Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
CHAPTER 10	
10.9-1/10.9-2	10.9-1/10.9-2
CHAPTER 11	
11.4-1/11.4-2	11.4-1/11.4-2
NRC QUESTIONS	
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CHAPTER 5	
5-i/5-ii	5-i/5-ii
5-v/5-vi	5-v/5-vi
5.1-3/5.1-4	5.1-3/5.1-4
5.1-7 through 5.1-12	5.1-7 through 5.1-12
5.1-15/5.1-16	5.1-15/5.1-16
5.1-16a/5.1-16b	5.1-16a/5.1-6b
5.1-16c/blank	5.1-16c/blank
5.1-27/5.1-28	5.1-27/5.1-28
----	Figure 5.1-10A
5.3-3 through 5.3-8	5.3-3 through 5.3-8
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5.3-11/blank	5.3-11/5.3-12
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5.4-1/5.4-2	5.4-1/5.4-2
CHAPTER 6	
6.1-25/6.1-26	6.1-25/6.1-26
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CHAPTER 8	
8-i/8-ii	8-i/8-ii
8.3-7 through 8.3-10	8.3-7 through 8.3-10
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CHAPTER 9	
9.2-19/9.2-20	9.2-19/9.2-20

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2.2-32a/2.2-32b	2.2-32a/2.2-32b
2.2-33/2.2-34	2.2-33/2.2-34
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Table 2.2-21b/Table 2.2-21c	Table 2.2-21b/Table 2.2-21c
Table 2.2-22/Table 2.2-23	Table 2.2-22/Table 2.2-23
Figure 2.2-11	Figure 2.2-11
Figure 2.2-22a	Figure 2.2-22a
Figure 2.4-7	Figure 2.4-7
2.6-1 through 2.6-6	2.6-1 through 2.6-6
----	2.6-6a/2.6-6b
2.6-7/2.6-8	2.6-7/2.6-8
----	Table 2.6-2 Sheet 1 of 3/ Table 2.6-2 Sheet 2 of 3
----	Table 2.6-2 Sheet 3 of 3/ blank
Figure 2.6-3	Figure 2.6-3
Figure 2.6-4	Figure 2.6-4
----	Figure 2.6-5a
----	Figure 2.6-5b
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CHAPTER 3

3.4-3/3.4-4	3.4-3/3.4-4
Figure 3.4-3	Figure 3.4-3
3.6-4a/blank	3.6-4a/3.6-4b
Table 3.6-5/Table 3.6-6	Table 3.6-5/Table 3.6-6
3.8-1/blank	3.8-1/blank

CHAPTER 4

4.1-9/4.1-10	4.1-9/4.1-10
----	4.1-10a/blank
4.1-11 through 4.1-14	4.1-11 through 4.1-14
Figure 4.1-2	Figure 4.1-2
Figure 4.1-7	Figure 4.1-7
Figure 4.1-8	Figure 4.1-8
Figure 4.1-9	Figure 4.1-9
4.5-1 through 4.5-4	4.5-1 through 4.5-4

File the NRC transmittal letter and the instruction sheets following the NRC tab.

File the Energy Facility Site Evaluation Council letter following the EFSEC tab.

The following information and check list are furnished as a guide for the insertion of new sheets for Amendment 8 into the Application for Site Certification/Environmental Report for the Skagit/Hanford Nuclear Project. This material is denoted by use of the amendment date in the upper right-hand corner of the page.

New sheets should be inserted as listed below:

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
EFSEC	
EFSEC-19/EFSEC-20	EFSEC-19/EFSEC-20
CHAPTER 1	
Figure 1.2-1	Figure 1.2-1
Figure 1.2-2	Figure 1.2-2
Figure 1.2-3	Figure 1.2-3
CHAPTER 2	
2-i through 2-iv	2-i through 2-iv
2-ix/2-x	2-ix/2-x
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2.1-11/2.1-12	2.1-11/2.1-12
2.2-15 through 12.2-20	2.1-15 through 2.2-20
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2.2-23/2.2-24	2.2-23/2.2-24
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PUGET
POWER

December 14, 1982
PL-EFSEC-56

Mr. W. L. Fitch
Executive Secretary
Energy Facility Site Evaluation
Council
Mail Stop PY-11
Olympia, Washington 98504

Subject: Puget Sound Power & Light Company
Skagit/Hanford Nuclear Project, Units 1 & 2
Application No. 81-1
Application for Site Certification/Environmental Report
Amendment 8

Dear Mr. Fitch:

Puget Sound Power & Light Company submits herewith Amendment 8 to its Application for Site Certification/Environmental Report (ASC/ER) for the Skagit/Hanford Nuclear Project.

Amendment 8 responds to the Washington State Energy Facility Site Evaluation Council's comments on Amendment 6.

The changes are indicated by a dark vertical line in the margin followed by the amendment number to which the change is applicable. Pages affected by Amendment 8 carry the date in the upper right-hand corner.

Instructions for incorporating the material into the ASC/ER are provided.

Attached is the EFSEC distribution list for the subject amendment.

Very truly yours,

Robert V. Myers

Robert V. Myers
Vice President
Generation Resources

Attach.

SKAGIT/HANFORD NUCLEAR PROJECT
APPLICATION FOR SITE CERTIFICATION/ENVIRONMENTAL REPORT
APPLICANT'S RESPONSES TO THE WASHINGTON STATE ENERGY FACILITY SITE EVALUATION COUNCIL'S AMENDMENT 6 COMPLETENESS REVIEW COMMENTS

SUBJECT/COMMENT	APPLICANT RESPONSE
General	
Applicant should identify whether the application was transmitted to parties, agencies, counties, etc.	See revised Distribution List (pages EFSEC-19a and EFSEC-20).
Transmission Systems	
Discuss impacts of removal of six miles of existing transmission line.	See revised Section 10.9.1.2.
Mitigation	
The Applicant could describe the substance of its mitigation plans more adequately.	The Applicant believes that it has provided a full and adequate description of its mitigation plans. Further details will be provided in the Construction Impact Control Program which will be submitted for EFSEC's review and approval prior to commencement of construction.
Applicant should clarify its use of the terms waste disposal and solid waste disposal.	See revised Section 4.5.4.1.
Geology/Groundwater	
Reference PSAR Amendment 26 on geology.	ASC/ER Section 2.5 already references PSAR Section 2.5 on geology and includes by this reference all amendments on geology and is a more complete reference.

SUBJECT/COMMENT	APPLICANT RESPONSE
Air Quality	
Discuss details of the Construction Impact Control Program (CICP) regarding control of fugitive dust and construction emissions.	A general description of methods to be used for control of fugitive dust and construction emissions is provided in Section 4.5.5.2. A detailed description of the elements of the CICP will be submitted to the Energy Facilities Site Evaluation Council (EFSEC) for its review and approval after final detailed design and preparation and awarding of construction contracts and procedures and prior to commencement of Site construction activities. The Applicant does not believe that it is necessary to submit details of the CICP at this time in order to evaluate the potential impacts of construction of the S/HNP and that later submission of the CICP for EFSEC's review and approval is reasonable and appropriate.
Diesel generators should not be tested concurrently.	There are several factors which suggest the estimate in the Draft Environmental Statement pertaining to operation of the emergency diesel generators (pages 4-169 and 4-170) is conservative (high). The exhaust from the diesels is released from stacks above the roof of the diesel generator building. The exhaust gas will be hot and will exhibit buoyancy. As a result, it is not clear that the plumes from both units will be trapped in the Unit 2 turbine building wake cavity. Also, general observations of flow behavior near large disturbances indicate that the building wake cavity will extend 5-10 building heights downwind. The turbine building height is about 141 feet, which implies that the building wake cavity will extend 1,410 feet from the facility under worst case conditions and, hence, the building wake cavity will be within the property limits of the S/HNP Site. The above factors suggest that simultaneous testing of the diesel generators for Unit 1 and 2 should not pose any problem with respect to the State Air Quality Standard of 0.4 ppm (1047 ug/m^3). It appears that constraining the testing of the Unit 1 and 2 diesel generators to different periods during a given month is unnecessary. In any case, it may be noted that it is not the intent of the Applicant to test all three of a unit's emergency diesel generators at the same time. Concurrent testing of all

SUBJECT/COMMENT	APPLICANT RESPONSE
	three generators would occur only as a result of regulatory direction by the NRC or possibly during pre-operational testing for the plant. Consequently, the situation postulated in the comment is unlikely to occur frequently if at all.
	In addition, it should be noted that the S/HNP Site is located on the Hanford Reservation. The nearest residence to the Site is over 7 miles away. Thus, it is not necessary to impose further limitations upon releases from the diesel generators to protect public health.
Terrestrial Biology	
Discuss details of mitigation measures.	The ASC/ER does contain a full description of each general measure to protect vegetation, animal life, and aquatic life. As discussed above, the Applicant does not believe that it is necessary to submit details of the CICP at this time in order to evaluate the potential impacts of construction of the S/HNP and that later submission of the CICP for EFSEC's review and approval is reasonable and appropriate.
Aquatic Biology	
References in ASC/ER do not provide "comprehensive" evaluations of the ecological characteristics of the Columbia River.	See revised Section 2.2.2.
Data on occurrence and seasonal abundance presented in tables and figures are rarely discussed in the text.	The Applicant believes that the tables and figures are self-explanatory and that further discussion beyond currently presented is unnecessary and would be redundant.
Discuss seasonal and annual fluctuations of phytoplankton in Figures 2.2-10 and 2.2-11.	See revised Section 2.2.2.1.

SUBJECT/COMMENT	APPLICANT RESPONSE
Compare plankton community in the Hanford Reach with that in other portions of the Columbia River.	Amendment 6 included a brief comparative discussion in Section 2.2.2.1. Because the Hanford Reach is the only free-flowing section of the Columbia River above Bonneville Dam, direct comparison to other impounded portions in the River is not practical.
Contrary to the response to EFSEC Question 290.05, Section 2.2.2.2 was not revised in Amendment 6.	The Applicant apologizes for this oversight. Section 2.2.2.2 has been revised to incorporate the answer to EFSEC Question 290.05.
Compare fluctuations and densities of periphyton in the Hanford Reach with those in other portions of the Columbia River.	The Applicant is not aware of calculations of such fluctuations and densities in other freshwater portions of the Columbia River. Section 2.2.2.2 presents such information for the Hanford Reach and the Applicant believes that this information is sufficient to analyze the potential impacts from S/HNP.
Text in Section 2.2.2.5 does not agree with Figure 2.2-16.	The Applicant respectfully disagrees with this comment.
Discuss cause of fluctuations in benthos densities.	See revised Section 2.2.2.5.
The criteria for designating a fish species as "important" should have included "likely" to be affected by S/HNP.	As explained in Section 2.2.2.6, the criteria for designating a fish species as "important" were not derived by the Applicant but were based upon NRC and EPA criteria, neither of which listed "likely" to be affected as an independent basis for classifying a species as "important." In any case, no species of fish is "likely" to be significantly adversely affected by construction or operation of S/HNP, and therefore application of the criterion suggested in the comment would not affect the list of important species.

SUBJECT/COMMENT	APPLICANT RESPONSE
The list of important fish species should have included prickly sculpin, walleye, and carp.	The Applicant respectfully disagrees with this comment. The Applicant believes that the list of fish species provided provides an adequate basis for analyzing any impacts of S/HNP. In the Applicant's opinion, prickly sculpin do not satisfy the criteria for an "important fish." Although prickly sculpin might be considered ecologically important because of their abundance, there is little qualitative information available to assess effects of the construction and operation of S/HNP on this species. Additionally, the fact that walleye and carp may be the subject of some fishing does not render either species "commercially or recreationally valuable" and thus a candidate for listing as an important species. Carp are not commercially important in the Hanford Reach; this species is harvested only intermittently in the McNary Pool. Walleye are not common near the intake/discharge location; a localized sports fishery occurs in the area immediately below Priest Rapids Dam.
Indicate the proportionate contribution of Hanford Reach and upriver stocks to various segments of the Columbia/Snake salmonid fisheries.	See revised Section 2.2.2.6. The Applicant does not possess any verifiable and reliable information regarding the proportionate contribution of Hanford Reach and upriver stocks to various segments of Columbia/Snake salmonid fisheries.
The sources of Tables 2.2-21a and 2.2-21b are not presented.	Contrary to this comment, Tables 2.2-21a and 2.2-21b cite references. Also see revised Table 2.2-21b.
Provide summaries of WDF estimates of juvenile outmigration and hatchery releases. See Question E290.12.	Data provided in Table 2.2-21 regarding outmigrants include WDF studies and hatchery releases as cited in Ref. 63.
Information on Table 2.2-23 is not discussed.	The Applicant believes that the information on Table 2.2-23 is self-explanatory and that further discussion would be redundant.
Information on Table 2.2-23 does not account for sublethal effects.	See revised Table 2.2-23.

SUBJECT/COMMENT	APPLICANT RESPONSE
Synergistic effects should be discussed.	Synergistic effects are discussed in both Appendix L and in Section 5.3.1.2. Given the nature of the subject and the information available, the Applicant does not believe that additional discussion in Section 2.2.2.6.1 is warranted.
Discuss ichthyoplankton tow speeds, gear speeds, gear avoidance, and indexing of ability of sampling equipment to capture 0+ salmonids.	See revised Section 2.2.2.6.3. As stated in Appendix K, ichthyoplankton samples were taken from an anchored boat at midstream. Because larval forms of fish drift with the current, net avoidance is not a factor in these abundance estimates. Chinook salmon were captured incidently in the ichthyoplankton nets on one occasion. Indexing of ichthyoplankton nets against beach seines is not appropriate because capture efficiency differs between gear types.
Sport fishing information should be in Section 2.1.4.6, not Section 2.2.2.6.4.	These sections will be revised to reference each other.
More appropriate information on sport fishing is available than what is presented in Section 2.2.2.6.4.	The information presented in Section 2.2.2.6.4 is based upon data compiled by the Washington Department of Game. The Applicant believes that this information is both reliable and appropriate for inclusion in Section 2.2.2.6.4.
Surely some judgment could be made regarding whether spawning habitat is fully or nearly fully utilized.	It is not known whether the spawning habitat is fully utilized and the Applicant does not desire to engage in unnecessary speculation.
A more detailed discussion of water level fluctuations, predator-prey relations, and downstream passage is warranted in Section 2.2.2.7.	The Applicant believes that the level of information on food chains previously presented in Section 2.2.2.7 is sufficient to evaluate the potential impacts from S/HNP. The Applicant further believes the migration of anadromous fish is described in sufficient detail in Section 2.2.2.6.1.

SUBJECT/COMMENT	APPLICANT RESPONSE
Discuss pre-existing stress of water allocation and consumption.	See revised Section 2.2.2.8. The environmental description of the site includes the description of the river and biological community present under existing conditions. An analysis of environmental impacts of the construction and operation of the S/HNP considered existing river flows including the regulated minimum flows. In doing this, the Applicant believes that the pre-existing stress of water allocation and consumption has been adequately addressed. Consumptive use of Columbia River water by S/HNP was judged to not adversely effect the biological community. Studies by the Northwest Electric Power and Conservation Planning Council and mid-Columbia PUDs are presently underway to assess the effects of various flow levels on fish. The Applicant believes that it is appropriate to await the final results of these studies prior to drawing any conclusions. Future changes in Columbia River flows now being considered by the Northwest Power Planning Council and mid-Columbia PUDs address increased river flows. Such changes would only serve to reduce the effects of construction and operation of the S/HNP. It should be noted that the ASC/ER used the minimum regulated river flow (36,000 cfs) for calculating environmental impacts upon fish and, therefore, is conservative with respect to aquatic impacts. See Sections 5.1.3.2.4 et seq and 5.3.1.2.
The velocity isopleth map does not specify discharge.	See revised Figure 2.4-7.
Statements regarding turbulence in Sections 2.4.1.1 and 5.1.2.1 appear to conflict.	There is no conflict between Section 2.4.1.1 and 5.1.2.1. Section 5.1.2.1 states that flow will be turbulent. Section 2.4.1.1 states that the river bottom is relatively uniform. However, the fact that river bottom topography is fairly smooth does not mean that the flow is laminar (i.e., not turbulent). Laminar flow is not expected in rivers.

SUBJECT/COMMENT	APPLICANT RESPONSE
No effort was made in Appendix K to confirm shoreline orientation of chinook juveniles.	The Applicant believes that existing information concerning outmigration patterns of Hanford Reach juvenile chinook salmon is adequate for assessing the aquatic impacts of S/HNP. The Appendix K studies were not designed to confirm shoreline orientation of juvenile salmonid fishes.
Methods for collecting ichthyoplankton in Appendix K should have been indexed in areas where other methods were successful in capturing juvenile chinook salmon.	Ichthyoplankton samples are not designed to capture juvenile salmonids. The collection of two 0+ age chinook in the ichthyoplankton nets was incidental. Therefore, indexing would not be appropriate.
No comparisons were made in Appendix K among stations; therefore, no conclusions regarding spatial distribution can be drawn.	Sampling stations were established in order to sample most of the habitat types available in the river. Stations differ with respect to physical characteristics. Therefore, comparisons between stations to determine fish distribution is not possible.
Data gathered in Appendix K on the east bank were not compared to data on the west bank. This is important since the point was made in the text that juvenile chinook salmon prefer the west bank.	No where in the text of Appendix K or in the ASC/ER is it stated that juvenile chinook salmon prefer the west bank. Because stations were not established with similar habitat and physical characteristics, quantitative comparisons between banks was not attempted.
Changes in whitefish C/UE during the seasons are said to be related to spawning in Appendix K. However, this reasoning is difficult to follow.	Whitefish spawning areas in the Hanford Reach near S/HNP are shown in ASC/ER Figure 2.2-19. The major whitefish spawning area in the Reach is at Vernita Bar. Whitefish are known to move past the intake/discharge location in the fall on the way to spawning grounds and again in spring after spawning. Such movement explains peak occurrence near S/HNP during these seasons.
Two of the top ten fish ranked in Table 3 of Appendix K are fry of other members of the top ten; they are therefore ranked twice.	This table clearly indicates that the fry were separately ranked and the Applicant does not believe that this table is confusing or misleading.

SUBJECT/COMMENT	APPLICANT RESPONSE
Tow speed was not given for ichthyoplankton tows in Appendix K.	Ichthyoplankton samples were collected from a stationary boat.
No contour map is provided showing shoreline changes.	As is described in Section 4.1.2.2, no shoreline changes are being proposed; therefore, no map was provided.
Drawings of the permanent intake structures are dimensionless.	See revised Figure 4.1-8.
Discuss procedures for constructing stilling well under pumphouse.	The Applicant's current plans for construction of the pumphouse are fully and accurately presented in Section 4.1.2.2. Final construction procedures have not been formulated. It should be noted that Section 4.1.2.2 discusses the Applicant's plans for using sedimentation ponds for construction of the pumphouse.
TRC values should appear in Tables 3.6-5 and 3.6-6.	As discussed in Section 3.6, chlorination of the circulating water systems will not be continuous, chlorination of both units will not occur simultaneous, and discharges of TRC will not occur unless the concentrations of TRC in the circulating water system has dropped to less than 0.14 mg/l for 15 minutes. Given these conditions, it was not believed to be appropriate to include TRC concentrations in Tables 3.6-5 and 3.6-6. A footnote will be added to Table 3.6-5 to indicate this.
Incorporate into text explanation of relative contributions to effluent of concentrating effects of operation and addition of chemicals.	See revised Section 3.6.3.
Values in Table 3.6-4 should be expressed in the same units as Tables 3.6-5 and 3.6-6.	The Applicant does not believe that it is appropriate to express the values in Table 3.6-4 (i.e., lbs/day) in the same units as Tables 3.6-5 and 3.6-6 (i.e., mg/l), since the chemicals listed in Table 3.6-4 will not be added to the various systems as a function of mg/l.

SUBJECT/COMMENT	APPLICANT RESPONSE
The greatest temperature change should be used to evaluate aquatic impacts.	See revised Section 5.1.3.2.
Coutant, 1973, found significant selective predation at 10% of equilibrium loss dose.	This reference is cited and discussed on page 5.1-16b of the ASC/ER.
Resolve discrepancy between statement that potential exposures for fish drifting through the plume centerline are less than 18% of the equilibrium loss duration and the statement that exposures to elevated temperatures and slightly elevated temperatures would be about one and ten seconds, respectively.	See revised Section 5.1.3.2.4.1.
Plot centerline temperatures against time for various river and plant conditions.	See new Figure 5.1-10a.
Provide 96-hour LC-50 levels for copper.	See revised Section 5.3.1.2.
Consistency in use of mg/l and ug/l is desirable, especially considering that the hard water 48-hour LC-50 concentrations for zinc are an order of magnitude less than the hardness of the Columbia River.	See revised Section 5.3.1.2. However, it should be noted that it is inappropriate to use the hardness of ambient Columbia River when evaluating the possible metal toxicity of the discharge plume, since the hardness of the discharge plume will be greater than ambient. See Table 5.3-1.
Mention synergistic effects of cadmium.	See revised Section 5.3.1.2. However, the Applicant does not believe that further discussion of potential synergistic effects from cadmium is warranted in light of the fact that average dissolved concentrations of cadmium at Vernita Bridge were below detectable levels. See Section 5.3.1.2.

SUBJECT/COMMENT	APPLICANT RESPONSE
Paragraphs 3 and 5 on page 5.3-5 do not seem to agree regarding TRC.	The Applicant cannot perceive any possible source of disagreement between these paragraphs. For worst case conditions, paragraph 3 states that the concentration of TRC will be 0.002 mg/l at 67 feet and that the concentration of TRC will be less than 0.01 mg/l at 50 feet. These are consistent statements.
Specify travel time for 150 feet under average conditions.	See revised Section 5.3.1.2.
Travel time and distance should be given for dilution of TRC to 0.002 mg/l under average conditions.	See revised Section 5.3.1.2.
Incorporate EPA report that rainbow trout exhibit avoidance behavior at 0.001 mg/l.	The EPA report discussing rainbow trout avoidance at 0.001 mg/ refers to the work of Sprague and Drury (1969). Critical examination of their methods indicates that chlorine concentrations were calculated rather than measured and statistical interpretation of the threshold avoidance levels was not possible because of variable overall test results. Because of these discrepancies, this study was not used in discussion of possible impacts of the S/HNP discharge.
Incorporate EPA report that rainbow trout are killed at 0.3 mg/l TRC.	This information is provided in Table 2.2-23 and Appendix L.
Provide data from studies cited in Section 5.3.1.2 regarding synergistic effects.	See revised Section 5.3.1.2.
There appears to be some conditions under which the discharge temperature would exceed ambient river temperatures by 20°C.	The Applicant is not aware of any conditions under which the discharge temperature would exceed ambient river temperatures by 20°C. See revised Section 5.1.3.2.

SUBJECT/COMMENT	APPLICANT RESPONSE
No orderly mitigation program is developed for aquatic biota.	The Applicant respectfully disagrees with this comment. Examples of the Applicant's mitigation program are provided in Attachment 1 (Responses to Completeness Review) to the August 20, 1982 cover letter transmitting Amendment 6 to the ASC/ER. Partially as a result of these mitigation measures, no significant effect upon aquatic biota is expected as a result of construction and operation of S/HNP. In light of this fact, the Applicant does not believe that additional mitigation measures are warranted.
Discuss shoreline construction techniques.	Shoreline construction techniques are generally discussed in Section 4.1.2. As discussed previously, details of the Construction Impact Control Program will be submitted to EFSEC for its review and approval prior to commencement of construction activities. The Applicant believes that the description of the shoreline construction techniques in Section 4.1.2 is sufficient to evaluate the potential impacts of the S/HNP.
Provide details of the Construction Impact Control Program.	Details of the Construction Impact Control Program (CICP) will be submitted to EFSEC for its review and approval prior to commencement of construction activities. As discussed previously, the Applicant believes that the description of the CICP in Section 4.5 is sufficient to evaluate the potential impacts of S/HNP.
Provide greater discussion of lack of need for construction window for installing the temporary intake system.	As Section 4.1.2.2 explains, installation and removal of the temporary intake system will entail minimal disturbance of the river bottom; consequently, no construction window is warranted. A greater discussion of this point would be superfluous.
Noise	
Operational noise should be discussed in Section 5.6 rather than 2.7.	In general, Section 2.7 discusses background noise levels and discusses areas which might be potentially affected by noise at S/HNP. Such discussions are appropriate for Section 2.
HUD Circular 1390.2 has been superceded and is not relevant.	See revised Reference 2 in Section 2.7.

SUBJECT/COMMENT	APPLICANT RESPONSE
Question E260.07 and its response are missing from Amendment 6.	Question E260.07 and its response were not included in Amendment 6 because they were not revised by the Amendment. See Amendment 5 for original question and response.
The 2 dBA projected noise increase along SR 240 is not based upon measurements but upon noise calculations prepared for the DEIS.	The 2 dBA projected noise increase along SR 240 was based on background noise measurements and calculations prepared for the ASC/ER.
Need for hearing protection should be emphasized.	As stated in Section 4.1.1, ear protection will be used if required and will comply with state and federal regulations.
Discuss fact that Washington noise regulations for industrial source properties is 50 dBA between 10 p.m. and 7 a.m.	See response to Question E260.07.
Socioeconomics	
Provide a qualitative discussion of the revised status and schedules of WNP-1 and 4.	See Sections 8.3.1 and 8.3.6 which were revised in Amendment 7.
A possible discrepancy exists between predicted number of workers and households which would not outmigrate.	See revised Section 8.3.11.2 of Amendment 7.
Although property values will most likely be higher with the project than without it, this does not imply that property values will increase because of S/HNP construction.	See revised Section 8.3.11.2 of Amendment 7.

SUBJECT/COMMENT	APPLICANT RESPONSE
The 10 percent figure for construction commuters from Yakima County was a result of the analysis of Reference 11 and not a finding of Reference 11.	See revised Section 8.3.2 of Amendment 7.
The Applicant did not respond to the comments on Summary of Social and Economic Benefits and Costs of the Application Completeness Review.	See revised Section 8.5 of Amendment 7.
Tabulation on page 8.3-7 is inaccurately titled and has no totals.	See revised page 8.3-7 of Amendment 7.
There are no estimates of sales and use taxes during construction in constant dollars.	See revised page 8.3-7 of Amendment 7.
Price level is not identified for the tabulation on page 8.3-8.	See revised page 8.3-8 of Amendment 7.
Reason for assuming that 50% of purchases would be local for estimating sales taxes is unclear and seems unduly conservative.	See revised Section 8.3.5.1 of Amendment 7.
Plant cost estimates ranging from $2.5 to $7.8 billion are confusing.	See revised Section 8.3.5.1 of Amendment 7
Statement added to Section 8.3.9 is narrow and misleading.	See revised Section 8.3.9 of Amendment 7.

SUBJECT/COMMENT	APPLICANT RESPONSE
The statements that tax revenues from S/HNP would enable local jurisdictions to maintain their budgets and avoid lay-offs is misleading.	These statements have been deleted from Sections 8.3.17 and 8.5 by Amendment 7.
On page 8.3-7, the sale/use tax revenues seem to be understated.	See revised page 8.3-7.
On page 8.3-19, the values of $150 million and $30 million seem to be high. Are they current dollars?	On page 8.3-19, the figures of $150 million and $30 million are total revenues available to Benton County if tax rates were to remain at 1981 levels.
Change title of Section 8.5.2.2 from Fiscal Costs to Potential Fiscal Impacts.	See revised title of Section 8.5.2.2.
Provide additional description of socio-economic mitigation and monitoring.	Development of the monitoring program is an ongoing process. The Applicant is in the process of considering different approaches to socioeconomic monitoring in order to achieve a thorough and accurate monitoring program. The precise nature of the local and regional impacts which may take place will be determined in the future through the impact monitoring program. Appropriate mitigative action will be undertaken prior to the actual occurrence of the impacts where practicable, but not until it is determined that the impact is likely to occur and is the result of S/HNP.
Discuss encouraging tax revenue sharing.	The issue of tax revenue redistribution is discussed at several points in the ASC/ER. On page 8.5-7, the Applicant notes the benefits of tax revenue redistribution. Such tax revenue redistribution should be a local decision.
On page 8.3-6a, discuss the possibilities of local governments enacting additional sales or property transfer tax.	See revised page 8.3-7.

SUBJECT/COMMENT	APPLICANT RESPONSE
On page 8.3-7, annual revenues table should be revised to show an annual average revenue.	The annual revenues table on page 8.3-7 was revised in Amendment 7 to show annual average revenue.
Provide a discussion of tax revenue benefits from WNP-2 and WNP-1 in Section 8.3.5.2.	See revised Section 8.3.5.2.
On page 8.3-20, clarify discussion of tax redistribution to reference an interlocal cooperation agreement (RCW 39.34).	See revised page 8.3-20.
Transportation	
There is no statement that the proposal conforms with applicable transportation plans.	See Amendment 6, Section 8.3.10.5.
Identify radwaste disposal routes.	See revised Section 3.8.
It is unclear how improving Route 10 will improve its capacity to handle traffic.	Presently, the condition of Route 10 is such that, due to its vertical relief, traffic proceeds more slowly than it would if the route's condition were improved. Consequently, by improving the condition of Route 10, traffic speeds can be increased, thereby improving the capacity of Route 10.
Alternative A is discussed as a possible access road, even though it will not be available for use.	The Applicant does not believe that the discussion in the ASC/ER is confusing. Alternative A is discussed to ensure that a consideration of alternative routes is presented in the ASC/ER.

SUBJECT/COMMENT	APPLICANT RESPONSE
Cultural Resources	
Provide additional details about cultural resource impacts.	See revised Sections 2.6 and 4.1.1.
Disclose timing of Phase III and IV of cultural resources work.	The timing of Phase III and IV in relation to other project activities is shown in Figure 2.6-1. More detailed timing information is not available.
Correct Table 1 attached to the response to Question N200.10.	See revised response to Question N200.10.
Additional Corrections or Modifications	
Operation of the WDOE hazardous waste site in Richland is independent of Arlington's acceptance and disposal of Washington's hazardous waste.	See revised Section 2.1.4.1.
EFSEC Questions E290-10 and E290-23 should be indicated in the margin on page 2.2-35.	The Applicant does not believe it to be appropriate to reference the responses to these questions since the responses were not transferred to the text.
Dimensions should be given on the vertical axis on Figure 2.2-22(a).	See revised Figure 2.2-22(a).
Add the word "treated" before "sanitary waste" in the third paragraph on page 5.4-1.	See revised Section 5.4.

SUBJECT/COMMENT	APPLICANT RESPONSE
Put Applicant's response to non-radioactive spillage prevention into Section 4.5.4.1.	See revised Section 4.5.4.1.
Put Applicant's third response to mitigation plans into Section 6.1.4.3.1.	See revised Section 6.1.4.3.2.
Put Applicant's fifth response to construction worker into Section 4.5.4.1.	The Applicant does not believe that such incorporation is appropriate.
Put Applicant's fourth response to SR240 improvements in Section 8.3.10.	See revised Section 8.3.10.5.
Put Applicant's third response to waste product transportation routes in Section 8.3.10.	See revised Section 8.3.10.4.1.

DISTRIBUTION OF APPLICATION TO EFSEC
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SKAGIT/HANFORD NUCLEAR PROJECT
APPLICATION NO. 81-1

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#13	Mr. John G. Douglass State Energy Office 400 East Union Olympia, WA 98504 ER-11

#14 Mr. John Ward
Department of Game
600 North Capitol Way
Olympia, WA 98504
GJ-11

#15 Mr. Sam I. Reed
Dept. of Social & Health Services
Olympia, WA 98504
LD-11

#16 Mr. John A. Clark
Parks & Recreation Comm.
7150 Cleanwater Lane
Olympia, WA 98504
KY-11

#17 Mr. Bert Baron
Planning & Comm. Affairs
400 Capitol Center Bldg.
Olympia, WA 98504
GH-51

#18 Comm. William H. Sebero
Board of County Commissioners
Benton County
P. O. Box 470
Prosser, WA 99350

#19 - 22 Energy Facility Site Evaluation Council
Technical Review Section
Mail Stop PY-11
Olympia, WA 98504

#23 & 24 Mr. Patrick Biggs
Administrative Law Judge
Energy Facility Site Evaluation Council
Mail Stop PY-11
Olympia, WA 98504

#25 & 26 Mr. Darrel Peeples
Administrative Law Judge
Energy Facility Site Evaluation Council
Mail Stop PY-11
Olympia, WA 98504

#27 Mari Ann Allen & Associates
Court Reporter
911 Tacoma Ave. South
Suite 201
Tacoma, WA 98402

#138 Kevin M. Ryan, Esq.
Assistant Attorney General
Temple of Justice
Mail Stop AV-21
Olympia, WA 98504

#152 Robert C. Lothrop, Esq.
Attorney for Columbia River Inter-Tribal Fish Commission
Suite 320
8383 N.E. Sandy Blvd.
Portland, Oregon 97220

#258 Thomas R. Bjorgen, Esq.
Assistant Attorney General
Department of Transportation
Mail Stop AQ-01
Temple of Justice
Olympia, WA 98504

#259 Spencer W. Daniels, Esq.
Assistant Attorney General
Department of Transportation
Mail Stop KF-01
Olympia, WA 98504

#260 Mr. R. C. Schuster
District Administrator
Department of Transportation
P. O. Box 52
Yakima, WA 98907

#261 Charles Lean, Esq.
Department of Ecology
Mail Stop PV-11
Olympia, WA 98504

#262 Paul S. Majkut, Esq.
Assistant Attorney General
Departments of Fisheries
and Game
Temple of Justice
Mail Stop PB-53
Olympia, WA 98504

#263 Frank J. Owens, Esq.
Construction Impact Group
Owens, Weaver, Davies &
Dominick
926 - 24th Way S.W.
Olympia, WA 98502

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Benton-Franklin Governmental Conference
Richland, Washington

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Perkins, et. al., Seattle, Washington
Stoel, Rives, et. al., Portland, Oregon
Washington Assistant Attorney General, Olympia, Washington
Thomas R. Bjorgen, Esq., Assistant Attorney General
Spencer W. Daniels, Esq., Assistant Attorney General,
    Department of Transportation
Charles Lean, Esq., Department of Ecology
Paul S. Majkut, Esq., Assistant Attorney General,
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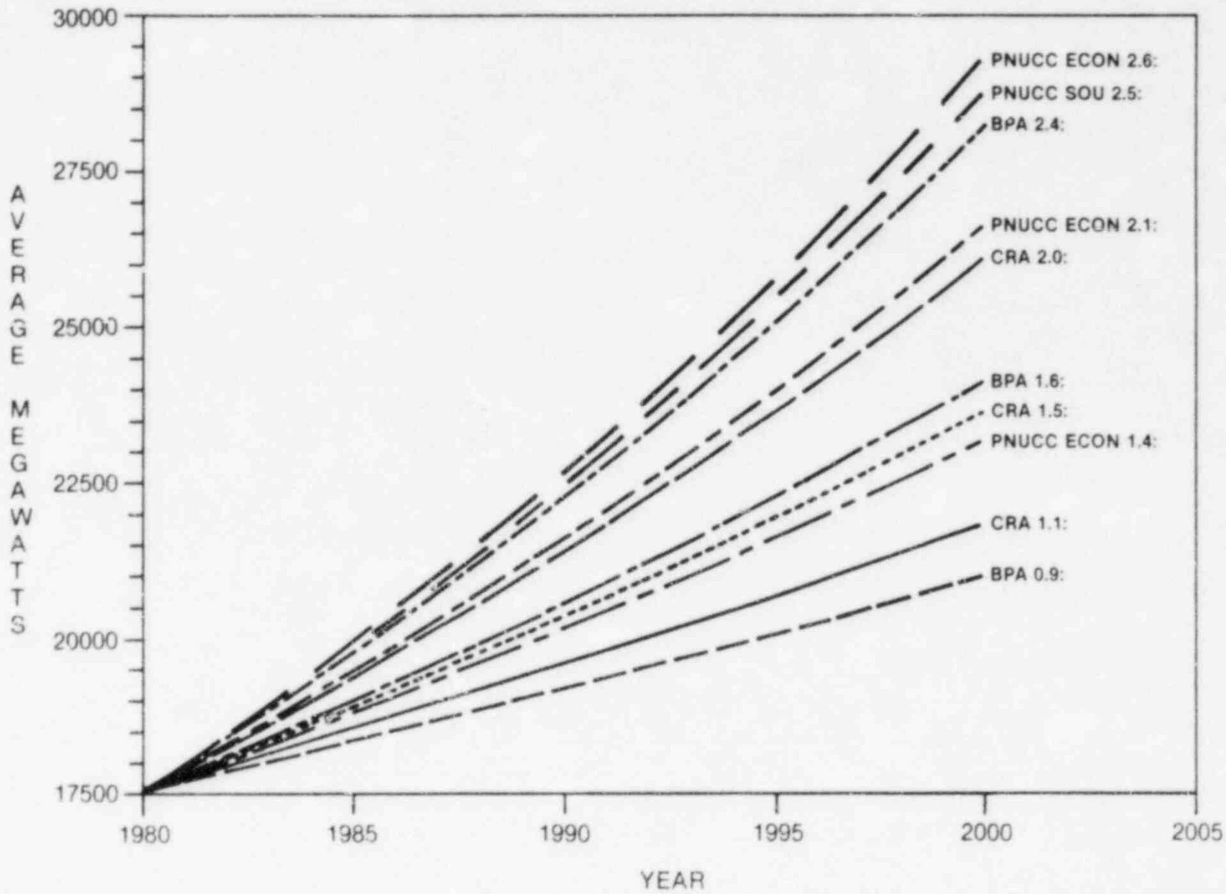
Portland General Electric Company, Portland, Oregon
Puget Sound Power & Light Company, Bellevue, Washington
The Washington Water Power Company, Spokane, Washington

INTERESTED PARTIES

Canadian Consulate General, Seattle, Washington
Coalition for Safe Power/Forelaws on Board
    Portland, Oregon
Columbia River Inter-Tribal Fish Commission
Construction Impact Group, Richland, Washington
National Wildlife Federation and Oregon Environmental
    Council
Natural Resources Defense Council
    San Francisco, California
Pacific Northwest Resources Center, Eugene, Oregon
URS Company, Seattle, Washington
Yakima Indian Nation



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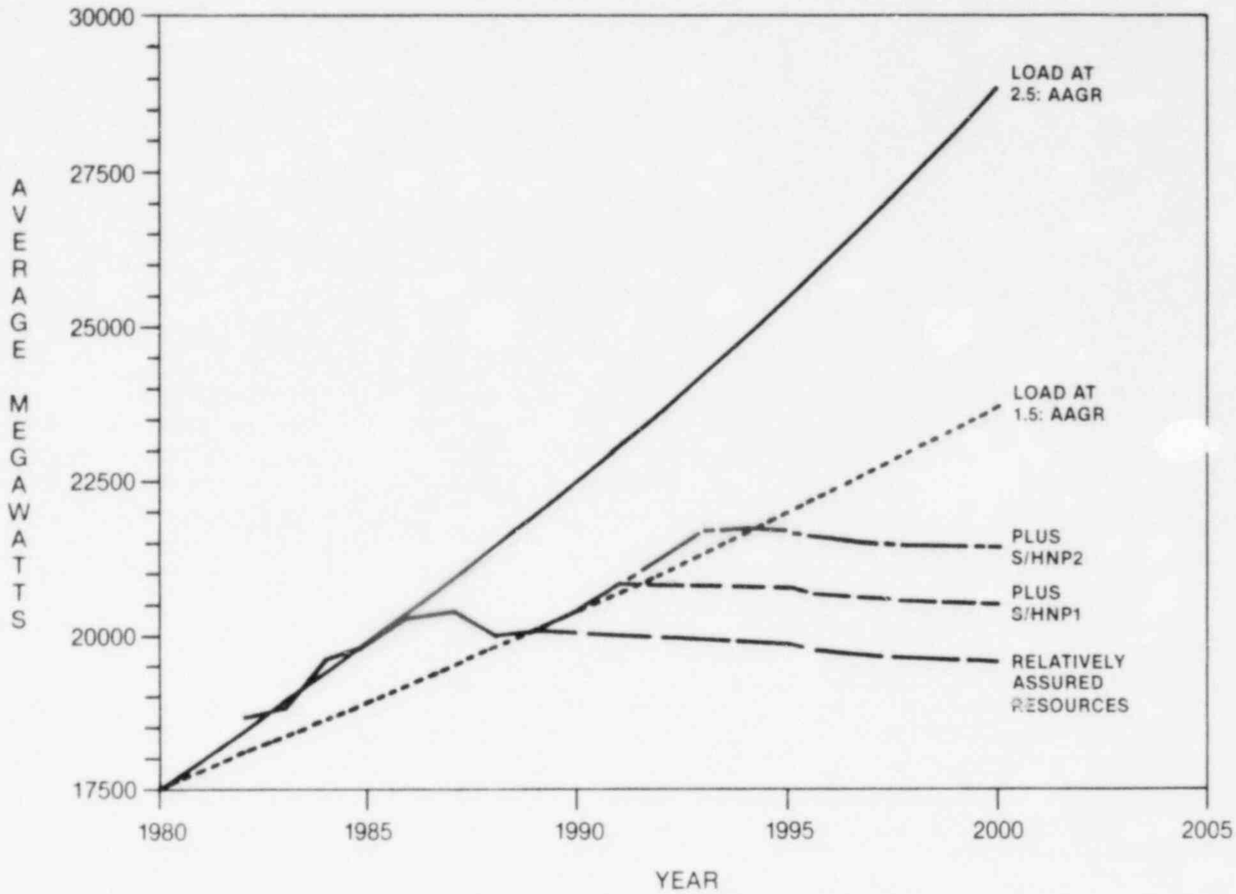
REGIONAL ELECTRICITY FORECASTS

FIGURE 1.2-1



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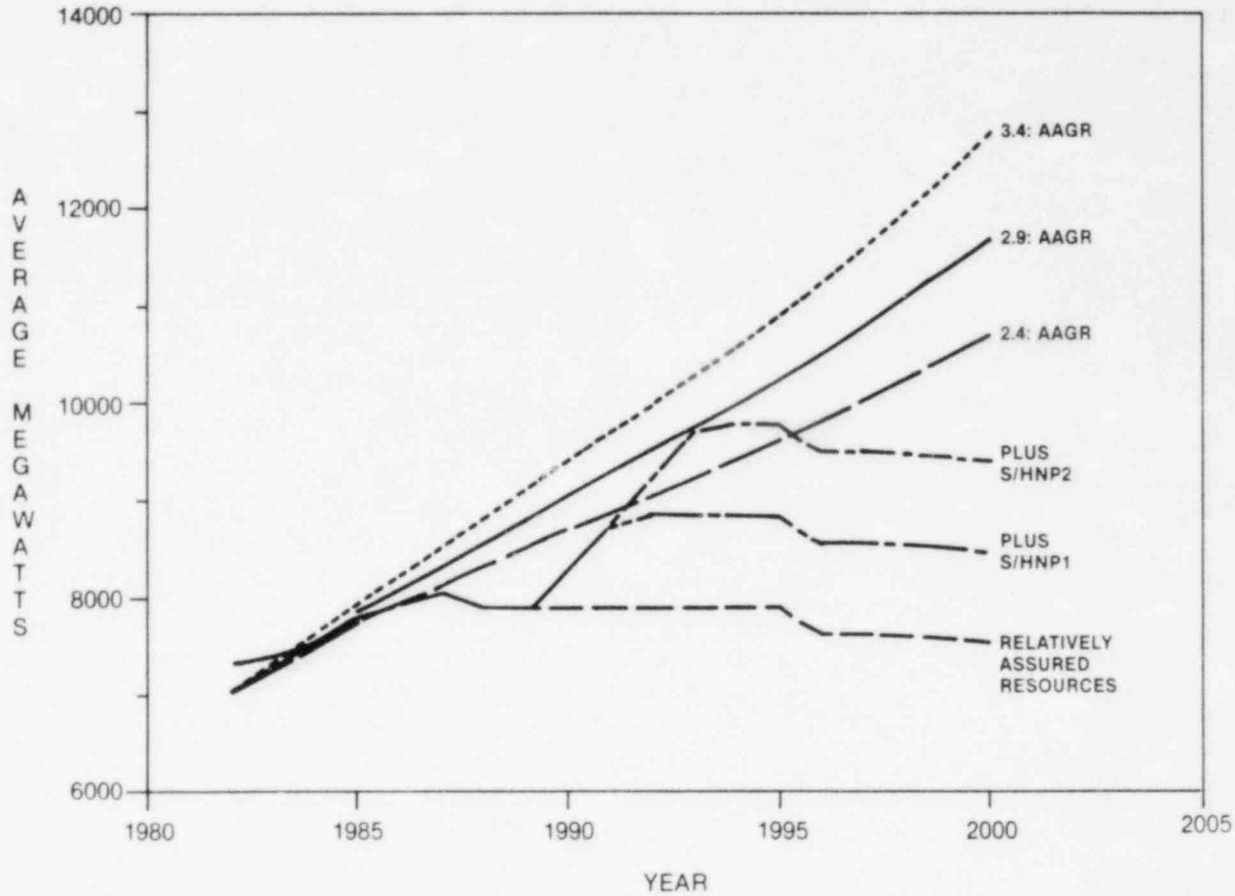
NORTHWEST REGION LOADS AND RESOURCES

FIGURE 1.2-2



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APPLICATION FOR SITE CERTIFICATION/ ENVIRONMENTAL REPORT

FOUR COMPANY COMPOSITE LOADS AND RESOURCES

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CHAPTER 2.0

THE SITE

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2.8-1	Federally and Privately Owned Nuclear Facilities

Facility	Easement Width	Estimated Acres Outside Site	
1. Intake and discharge pipelines	150 feet (200 feet at pumphouse)	134	4
2. Railroad	100 feet	42	
3. Transmission Lines	600 feet	192	
4. Access Roads			
a. North	100 feet	19	
b. South	100 feet	17*	8

* An alternate access road, totalling 33 acres, identified as South Alternate Access Road on Figure 2.1-3, is being considered.

Figure 2.1-3 shows the centerlines for the preliminary corridors (each 1,000 feet wide) in which the final respective easement routes will be selected. A legal description and final area for each easement will be provided after selection of the final routes. 4

The Columbia River shoreline at the proposed location of the intake and discharge system is not within the jurisdiction of the Shoreline Management Act. WAC 173-18-070. This shoreline is also not within the boundary of the coastal zone nor would the proposed use affect land or water uses in the coastal zone. Washington State Coastal Zone Management Program, June 1976, pp. 119-20. 6 E250.02

2.1.4.1 Land Use Within a 5-Mile Radius

As indicated on Figures 2.1-16 and 2.1-17, the only land uses within a 5-mile radius of the S/HNP Site are the various industrial facilities located within the DOE Hanford Reservation. Approximately 5 miles east of the Site is the Supply System WNP-2 reactor, currently under construction. Two more Supply System nuclear plants, WNP-1 and WNP-4, are located within a mile to the east of WNP-2. 4 A permanent meteorological tower operated by the Supply System is located one-half mile west of WNP-2. Immediately west of the WNP-2 site is the DOE Wye Burial Ground for radioactive waste. Approximately 5 miles southeast of the S/HNP Site is DOE's Fast Flux Test Facility (FFTF), which is a sodium-cooled reactor for testing reactor fuel elements. The DOE 200 East Area is 5.9 miles northwest of the Site. The H. J. Ashe Electrical Substation is located 4.5 miles east of the S/HNP, and is operated by the Bonneville Power Administration as part of its transmission system. 5 N260.02

The central landfill is located 2.5 miles north-northwest
of the S/HNP. This landfill receives approximately 22,000
cubic yards of office waste per year, some scrap
construction materials, some residual chemicals and 5
laboratory chemical wastes, and some asbestos pipe N260.02
loggings. The pipe loggings, laboratory wastes, and
residual chemicals are all enclosed in double containers.
The largest containers buried at the landfill are 30 gallon
drums, which may contain as much as a gallon of residual
chemicals (Ref 39). An Environmental Impact Statement has
been issued by the Washington Department of Ecology for a 4
hazardous waste disposal site to be located in Section 15
T11N, R27E approximately 2.5 miles south-southeast of the
S/HNP Site. 8

No significant changes are forecast in the use of the land
within 5 miles. The Hanford Reservation is expected to
remain dedicated primarily to industrial use, with no 4
private residences.

feed is supplemented year round with such grains as corn, barley, and wheat (or wheat milling residue), with corn silage and sugar beet pulp, and with such protein additives as soybean or cottonseed meal (Ref 18).

The average annual milk production per cow in 1979-1980 was 14,000 lb per cow, in all counties (Ref 26) except Morrow, Oregon, which had a yield of 11,000 lb per cow (Ref 23).

2.1.4.5 Meat Production Within a 50-Mile Radius

Table 2.1-8 lists, by distance and direction, the approxi-
mate 1979 and 1980 meat production within a 50-mile radius
of the Site (Refs 12, 14, 24, 26). There are no cattle
feedlots in Kittitas, Klickitat, or Morrow Counties within
50 miles of the Site. The meat production is from beef
cattle, with the exception of 85,000 lambs on one feedlot 4
in Umatilla County. The average weight of slaughtered beef
ranged from 1100 to 1125 lb per animal (Ref 24). The
average weight of lambs prior to slaughter was 95 lb.

Cattle are fattened in feedlots for 6 to 12 months before they are slaughtered. During this time, cattle do not graze on open pasture or eat green chop feed. They generally are fed on such crop aftermath as potato waste, apple stumpage, or corn silage.

2.1.4.6 Fishing and Hunting

Fishing occurs in the Columbia, Snake, Yakima, and Walla
Walla Rivers, as well as in isolated lakes and ponds.
Table 2.1-9 shows the 1978 sport catch for salmon and
steelhead on the Columbia River above Bonneville Dam.
Other species, including bass, channel catfish, sturgeon,
walleye, crappie, sunfish, and bluegill are also caught in
this area, however, no catch statistics are compiled for N210.11
these species. The only commercial fishing, which occurs 5
within McNary pool, is a small fishery for carp which is
used primarily for mink food. The catch is variable and
subject to market demand (Refs 30, 31). Sport fishing
statistics specific to the Hanford Reach are presented in 8
Section 2.2.2.6.4.

Hunting is extensive within a 50-mile radius of the Site.
Much of the farmland is open to hunters, with upland bird
and fowl hunting being the most popular. Table 2.1-10
shows the annual game harvest within a 50-mile radius of
the Site. The totals for the Washington Counties are based 4
on 1980 statistics; Oregon totals are based on the latest
hunter survey, conducted in 1977, except for the deer
count, which is from 1980 (Refs 32, 33).

The Columbia River banks are the closest location to the S/HNP point of discharge where fishing and hunting can occur. Access to the river is usually open on both banks to the normal high water mark. However, during hunting season (approximately October 15 to January 15), no access to the river is allowed from the Hanford townsite to Vernita Bridge. Hunting also occurs east of the river.

2.1.4.7 Water Use

The primary uses of Columbia River water for 50 miles downstream of the S/HNP discharge structure are irrigation and the municipal water supplies of the cities of Richland, Pasco, and Kennewick. Richland and Pasco pump water directly from the river for municipal use after appropriate filtration and treatment. Kennewick obtains its water indirectly from the river by use of Ranney collectors, which results in filtration of the water before it enters the collectors.

Changes are occurring in the uses of adjacent lands and waters because of increased construction activity on the Hanford Reservation, the new industrial development in the Tri-Cities, and the expansion in irrigated agriculture. The amount of irrigated acreage will continue to increase in the time period from 1980 to 2020/2030 (Ref 34).

The principal sources of water for the irrigated areas south and west of the Tri-Cities are the Columbia, Snake, and Yakima Rivers. Groundwater is being pumped in several areas, and additional areas are expected to be irrigated with groundwater in the next few years. New irrigation in the Columbia Basin Project will receive its water from the Grand Coulee Dam on the Columbia River.

Tables 2.1-11 and 2.1-12 list permits and certificates for surface and groundwater use, respectively, for 50 miles downstream from the S/HNP intake and discharge location (Ref 35). Each table includes information about location, distance from discharge point, withdrawal rate, and use. Groundwater data are limited to wells located within one-half mile of the river; greater distances were not examined because the groundwater flow is toward the river except for a small outward flow during flood seasons (refer to Section 2.4.2). Types of use include irrigation, domestic, commercial/industrial, fire protection, and heat exchange. Each permit listed in Tables 2.1-11 and 2.1-12 has been indicated on Figures 2.1-18 and 2.1-19, respectively. Permit applications, pending on May 18, 1981, for both surface and groundwater use are listed in Tables 2.1-13 and

The Washington Natural Heritage Program 1981 list of endangered, threatened, and sensitive vascular plants (Ref 40) was also reviewed. The list is expected to become an official Washington State list as soon as adopting regulations are completed by the Washington State Department of Natural Resources. This list recognizes Rorippa calycina var. columbiae as threatened. No other plants in the vicinity of the Site and Associated Areas are listed as threatened or endangered, but two species are recognized as sensitive (Ref 40). These species, found in the Site and Associated Areas are Astragalus sclerocarpus, which is common in much of the Hanford Reservation, and Cryptantha leucophaea which is found in sandy habitat such as sand blowouts. The designation "sensitive" includes species with small populations or localized distribution within the State whose populations and habitats will be jeopardized if current land use practices continue.

2.2.1.7.2 Wildlife

Two federally listed, threatened or endangered animal species, are known to occur within the Hanford Reservation (Ref 2), bald eagles and peregrine falcons. Bald eagles are endangered throughout the 48 conterminous states except in Washington, Oregon, Minnesota, Wisconsin and Michigan, where they are listed as threatened (43 FR 4310-55). The peregrine falcon is considered endangered throughout the United States. 4

Bald Eagles

Bald eagles are winter residents of the Hanford Reservation, although sporatic nesting attempts have been made in the past. They generally arrive in mid-November and are present through February (Ref 11). During this period, bald eagles can be found perching in trees along the Columbia River. The roosting site most commonly used at the old Hanford townsite is located 1.2 kilometers from the pumphouse location. During the winter, bald eagles rely upon waterfowl and salmon carcasses that are found in the Hanford Reach of the Columbia River (Ref 41). The wintering population of the Hanford Reservation has increased over the years from 2-6 birds in the 1960's to over 20 birds in the late 1970's (Refs 11, 41).

Even though the bald eagle occurs primarily along the Columbia River, this raptor also utilizes sagebrush/cheatgrass habitat for hunting. Presently, little data exists on daily movement patterns of bald eagles on the Hanford

Reservation and little is known about their utilization of various habitats for feeding and nesting.

Peregrine Falcon

Peregrine falcons require a nesting cliff greater than 30 meters in height and within 1 kilometer of water, and an open foraging area (Refs 42-44). Relatively little of this type of habitat exists within the Hanford Reservation and nesting peregrines have not been reported in this area. The only published record of peregrine falcons in the Tri-Cities area is of winter migrants (Audubon Christmas Counts, Ref 2).

These data indicate that winter or migratory sightings of
transient birds can be expected near the Site in the
future. However, these sightings are not viewed as
significant because peregrines range over a large area (up
to 40 kilometers per day), and the Hanford Reservation does 4
not appear to be prime habitat for this species.

2.2.2 AQUATIC ECOLOGY

The Columbia River is a very complex aquatic ecosystem
because of the number of man-made alterations, the
diversity of the biota, and the size and diversity of its
drainage basin. Hanford Reach, the only free-flowing
section of the Columbia River within the United States and
above Bonneville Dam, is characterized by a variety of
habitats ranging from swift currents and rocky substrates
to slowly flowing sloughs and backwater areas. Flow
through the Hanford Reach is regulated by Priest Rapids
Dam. Comprehensive evaluations of the ecological
characteristics of the Columbia River are presented in the
References for Section 2.2. 8

Studies of the various aquatic organisms in the Columbia
River, relating primarily to the influence of reactor operation, have been conducted over a 36-year period (1947 to
1981). A bibliography with abstracts of these
investigations was published in 1973 (Ref 51) and updated
in 1979 (Ref 52). The following sections summarize the 4
essential ecological characteristics of the major
communities and identify important species as defined in
Regulatory Guide 4.2, Rev 2. Species collected in the
Hanford Reach are listed in Tables 2.2-15 through 2.2-19.
Species of special concern or importance are listed in
Table 2.2-20.

2.2.2.1 Phytoplankton

The plankton community in the Hanford Reach is influenced
by the communities in pools by dams upstream of the Reach
and by manipulation of reservoirs by the dam operators.
The plankton communities observed at Hanford are mostly 6
transients flowing from one reservoir to another. There is
not sufficient time for an edemic potamoplankton to develop
in the Reach. Consequently the communities in the Hanford
Reach are expected to differ from those elsewhere in the
Columbia River.

An inventory of the phytoplankton species identified in the 4
Hanford Reach is presented in Table 2.2-15.

Phytoplankton in the Hanford Reach are derived from reser-
voirs and periphyton upstream of the intake/discharge site.
Because of the unimpounded nature of the Reach and the 6
rapid transport through the Reach, phytoplankton are E290.04
expected to have a lesser role in ecosystem dynamics in the
Hanford Reach than at other locations in the Columbia.
Hence seasonal and annual fluctuation of phytoplankton may
have less significance here compared to other sites.

Diatoms are the dominant algae in the Columbia River, 4
usually representing over 90 percent of the population. 8
The main genera in the vicinity of the S/HNP intake/dis-
charge include Cyclotella, Stephanodiscus, Asterionella,
Melosira, Fragilaria, and Synedra. Lentic forms that
originate in the impoundments behind the upstream dams are
dominant in this section of the river (Ref 53). The phyto-
plankton community also contains a number of species
derived from the periphyton or sessile algae. Daily
fluctuating water levels, due to operation of Priest Rapids
Dam immediately upstream from Hanford, may potentially
explain the presence of these species. Periphytic algae
exposed to the air for part of the day may dry up and
become detached and suspended in the water when the river
level rises. Green and blue-green algae occasionally occur 4
during warmer months, but in substantially fewer numbers
than the diatoms.

Peak biomass of phytoplankton is about 2.0 g dry wt/m^3 and occurs in May. Winter values are typically less than 0.1 g dry wt/m^3 (Ref 54). A spring increase in biomass with a second increase in late summer and autumn has been observed in the Hanford Reach (Refs 55, 56). The spring bloom is probably related both to increased light and to increased water temperature rather than to availability of nutrients. Nutrients do not decrease to concentrations limiting algal growth.

Phytoplankton densities range from a minimum of 100 algal units/ml in the winter to a maximum of 16,000 algal units/ml in the spring. Fall peaks in abundance of approximately 1,500/ml are frequently observed (Figure 2.2-10). 4

Seasonal peaks in phytoplankton density are most likely related to increased light attenuation and increased water temperature. Increased productivity in recent years may be the result of increased productivity in the reservoirs of upstream dams. 8

Carbon productivity data range from less than 0.001 to greater than 0.020 mg 14 C/hr. These values are typical of river productivity in a temperate climate. Peak productivity generally occurs in summer and fall, and minimums occur in winter. Chlorophyll _a_ concentrations range from less than 1.0 ug/l to greater than 24.0 ug/l. Chlorophyll _a_ concentrations peak in the late spring/early summer, and are lowest in late fall/early winter (Figure 2.2-11).

Comparisons of chlorophyll _a_ and primary productivity curves for various depths illustrate a light attenuation effect. Chlorophyll _a_ concentrations are consistent throughout the water column, but primary productivity rates decrease with depth (Ref 49). This finding supports the conclusion that stratification of carbon fixation rates in the Columbia River is a function of light attenuation, rather than phytoplankton stratification. Plankton distribution, productivity data and pigment analysis suggest that the river is uniformly mixed from shore to shore throughout the year. 4

Uniform distribution of phyto- and zooplankton at midstream has been supported by studies conducted near Columbia River Mile 380 (Ref 66) and near Columbia River Mile 350 (Ref 64). Vertical differences (ANOVA, a = 0.05) in number per volume of Columbia River phytoplankton occurred on only two of 51 sampling dates in 1973-1974 and one of seven dates in 1974-1975. In addition, chlorophyll _a_ and phaeophytin _a_ concentrations were also generally equally distributed with respect to depth and station. 6 N210.08

2.2.2.2 Periphyton

The periphyton community in the Hanford Reach (Table 2.2-15) is primarily composed of diatoms dominated by: _Cocconeis, Asterionella, Synedra, Gonphonema, Achnanthes, Nitzschia_ and _Stephanodiscus_ (Refs 57, 60). One set of samples in June 1979 was dominated by non-diatom blue-green algae: _Schizothrix_ and _Entophysalis_ (Ref 59). 4

Periphyton densities (Figure 2.2-12) and organic matter estimates (Figure 2.2-13) tend to be highest in fall and winter and lowest in summer. Average densities range from 4
4,659 in June to 1,146,250 algal units/cm^2 in March. Average organic matter estimates range from 0.2 in June to 21.0 g/m^2 in September (Refs 57, 60). This community is typical of the Columbia River at Hanford. It provides the 8
primary authocthonus energy source to the aquatic eco- E290.05
system.

2.2.2.3 Macrophytes

Fluctuating water levels, strong currents, and rocky substrate inhibit the development of a rooted macrophyte 4
community in the Hanford Reach. Rooted macrophytes are generally restricted to isolated slack water areas in the main river channel and in muddy bottom areas of sloughs. Because of currents and rocky substrate, there are no macrophyte aggregations in the construction area or downstream in the vicinity of the S/HNP discharge. Where they 6
exist, macrophytes are of great significance. Aquatic vege- E290.06
tation provides food and shelter for juvenile fishes and spawning habitat for some warm water game species.

The most common macrophytic species likely to be found along the shoreline is the curled leave pondweed, *Potomogeton crispus*. Pondweed is common among quiet pools, and is most visible at reduced flows after summer growth. 4
Emergent macrophytic vegetation, including rushes (*Juncus* spp), sedges (*Carex* spp) and cattails (*Typha latifolia*), also may be encountered along the main river shoreline. Macrophytic species that have been identified in the Hanford Reach (Refs 61, 62, 63) are presented in Table 6
2.2-16.

2.2.2.4 Zooplankton

The zooplankton known to exist in the Hanford Reach are listed in Table 2.2-17. Copepods dominate in the late fall, winter and spring. Cladocerans dominate in the 4
summer and early fall. *Bosmina* spp is the dominant cladoceran observed near WNP-1/4 and 2. The relative abundances of dominant zooplankton in the Hanford Reach vary seasonally as shown in Figure 2.2-14.

Average densities of zooplankton (Figure 2.2.-15) may range from less than 10 organisms/m^3 in autumn to 4,700 organisms/m^3 in late spring (Refs 53, 57, 59, 60, 64-66). 8

Zooplankton form only a minor dietary item for young salmon in the Hanford Reach (Ref 67). Dauble et al. (Ref 108), however, indicate that cladocerans may seasonally 4 constitute a major component of the diet of 0 age chinook salmon during some years. The best scientific judgment is that at Hanford, juvenile salmonids are opportunistic feeders and they may occasionally take advantage of 6 zooplankton blooms. E290.07 Evidence does not indicate that zooplankton populations at Hanford are critical to the survival of juvenile salmonids.

Insect larvae, the primary food items for salmonids, are not numerically important components of the zooplankton community. Insects typically account for less than five percent of the zooplankton organisms (Ref 49). Numbers of insect larvae found in midstream drift peak in mid-July at about 7 larvae/m^3 (Ref 49).

4

2.2.2.5 Benthos

Macrobenthic populations are diverse (Table 2.2-18), but are numerically dominated (90 percent) by two taxa: midge fly larvae (Chironomidae) and caddisfly larvae (Trichoptera). Other taxa include black flies (Simuliidae), oligochaetes, molluscs, crayfish, sponges and mites. Population densities change seasonally and annually. 6 With few exceptions, numbers are lowest in June and July, increase dramatically in September and October and are moderately high from December through April. Average densities (Figure 2.2-16) for September, December, March and June in samples collected between 1973-1980 were 4 53,656/m^2, 33,580/m^2, 6,984/m^2 and 5,944/m^2, respectively 5,E290.09 (Refs 53, 57, 59, 60, 64-66). Seasonal fluctuations in benthos densities are related to annual emergence cycles of dominant aquatic insect populations. Peak densities in the fall reflect colonization by insect larvae following oviposition by adult insects in the summer and early fall. 8 The populations of these larvae decline in numbers until emergence as adults. Comparisons among years are not always possible because of differences in sample locations, duration of colonization and collection dates.

Mean total benthic biomass peaks in December while the lowest biomass typically occurs in March. Biomass measurements coincide with high December and low March Trichoptera 4 populations. On occasion Simuliidae, Chironomidae and molluscs will constitute a major portion of the biomass.

Stomach contents of fish collected at Hanford were examined 6 from June 1973 through March 1980 (Refs 49, 53, 57, 59, 60, 8 and 64) and indicate that benthic invertebrates are important food items. Tables in these references contain macro and microscopic stomach content and analysis including percent volume and percent frequency of food items observed in all fish species regularly collected from 1973 through 1980. Conclusion of these examinations include: most Hanford fishes are opportunistic; they utilize juvenile and adult insects, mainly caddisflies and midge flies, smaller fish and occasionally zooplankton for food; and kinds and abundance of benthic invertebrates in Hanford fish diets were generally reflective of the community composition identified in macroinvertebrate samples. 6 E290.08

Hanford Reach serves as the last major main stem spawning ground for fall chinook salmon and steelhead trout.

Salmonids are of greatest commercial and recreational importance; hence, most fisheries research has been concerned with these species. An estimated production of 14 million salmonid smolts from both natural and artificial sources (Table 2.2-21) represent a combined sport and commercial value of 30 million dollars annually (Ref 63).

Salmonids have similar life cycles, but each species and race matures at a different rate, resulting in differences in migration timing (Figure 2.2-17) and duration of life stages and activities. Adult salmonids move past the intake/discharge location during all months of the year, with the greatest numbers passing during spring to early fall. Peak adult migration periods are generally as follows: 4

Sockeye:	July-August
Chinook:	
Spring:	mid-March to mid-June
Summer:	mid-June to mid-August
Fall:	mid-August to November
Coho:	September-October
Steelhead:	August-October

Studies of upstream salmonid migration routes through the Hanford Reach indicate a preference for the east-northeast bank (across the river from the S/HNP intake location). This pattern persists from Priest Rapids Dam downstream to Richland (Ref 62).

2.2.2.6.1.1 <u>Chinook salmon</u>. Fall chinook <u>(Oncorhynchus tshawytscha)</u> spawning usually occurs from mid-October through early-December, and peaks in mid-November (Refs 71, 73). An aerial census of the fall chinook spawning in the Hanford Reach has been made annually since 1947. Esti- 6
mates of fall chinook utilizing the Hanford Reach are pre- E290.12
sented in Tables 2.2-21a and 2.2-21b. Major spawning areas are shown in Figure 2.2-18. The only spawning habitat in the Hanford Reach, downstream of the S/HNP intake/discharge location (RM 361.5), is the section of the river from Wooded Island to Ringold (RM 347-354) (Refs 72, 73).

The upstream portion of this spawning habitat is located 4
7.5 miles downstream from the S/HNP discharge. Data (Table 2.2-22) indicate that this spawning area comprises less than 4 percent of the fall chinook spawning activity for the entire Hanford Reach (Ref 72). Since 1962, the local fall chinook spawning population has increased to an

average of 20,000 fish, or approximately 15 to 20 percent 4
of the total fall chinook escapement to the river (Ref 73)
and approximately 30 percent of the escapement above McNary 8
Dam (Table 2.2-21b).

Eggs incubate in the gravel from late fall to mid-winter, and fry typically emerge from redds during March through June (Refs 55, 56, 74). Following emergence, young-of-the-year (0-age fish) begin their migration to the Pacific Ocean. The peak seaward migration of juvenile chinook in the mid-Columbia River, including those fish produced in the Hanford Reach, occurs in mid-April to mid-June (Refs 75, 76). However, the out-migration of chinook produced in areas upstream of Priest Rapids Dam is now later than in the past, apparently as a result of delays in passage through the reservoir complex (Refs 62, 81).

Chinook juveniles move through the Hanford Reach in two size classes. The young-of-the-year, especially the small, newly emergent fry produced in the Hanford Reach, inhabit backwater sloughs and nearshore areas from late winter through midsummer as they move downstream. Shoreline indentations and backwater areas are important rearing habitat for small 0-age chinook. Upriver- and hatchery-reared 0-age chinook are typically larger than fish produced in the Hanford Reach when they migrate past the S/HNP intake/discharge location. They may move offshore
somewhat in comparison to the locally reared juveniles. 4

The migration of adult spring chinook salmon generally occurs in the Hanford Reach between mid-March and mid-June; it peaks the first week of May. Spawning grounds are located in tributaries of the Columbia River upstream of the Hanford Reach. Fish passage counts at Priest Rapids Dam (Ref 77) since 1960 have ranged from 5,086 to 21,427 fish, and averaged 10,234 fish. Spring chinook juveniles generally reside in freshwater for one year and migrate to sea between April and June during their second spring as 1+ age class fish.

The summer run of adult chinook salmon generally occurs between mid-June and mid-August, and peaks the third week of July. These fish pass the S/HNP and spawn above Priest Rapids Dam in upstream tributaries, primarily the Wenatchee, Okanogan, Entiat and Methow Rivers. Since 1960, the number of summer run chinook migrating through the Hanford Reach past Priest Rapids Dam has ranged from 13,703 to 29,736 fish and has averaged 21,350 fish (Ref 77). Summer chinook juveniles generally reside in freshwater only a few months and migrate to sea between March and August during their first spring as 0-age class fish (Refs 78-81).

reduced river velocity and increased temperatures from impoundment may be beneficial (Ref 117).

Shad have extended their range up the Columbia River to Priest Rapids Dam. Fish counts at the dam, prior to 1969 averaged only 500 fish annually. Recent counts average 8,300 fish and range from 1,360 to 26,500 fish annually (Ref 77). The design of the fishway will not allow shad to 4
pass Priest Rapids Dam. There is some speculation that shad may be spawning in the fishway at the dam (Ref 130).

Shad spawning occurs in groups; a female is often accompanied by one to several males. Spawning occurs near the water surface. Semibuoyant eggs are laid in open water, primarily at night, and are carried downstream by the river flow (Ref 115). Ichthyoplankton samples in the area of the proposed intake and discharge location for
S/HNP indicate that shad eggs and larvae constitute an 6
insignificant (i.e., less than one percent) portion of the ichthyoplankton at that location (Appendix K). Juvenile shad spend their first summer of life in the river, and migrate to sea in the late fall. Shad mature three to four years in the ocean prior to returning to freshwater to spawn.

There is little known regarding the role of the shad in the ecosystem of the Columbia River. Shad are plankton feeders. Juveniles first feed on microscopic animals and later on aquatic insects (Ref 115). Mature shad are not known to feed during their spawning migration, however, they will readily strike small lures and flies (Ref 115).

Thermal tolerance data are generally lacking for this 4
species. Shubel et al. (Ref 131) state that the lethal limit for juvenile American shad is 83.3°F.

American shad are a popular sport species; however, the spawning run is brief and these fish are available to the sportsmen for only about a month. Commerical harvest is limited because of low prices and conflicts with summer run chinook salmon which are presently receiving protection.

2.2.2.6.2 Resident Fish Species

Resident fishes of the Hanford Reach and habitat requirements for a number of the species, have been thoroughly documented in the literature (Refs 59, 68, 89-92). A total of 39 species representing 14 families of fish have been collected since 1974 (Table 2.2-19). The top five in relative abundance are largescale sucker, *Catostomus* *macrocheilus*; bridgelip sucker, *C. columbianus*; squawfish, *Ptychocheilus oregonensis*; chiselmouth, *Acrocheilus alutaceus*; and redside shiner, *Richardsonius balteatus*) (Ref 68).

Although the majority of fish species are assumed to be most abundant in the nearshore zone, complete fish distribution patterns are unknown because of the inability to adequately sample the river cross-section. The important resident species (Table 2.2-20) in the Hanford Reach are discussed below.

4

2.2.2.6.2.1 Mountain Whitefish. Mountain whitefish (*Prosopium williamsoni*) are recreationally important throughout the Columbia River. They are known to feed on the eggs of commercially important species (Ref 50).

Mountain whitefish is the most abundant resident coldwater game species found in the Hanford Reach, and comprises approximately 15 percent of the sport catch. Spawning occurs annually from late November through early January when water temperatures average 37.4 to 46.4°F (Refs 53-56, 59-60). Although specific spawning sites in the Hanford 8
Reach have not been documented, areas outlined in Figure 2.2-19 appear to have suitable flow and bottom type.

4

Fry emergence occurs annually in the Hanford Reach in early April (Refs 53-55, 59-60). The Hanford Slough slackwater 8
environment may provide rearing habitat for whitefish fry, but no fry were found during a one-year study of this area 6
(Appendix K). As fry grow and develop, they disperse throughout the entire river. There is a tendency for juvenile mountain whitefish to move downstream by the end of their first year and to utilize nearshore riffle areas and deep pools out of the main current.

Mountain whitefish feed primarily on immature forms of bottom-dwelling aquatic insects such as mayflies, stoneflies, caddisflies, and midge flies. 4 They are also known to eat crayfish, freshwater shrimp, leeches, fish eggs and occasionally small fish (Ref 115). Feeding primarily occurs at dusk and dawn.

Adult whitefish prefer water temperatures between 48.0 and 52.0°F (Ref 115). Thermal tolerance data are generally lacking for this species.

large squawfish at the Hanford Reach are females (Ref 94). Gray and Dauble (Ref 94) collected northern squawfish up to 15 years old near WNP 1/4 and 2. 4

2.2.2.6.3 Ichthyoplankton

In studies conducted from June 1973 to June 1974 at Columbia River RM 380 (Ref 66) only 5 unidentified larvae and no eggs were observed in 575 zooplankton samples. Weekly tows were made from June 1973 to June 1974 at three stations and three depths (surface, mid-water column and within 1m of the bottom) with a metered Clarke-Bumpus Plankton Sampler equipped with a 158 micron mesh net. Sampling time was three to five minutes at each depth. Ichthyoplankton were only collected in May and July. One 6 unidentified ichthyoplankton was incidentally collected in N210.03 a zooplankton sample taken near Columbia River RM 350 in June 1975 (Ref 64). Beak (Ref 59) conducted ichthyoplankton tows near RM 350. Replicate tows were made monthly from September 1978 to March 1980 at one station with a metered Tucker travel net having a 0.5 X 0.5m square mouth and 333 micron mesh net. Tows were steppe-oblique samples resulting in one minute sampling time at each of three depths; surface, mid-water column and within 1m of the bottom. Only a single species, Cottus asper was captured from May through July 1979. Densities ranged from 0-0.14 individuals per cubic meter.

Information specific to the S/HNP has recently been compiled as part of the site studies and is included as Appendix K. Duplicate samples of 5- and 15-minute duration were taken twice monthly at the surface and within 1m of the bottom at a single station near the proposed S/HNP intake and discharge site (RM 361.5). Paired 550 micron 8 mesh ichthyoplankton nets, each 30 cm in diameter and 1 meter long, were lowered from a stationary boat.

Five species of fish were captured in midstream ichthyo- 6 plankton tows (Table 2.2-21c). Peak abundance (0.17 larvae per cubic meter) occurred in May and June 1981. About 95 6 percent of the fish captured (211 of 222) were prickly E290.03 sculpin (Cottus asper). Two shad larvae (Alosa sapidissima) and a single carp lavae (Cyprinus carpio) were also identified in ichthyoplankton samples. Two chinook 6 fry (40 and 42 mm FL) were captured in bottom tows in April. Because of the species composition and the low densities observed, ichthyoplankton are not thought to be 6 of major importance to the aquatic ecology of the Reach. E290.03

Spatial distribution of larval fish collected at midstream
was similar (Figure 2.2-22a), and no significant difference 6
(α = 0.05) was noted between catches obtained at surface
versus bottom tows. On days in which samples were
captured, the range of ichthyoplankton densities were 0.0
to 0.2133 and 0.0 to 0.2618 per cubic meter for surface and 6
bottom tows respectively. Mean density was 0.0630 $\pm$ N210.08
0.0626/m^3 at the surface and 0.0785 $\pm$ 0.0850/m^3 at the
bottom (see Appendix K).

2.2.2.6.4 Sport Fishing

Sport fishing in the Hanford Reach is focused in two major areas: Ringold Springs and in the Vernita Bar area below Priest Rapids Dam. Principal species sought in those areas include spring and fall chinook salmon, steelhead trout and mountain whitefish. Some angling occurs throughout the Reach for white sturgeon. An additional warm water fishery exists in four slough areas: Jap Slough, Hanford Slough, 100-F Slough and White Bluffs.

The Washington Department of Game (Ref 146) conducted creel
census surveys at Ringold Springs from May 1980 through
April 1981. Bank anglers fished an estimated 61,454 hours
in 15,684 trips and caught 1,794 steelhead and 476 salmon.
Boat anglers fished an estimated 13,882 hours in 2,610 6
trips. Additional surveys were conducted near the Priest
Rapids Dam tailrace from August 1980 through April 1981.
Bank anglers fished an estimated 32,798 hours and boat
anglers fished 15,906 hours. Bank salmon-steelhead anglers
fished 20,323 hours and caught 372 steelhead and 389
salmon. Boat salmon-steelhead anglers fished 10,441 hours
and caught 392 salmon. Whitefish anglers fished 8,532
hours in 5 months for 7,074 whitefish. During 275 hours of
fishing by 53 anglers, only one sturgeon was caught.
Angler use for salmon and steelhead was greatest in April
and September; whitefish effort was highest in December and
January.

For the 1980-1981 season, the Washington Department of Game estimated the following angler days for the entire Hanford Reach from the proposed Ben Franklin Dam site to Priest Rapids Dam: 26,500 angler days for the steelhead fishery, 3,500 angler days for resident salmonids, primarily whitefish near Vernita, and 4,000 angler days for resident warm water species, primarily in sloughs and backwater areas for bass, walleye and sunfish.

Sport fishing information for the regional area is 8
presented in Section 2.1.4.6.

In general, temperature and river current may limit primary production as well as development of some herbivore species. Resident fish rearing and spawning habitat may be limited by river, topography (e.g., lack of backwaters and sloughs) water level fluctuations. The factors limiting 6
anadromous fish production are not entirely known. For example, available spawning areas may or may not be at capacity. Clearly harvesting and passage of adults and juveniles at dams effects production. Effects of predation are of concern but definitive data are lacking at this point.

A simplified diagram of the food-web relationships in selected Columbia River biota and probable major energy pathways are shown in Figure 2.2-22.

2.2.2.8 Preexisting Environmental Stress

4

The man-caused factors that affect aquatic resources are numerous and their effects, whether direct or indirect, are quite complex (Figure 2.2-23). Changes in the physical and biological systems of the Columbia River result from the presence of hydroelectric dams, irrigation and agricultural runoff, water diversions, and municipal and industrial wastewater discharges.

The Pacific Northwest Electric Power and Conservation Planning Council has been charged with developing a regional program related to energy conservation, renewable resources and other resources while protecting, mitigating and enhancing fish and wildlife resources of the Columbia River system (Ref 147). The Council has proposed a draft fish 8
and wildlife program requesting specific research projects and other program measures be implemented by hydroelectric projects and other entities to enhance the fish and wildlife resources of the Columbia River (Ref 148).

2.2.2.8.1 Impoundments

Impoundments and attendant water release cycles of hydroelectric projects have produced a number of changes in water temperature, daily fluctuations of the water level, and composition and/or concentration of various aquatic organisms in parts of the river (Refs 111, 112). Daily water fluctuations in the Hanford Reach have resulted in reduced benthic production and loss of rooted macrophytes in littoral zones. Dams influence the survival of 4
anadromous and resident fishes by reducing suitable spawning habitats and by hindering adult and juvenile migration (Ref 112).

Changes in river velocities and temperatures also provide a competitive advantage to non-game species. Non-game fish dominate the community composition in impounded areas as well as in the Hanford Reach of the Columbia River (Section 2.2.2.6.2).

2.2.2.8.2 Irrigation and Agricultural Runoff

A number of irrigation discharges occur along the left bank
(Franklin County) of the Hanford Reach. Runoff from
irrigated lands contribute inorganic and organic constituents from pesticides, herbicides and fertilizers, and 4
dissolved constituents from the soil (Ref 113). Irrigation
return waters in the Hanford Reach also have added heat and
increased the background concentrations of dissolved and
suspended solids, trace metals and organic compounds
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TABLE 2.2-21b

CALCULATION OF AVERAGE FALL CHINOOK INTERDAM POPULATION AND ESTIMATE OF THE NUMBER OF FISH UTILIZING HANFORD REACH 1962-1980

Dam Counts(5)		
McNary	64,562	(1)
Ice Harbor	10,325	(1)
Priest Rapids	11,699	(1)
Interdam Population(5)	41,225	(1)
Yakima spawners	1,313	(1)(2)
Hanford spawners	17,548	(1)(3)
Ringold Springs	500	
Priest Rapids (volunteers)	380	
Unaccounted (Including sports catch and natural mortalities	22,797	(1)(4)

8
E290.12

NOTE:

(1) Numbers with inherent inaccuracies.

(2) Assumption of 3 fish per redd (Ref 73).

(3) Assumption of 7 fish per redd (Ref 73).

(4) Represents 35 percent of the McNary count.

(5) Table 2.2-21a.

TABLE 2.2-21c

FISH SPECIES COLLECTED IN MIDCHANNEL ICHTHYOPLANKTON TOWS AT RM 361.5
APRIL-SEPTEMBER 1981 AND MARCH-APRIL 1982

Scientific Name	1981 Apr	1981 May	1981 June	1981 July	1981 Aug	1981 Sept	1982 March	1982 Apr	Total	% Total
Alosa sapidissima (American shad)	0	0	0	2	0	0	0	0	2	<1
Cottus asper (Prickly sculpin)	13	95	73	30	0	0	0	0	211	95.0
Cottus sp. (Sculpin)	0	0	1	0	0	0	0	0	1	<1
Cyprinus carpio (Carp)	0	0	0	1	0	0	0	0	1	<1
Unknown cyprinid	0	0	0	1	0	0	0	0	1	<1
Oncorhynchus tschawytscha (Chinook salmon)	2	0	0	0	0	0	0	0	2	<1
Unknown (damaged)	0	0	0	4	0	0	0	0	4	1.8
Totals	15	95	74	38	0	0	0	0	222	100.0

6

TABLE 2.2-22

RELATIVE UTILIZATION OF MAJOR HANFORD REACH FALL CHINOOK SPAWNING GROUNDS

Spawning Area	Section	10 Year Average # Redds (1967-1976)	Percent Contribution Per Area
1. Wooded Island/ Ringold	RM 347-354	103	3.9
2. --	RM 365-368	259	9.8
3. White Bluffs	RM 371	183	6.9
4. --	RM 373-374	235	8.9
5. Locke Island	RM 375	530	20.1
6. --	RM 376	111	4.2
7. --	RM 377	226	8.6
8. Coyote Rapids	RM 383	51	1.9
9. Vernita Bar	RM 393-395	943	35.7
TOTAL 10 Year Average		2,639	100.0
Range		623-3,981 Redds	

Source: Ref 72

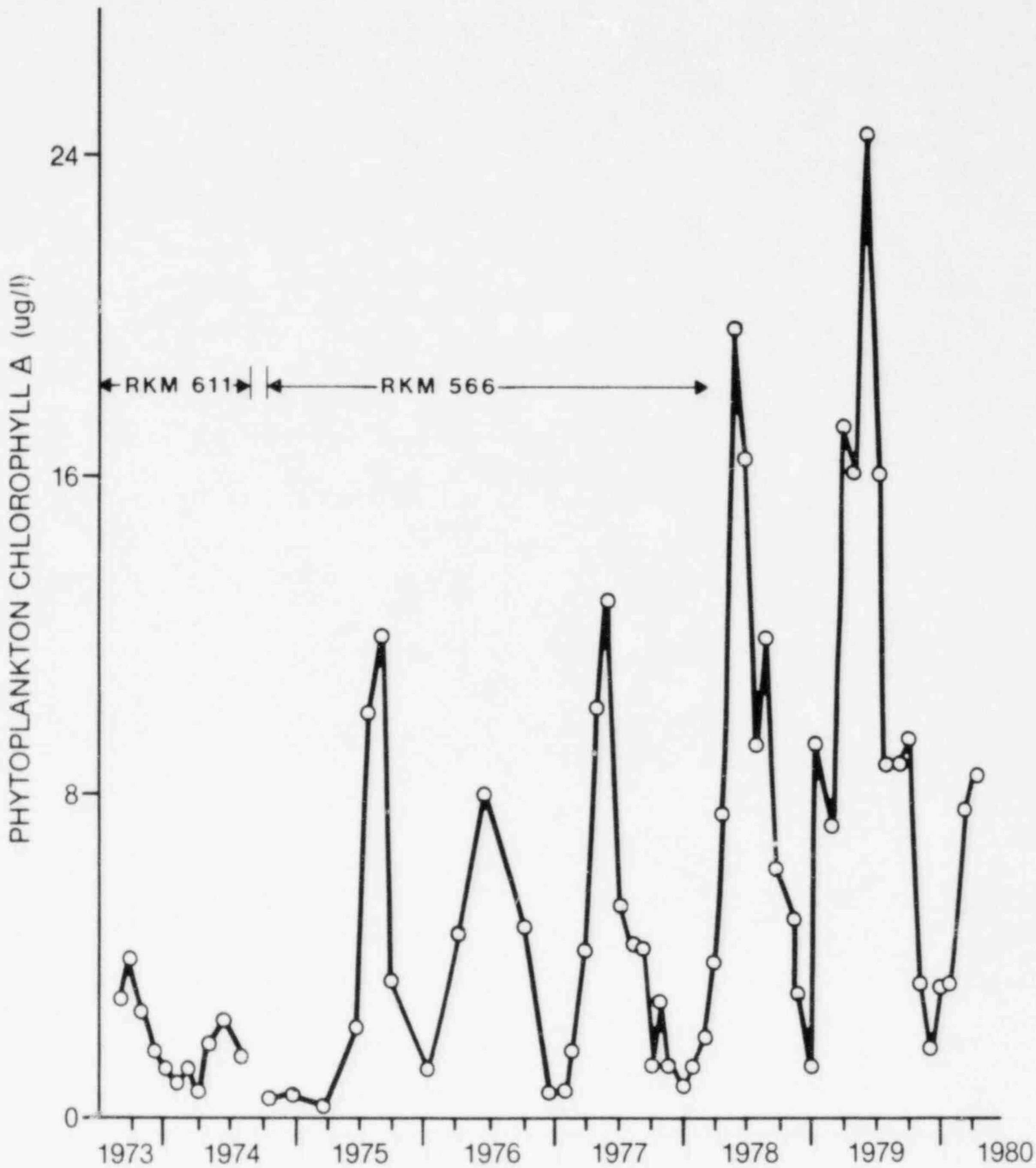
4

TABLE 2.2-23

TOXICITY OF CHLORINE TC SENSITIVE FISH SPECIES FOUND IN THE HANFORD REACH (SEE APPENDIX L)

Species	Concentration (mg/liter)	Parameter
Oncorhynchus kisutch (Coho salmon)	0.01 - 0.04	est. 96 h LC_{50}
	0.083	7 day-TLm, acute
	0.023	reduced growth (embryo-alevin exposure) (Ref 149)
O. tshawtyscha (Chinook salmon)	0.3	100 kill, 85 min
Salmo gairdneri (Steelhead trout)	0.01	lethal at 12 days exposure
	0.023	96 h LC_{50}
	0.1	lethal at 4 days exposure
	0.3	100 kill, 2-5 h
Micropterus dolomieui (Smallmouth bass)	0.5	median mortality, 15 h
Perca flavescens (Yellow perch)	0.365	12 h TL-50 acute

8



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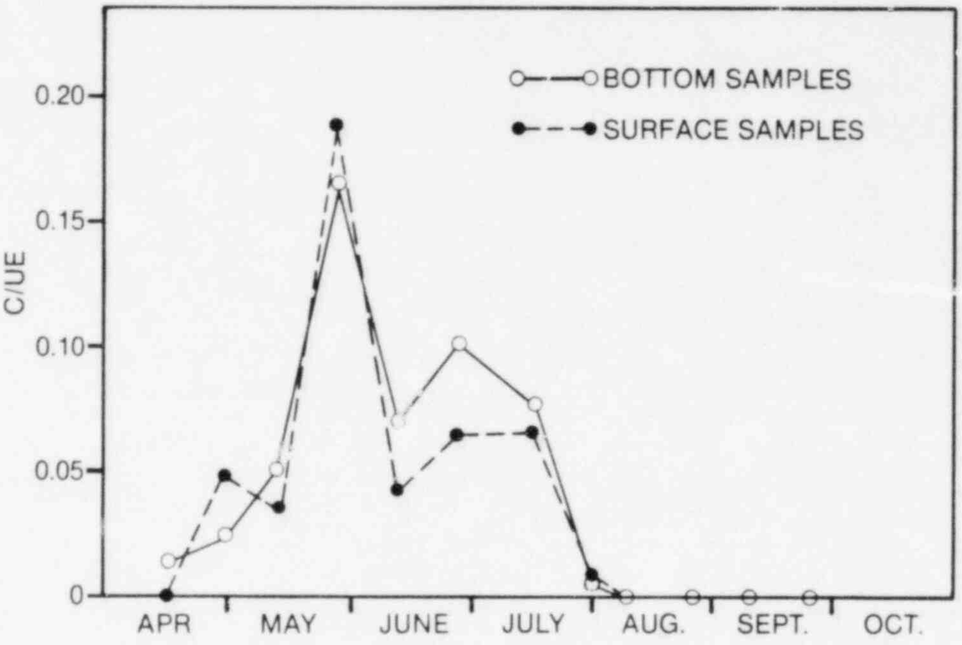
CHLOROPHYLL A CONCENTRATIONS FOR COLUMBIA RIVER PHYTOPLANKTON SAMPLES COLLECTED IN THE HANFORD REACH (1973-1980)

FIGURE 2.2-11



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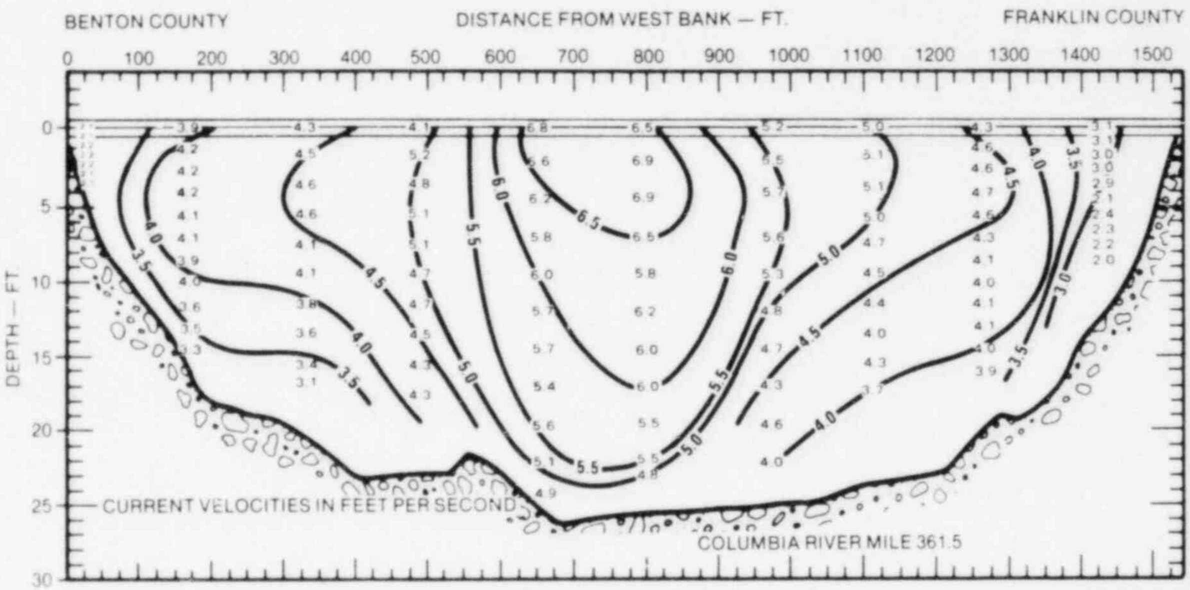
SPATIAL DISTRIBUTION OF ICHTHYOPLANKTON (APPENDIX K)

FIGURE 2.2-22a



Date of Survey: 5-8-81
Water Surface Elevation: 361.33
(Average) Above: NGVD
River Discharge: 142,800 cfs

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COLUMBIA RIVER MILE 361.5 ISOVEL MAP

FIGURE 2.4-7

2.6 REGIONAL HISTORIC, ARCHAEOLOGICAL, ARCHITECTURAL, SCENIC, CULTURAL, AND NATURAL FEATURES

2.6.1 ARCHAEOLOGICAL AND HISTORICAL RESOURCES

2.6.1.1 Cultural Resources Program

A cultural resources program has been developed for the S/HNP to ensure that appropriate levels of cultural resource investigations are carried out during each phase of S/HNP planning, licensing and construction. This program will provide for compliance with applicable laws, adequate input to agencies responsible for environmental review, and protection and/or preservation of our cultural heritage.

The cultural resources program is divided into four phases. 4 Phase 1 consists of a regional cultural resources overview which includes background literature and records search as well as agency and professional consultation. Phase 2 includes a more S/HNP-specific literature and records review and a field reconnaissance to visit known sites and investigate the general environmental characteristics of the Site and Associated Areas. Phase 3 consists of intensive field survey of the areas to be impacted by construction of the Plant and associated facilities, an assessment of S/HNP impacts to cultural resources, determination of eligibility of properties to be affected to the National Register of Historic Places, and formulation of a detailed mitigation plan. Phase 4 consists of implementing the mitigation plan through avoidance of significant sites or data recovery prior to construction and through monitoring of construction activities. Figure 2.6-1 shows the S/HNP cultural resources program in relation to other S/HNP acivities. Phases 1 and 2 and part of Phase 3 have been 8 carried out by Ertec Northwest, Inc., in order to provide information on cultural resources for this report.

2.6.1.2 Archaeological and Historical Methods

A study was carried out for the first two phases of the 4 cultural resources program, to determine the existence and significance of known archaeological or historical sites within the areas to be directly impacted (the Site, the cooling water make-up and discharge line corridor, the railroad access corridor, the transmission corridor, and the intake and discharge facilities) as well as in the area

surrounding these facilities (Ref 14). This study 6
consisted of a thorough records and literature review, 4
consultations with agency and academic personnel familiar
with the area, and interviews of long time residents of the
area. Literature reviewed and agencies and personnel
contacted are listed in the reference section (Ref 2). 8
Figure 2.6-2 shows study area boundaries described in this
section.

Prior to this study an intensive survey of Section 33 was
carried out between May 20 and May 30, 1981, as part of a
land disposal action by the Department of Energy (Ref 1). 4
This section is going to be the location of the main power
block. The intensive survey was conducted to identify any
cultural resources located on the property and evaluate the
effect of the land disposal action on those resources.

Fieldwork for Phase 2, conducted between May and July 1981,
consisted of a reconnaissance of facility site areas most 8
likely to contain cultural resources as well as field
checks at the locations of other facilities (Figure 2.6-3).
The field reconnaissance was designed to determine the
condition of previously recorded sites along the river in
the vicinity of the pumphouse and to evaluate the micro-
environments and survey conditions at the other Project
facilities. To accomplish this, two different methods were
used. The 2-mile corridor along the river, centered on
River Mile 361.5, was surveyed by two archaeologists who
examined a 500-foot-wide area by walking at 50- to 150-foot
intervals away from and parallel to the river, depending on
terrain and vegetation conditions. All archaeological and
historical materials observed were noted, and the locations
of previously recorded sites were visited. In addition,
survey conditions and general observations on the survey 4
area were recorded.

The reconnaissance of the main facility location consisted of walking through the northern portion of Sections 27 and 28.

The two surveyors walked at 80-foot intervals and recorded cultural resources and the vegetation and topographic conditions. Field checks of the remaining facilities, including access roads and transmission corridors, consisted of visiting the places where those facilities crossed existing roads. At these intersections, the topographic and vegetative characteristics of the environments that the facilities crossed were noted to help plan the intensive survey.

Initial fieldwork for Phase 3 was conducted during November and December 1981 under Federal Antiquities Permit Number 82-WA-335. The fieldwork consisted of an intensive survey of the areas likely to be impacted by construction of the Plant and associated facilities and exploratory excavations along the Columbia River at the site of the proposed pumphouse. The research design for the fieldwork was reviewed and approved by staff of the Washington State Office of Archaeology and Historic Preservation (Ref 16).

The Plant location area and buffer zone, excluding those portions of Section 33 previously surveyed (Ref 1), were divided into units 1,000-ft by 0.5 mile, of which alternating tracts were surveyed. Along the transmission corridor, intake and discharge pipeline and access road and railroad corridors, similar 1,000-ft wide by 0.5 mile units were laid out and alternating 0.5 mile tracts were surveyed (Figure 2.6-5a). Each of the resulting 27 tracts was surveyed at 50-foot intervals by a team of four archaeologists. Isolated artifacts and sites were noted, mapped, photographed and recorded on Washington Archaeological Research Center site record forms.

Phase 3 also included exploratory excavations around the proposed site of the pumphouse which is located on the river. The purpose of these excavations was to determine whether undisturbed buried archaeological materials are 8
present in the vicinity. The excavation covered an area of 260 meters along the shoreline by 90 meters perpendicular to it. Nineteen test pits, measuring 1 by 1 meter, were laid out in two trenches centered on the stake marking the pumphouse site. One trench followed the river shoreline, while the other ran perpendicular to the first, crosscutting it (Figure 2.6-5b). Excavations were made in 20 centimeter levels below ground surface to a depth of 1 meter and all materials were screened through 0.25 inch mesh. Details of the survey and excavation methods are contained in the survey report (Ref 15).

Additional Phase 3 work will include determinations of eligibility to the National Register of Historic Places of cultural resources located during the fieldwork along with a detailed assessment of project impacts on significant resources and a plan to mitigate adverse impacts. As additional areas are identified for project construction, including roads, borrow pits, laydown areas and others, appropriate assessments will be undertaken in consultation with the State Historic Preservation Officer. Phase 4 will implement the plan through avoidance of significant resources or scientific data recovery prior to construction and through monitoring of construction activities.

2.6.1.3 Archaeological and Historical Resources in the Site and Associated Areas

4

The portion of the Columbia River known as the Hanford Reach has been occupied since prehistoric times. At historic contact, the inhabitants of this area were a group of 8
Indians now called the Wanapam. The Wanapam were one of a number of groups inhabiting the southern Columbia Plateau that shared similar lifeways based on a seasonal round of fishing, hunting, and gathering that was centered around the Columbia River. Several recorded Wanapam villages and 4
camp sites were located along the Columbia River between Richland and White Bluffs, but only one, Chanout, is located within the Site and Associated Areas (Ref 3). 8
Chanout is recorded where the Hanford townsite is presently situated.

During historic times the Hanford-White Bluffs region played an important role in the development of the interior portions of Washington and Idaho. The area was an important transportation location and provided resources for grazing livestock. With the advent of large scale irrigation projects it became recognized as one of the finest fruit producing regions in the state. Recently this area 4
attained national and global significance as one of the principal sites associated with the atomic age.

Archaeological work has been carried out for 13 years on the Hanford Reservation by Dr. David Rice. He has recorded 115 sites, the majority of which consist of organic debris, fire-cracked rock, artifacts, and clearly discernible archaeological features such as fire hearths. Site types include open camps, fishing stations, open camps with housepits, cemeteries, and flaking floors (Ref 4).

The present study determined that three previously recorded archaeological and two previously recorded historical sites 4
are located within the Site and Associated Areas and numerous other sites surround it (Figure 2.6-4). A list of previously recorded archaeological sites and districts in 8
the cultural resources overview and survey area is presented in Table 2.6-1. These data were obtained from the Washington State Office of Archaeology and Historic Preservation (Ref 2).

One archaeological site in the S/HNP Site and Associated Areas is listed on the National Register of Historic 4
Places: 45BN119, an open campsite which is part of the Savage Island Archaeological District (Ref 5). Its location is recorded as approximately 1 mile downstream from the proposed location of the intake and discharge facili-

ties; however, during the reconnaissance only a thin scatter of shell and fire-cracked rock was noted in this area.

Archaeological sites recorded in the S/HNP Site and Associated Areas which have not been listed on the National Register include 45BN120 (Ref 5), a very disturbed site located at the center of the old Hanford townsite and 45BN266, a lithic scatter located in Section 33 and previously collected (Ref 6). Site 45BN120 was visited during the field reconnaissance, but only two cryptocrystalline flakes and some fire-cracked rock were observed. 4

The National Register districts and sites surrounding the S/HNP Site and Associated Areas include the Hanford North District to the north, the Hanford Island Site approximately 1 mile north of the intake and discharge facilities, the Savage Island District which begins at site 45BN119 and runs 1.5 miles south, including several sites, and the Wooded Island Archaeological District 7 miles to the south (Figure 2.6-5).

Three known historic sites or features fall within the S/HNP Site and Associated Areas. These include the Hanford townsite, the Hanford irrigation ditch, and the remains of what may have been a stock corral discovered during the field reconnaissance. As discussed below, the Hanford irrigation ditch and the Hanford townsite may be eligible for listing on the National Register of Historic Places (Ref 4).

The intensive survey recorded one additional prehistoric site and ten historic sites. The prehistoric site consisted of an isolated, unmodified primary flake of gold chert (45 BN 304) located in an area of stabilized sand dunes. The historic sites consisted of seven small scatters of bottles and cans, two areas representing historic habitation, and the Hanford irrigation ditch. The
historic habitation areas included the stock corral, 8
located during the Phase 2 reconnaissance, which was determined to be a sheepherder's cabin and corral (45 BN 305H), and the well-known Hanford townsite (45 BN 308H), which had not previously been assigned a site number. The Hanford irrigation ditch (45 BN 309H) also had not been previously assigned a site number. These sites are listed in Table 2.6-2 and shown in Figure 2.6-5c.

The exploratory excavations revealed disturbed and undisturbed prehistoric and historic deposits at the pumphouse site. The prehistoric materials showed two areas of occupation, both probably dating to about 1500 A.D. and representing temporary camping and resource processing along the river during fall or winter. The historic materials also showed two areas of occupation, including residential and commercial crating and shipping use areas; they probably result from occupation of the Town of Hanford before 1943. Detailed information on the results of the survey and excavations and their analyses is contained in the survey report (Ref 15). 8

Further investigations and evaluations will be undertaken in consultation with the Washington State Historic Preservation Officer to determine the significance of this site.

2.6.2 NATURAL AND SCENIC FEATURES

2.6.2.1 Setting

The S/HNP is located in the center of the Hanford Reservation in southeastern Washington. This sparsely populated desert area has not been used by the public since 1943 when the Hanford Reservation was established. Numerous nuclear power and waste management facilities surround the S/HNP Site location.

2.6.2.2 Natural and Scenic Features

Two categories of natural and scenic resources are represented near the S/HNP Site location: (1) resources that have been designated or suggested for designation under Federal laws or registers, such as the Wild and Scenic Rivers Act (PL 90-542) or the National Registry of Natural Landmarks (Ref 8); and (2) resources that have scenic or natural values which have not been recognized in this manner. Figure 2.6-6 shows the locations of natural and scenic resources. 4

Federally Recognized Resources. No national parks or forests are located in the Site Vicinity. However, two sites have been proposed for designation as National Natural Landmarks: the Hanford Dunes and the Arid Lands Ecology Reserve (Ref 9). In addition, the entire Reservation has been designated the Hanford National Environmental Research Park (NERP) (Ref 10).

The Hanford Reach of the Columbia River, which includes the entire length of the river within the Hanford Reservation, is the last free-flowing section of the Columbia River.

This portion of the river, about 8 miles east of the S/HNP Site, has been proposed as a potential wild, scenic, or recreational river under the Wild and Scenic Rivers Act (PL 90-542) (Ref 11). It has also been included on the Heritage Conservation and Recreation Service's Nationwide Rivers Inventory List of Significant Resources (Ref 12).

Other Natural and Scenic Resources. Other natural and scenic resources located near the S/HNP Site are not officially recognized as significant, but are important. The White Bluffs are part of the Ringold Formation, which is composed of sediments between 10 and 3 million years old. These white cliffs contain volcanic debris with fossils that represent an important paleontological resource. The bluffs, which rise 200-300 feet along the eastern shoreline of the Columbia, provide a valuable natural resource which has also, since historic times, been considered a scenic resource.

Gable Butte and Gable Mountain are prominent geologic features that consist of exposed basaltic uplands which are located approximately 7 miles north of the Site.

Across the river to the northeast of the S/HNP is the Wahluke Wildlife Recreation Area, managed by the Washington State Department of Game. It encompasses 54,000 acres and is open to the public for hunting and fishing, with 4
seasonal and locational limitations, and for hiking and wildlife observations.

Rattlesnake Mountain is an exposed basaltic upland which is part of the Columbia River Basalt Group. It is located 6 miles southwest of the S/HNP Site and rises approximately 3,200 feet above the surrounding terrain. It is the dominant landform in the area.

Number of Persons to be Affected. The Hanford Reservation has served as a nuclear center since 1943, and since that time, access to the area has been restricted.

The Wahluke Wildlife Management Area is used by the public for fishing, bird hunting, picnicking, and sightseeing. The number of persons using the entire management area in 1980 was 23,000 (Ref 13).

The number of persons who visit Rattlesnake Mountain each year is difficult to assess. It is not located in a natural or scenic area, and its northeastern slope is restricted by the Arid Lands Ecology Reserve.

State Highway 240 passes through the western edge of the Reservation. This stretch of road passes within 3 miles of

the proposed Plant location. The average daily traffic
count for this stretch is 1470, which is well below the
average for a two-lane highway and probably represents 4
workers from the Hanford Reservation.

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TABLE 2.6-2

ARCHAEOLOGICAL AND HISTORICAL SITES RECORDED
DURING PHASE 3 SURVEY

Site Number	Name	Location	National Register Status	Description
45 BN 298H	--	T.12N R.28E Sec 31	Unevaluated, likely ineligible	Historic debris scatter
45 BN 299H	--	T.12N R.27E Sec 1	Unevaluated, likely ineligible	Historic debris scatter
45 BN 300H	--	T.12N R.27E Sec 13	Unevaluated, likely ineligible	Historic debris scatter
45 BN 301H	--	T.12N R.27E Sec 14	Unevaluated, likely ineligible	Historic debris scatter
45 BN 302H	--	T.12N R.27E Sec 23	Unevaluated, likely ineligible	Historic debris scatter
45 BN 303H	--	T.12N R.27E Sec 24	Unevaluated, likely ineligible	Historic debris scatter
45 BN 304	--	T.12N R.27E Sec 26	Unevaluated, likely ineligible	Prehistoric isolated artifact

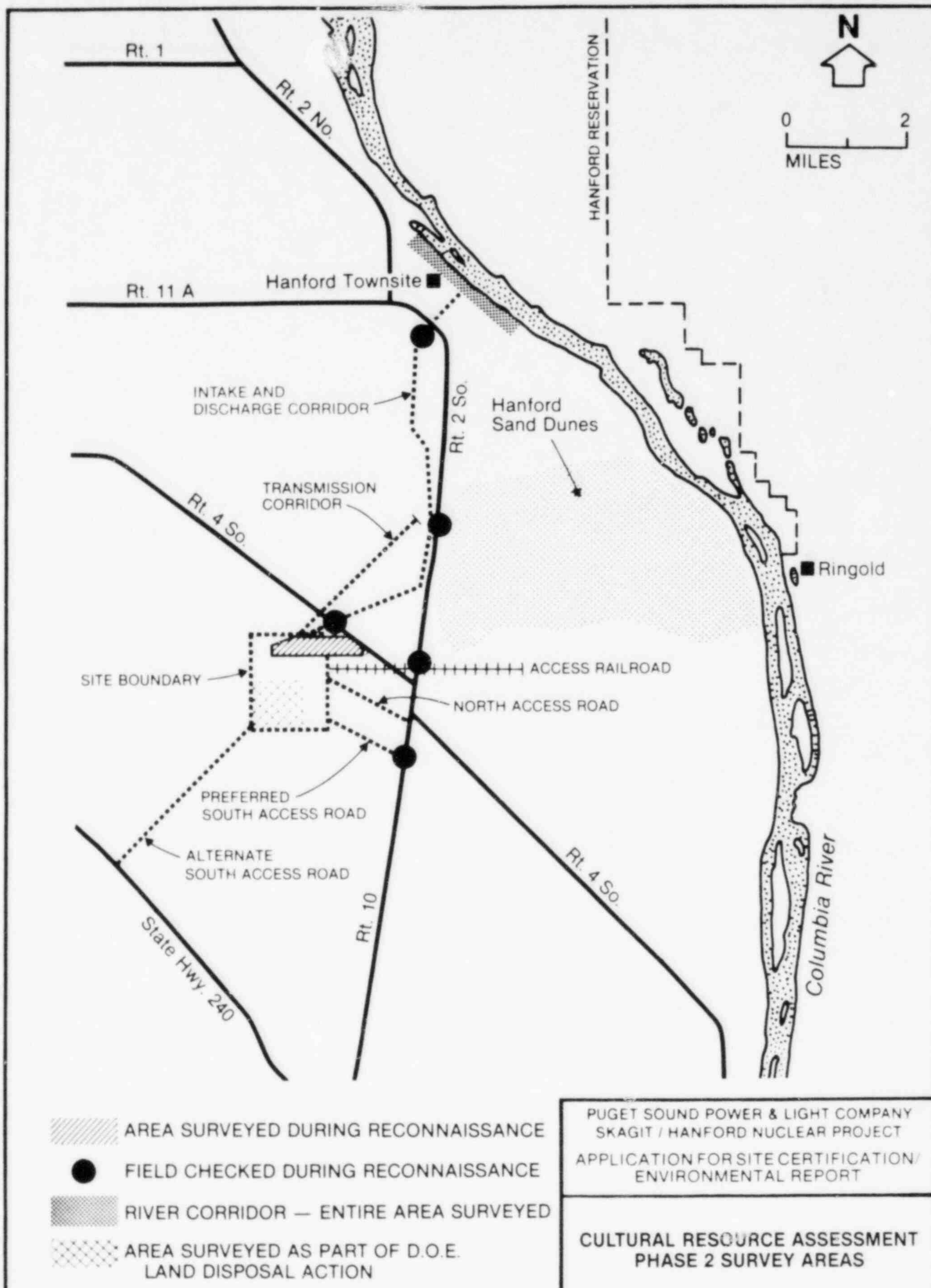
8

Site Number	Name	Location	National Register Status	Description
45 BN 305H	--	T.12N R.27E Sec 27	Unevaluated, likely ineligible	Historic sheep-herder's corral and cabin
45 BN 306H	--	T.12N R.27E Sec 23	Unevaluated, likely ineligible	Historic debris scatter
45 BN 307	--	T.13N R.27E Sec 25	Unevaluated, potentially eligible	Prehistoric temporary campsite
45 BN 308H	Hanford townsite	T.13N R.27E Secs 25, 26, 36	Unevaluated, potentially eligible	Historic townsite

8

TABLE 2.6-2

Site Number	Name	Location	National Register Status	Description
45 BN 309H	Hanford ditch	T.12N R.28E Secs 5,6 T.13N R.28E Sec 31 T.13N R.27E Secs 6, 7, 8, 16, 17, 21, 22, 26, 27, 35, 36 T.13N R.26E Sec 1 T.14N R.26E Secs 25, 26, 27, 32, 33, 34, 36	Unevaluated, potentially eligible	Historic irrigation ditch



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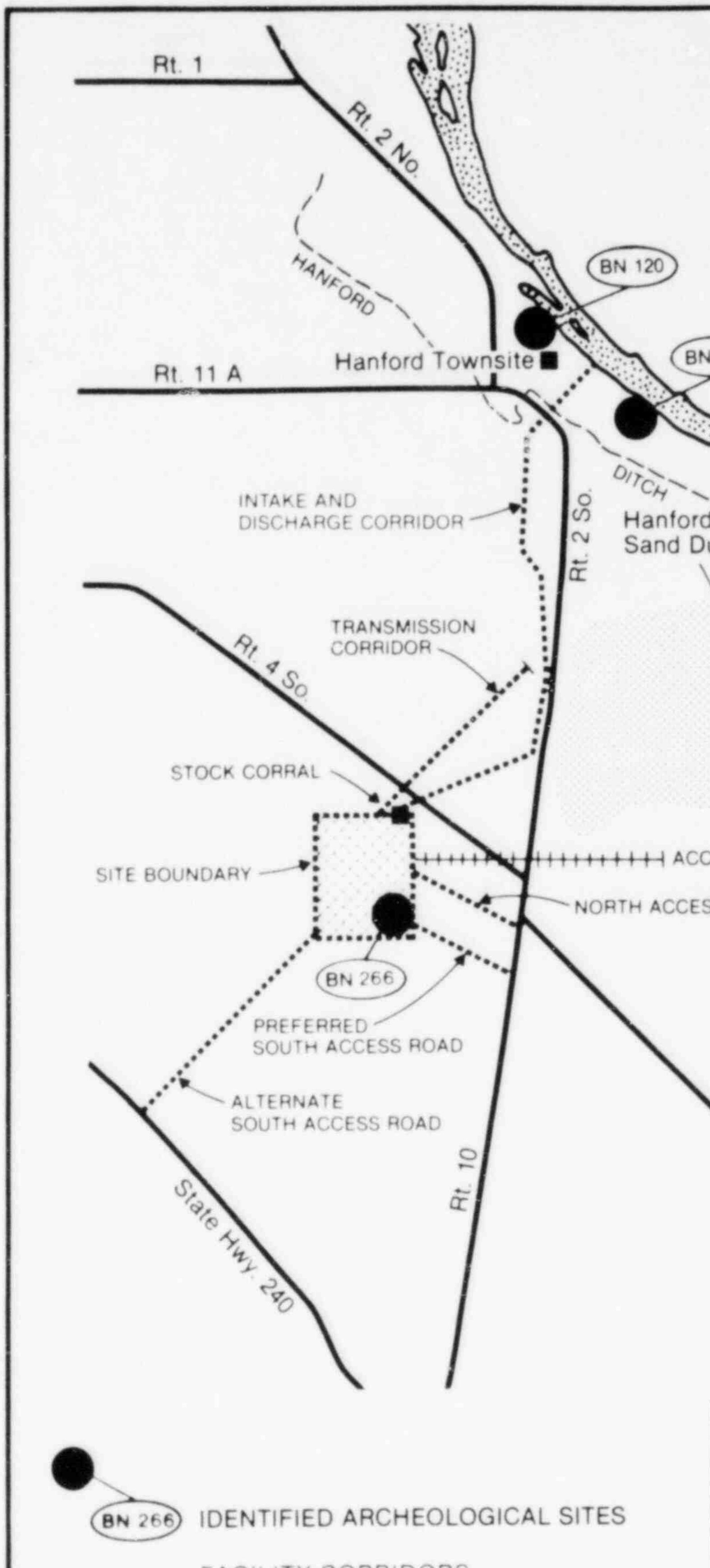
CULTURAL RESOURCE ASSESSMENT PHASE 2 SURVEY AREAS

FIGURE 2.6-3



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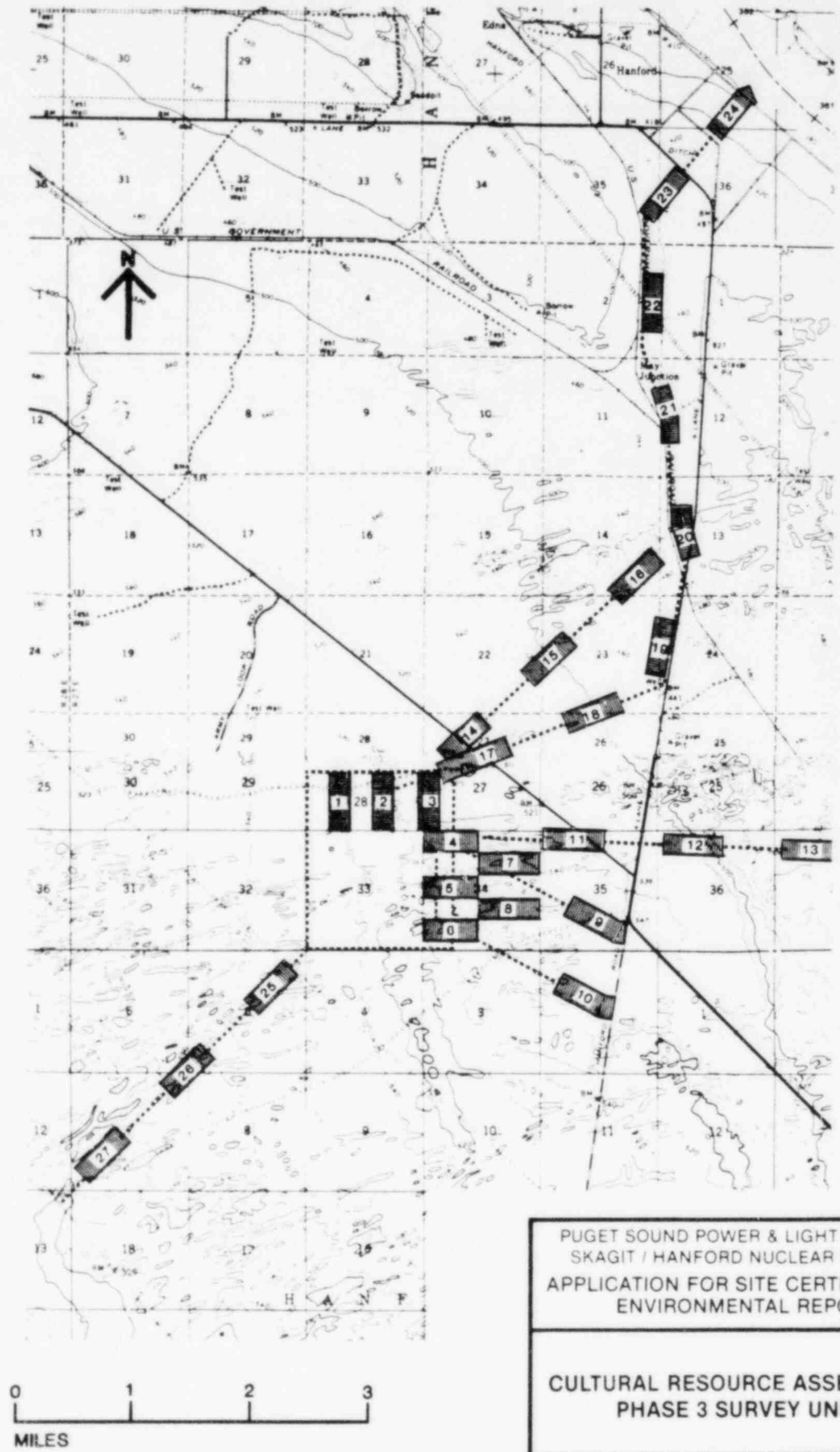
PREVIOUSLY RECORDED CULTURAL RESOURCES WITHIN THE SITE AND ASSOCIATED AREAS

FIGURE 2.6-4



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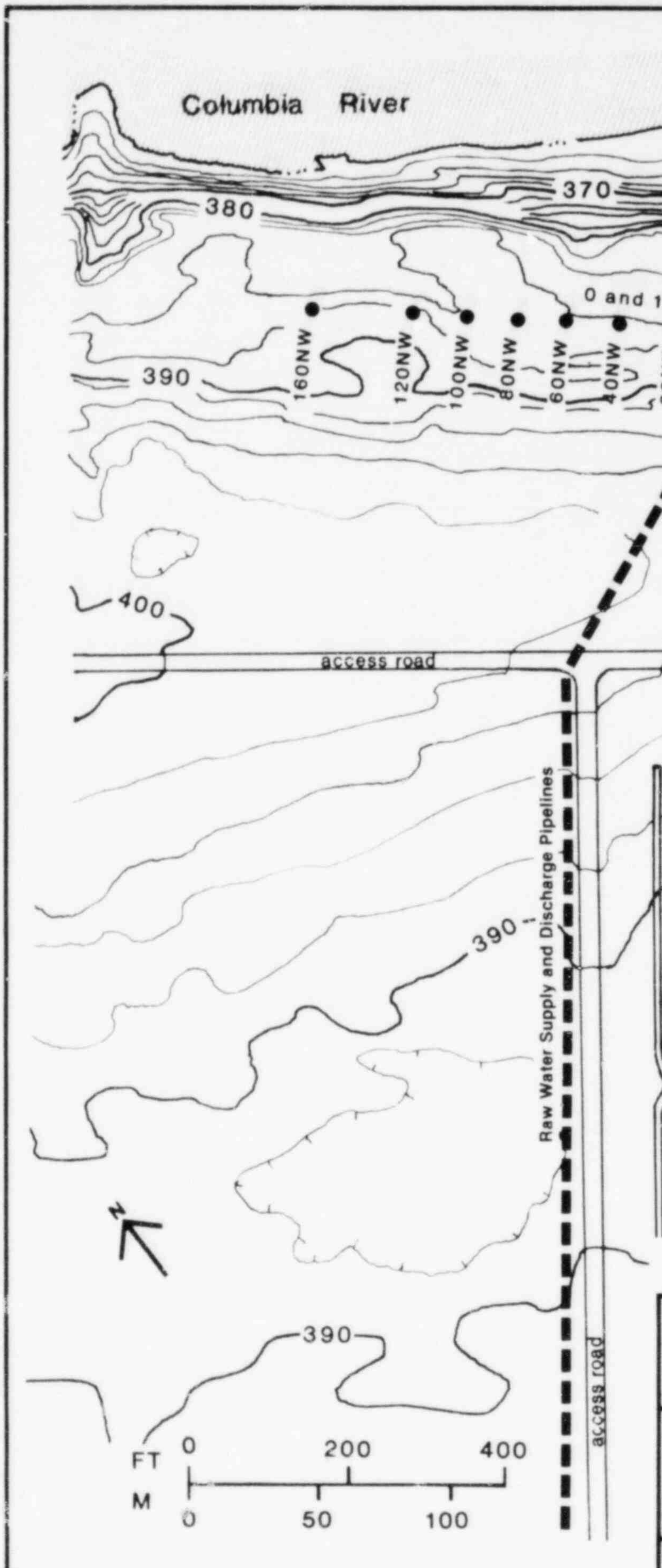
CULTURAL RESOURCE ASSESSMENT PHASE 3 SURVEY UNITS

FIGURE 2.6-5a



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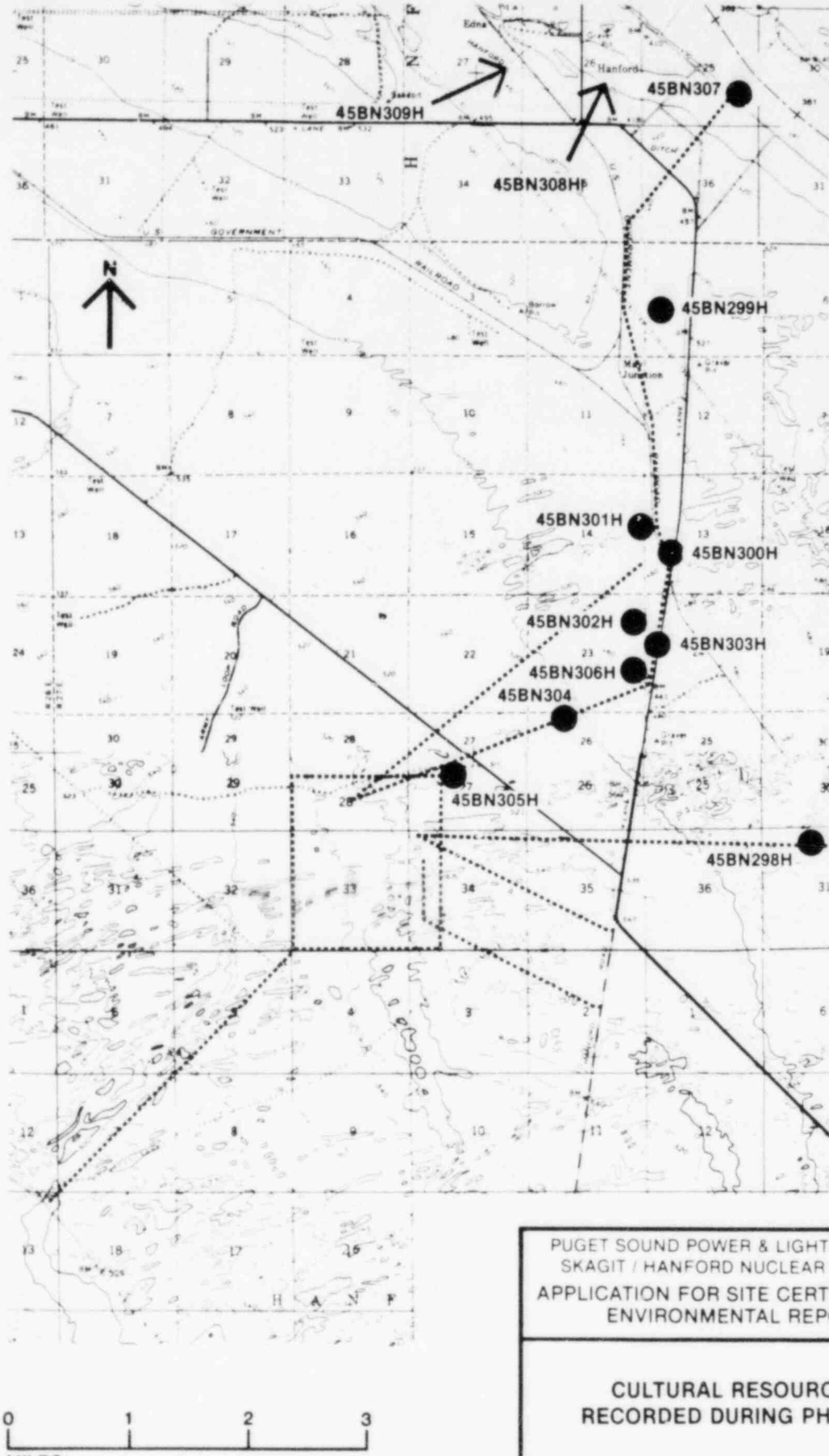
LAYOUT OF ARCHAEOLOGICAL TEST EXCAVATIONS NEAR PUMPHOUSE FACILITY

FIGURE 2.6-5b



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CULTURAL RESOURCES RECORDED DURING PHASE 3

FIGURE 2.6-5c

References for Section 2.7

1. Washington Administrative Code (WAC), Chapter 173-60, Maximum Environmental Noise Levels.

2. U.S. Department of Housing and Urban Development, Noise Abatement and Control, Department Policy, EPA 550/977-354 (April 1977).

3. U.S. Environmental Protection Agency, Information on Levels of Environmental Noise Requisite To Protect the Public Health and Welfare with an Adequate Margin of Safety, EPA 550/9-74-004 (March 1974).

temperature with the wet-bulb temperatures shown in Table 3.4-1 indicates that the cooling tower design conservatively assumes worst-case temperature conditions.

3.4.2 CIRCULATING WATER SYSTEM

Water is lost from the heat dissipation system by evaporation, drift, and blowdown. To balance these losses, makeup water from the Columbia River is required.

The design values used for blowdown are based on a dissolved solids concentration factor of ten in the cooling tower water as compared to river water. The blowdown rates calculated for normal operation vary from about 1100 to 3700 gpm. A higher rate, ie, up to 5500 gpm, may be needed on occasion to lower the concentration of dissolved solids in the Circulating Water System. The compositions of the Columbia River and blowdown water are given in Tables 3.6-5 and 3.6-6.

Expected values of evaporation, blowdown, and drift rates are given in Table 3.4-2 as a function of time of year.
Each value given is an expected average value over the 4
month.

The following table gives approximate values of both maximum and annual average water use for the heat dissipation system. The results from experimental methods, such as the Isokinetic Sampling method and the Particle Instrumentation via Laser Light Scattering (PILLS) method used to measure the drift rate for cooling towers under operation, indicate the drift loss of about 0.005 percent of circulating water flow (Ref 1). Consumptive use is evaporation plus drift. Required makeup is evaporation plus drift plus blowdown.

	Maximum Values, gpm	Annual Average Values, gpm
Consumptive use	33,400	25,200
Blowdown	5,500	2,800
Required makeup	38,900	28,000

The design makeup water capacity for the S/HNP is approximately 42,000 gpm (See Section 3.4.2.1). See Figure 3.3-1 for a Plant water use diagram.

3.4.2.1 Intake System

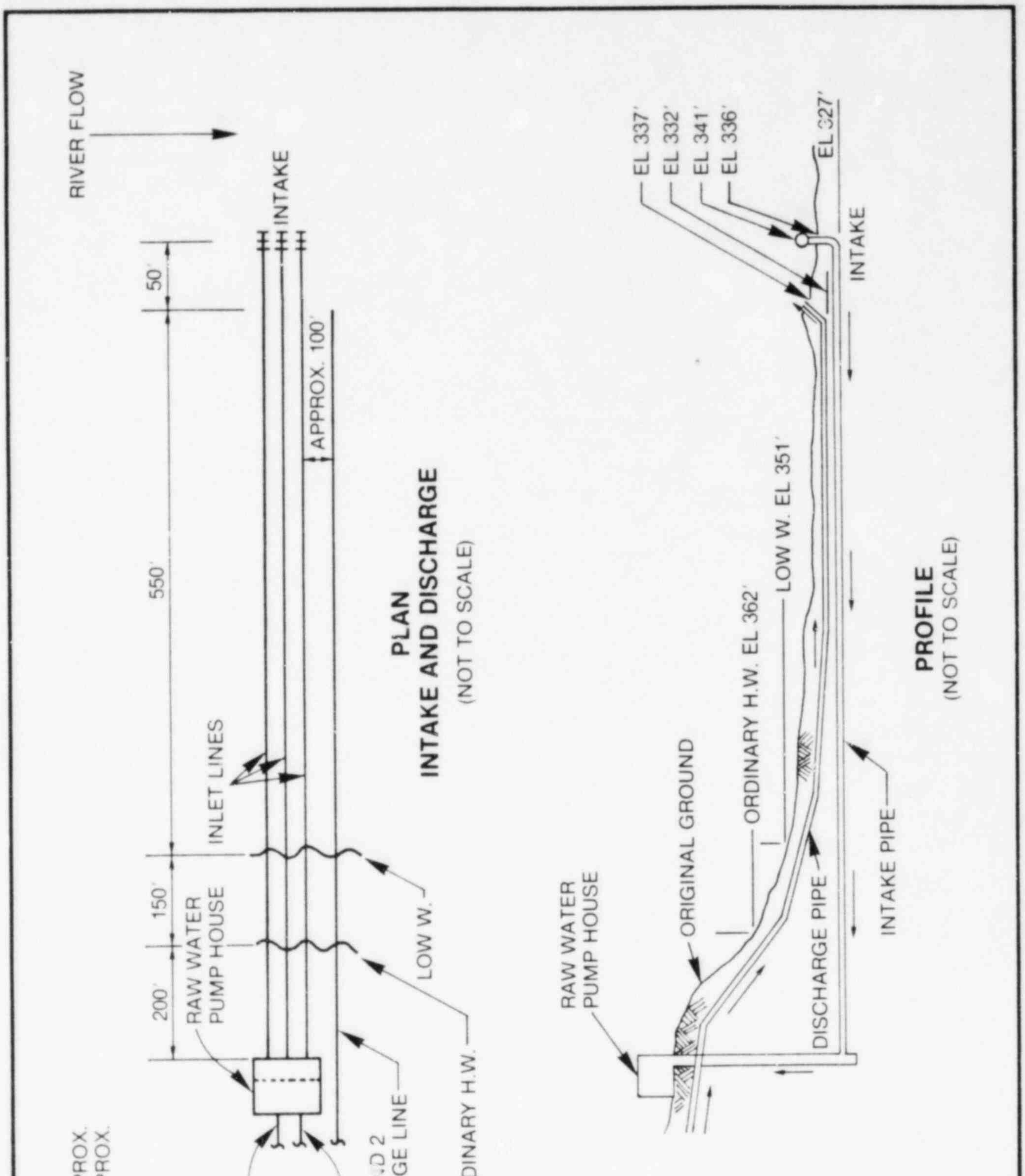
The Raw Water Supply System pumphouse will be constructed 4
to supply makeup water to both units and is located on the
west shore of the Columbia River, approximately 7 miles
from the Site at River Mile 361.5. The pumphouse will
contain three 10,500 gpm pumps for each unit. Two pumps
will supply a unit's maximum water requirements, with the
third pump acting as a spare. The pump head is estimated
to be approximately 400 ft, with an associated energy 6
requirement of approximately 1.1 MWe per pump. Two 500 gpm E 220.04
pumps per unit will also be provided to supply makeup water
required by a unit when that unit is not operating. A 4
section of the pumphouse is shown in Figure 3.4-2.

The intake will be a system comprised of three water inlet 8
assemblies, located above the river bottom, and three inlet
lines approximately 950 ft long running below the riverbed 6
to the pumphouse sump. The river depth at the intake point 4
is estimated to be 15 ft during a minimum river flow of 6
36,000 cfs. The intake and discharge configurations are 4
shown on Figures 3.4-3, 4.1-8 and 4.1-9. Figure 3.4-4 6
shows detailed topographic information in the vicinity of 5
the intake and discharge structures. N 210.07

The water inlets will be designed to limit intake velocity
to a maximum of 0.5 fps and to limit openings to a maximum
of 1/8 inch (or 3/8 inch in the event that testing of the
WNP-2 3/8 inch intake screens establishes acceptable 8
results to the satisfaction of the Washington State Energy
Facility Site Evaluation Council). This design velocity is
expected to be well below the acceptable limit required for
suitable protection of small fish when water is being taken 6
into the system (see Section 5.1.2.1).

The river velocity will always be greater than the inlet
velocity (2.32 fps or more) and will be along the faces of
the inlets, thus tending to wash fish and debris clear.
Since the design inlet velocity assumes maximum makeup
water flow, any condition resulting in reduced makeup water
flow will reduce intake velocity to even smaller values. 4

Undesirable debris is not expected to pass through the inlets with these very low velocities. The inlets will be designed to reduce the potential for debris collection and to permit complete removal for periodic inspection, cleaning, repair, and replacement.



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INTAKE AND DISCHARGE CONFIGURATIONS

FIGURE 3.4-3

3.6.3 CHEMICAL DISCHARGES

The waste flows for two units are given in Table 3.6-2. These flows include the maximum and nominal (average) flows of the cooling tower blowdown, treated clarifier sludge blowdown, filter backwash water, neutralized demineralizer wastewater, effluent from the Plant facility floor drainage treatment system (Section 3.7), and sanitary sewage effluent (Section 3.7).

The S/HNP discharge consists of cooling tower blowdown and all other treated nonradioactive liquid wastes. All radioactive waste will be treated in the Radioactive Waste Treatment System (Section 3.5). 4

During normal operation, an average cooling tower blowdown rate of 1400 gpm per unit is required to maintain the circulating water at 10 cycles of concentration. At thirteen cycles of concentration, the expected maximum, the blowdown rate for maximum evaporation is 1363 gpm per unit. The chemical composition of the combined cooling tower blowdown for both units at 13 cycles (maximum values) and at 10 cycles (average values) is given in Tables 3.6-5 and 3.6-6, respectively.

The relative contributions to the effluent of the concentrating effects of operation of the plant and of added chemicals can be observed from Tables 3.6-5 and 3.6-6. For example, on Table 3.6-6, average chemical concentrations are listed for the Columbia River (ambient) and the Project discharge. As can be seen, most of the concentrations in the Project discharge are about ten times greater than the ambient concentration which is a result of the concentrating effects of operation of the plant. However, the concentrations of sodium, sulfate and chloride in the Project discharge are noticeably greater than ten times the ambient concentrations. This additional increase in the concentration may be considered as being attributable to the addition of chemicals to the circulating water system. 8

It would not be desirable to operate at lower cycles of concentration to avoid the addition of acid to control scaling. Using maximum Columbia River water quality from Table 3.6-5, the circulating water system can be operated only up to about 2 cycles of concentration without acid addition. Operation at 2 cycles would lead to an average cooling tower blowdown of over 25,000 gpm for the Project, an increase in excess of 22,000 gpm over the planned level. Maximum blowdown at 2 cycles would be more than 33,000 gpm for the Project, an increase of about 28,000 gpm over the planned maximum. As a result, maximum intake requirements 6 N220.03

increase from about 40,000 gpm to about 67,000 gpm for the Project. Due to the increased makeup and blowdown flows, larger raw water pumps and larger intake and discharge pipelines would be required. In addition, thermal impacts to the Columbia River would increase since average blowdown flow would increase by 800%. Heat dissipated to the Columbia River would increase from about 12.5 x 10^6 Btu/hr per unit to 112.5 x 10^6 Btu/hr per unit. 6 N220.03

The chemicals added to the Reactor Closed Cooling Water and Turbine Building Closed Cooling Water Systems will not be discharged into the Columbia River. If these systems should require drainage, the coolant will either be stored for refilling the system, removed by a contractor, or treated in the radioactive waste treatment system. 4

TABLE 3.6-5

WATER QUALITY PARAMETERS

(Maximum Values)

Constituent	Unit	Columbia[1] River Analysis	Low Volume Waste Treatment Effluent	Cooling[2][5] Tower Blowdown	Project[3][4] Discharge	
Calcium, as Ca	mg/l	24.0	74	312	309.4	
Magnesium, as Mg	mg/l	5.7	16	74	73.4	4
Sodium, as Na	mg/l	3.1	534	112	116.6	
Potassium,as K	mg/l	1.1	3	14	13.9	
Bicarbonate, as HCO_3	mg/l	82.0	254	12	14.6	
Sulfate, as SO_4	mg/l	19.0	1043	1089	1088.5	
Chloride, as Cl	mg/l	5.4	8	181	179.1	
Silica, as SiO_2	mg/l	6.6	18	86	85.3	
Total Alkalinity, as $CaCO_3$	mg/l	67.0	208	10	12.1	
Hardness, as $CaCO_3$	mg/l	82.0	252	1085	1076	
Non-carbonate Hardness, as $CaCO_3$	mg/l	22.0	---	---	----	
Specific Conductance	10^{-6} mho/cm	170.0	2851	2495	2498	5
pH	Units	8.8-7.1	8.5-6.5	7.7	6.5-8.5	
Dissolved Solids	mg/l	109.0	1828	1600	1602	
Color	Pt-Co Units	15.0	---	----	----	
Suspended Solids	mg/l	24.0	100	312	309.7	
Turbidity	NTU	4.9	---	----	----	
Fecal Coliform	Col/100 ml	13.0	---	----	----	
Dissolved Oxygen	mg/l	15.8	11.08	7.7-9.6	7.74-9.62	4
Total Cadmium, as Cd	10^{-6}g/l	3.0	6	39	38.4	
Total Chromium, as Cr	10^{-6}g/l	20.0	19	260	257.4	
Total Copper, as Cu	10^{-6}g/l	28.0	46	364	360.4	
Total Iron, as Fe	10^{-6}g/l	290.0	514	3770	3735	
Total Lead, as Pb	10^{-6}g/l	73.0	90	949	939.7	
Total Mercury. as Hg	10^{-6}g/l	1.0	1.04	13.0	12.87	
Total Zinc, as Zn	10^{-6}g/l	90.0	165	1170	1159.2	
Ammonia Nitrogen, as N	mg/l	0.07	0.067	0.91	0.9	
Nitrate Nitrogen, as N	mg/l	0.14	0.39	1.82	1.8	
Ortho-Phosphate. as P	mg/l	0.04	0.05	0.52	0.51	5
Total Phosphorus, as P	mg/l	0.11	0.15	1.43	1.42	

NOTES:
(1) Concentrations of Columbia River water are developed from USGS data October 1977 to October 1980 for Vernita Bridge near Priest Rapids Dam, Washington.
(2) Represents water analysis after concentrating the river water dissolved solids 13 times in the towers. 4
(3) Project discharge consists of cooling tower blowdown and low volume waste treatment effluent.
(4) Table 5.3-1 compares constituents with State and Federal limitation guidelines.
(5) Chlorination of the circulating water systems will not be continuous and chlorination of both units will not occur at the same time. Discharges of total residual chlorine will not occur unless the concentration in the circulating water system has dropped to less than 0.14 mg/l TRC for 15 minutes. 8

TABLE 3.6-6

WATER QUALITY PARAMETERS

(Average Values)

Constituent	Unit	Columbia[1] River Analysis	Low Volume Waste Treatment Effluent	Cooling[2] Tower Blowdown	Project[3] Discharge
Calcium, as Ca	mg/l	19.7	69	197.0	196.2
Magnesium, as Mg	mg/l	4.3	25	43.0	42.8
Sodium, as Na	mg/l	2.3	502	28.4	31.3
Potassium, as K	mg/l	0.8	2.8	8.0	7.7
Bicarbonate, as HCO_3	mg/l	67.5	286	15.5	16.9
Sulfate, as SO_4	mg/l	12.8	979	657.0	659.0
Chloride, as Cl	mg/l	1.5	5	23.3	23.2
Silica, as SiO_2	mg/l	4.8	17	48.0	47.8
Total Alkalinity, as $CaCO_3$	mg/l	55.3	194	12.7	13.8
Hardness, as $CaCO_3$	mg/l	66.9	234	669.0	666.0
Non-carbonate Hardness, as $CaCO_3$	mg/l	11.4	----	114.0	----
Specific Conductance	10^{-6} mho/cm	135.0	2836	1373.0	1382
pH	Units	8.0	6.5-8.5	7.8	6.5-8.5
Dissolved Solids	mg/l	81.5	1712	829.0	834
Color	Pt-Co Units	10.0	----	----	----
Suspended Solids	mg/l	3.7	30	37.0	36.9
Turbidity	NTU	1.7	----	----	----
Fecal Coliform	Col/100 ml	2.0	----	----	----
Dissolved Oxygen	mg/l	11.9	11.08	8.5	8.52
Total Cadmium, as Cd	10^{-6} g/l	1.3	5	13.0	12.9
Total Chromium, as Cr	10^{-6} g/l	3.0	11	30.0	29.9
Total Copper, as Cu	10^{-6} g/l	10.3	36	103.0	102.6
Total Iron, as Fe	10^{-6} g/l	117.0	410	1170.0	1165.3
Total Lead, as Pb	10^{-6} g/l	16.9	59	169.0	168.3
Total Mercury, as Hg	10^{-6} g/l	0.17	0.6	1.7	1.69
Total Zinc, as Zn	10^{-6} g/l	38.2	134	382.0	380.5
Ammonia Nitrogen, as N	mg/l	0.01	0.035	0.1	0.099
Nitrate Nitrogen,as N	mg/l	0.1	0.35	1.0	0.996
Ortho-Phosphate, as P	mg/l	0.01	0.035	0.1	0.099
Total Phosphorus, as P	mg/l	0.03	0.11	0.3	0.299

NOTES: (1) Concentrations of Columbia River water are developed from USGS data October 1977 to October 1980 for Vernita Bridge near Priest Rapids Dam, Washington.
(2) Represents water analysis after concentrating the river water dissolved solids ten times in the towers.
(3) Project discharge consists of cooling tower blowdown and low volume waste treatment effluent.

4

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4

3.8 REPORTING OF RADIOACTIVE MATERIAL MOVEMENT

The transportation of new fuel to the reactor and
irradiated fuel from the reactor to a fuel reprocessing
plant and the transportation of solid radioactive wastes 4
from the reactor to waste burial grounds is within the
scope of paragraph (g) of 10 CFR 51.20. The contribution
of the environmental effects of such transportation to the
environmental costs of licensing the nuclear power reactors
are as set forth in Summary Table S-4 of 10 CFR 51.

Radwaste disposal locations and routes have not been
selected. However, because of the existence of a low level
waste disposal site and the consideration being given to 8
location of a high level waste repository at the Hanford
Reservation, it may not be necessary to transport radwaste
off the Hanford Reservation.

that the data from the Bechtel study are representative of the results one would get for the S/HNP Site. 6 E260.06

Noise measurements made adjacent to the WNP-2 project during construction (see Section 2.7) indicate that the noise levels at off-Reservation locations are well below the measured ambient levels. This was verified by observations during the testing period during which construction noises were heard only at the three locations adjacent to the WNP-2 site.

Workers on the construction site will be exposed to the normal levels of noise associated with a major construction project. 4

There is a possibility of some noise annoyance to the population in the Tri-Cities area (Richland-Kennewick-Pasco) resulting from the movement of trucks to and from the Site during construction. This effect, if any, will be felt primarily in North Richland, and will decrease with distance from the Hanford Reservation.

Because S/HNP construction rail traffic is expected to be less than rail traffic associated with the construction of WNP-1, 2 & 4, there should be no impact from rail traffic noise. 6 E260.01 As reported in Section 8.3, vehicular traffic on all routes except SR 240 is expected to be lower during S/HNP construction than that associated with the construction of WNP-1, 2 & 4. As reported in the noise survey in Section 2.7, the noise adjacent to SR 240 due to the increased vehicular traffic will increase approximately 2 dBA. 6 E260.02 All other traffic routes should experience a reduction in noise levels due to reduced traffic as construction of WNP-1, 2 & 4 is completed.

Construction noise will be prevalent, particularly during the operation of heavy equipment during excavation. 4 Measurements of construction noise have been made by Bechtel at four power plant construction sites in the Southwestern United States (two fossil plants and two nuclear plants). Construction noise at the plant sites is considered typical. Therefore, construction workers at S/HNP may be exposed to similar noise levels, although lower noise levels are likely for newer equipment. 6 E260.03 The results of the measurements are organized below by area of construction. All sound levels presented have been normalized to a 50 foot distance from the noise source.

Batch Plant

The most notable batch plant noises are aggregate dropping into hoppers (105 dBA maximum), the operation of hopper vibrators (99 dBA), the pneumatic transfer of powdered cement (97 dBA) and the mixing of concrete in the trucks (98 dBA).

Laydown Areas

In the laydown areas the dominant noise sources are exhaust of engine-powered equipment, which typically ranges from 82 to 88 dBA, but can reach 100 dBA. Other high sound levels, but less prevalent, are metal fabrication such as air gouging, (95 dBA), hammering (100 dBA), chipping (103 dBA) as well as backup alarms (91 dBA).

Concrete Placement

The loudest noises associated with concrete placement are sand blasting (82 dBA steady, 96 dBA when hoses were disconnected), concrete vibrator rattling (93 dBA), and premix truck mixing noise and chute rattles (98 dBA). While concrete placement will occur mainly at the power block, it can occur almost anywhere on site. 6 E260.03

Craft Shops

Craft shop noise consists of an irregular pattern of sawing (88 dBA), grinding (86 dBA), hammering (88 dBA), cutting with a torch (83 dBA), pneumatic tool use (86 dBA), work pieces being dropped (83 dBA), equipment being moved, and other sounds. Most other craft shop sounds range from below 70 to 82 dBA.

Power Block

Major noise sources in the power block area are metal fabrication, concrete placement and excavation. Excavation noise is due mainly to equipment exhausts and typically ranges from 82 to 88 dBA, although higher levels are possible for poorly maintained exhaust systems.

Construction worker hearing protection will comply with state and federal regulations. Ear protection will be used if required.

Archaeological programs will continue through construction of S/HNP in consultation with the Washington State Historic Preservation Officer. As described in Section 2.6, Phase 3 6
of the cultural resources program which has been started 8
consists of (1) intensive field surveys of areas to be impacted by construction of the Plant and associated facilities, (2) determination of eligibility of inventoried 6
cultural resources to the Natural Register of Historic Places, (3) assessment of S/HNP impacts to eligible

resources and (4) formulation of a detailed mitigation 6
plan. Also, as additional areas are identified for project construction, including roads, borrow pits, laydown areas and others, appropriate assessments will be undertaken in 8
consultation with the State Historic Preservation Officer. Phase 4 will implement the plan through avoidance of significant resources or scientific data recovery prior to 6
construction and through monitoring of construction activities. An archaeologist will be retained during the excavation phase to monitor areas as specified in the mitigation plan to be developed in consultation with the State 8
Historic Preservation Officer. In addition, the consulting archaeologist will recommend means to preserve or interpret any historical or archaeological sites or artifacts 4
uncovered.

Of the 13 archaeological and historical sites known to be located in the S/HNP Site and Associated Areas, only three are listed in or potentially eligible for listing in the National Register of Historic Places (NRHP). As discussed in Section 2.6, archaeological site 45 BN 119 is included in the Savage Island Archaeological District, and the Hanford townsite and Hanford irrigation ditch may be eligible for listing in the NRHP. Archaeological site 45 BN 266, a lithic scatter located within the S/HNP Site, has been mitigated and will not be impacted. Because 45 BN 119 lies approximately 1.0 mile south of the intake and discharge facility area, no impacts to this site are 8
expected. Small portions of the Hanford townsite will be disturbed by construction of the intake and discharge pipeline trench and the intake and discharge facility. Prehistoric site 45 BN 307 will be disturbed by construction of the pumphouse. A very small portion (150 feet) of the 18-mile Hanford ditch will be disturbed by construction of the intake and discharge pipeline trench.

Based on the mitigation plan committed to in Phase 3 and 4, no significant adverse impacts are anticipated on archaeological or historical sites located near the S/HNP Site and Associated Areas identified in Section 2.6.

The primary impact on vegetation will be the direct loss of vegetation from the clearing and excavation required for construction of the S/HNP and associated access roads, railroad, parking, water supply and discharge pipelines, raw water pumphouse, and transmission facilities. Disturbance of some of the construction area will be temporary 4
and vegetation will grow on these areas after the disturbance has ceased. Vegetation loss will be permanent on the remainder of the construction area. The total number of acres on which the vegetation is expected to be disturbed is listed in Table 4.1-1.

The vegetation community types found on the Site and Associated Areas (Section 2.2.1) are common in the Columbia Basin. The area to be disturbed by construction represents less than one tenth of one percent of the Hanford Reservation. Since additional area outside the Hanford Reservation is occupied by each of the vegetation types to be disturbed, the regional impact of the vegetation loss is negligible.

About one acre of riparian vegetation near the intake/discharge location will be disturbed. It is located within an area in which a population of the proposed threatened species Rorippa calycina var. columbiae was found (Section 2.2.1.7). Based on field reconnaissance (see Section 2.2.1), it is probable that the population of Rorippa extends for some distance up and down the river from this location. Although this population might be temporarily reduced by construction activities it should not be threatened by this disturbance. 4

Two types of wildlife impacts will occur as a result of the S/HNP: habitat loss, and habitat disturbance. Habitat loss occurs when viable wildlife habitat is converted to an area unsuitable for wildlife habitation. Habitat disturbance occurs when: (1) areas are only partially developed such that some wildlife habitat still exists through revegetation or habitat protection, or (2) local wildlife populations are disturbed by increased human activity and noise associated with nearby construction.

The major wildlife habitat loss associated with the S/HNP construction will be approximately 500 hectares of sagebrush-bitterbrush/cheatgrass and sagebrush/cheatgrass habitat within the Site Boundary. The important wildlife species most affected by this loss include: pocket mice, black-tailed hare, badger, mule deer, sage sparrow, horned lark, meadowlark, white-crowned sparrow, loggerhead shrike, long-billed curlew, and burrowing owl.

Animals inhabiting this area will attempt to relocate in adjacent areas with similar habitat features. This relocation will be limited by the carrying capacity of the adjacent areas, and in some cases may not be possible. Some animals, such as small mammals and reptiles, will undoubtedly be destroyed during Site preparation.

The major areas of habitat disturbance within the S/HNP Site and Associated Areas are the transmission corridor (see Section 4.2), pipeline corridor, access road corridors and railroad corridor. Typical types of disturbances include increased human activity, noise and operation of construction equipment, dust, and temporary placement of construction materials and equipment. These impacts primarily occur during construction and greatly subside thereafter. Wildlife species most affected by habitat disturbance include nesting raptors and long-billed curlews, and mule deer during the fawning season. These species have known breeding areas within the Site and Associated Areas. 4

The old Hanford townsite is an area of special concern. This area supports many nesting raptors and provides valuable fawning habitat for mule deer. The intake/discharge pipelines construction activities in the townsite will temporarily affect the wildlife ecology of this area. A reduction in the breeding activity of these species at the townsite is anticipated during the construction period; however, breeding activity is expected to regain preconstruction levels soon thereafter. Construction activities in this area will be scheduled to minimize disturbance to these species.

Three pairs of nesting long-billed curlews were found within the S/HNP Site and the railroad access corridor. No significant impacts upon the Hanford population are anticipated. Little data exists to predict how these birds will react to construction activities. They probably will avoid construction areas and nest away from such activity, thus developing a buffer zone to protect their young. 4

A summary of potential impacts to endangered, threatened, sensitive and special interest terrestrial species is presented on Table 4.1-4.

4.1.2 WATER

The primary effects of S/HNP construction on aquatic resources will be associated with construction of the temporary water supply line and the permanent intake and discharge systems at River Mile 361.5.

4.1.2.1 Construction of the Temporary Water Supply Line

During the construction phase of the Project, water will be required for Site preparation, access road development, soil compaction, dust control, fire protection and other construction services. The rate of water consumption during construction will be far less than during operation of S/HNP and the need for construction water will arise as soon as construction begins. Consequently, it is proposed to construct a temporary intake and pumping system to supply water needed for construction of S/HNP and to later construct a permanent structure for operation of S/HNP. 6

The temporary pipeline, eight inches in diameter, will be laid on the river bed to a depth of approximately 21 feet (elevation ft) and a distance of approximately 400 feet out from the ordinary high water line of the west bank of the Columbia River at River Mile 361.5. Pipe located on-shore will be secured by designed pipe supports and thrust blocks. Submerged pipe sections, with steel collars, will be clamped to concrete anchor blocks sufficient to prevent flotation or lateral displacement due to stream flow. The concrete anchor blocks will rest on the river bottom. A barge will be anchored over the route locations so that a barge mounted crane can lift pipe and concrete anchor blocks and lower them into place on the bottom. Concrete anchors will be used during construction to position the work barge. These anchors will be removed upon completion of the work. All construction debris will be disposed of on land and none in the water. Navigation markers will be provided to meet U.S. Coast Guard standards, if required.

A diesel driven pump will be located on a concrete foundation slab approximately 8 feet above the ordinary high water line of 362 feet elevation. The 1,000 gallon above
ground fuel tank will be provided with an impermeable dike 6
to retain more than the entire contents of the tank in the event of leakage.

Although the maximum pumping rate will be 750 gallons per minute to satisfy fire protection requirements, the normal daily use during construction is expected to be less than 100,000 gallons per day. A screened inlet section with
openings limited to 1/8 of an inch will be flanged and 8
bolted at the terminus of the suction pipe to provide protection from entrainment of river debris and fish. Intake velocity across the screen will not exceed 0.5 feet per second. Additional details regarding the temporary intake line are shown on Figures 4.1-5, 4.1-6 and 4.1-7.

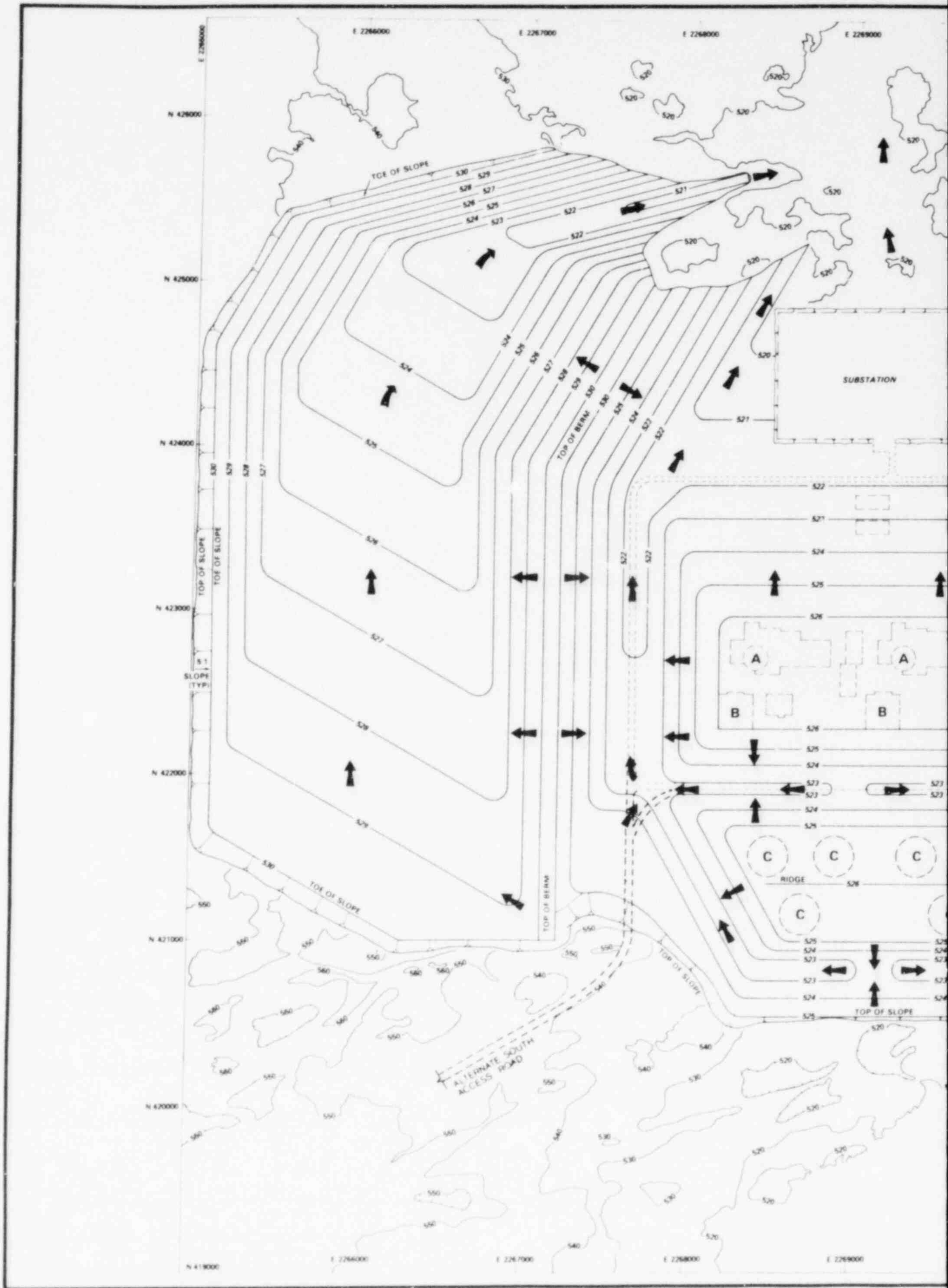
When the temporary line is no longer required, the piping and anchor blocks will be lifted out of the river by crane and barge in much the same way as they were installed.

With the exception of movement of some boulders or cobble to provide stability for the concrete anchor blocks which will hold the temporary line in place, little or no disturbance of the bottom material is expected as a result of installation of the temporary intake system and any resultant aquatic impacts are expected to be insignificant. Due to the inconsequential nature of any impacts, no specific seasonal constraints are proposed for installation of the temporary intake line. Installation and removal of the
temporary intake line are each expected to require less 6
than a month to accomplish.

4.1.2.2 Construction of the Permanent Intake and Discharge Systems

Installation of the permanent facilities will require the excavation of two trenches in the river bed, one for the three intake pipes and one for the discharge pipe. Selection of the construction technique will depend largely on the material found in the river bed at River Mile 361.5. No dams or channel improvements of any kind will be required for the in-river construction activities.

The intake will be a series of finely screened inlets placed just above the river bottom 600 ft offshore at low



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TOE OF SLOPE
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C
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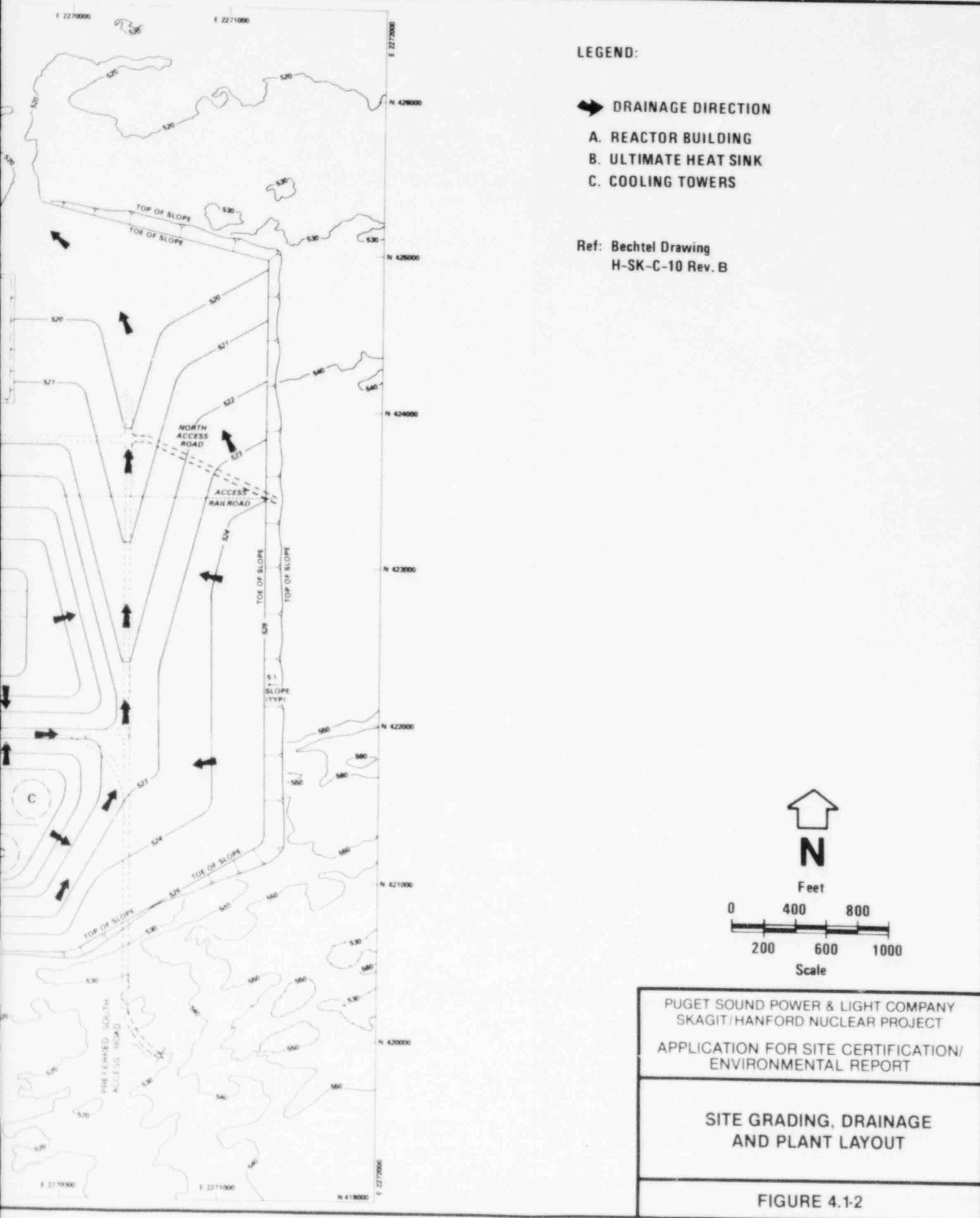
ACCESS ROAD



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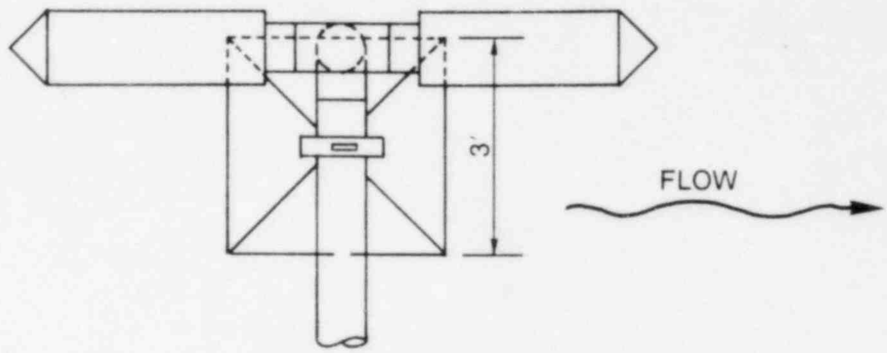
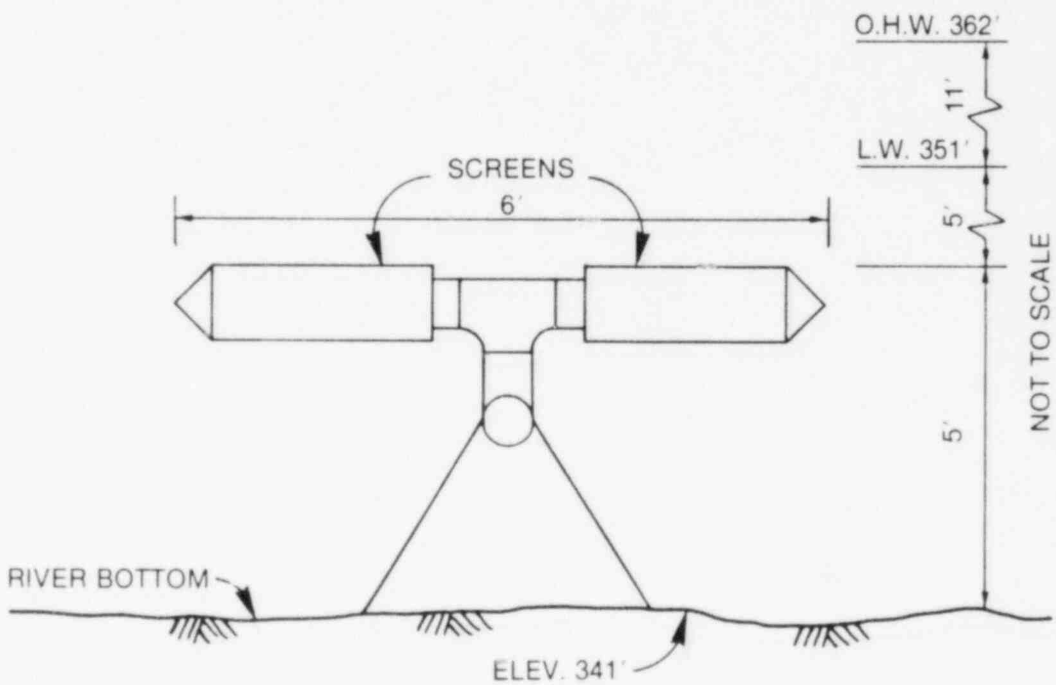
SITE GRADING, DRAINAGE AND PLANT LAYOUT

FIGURE 4.1-2



PLAN



PROFILE

NOTES:

1. MAXIMUM PIPE INTAKE FLOW VELOCITY: 4.8 FPS
2. SCREEN INTAKE VELOCITY: 0.5 FPS AT MAX FLOW
3. MAXIMUM SCREEN SIZE OPENING: 0.125 INCH

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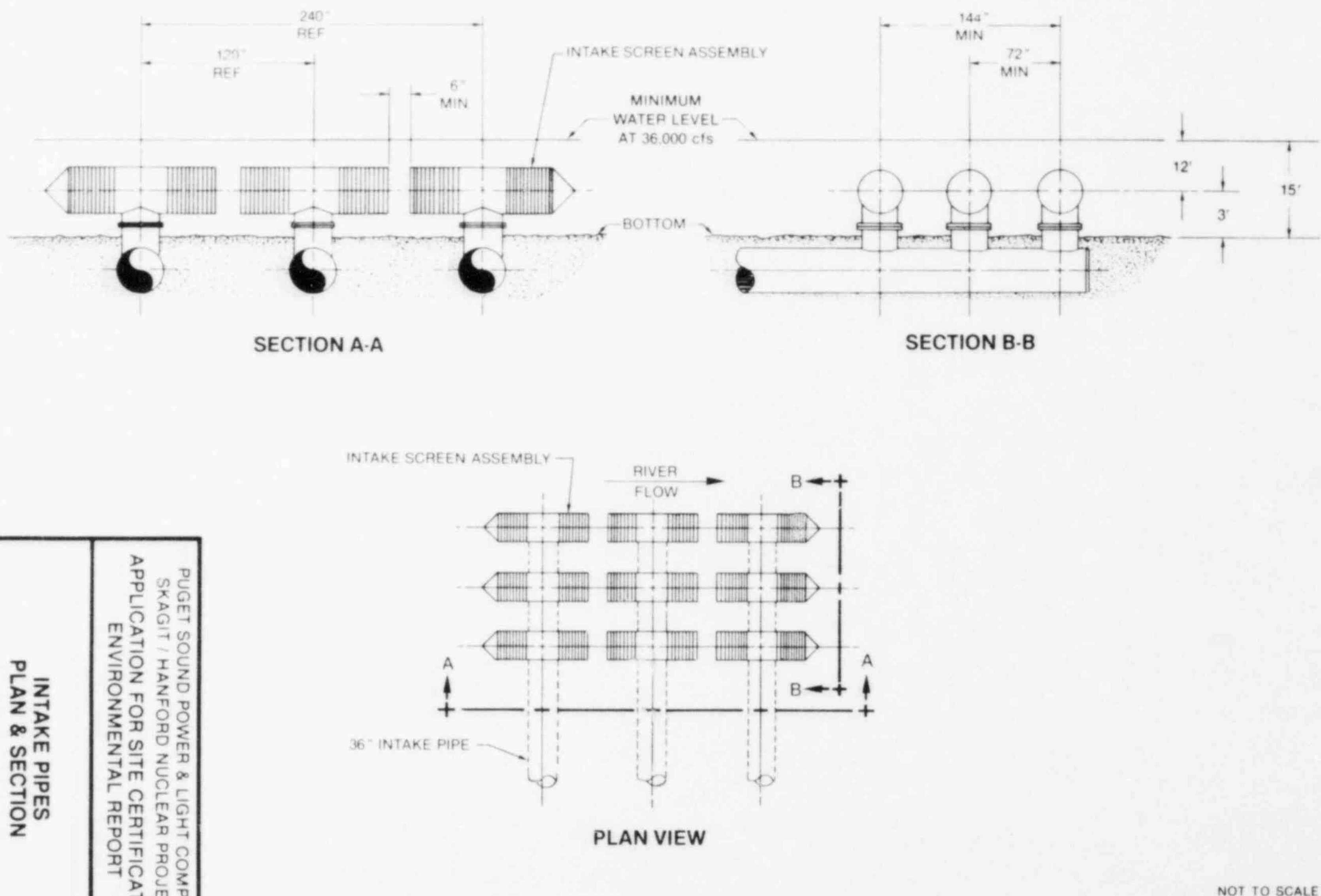
CONSTRUCTION WATER INTAKE PLAN & PROFILE

FIGURE 4.1-7



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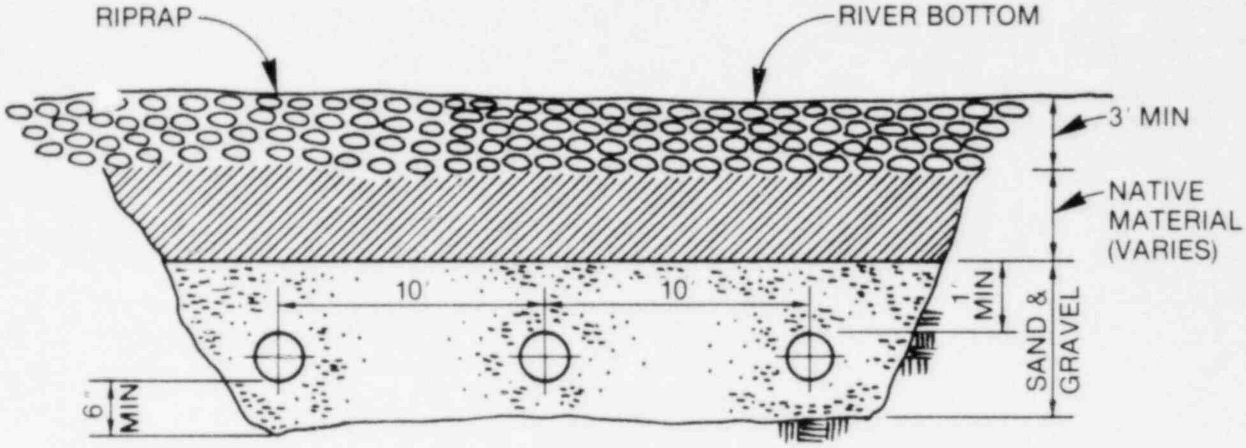
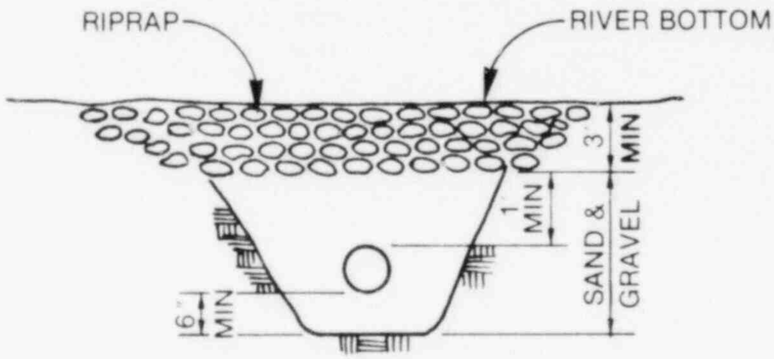
INTAKE PIPES
PLAN & SECTION

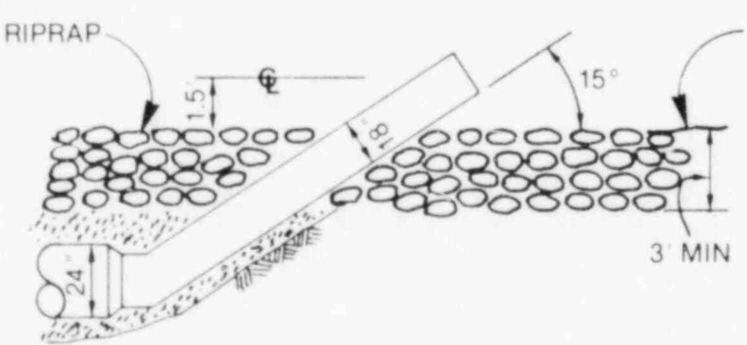
FIGURE 4.1-8



INTAKE PIPES TYPICAL SECTION



DISCHARGE PIPE TYPICAL SECTION



DISCHARGE PIPE

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INTAKE & DISCHARGE PIPE SECTIONS

FIGURE 4.1-9

4.5 CONSTRUCTION IMPACT CONTROL PROGRAM

The following paragraphs provide a summary description of the Construction Impact Control Program (CICP) which Puget intends to follow as a means of implementing adherence to environmental quality control limits. A detailed description of the elements of the CICP will be submitted to the Energy Facilities Site Evaluation Council for its review and approval prior to commencement of Site construction activities.

4.5.1 PURPOSE

The purpose of the Construction Impact Control Program (CICP) is to ensure that good construction practices are employed on S/HNP in order to limit adverse impacts on the environment. The CICP is designed to comply with the Site Certification Agreement between the State of Washington and Puget Sound Power & Light Company (Puget) and with the Nuclear Regulatory Commission Construction Permit requirements for the S/HNP. The program will control all construction impact activities, detect unexpected harmful effects or evidence of serious damage, provide for periodic management audits to determine the adequacy of 5
implementation of environmental controls and maintain sufficient records to furnish evidence of compliance with all environmental control requirements. The CICP will ensure compliance with new source performance standards (40 CFR 423) which are applicable to construction activities.

4.5.2 PROGRAM DESCRIPTION

The CICP will consist of procedures for (1) ensuring the use of good construction practices for the purpose of limiting adverse environmental effects of construction, (2) evaluating and reporting adverse environmental impacts, and (3) auditing and inspecting environmental and construction activities. These procedures will be implemented and maintained via two primary methods:

a. Written direction to contractors through specifications and correspondence.

b. Routine inspection of the Site by non-construction management representatives to ensure compliance with the Site Certification Agreement and the Construction Permit requirements.

4.5.3 RESPONSIBILITY AND AUTHORITY

The requirements of the State of Washington Site Certification Agreement and the Nuclear Regulatory Commission Construction Permit for S/HNP will be implemented by Puget and its agent, Northwest Energy Services Company (NESCO), through auditable contractual agreements with contractors. Bechtel construction management personnel will inspect construction activities to ensure contract adherence, and NESCO will audit the 5
construction activities through periodic on-Site inspection.

When a construction activity results in a significant adverse environmental impact not previously considered or an impact which will be significantly more adverse than previously considered, or may have such result, work will be stopped or further processing, delivery or installation will be controlled until proper disposition has been approved. The NESCO Site Manager or the Puget Vice President, Generation Resources will determine if a significant impact has occurred. The NESCO Site Manager and the Puget Vice President, Generation Resources have the 6
authority to stop work and determine appropriate corrective measures. Work may be restarted when appropriate corrective measures are taken. The on-Site Environmental Compliance Supervisor will also have direct access to the Puget Vice President, Generation Resources.

The Puget Vice President, Generation Resources, will notify NRC and EFSEC when such impacts have taken place.

4.5.4 PLAN DESCRIPTION

The CICP plans are divided into 3 categories; Construction Control, Environmental Monitoring, and Restoration. 5

4.5.4.1 Construction Control Plans

Construction Control plans will be developed in accordance with schedules necessary to meet licensing and construction activity requirements. These plans will include, but not be limited to, the following:

a. Oil and Hazardous Substances, Spill Prevention, Control and Countermeasures for unauthorized discharges of toxic wastes that come under the Resource Conservation and Recoverey Act or WDOE 8
713-303.

b. Erosion Control

c. Dust Control 5

d. Noise Control

e. Dangerous Waste Disposal 8

f. Vegetation Removal/Restoration 6

g. Municipal Waste Disposal 8

4.5.4.2 Environmental Monitoring Plans

Predicted environmental impacts from the construction of S/HNP are addressed in Sections 4.1 to 4.4. Commitments were made to monitor specific archaeological, terrestrial and water quality impacts associated with the construction of S/HNP. S/HNP environmental monitoring programs are discussed in Section 6 and are adequate for monitoring construction impacts.

5

4.5.4.3 Restoration Plan

Restoration plans will be developed to return those areas not landscaped or utilized for other activities essentially to their natural conditions.

4.5.5 CONTROL MEASURES

4.5.5.1 Erosion Control

The Project is located in a shrub steppe region consisting of several shallow rolling hills, with the eastern extremity having a general slope to the river. Surface drainage is good. Due to the open and dry nature of the area (average rainfall is 6.25 in. per year) and sandy granular soil type, precipitation readily infiltrates into the soil
and is not expected to be a problem. Runoff from a severe 4
storm will be controlled by grading away from the power block area and by constructing ditches if necessary. Dewatering is not expected to be a problem because the water table is below any anticipated excavation point.

During construction, contractors will be required to maintain drainage and erosion control around the construction areas and especially in areas of excavation or fill. Areas requiring clearing and grubbing will be sequentially scheduled to accommodate the needs and schedule of construction. These areas will be marked off and removal of vegetation will be minimized. Controls will be employed to ensure proper embankment slopes. Slopes will not be cut steeper than the natural angle of repose.

On-Site borrow pits will be prepared by grading to minimize wind and water erosion and to conform, where possible, to the natural topography. Any accumulations of precipitation within the excavation area will be allowed to infiltrate into the permeable soils. Where required, wind erosion will be controlled by employing soil stabilization techniques.

4.5.5.2 Dust, Noise, and Emission Control 4

During construction there will be emissions resulting from the activities of heavy equipment, from permitted open burning, and from operation of the concrete batch plant. Control will be exercised to ensure that these emissions comply with applicable standards. Construction vehicles will be maintained in good mechanical condition so emissions and noise levels will conform to State environmental standards.

After the initial Site preparation work is completed, the primary source of construction-generated dust is expected to be the unpaved construction roads. Permanent roads within the Site (those roads not near construction activity) are completed during the early stages of construction to minimize dust problems.

In areas where grading by itself is not sufficient to control wind erosion, gravel over the surface of eroding
areas will be used for stabilization. If necessary, 6
chemical stabilizing agents (resinous adhesives, dust N200.02
palliatives, etc.) will be used after a review of the impacts of any toxicity.

Watering or other approved dust control methods will be used to control fugitive dust generated by construction activities. Site roadways will be watered by sprinkler
trucks or covered by protective material such as gravel, 4
crushed stone or pavement, as necessary, to decrease the impact of windblown soil. Parking lots will be gravelled.
Access roads will be surfaced with asphaltic concrete. 6
E280.03

During open burning, care will be taken to reduce emissions
to a minimum. Applicable burning regulations will be 4
complied with, and precautions will be taken to prevent accidental fires. Smoke which may occur during open

CHAPTER 5.0

ENVIRONMENTAL EFFECTS OF PLANT OPERATION

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(2) the wastewater discharge system, and (3) the cooling tower vapor plume. The environmental effects of these components are discussed in the following sections. The locations of intake and discharge lines are depicted in Figure 3.4-3.

4

5.1.2.1 Intake Effects

The intake for the makeup water of the cooling system consists of three torpedo shaped assemblies placed parallel 8
to the river flow above the river bottom (Section 3.4.2). 4
The top of the assemblies will be submerged about 10 ft 8
below the water surface for the lowest regulated flow of 36,000 cfs. The combined maximum pumping rate of 94 cfs is about 0.26 percent of the lowest regulated flow and 0.08 4
percent of the median river flow (115,752 cfs). The average makeup water requirement will be about 62 cfs. 5

Detailed hydraulic model studies of similar intake structures used at WNP 1/4 have been conducted by the Supply System (Ref 6). These studies concluded that a perforated pipe inlet with an internal sleeve would give uniform flow distribution and would offer maximum protection to small 4
fish during all operating conditions. At design conditions, the inlet velocity at the external screen surface is approximately 0.5 fps. However, at a distance of one inch from the outer screen surface, the velocity is approximately 0.1 fps. Intake velocities will normally range between 0.30 and 0.35 fps except during the peak temperature day of the year when cooling tower evaporation necessitates the highest intake flow. On this peak temper- 6
ature day, the intake velocity may approach 0.5 fps for a short period (historically of about 5 hours annual duration). Undesirable debris is not expected to pass through the outer penetrations at these low velocities.

Biological effects of the intake structure are described in Section 5.1.3. The critical intake approach velocity will be maintained below 0.5 fps, thereby reducing impingement, 4
entrainment and entrapment effects upon aquatic organisms. Riprap will be placed around the intake structures to prevent riverbed erosion and scouring.

Nonparallel flow past the three intake assemblies (within 8
the expected range of construction tolerance) will have minimal effect on approach velocities. Neither the intake velocity nor the river velocity are of such magnitude that flow problems would occur due to nonparallel flow. Also 6
because of the level of turbulence in the river (random E290.35
turbulence will create varying local velocities) approach velocity variation due to nonparallel flow will be insignificant.

The range of instantaneous water loss from the Columbia River due to the operation of the S/HNP is estimated to be 20-70 cfs. The average water consumption is about 56 cfs. The loss of water from the Hanford Reach potentially affects the downstream hydroelectric generation at, successively, McNary, John Day, The Dalles and Bonneville. 6 E220.02
The net generation per cfs of flow for the four facilities combined is 23.8 kilowatts per cfs (see Table 5.1-10). For an average water consumption of 56 cfs, the generation loss would be 23.8 kilowatts per cfs times 56 cfs equals 1332.8 kilowatts or, on an annual basis a loss of 11,675,000 kilowatt hours per year.

5.1.2.2 Wastewater Discharge Effects

The wastewater discharge system described in Section 3.4 will convey effluent from the Plant to the Columbia River. A single discharge pipe will be buried in the river bottom and will have an 18-in. round outlet discharging perpendicularly to the river flow direction at an upward angle of 15° from the horizontal (Figure 3.4-3). The exit flow velocity will be approximately 7.5 fps at the maximum discharge rate of 5,910 gpm, and 3.6 fps at the average discharge rate of 2,817 gpm.

As the effluent enters the river, it will mix with ambient water, resulting in local increases in river temperature, velocity, and chemical concentrations. As the discharge is transported downstream by the river current, progressive mixing of the relatively small discharge flow in comparison to the large river flow will result in local temperatures, velocities, and concentrations which are virtually indistinguishable from ambient conditions. 4

Mathematical predictions of the discharge plume dispersion for S/HNP were conducted for a combination of conditions which are considered representative of worst-case and average situations. A description of the thermal plume model (HOTSUB3), based upon modifications proposed by Koh and Fan (Ref 7), are given in Appendix C.

Briefly, the model is composed of two sub-models describing the near and far fields. The former consists of the region near the discharge structure where the discharge momentum determines mixing. This model is based on a solution for an infinitely deep quiescent receiving water modified to account for boundary and ambient velocity effects. The far field considers the region removed from the discharge where the river momentum determines the mixing characteristics. For the latter, the river is assumed fully mixed in the vertical direction, a typical condition in the Columbia of the indicated excess temperatures would be even smaller than those at the surface. Figures 5.1-8, 5.1-9, and 5.1-10 show isotherms along the vertical section through the plume trajectory. 4 Maximum excess temperatures, along the river bottom, are approximately 0.45, 0.11, and 0.39°F for Cases 1, 2, and 3, respectively. These temperatures occur at downstream distances from the discharge of 40, 145 and 52 ft for Cases 1, 2 and 3, respectively.

Worst case anticipated dilution at the centerline of the plume is 190:1 at the downstream boundary of a 300 ft 6 E290.27 mixing zone. Thermal isotherms/concentration isopleths are provided in Figures 5.1-5 through 5.1-10 and 5.3-1 through 5.3-4 for various flow and discharge cases. Centerline differential temperatures are plotted as a function of time and distance for Case 3 in Figure 5.1-10a. 8 Dilution factors and concentration factors can be calculated using the variables presented in Table 5.1-1, as follows:

$$DL = \frac{(Ce-Ca)}{(Cf-Ca)} \qquad X = \frac{Cf}{Ca}$$

Where:

DL = centerline dilutions
Ce = Effluent concentration
Ca = Ambient concentration
Cf = Final concentration
X = Concentration factor 6 E290.27

For example, Figure 5.1-5 for the worst case scenario would be:

Isotherm	DL	X	Maximum Distance Downstream
3.0°F	5.5	3.16	32 ft.
2.0°F	8.3	2.44	40 ft.
1.0°F	16.5	1.72	48 ft.
0.5°F	33.0	1.36	52 ft.
0.09°F	190.0	1.06	300 ft.

Modeling results indicate that no intake-discharge recirculation, thermal buildup, shoreline plume attachment or thermal block will occur as a result of wastewaters discharged by S/HNP.

The ratio of the discharge velocity to the river velocity is relatively low for the S/HNP. 4 The river dominates the flow regime and no impact from the discharge is expected on such velocity-induced phenomena as turbidity, scouring, erosion or sedimentation. Even at the highest S/HNP discharge velocity, 7.45 fps, the maximum induced bottom velocity is essentially zero, as a result of the discharge orientation of 15° above horizontal (Appendix C). The maximum plume velocity at the river surface is projected to be 2.76 fps, occurring approximately 36 ft downstream and offshore of the discharge. This maximum velocity is only 19 percent higher than the low flowing river velocity.

Case 1 conditions evaluated above are for conditions worse than any expected to occur. The worst expected conditions would occur in late summer and would create smaller impacts than modeled above.

5.1.3 BIOLOGICAL EFFECTS OF THE HEAT DISSIPATION SYSTEM

4

Operation of the heat dissipation system (Section 3.4) may affect aquatic biota as a result of two system components: (1) the water intake structure (impingement and entrainment effects) and (2) the cooling tower discharge system (thermal stress). Aquatic biota in the Hanford Reach of the Columbia River are described in Section 2.2.2. Although minimal, the potential environmental effects of intake and discharge systems upon biota are discussed in the following sections. Analyses demonstrate that there will be no significant adverse biological effects.

5.1.3.1 Effects of the Intake System

The S/HNP intake structure is located in mid-channel of the Columbia River at RM 361.5. At low flow, the intake is situated 600 ft off the Benton County Shore in 15 ft of 6
water (Figure 3.4-3). The effects of the intake structure upon the aquatic biota are expected to be insignificant. Entrainment of aquatic organisms will not adversely impact Columbia River biota because of the small volume of water withdrawn and because the intake structure will be designed to reduce fish entrainment. Essentially all of the drifting organisms occurring in the water column that are drawn into the intake structure will perish in the recirculating water system. This loss, however, will be slight in 4
comparison to the total populations of these organisms in the river, and the loss will not affect the ecosystem. The maximum water withdrawal will be less then 0.26 percent of the river volume at the lowest regulated flow of 36,000 cfs. Because plankton have been found to be equally distributed both horizontally and vertically in the Columbia River near the Site (Section 2.2.2), it can be assumed that no greater than 0.26 percent of the total plankton populations will be adversely affected.

There is no mechanism operating at S/HNP that would alter
the biomass or relative abundance of Columbia River phyto-
plankton. Given the rapid population cycling (short
replacement time) of algae, any loss of cells or produc- 4
tivity can be expected to be naturally mitigated in a short
time and the loss would not persist downstream. Columbia
River phytoplankton will not be adversely impacted by the
S/HNP intake.

No adverse impact upon fish is expected to occur as a
result of water consumption by S/HNP since maximum
consumption will only represent approximately 0.2 percent 6
of the regulated minimum river flow (36,000 cfs) and since E290.22
consumption will not cause a measurable difference in water
elevations and river velocities.

Of greater concern is the potential for impingement or
entrainment of the eggs, larvae or juveniles of important 4
fish species. Sport and commercial fish species conceiv-
ably affected are the whitefish, smallmouth bass, steelhead
trout and the various salmon species.

Midstream ichthyoplankton are not abundant. Sculpin larvae
are the most numerous organisms collected (Ref 11,
Appendix K). Some small fraction of the ichthyoplankton
may be entrained into the intake system. Assuming the fry
behave as passive particles and conservatively assuming
that they are homogenously distributed, then entrainment
may be estimated from the volume of the intake relative to
the river. Maximum water withdrawal is expected to be 0.26 6
percent of the minimum regulated river flow of 36,000 cfs.
Average water withdrawal is expected to be 0.08 percent of
the median river flow of 115,780 cfs. Loss of 0.08 or 0.26
percent of the ichthyoplankton (fish eggs and larvae) is
not expected to have significant adverse effects on the
Columbia River ecosystem. Similarly, the loss of other
prey organisms (e.g., zooplankton) is not expected to
exceed 0.26 percent of that passing the S/HNP intake.
These losses are not expected to have significant adverse
impact on the Columbia River ecosystem.

Juvenile chinook salmon and steelhead trout produced in the
Hanford Reach upriver from the intake are of particular
importance. Since egg and larval development occurs in the
gravel, these life stages should not be vulnerable to
intake effects. However, young fry that emerge from the 4
gravel are not strong swimmers and are carried downstream.
Some of these fry may pass the intake structure and may be
vulnerable to entrainment or impingement. Only those small
fish unable to escape the approximate maximum intake
velocity of 0.5 fps at the 1/8 in. intake screen openings 8
will be impinged and lost. Laboratory tests, conducted to 4

determine the swimming ability and impingment tolerance of young-of-the-year chinook salmon (36-56 mm) and steelhead trout (22-36 mm), demonstrated that juveniles avoided impingement at approach velocities up to 1.0 fps and they 4 were capable of surviving impingement at approach velocities of 2.5 fps for up to six minutes (Ref 12).

The design of the intake (Section 3.4.2.1), and its offshore location should reduce interaction with downstream 8 migrating salmonids. Most of the juveniles spawned in the Hanford Reach will utilize the shallow nearshore areas as they pass the intake during the spring. Thus, impingement of these fish will be minimal. The very low entrance velocities (no greater than 0.5 fps) and swift river current (greater than 2.3 fps) will tend to sweep clear of the intake juvenile fish that stray into offshore areas. The fact that most young salmon pass through the area of the intake structure during the spring runoff when flows are high further decreases their susceptibility to impingement.

Because of their larger size, juvenile salmonid fishes artificially and naturally reared in areas upstream of the Hanford Reach may frequent offshore waters during outmigration (Section 2.2.2). While these fish may encounter the 4 intake structure, their improved swimming capabilities in comparison to the smaller fry should preclude impingement effects.

Because the whitefish deposit adhesive eggs, only the drifting lavae may encounter the intake structure. Smallmouth bass spawn in nests in quiescent backwater slough areas. Juvenile bass rear from one to three months in the slough prior to dispersing into the main river. Should the small bass stray into the deep swift portion of the river, their size and swimming capability should preclude impingement effects. White sturgeon are known to spawn in deep holes in the main channel of the Columbia River (Section 2.2.2.6.2). Little information is available, however, regarding juvenile life forms and their activity. Yolk sac fry, approximately 0.7 in. in length (Ref 13), should not be drawn into the intake structure. Given the low water velocity at the surface of the screen (0.5 fps maximum) and 6 the shear velocity of greater than 2.3 fps, impingement of adult fish is not expected to occur. Should impingement effects occur on any fish species, the fact that such a small volume of water is withdrawn for the S/HNP renders any impact negligible.

The Washington Public Power Supply System has conducted 4 entrainment and impingement testing of the WNP 2 offshore, perforated pipe intake (Ref 14). Entrainment sampling

during a period when chinook salmon fry were abundant in the river failed to produce evidence of entrainment. 4
Inspections of intake structures by scuba observation likewise revealed no incidents of fish impingement, damage or other irregularities. 8
Since the S/HNP intake will have even smaller openings than the WNP-2 stuctures, these data indicate that impingement and entrainment will not result in any significant adverse impact at S/HNP.

5.1.3.2 Effects of the Discharge System 4

The discharge system, as described in Section 3.4.2.2, will be located in 14 ft of water (at low flow), 550 ft offshore. Thermal effects of the S/HNP discharge to the Columbia River are expected to be negligible. 8
Thermal effects due to either an increased exposure to heat or sudden cessation of thermal discharges at Plant shutdown (cold shock) are not expected.

Maximum instantaneous temperature difference between the S/HNP discharge and the ambient water will occur in winter and will be $\Delta T = 29.9^{\circ}F$. Extreme temperature differential during the summer will be $16.9^{\circ}F$. Because the maximum discharge volume, 13.2 cfs, is insignificant (0.04 percent) in relation to the minimum river flow, dilution and dispersion of the thermal discharge will be rapid.

A preliminary study was conducted to determine the plume characteristics of the S/HNP discharge when two units are in operation. A description of the computational methodologies is presented in Appendix C. Modeling results of the worst-case condition (maximum S/HNP discharge during minimum river flow) suggest that the most restrictive 4
thermal criterion ($0.54^{\circ}F$) will be met within 52 ft downstream of the outfall in a plume travel time of 22 sec. Area of the surface plume and volume of the water column encompassed within a $0.54^{\circ}F$ isotherm is 390 sq ft and 2000 cu ft, respectively. Maximum excess temperature along the river bottom is estimated to be $0.45^{\circ}F$ (Section 5.1.2) at a distance 40 ft downstream from the discharge.

Changes in ambient water temperature can affect the metabolism, development, growth, and reproduction of aquatic organisms. The tolerance of organisms to thermal changes is species specific, dependent on magnitude and duration of the change, and previous thermal acclimation. Potential thermal impacts to all aquatic communities in the Columbia River near the discharge site are assessed in the following sections.

5.1.3.2.1 Thermal Effects on Plankton

Prolonged exposure to elevated temperatures in thermal discharges have been reported to affect the growth rate and species composition of phytoplankton and zooplankton (Refs 15, 16, 17). Entrainment of river planktonic organisms in the thermal plume created by the S/HNP discharge, 4 will be too brief to cause significant changes in growth or composition. During low flow with a maximum temperature differential at the discharge point, the transit time that organisms will be exposed in the plume to temperatures greater than 2.0°F above ambient will be approximately 25 6 sec. This brief exposure time is below levels reported to have measurable effects on abundance and composition in plantonic organisms (Refs 15, 16, 17).

Patrick (Ref 16) observed that diatom growth was limited at temperatures below 50.0 to 59.0°F and above 84.0 to 86.0°F. Because the maximum thermal discharge at S/HNP is only 84.5°F, diatom species could live and subsist in 100 percent effluent.

The ecological consequences of the thermal discharge on the planktonic community are neglible. No measurable effect on the abundance and composition of food organisms in the stream drift and no indirect impact upon important fish 4 resources are anticipated to occur.

5.1.3.2.2 Thermal Effects on Periphyton

The S/HNP thermal discharge to the Columbia River is not expected to adversely affect the periphyton community in Hanford Reach. The river bottom area exposed to heated water is small. The maximum percentage of the cross-sectional area of the river bed receiving heated water is less than 1.2 percent. The highest excess temperature 5 expected under any conditions on the river bottom is 0.45°F, 40 ft downstream from the discharge point.

Periphyton communities in the Hanford Reach are limited in population size by turbulent river flow and seasonally low water temperatures (Section 2.2.2.2). Diatoms are the dominant forms of periphyton in Hanford Reach populations 4 (Ref 18, 19).

The discharge of heated water may cause an increase in growth of periphyton residing on the river bottom in the immediate vicinity of the discharge structure. Algae species have different optimum ranges. Any increased

Migration Routes	45.0 to 60.0°F
Spawning Areas	45.0 to 55.0°F
Rearing Areas	50.0 to 60.0°F

4

The preferred temperatures for juvenile salmonids are reported as 41.0 to 62.6°F (Ref 17). Ultimate upper lethal temperatures (50% mortality after seven days exposure) for juveniles of the five species of Pacific salmon range from 6 74.8 to 77.2°F (Ref 24). A minimum of 5.4°F below the ultimate incipient temperature has been recommended as the maximum allowable for juvenile salmonids "to avoid significant curtailment of activity." Temperatures near 62.6°F are considered the upper optimum temperature (Ref 17). 4

The period of greatest probable effect of thermal discharge on these species is at Case 1, with extreme low flow and high ambient river temperatures. Although Case 3 would result in greater excess temperatures, it would occur in the winter when ambient temperatures are lowest and prior to juvenile salmonid emergence and outmigration. Under Case 3, ambient river temperatures would be 39.0°F (3.9°C) and maximum exposure temperatures would not exceed 68.9°F (20.5°C). If the exposure scenario considered the ΔT of 8 29.9°F, potential exposures of passively drifting organisms would be about 4 seconds at $\Delta T \geq 18°F$ (10°C) or about 1 second at $\Delta T \geq 28°F$ (15.6°C) (Figure 5.1-10a). These potential exposures are well below those expected to result in sublethal effects. Therefore, the critical period when maximum combined temperatures in the zone of discharge could exceed levels causing sublethal or lethal effects on anadromous salmonids (70.0°F) is during August and September.

A portion of the downstream migrant salmonids move through the Hanford Reach when ambient temperatures are greatest and when additional thermal increments have the greatest likelihood of elevating temperatures in the vicinity of the 4 discharge above lethal limits. Juveniles most likely to encounter these conditions are delayed downstream migrating chinook salmon (Ref 26) and steelhead trout. At ambient temperatures near 64.5°F, if a fish was subjected to a ΔT 5.5°F for extended exposure periods, detrimental effects to salmonid populations would be expected. Cumulative exposure to a fish passively drifting through the discharge plume in August would not exceed 12.9 sec at a ΔT of 6°F. Snyder and Blahm (Ref 25) reported no mortality for 6 juvenile chinook salmon acclimated at 66.2°F and subjected to ΔT up to 10.8°F for four hours.

4

Exposure times would be less if avoidance occurs. Gray et al. (Ref 27) showed 0-age chinook salmon avoided simulated thermal discharges at a plume velocity of 2.0 fps when the ΔT exceeded 16.2 to 19.8°F.

Preference of fish for particular temperature regimes has been documented. Brett (Ref 24) reported juvenile salmon had a preferred range of 54.0 to 57.0°F when acclimated from 41.0 to 75.0°F, and avoided temperatures in excess of 59.0°F except when feeding. Cherry et al. (Ref 28) found that rainbow trout selected a preference range from 52.9 to 68.2°F when acclimated at 43.0 to 70.0°F (Table 5.1-4). These data imply that given a choice, fish will avoid potentially lethal temperatures. 4

Juvenile salmonids could drift through the effluent plume during downstream migration periods. 0-age fall chinook abundance in the Hanford Reach is greatest in May with only small numbers of fish present in July. Peak movement of steelhead and salmon smolts originating from upstream areas occurs in May. Since ambient water temperatures in May range from about 45.0 to 54.0°F, the thermal plume would have to elevate ambient temperatures 16.0°F for extended exposure periods before detrimental effects to salmonid populations would be expected. Even at the surface where maximum temperatures are expected, ΔT's will not exceed 6.3°F. Cumulative exposure to a fish passively drifting through the S/HNP discharge plume would not exceed 1.8 sec at a ΔT of 16.0°F. Snyder and Blahm (Ref 25) reported that juvenile chinook salmon held at ambient river temperature (50°F) suffered no mortality following four hour exposure 6 to elevated temperatures ranging from 64.4 to 69.8°F (ΔT of 14.4 to 19.8°F). 8

Water temperatures exceeding 70.0°F are reported to impede or block adult salmonid migrations (Ref 17). Nevertheless, migration in the Columbia River has occurred at higher temperatures (Ref 17). Studies on adult Columbia River salmon and steelhead trout indicate that over a period of many days, temperatures in excess of 70.0°F also may be lethal (Ref 29).

The primary migration route for adult salmonids is along 4 the eastern shoreline in the Hanford Reach (Refs 30, 37). In addition, returning adults showed a preference for shoreline areas of depth less than 10 ft. Therefore, they are not expected to frequent the discharge area (Ref 30). Adult chinook in the Hanford Reach have been shown to avoid the immediate areas of thermal discharges (Ref 17). Templeton and Coutant (Ref 30) concluded that thermal discharges from the early Hanford reactors had no significant effects on migration.

During periods of peak adult salmonid migration, the worst-case thermal increment at the point of discharge will be $\Delta T = 16.5^{o}F$. Even during low flow conditions and ambient
river temperatures of $68.0^{o}F$, temperatures in the receiving 4
water would be below lethal temperatures after a time interval of a very few seconds. A thermal differential of $2.0^{o}F$ would occur at the surface approximately 40 ft downstream of the discharge location and the corresponding
surface area for a $2.0^{o}F$ isotherm would consist of 100 sq 5
ft. A differential of only $0.09^{o}F$ would occur 300 ft downstream of the outfall (Section 5.1.2).

The maximum cross sectional area of the river which would 4
experience thermal increases greater than $0.5^{o}F$ is less
than 1.2 percent of the main channel during worst case 5
conditions. Since approximately 99 percent of the river cross section is available for passage at ambient temperatures, it is evident that free passage of adult migrants will be assured under all conditions.

The discharge of heated effluent from other facilities into the Hanford Reach has not been demonstrated to have a detrimental effect on spawning salmon (Ref 17). However, temperature stresses could indirectly and adversely affect reproductive success through excess energy costs, increased vulnerability to disease or increased vulnerability to
toxicants which may be present. 4

The frequency of fish disease may increase with increased water temperature. Infectious diseases appear less likely to cause mortalities in adult salmonids at temperatures below $60.0^{o}F$ (Ref 17). There is no evidence of increased incidences of infection by Chondrococcus columnaris in areas below the thermal discharges of early Hanford reactors when compared to areas not influenced by the thermal plumes (Ref 30). No increased incidences of fish disease are expected to result from S/HNP discharge.

Exposure of passively drifting rainbow/steelhead trout to sublethal thermal increments will be too short to expect increased mortality due to predation. In laboratory experiments, Coutant (Ref 39) found that vulnerability of rainbow trout to predation increased with duration of
exposure of thermal shock temperatures of 26-30°C. How- 6
ever, for fish acclimated at 15°C, a significant difference E290.
in predation rate was not determined until 1.5 min exposure at 30°C. Maximum discharge temperatures for S/HNP is expected to be 29.2°C. Fish passing through the plume centerline would potentially be exposed to this temperature for less than one second.

The thermal plume from the S/HNP discharge will not inter-
sect any known spawning areas and will be fully mixed at
the nearest chinook or steelhead spawning area, 7.5 miles
downstream of the discharge location. Olson (Ref 31) found
no adverse effects on different developmental stages of
salmon eggs and fry when thermal increments were less than 4
2.9°F. The worst-case thermal increase at the spawning
grounds after mixing, will be less than 0.004°F. No
measurable effect on spawning or on the growth and
development of egg and larval stages in this area will
occur.

At ambient river conditions of 15°C (59°F) and a ΔT of 11°C
(19.8°F) Coutant (Ref 40) stated that exposures of 32
minutes would induce changes in prey behavior or per-
formance that would result in increased vulnerability of
shocked fish to predation. This duration is approximately
10% (chinook) and 20% (rainbow) of the exposure duration
that caused obvious loss of equilibrium to half the test
population (EL_{50}). Longer exposures increased vulner-
ability to predation relative to controls almost exponen-
tially. Shorter exposures made shocked fish less sus-
ceptible to predation. In addition, Stober et al. (Ref 38) 6
found no significant difference between predation rates of
juvenile chinook salmon exposed to 15, 20, 22.5 and 25°C
for 10 minutes or ΔTs ranging from 4 to 14°C at ambient
temperatures averaging 11.2°C (5.2°F).

At the S/HNP discharge, ΔTs will generally be less than
10°C with a corresponding passive drift exposure of about 2
seconds. Passive drift travel time for ΔTs $\geq$ 4°C (7.2°F)
will be only about 10 seconds. Thus, exposure times
expected for juvenile downstream migrant salmonids should
be well below those expected to cause increased
susceptibility to predation based on thermal shock.

Resident Cold Water Species

Thermal tolerances and preferred temperature ranges of
mountain whitefish have not been studied in detail, but
they are expected to be adapted to a generally lower
temperature regime than the thermal plume (Ref 32). Prefer-
red spawning temperatures are near 50.0°F (Ref 13).

Although mountain whitefish are known to be present near 4
the Site, there is evidence (Ref 33) of reduced abundance
in the Hanford Reach during summer months. Emergent fry
apparently move out of the area to downstream nursury areas
by early May. Peak adult abundance typically occurs in
early fall through spring, with fish moving upstream to
spawn in December and January. Because of these life
history characteristics, mountain whitefish should not be

significantly impacted by the thermal discharge in this area.

Water temperature is thought to initiate seasonal movement patterns in white sturgeon in the Hanford Reach (Refs 34, 35). Long distance and localized shallow movements, assumed to be related to spawning and/or feeding migrations, begin each year in June when water temperatures exceed 55.0°F. 4

Because sturgeon remain near the river bottom, they should not be influenced significantly by the rising plume. Maximum thermal increment along the river bed is less than 0.45°F. The zone of thermal influence is small and the temperature differential is slight. Thus, no effect of the S/HNP discharge upon white sturgeon activity in the Hanford Reach is expected.

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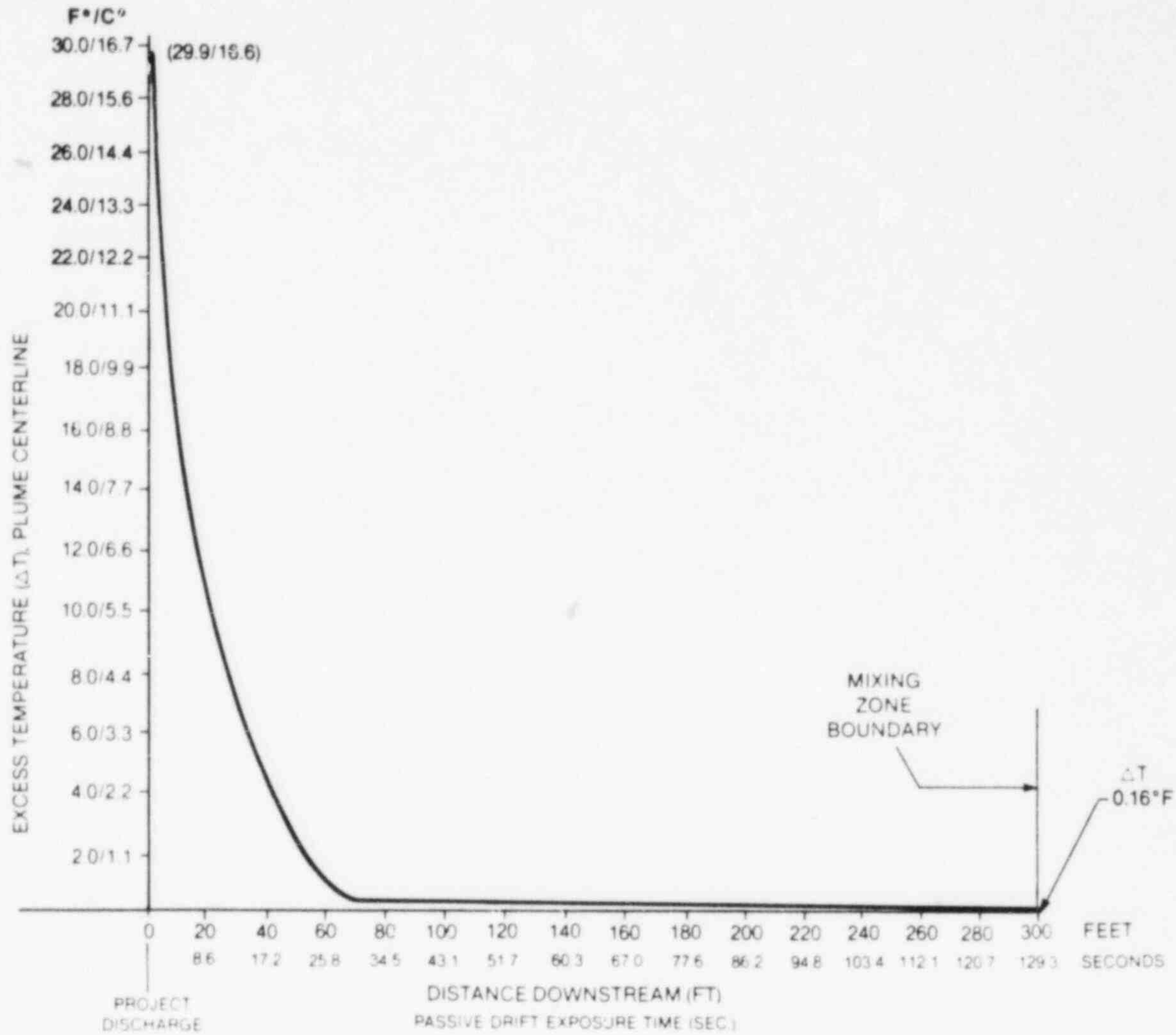

DURING CASE 3 CONDITIONS
(MAXIMUM EXCESS TEMPERATURE,
MINIMUM RIVER FLOW)

PUGET SOUND POWER & LIGHT COMPANY
SKAGIT / HANFORD NUCLEAR PROJECT
APPLICATION FOR SITE CERTIFICATION/ ENVIRONMENTAL REPORT

EXCESS TEMPERATURES (△T) AND DOWNSTREAM PENETRATION OF THE S/HNP DISCHARGE PLUME

FIGURE 5.1-10a

mixing zone boundary with U.S. Environmental Protection Agency's Water Quality Criteria (Refs 3, 4) indicates that all regulated parameters are less than the Federal criteria, with the exception of certain trace metals; cadmium, copper, iron, lead and mercury.

Ambient values for these metals in the Columbia River, upstream of the S/HNP intake, occasionally exceed Federal criteria. Trace metals will not be introduced from Plant 4
operation or from corrosion products of the stainless steel condenser tubes. However, the metals originally present in the river will be concentrated ten fold, on the average, in recirculated cooling water prior to being returned to the Columbia River. Following worst-case dilution on the order of 190:1 at the edge of the mixing zone, metal concentrations are estimated to be only six percent above ambient levels. This negligible increase in trace metal concentrations should not affect aquatic biota outside the mixing zone. Acidification of the cooling water will not be extreme. Prior to discharge, waste waters will be neutral- 6
ized to maintain pH levels between 6.5 and 8.5. As a N220.06
result, no change in metal toxicity will occur in the receiving water.

The potential effect of metals inside the mixing zone was also evaluated. Toxicity of metals is dependent on their bioavailability which is a function of their chemical form. Toxicity is also a function of exposure time and concentration. Higher concentrations can be tolerated for short time periods. None of the fish expected in the area of the proposed discharge location for the S/HNP are likely to remain in the discharge plume for a sufficient length of time to experience a toxic reaction. 6

The majority of the ambient copper in the Columbia River appears to be particulate copper which is generally considered to have a low bioavailability and hence a low toxicity. Copper toxicity is also related to water hardness. The greater the hardness, the more copper that can be bound and removed from that which is bioavailable. The hardness of the water is expected to increase in the discharge plume. This increased hardness may result in a further reduction in soluble copper in the discharge.

Copper concentrations in undiluted discharge water may be in the range of the 96-hr LC_{50} for some species. Based upon Columbia River water hardness, pH, alkalinity and the copper complexing capacity, the 96 hr LC_{50} for salmonid 8
fishes in the Hanford Reach is between 90 and 110 μg/l total copper (Refs 25, 26, 27, 28, 29). Within 31 ft (13.4 sec) downstream of the discharge, copper concentrations would be below the 96-hr LC_{50} for salmon during Case 1 6
conditions. The plume area at this point represents

approximately 0.1 percent of the river cross section. It 8
is unlikely that a fish would choose to remain in this portion of the river for sufficient time to become intoxicated. In fact, the river velocity in the plume exceeds the swim speed of some juvenile fish. Additionally, fish have been shown to detect and avoid copper concentrations of this level. There are no copper concentrations in the plume that are expected to be immediately lethal.

The toxicity of mercury varies with its chemical form. Organomercuric complexes have a different toxicity than
ionic mercury. There appears, however, to be little differ- 6
ences in toxicity to fish among various organomercuric compounds. Sockeye salmon have been reported to tolerate 10 mg/l of pyridyl mercuric acetate for one hour with no toxic effects (Rucker and Whipple 1951) (Ref 7). Reference 8 reports that short-term bioassay data indicated that a 1 mg/l of inorganic mercury was fatal to fish. Examination of the expected plume concentrations of mercury in Table 5.3-1 indicate that no significant adverse effects are expected from exposure to mercury in the discharge.

Like most metals, the acute toxicity of zinc is a function of the availability of the ionic species and toxicity is reduced by increases in hardness, alkalinity and pH (Refs 3, 8, 32, 33, 34, 35, 36). Toxicity of zinc to salmonid fishes, the most sensitive aquatic species in short duration tests (Ref 37), is reported to vary considerably; 96 hr LC_{50}s range between 90-4,700 μg/l total zinc (Refs 24, 31, 34, 37-43). Based upon the water hardness of the Columbia River and the relationship between hardness and metal toxicity described by Brown (Ref 33), the 48 hr LC_{50} for ambient Columbia River water would lie between 1,100 and 1,400 μg/l total zinc. Utilizing the maximum hardness of the S/HNP discharge (Table 5.3-1), total zinc levels would have to be on the order of 5,100 to 6,600 μg/l
prior to observing 48 hr LC_{50} acute effects. 8

Chronic exposures of three generations of brook trout to total zinc concentrations ranging from 2.6 to 534 μg/l produced no signs of harmful effects (Ref 41). Chapman (Ref 35) found that 3-month exposure of adult sockeye salmon followed by 18-months exposure of embryo through smolt stages, in total zinc concentrations ranging from 30 to 242 μg/l in soft waters (32-37 mg $CaCO_3$/l) produced no adverse effects on survival, fertility, fecundity or growth. The apparant absence of chronic effects at these levels may be attributable to the acclimation of fish to zinc (Refs 35, 36, 42).

Maximum acceptable toxicant concentrations (MATC), based upon life history testing of salmonid fishes, have been reported from 1,210 to 1,360 µg Zn/l, depending upon water hardness (Refs 36, 41, 44). Gill ventilation response data (Ref 36) suggest that juvenile steelhead trout detected total zinc levels of 144 µg/l in soft water and Sprague (Ref 45) reported that Atlantic salmon avoided total zinc concentrations as low as 55 µg/l. 3

It is apparent from these acute and chronic toxicity data, and from avoidance response data, that brief exposures (2.2 minutes passive drift) to maximum levels of total zinc in the S/HNP mixing zone are not expected to have a signficant adverse affect on the Columbia River ecosystem.

Toxicity of iron depends upon its valence state and whether it is in solution or suspension. For practical purposes, iron has little direct toxic effect on aquatic life because it is complexed and relatively inactive chemically or physiologically (Refs 3 and 22). In the Columbia River, iron readily forms insoluble complexes. Data from the USGS at Vernita Bridge (1977-1980) indicated that dissolved iron averaged only 28.0 µg/l or approximately 20 percent of the mean total iron concentration. Therefore, the bio-availability of iron in the Hanford Reach of the Columbia River is low. The Project discharge is not expected to be toxic. Although not directly toxic, suspended iron can stress fish by causing respiratory distress, damaged gills or reduced growth and maturation. Suspended iron has been shown to have sublethal effects of brook trout in concentrations of 12.0 mg/l or greater (Ref 23). The S/HNP discharge would contain a maximum of approximately 3.7 mg/l total iron concentration. Thus, no sublethal impacts are anticipated on fish species. 6

Fish and certain invertebrates have been found to be sensitive to low levels of cadmium in water. Increased hardness (and/or alkalinity) and increased concentrations of metal-complexing organic compounds have been demonstrated to decrease availability and therefore decrease toxicity of cadmium (Refs 3 and 24). USGS water quality data from Vernita Bridge (1977-1980) indicate that on the average dissolved cadmium concentrations were below detectable levels. Thus, dissolved cadmium in the Project discharge is not expected to be toxic.

The maximum total cadmium concentration in the Project discharge is expected to be 38.4 µg/l. However, the corresponding hardness of the Project discharge is high (1076 mg/l of $CaCO_3$), and fish are not anticipated to maintain a position in the plume, so exposure time to elevated concentrations would be brief. Consequently, no adverse impact upon fish is expected to occur as a result of discharge of cadmium by the Project.

Sodium hypochlorite (NaOCl) is the preferred biocide for
treatment of the cooling towers. The receiving water
criterion for total residual chlorine (TRC) is 0.002 mg/l, 4
as specified by U.S. Environmental Protection Agency
(Ref 3). Assuming Case 1 conditions (maximum project
discharge; minimum river flow), the total residual chlorine
level in the S/HNP discharge would be reduced in the
Columbia River to the Federal criterion level within 29 sec
(67 ft downstream from the discharge). Under Case 2 model-
ing conditions (average project discharge; median river
flow), compliance with the Federal criterion would occur 8
within 35 sec (155 ft downstream of the discharge).
Although this plume is carried further downstream with the
increased current velocity in comparison to Case 1 condi-
tions, the width of the plume is substantially more
confined.

Research to date does not suggest a major toxic impact on
biota as a result of the TRC discharge. An analysis of the
chlorine plume (Ref 5) indicates that all aquatic life
passing through the plume will remain unharmed. Data
suggest that sessile benthic organisms in the path of the 4
S/HNP plume may be adversely affected within a relatively
small area immediately downstream of the discharge
location. This area, however, is small compared to the
total habitat available in the river; therefore, a
localized loss in productivity should not affect the
aquatic community as a whole (see Appendix L).

Acute mortality from TRC to passively drifting fish
entrained in the discharge plume is unlikely. Potentially
lethal conditions from TRC exist only in the area directly 6
below the discharge. Under high discharge and low river
flow conditions, maximum chlorine concentrations are
rapidly diluted to <0.01 mg/l within 50 feet downstream of
the discharge.

8

A comparison of toxicity thresholds for several fish
species found in the Hanford Reach (Table 2.2-23) indicate
that a fish would have to reside in the extreme upstream
portion of the plume centerline for several minutes to
several hours before mortality would result. This is
unlikely because of the fast river currents at midstream.
Because the plume centerline rapidly rises to the surface,
energy expenditures for fish maintaining their position in 6
the discharge zone would probably be excessive. Further
reduction of impact would result if fish detected and
avoided the discharge plume. Cherry et al. (Ref 9) found
that the ability of fish to actively avoid concentrations
of TRC was species specific and dependent on accumulation
temperatures and water quality. Threshold avoidance ranged
from 0.05 mg/l TRC for coho salmon (Oncorhynchus kisutch)

to 0.41 mg/l TRC for channel catfish (<u>Ictalurus punctatus</u>). In most cases, avoidance was noted at concentrations below those causing acute mortality.

Adult salmon and steelhead can maintain a cruising speed of 4 to 5 fps (Ref 10), but it is unlikely they would maintain themselves near the worst case discharge velocity of greater than 7 fps for more than a few minutes. Discharge velocities under average flow conditions are near adult salmonid cruising speed. However, under these conditions, plume chlorine concentrations would be reduced. If temperatures in the thermal plume are elevated above 20°C, upstream-migrating adult salmonids may not enter the plume (Ref 11). In addition, adult salmonids generally show a preference for shoreline areas during migration (Refs 11, 12, 13 and 14) and thus may avoid the plume entirely.

The discharge plume will not block upstream migration of
salmonids since it constitutes only a small portion of the
river cross section. Even during peak upstream migration
of fall chinook salmon and steelhead trout (August-
October), and given worst case conditions, the discharge
plume (concentrations greater than 0.004 mg/l chlorine) 6
would cover only 1.2 percent of the river cross section.
At all other times, the cross-sectional extent of the plume
will be less.

In contrast to migrating anadromous fish, bottom-dwelling resident fish could maintain positions at midriver. However, potential impacts to these populations are reduced because the plume is nearly mixed when it intersects the bottom. Maximum chlorine levels at the bottom are estimated to be only 0.0038 and 0.0008 mg/l for worst case and average conditions, respectively. Because of the turbulent nature of the river at midstream, even these concentrations would be transient and affect only a small portion of the river bottom. Hence, no adverse impacts are expected to these populations.

The combined effects of heat and chlorine on aquatic biota
has been studied by several authors. Specifically,
Thatcher et al. (Ref 15) and Stober and Hanson (Ref 16)
reported lower acute LC_{50} concentrations for salmonids
exposed to chlorine at 20°C than those exposed at 10° to
15°C. Thatcher (Ref 15) reported 96 hr LC_{50} values for
juvenile brook trout near 0.15 mg/l TRC at 10 and 15°C and
values about 0.10 mg/l TRC for trout exposed at 20°C. 8
Brooks and Seegert (Ref 21) reported thirty-minute LC_{50}
values for TRC for coho salmon of 0.56 mg/l at 10°C and
0.29 mg/l at 20°C. In addition, Dandy (Ref 17) suggests
that fish in contact with chlorine may lose respiratory 6
efficiency due to mucous production or gill damage. If

fish were exposed to heat and chlorine for extended time
periods in the discharge plume, increased metabolic rate
and decreased oxygen levels could further stress the fish.
However, Giattina et al. (Ref 18) recently showed that most
fish species avoided intermittent heated chlorinated dis-
charges where chlorine residuals were 50 percent or less of
the median lethal concentration. Therefore, there is no
reason to expect that a fish would voluntarily remain under 6
these conditions for sufficient duration to cause mor-
tality.

The presence of suspended colloidal matter in effluents has
also been found to increase toxic effects of TRC to fish
(Ref 19). Additionally, lethal effects of temperature may
be synergistically increased when combined with sublethal
concentrations of metals (Refs 20, 21). There is little
information available regarding synergistic or antagonistic
actions of a composite of many trace metals. Effects have
been reported for combinations of up to two or three trace
metals. Finlayson and Verrue (Ref 31) reported that no 8
synergism occurred among various mixtures of zinc, copper
and cadmium and that two or three metal combinations had
additive or antagonistic toxic effects on juvenile chinook
salmon. Although the S/HNP discharge may contain levels of
suspended and dissolved solids nearly ten times above
ambient, these are quickly diluted to levels only 6 percent
above ambient at the edge of the 300-foot mixing zone. 6
Because of this rapid dilution, the synergistic effects of
TRC, heat, metals and suspended solids could only cause 8
mortality to fish maintaining position on the midstream
water column directly below the plant discharge for a signi-
ficant period of time. Fish could not maintain their posi-
tion there without considerable energy costs and it is
unlikely that fish would choose to remain in the discharge 6
plume for a significant period of time. Consequently, the
potential for combined effects represents minimal incre-
mental risk and no significant impact upon fish is expected
as a result of the plant discharge.

5.3.2 EFFECTS OF DRIFT ON VEGETATION AND WILDLIFE

After approximately 10 cycles of concentration, the circu-
lating water will contain about 829 mg/l of dissolved
solids. Drift from the cooling towers will be controlled 4
to 0.005 percent loss of the circulating water flow
(Section 5.1.4). Biocides and heavy metals in the drift
are anticipated to be at a level so low as not to be
distinguishable from normal background levels in the soils
(a minute fraction of one percent by weight of solids).

The predicted distribution and amounts of drift from the
cooling towers are shown in Figure 5.1-14. The model
employed to determine these distributions is described in
Section 6.1.3.3. The maximum total solids deposition is
calculated to be less than 10 pounds per acre per year (or
less than 11 kg/ha-yr). According to NRC Regulatory Guide
4.11: "Chemical analyses of soils, plants, and animals in
the drift field of freshwater cooling towers are not
usually needed when all of the following apply: (1) the
dominant salts are harmless mixtures of biological nutri-
ents as shown in Table 4, (2) the expected peak deposition
beyond the site boundary is less than 20 kg/ha-yr (no more 4
than 50% in any 30-day period during the growing season) of
mixed salts, and (3) the drift does not contain toxic
elements or compounds in amounts that could be hazardous to
plants or animals either by direct or indirect exposure
over the expected lifetime of the facility."

All three of the above conditions apply to the Skagit/Hanford Nuclear Project cooling tower drift. The expected concentrations are below the level at which effects on vegetation and wildlife can be considered measurable.

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5.4 EFFECTS OF SANITARY DISCHARGES

This section discusses the environmental effects of
sanitary discharges during Plant operation. Sanitary 4
facilities are described in Section 3.7.

Sanitary waste disposal will be by means of a package
sewage treatment plant with a percolation pond. Discharge
into the percolation pond will average 7 gpm with a peak 6
flow of 10 gpm. Effluent characteristics are described in 4
Section 3.7.1.

As discussed in Section 3.7, only treated sanitary wastes 8
will be discharged into the percolation pond. Water
discharged into the pond would penetrate to the water table
within a period of one to two months. Travel times to the
river in the groundwater has been calculated and are
included in PSAR Table 2.4-33. Average travel time appears 6
to be 37.6 years. E221.01

The soil acts similar to an ion exchanger and tends to
retard cations. Retardation mechanisms such as mineral
displacement and precipitation will cause chemicals in the
sanitary discharge to accumulate in the soil beneath the
pond.

Evaporation and percolation due to the arid climate and
porous soil in combination with a high degree of treatment
result in no significant effect on groundwater quality.
Saturated soil conditions will exist within a few feet of
the point of disposal. However, much of the water is not 4
expected to enter the water table (approximately 125 feet
below the ground surface), because moisture in the upper
soil layers moves toward the surface due to evaporation and
evapotranspiration (Ref 1). Contamination of groundwater
by pathogenic bacteria, if it occurs, will be restricted to
within a few feet of the pond where saturated flow
conditions exist.

The only wells that exist within approximately five miles 6
of the S/HNP Site are used only for sampling an acquifer E221.04
that is not connected to the surface near the S/HNP Site.

Because of the limited zone of potential contamination and
the limited use of groundwater in the area, the operation
of the treatment facility will have no measurable effect on
groundwater resources.

4

Because there will be no discharge to any surface waters,
no measurable effect upon water quality or the biota of the
Columbia River will occur. The percolation pond may

attract wildlife or waterfowl; however, they will not be adversely affected because wastewater from the aerated treatment plant will be treated prior to discharging into the percolation pond. During normal operation, the aerobic process will not be a source of odors. 4

Solid wastes will be collected and disposed of in accordance with Federal and State requirements.

b. Monitor abundance and/or habitat usage of species indicated in c. above

c. Estimate the impact of Site preparation and construction upon plant or wildlife species and/or habitats

d. Describe potential mitigation measures, if necessary, to ameliorate and/or compensate for adverse terrestrial impacts.

Preoperational monitoring is the final stage before operation and is designed to provide the data necessary for evaluating any changes to the terrestrial environment arising from S/HNP operation. In many instances, the previous monitoring programs will provide the necessary data base.

6.1.4.3.1 Preapplication Monitoring

The vegetation and wildlife of the Hanford Reservation has been thoroughly studied in connection with the activities of the U.S. Department of Energy (and its predecessors), the Supply System and the U.S. Army Corps of Engineers (riparian zone only). The preapplication monitoring program was designed to confirm that the area likely to be affected by the S/HNP is similar to areas already described in the literature, and therefore, impacts will be predictable based primarily on data from previous studies. Field surveys also were conducted to check for the occurrence of important species, as defined in NRC Regulatory Guide 4.2. 4

Relevant literature is listed in Section 2.2. The area studied was the Site and Associated Areas, which encompassed the Site and the railroad, transmission line, pipeline, and access road corridors (see Section 2.2.1.3). To assure proper coverage, the corridor width was assumed to be 300 m.

Qualitative field surveys of vegetation were conducted in April-October, 1981. Each area was searched on foot by a plant taxonomist/ecologist to identify any threatened, endangered, or other sensitive plant species or habitats and to document their presence, local and regional abundance, sensitivity, and relationships to the S/HNP.

A qualitative field investigation of wildlife was conducted to: (a) assure applicability of existing information to the Site and Associated Areas, (b) locate specific areas used by important wildlife species, and (c) search for unique wildlife features within the area to be directly impacted by Site preparation and station construction. This field investigation was conducted in May, June and July, 1981.

The Site and Associated Areas were traversed in a systematic manner to record all wildlife sign and observations.

The S/HNP intake/discharge location and the old Hanford townsite were studied in detail. The townsite is unique within the Hanford Reservation because of the trees planted decades ago by early settlers for shade and fruit production. Since the pipeline corridor transects the townsite, a reconnaissance of the entire area was conducted.

Most of the trees within the townsite were checked for wildlife use signs. Trees with significant wildlife sign (eg, raptor nests) were mapped for future identification. 4
An attempt was made to ascertain if nests were active and which species was using them. If possible, nest success was determined. In addition to trees, all other remaining features of the townsite (ie, the old schoolhouse, pumphouse, and miscellaneous remnants from the town) were checked for signs of wildlife use.

The remaining important feature of the townsite was the riparian habitat along the Columbia River. This area was checked for wildlife use sign, especially breeding and feeding activity of hydrophilic species. The extent and quality of riparian habitat available to wildlife was noted on aerial photographs.

6.1.4.3.2 Site Preparation and Construction Monitoring

Sections 4.1, 4.2 and 4.5 describe mitigation measures to be utilized to minimize environmental impacts during construction. The Construction Impact Control Program, described in Section 4.5, is divided into three categories: Construction Control, Environmental Monitoring and 8
Restoration. As indicated in Section 4.5, a detailed description of the elements of the Construction Impact Control Program will be submitted to EFSEC for its review and approval prior to commencement of Site construction activities.

As previously mentioned, the site preparation and construction monitoring effort will determine the distribution of important species within the Site and Associated Areas and monitor the abundance of these 4
important species or areas of special concern (as indicated

from preapplication studies): bald eagles, long-billed 4
curlews, and the old Hanford townsite. As shown in Figure 6
6.1-4a, this monitoring effort will begin sufficiently in advance of the start of construction activities to provide the preconstruction data base necessary for assessing the extent of construction impacts. Studies will continue until construction effects have subsided or the extent of impact has been satisfactorily appraised. The following
describes the methodologies for each facet of the 4
monitoring program.

Important Plant Species. The listing status of persistant sepal yellow cress, *Rorippa calycina*, var. *Columbiae*, will

CHAPTER 8.0

ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

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Annual Sales and Use Tax Revenues (in 1980 dollars) 7

Recipient	Total Rev. 1983-1992	Average Annual Revenues	Example Yr. 1987	
State	93,960,000	10,440,000	17,210,000	
Benton County	10,440,000	1,160,000	1,912,000	8
Benton-Franklin Transit District	6,264,000	696,000	1,147,000	
Total	110,664,000	12,296,000	20,269,000	

During operation, the sales and use tax is particularly important because of the cost of nuclear fuel. 4
It is estimated, for example, that the costs of the initial cores of the two units will be $292.9 million in 1980 dollars. Purchase of these cores could provide $13,180,000 in revenues to the State; $1,464,000 to Benton County and $878,000 to the Benton-Franklin Transit Authority (in 1980 dollars).

The following revenues would be generated if annual fuel costs were $120.4 million in 1980 dollars:

Entity	Annual Revenues due to Nuclear Fuel Costs Only (in 1980 $)	
		7
State	$5,418,000	
Benton County	602,000	
Benton-Franklin Transit District	361,000	
Total	$6,381,000	

In addition to these fuel costs, the tax on local purchases will produce revenues each year during the 5
operation phase. It is estimated that approximately $5,000,000 (in 1980 dollars) in local purchases of 6
materials and services will be made each year resulting in increased annual revenues for both Benton 5
County and the Transit District.

Finally, to supplement the above revenues, local governments could enact additional sales or property transfer taxes under Sub Chapter 49 RCW. Also, an 8
additional 0.25 percent state property transfer tax has been enacted by the law for capital facility development.

3. Business and occupational taxes are collected by the State during construction. On 2.9 billion dollars of 7

tax base, taxes would be over $12,500,000 (in 1980 dollars).

4. Business taxes imposed by local communities will generate revenues from the Project. Purchases of local materials, supplies and engineering services, for example, will result in increased business activity during both construction and operation. 4

5. Other revenues will accrue to the local taxing jurisdictions and the State through the business activity generated by expenditures of persons employed at the Project. The relatively high incomes of such employees will mean that they will stimulate more business activity than the average worker and that they will pay more than average taxes. Estimated annual income per worker at S/HNP during construction is $37,289 (1980 dollars). Estimated annual salary per employee during the operations phase is $23,600 (1980 dollars). In 1979, the average annual wages in the Tri-Cities SMSA were $15,962. 7 The total annual operations payroll is shown in Table 8.3-20.

8.3.5.2 Projected Conditions Under Alternative Scenarios

Under Scenarios 2 and 3, if 1981 levies were in effect, the Project would generate the following estimated revenues during construction: 4

	Estimated Revenues During Construction (in 1980 dollars)
State	$178 million
Benton County	$100 million
Benton-Franklin Transit District	$ 7 million
	$285 million

7

In 1980 dollars, during S/HNP operation Benton County and other local jurisdictions would annually receive $11 million in property taxes and over $600,000 in sales tax. The Benton-Franklin Transit District would receive $370,000 per year from sales taxes.

The magnitude of these additional revenues over those that would be collected under Scenario 1 would allow Benton County to consider such options as significantly improving services, disbursing funds to local communities and/or lowering tax levies. 4

Under the baseline scenarios, neither these revenues nor these options would exist. 4

Revenues generated by S/HNP would be separate and discrete from those generated by WPPSS activities. Operation of WNP-2 and continued construction of WNP-1 will produce 8 revenues for use by local governments.

8.3.6 POPULATION

8.3.6.1 Existing and Developing Conditions

Table 8.3-4 presents population changes for the area over the period 1940 to 1980. As these data indicate, the SMSA has had significant and sustained growth in recent decades with an increase of 54.8 percent in the 1970-80 period.

With regard to age structure, the population of the SMSA is composed of a disproportionately large number of younger persons as projected for 1982 (Ref 4):

Age Category	1982 (Ref 7) N	%	
0-19	50,120	33.7	
20-34	41,860	28.1	
35-44	17,140	11.5	4
45-64	28,970	19.5	
65+	10,810	7.2	
Total	148,900	100.0%	

In terms of projections of future population growth, Yandon (Ref 6) has pointed out that population projections for the Tri-Cities have been notoriously inaccurate to the extent that some projections have been out of date even before they were published. Thus, in evaluating projections, the impact of external decisions must be fully recognized.

The 1982-1990 population of the Tri-Cities will be influenced by the level of construction activity on the Hanford Reservation. Table 8.3-5 presents projected nuclear related construction workforce by year for the Project as well as WNP 1, 2, and 4. As these data indicate, in no case will the workforce between 1982-1990 exceed the 1981 workforce. These data demonstrate a declining construction workforce in the area related to nuclear construction even with S/HNP. This situation may lead to either absolute population losses or declines in the expected rate of growth.

As Schau (Ref 7) has shown, the bulk of population growth
in the Tri-Cities area during the latter 1970's was due to 4
high rates of in-migration. Much of this in-migration was
associated with increased USDOE and Supply System
employment in the area. From 1975-1980, employment by
USDOE and its contractors increased from 9,800 to 12,100.
From 1975-1980, Supply System average annual employment 5
increased from 1,585 to 6,549. During the latter half of
the decade, these two agencies accounted for 35 percent of
all average annual non-agricultural jobs added to the
economy during 1975-1980. The combined effect of primary
and secondary jobs created by these two agencies was over
63 percent of new jobs created in the Tri-Cities area.

The State of Washington population projections for the Tri- 4
Cities SMSA over the next two decades are reflective of
dramatic population increases in the 1970's and project
large increases continuing through the 1982-1992 period.
These projections overstate the potential for population
growth for four reasons: (1) a decline of Supply System
construction employment is underway, (2) there is a high 7
degree of uncertainty relating to the future level of USDOE
funding, projected growth rates range from being slightly
negative to 1 percent per year, (3) even if WNP-4 and S/HNP 4
are constructed the workforce would not exceed 1981 levels
and (4) no other new large construction projects are 7
definite for the area.

On the basis of this line of reasoning, it is assumed that
actual population growth rates during 1982-1993 will
reflect the population growth rates that would have applied 4
during 1970-1981 had the Supply System not existed and DOE
employment remained constant at its 1970 level (Kenneth W.
Bracken, Director-Facilities and Site Services Division, 6
DOE, personal communictions, December 18, 1981; James E230.02
Skubic, Economist, Social Impact Research, Inc.,
December 20, 1981). It is assumed that the intrinsic
growth rate for population is approximately 1 percent per 4
year, or similar to the national growth rate projections
(James Skubic, Economist, Social Impact Research, Inc., 6
December, 1981). However, these intrinsic growth rates E230.02
will not compensate for the fact that population will be
lost as nuclear construction is completed and workers and
families migrate to other sites. Therefore, population 4
under every scenario is expected to decline at some point
during 1981-1993.

services, (b) security of persons and property, and (c) transportation.

As is true of many areas, particularly those which have experienced the added demands of rapid population and economic expansion, governments in the Tri-Cities area have experienced increased expenditure demands and restricted revenues in recent years. These pressures have resulted in proposals for increased local tax rates to provide additional revenues (Refs 12-1, 12-2). Local voters, however, have been hesitant to approve additional or increased taxation, forcing a reduction in some program areas and a general emphasis on fiscal austerity - a trend which is likely to continue into the near-term future. Municipal revenues in 1981 are estimated to have declined in Richland, Kennewick, and Pasco from 1980. Among the consequences of budget restrictions have been program reductions and employee cut-backs. Additional cut-backs may be expected. For example, the city of Richland has projected a decline in manpower in the fire and emergency services department from 39 to 35 persons as a result of anticipated 1982 budget levels.

8.3.9.2 Projected Fiscal Conditions Under Alternative Scenarios 4

Scenarios 1 and 4 show that there would be outmigration from the study area as the employment and income from the construction sector declines (Table 8.3-6). This would lead to declines in revenues to local communities. The additions of employment and income due to S/HNP, as shown in Scenarios 2 and 3, would significantly increase local revenues over what would be the case under Scenario 1 at similar points in time without these economic variables. Additional revenues to the State and local areas would come from such sources as property taxes, sales taxes, and B&O taxes, etc.

As indicated in Section 8.3.5, construction and operation of S/HNP would generate significant tax revenues in Benton County, if tax rates are not lowered. It is estimated, for example, that Benton County could potentially receive $150 million in revenues from the facility during the construction period alone for use by the County and for disbursement to local jurisdictions. Additional revenues of $30 million would potentially be available during each 5
year of operation, if tax rates remain at 1981 levels.

These revenues would have a sustained and significantly 4
positive impact on the fiscal condition of Benton County

and, depending upon the manner in which the revenues are disbursed, upon communities within Benton County.

It has been suggested by some (Ref 13) that these property 4
tax revenues collected by Benton County should be shared
proportionately with cities, school districts and other
jurisdictions where the bulk of the S/HNP work force will
reside. Potential inequities in revenues and costs could 7
occur if tax revenues generated by the Project in some
jurisdictions were insufficient to pay for government 6
services necessitated by the Project in those same E231.10
jurisdictions. Based on past trends of the WPPSS labor
force, the areas most likely to be affected would include
Richland, West Richland, Kennewick and Benton City. Under
the existing tax system those cities would receive property-
tax revenues at the discretion of Benton County
Commissioners. Neither Franklin County nor the City of 4
Pasco (also within the immediate impact area) would receive
any property-tax revenues emanating from the Project under
the existing tax system.

Redistribution of revenues is achievable through interlocal
cooperation agreement RCW 39.34. Such redistribution could
serve as a means of mitigating negative impacts during 8
construction and equalizing revenue distribution even where
there were no demonstrated negative impacts.

Under the baseline scenarios none of these revenues would
be available to improve the fiscal condition of Benton 4
County and its local jurisdiction.

8.3.10 TRANSPORTATION

This section describes the anticipated transportation
impacts of the S/HNP. Additional information may be 6
obtained from the Questions and Responses on pages E-52
through E-64.

The transportation related analyses and conclusions
contained in this section were based upon the assumption
that access to the S/HNP will be provided by a new access
road connecting the southwest corner of the Project Site to 7
SR 240 (Alternate South Access Road). This access

WSDOT:

I-82 and I-182 between I-82 and Highway 395 north of Pasco (completed by 1986)

City of Richland

Widening of Horn Rapids Road between Stevens Drive and Highway 240 (by 1987)

Improvement of Grosscup Road south of Highway 240 (1987)

Construction of Loop Road between Horn Rapids Road and Highway 240 (1984)

Benton County

Improvement of Twin Bridges (1984)

Improvement of Grosscup Road north from Twin Bridges (to meet the City of Richland's project) (1984)

A start on engineering for the Horn Rapids Bypass (1984) 6

In addition, Franklin County has programmed several road improvements to provide and enhance connections to the new I-182.

I-182 should be completed between I-82 and Highway 395 by 1986, with major portions completed by 1984. The Yakima River Bridge is now under construction. 1984 should see early opening of connections between Bypass Highway and Highway 12, and between George Washington Way and the new Columbia River Bridge.

A significant project not assumd to be constructed is the proposed North Richland Toll Bridge. The feasibility of this Columbia River crossing, at Horn Rapids Road, is related to bond interest rates. Although WSDOT is moving towards implementation, current high rates cast doubt on near-term construction, so it has not been included as a project within the construction impact life of the S/HNP.

Also, and not to be overlooked, is future bus service now being planned by Ben Franklin Transit (the PTBA), and forthcoming ridesharing promotion activities by WSDOT that will be targeted on employment concentrations off of the Hanford Reservation.

8.3.10.4 Impacts

8.3.10.4.1 Construction Impacts

A considerable amount of study has been undertaken in earlier years covering travel patterns and impacts distribution of WPPSS construction employees. The results of these studies, presented in terms of percent of the construction force traveling to cities and parts of the counties, provided the basis for estimating a pattern of trips applicable to S/HNP construction workers. The percentage trip distribution for WPPSS was related to population in each of the cities and parts of the counties as well as to the estimated travel time between the WPPSS construction sites and these residential locations. The estimated travel time between the S/HNP construction site and the same destinations was then used to calculate the S/HNP travel pattern. The results showed that the principal differences between the two travel patterns, considering the influence of future I-182, was a 2 percent decrease in the number of worker-commuter destinations in Richland and Kennewick and a 2 percent increase for Benton City area. Figure 8.3-5 (Golladay and Spink Engineering and Surveying, Inc., 1978) shows the resulting trip distribution pattern for the S/HNP Site. Generally, it is expected that the construction workers will travel to and from the S/HNP Site using the access road to Highway 240 and/or Route 10, and then utilize major thoroughfares and local access roads in the Tri-Cities area in a manner similar to that currently practiced. 6

The peak home-to-work travel volumes (to which the percentages can be applied) were calculated for 1988 when construction employment would be at its highest and using estimated conditions that home-to-work travel would occur every 1.5 hours and at an average vehicle occupancy of about 1.6 persons per vehicle. The approximately 4,500 employees forecast for 1988 will then generate about 1,900 outbound evening peak hour vehicle trips.

Specific waste product transportation routes will be determined after the specific amounts of waste product and waste disposal methods and locations are known. As indicated in Section 4.5.4.1, the Applicant will prepare and submit a municipal waste disposal plan as part of the Construction Impact Control Program for EFSEC's review and approval prior to commencement of Site construction activities. 8

8.3.10.4.1.1 Peak Hour Conditions

Estimates of the impacts of peak hour S/HNP traffic were developed by converting the forecasted 1988 baseline daily traffic volumes to peak-hour traffic volumes at key intersections. Peak-hour S/HNP traffic was then overlayed and impacts assessed. Impacts were calculated in terms of the ratio between traffic volume and street capacity (V/C ratio).

Using Figure 8.3-6, it is possible to trace the evolution of peak hour traffic conditions at these critical locations from 1981 through 1988 with and without the project. Two peak hours, 3:00 to 4:00 p.m. and 4:00 to 5:00 p.m., are shown since the heavy commuter traffic in the region requires more than the normal one-hour peak that is found in most other areas. The actual time that each hour starts may vary throughout the region, but the first and second peak hours are identified as the 3:00 and 4:00 p.m. peak hours for convenience.

It is the general consensus of previous studies (Refs 14, 27, 28) that the completion of I-182 will provide sufficient additional capacity to relieve existng congestion at the Causeway. At the present time, the Causeway with two lanes in each direction must serve virtually all Pasco and Kennewick traffic. The completion of I-182 6 will provide two interchanges and three additional lanes in each direction for a traffic volume with only moderate predicted growth by 1988.

Figure 8.3-6 identifies projected V/C ratios at key intersections for both 1981 and 1988 baseline conditions, and shows an improvement in traffic conditions as traffic volumes decrease. The decrease is greatest in the first peak hour, and concentrated on Stevens Drive, which leads directly to the WPPSS construction area. The ratios in this column reflect not only the deduction of WPPSS trips, but also an infilling of the gap left by WPPSS traffic by traffic from adjacent hours. The addition of traffic from the S/HNP leads to more severe congestion than existing conditions because of this traffic infilling effect. Logical operations planning would schedule project traffic to replace that of WPPSS in the traffic system so that the impacts are concentrated in the first peak hour. The values shown, well in excess of 1.00, reflect the inability of existing streets and roads to absorb these peak loads.

Mitigating measures are discussed specifically in a later section. However, the fourth column of Figure 8.3-6 shows the result and effectiveness of the suggested measures in relieving the predicted congested conditions with the project.

As stated earlier, the impact of the project (and the development of mitigating measures) is based on comparison of 1988 baseline conditions with the direct traffic impacts generated by construction workers at S/HNP. Figure 8.3-3 showed that, in addition, traffic volumes would be generated by secondary employment and population supporting S/HNP. The V/C ratios for 1988 have been estimated, however, to illustrate what forecasted conditions would be with total traffic on the system, both primary and secondary components.

8.3.10.4.2 Operations Impacts

Operations at the S/HNP Site will involve a relatively small number of persons, and will result in an insignificant number of vehicular trips. Therefore, the operation of the S/HNP Site will result in no significant transportation impacts.

8.3.10.4.3 Impacts on Other Modes of Transportation 6

The construction and operation of S/HNP will generate substantial revenues for the Benton-Franklin Transit Authority. For example, S/HNP may generate as much as $8 million for the Transit Authority during the construction period 1983-1992. During operation, revenues of over $100,000 would be generated each year.

Also, substantial revenues will accrue to the Road District in Benton County through property taxes paid on the facility. These funds could be utilized to improve roads in the County. Under the baseline scenarios, these property tax revenues would not be available to either the Benton-Franklin Transit Authority or the Benton County Road District.

8.3.10.5 Mitigating Measures

A number of logical and appropriate mitigating measures have been evaluated to minimize the construction worker traffic impacts of S/HNP. Design and implementation decisions about roadway improvements require the joint efforts 8 of the Applicant, WSDOT, DOE, EFSEC and local agencies and these efforts are currently being pursued. 8

Based on the results of the peak hour capacity analyses summarized in Figure 8.3-6, the following mitigating measures are being considered:

1. Staggering construction shift times so that ingress and egress travel is spread out. This measure would be most appropriate during the years of peak construction work force, and could be relaxed for times of reduced onsite construction work force. 6

2. Implement one of several alternative strategies involving new access road construction, along with upgrading of existing highways and key intersections. These alternatives are similar in nature, but involve two different access corridors connecting the S/HNP Site to Highway 240. These alternatives are:

Alternative A

Construct a new Site access road for construction worker traffic between the southwest corner of the Site and Highway 240 (the Alternate South Access 7
Road shown in Figure 8.3-7). This roadway would consist of a two-lane reversible operation facility during the work day. The road would operate as two lanes for single direction travel only during the morning and afternoon peak periods: one-way northbound ingress between 6:00 and 8:30 a.m.; and one-way southbound egress between 3:00 and 5:30 p.m. At all other times, this access road would operate as a two-way facility, with one lane in each direction. This improvement includes two 14-foot wide travel lanes with 8-foot shoulders, and appropriate pavement markings, signing, and control flagmen at each end to assure safe and efficient operation (a 6
temporary traffic signal may be required at the intersection with Highway 240). This improvement would include developing the intersection of the Site access road and Highway 240 to provide dual left-turn lanes from the access road for the afternoon peak egress traffic flow. It would also require the development of matching dual right-turn lanes from Highway 240 for the morning peak ingress traffic flow.

Construct a new Site access roadway for non-construction traffic connecting the east side of 7 the S/HNP Site to Route 10 (the North Access Road shown in Figure 8.3-7). This roadway would operate at all times as a two-lane facility, with one lane in each direction. This improvement includes two 14-foot wide travel lanes with 8-foot shoulders, and appropriate pavement markings and signing to assure safe and efficient operations. 7

Widen Highway 240 between the intersection with the new Site access roadway and Bypass Highway to provide two lanes for regular travel, plus two shoulder lanes for high occupancy vehicle (HOV) use during the morning and afternoon peak traffic periods on work days. This improvement is shown on Figure 8.3-7. The shoulder HOV lanes would be 6

8.5 SUMMARY OF SOCIAL AND ECONOMIC BENEFITS AND COSTS

8.5.1 BENEFITS

The primary benefit of the Project will be the employment, income and population effects on the socioeconomic infrastructure of the local area. Each of the four scenarios projects out-migration of construction and secondary workers over the period 1983-1992 resulting in absolute population losses and/or declines in the rate of growth. Construction of the Project, however, diminishes the out-migration for the area and thus helps support the socioeconomic infrastructure of the area. This support may provide a useful time period for the Tri-Cities to diversify its economic base.

One example of the S/HNP effects on the socioeconomic infrastructure can be drawn from the difference between the projected conditions of local schools without, e.g. Scenario 4, and with, e.g. Scenario 3, the Project.

Scenario 4 (baseline) - Schools would experience declines in enrollment of over 4,000 during the 1982-1986 period. This loss of students would mean reduced funding from the State and could result in reductions in the teaching and administrative staff. Special levies to support non-basic educational activities would be needed. 4

Scenario 3 (Construction of S/HNP) - Declines in enrollment would occur but would be less than in Scenario 4 due to the population effects of the S/HNP construction and secondary workers in the area over the 1983-1988 period. This maintenance of enrollment would provide for continuation of State funding and reduce the need for special levies and staff reductions. Finally, the major addition of the S/HNP to the tax base of the Richland School District would virtually eliminate the District's special levy for residents.

While projected school conditions are one example of the manner in which S/HNP will support the socioeconomic infrastructure of the Tri-Cities, other illustrations could be drawn from such dimensions of the community as housing, health care, fiscal condition and the impact on local businesses. In each of these areas, the S/HNP effects on the infrastructure would be of major benefit as compared to the declining economy and stagnant population depicted by the baseline scenarios.

In addition to supporting of the socioeconomic infrastructure the Project will provide:

1. Adequate Generation

   The Project will contribute to ensuring sufficient generating capacity for the region and decrease the probability of an inability to meet the load 4 in the future. The potential socioeconomic costs of power shortages and curtailments have been shown to be significant in the State of Washington (Ref 1).

2. Tax Benefits

   The Project's payment of direct taxes will have a 7 significant positive impact upon Benton County as well as the State. Based on 1981 tax rates, it is estimated the Project would generate the following revenues during construction over and above those revenues generated under Scenarios 1 and 4 at the 4 same points in time.

	Estimated Revenues During Construction (1980 dollars)	
State	\$ 187 million	
Benton County	\$ 101 million	8
Benton-Franklin Transit District	\$ 8 million	
	\$ 296 million	

   Under 1981 tax rates, during operation, the S/HNP would annually provide Benton County with over \$11 million (in 1980 dollars) in property taxes and in sales tax. 7 The Benton-Franklin Transit District would receive nearly \$370,000 per year (in 1980 dollars).

   The significant increase in the tax base would allow Benton County to consider such options as (a) significantly improving services, (b) disbursing funds to local communities, and (c) 4 lowering tax rates by as much as 70 percent.

   Increased revenues for local jurisdiction will allow them to maintain and improve services and potentially reduce the property tax levy in the 7 County.

8.5.2 COSTS 7

8.5.2.1 Traffic Costs

Local roads have been overburdened by the rapid growth experienced in the Tri-Cities area, resulting in traffic congestion and high accident rates in several places. In 1981, for example, it is estimated that approximately 6,100 commuter vehicles were associated with the construction force of WNP 1, 2 and 4 on the average for the year.

The difference between commuter vehicle traffic on the Reservation with S/HNP as opposed to without is projected to average approximately 2,100 additional vehicles per day between 1984-1990.

The greatest amount of commuter traffic will occur under 4
Scenario 2 when 4,960 total vehicles are projected. Even this peak, however, will only be 81 percent of the estimated average of 6,118 construction union vehicles associated with WNP 1, 2 and 4 in 1981.

Under Scenario 3, in no year would the number of commuter vehicles exceed 45 percent of the estimated commuter vehicles in 1981.

Although the construction scenarios indicate commuter traffic well below that which existed in 1981, several improvements are being considered by Puget. These 6
improvements are described in detail in Section 8.3.10.5.

It should be noted that construction and operation of S/HNP will generate substantial revenues for the Benton-Franklin Transit Authority. During construction, for example, S/HNP 4
may generate as much as $8 million for the Transit Authority between 1983-1992 over the revenues received under Scenarios 1 and 4 for the same time period. During operation nearly $400,000 more would be available annually 5
under Scenarios 2 and 3 versus Scenarios 1 and 4.

Finally, substantial revenues will accrue to the Road District in Benton County through property taxes paid on the facility. These funds could be utilized to improve 4
roads in the county.

Under the baseline scenarios these revenues would not be available to either the Benton-Franklin Transit Authority or the Benton County Road District.

8.5.2.2 Potential Fiscal Impacts 8

The uncertainties which characterize the socioeconomic future of the Tri-Cities make it particularly difficult to project the fiscal conditions which will exist during the construction and operation of the S/HNP. In general, however, five points must be considered in evaluating potential fiscal costs.

1. The case of S/HNP differs from other facilities on the Hanford Reservation because it will be privately owned. Therefore, in addition to the indirect taxes it would generate through payment of wages and salaries to project-related employees, S/HNP would also pay direct property taxes, beginning soon after the start of construction. The indirect taxes are distributed to the local jurisdictions as the workers take their wages and salaries from their place of work to their place of residence. The cost/benefit impacts of these effects will depend upon the revenues produced and the costs of providing services in each jurisdiction.

2. As in the case of any taxable industry which locates in any community in Washington State, the 7 direct taxes paid on behalf of S/HNP will accrue to the taxing jurisdiction in which the plant is located. This means that direct taxes are not distributed proportionately with the population and household effects. Therefore, some jurisdictions may reap large tax windfalls, while other jurisdictions may provide public services to the project-related population without, at the same time, having access to the direct tax revenues. This could be viewed by local jurisdictions as an inequitable distribution of costs and benefits even if they might not experience actual negative fiscal impacts because they collect indirect taxes.

3. In order to identify fiscal impacts as they emerge, the Applicants will develop and implement an approved monitoring program in cooperation with appropriate local and State agencies.

4. Apart from any individual jurisdictions, it is clear that the total tax revenues which will be generated by the S/HNP will far exceed the

little additional firm capacity and their primary benefit will generally be as an energy producer (Ref 20).

The extent to which further small hydro projects can be developed is being investigated by the Applicants. At present, the possibility of adding capacity beyond that currently planned is uncertain due to environmental and economic constraints. The costs of small hydro projects is 7
extremely site specific (Refs 6 and 20). Capital costs of constructing existing projects were extremley low, in the range of \$100 to \$1000/kw (1980 \$) (Refs 6 and 20). However, these projects represent the least costly sites available for hydroelectric generation. Cost of planned and prospective projects are higher, generally in the range of \$1000 to \$3000/kw (1980 \$) (Refs 6, 12, 20 and 21). 8
Costs of projects in addition to these can be expected to be the same or even higher. Nevertheless, there undoubtedly exists projects which are cost-competitive with other 7
forms of new generation.

Conventionally, the environmental impacts of hydroelectric projects also tend to be site-specific and project-specific. Construction of hydro projects can, for the period of construction, have a short term effect on water quality and turbidity and would involve the normal noise and dust impacts associated with any type of construction. Operation of a hydro project can pose its own set of unique impacts. The projects may present a barrier to anadromous fish migration and passage of fish through the project turbines, spillways and intakes result in some mortality. (Refs. 6, 12, 20 and 22). These impacts can be mitigated by providing fish ladders, screening intakes, increasing minimum flows, and increasing spill rates (which coincidentally reduces electricity production). (Refs. 6. 12 and 22). However, spilling large amounts of water also may create supersaturated nitrogen in the tailwater which can cause fish mortality. (Refs. 6, 12, 20 and 22). Major 8
reservoirs can cause altered thermal regimes which, depending upon the fish species present, may be either beneficial or detrimental. Substrate changes may occur due to increased siltation behind a dam and increased scouring below a dam. (Refs. 6, 20 and 22). Finally, a hydroelectric development alters the nature of the river, its water levels, and the use of the inundated lands in the case of a major reservoir project. (Refs. 6 and 12). A hydro project may increase the recreational, navigational, flood control, water supply and irrigation potential of the river, it also can impact fish spawning grounds, rearing areas, and wildlife habitats. (Refs. 6, 12, 20 and 22). Operation of a hydro project as a peaking facility can lead to rapid changes in upstream and downstream water levels, causing stranding of fish, uncovering of sandbars, exposure

of redds, and increase bank erosion and siltation. (Refs. 11, 20 and 22). However, it may also be noted that hydroelectric facilities do not emit any air pollutants and do not have the potential for air and water quality
problems associated with most thermal facilities. 8

The Applicants are actively pursuing the addition of hydro facilities at environmentally and economically sound sites and are planning to augment their present hydroelectric capacity. The extent to which increases in hydroelectric capacity can be made beyond that currently planned is uncertain due to economic and environmental constraints. However, even if such increases are possible, it is likely that any new facilities would be small hydro projects whose primary effect would be to displace fuel use and not to obviate the need for additional baseload capacity such as S/HNP. As a result of these considerations, the Applicants do not believe that it is prudent to foreclose the option of constructing and operating S/HNP.

9.2.1.2.5 Solar Energy

There are currently two means by which radiation emitted by 7
the sun can be converted directly into electricity. The first utilizes the warming effects of the sun's rays to vaporize a fluid, typically water, to drive a turbine. This process is termed "solar thermal." The second process directly converts solar radiation into electricity through use of solar photovoltaic chips.

The potential for employing either of these techniques in the Pacific Northwest is relatively limited compared to other parts of the country due to its northern latitude and the large proportion of overcast days in much of the region. The most promising locations in the region for utilizing solar energy to generate electricity are in eastern Washington and Oregon and southern Idaho, especially in southeastern Oregon where the average solar insolation is approximately 75% of the intensity in the southwestern portion of the United States (Refs 3, 6, 12, 23 and 24). This area of Oregon receives average solar energy equivalent to 4 to 6 kwh/m^2 per day. (Refs 12 and 23.) This is the maximum theoretical energy which can be generated at this location. However, the practical energy

10.9 TRANSMISSION FACILITIES

The transmission system for the S/HNP is described in Section 3.9. The only new transmission right-of-way (ROW) would intertie with BPA's Ashe-Hanford ROW to the east of the S/HNP Site. This section discusses the transmission alternatives considered for the S/HNP. Table 10.9-1 provides a summary comparison.

10.9.1 GENERAL DESCRIPTION OF THE PROPOSED AND ALTERNATIVE ROUTES

The basic considerations for selecting the alternative route for the 500-kV lines were:

a. Transmission Line Costs
b. Land Use Considerations
c. Environmental and Cultural Resource Impacts. 4

10.9.1.1 Proposed Route

The proposed route is a 600 ft wide ROW originating at the Plant Substation, and proceeding to the northeast for approximately 3.2 miles to BPA's Ashe-Hanford ROW (Figure 10.9-1). This route is 600 ft wide and contains four single circuit 500-kV lines.

10.9.1.2 Alternative Route

The alternative route consists of two ROWs originating at the Plant Substation. One ROW proceeds to the east for a distance of 3.7 miles, and the other to the north for 4.6 miles (Figure 10.9-2). Each ROW is 200 ft wide and contains two single circuit 500-kV lines. This alternative route could potentially eliminate the need for 5.3 miles of 6
existing transmission line. It is unlikely that the 5.3 miles would be removed, but would probably be maintained in place for future system use. However, if the 5.3 miles were removed, this would result in approximatley 28 to 30 steel lattice towers being removed. Removal of these 8
towers would temporarily impact 30 to 40 acres of vegetation. These impacted areas would require several years to recover. In addition, removel of these towers would result in the loss of an existing raptor site.

10.9.2 MONETIZED COSTS

4

The proposed route requires approximately 12.8 miles of single circuit 500-kV line, and the alternative route requires 16.6 miles, or 30% more miles of line. Because the land to be crossed is similar for both routes, construction costs per mile are nearly identical. The total cost for the alternative route is 30% more than for the proposed route.

10.9.3 ENVIRONMENTAL COSTS

10.9.3.1 Land Use Considerations

The proposed route requires 3.2 miles of access road, while the alternative requires 8.3 miles. Both routes cross similar terrain and are located entirely on the Hanford Reservation.

10.9.3.2 Recreation

Neither route impacts recreational facilities.

10.9.3.3 Historical and Archeological Sites

4

Neither route impacts any identified historical or archeological sites.

10.9.3.4 Wildlife and Vegetation

Neither route adversely affects any wildlife, except during the construction period, when some animals will be displaced for a short time.

Clearing sagebrush from the access roads and tower sites may temporarily disturb songbirds, birds of prey, and upland birds within the vicinity.

10.9.3.5 Water

No streams or water bodies are crossed by either route.

11.4 COSTS SUMMARY

11.4.1 S/HNP COSTS

The total estimated capital cost of S/HNP at commercial operation is $7.8 billion (Section 8.2.1). The annual costs of operation, expressed as bus bar costs levelized over 30 years, are 141 mills per kilowatt-hour (Section 8.2.2).

11.4.2 ENVIRONMENTAL COSTS

The costs presented in this summary are the environmental costs of S/HNP. They include natural surface water, groundwater, air, and land. The specific costs (Table 11.4-1) are based on Chapters 4, 5, 8, and 10. 4

11.4.2.1 Natural Surface Water

The environmental effects of the S/HNP on the quality of the Columbia River water and aquatic biota are discussed in Sections 5.1 and 5.3.

The Project average water requirement will be obtained from the Columbia River from a submerged, mid-river intake system near River Mile 361.5 (Section 3.4). This untreated water will be pumped to the Plant Site for use in the Cooling Tower Makeup and Blowdown System, the process water makeup system, domestic use, and S/HNP irrigation water (Section 3.3). The potential for impingement or entrainment of fish will be insignificant. Only those small fish unable to escape the maximum intake velocity of 0.5 fps at the 1/8 in. intake screen openings will be 8
impinged or lost, but this possibility is greatly reduced by the location offshore and depth of the intake structure. Phytoplankton, zooplankton, fish eggs and larvae drawn into the intake would be lost but at most this would amount to 0.26 percent of the total population of these organisms (Section 5.1.3).

A single port discharge system will be installed mid-river 4
to release S/HNP discharge at a location in the river where it will mix quickly with the ambient river water. This rapid dilution results in a greatly reduced impact on surface water temperature. The discharge design (Sections 3.4 and 5.1) that was selected will ensure that

the thermal discharge plume meets Washington State water quality criteria.

The discharge structure will be near River Mile 361.5. The maximum expected S/HNP discharge of about 5910 gpm will 4
have a maximum temperature of 84.5°F. During winter conditions for low and mean river flows, the thermal plume width is estimated to be about 50 ft in the vicinity of the 0.5°F isotherm. The maximum temperature increase in the Columbia River 300 ft downstream of the discharge area will be about 0.09°F for the minimum regulated low flow 5
conditions. The impact of excess heat on water quality at low flow conditions in terms of water volumes affected (Section 5.1) is estimated to the 90, 325, and 740 ft^3 for 5, 3, and 2°F temperature rise isotherm differentials above ambient, respectively.

S/HNP discharge will have no effect on the dissolved oxygen concentration of the Columbia River, resulting in no impact on the aquatic biota (Section 5.3).

The design of the S/HNP intake and discharge structures ensures that the S/HNP will have minimal physical or thermal effect upon the aquatic life of the Columbia River. The effect of the plume on nonmigratory fish spawning and rearing will be minimal because temperature increases resulting from the plume are well within the tolerance ranges of these aquatic biota (Sections 5.1 and 10.3).

Migratory fish such as salmon, steelhead, and shad use the 4
Columbia River and its tributaries as a spawning and nursery ground (Section 2.2). The plume will not cause thermal blockage to migration of salmonid fish which migrate in shallow water along the west bank of the river because the plume will be restricted to a narrow band in mid-river and occupies less than one-percent of the river width. No detectable adverse impact on the aquatic biota of the river is expected to result from the thermal effect of the S/HNP discharge (Section 5.1.3).

The S/HNP discharge will contain chemicals and biocides as well as the constituents present in the makeup water (Section 3.6). The maximum total dissolved solids concentration in the S/HNP discharge will be lower than the Washington State Board of Health public water supply criterion (Section 5.3.1).

All radioactive waste will be treated in the radioactive waste treatment systems. The radwaste systems are designed for recycle of liquid radioactive waste. However, the design will allow for the release, in accordance with applicable regulations, of radioactive liquids via the

RESPONSES TO NRC QUESTIONS

Question N200.09 (Terrestrial Ecology, Land Use and Transmission Lines - Question 9)

For the Pebble Springs site, at which river mile would the proposed transmission line cross the John Day River.

Response:

The proposed transmission line would most likely cross the John Day River between River Mile 6 and 7 parallel to an existing 500 kV line. However, final determination as to the location of any river crossing would entail detailed field studies.

Question N200.10 (Terrestrial Ecology, Land Use and
Transmission Lines - Question 10)

Need the following information for the Ryderwood, Cherry Point and Goshen sites:

a. Approximate number of miles of new or upgrading of highways for site access.

b. Same for railroad.

c. Approximate number of miles to cooling water 5
source.

d. The number of river/stream that the transmission lines would cross.

Need this information for Pebble Springs and Centerville sites also.

Response:

For the Ryderwood, Cherry Point, and Goshen sites, the requested information can be found in Table 1 (attached) to the 1977 Supplemental Testimony of A. Dvorak, P. Leech, I. Peltier, and J. Parker for the U.S. Nuclear Regulatory Commission Staff on Alternative Sites. It should be noted
that since this testimony was given, one additional 8
archeological site, 45WH23, was recorded at the Cherry Point Alternatie Site.

Additional information concerning the Pebble Springs and
Centerville sites can be obtained from the Nuclear Power 5
Plant Siting Program Site Selection Study, 1980.