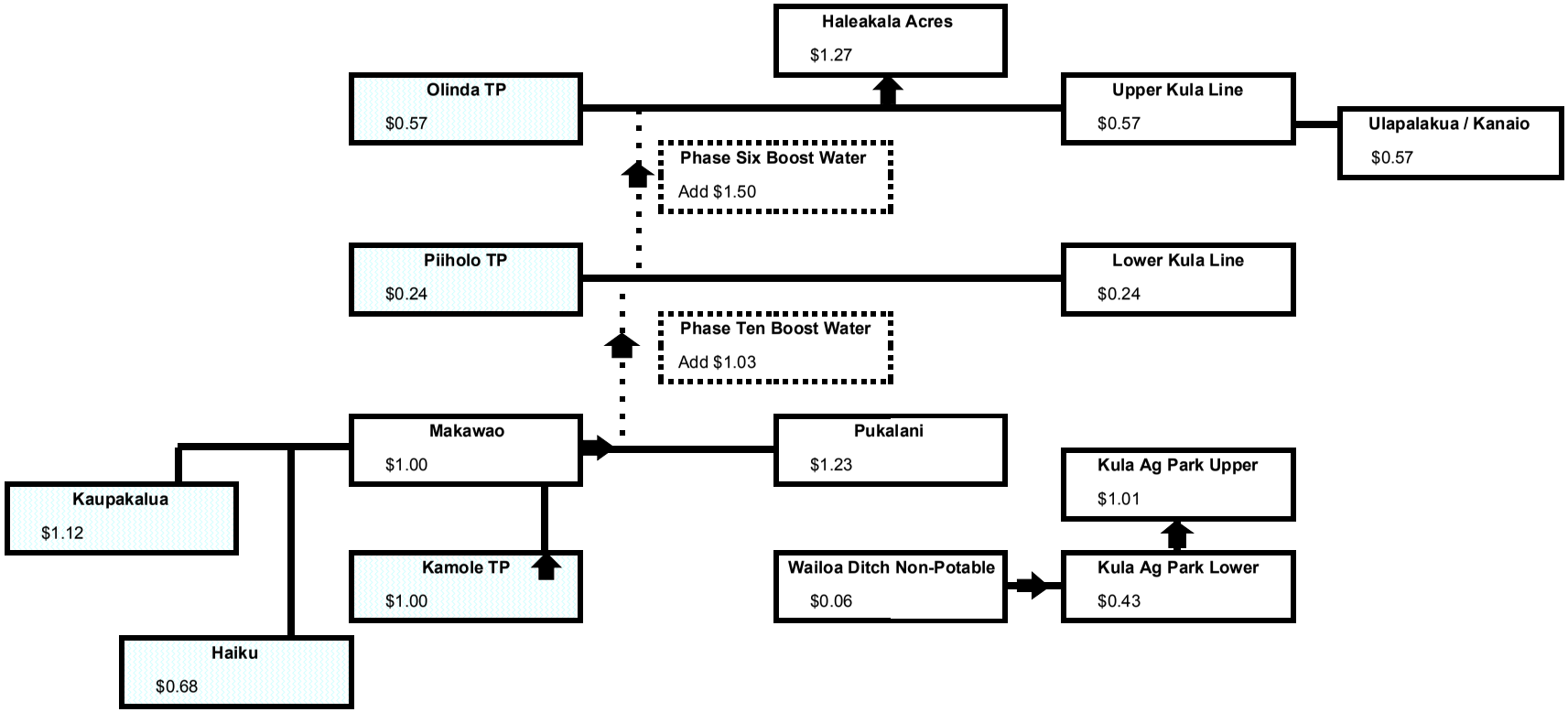
The short run marginal costs to provide water to each area of each of the DWS systems were calculated based on average system conditions. Details regarding the operation costs for each well, treatment plant and booster pump were determined. Operating costs were differentiated between variable and fixed costs. Based on a hydraulic schematic of the water systems the short run marginal costs to deliver water to each DWS water tank were calculated. Charts of these costs for several areas of the Central and Upcountry systems are provided below. Several tables indicate the component costs used to determine the costs by area. Information regarding the efficiency and unit water lift costs for wells and booster pumps is also provided.

Long Run Marginal Costs by System

The long run marginal costs of various candidate resource alternatives and strategies is the subject of the economic analysis to be performed in the WUDP process. These costs may be summarized here and will be addressed in detail in later chapters of the WUDP.

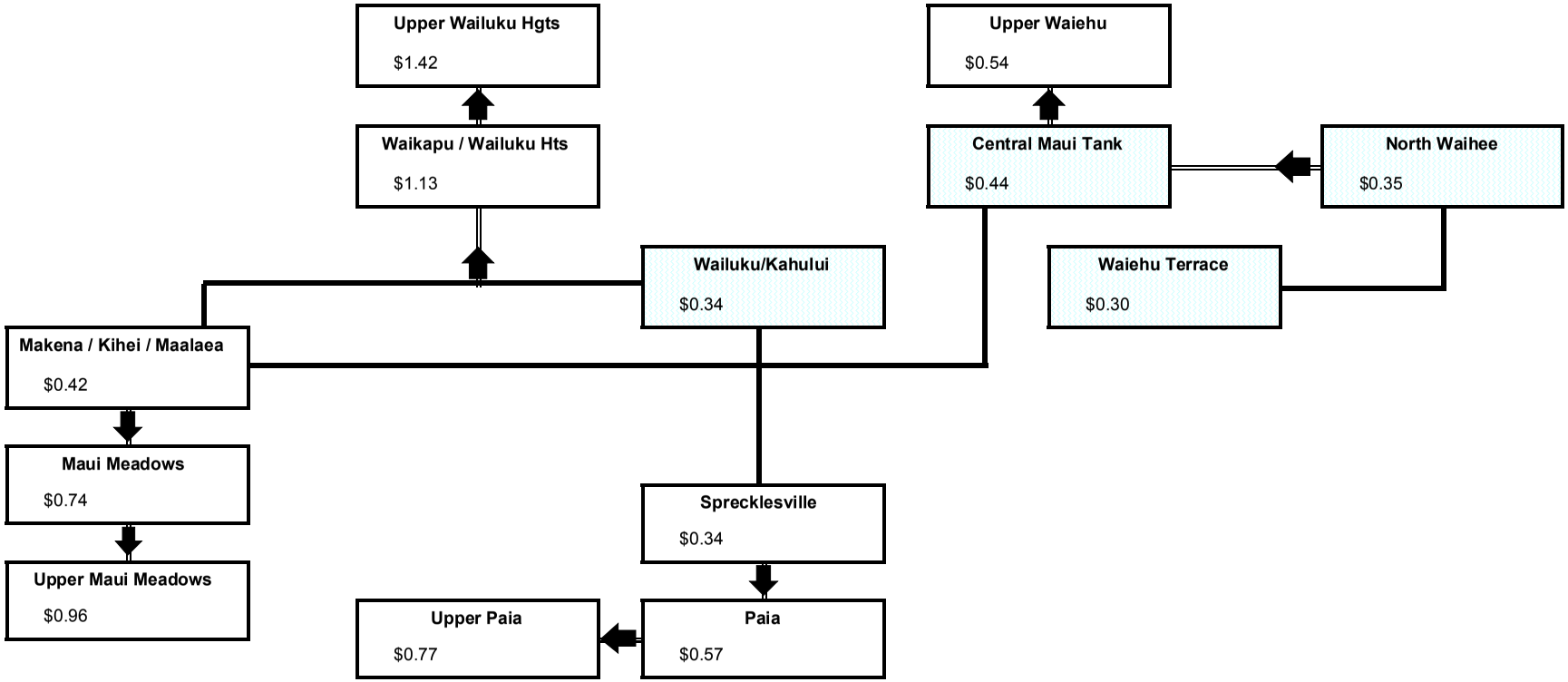
Upcountry System Variable Operating Costs by Geographic Area (Short Run Marginal Costs)

The variable operating costs of producing and delivering water to each area of the DWS Upcountry system is indicated (average of actual calendar year 2004 costs). Variable operating costs include the cost of electrical energy for water pumping and any other costs that vary directly with the amount of water produced.
Shaded boxes show water source production costs. Arrows show booster pumps. Dotted boxes show costs of water boosted to higher elevations under some drought conditions.



Central System Variable Operating Costs by Geographic Area (Short Run Marginal Costs)

The variable operating cost of producing and delivering water to each water tank on the DWS system was calculated. These costs are presented for several geographic areas in the chart below. Variable operating costs include the cost of electrical energy for water pumping and any other costs that vary directly with the amount of water produced.
The cost shown on the left in normal type for each area is the calculated actual variable water production cost per thousand gallons for the year 2004.
Shaded boxes show water source production costs. Arrows show booster pumps.



DWS Well Production and Electric Costs

CY2004	Production Station Kgals Kgals	Electric Energy KWH	Electric Cost Total $	Electric Cost Unit Cost $ per Kgal	Electric Cost Fixed $	Electric Cost Fixed % of Total	Electric Cost Variable $	Electric Cost Var Rate $/KWH	Electric Cost Variable $ per Kgal	Chemical Cost Total $	Chemical Cost Unit Cost $/Kgal	Marginal S.Run Unit Cost $/Kgal	Labor District Unit Cost $/Kgal	Op.Cost Total Unit Cost $/Kgal
MOKUHAU	1,391,724	2,650,800	$448,637	$0.322	$40,062	8.9%	$408,575	$0.154	$0.294	$6,959	$0.005	$0.299	$0.014	$0.341
WAIHEE	1,947,353	4,651,200	$821,523	$0.422	$30,217	3.7%	$791,306	$0.170	$0.406	$9,737	$0.005	$0.411	$0.014	$0.441
WAIEHU HTS	295,533	529,270	$112,933	$0.382	$25,663	22.7%	$87,270	$0.165	$0.295	$1,478	$0.005	$0.300	$0.014	$0.401
WAILUKU SHAFT	1,617,935	5,137,600	$843,307	$0.521	$62,953	7.5%	$780,354	$0.152	$0.482	$8,090	$0.005	$0.487	$0.014	$0.540
KEPANIWAI 511	307,202	345,760	$60,370	$0.197	$3,278	5.4%	$57,092	$0.165	$0.186	$1,536	$0.005	$0.191	$0.014	$0.216
NORTH WAIHEE	575,571	1,111,350	$208,796	$0.363	$26,455	12.7%	$182,341	$0.164	$0.317	$2,878	$0.005	$0.322	$0.014	$0.382
KANOA #1	376,962	836,700	$156,212	$0.414	$10,230	6.5%	$145,982	$0.174	$0.387	$1,885	$0.005	$0.392	$0.014	$0.433
KANOA #2	453,433	886,800	$158,454	$0.349	$10,131	6.4%	$148,323	$0.167	$0.327	$2,267	$0.005	$0.332	$0.014	$0.368
IAO TUNNEL	583,019	45,564	$9,684	$0.017	$231	2.4%	$9,453	$0.207	$0.016	$0	$0.000	$0.016	$0.014	$0.031
HAIKU	117,937	467,850	$85,119	$0.722	$5,489	6.4%	$79,630	$0.170	$0.675	$590	$0.005	$0.680	$0.036	$0.763
H'POKO	82,012									$410	$0.005	$0.005	$0.036	$0.041
KAPAKALUA	57,782	346,400	$108,932	$1.885	$44,737	41.1%	$64,195	$0.185	$1.111	$289	$0.005	$1.116	$0.036	$1.926
KANAHA 575	76,247	249,600	$46,865	$0.615	$3,685	7.9%	$43,180	$0.173	$0.566	$381	$0.005	$0.571	$0.045	$0.665
KANAHA 576	38,410	137,120	$28,407	$0.740	$3,784	13.3%	$24,623	$0.180	$0.641	$192	$0.005	$0.646	$0.045	$0.790
WAIPUKA	39,315	100,160	$23,438	$0.596	$5,104	21.8%	$18,334	$0.183	$0.466	$197	$0.005	$0.471	$0.045	$0.646
NAPILI A 569	26	6,400	$12,204	$0.000	$12,204	100.0%	$0	$0.000	$0.000	$0	$0.005	$0.005	$0.045	$0.000
NAPLI B 570	301,772	1,399,680	$235,204	$0.779	$21,175	9.0%	$214,029	$0.153	$0.709	$1,509	$0.005	$0.714	$0.045	$0.829
NAPILI C 571	243,244	1,120,960	$194,909	$0.801	$26,708	13.7%	$168,201	$0.150	$0.691	$1,216	$0.005	$0.696	$0.045	$0.851
HONOKAHUA A 572	0	600	$11,882	$0.000	$11,882	100.0%	$0	$0.000	$0.000	$0	$0.000	$0.000	$0.045	$0.000
HONOKAHUA B 573	255,306	1,008,000	$182,635	$0.715	$21,549	11.8%	$161,086	$0.160	$0.631	$1,277	$0.005	$0.636	$0.045	$0.765
HAMOA 597	73,102	82,214	$18,822	$0.257	$2,167	11.5%	$16,655	$0.203	$0.228	$366	$0.005	$0.233	$0.167	$0.429
KEANAE 592	20,935	44,560	$9,509	$0.454	$396	4.2%	$9,113	$0.205	$0.435	$105	$0.005	$0.440	$0.167	$0.626
WAKIU	33,593	46,960	$10,374	$0.309	$396	3.8%	$9,978	$0.212	$0.297	$168	$0.005	$0.302	$0.167	$0.481
KAWELA 551	137,388	150,469	$33,937	$0.247	$1,749	5.2%	$32,188	$0.214	$0.234	$687	$0.005	$0.239	$0.053	$0.305
UALAPUE	77,091	88,160	$13,394	$0.174	$1,606	12.0%	$11,788	$0.134	$0.153	$385	$0.005	$0.158	$0.053	$0.232
KUALAPUU	171,666	819,600	$192,626	$1.122	$13,915	7.2%	$178,711	$0.218	$1.041	$858	$0.005	$1.046	$0.053	$1.180
WAIKALAE TUNNEL	1,208	0	$0	$0.000	$0	0.0%	$0	$0.000	$0.000	$6	$0.005	$0.005	$0.053	$0.058

Period of record is Jan - Nov 2004 for most stations but Feb - Nov or March - Nov for some stations.
Chemical costs estimated at $0.005 per Kgal based on 2001 reported costs escalated; calculated in spreadsheet: *Well Pump Cost Estimating Rule 2.qpw*

DWS Well Electric Costs and Efficiency

CY2004	Vertical Lift Feet	Production Station Kgals Kgals	Electric Energy KWH	0 Electric Energy Unit Energy KWH/Kgal	Electric Unit Energy per Lift KWH/Kgal/Kfeet	Electric Cost Total $	Electric Cost Unit Cost $ per Kgal	Electric Cost Fixed $	Electric Cost Fixed % of Total	Electric Cost Variable $	Electric Cost Var Rate $/KWH	Electric Cost Variable $ per Kgal	Electric Unit Cost per Lift $/Kgal/Kfeet
MOKUHAU	358.0	1,391,724	2,650,800	1.90	5.32	$448,637	$0.322	$40,062	8.9%	$408,575	$0.154	$0.294	$0.820
WAIHEE	491.0	1,947,353	4,651,200	2.39	4.86	$821,523	$0.422	$30,217	3.7%	$791,306	$0.170	$0.406	$0.828
WAIEHU HTS	347.0	295,533	529,270	1.79	5.16	$112,933	$0.382	$25,663	22.7%	$87,270	$0.165	$0.295	$0.851
WAILUKU SHAFT	500.0	1,617,935	5,137,600	3.18	6.35	$843,307	$0.521	$62,953	7.5%	$780,354	$0.152	$0.482	$0.965
KEPANIWAI 511	78.0	307,202	345,760	1.13	14.43	$60,370	$0.197	$3,278	5.4%	$57,092	$0.165	$0.186	$2.383
NORTH WAIHEE	400.0	575,571	1,111,350	1.93	4.83	$208,796	$0.363	$26,455	12.7%	$182,341	$0.164	$0.317	$0.792
KANOA #1	400.0	376,962	836,700	2.22	5.55	$156,212	$0.414	$10,230	6.5%	$145,982	$0.174	$0.387	$0.968
KANOA #2	400.0	453,433	886,800	1.96	4.89	$158,454	$0.349	$10,131	6.4%	$148,323	$0.167	$0.327	$0.818
IAO TUNNEL	1000.0	583,019	45,564	0.08	0.08	$9,684	$0.017	$231	2.4%	$9,453	$0.207	$0.016	$0.016
HAIKU	826.0	117,937	467,850	3.97	4.80	$85,119	$0.722	$5,489	6.4%	$79,630	$0.170	$0.675	$0.817
H'POKO	1000.0	82,012	0	0.00	0.00	$0	$0.000	$0	0.0%	$0	#DIV/0!	$0.000	$0.000
KAPAKALUA	1235.0	57,782	346,400	5.99	4.85	$108,932	$1.885	$44,737	41.1%	$64,195	$0.185	$1.111	$0.900
KANAHA 575	591.0	76,247	249,600	3.27	5.54	$46,865	$0.615	$3,685	7.9%	$43,180	$0.173	$0.566	$0.958
KANAHA 576	591.0	38,410	137,120	3.57	6.04	$28,407	$0.740	$3,784	13.3%	$24,623	$0.180	$0.641	$1.085
WAIPUKA	456.0	39,315	100,160	2.55	5.59	$23,438	$0.596	$5,104	21.8%	$18,334	$0.183	$0.466	$1.023
NAPILI A 569	883.0	26	6,400	0.00	0.00	$12,204	$0.000	$12,204	100.0%	$0	$0.000	$0.000	$0.000
NAPLI B 570	883.0	301,772	1,399,680	4.64	5.25	$235,204	$0.779	$21,175	9.0%	$214,029	$0.153	$0.709	$0.803
NAPILI C 571	910.0	243,244	1,120,960	4.61	5.06	$194,909	$0.801	$26,708	13.7%	$168,201	$0.150	$0.691	$0.760
HONOKAHUA A 572	861.0	0	600	0.00	0.00	$11,882	$0.000	$11,882	100.0%	$0	$0.000	$0.000	$0.000
HONOKAHUA B 573	861.0	255,306	1,008,000	3.95	4.59	$182,635	$0.715	$21,549	11.8%	$161,086	$0.160	$0.631	$0.733
HAMOA 597	352.0	73,102	82,214	1.12	3.20	$18,822	$0.257	$2,167	11.5%	$16,655	$0.203	$0.228	$0.647
KEANAE 592	0.0	20,935	44,560	2.13	0.00	$9,509	$0.454	$396	4.2%	$9,113	$0.205	$0.435	$0.000
WAKIU	325.0	33,593	46,960	1.40	4.30	$10,374	$0.309	$396	3.8%	$9,978	$0.212	$0.297	$0.914
KAWELA 551	260.0	137,388	150,469	1.10	4.21	$33,937	$0.247	$1,749	5.2%	$32,188	$0.214	$0.234	$0.901
UALAPUE	250.0	77,091	88,160	1.14	4.57	$13,394	$0.174	$1,606	12.0%	$11,788	$0.134	$0.153	$0.612
KUALAPUU	1040.0	171,666	819,600	4.77	4.59	$192,626	$1.122	$13,915	7.2%	$178,711	$0.218	$1.041	$1.001
WAIKALAE TUNNEL	0.0	1,208	0	0.00	0.00	$0	$0.000	$0	0.0%	$0	$0.000	$0.000	$0.000

Period of record is Jan - Nov 2004 for most stations but Feb - Nov or March - Nov for some stations.
Chemical costs estimated at $0.005 per Kgal based on 2001 reported costs escalated; calculated in spreadsheet: *Well Pump Cost Estimating Rule 2.qpw*

DWS Booster Pump Volume and Electric Costs

CY2004	Production Station Kgals Kgals	Electric Energy KWH	Electric Energy Unit Energy KWH/Kgal	Electric Cost Total $	Electric Cost Unit Cost $ per Kgal	Electric Cost Fixed $	Electric Cost Fixed % of Total	Electric Cost Variable $	Electric Cost Var Rate $/KWH	Electric Cost Variable $ per Kgal
WAIALE	156,418	308,480	1.97	$65,888	$0.421	$8,547	13.0%	$57,341	$0.186	$0.367
WKU HTS 31	133,409	299,800	2.25	$64,236	$0.481	$8,393	13.1%	$55,843	$0.186	$0.419
WKU HTS 30	37,229	52,100	1.40	$11,192	$0.301	$396	3.5%	$10,796	$0.207	$0.290
M.MDS 17	530,685	1,035,040	1.95	$188,057	$0.354	$21,175	11.3%	$166,882	$0.161	$0.314
M.MDS 18	141,411	180,160	1.27	$35,768	$0.253	$3,960	11.1%	$31,808	$0.177	$0.225
POOKELA	208,567	256,000	1.23	$62,987	$0.302	$14,817	23.5%	$48,170	$0.188	$0.231
MALUHIA	107,153	222,080	2.07	$71,355	$0.666	$32,153	45.1%	$39,202	$0.177	$0.366
OLIN 50K	94,235	193,920	2.06	$60,240	$0.639	$19,157	31.8%	$41,083	$0.212	$0.436
KULA KAI	157,901	342,750	2.17	$78,051	$0.494	$11,506	14.7%	$66,545	$0.194	$0.421
H.FIELDS	157,573	362,560	2.30	$79,249	$0.503	$9,812	12.4%	$69,437	$0.192	$0.441
NAGAMATSU	109,415	368,850	3.37	$78,950	$0.722	$9,515	12.1%	$69,435	$0.188	$0.635
H. ACRES	9,233	30,400	3.29	$6,820	$0.739	$396	5.8%	$6,424	$0.211	$0.696
PAIA MCC	143,707	192,960	1.34	$40,123	$0.279	$4,906	12.2%	$35,217	$0.183	$0.245
SKILL VIL	29,896	27,680	0.93	$6,101	$0.204	$396	6.5%	$5,705	$0.206	$0.191
KOALI	7,717	17,029	2.21	$3,697	$0.479	$231	6.2%	$3,466	$0.204	$0.449
KALAE, MOL	12,247	22,240	1.82	$6,991	$0.571	$363	5.2%	$6,628	$0.298	$0.541
KULA AG A	203,464	394,400	1.94	$82,792	$0.407	$7,953	9.6%	$74,839	$0.190	$0.368
KULA AG B	84,024	400,400	4.77	$96,176	$1.145	$22,187	23.1%	$73,989	$0.185	$0.881
KEANAE	22,115	44,560	2.01	$9,507	$0.430	$396	4.2%	$9,111	$0.204	$0.412
N. WAIHEE	992,820	868,200	0.87	$163,083	$0.164	$21,175	13.0%	$141,908	$0.163	$0.143

DWS Booster Pump Electric Costs and Efficiency

CY2004	Vertical Lift Feet	Production Station Kgals Kgals	Electric Energy KWH	Electric Energy Unit Energy KWH/Kgal	Electric Unit Energy per Lift KWH/Kgal/Kft	Electric Cost Var Rate $/KWH	Electric Cost Variable $ per Kgal	Electric Unit Cost per Lift $/Kgal/Kft
WAIALE	402.0	156,418	308,480	1.97	4.91	$0.186	$0.367	$0.912
WKU HTS 31	388.0	133,409	299,800	2.25	5.79	$0.186	$0.419	$1.079
WKU HTS 30	210.0	37,229	52,100	1.40	6.66	$0.207	$0.290	$1.381
M.MDS 17	361.0	530,685	1,035,040	1.95	5.40	$0.161	$0.314	$0.871
M.MDS 18	240.0	141,411	180,160	1.27	5.31	$0.177	$0.225	$0.937
POOKELA	250.0	208,567	256,000	1.23	4.91	$0.188	$0.231	$0.924
MALUHIA	404.0	107,153	222,080	2.07	5.13	$0.177	$0.366	$0.906
OLIN 50K	306.0	94,235	193,920	2.06	6.72	$0.212	$0.436	$1.425
KULA KAI	375.0	157,901	342,750	2.17	5.79	$0.194	$0.421	$1.124
H.FIELDS	365.0	157,573	362,560	2.30	6.30	$0.192	$0.441	$1.207
NAGAMATSU	370.0	109,415	368,850	3.37	9.11	$0.188	$0.635	$1.715
H. ACRES	284.0	9,233	30,400	3.29	11.59	$0.211	$0.696	$2.450
PAIA MCC	134.0	143,707	192,960	1.34	10.02	$0.183	$0.245	$1.829
SKILL VIL	189.0	29,896	27,680	0.93	4.90	$0.206	$0.191	$1.010
KOALI	427.0	7,717	17,029	2.21	5.17	$0.204	$0.449	$1.052
KALAE, MOL		12,247	22,240	1.82		$0.298	$0.541	
KULA AG A	370.0	203,464	394,400	1.94	5.24	$0.190	$0.368	$0.994
KULA AG B	486.0	84,024	400,400	4.77	9.81	$0.185	$0.881	$1.812
KEANAE		22,115	44,560	2.01		$0.204	$0.412	
N. WAIHEE	91.0	992,820	868,200	0.87	9.61	$0.163	$0.143	$1.571

Treatment Plant Production Costs

W/Updated Iao TP Production Costs		2004 TOTAL
Piiholo		**1,082,556**
Station SR Marginal Cost/Kgal	WChrg+Chem+VarElec	**$0.242**
Station Fixed Operation Cost/Kgal	Labor+FixedElec	**$0.235**
Station Total Operating Cost/Kgal		**$0.477**
Station Capital Cost/Kgal	Depreciation	**$1.037**
Station Total Cost/Kgal		**$1.514**
Kamole		**982,104**
Station SR Marginal Cost/Kgal	WChrg+Chem+VarElec+Memcor	**$0.995**
Station Fixed Operation Cost/Kgal	Labor+FixedElec	**$0.328**
Station Total Operating Cost/Kgal		**$1.324**
Station Capital Cost/Kgal	Depreciation - Memcor	**$0.693**
Station Total Cost/Kgal		**$2.016**
Olinda		**361,970**
Station SR Marginal Cost/Kgal	WChrg+Chem+VarElec+Memcor	**$0.572**
Station Fixed Operation Cost/Kgal	Labor+FixedElec	**$0.260**
Station Total Operating Cost/Kgal		**$0.832**
Station Capital Cost/Kgal	Depreciation - Memcor	**$0.902**
Station Total Cost/Kgal		**$1.734**
Iao	***Based on 2 Mos New Config.***	**60,372**
Station SR Marginal Cost/Kgal	WChrg+Chem+VarElec+Memcor	**$0.721**
Station Fixed Operation Cost/Kgal	Labor+FixedElec	**$0.247**
Station Total Operating Cost/Kgal		**$0.969**
Station Capital Cost/Kgal	Depreciation	**$0.000**
Station Total Cost/Kgal		**$0.969**
Mahinahina		**664,941**
Station SR Marginal Cost/Kgal	WChrg+Chem+VarElec	**$0.137**
Station Fixed Operation Cost/Kgal	Labor+FixedElec	**$0.239**
Station Total Operating Cost/Kgal		**$0.375**
Station Capital Cost/Kgal	Depreciation	**$1.225**
Station Total Cost/Kgal		**$1.600**
Lahaina		**591,527**
Station SR Marginal Cost/Kgal	WChrg+Chem+VarElec+Memcor	**$0.337**
Station Fixed Operation Cost/Kgal	Labor+FixedElec	**$0.265**
Station Total Operating Cost/Kgal		**$0.602**
Station Capital Cost/Kgal	Depreciation - Memcor	**$0.993**
Station Total Cost/Kgal		**$1.595**