LUMMI NATION
WATER CONSERVATION PLAN

March 2004

WATER CONSERVATION PLAN

FOR THE LUMMI INDIAN RESERVATION

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1. INTRODUCTION

Pursuant to Lummi Indian Business Council (LIBC) resolutions 90-88 and 92-43, the Lummi Water Resources Division (LWRD) is developing a Comprehensive Water Resources Management Program (CWRMP) to protect water resources of the Lummi Nation. The LWRD of the Lummi Natural Resources Department is responsible for developing and implementing the CWRMP. This Water Conservation Plan is integral to the Lummi Nation Wellhead Protection Program (LWRD 1997, LWRD 1998), which is a primary element of the CWRMP.

The purpose of this Water Conservation Plan is to provide guidelines to conserve the Lummi Indian Reservation (Reservation) water supply. This report identifies water conservation strategies that support efforts to reliably provide high quality potable water to a growing population within a developing service area. The goal of the Water Conservation Plan is to identify, support, and implement water efficiency and conservation strategies that will reduce the effects of increasing demands on water supply sources, and thereby extend the existing system's usable capacity. The Water Conservation Plan is intended to protect the Lummi Nation's ground water resources, while providing for future tribal growth and development. Because locally available ground water is currently the primary water supply on the Reservation, water conservation will substantially affect the economic security, political integrity, and the health and welfare of the Lummi Nation and all persons present on the Reservation.

The primary goal of a public water supply system is to reliably deliver adequate quantities of high quality water to its customers. A water conservation strategy that addresses both supply and demand can help achieve this goal by reducing the effects of increased demands on water supply resources and thereby extending their usable capacity. The three main approaches to municipal water conservation are the use of voluntary conservation measures, economic measures such as metering and pricing, and mandatory measures including regulations and restrictions (Lyon 1978).

Protection and conservation of ground water quantity and quality on the Reservation is a high priority for the Lummi Nation, due to the following considerations:

- As a finite resource, ground water is one of the most important and critical of the Lummi Nation's natural resources.
- An ample supply of ground water of high quality is essential to serve the purposes of the Reservation as the permanent, economically viable homeland of the Lummi Nation and its citizens.
- Over 95 percent of the Reservation's domestic, commercial, municipal, and industrial water supply is currently pumped from on-Reservation ground water wells.
- Ground water is the only source of water on the Reservation that can be developed for potable domestic supply with minimum treatment.
- Utilization of surface water that would meet drinking water standards requires expensive treatment facilities.

- Salt-water intrusion due to over pumping could lead to the loss of the primary water supply source for the Reservation because water supply wells are difficult to replace and ground water contamination can be expensive and/or impossible to treat.
- Purchase of water from the City of Bellingham or other sources at current rates is considerably more expensive than developing the ground water sources to serve Reservation residents.

This Water Conservation Plan is based on a literature review and on the Water Conservation Plan Guidelines prepared by the U.S. Environmental Protection Agency (EPA 1988). This plan is divided into the following sections:

- Section 1 is this introductory section.
- Section 2 describes the existing water supply sources and systems on the Reservation.
- Section 3 describes selected water conservation measures.
- Section 4 presents an action plan.
- Section 5 summarizes the Water Conservation Plan.
- Section 6 lists the references cited in the report.

2. EXISTING RESERVATION WATER SUPPLY SOURCES AND SYSTEMS

The Lummi Reservation is located in the northwest portion of Washington State at the northern extent of Puget Sound and the southern extent of Georgia Strait (Figure 1). The Reservation uplands are comprised of four main areas: the Northwestern Reservation (which includes the Sandy Point peninsula), the Nooksack and Lummi River floodplain, the Lummi Peninsula, and Portage Island.

In this section, the existing water supply sources and distribution systems on the Reservation are described.

2.1 Reservation Water Supply Sources

There are two main aquifer systems on the Reservation: the Lummi Peninsula aquifer system and the Northwestern Lummi aquifer system. The geologic unit for these aquifer systems is the sand and gravel sediment deposited in advance of the Vashon glacier, which is overlaid in places by a relatively impermeable glaciomarine drift (interbedded lenses of sand, silt, and clay) and glacial till. The upper sand lenses in some locations provide limited supply for individual wells, and function as storage for recharge of the deep aquifers.

There are approximately 38 miles of marine/saltwater shoreline on the Reservation. Salt water surrounds the Reservation to the east, west, and south, and Reservation aquifers have been shown to be underlain with salt water. Several wells on the Reservation have been affected by salt-water intrusion such that pumping of those wells has been reduced or curtailed.

The source of recharge for the Reservation aquifers is seasonal precipitation. The source of recharge for the Lummi Peninsula aquifer system is precipitation that occurs on-Reservation. The source of recharge for the Northwestern Lummi aquifer system is precipitation both on-Reservation and off-Reservation in the adjacent Mountain View upland. Discharge from both aquifer systems occurs by way of offshore springs, springs along the slopes of the uplands, and ground water withdrawals (USGS 1974). The yield of ground water wells on the Reservation is generally low and variable over short distances. In general, wells on the Reservation yield less than one gallon per minute (gpm) up to approximately 60 gpm (USGS 1974). Yields of Lummi Water District operated wells on the Lummi Peninsula currently average about 22 gpm.

Under a perpetual contractual agreement, the Lummi Water District can also purchase up to 1,000 gallons per minute (1.44 million gallons per day) from the City of Bellingham through a 10-inch intertie. Although the Lummi Water District has access to City of Bellingham water, its high cost and concerns about the impact of diversions from the Nooksack River fisheries resources limit the utilitization of the Bellingham supply source for the water district. Currently the Bellingham supply is viewed only as a stand-by source for the water district. In 2001 and 2002 about five percent of the water supplied by the district came from the Bellingham source. Local ground water is the only water

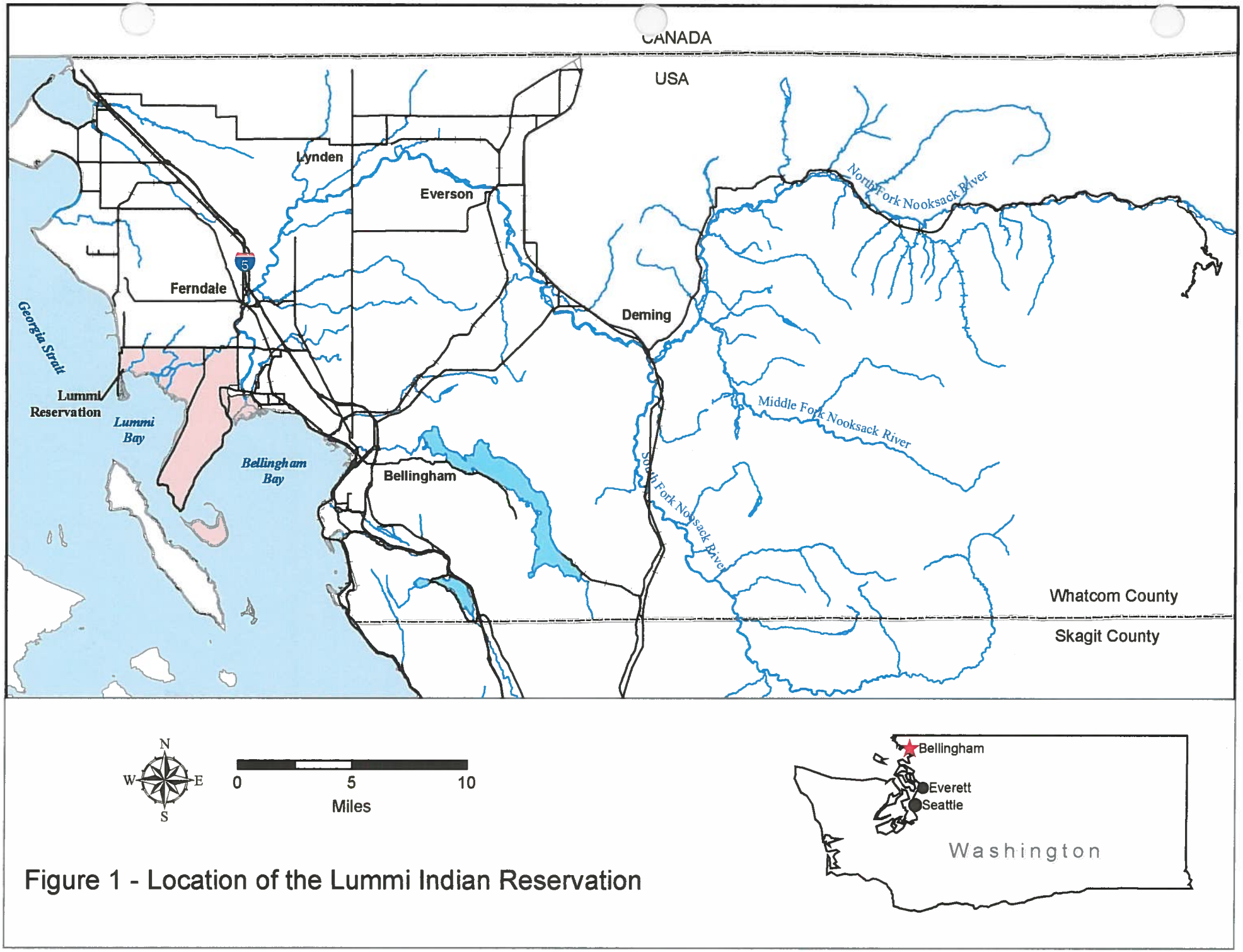

Figure 1 - Location of the Lummi Indian Reservation

source available to Reservation residents who are not supplied by the Lummi Water District.

2.2 Reservation Water Distribution Systems

Currently, there are four categories of water purveyors on the Reservation. The Lummi Water District operates and maintains the largest water system on the Reservation. The Lummi Water District currently operates a network of four production wells. Non-tribal water associations are the second category of water purveyor on the Reservation. There are currently nine non-tribal water associations (Neptune Beach, Sandy Point Improvement Company, Gooseberry Point, Sunset, Georgia Manor, Harnden Island View, Leeward-Northgate, Gulfside Mobile Home, and Kel Bay) which serve predominately non-tribal members in residential areas along the Reservation shorelines. The third category of water purveyors is represented by the approximately 129 individual or small group domestic water supply wells. The fourth category is the Lummi Natural Resources Department operated system that supplies untreated surface and ground water for the Lummi Nation salmon propagation program.

Prior to the 1960s, Reservation residents generally obtained water from springs, hand dug wells, or relied on water hauled from community wells. The water distribution system that was to become the Lummi Water District system was constructed beginning in 1964 with funding provided by the Indian Health Service (IHS) under P.L. 86-121 (Projects PO-63-832 and PO-63-839). In the first projects, eight small low-pressure community systems relying on 22 individual wells were developed to serve 86 families (LWRD 1995). From that point forward, the Lummi Water District system expanded to meet the needs of the growing community.

The Lummi Water District serves the Reservation in two separate subsystems: the Lummi Peninsula water system and the Lake Terrell/North Red River Road water system. The Lummi Peninsula subsystem currently serves most of the tribal members on the Reservation and approximately 81 non-tribal residences (16 percent of customers). There are currently approximately 505 active residential connections and 60 commercial/municipal customers of the Lummi Water District's Lummi Peninsula subsystem. The subsystem currently obtains water primarily from four tribal wells with a combined capacity of about 150 gpm. There are currently two operational water storage tanks with a combined capacity of 350,000 gallons. The distribution system consists mainly of 10-inch ductile iron (DI), 6- and 8- inch polyvinyl chloride (PVC), and 4-inch asbestos cement (AC) pipe, but also has various sections of pipe that vary from 10-inch high-density polyethylene (HDPE) to 3-inch AC and 2½-inch polyethylene (PE). The total length of the Lummi Peninsula distribution system is approximately 108,000 feet, or over 20 miles. The Lummi Water District currently purchases water for its Lake Terrell/North Red River Road subsystem from the Sandy Point Improvement Company under a 1972 agreement. This distribution system, which has been operated and maintained by the Lummi Water District since its construction, currently provides water

to approximately 35 tribal residences. The approximate length of the Lake Terrell/North Red River Road subsystem is 4,500 feet.

3. CONSERVATION MEASURES

The three main approaches to water conservation are the use of voluntary conservation measures, economic measures such as metering and pricing, and mandatory measures including regulations and restrictions (Lyon 1978). The Lummi Nation water conservation strategy will include each of these components:

- Voluntary conservation measures, including public education, implementation of a rebate/retrofit kit program, a leak detection and repair program, and a water audit program. A water-saving community facility/pilot program is also being considered.
- Economic measures, including the evaluation of existing water rates and identification of a new water rate structure.
- Mandatory conservation measures, including development of regulations to reduce average daily water demand and demand during droughts or other water-supply emergencies.

Within the next five years the Lummi Nation will implement the initial phases of a water conservation program, which includes these identified components and an effort to monitor and evaluate its effectiveness. The following sections discuss the types of programs that will be included in the conservation effort. The Lummi Nation already has some programs established for several of the recommended conservation measures. For those measures that do not have established programs, recommendations are provided.

3.1 Voluntary Conservation Measures

In this section, voluntary conservation measures that will be included in the Lummi Nation Water Conservation program are described.

3.1.1 Public Education

Public education is the most essential component of a successful water conservation program (Maddaus 1987). A number of tools can be used as part of a public education campaign, including utility bill inserts, feature articles, workshops, booklets, posters, bumper stickers, the distribution of water-saving devices, and a water conservation demonstration program. The emphasis of the public education campaign will be to promote an understanding that efficient water use can have major environmental, public health, and economic benefits by helping to improve water quality, maintain aquatic ecosystems, and protect drinking water resources.

According to Maddaus (1987), water conservation initiatives are more likely to succeed if they are socially acceptable. Measuring social acceptability will be accomplished with a two-part survey technique. First, interviews with community leaders will be conducted to identify the conservation measures that will be most acceptable to the community. Second, the acceptability of the identified conservation measures will be evaluated via a questionnaire mailed to a random sample of water customers.

A component of the public education effort related to water conservation will focus on changing behavioral practices. Behavioral practices include changing water use habits to use water more efficiently in a home. Changed behavioral practices that result in water conservation can be applied both indoors (e.g., kitchen, bathroom, laundry room) and outdoors (e.g., landscaping, car washing). Overall acceptance of conservation measures is strongly related to attitudes about the importance of water conservation, as well as to age and income (Maddaus 1987). The public generally accepts lawn watering restrictions, education, home water-saver kits, low-flush toilet rebates, and a low-flow fixtures ordinance for new construction (Maddaus 1987).

Education and outreach are important components of an overall water conservation strategy. Contacts through the Reservation schools will be emphasized as a mechanism to help socialize young people about the value of water and conservation techniques, as well as help schools and students communicate with parents.

3.1.2 Retrofit and Rebate Program

Retrofitting is the replacement of existing plumbing fixtures with plumbing fixtures that use less water. A rebate program involves reimbursing customers who install new water saving devices in their homes or businesses. The most successful water-saving fixtures operate in the same manner as the fixtures they replace, such as low flow faucets, low-flow showerheads, and low-flow toilets. Both techniques encourage permanent water savings and can be implemented with little or no additional cost over their lifetimes (Jensen 1991).

Nationally, toilet-water use constitutes 38 to 45 percent of interior water use (Consumers Union 1990) and is the largest single use of indoor water. In households that do not utilize water-efficient fixtures, toilets used the most water on a daily basis (20.1 gallons per day per person) and clothes washers were the second largest water user (AWWA 1999). Bath and shower water consume about 30 percent of indoor water in an average home (AWWA 1999).

The Lummi Code of Laws contains provisions specifying plumbing fixtures in its Sewer Code (Title 16) and Building Code (Title 22). A revised Building Code (Title 22) was adopted in 2004. Chapter 22.03 of the 2003 Building Code (Title 22) adopts the Uniform Plumbing Code, 2000 Edition, published by the International Association of Plumbing and Mechanical Officials, together with supplements and amendments thereto. The UPC requires toilets to consume not more than 1.6 gallons per flush, and requires lavatory faucets/shower heads to not exceed a water flow rate of 2.5 gallons per minute. As a result, all new housing units on the Reservation are required to incorporate water conservation fixtures. In addition, as part of the Lummi Nation Water Resources Protection Code (Title 17), regulations related to the Wellhead Protection Program will be developed to reduce daily water demand and water demands during droughts or other water-supply emergencies.

3.1.3 Water Audit Program

A water audit program provides information to the purveyor and the customer that shows where and how water is used in the home or business. A water use evaluation report typically includes a water balance, a listing of opportunities for water conservation, and an estimated payback period for each recommended conservation measure. Water audits can be directed at residential, municipal, commercial, or industrial water users.

Water audits targeted to older and low-income homes can be particularly beneficial in terms of identifying and repairing plumbing leaks. Targeted programs will be designed in cooperation with community organizations, such as the Lummi Housing Division, and a retrofit and/or rebate program will be part of a residential water-use audit program.

The Lummi Water District (LWD) will develop and offer a water audit and efficiency program for the top 20 water users on the Reservation, focusing on tribally owned facilities. Following the audit, the LWD Superintendent and LWD staff will evaluate the costs and benefits of repairing all of the identified leaks, and will seek funding to institute a comprehensive leak detection and repair strategy. This strategy will include regular on-site testing using computer assisted leak detection equipment, a sonic leak-detection survey, or other acceptable methods for detecting leaks along water distribution mains, valves, services, and meters. An audit program can be selective in terms of targeting customer groups that have particular needs or for which water conservation would be particularly beneficial.

The Lummi Water District will use an index of water efficiency, or "W-Index" (DeCook et al. 1988), to evaluate residential water savings and as a way to motivate residents to adopt water-saving practices. The W-Index provides a calculated numerical value that is derived from the number and kind of water-saving features present. Typically, a W-Index rating of W-50 would be considered fair, W-80 good, and W-110 excellent, based on a specific set of community water conservation goals (DeCook et al. 1988). Use of the W-Index will be promoted via the public education campaign, and if customers volunteer to be rated, LWD staff will calculate the W-Index.

3.1.4 Leak Detection Program

Leak detection is a systematic method of using listening equipment or other means to survey a water distribution system, identify leaks by sound, and locate the exact locations of hidden underground leaks. Accurate determination of the position of leaks within a supply system and subsequent repair improves operational efficiency, lowers system costs, and reduces cross-contamination risk. In general, a 10 to 20 percent allowance for unaccounted-for-water is normal (Lahlou 2001). A survey of water meters should be undertaken whenever the rate of unaccounted for water exceeds 10 percent. When water loss exceeds 20 percent, priority attention and corrective actions should be undertaken. In general, advances in technologies and expertise should make it possible to reduce losses and unaccounted-for-water to less than 10 percent (Lahlou 2001).

A survey conducted by the LWD in 2000 indicated that unaccounted-for water was 18.2 percent of the total water supplied (Solomon, personal communication). Because this estimate is greater than 10 percent, a leak detection program will be implemented in the next two years. The goal of leak detection will be to employ the necessary corrections to lower the rate of unaccounted-for water. Proper implementation of a leak detection program will reduce rates of unaccounted-for water to a goal of below 10 percent of total water production. Future development can be expected to further decrease the amount of water lost as newer piping, services, meters, and facilities begin to predominate.

Efficient water use will also be promoted by increased maintenance of the existing distribution system valves and meters. Valves will be checked and exercised yearly, and will be repaired if necessary. The AWWA recommends that utilities test 2- and 4-inch meters every one to three years, and test 6-inch meters every year. Small customer meters should be replaced and/or calibrated after 10 to 15 years of service. A meter testing service will be sought to assess the accuracy of a representative number of the oldest meters in the system. If results of these tests indicate inaccuracy, appropriate measures will be undertaken to correct the deficiencies including water meter replacement.

Although engineering guidelines identify minimum water pressure requirements for systems for average daily demand, maximum daily demand, and fireflow conditions, system water pressure in excess of 60 pounds per square inch (psi) can negatively affect a water system. Water pressure management in the distribution system can save a significant quantity of water. Lower water pressure decreases system deterioration, reducing the need for repairs and extending the life of existing facilities. Furthermore, lower pressures can help reduce wear on end-use fixtures and appliances.

An evaluation of the accuracy of the meters at the four Lummi Water District production wells indicated that these meters indicated flows that were between 74 and 92 percent of actual flows (AESI 1999). It is noted that the accuracy of the water meters at the wells and throughout the distribution system should be determined prior to conducting a water audit to ensure that the audit results are valid and are not simply reflecting inaccuracies in

water meters. Production well meters will be calibrated annually in order to accurately assess unaccounted-for water.

A process such as the one presented in the following outline is needed to identify existing leaks:

1. Determine the accuracy of the meters that will be used in the water audit.
2. Perform a survey to determine obvious leaks and water losses through malfunctioning pumps, valves, and other appurtenances.
3. Measure flow by isolating each distribution zone, then listening to water movement, testing pressures, and watching tank levels and meters to quantify leakage.
4. Pinpoint leaks with listening devices and record the size and location of leaks.
5. Repair the discovered leaks. Depending upon the extent of the leaks, repairs or replacement may need to be scheduled into a capital improvement program.

3.1.5 Community Facility

Another way to provide public information and education is through the use of a community demonstration project. In Tucson, Arizona, the Casa del Agua has been used to demonstrate and study water conservation and reuse techniques and technologies for a single-family home. Measurements of water use and water quality at the Casa del Agua have provided a useful collection of data for evaluating the possible benefits of conservation techniques and technologies in a residential home (Karpiscak et al. 1991).

In response to the water shortage being experienced both locally and nationally, an increased demand has emerged for alternative means of watering garden areas with grey water. Grey water is defined as "untreated household wastewater that has not come in contact with toilet waste and includes wastewater from bathtubs, showers, washbasins, clothes washing machines and laundry tubs, but does not include wastewater from kitchen sinks or dishwashers or laundry water from the washing of material soiled with human excreta, such as diapers." Blackwater is wastewater generated from toilets and must never be used for garden watering without extensive treatment.

One possibility for a community demonstration project is the construction of a tribally-owned community laundry facility that uses high efficiency washing machines and clothes driers. In conjunction with this facility, the use of recycled grey water could be considered, although tribal building codes would need to be revised before gray water use could be undertaken. The preferred and safest disposal/dispersal method for gray water is irrigation below the soil surface in garden beds to minimize exposure to humans. Because most outdoor irrigation is seasonal, it will be necessary to divert gray water to the sanitary sewer during the non-growing season to prevent waterlogging and surface run-off. Other possible uses of gray water generated from the demonstration facility could include irrigation of fruit trees, ground cover, and ornamental trees and shrubs. Reclaimed water could also be used for dust control and compaction at construction sites (LWRD 1998).

3.1.6 Summary of Potential Water Savings

The potential savings from rebate and retrofitting, water audit, and leak detection programs are summarized below and in Table 1.

Toilet Retrofit and Rebate Program: Toilet flushing is the largest single indoor user of water. The majority of toilets in use today are less efficient than the 1.6 gallon-per-flush toilets required to be installed in new homes because they exist in homes and apartments that were built before 1997. Initiating a toilet retrofit and rebate program on the Lummi Reservation has the potential to save approximately 4.3 million gallons over a five-year period.

Plumbing Retrofit Program for Residential Users: A less expensive approach than buying new fixtures and appliances is installing retrofit kits for faucets and shower heads that lower the amount of water that is used. While the savings from these seemingly minor measures seem small, they add up when many people take these steps simultaneously. A plumbing retrofit program for residential users on the Lummi Reservation has the potential to save approximately 2.0 million gallons per year after 250 installations have been completed.

Plumbing Retrofit Program for Tribal Facilities: Replacement of toilets and plumbing fixtures in Tribally owned facilities have the potential to save approximately 1.5 million gallons per year.

Implementation of Leak Detection Programs: Implementation of a leak detection program that reduces system losses from 18 percent to 10 percent has the potential to save approximately 5.2 million gallons per year at year 2000 production rates. Leak detection investigations should be required every 2 years.

Table 1 – Potential Savings from Water Conservation Measures Implemented 2005-2010

Conservation Action	Cost and Funding Source	Approximate Savings in Gallons per Year	Proposed Implementation Date
Toilet Rebate Program (1.6 gallon-per-flush toilets for older homes to replace 4.0 or more gallon-per-flush toilets)	$100 per unit Grant funding will be sought	~24 gallons per day savings per household; 100 installations per year for five years will save ~4.3 million gallons after the fifth year	Project will begin in 2005, and will be increased in scope as the Reservation population increases.
Plumbing Retrofit Program (Low flow fixtures in older homes)	$25 or less per unit Grant funding will be sought	~22 gallons per day per household; 50 installations per year for five years will save ~2.0 million gallons after 250 installations	Project will begin in 2005, but cannot be increased in scope because new housing will begin to predominate as Reservation population increases.
Plumbing Retrofit Program for Tribally-owned facilities	Cost is not determined Grant funding will be sought	100 toilets will be replaced, each saving ~3 gallons per flush or ~1.5 million gallons per year using 14 flushes per day per toilet	Project will begin in 2005, but cannot be increased in scope because new Tribal facilities will begin to predominate in the future.
Water Audit and Retrofit Program for top 20 water users on the Reservation	Cost is not determined Grant funding will be sought	Estimate not available	Project will begin in 2005.
Implementation of Leak Detection Program	$59,955 per year	If leaks are reduced from 18% to 10%, approximately ~5.2 million gallons will be saved per year At the year 2000 production rate	Project will begin in 2005, and will be increased in scope as infrastructure is expanded to meet increased population.

Summary of potential water savings with implementation of proposed measures: up to approximately 13.0 million gallons per year after measures are implemented.

3.2 Economic Measures

Although an essential element of water conservation efforts, information and education promoting water conservation does not appear to be an effective method for achieving conservation goals unless financial incentives are also offered (Maddaus 1987). In general, customers use less water when they have to pay more for it and use more when they know they can afford it or it does not increase their costs. Rate structures designed to encourage conservation have the advantage of avoiding the costs of overt regulation, restrictions, and policing while retaining a greater degree of individual freedom of choice for water users.

Demand for water varies in response to a number of factors (e.g., climate, water price, number and type of water-conserving fixtures, landscaping, and income). In order to meet their obligation, water purveyors must have the capacity to satisfy peak demand. Since the peak day demand is typically around 2.5 times greater than the average daily demand for water purveyors (although it may be up to four times greater than the average daily demand), satisfying this demand results in excess distribution system capacity for most of the year (Martin et al. 1984). Consequently, if water companies and the political entities that govern their operation can reduce demand during peak periods, large capital expenditures to increase conveyance capacity can be postponed or avoided and financial resources used to address other community requirements.

A rate/pricing system should promote a sensible use of water in which prices ideally reflect the true and complete social costs of providing water – especially regarding resource depletion (OECD 1987). Quantitative resource depletion, such as lowering the water table or causing saltwater intrusion by excess pumping, should be valued by the costs that would have to be incurred to replace that water supply with one of equal quality.

3.2.1 Water Rates

Rate structures employed by public and private water supply companies include flat-rate charges, average cost pricing, declining block rates, increasing block rates, commodity surcharge, lifelines, peak demand surcharges, seasonal differentials, as well as lift and remote area surcharges (AWWA 1999). Adopting a water rate structure that encourages water conservation can be a very effective strategy (AWWA 1999). By structuring water rates to be more expensive at certain usage levels or during certain time periods, customers will be encouraged to consume less water overall during peak water use periods. It is important to note that conservation-oriented rates are meant to restructure rate components rather than increase overall rates.

The existing rate structure of the Lummi Water District is best described as a "commodity surcharge" or a per-unit charge for the quantity of water consumed. Water service within the LWD was billed on a flat rate basis until July 1992, when the LIBC passed a resolution authorizing new graduated rates for residential uses. The residential rates being charged as of January 2004 are $19.23 for the first 600 cubic feet, (~4,500

gallons) and $1.62 for each additional 100 cubic feet (~748 gallons). A graphic representation of the existing rate structure is provided in Figure 1. A graphic representation of monthly cost incurred from this rate structure is shown in Figure 2.

Inverted block rates are rates for which the price per "unit" of water rises with each successive block of use. Rates are charged per unit and increase as the level of consumption increases. For example, a single-family residence that uses under 600 cubic feet a month pays $19.23 for the first unit. If between six and ten units are used, the price increases for the second block of 100 cubic feet increases to $1.62 per unit. The price per unit could then increase to $3 per unit when between 10 and 13 units are used. The price per unit could then increase to $5 per unit when over 13 units are used. A graphic representation of this hypothetical inverted block rate structure is provided below in Figure 3. A graphic representation of monthly cost incurred from this hypothetical example is provided in Figure 4.

The number of units in a block and the cost increase per block needs to be evaluated and the structure and associated costs shown in Figure 3 and 4 are hypothetical. This type of rate structure would apply to all customer classes. The inverted block rate structure provides a monetary incentive to conserve water on a year-round basis and can help control peak demand during the summer months. With this type of rate structure, customers with high levels of consumption face increasingly higher water bills and customers with low consumption have relatively lower water bills. Seasonal increases in the block rates can also be incorporated into the rate structure to further encourage conservation during summer months.

Table 2 illustrates how the monthly cost of the existing rate structure would compare with the monthly cost of the hypothetical inverted block rate structure. As shown in Table 2, customers who use 1,000 cubic feet per month (7,480 gallons or about 250 gallons per day per connection) would pay the same monthly cost under either rate structure. Customers who use more than 1,000 cubic feet per month would then start paying considerably more under the hypothetical inverted block rate structure.

Figure 1 - Lummi Water District Rate Structure (January 2004) Price Increments

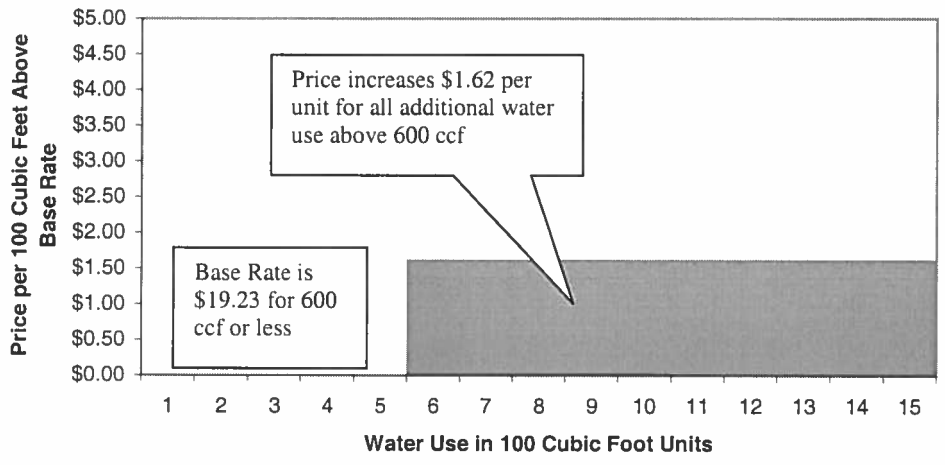

Figure 2 - Lummi Water District Rate Stucture (January 2004) - Monthly Cost

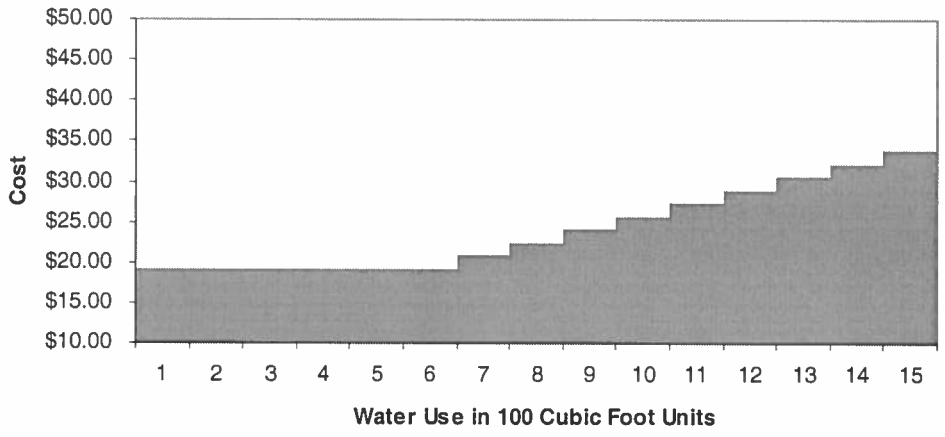

Figure 3 - Hypothetical Example of Inverted Block Rate Price Structure - Price Increments

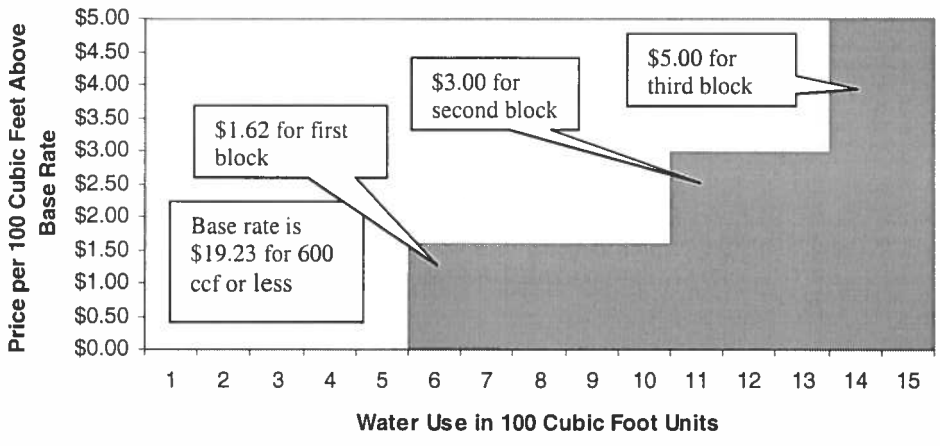

Figure 4 - Hypothetical Example of Inverted Block Rate Structure - Montly Cost

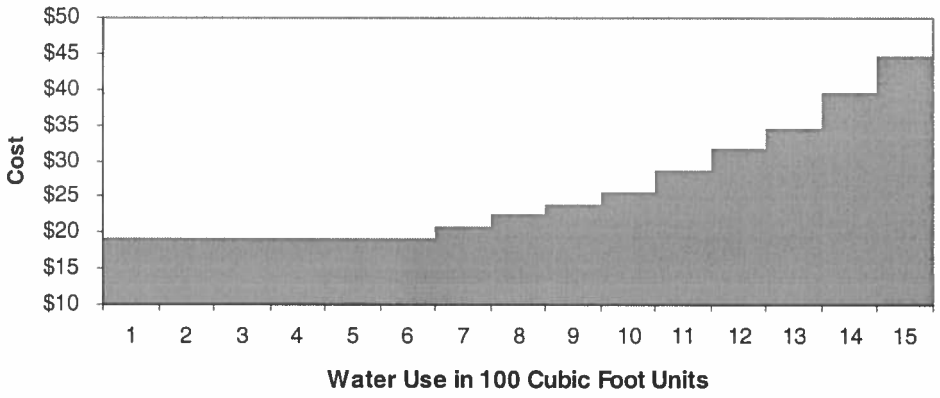

Table 2. Comparison of Monthly Water Costs for Existing and Hypothetical Inverted Block Rate Structure

Monthly Water Use (Cubic Feet)	Monthly Cost Current Rate Structure	Monthly Cost Hypothetical Block Rate Structure
0-600	$19.23	$19.23
600-700	$20.85	$20.85
700-800	$22.47	$22.47
800-900	$24.09	$24.09
900-1000	$25.71	$25.71
1000-1100	$27.33	$28.71
1100-1200	$28.95	$31.71
1200-1300	$30.57	$34.71
1300-1400	$32.19	$39.71
1400-1500	$33.81	$44.71

3.3 Mandatory Measures

As described above, the Lummi Code of Laws contains provisions specifying plumbing fixtures in its Sewer Code (Title 16) and Building Code (Title 22). A revised Building Code (Title 22) was adopted in 2004. Chapter 22.03 of the 2003 Building Code (Title 22) adopts the Uniform Plumbing Code, 2000 Edition, published by the International Association of Plumbing and Mechanical Officials, together with supplements and amendments thereto. In addition, as part of the Lummi Nation Water Resources Protection Code (Title 17), regulations will be developed to reduce daily water demand and water demands during droughts or other water-supply emergencies. Examples of water-use regulations that will be considered on the Reservation include:

- Emergency restrictions on nonessential uses such as lawn watering, car washing, filling swimming pools, washing sidewalks, and irrigating golf courses;
- Agricultural and irrigation efficiency standards;
- Emergency restrictions on commercial car washes, nurseries, hotels, and restaurants; and
- The prohibition of the use of hoses for cleaning sidewalks, patios, parking lots, paved surfaces, washing of buses, boats, trailers, or other vehicles unless a positive automatic shutoff at the outlet end of the hose is present.

3.3.1 Agricultural Uses

Irrigated agriculture consumes the majority of the water used in the western United States (USDA 1993). Water conservation measures related to agricultural water management include evaluation and improving efficiency of irrigation systems, integration of climate data/information, water storage systems, and water metering. Computer irrigation control systems are available, and have proved successful in reducing the amount of water used for irrigation (USDA 1993). Land management practices that conserve water include

conservation tillage, farming practices that reduce runoff and encourage infiltration of water into the soil, monitoring of soil moisture, maintenance of riparian buffers, crops that withstand dryness, and cropping systems that are less water dependent. As described above, irrigation efficiency standards may be incorporated into regulations developed and adapted pursuant to Title 17.

3.3.2 Water Reclamation and Reuse

Water reclamation and reuse opportunities on the Reservation and at the Lummi Nation Skookum Creek Fish Hatchery were previously evaluated (LWRD 1998). The evaluation consisted of a review of current regulations and standards for reclaiming and reusing wastewater, an inventory and characterization of potential sources of wastewater, identification of the costs associated with water reclamation and reuse, and an assessment of wastewater reuse opportunities for each source.

In general, current water reclamation and reuse opportunities on the Reservation are limited by the costs to: 1) monitor the reclaimed water quality, 2) provide additional treatment to the available wastewater, 3) convey the reclaimed water to places of reuse, and, 4) the relatively low cost of potable water. At some time in the future, especially with new economic development activities, water reclamation and reuse may become more cost effective.

3.3.3 Water Shortage Contingency Measures

A Water Shortage Contingency Plan will be developed to manage water supply and demand in the event of a shortage or supply disruption. The guidelines or regulations in the contingency plan will identify actions and procedures that will help the LIBC maintain essential public health and safety while minimizing adverse impacts on economic activity and environmental resources. The guidelines or regulations will be designed to be applied according to the specific situation and include communication actions, demand management actions, and supply alternatives. In some cases it may be necessary to extend water-use regulations to promote conservation during non-emergency situations (e.g., during and/or after times that a shortage is forecasted to occur). The Water Shortage Contingency Plan should identify specific actions and the roles and responsibilities of various LIBC agencies for each of the following four stages:

- *Advisory:* the public is informed that a possible shortage may occur.
- *Voluntary:* specific voluntary actions are suggested for residential and commercial water customers in order to forestall or minimize the need for more stringent demand or supply management options.
- *Mandatory:* when supply conditions have worsened and/or demand levels indicate the need for a more systematic response, certain water uses are limited or prohibited and repeat violators may be subject to fines.
- *Emergency:* the last stage of a progressive situation or an immediate crisis, and could include a combination of mandatory measures, fines, and rate surcharges.

4. ACTION PLAN

This section outlines the roles and responsibilities of LIBC staff; identifies proposed water conservation actions and associated schedule and budgets; and describes an approach for monitoring and evaluating the effectiveness of activities.

4.1 Roles and Responsibilities

The Lummi Water District will take the lead role in carrying out the majority of the conservation measures outlined in this plan. Natural Resources staff will assist the LWD staff when necessary and will be responsible for developing and adopting the regulations to implement the Water Conservation Plan and the Water Shortage Contingency Plan. Natural Resources staff will provide technical support, assistance with grant writing and grant administration, and will develop a method to monitor the effectiveness of conservation measures.

4.2 Proposed Actions

This section describes how each proposed water conservation action will be carried out.

4.2.1 Public Education

Staff of the Lummi Water District and the Lummi Natural Resources Department's Water Resources Division will jointly undertake a public education effort. Staff from both the District and the Division will provide the Lummi Tribal School (K-12) with public education materials for presentations and/or give presentations to students. Water Resources staff will prepare articles for the *Squol Quol* (monthly Lummi Nation newspaper) that will highlight current water issues and water efficiency concepts including seasonal water conservation tips and promotion of water-saving fixtures and retrofit kits. Conservation messages will continue to appear on monthly billing statements issued by the Lummi Water District. The Lummi Water District will undertake an increased level of public education by increasing the regularity of monthly utility bill inserts as well as developing and distributing and/or using brochures, public displays, and other forms of public outreach.

4.2.2 Rebate and Retrofit Program

The Lummi Water District will take the lead in implementing and administering the rebate and retrofit element of the plan. Rebates for retrofitting existing water use fixtures with more efficient fixtures will be offered to encourage a permanent reduction in indoor water use. Starting no later than January 2006, free plumbing retrofit kits will be available to water customers whose homes were built prior to 1997. These kits will contain:

- One ultra low-flow showerhead plus sealant tape;
- Two faucet aerators for the kitchen and bath;
- Leak detection tablets; and

- Instructions.

The LWD will also provide assistance to low-income, elderly, and disabled customers, and consider training high school students to help low-income residents with rebate and retrofit kits. Natural Resources staff will assist Water District staff with a recordkeeping system to monitor the installation of flow restricting devices. Natural Resources staff will also assist with the grant and report writing element of this task.

4.2.3 Leak Detection Program

Lummi Water District staff will take the lead in implementing the leak detection program. Efforts to fix leaks are already undertaken and efforts will be continued.

Contracting with a professional leak detection service will be considered, as will the purchase of state-of-the-art leak detection equipment. It may be possible to secure grant funding for the services of a consulting firm to train the Lummi Water District staff to use leak detection equipment. Grant funding will also be sought during 2004 so that the retrofitting outlined in the water audit reports can be implemented in a future phase of the program.

Natural Resources Division staff will assist Lummi Water District staff with production of a report summarizing the results of leak detection efforts.

4.2.4 Water Audit Program

Lummi Water District staff will lead the implementation of the water audit program, and will collect summary data for reporting purposes. The "W-Index" will be employed by Lummi Water District staff to evaluate residential water savings, as a way to motivate water users to adopt water-saving practices, and as a tool to evaluate the effectiveness of the water conservation plan implementation. The use of a "W-Index" by the Lummi Housing Division will be promoted by the Lummi Water District and Natural Resources staff.

4.2.5 Community Facility

The decision about whether to proceed with building a Community Facility/Laundry will be made by the Lummi Economic Development Department and/or the Lummi Housing Division, and/or the Northwest Indian College. Grant funding will be sought to build a demonstration facility that would provide high-efficiency washing machines and clothes driers at a central location on the Reservation. Water Resources Division staff may be able to provide assistance with grant funding if one of these organizations decides to move forward with plans for this facility.

4.2.6 Water Rates

Water Resources Division management staff and the Lummi Water District will take the lead in evaluating and recommending revised water rates. When considering rate structures, a key issue is the service population's ability to afford higher rates. The best rate design involves taking into account the characteristics of particular customer classes. In considering conservation pricing, the primary consideration on the Lummi Reservation is the service population's ability to afford higher rates. Many Tribal members have very limited resources, making rate increases politically difficult.

An inverted block rate structure will be considered in which the first 600 cubic feet of water per household would cost $19.23 (the same as the current rate). Cost per 100 cubic foot increment of water would then increase in increments to be determined. As described previously, an inverted block rate structure provides a monetary incentive to conserve water on a year-round basis and helps control peak demand during the summer months especially if used in combination with a seasonal surcharge.

4.2.7 Regulations and Restrictions

As part of the Lummi Nation Water Resources Protection Code (Title 17), the Lummi Water Resources Division is responsible for promulgating regulations to achieve the goals of the Wellhead Protection Program. Part of this effort will be to reduce average daily water demand, peak daily demand, and to conserve water during droughts or other water-supply emergencies. Examples of water-use regulations that will be considered on the Reservation include:

- Emergency restrictions on nonessential uses such as lawn watering, car washing, filling swimming pools, washing sidewalks, and irrigating golf courses;
- Agricultural and irrigation efficiency standards; and
- Emergency restrictions on commercial car washes, nurseries, hotels, and restaurants.

4.2.8 Agricultural Leases

Staff of the Water Resources Division and the Realty Division of the Lummi Planning Department will jointly undertake efforts to incorporate water efficiency requirements into agricultural leases. Water use standards for agricultural users will be developed as a regulation under the Lummi Nation Water Resources Protection Code. Water conservation for agriculture will require that all aspects of irrigated agriculture on the Reservation be evaluated. Alternative cropping and tillage systems and other changes can contribute to water conservation in irrigated agriculture. Water management techniques for conservation in the agricultural setting includes the use of water storage systems, storage of water in ditches along fields, installation of meters, and inverted block rate pricing. Land management techniques for water conservation include conservation tillage, practices that reduce runoff, monitoring of soil moisture, establishment and monitoring of riparian buffers, and use of crops that are able to withstand dry conditions.

A small number of leases are regularly negotiated between farmers and the Realty Division of the Lummi Planning Department on behalf of the land owners. As part of this program, once regulations are established as part of Title 17, conservation goals will be incorporated by the Lummi Planning Department into agricultural lease agreements involving tribal lands. At a later date, regulations will be considered that will require irrigation to be designed to specific conservation standards.

4.2.9 Water Reclamation and Reuse

Water reclamation and reuse opportunities on the Reservation and at the Lummi Nation owned and operated Skookum Creek Fish Hatchery will be exploited if they become cost effective. In the future, especially if certain types of new economic development activities are undertaken, it is possible that water reclamation and reuse practices may become cost effective. The decision to undertake water reclamation and reuse actions will be made by project proponents and the Lummi Nation policy staff on a case-by-case basis.

4.2.10 Water Contingency Measures

Staff of the Water Resources Division and the Lummi Water District will jointly develop water contingency measures. A set of guidelines, a water shortage contingency plan, and possibly emergency water-use regulations will be promulgated to promote water conservation during emergency situations.

4.2.11 Monitoring and Evaluation

The success of the water conservation plan can be measured both quantitatively and qualitatively. Administrative effectiveness and costs can be evaluated through discussions with conservation program staff and surveys of program participants. Customer acceptance and participation is necessary for many of the measures to be effective. A detailed customer survey could provide valuable information concerning conservation kit availability, customer usage patterns, perceptions and attitudes about water conservation, and participant demographics.

Annual and seasonal savings in the service area can be measured by monitoring the amount of water consumed per person. Following implementation of selected elements of this plan, water consumption data will be compared to historical consumption data. Another method of monitoring the success of the program is by tracking the amount of unaccounted for water. A reduction in the amount of unaccounted for water can result in water production savings and extend existing capacity to supply future system demands.

By developing reliable data on each conservation measure, the Lummi Nation will be able to monitor and evaluate the effectiveness of the various measures. Some measures, such as public education, can only be evaluated on a qualitative basis. Other measures, such as water savings realized by plumbing fixture retrofits can be tracked by

determining the number of customers who installed the devices and comparing the average water use or similar types of services before and after the installations.

Ensuring the accuracy of meters is an important first step in the evaluation process. The "W-Index" can also be used as an evaluation tool. The "W-Index" can be calculated for targeted houses and/or houses constructed and managed by the Lummi Housing Division at the beginning of the program and compared to the "W-Index" values during implementation.

With a means of monitoring the conservation measures in place, evaluation of the conservation program will be easier. Evaluation should be undertaken periodically to allow "fine-tuning." Evaluation involves looking at the program as a whole after a period of time to see if the original goals have been met. Evaluation can lead to adjustments in the goal or in the individual measures, subject to the economic and administrative constraints of the Nation.

4.3 Schedule

The Lummi Water District or the Lummi Water Resources Division will hire and train a part-time "water surveyor" in 2005. The primary task of this 0.5 Full Time Equivalent (FTE) person will be to implement this plan. The surveyor will also provide assistance to customers upon request.

4.4 Staff, Training, and Budget Needs

The steps outlined in this plan will require a 0.5 FTE for five years. This staff person should have a background in environmental education and water conservation. Training needs will be determined according to the background of the person hired for this task.

Estimates of annual budget needs for implementation of the Water Conservation Plan are listed in Tables 3 and 4.

Table 3. Estimated Personnel Costs for the Lummi Nation Water Conservation Program

Personnel Costs	Estimated Cost per year
Salary for "Water Surveyor" Staff Person ($17.00/hr @ 1040 hours)	$17,680
Fringe Benefits Water Conservation Program Staff Person ($17.00 x 1040 hours @ 23.17%)	$4,096
Supplies	
Photo copy and Postage ($75/month @ 12 months)	$900
Telephone, Fax, and Office Supplies ($100/month @ 12 months)	$1,200
Computer Work Station and Color Printer	$2,000
Vehicle ($100/month @ 12 months)	$1,200
Total Direct Staff Costs	$27,076
Total Indirect Costs @ 56.95%	$15,406
Total Staff Costs per year	**$42,482**

Table 4. Estimated Program Element Costs for the Lummi Nation Water Conservation Program (2004-2010)

Program Element Costs	Estimated Cost per year
Toilet Rebate Program ($100 per unit @ 100 installations/year)	$10,000
Plumbing Retrofit Program ($25 per unit @ 50 installations/year)	$6,250
Plumbing Retrofit Program for Tribally owned facilities	$5,000
Water Audit and Retrofit Program	$5,000
Leak Detection Program	$55,955
Total Indirect Costs @ 56.95%	$46,774
Total Estimated Cost per year	**$128,979**

5. SUMMARY

It is broadly accepted and well proven that water conservation can result in significant savings of water and money. As the Reservation's population and economy continues to grow, water efficiency will become increasingly important. Using water more efficiently is the most cost-effective way to meet competing needs for water. Conservation is a cheaper source of new water supply when compared to the cost of developing new water sources, storage, and supply systems. Implementing water efficiency through conservation measures is an important step toward protecting the vital economic and natural resources of the Lummi Reservation.

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