APPENDIX C

WANAPA ENERGY CENTER
WATER SUPPLY, USE, AND DISCHARGE

WANAPA ENERGY CENTER
WATER SUPPLY, USE, AND DISCHARGE
Draft 8-25-04

Water Supply

The Wanapa Energy Center will utilize approximately 12.4 cubic feet per second (cfs) or 5,550 gallons per minute for all plant uses except drinking water and domestic consumption. Columbia River water will be withdrawn at an existing pump station located approximately 2.5 miles from the plant site. The plant's raw water will be purchased under a contract from the Regional Water System. The Port of Umatilla originally constructed the Regional Water System and this system is operated by the City of Hermiston. The Regional Water System takes its water from the Columbia River under an existing water right.

To supply water to the project, the project intends to build an interconnection facility, supply pipeline, and metering facilities. In addition, the project will procure and install an additional pump in the existing pump well in the pumping platform at the Columbia River. All supply systems and the pump will be constructed in accordance with all applicable laws, codes, standards, and permits.

The raw water from the Regional Water System will be filtered before it is storage in the raw water storage tank at the project Site.

Water Usage

Table C-1 shows the plant water requirement for one block (650-megawatt [MW]) and two Blocks (1,300-MW) operation. It is worth noting that the maximum flows represent instantaneous water flow during the plant operation at the hottest hour of the day when the ambient dry bulb temperature is at 109 degrees Fahrenheit (°F).

Table C-1
Wanapa Energy Center – Raw Water Supply

Annual Average, And Maximum Flow Rate	*Raw Water Supply Two Blocks*	*Raw Water Supply One Block*
Average flow rate (annualized over 12 months)	*5,550 gallons per minute* *12.4 cfs* *8.02 million gallons per day (MGD)* *24.6 acre-feet/day* *8,979 acre-feet/year*	*2,775 gallons per minute* *6.18 cfs* *4.01 MGD* *12.3 acre-feet/day* *4,490 acre-feet/year*
Maximum flow rate	*7,975 gallons per minute* *17.7 cfs* *11.5 MGD* *35.2 acre-feet/day* *12,864 acre-feet/year*	*3,988 gallons per minute* *8.85 cfs* *5.6 MGD* *17.6 acre-feet/day* *6,432 acre-feet/year*

Raw water from the Regional Water System will be metered and filtered before it is used. Since Columbia River water is already high quality, most of the plant's water will only require filtration for removal of suspended solids. This filtered water will supply most of the plant's water needs, and it will be used primarily for cooling system make-up. The remainder of this filtered water will be used for general plant water. Downstream of the filter, the water will be routed to the plant cooling tower as cooling tower makeup and the raw water storage tank. The make up water for the cooling tower constitutes the largest quantity of the plant water needs. The cooling tower provides cooling water for the steam surface condensers, the hydrogen coolers for the electric generators, gas and steam turbine lube oil coolers, and other miscellaneous plant coolers. The water from the raw water storage tank will be used for the gas turbine evaporative coolers, steam cycle make up, plant fire protection system, and miscellaneous wash water.

A small percentage of raw water from the raw water storage tank will be further treated by reverse osmosis (R.O.) or by a cation, anion, and mixed bed demineralization system to remove most of the dissolved ions. This "deionized" water will be stored in a demineralized water storage tank. The "deionized" water from this tank will be used as make-up to the steam turbine cycle which requires a very high quality water to prevent corrosion or deposition in the steam cycle.

The dissolved ions that are removed in the R.O. or demineralization process, called R.O. reject, will be returned to the cooling system as make-up.

Since the Columbia River water is good quality for power plant cooling, it can be cycled six times in the cooling tower. This means that the water in the cooling system is re-circulated, and a portion is lost from the cooling tower due to evaporation, until the dissolved ions in the cooling tower water (which are not lost in evaporation) are concentrated six times. In order to maintain this level of concentration at six times, some water from the cooling tower will be discharged and replaced by raw water. The water that is removed from the tower is called cooling tower blowdown. The cooling water will be treated with small concentrations of additives to prevent corrosion and microbiological growth in the system components. These additive concentrations are usually less than 10 parts per million in the recirculating water and the additives are almost completely consumed, absorbed, evaporated, or reacted with system surfaces or the dissolved ions in the cooling water. These additives are expensive – they are added in sufficient enough quantities to protect the cooling system but only negligible amounts are discharged with the cooling system blowdown. Without these additives, the cooling system would very quickly begin to experience significant corrosion, deposit buildup, and microbiological/algae growth. If these continued, the system would begin to lose heat exchange efficiency, would require more raw water and would necessitate a higher rate of blowdown (and discharge). Eventually, the system could experience a catastrophic component failure or could require such a high rate of cleaning, maintenance, and repair that the plant could become uneconomical to operate.

Cooling system additives are primarily chemicals with minimal toxicity, no heavy metals, and no persistent pesticides. Corrosion and deposit inhibitors are phosphate and phosphonate based with small amounts of polymeric dispersants. They work by passivating metal surfaces and preventing corrosion and by interfering with the precipitation of salts, such as calcium carbonate, as deposits. Very small quantities of one or more microbiocides also will be added to prevent the growth of microbes in the system – microbial growth can accumulate as deposits in the system and interfere with heat exchange surfaces or operating components. Generally, chlorine, in the form of sodium hypochlorite (a low level chlorine compound), is used, and fed intermittently at low levels. If the chlorine level in the plant discharge water was believed to be excessive (above permit levels) then it can be removed by de-chlorination of the cooling tower blowdown before discharge. Sulfuric acid also will be added to the cooling system to maintain pH – this will add sulfates to the recirculating water.

Blowdown from the cooling system will predominantly contain dissolved ions that were originally found in the incoming river water. Ions added during plant operation will be negligible. The mass loading of these ions will be almost the same (and some components will be *lower) as if the Columbia River water was utilized once through the plant and then discharged. Only the flow rate of water will be six times less.*

Water Discharge

Plant wastewater, most of which will be cooling tower blowdown (<85°F), will be piped to a large holding pond on the plant site. The retention time of the pond will vary according to the time of year, from hours to days. When the plant wastewater is in the holding pond, it will generally decrease in temperature (depending on the ambient temperature) and some dissolved ions will precipitate and settle out in the pond. The discharge from this pond will be monitored for flow and a number of other parameters based on the discharge permit's requirements. The monitored components will be determined during the National Pollutant Discharge Elimination System (NPDES) permitting process. 40 Code of Federal Regulations (CFR) 423, which establishes New Source Performance Standards (NSPS) for discharges from steam electric generating plants, requires certain parameters to be monitored which include pH, oil and grease, total suspended solids, and possibly free available chlorine. Other parameters may be added depending on the results of modeling and water quality impact analysis. All required monitoring will be conducted and wastewater parameters will be closely evaluated before discharge.

Table C-2 shows the quantities of the plant discharge water for both one block (650-MW) and two block (1,300-MW) plant.

Table C-2
Plant Discharge Water

Annual Average, And Maximum Flow Rate	Wastewater Discharge Two Blocks	Wastewater Discharge One Block
Average flow rate (annualized over 12 months)	1,088 gallons per minute 2.4 cfs 1.6 MGD 4.8 acre-feet/day 1,752 acre-feet/year	544 gallons per minute 1.2 cfs 0.8 MGD 2.4 acre-feet/day 876 acre-feet/year
Maximum flow rate	1,507 gallons per minute 3.4 cfs 2.2 MGD 6.7 acre-feet/day 2,449 acre-feet/year	754 gallons per minute 1.7 cfs 1.1 MGD 3.35 acre-feet/day 1,224.5 acre-feet/year

The water from the holding pond will be pumped (low head pumping) and it will travel through a pipeline for approximately 6 miles to Cold Springs Reservoir at an average flow rate of approximately 600 gallons per minute. Careful engineering using approved calculation-modeling techniques and proper outfall design will be selected to promote rapid mixing and minimal water quality impacts. The final design of the delivery pipe may include extension out into one of the deeper areas of the reservoir so that good mixing can be achieved even during low reservoir levels. This type of diffuser design may include a horizontal diffuser outlet that is situated on or near the bottom. Discharge outlets may be positioned to promote high velocity, vertical and horizontal mixing, and would be selected based on typical water movement through the reservoir across an operating year.

Table C-3 shows the comparison of reservoir water quality, Wanapa wastewater quality and applicable water quality standards. For most parameters, concentrations of specific ions are higher in the wastewater discharge than in the reservoir. Wastewater concentrations for metals have been estimated as total recoverable concentrations which are always equal to or greater than the dissolved concentrations. However, water quality standards for metals are expressed as dissolved concentrations.

Estimated concentrations for ions in the wastewater will meet the Oregon Department of Environmental Quality (ODEQ) standards, and will not exceed state water quality standards. For almost every parameter, the concentration in the wastewater is less than 50 percent of the water quality standard. This indicates that the quality of the wastewater will be very good and would not negatively impact reservoir quality for the intended primary and secondary use. As discussed, the project will apply for a NPDES discharge permit from ODEQ for discharge to Cold Springs Reservoir. The permit application will include detailed information about the following:

- *Raw water quality and treatment;*
- *Plant processes and how wastewater is generated;*
- *Flow rates with seasonal variations;*
- *Water treatment – specific types and feed rates of treatment chemicals, material safety data sheets of those chemicals;*
- *Wastewater storage and pumping operations;*
- *Wastewater quality – average and maximum concentrations;*

Table C-3

Comparison of Cold Springs Reservoir Water Quality with Estimated Effluent Quality

Analyte	Units	Reservoir (average)	Estimated Effluent	Lowest Applicable Aquatic Life Water Quality Standard
Total Recoverable Antimony – Sb	µg/l	0.112	0.700	
Dissolved Antimony – Sb	µg/l	0.114		1,600
Total Recoverable Beryllium – Be	µg/l	0.033	0.042	
Dissolved Beryllium – Be	µg/l	0.025		5.3
Total Recoverable Cadmium – Cd	µg/l	0.014	0.074	
Dissolved Cadmium – Cd	µg/l	>0.008		1.1
Total Recoverable Copper – Cu	µg/l	2.03	5.80	
Dissolved Copper – Cu	µg/l	1.05		12
Total Recoverable Iron – Fe	µg/l	979	685	
Dissolved Iron – Fe	µg/l	19.7		1,000
Total Recoverable Lead – Pb	µg/l	0.511	0.800	
Dissolved Lead – Pb	µg/l	0.016		3.2
Total Recoverable Mercury – Hg	µg/l	0.00193	0.00160	
Dissolved Mercury – Hg	µg/l	0.00054		0.012
Total Recoverable Nickel – Ni	µg/l	0.65	1.50	
Dissolved Nickel - Ni	µg/l	0.09		160
Total Recoverable Selenium – Se	µg/l	0.45	0.75	
Dissolved Selenium – Se	µg/l	0.42		5
Total Recoverable Silver – Ag	µg/l	0.020	0.011	
Dissolved Silver – Ag	µg/l	0.017		0.12
Total Recoverable Thallium – Th	µg/l	0.191	0.074	
Dissolved Thallium - Th	µg/l	0.172		40
Total Recoverable Zinc – Zn	µg/l	2.33	8.9	
Dissolved Zinc - Zn	µg/l	0.13		110
Alkalinity	mg/l	78	188	20[1]
Chloride	mg/l	9.8	20.0	230
pH	S.U.	9.12	7.5-8.5	7 – 8.5
Phenolics	mg/l	0.01	0.053	2.56

[1]*Minimum concentration.*

- ***Reservoir water quality and hydrology;***
- ***Beneficial uses of the reservoir and applicable water quality standards; and***
- ***Estimated effects of wastewater on reservoir water quality.***

ODEQ will carefully evaluate this information and will request additional detail on any parameter of concern. The agency utilizes a software/workbook program that performs a "reasonable potential analysis" for each pollutant of concern and develops water quality based effluent limits (WQBELs). The spreadsheets used in these calculations have been developed based on U.S. Environmental Protection Agency's (USEPA's) methodology "Technical Support Document for Water Quality-Based Toxics Control (TSD)." This methodology was developed by USEPA and uses a number of equations to compare wastewater quality against water quality standards and receiving water quality. The equations that are applied are highly conservative and do not allow a receiving water to approach the standards closely, i.e., the receiving water quality is maintained at significantly lower concentrations than the applicable standards. The results of the application of this program are made available to all requestors.

It is important to note that in the application of this program and calculation of WQBELs, ODEQ will use the maximum concentration of each potential pollutant. Permit limits will be developed that will be protective of the reservoir as if the maximum concentration of each pollutant was discharged 365 days a year. This adds additional protection and minimizes potential impacts to the reservoir. In addition, the facility also will probably be required to conduct regular aquatic toxicity testing – this involves placing aquatic organisms, usually daphnids and fish, in plant effluent and measuring the potential toxicity to living organisms.

State water quality standards have been developed (and are regularly evaluated and modified) based on actual aquatic and wildlife toxicity and human health data. The standards are designed to be conservative and highly protective and take into consideration such aspects as potential bioaccumulation (an example would be the recent reduction in the state water quality standard for selenium which can demonstrate bioaccumulation potential). The NPDES permit that will be issued for the Wanapa Energy Center will have to be re-applied for and renewed every 5 years – the wastewater will be re-evaluated each time against current water quality standards and existing receiving water quality.

When evaluating water quality impacts, Oregon water quality standards and regulations (OAR 340-041-0053) allow the use of a mixing zone in determining how a wastewater discharge will meet state water quality standards. A mixing zone is an area of a receiving water body that is

calculated using flow and water quality data (of both the wastewater and receiving water), physical data about the receiving water, and other site-specific information. According to Oregon standards, the wastewater discharge must meet acute water quality standards at end-of-pipe to prevent acute toxicity to organisms in the mixing zone. However, the concept of a mixing zone is to allow a small area in the receiving water body where chronic water quality standards are temporarily exceeded. At the edge of the mixing zone, chronic standards must be met so that the rest of the water body is protected. An additional requirement is that no water quality standard can be exceeded in the receiving water even under low flow conditions. The State will evaluate the calculated mixing zone and the potential water quality impacts associated with it. The mixing zone will be carefully evaluated to make sure that organisms passing through it will not experience lethality. It also will be evaluated to assure that the overall integrity of the reservoir will be protected. There is a specific multi-step procedure for evaluating the overall acceptability of the mixing zone. Since the wastewater should meet water quality standards at end-of-pipe, the mixing zone analysis will be primarily used to determine if good mixing will be achieved and overall quality of reservoir water will be protected. ODEQ will evaluate and determine what temperature and total dissolved solids (TDS) standards will apply to the reservoir – since temperature and TDS of the effluent will exceed that of the reservoir, especially in the summer, the mixing zone analysis will probably be applied to insure that water quality is maintained in the reservoir at all times of the year.

Bureau of Indian Affairs, Bonneville Power Authority, and Bureau of Reclamation (Reclamation) will have an opportunity to review the draft NPDES permit before it is formally issued and comments will be evaluated and addressed by ODEQ. USEPA Region X also will review the draft NPDES permit and provide comments to ODEQ. There will be a 30-day public review and comment period for the permit after initial cooperating agency review.

Finally, after the NPDES permit is in place and the Wanapa Energy Center begins operation, the plant will be required to sample its effluent in the first 30 to 90 days of operation (after full operating output is achieved). The effluent must be tested not only for the parameters listed in the NPDES permit but for the 126 priority pollutants. The results of this sampling and analyses will be submitted to ODEQ for review; ODEQ can then modify the NPDES permit for additional parameters and limits if necessary. The facility will be required to submit monthly Discharge Monitoring Reports (DMRs) with all the monitoring and analytical information required by the permit. These DMRs also can be provided each month to Reclamation. The data in the DMRs are evaluated every month by ODEQ and if the plant exceeds its permit limits, plant personnel *will be contacted for explanation and resolution. Exceedance of permit limits can result in Notices of Violation and enforcement action, including fines.*

The ODEQ's discharge permitting process requires detailed modeling, data analysis, and direct application of state water quality standards for any proposed discharge of wastewater to a water of the state. Since Cold Springs Reservoir is considered a water of the state, this process will be strictly followed. The discharge from Wanapa will be required to meet all state and federal water quality standards, which are specifically selected to protect aquatic organisms, wildlife, human health, and agricultural uses. The operations of Wanapa Energy Center will comply with all applicable water quality standards and associated discharge permit limits that are required by ODEQ.

Potential Impacts to Cold Springs Reservoir

Plant discharge water will meet all applicable water quality standards, which are designed to be protective of aquatic and wildlife species. Impacts to aquatic and wildlife use and irrigation use of the reservoir are expected to be negligible. The quality of the plant discharge water will be monitored on a daily basis; if any chemical parameter changes significantly, it will be addressed immediately in order to protect the quality of final plant discharge water.

Because of regulatory and public interest in the potential for bioaccumulation, an evaluation of water quality in Cold Springs Reservoir and the effect of plant discharge water was conducted. Many environmental chemicals, both organic and inorganic, will tend to accumulate in the tissues of organisms beyond the concentrations found it the environment. Although often thought of as deleterious, some materials, particularly certain trace and rare-earth metals, accumulate naturally and are critical components in biochemical processes, acting, for example, as coenzymes in certain reactions. For critical ions, such as calcium, organisms' mechanisms may be specifically adapted to scavenge and sequester critical nutrients and elements. Bioaccumulation factors (tissue concentrations/ambient concentrations) for some aquatic organisms exceed 1000 for many elements, including trace and rare-earth metals, and are over 100,000 for some elements, such as phosphorus, vanadium, and molybdenum (Cowgill 1976).

Bioaccumulation is defined as the net accumulation of a chemical in an organism (or a specific tissue) that results from environmental exposure. Bioaccumulation can only occur if the rate of uptake exceeds the rate of elimination. For essential materials, mechanisms accumulate needed amounts but then typically eliminate what is not needed. Organisms that have evolved in *environments rich in certain elements also have developed adaptions that provide for normal physiology in the face of atypical environmental concentrations. Such mechanisms do not work for all chemicals or in all organisms, however. The intense accumulation of artificial organic molecules (e.g., DDT) in biological tissues to many times the environmental concentrations resulted in unforeseen food web and life cycle consequences.*

For toxic effects to occur in an exposed organisms (e.g., fish) chemicals must first be accumulated by the organism above normally regulated levels. That is, it is not the ambient concentrations (for example, measured concentrations in Cold Springs Reservoir) that organisms respond to, but only to the levels (of metals for example) which become associated with the organism (either in them or on them). Thus, only if chemicals are bioavailable do they represent a hazard to the organism. There are several factors that can influence bioavailability, most notably water hardness, but also the presence of organic compounds, which sorb metals and reduce their bioavailability.

As described above, most metals tend to bioaccumulate, often to high levels, when measured directly under field or laboratory conditions. However, even when accumulated to many time ambient levels, toxic effects may not be observed (Drexler et al. 2003). There are numerous factors, both abiotic and biological, that interact to affect the toxicity of a bioaccumulative element.

Some metals have been shown to be more of a concern than others. Selenium, for example, has been shown to be of concern, as has mercury. The serious problems associated with selenium bioaccumulation were well documented in the Kesterson Wildlife Refuge in California. Accumulation of mercury in fish tissues has resulted in sporadic warnings about consumption of both natural and farm-raised salmonids.

Because of the well-researched issues with selenium and mercury, ambient water quality criteria for these two materials are based on bioaccumulative potential. The Criteria Maximum Concentration (CMC) and Criteria Continuous Concentration (CCC) for inorganic mercury are 1.4 and 0.77 µg/L, respectively, based on dissolved concentration (USEPA 2002). The mean concentration of dissolved mercury measured in Cold Springs Reservoir is 0.00082 µg/L (total = 0.0051 µg/L). The estimated effluent concentration of total mercury is 0.00160 µg/L, which is approximately 1/3 of the mercury concentration under existing conditions. Effluent, therefore, should not increase the ambient levels of inorganic mercury, and existing or future mercury concentrations should not pose a significant bioaccumulative problem, assuming *mercury remains in an inorganic form. Inorganic mercury can convert to methyl mercury under the right chemical conditions. Methyl mercury is highly bioaccumulative, and criteria are not necessarily reflective of the potential for organic to bioaccumulate. The tendency of conversion to organic mercury in Cold Springs Reservoir has not been determined. [Additional information to be added on the factors that determine the potential for conversion.]*

The CCC for selenium is 5.0 µg/L. The CMC is based on the relative proportions of selenate and selenite, which are unknown in Cold Springs Reservoir. The mean concentration of dissolved selenium measured in Cold Springs Reservoir is 0.41 µg/L; the estimated total selenium concentration in the effluent is 0.75 µg/L. Effluent might, therefore, slightly increase the concentration of selenium in the Reservoir. However, the estimated effluent concentration is still well below the selenium CCC and should not pose and toxicological or bioaccumulative problems.

References

Cowgill, U.M. 1976. The chemical composition of two species of Daphnia, their algal food and their environment. Sci. Total Environ. 6:79-102.

Drexler, J., N. Fisher, G. Henningsen, R. Lanno, J. McGeer, and K. Sappington. 2003. Issue paper on the bioavailability and bioaccumulation of metals. Draft. Submitted to USEPA.

USEPA. 2002. National Recommended Water Quality Criteria: 2002. EPA-822-R-02-047. United States Environmental Protection Agency.