PUGET
POWER

August 20, 1982
PLN-267

Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Puget Sound Power & Light Company
Skagit/Hanford Nuclear Project, Units 1 & 2
Docket Nos. 50-522 and 50-523
Application for Site Certification/Environmental Report
Amendment 6

Gentlemen:

Puget Sound Power & Light Company herewith submits Amendment 6 to its Application for Site Certification/Environmental Report (ASC/ER) for the Skagit/Hanford Nuclear Project.

Amendment 6 addresses the Washington State Energy Facility Site Evaluation Council Application Completeness Review, comments on the Draft Environmental Statement (NUREG-0894) and changes as a result of the NPDES hearing.

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 6 carry the date in the upper right-hand corner.

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

Very truly yours,

Robert V. Myers
Vice President
Generation Resources

cc: Perkins, Coie, Stone, Olsen & Williams
Attn: F. Theodore Thomsen
1900 Washington Building
Seattle, Washington 98101
(206) 682-8770
Attorneys for Applicant

Lowenstein, Newman, Reis & Axelrad
Attn: D. G. Powell
1025 Connecticut Avenue N.W.
Suite 1214
Washington, D.C. 20036
(206) 833-8371
Of Counsel for Applicant

Robert V. Myers to Director of Nuclear Reactor Regulation, August 20, 1982, transmittal of Skagit/Hanford Nuclear Project, Application for Site Certification/Environmental Report Amendment 6.

VERIFICATION

STATE OF WASHINGTON)
)SS.
COUNTY OF KING)

Robert V. Myers, being first duly sworn, on oath deposes and says: That he is Vice President-Generation Resources of PUGET SOUND POWER & LIGHT COMPANY, an applicant herein, and has been authorized by said corporation and by Pacific Power & Light Company, The Washington Water Power Company and Portland General Electric Company, the other applicants herein, to execute the foregoing transmittal and this verification on behalf of all applicants herein; that the foregoing transmittal was prepared under his supervision and direction, and that, to the best of his knowledge and belief, it and the facts contained therein are true and correct.

Robert V. Myers

Robert V. Myers

SUBSCRIBED AND SWORN to before me this 24th day of August 1982.

Carolyn J. Evele

Notary Public in and for
the State of Washington

File the Nuclear Regulatory Commission (NRC) letter and the instruction sheets following the NRC tab.

File the Energy Facility Site Evaluation Council (EFSEC) letter and attachments following the EFSEC tab.

The following information and check list are furnished as a guide for the insertion of new sheets for Amendment 6 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 and the amendment number in the lower right-hand corner.

New sheets should be inserted as listed below:

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
EFSEC TAB	
EFSEC-5/EFSEC-6 through EFSEC-15/EFSEC-16	EFSEC-5/EFSEC-6 through EFSEC-19/EFSEC-20
CHAPTER 2	
2-i/2-ii through 2-xiii/blank	2-i/2-ii through 2-xiii/2-xiv
2.1-1/2.1-2	2.1-1/2.1-2
-------	2.1-2a/blank
2.1-9/2.1-9a	2.1-9/2.1-9a
2.2-17/2.2-18 through 2.2-27/2.2-28	2.2-17/2.2-18 through 2.2-27/2.2-28
2.2.31/2.2-32	2.2-31/2.2-32
-------	2.2-32a/2.2-32b
-------	2.2-32c/blank
2.2-33/2.2-34	2.2-33/2.2-34
2.2-35/2.2-36	2.2-35/2.2-36
2.2-49/2.2-50	2.2-49/2.2-50
-------	2.2-51/blank
Table 2.2-16/ 2.2-17 1 of 2	Table 2.2-16/ 2.2-17 1 of 2
Table 2.2-21/2.2-22	Table 2.2-21/2.2-21a
-------	Table 2.2-21b/2.2-21c
-------	Table 2.2-22/2.2-23
Figure 2.2-16	Figure 2.2-16

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
-------	Figure 2.2-22a
2.4-5/2.4-6	2.4-5/2.4-6
-------	2.4-6a/2.4-6b
2.4-11/2.4-12	2.4-11/2.4-12
-------	2.4-12a/blank
2.4-13/2.4-14	2.4-13/2.4-14
2.4-15/2.4-16	2.4-15/2.4-16
Table 2.4-21/2.4-22	Table 2.4-21/2.4-22
-------	Figure 2.4-7a
-------	Figure 2.4-11a
-------	Figure 2.4-11b
-------	Figure 2.4-11c
2.6-1/2.6-2	2.6-1/2.6-2
2.6-5/2.6-6	2.6-5/2.6-6
2.6-7/2.6-8	2.6-7/2.6-8
2.7-1/2.7-2	2.7-1/2.7-2
-------	2.7-3/blank

CHAPTER 3

3-i/3-ii through	3-i/3-ii through
3-ix/blank	3-ix/3-x
3.3-1/3.3-2	3.3-1/3.3-2
-------	3.3-2a/blank
3.3-3/3.3-4	3.3-3/3.3-4
-------	3.3-5/blank
Table 3.3-1 1 of 2/ 3.3-1 2 of 2	Table 3.3-1 1 of 2/ 3.3-1 2 of 2
-------	Table 3.3-2/blank
Figure 3.3-1	Figure 3.3-1
3.4-3/3.4-4	3.4-3/3.4-4
-------	3.4-4a/blank
Figure 3.4-3	Figure 3.4-3
Figure 3.4-4	Figure 3.4-4
Table 3.5-5/ 3.5-6 1 of 4	Table 3.5-5/ 3.5-6 1 of 4
Table 3.5-6 2 of 4/ 3.5-6 3 of 4	Table 3.5-6 2 of 4/ 3.5-6 3 of 4
Table 3.5-6 4 of 4/ 3.5-7 1 of 4	Table 3.5-6 4 of 4/ 3.5-7 1 of 4
3.6-1/3.6-2	3.6-1/3.6-2
-------	3.6-2a/blank
-------	3.6-4a/blank
3.6-5/3.6-6	3.6-5/3.6-6

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
Table 3.6-5/3.6-6	Table 3.6-5/3.6-6
3.7-1/3.7-2	3.7-1/3.7-2
3.7-3/3.7-4	3.7-3/3.7-4
3.7-5/blank	3.7-5/blank
3.9-1/3.9-2	3.9-1/3.9-2
3.9-3/3.9-4	3.9-3/3.9-4
3.9-5/blank	3.9-5/blank
-------	Figure 3.9-8
-------	Figure 3.9-9

CHAPTER 4

4-i/4-ii	4-i/4-ii
4-iii/4-iv	4-iii/4-iv
4.1-5/4.1-6 through	4.1-5/4.1-6 through
4.1-11/4.1-12	4.1-11/4.1-12
-------	4.1-13/4.1-14 through
-------	4.1-19/4.1-20
-------	Table 4.1-3/4.1-4 1 of 4
-------	Table 4.1-4 2 of 4/ 4.1-4 3 of 4
-------	Table 4.1-4 4 of 4/blank
Figure 4.1-3	Figure 4.1-3
-------	Figure 4.1-5 through
-------	Figure 4.1-9
4.2-3/4.2-4	4.2-3/4.2-4
4.5-1/4.5-2 through	4.5-1/4.5-2 through
4.5-5/4.5-6	4.5-7/blank

CHAPTER 5

5-i/5-ii through	5-i/5-ii through
5-vii/blank	5-vii/5-viii
5.1-3/5.1-4 through	5.1-3/5.1-4 through
5.1-15/5.1-16	5.1-16c/blank
5.1-29/blank	5.1-29/blank
Table 5.1-9/blank	Table 5.1-9/5.1-10
Figure 5.1-1	Figure 5.1-1
5.3-1/5.3-2 through	5.3-1/5.3-2 through
5.3-5/blank	5.3-11/blank
Table 5.3-1/blank	Table 5.3-1/blank
-------	Tab 5.3 (dk blue)

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
-------	Figure 5.3-1 through
-------	Figure 5.3-4
5.4-1/5.4-2	5.4-1/5.4-2
-------	5.4-3/blank
5.5-1/5.5-2	5.5-1/5.5-2
5.6-1/5.6-2	5.6-1/5.6-2
-------	5.6-3/blank
-------	Tab 5.6 (dk blue)
-------	Figure 5.6-1

CHAPTER 6

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
6-v/blank	6-v/blank
6.1-25/6.1-26	6.1-25/6.1-26
6.1-27/6.1-28	6.1-27/6.1-28
Figure 6.1-1	Figure 6.1-1
Figure 6.1-2	Figure 6.1-2
-------	Figure 6.1-4a

CHAPTER 8

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
8-i/8-ii through	8-i/8-ii through
8-v/blank	8-v/8-vi
Table 8.2-1/8.2-2	Table 8.2-1/8.2-2
8.3-1/8.3-2 through	8.3-1/8.3-2 through
8.3-11/8.3-12	8.3-11/8.3-12
8.3-15/8.3-16 through	8.3-15/8.3-16 through
8.3-23/8.3-24	8.3-23/8.3-24
8.3-29/8.3-30	8.3-29/8.3-30
8.3-33/8.3-34 through	8.3-33/8.3-34 through
8.3-37/8.3-38	8.3-37/8.3-38
8.3-41/blank	8.3-41/blank
Table 8.3-1/8.3-2	Table 8.3-1/8.3-1a
-------	Table 8.3-1b/8.3-2 Sheet 1 of 2
-------	Table 8.3-2 Sheet 2 of 2/ blank
Table 8.3-3/8.3-4 through	Table 8.3-3/8.3-4 through
Table 8.3-10/8.3-11	Table 8.3-10/8.3-11
Table 8.3-16/8.3-17	Table 8.3-16/8.3-16a
-------	Table 8.3-17/8.3-18 Sheet 1 of 2

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
Table 8.3-18 Sheet 1 of 2/ 8.3-18 Sheet 2 of 2	Table 8.3-18 Sheet 2 of 2/ 8.3-19
Table 8.3-19/8.3-20	Table 8.3-20/blank
-------	Tab 8.3 (dk blue)
-------	Figure 8.3-1 through Figure 8.3-7
8.5-5/8.5-6	8.5-5/8.5-6
8.5-7/blank	-------

CHAPTER 9

9-i/9-ii	9/i-9/ii
9.2-7/9.2-8	9.2-7/9.2-8
-------	9.2-8a/blank

CHAPTER 10

10-iii/10-iv	10-iii/10-iv
10-v/10-vi	10-v/10-vi
Table 10.2-1 1 of 2/ 10.2-1 2 of 2	Table 10.2-1 1 of 2/ 10.2-1 2 of 2
10.5-1/10.5-2	10.5-1/10.5-2
10.9-1/10.9-2	10.9-1/10.9-2
-------	Tab 10.10 (clear)
-------	10.10-1/10.10-2
-------	10.10-3/10.10-4
-------	Tab 10.10 (blue)
-------	Table 10.10-1/10.10-2
-------	Tab 10.10 (dk blue)
-------	Figure 10.10-1 through Figure 10.10-5

APPENDIX B

B.1/B.2	B.1/B.2

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
APPENDIX F	
Figure F-2	Figure F-2
Figure F-3	Figure F-3
APPENDIX J	
Discard entire Appendix J	J-i/blank
APPENDIX K	
------	Tab App. K (clear)
------	K-i/K-ii through K-81/blank
APPENDIX L	
------	Tab App. L (clear)
------	L-i/L-ii through L-17/L-18
QUESTIONS AND RESPONSES	
------	Tab NRC Questions (dk blue)
N-1/N-2	N-1/N-2
N-5/N-6	N-5/N-6
N-13/Figure N210.03	N-13/Figure N210.03
Table N210.03/N-14	Table N210.03/N-14
N-15/N-16 through	N-15/N-16 through
N-23/N-24	N-23/N-24
N-27/N-28	N-27/N-28
N-42/N-43	N-42/N-43
N-48/N-49	N-48/N-49
N-50/Table N240.02	N-50/Table N240.02
N-56/blank	N-56/blank

Discard Old Sheet (Front/Back)	Insert New Sheet (Front/Back)
Figure N250.01	Figure N250.01
N-57/N-58	N-57/N-58
N-59/N-60	N-59/N-60
N-63/N-64	N-63/N-64
------	Tab EFSEC Questions (dk blue)
E-21/E-22 through	E-21/E-22 through
E-37/E-38	E-37/E-38
E-39/Table E230.06 1 of 1	E-39/Table E230.06 1 of 1
E-40/E-41	E-40/E-41
E-42/E-43	E-42/E-43
E-46/Table E231.06A	E-46/Table E231.06A
Table E231.06B/E-47	Table E231.06B/E-47
E-48/E-49	E-48/E-49
E-50/E-51	E-50/E-51
E-65/E-66 through E-69/E-70	E-65/E-66 through E-69/E-70
E-73/E-74 through E-87/blank	E-73/E-74 through E-87/blank
Figure E260.06	Figure E260.06
Attachment E260.07 page 4 of 4/E-89	Attachment E260.07 page 4 of 4/E-89
E-90/E-91	E-90/E-91
E-94/E-95 through E-136/ E-137	E-94/E-95 through E-136/ E-137

PUGET
POWER

August 20, 1982
PL-EFSEC-52

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 6

Dear Mr. Fitch:

Puget Sound Power & Light Company submits herewith Amendment 6 to its Application for Site Certification/Environmental Report (ASC/ER) for the Skagit/Hanford Nuclear Project.

Amendment 6 addresses the URS/TRS Completeness Review, comments on the Draft Environmental Statement (NUREG-0894) and changes as a result of the NPDES hearing.

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 6 carry the date in the upper right-hand corner.

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

Attachment 1 to this letter is a matrix indicating the Applicant's responses to the Completeness Review comments. Attachment 2 is the EFSEC distribution list for the subject amendment.

Very truly yours,

Robert V. Myers
Vice President
Generation Resources

Encl.

SKAGIT/HANFORD NUCLEAR PROJECT
APPLICATION FOR SITE CERTIFICATION/ENVIRONMENTAL REPORT
APPLICANT'S RESPONSES TO URS/TRS
COMPLETENESS REVIEW COMMENTS

SUBJECT/COMMENT	APPLICANT RESPONSE
General Overall Discussion	
Revise EFSEC Cross Reference Index/Matrix.	See revised EFSEC Cross Reference Index/Matrix.
Provide a distribution list of all recipients of the Application.	The ASC/ER distribution list is provided following the EFSEC Cross Reference Index/Matrix.
Additional information provided in the Questions and Responses should be included in the pertinent sections of the Application.	Additional information from the Questions and Responses has been provided in the pertinent sections of the Application. Additions to the Application sections are denoted by a bar in the right-hand margin indicating Amendment 6 and the question number where the information was originally provided.
Address the potential acquisition of WPPSS Nos 4 and 5 in the Alternatives section.	A new section will be added to Chapter 9 in Amendment 7 which will address this subject.
Provide information on other regional forecasts which are more recent than the 1981 PNUCC forecast.	As indicated in the July 16, 1982 letter from Mr. Robert V. Myers of Puget Power to Mr. W. H. Regan of the Nuclear Regulatory Commission, the Need-for-Power section will be revised in Amendment 7 and will address all available forecasts. This amendment is currently planned to be submitted in September 1982.
Discuss insurance and bonding in the Application.	Instead of insurance or bonding, the Applicant has chosen the "other arrangements" alternative provided for in Guideline WAC 463-42-075. The arrangements (mitigation measures) proposed are set forth in Chapters 3, 4 and 5.

SUBJECT/COMMENT	APPLICANT RESPONSE
Discuss who will determine that a significant impact has occurred and who will approve disposition.	Section 4.5.3 has been revised to indicate that the NESCO Site Manager or the Puget Vice President-Generation Resources will determine if a significant impact has occurred and will approve appropriate corrective measures. In addition, as indicated in Section 4.5.3, NRC and EFSEC will be notified when such impacts have taken place. For additional information, see Section 4.5.6.
The Application should contain a statement that it is substantially complete.	See page EFSEC-4 of the Application.
Mitigation/Quality of Information	
Provide additional information on mitigation measures.	Sections 4.1, 4.2 and 4.5 describe mitigation measures to be utilized. 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.
Identify all preapplication studies and criteria for fish designated as important.	Preapplication studies have been identified in the appropriate ASC/ER sections. In addition, a site specific aquatic monitoring program was conducted to confirm the applicability of baseline studies to the intake/discharge location. Criteria for designating a fish species as important have been provided in Section 2.2.2.6.
Site Description and Ownership	
Land use plans and zoning for Benton County should be discussed in Section 2.	See Section 2.1.4.9 and response to Land Use comments.

SUBJECT/COMMENT	APPLICANT RESPONSE
Site Construction Characteristics, Schedules and Methods	
Discuss major construction equipment to be used.	Major construction equipment to be used was discussed in Section 4.1, Appendix J and responses to Questions E260.01, E260.02, E260.03 and E280.02. It should be noted that Sections 4.1.1 and 4.1.2 have been revised to include the information provided in Appendix J, responses to Questions E260.01, E260.02, E260.03 and E280.02 and additional information provided at the NPDES hearings.
Provide additional information on construction procedures and extent of shoreline disturbance.	See new Section 4.1.2.2.
The numbers for manual labor in Figure 4.1-4 do not match those in Table 4.1-2.	Figure 4.1-4 presents information on a six-month interval. Table 4.1-2 presents average information on a one-year interval.
Indicate whether Shoreline Master Plans apply or in what aspect the Corps of Engineers' 404 Permit applies.	No shoreline management plans apply. The Corps of Engineers' 404 Permit will apply to the temporary intake and permanent intake and discharge for the S/HNP.
Indicate what is done with the flushing water used in hydrostatic testing.	See revised Section 4.1.2.
Provide additional information on the construction impact control plans.	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.

SUBJECT/COMMENT	APPLICANT RESPONSE
Provide site specific aquatic data at the intake/discharge site.	As indicated in Sections 2.2.2 and 6.1.1.2.1, aquatic information was based on comprehensive baseline studies on the composition, structure and function of the aquatic ecosystem of the Hanford Reach. In addition, a site specific aquatic monitoring program was conducted to confirm the applicability of these baseline studies to the intake/discharge location. This aquatic monitoring report has been included as Appendix K.
Transmission Systems	
There appears to be an inconsistency between the description of the typical 500 kV tower in Section 3.9.1.1 and Figure 3.9-6.	See revised Section 3.9.1.1.
Provide information on the source of 115 kV construction power and the conversion to 69 kV.	See revised Section 4.1.1.
Provide a description of the terminal modifications required in the Ashe and Hanford Substations for the S/HNP units.	No significant equipment modifications are required in the Ashe and Hanford Substations for the S/HNP.
Provide a figure showing the 69 kV armless tower construction.	See new Figures 3.9-8 and 3.9-9.
The construction schedule in Figure 4.1-3 is now out of date and should show construction and energization of the S/HNP transmission lines.	The construction schedule shown in Figure 4.1-3 is considered to be a typical construction schedule and representative of the types of construction activities and their anticipated schedules. Figure 4.1-3 has been revised to show construction and energization of the S/HNP transmission lines.

SUBJECT/COMMENT	APPLICANT RESPONSE
Provide information on the mitigation measures described in the BPA "General Construction and Maintenance Program Statement" which will be used for the S/HNP.	As indicated in Section 4.5, detailed mitigation measures to be utilized for transmission line construction will be developed as part of the Construction Impact Control Program and submitted to EFSEC for its review and approval prior to construction.
Provide additional information on noise and electrical effects.	See revised Sections 3.9.2.2 and 5.6.
Provide additional information on the restoration plan described in Section 4.5.4.	See revised Section 4.5.4.
Provide additional information on the criteria used for transmission line design and route selection.	Transmission line design criteria is discussed in revised Section 3.9.1.1. Criteria used for transmission line route selection is discussed in Section 10.9.1.
Provide a discussion of the removal of approximately six mile segment of existing 500 kV transmission lines in the comparison of transmission line alternatives.	See revised Section 10.9.1.2. The "six mile" segment of transmission line is not under the authority of the Applicant. Bonneville Power Authority has indicated that it is not known at this time if the "six mile" segment would be removed if this alternative was selected.
<u>Water Supply System</u>	
Clarify number of components in the intake water system.	See revised Section 3.4.2.1.
Provide additional information on the intake design and shoreline modifications.	See revised Section 3.4.2.1 and new Section 4.1.2.2.

SUBJECT/COMMENT	APPLICANT RESPONSE
Heat Dissipation System	
None.	No response required.
Aquatic Discharge System	
Provide a figure of the discharge nozzle.	Appendix J provided a figure of the discharge nozzle. It should be noted that Section 4.1.1 has been revised to include the figure from Appendix J (new Figure 4.1-9).
Water Treatment	
The unit for specific conductance in Table 3.6-6 should be 10^{-6} mho/cm.	See revised Table 3.6-6.
The Applicant should guarantee that none of the chemicals used in the plant for controlling water quality are on the EPA 129 Priority Pollutant List.	See revised Section 3.6.1.
Discuss potential synergistic effects of the discharge of chemicals and heat to the Columbia River.	See revised Section 5.3.1.2.
A surface water runoff control plan should be submitted.	As indicated in Section 4.5.4.1, an erosion control plan will be submitted to EFSEC for its review and approval prior to commencement of Site construction activities.

SUBJECT/COMMENT	APPLICANT RESPONSE
Non-radioactive Spillage Prevention	
Provide additional information on unauthorized discharges of toxic dangerous waste that come under the Resource Conservation and Recovery Act or WDOE 173-303.	The Oil and Hazardous Substances, Spill Prevention, Control and Counter Measures Plan discussed in Section 4.5.4.1 will ensure that no unauthorized discharges of toxic wastes that come under the Resource Conservation and Recovery Act or WDOE 173-303 occur. This plan will be submitted to EFSEC for its review and approval prior to commencement of Site construction activities.
Protection from Natural Hazards	
None.	No response required.
Security Concerns	
None.	No response required.
Potential for Future Activities at Site	
None.	No response required.
Geology	
Provide additional detail on transmission line topography.	See Figures 3.1-1a, 3.9-4 and 4.1-2.
Provide additional information on shoreline modifications.	See revised Section 3.4.2.1 and new Section 4.1.2.2.
Provide additional information on excavation, fill volumes and disposal areas.	See revised Section 4.1.1.

SUBJECT/COMMENT	APPLICANT RESPONSE
Provide additional information on landscaping methods.	See revised Sections 4.5.4 and 4.5.5.5. 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.
Provide additional information on the Construction Impact Control Program plans.	These plans will be developed after detailed engineering and construction planning are completed. As indicated in Section 4.5, a detailed description on 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.
Provide additional information on geology.	As indicated in Section 2.5, the results and conclusions of detailed geologic and seismic studies are described in Section 2.5 of the S/HNP Preliminary Safety Analysis Report.
<u>Air Quality</u>	
Discuss compliance with the Tri-County Air Pollution Control Authority standard for particulate emissions from the concrete batch plant.	See revised Section 4.1.1.
Provide additional information on routine radioactive releases and appropriate compliance standards.	See Sections 3.5, 3.5.2.7 and 3.5.3.9 and Appendix G.
Provide additional information on auxiliary generator emissions and testing schedules.	See Section 3.7.4 and Table 3.7-3 for information on diesel generators and auxiliary steam generators emissions.
Provide additional information on construction emissions.	See revised Section 4.1.1.

SUBJECT/COMMENT	APPLICANT RESPONSE
Provide a dust control plan.	As indicated in Section 4.5.4.1, a dust control plan will be developed and submitted to EFSEC for its review and approval prior to commencement of Site construction activities.
Compatibility with Water Quality Standards	
None.	No response required.
Hydrographic Study of Receiving Water	
Provide specific information about effluent distribution.	See new Figures 5.3-1 through 5.3-4.
Groundwater	
Provide additional groundwater information regarding U-Pond, well 699-31-31 and Table 2.4-24.	See revised Section 2.4.2 and Table 2.4-22.
NPDES Application	
Provide additional information on chemical concentrations of the radwaste system.	See revised Section 3.3.8.
Terrestrial Biological Resources	
Provide additional information on the terrestrial preapplication monitoring program.	See Section 6.1.4.3.1.

SUBJECT/COMMENT	APPLICANT RESPONSE
Provide additional information on mitigation measures from BPA's "General Construction and Maintenance Program Statement" which will be utilized for transmission line construction.	Detailed mitigation measures to be utilized for transmission line construction will be developed as part of the Construction Impact Control Program and will be submitted to EFSEC for its review and approval prior to construction.
Provide additional information on mitigation measures to be used for terrestrial resources	Sections 4.1, 4.2 and 4.5 describe mitigation measures to be utilized for terrestrial resources. 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.
Provide more specific information on the duration of terrestrial monitoring activities prior to construction.	See revised Section 6.1.4.3.2
Provide a mitigation plan for unanticipated impacts.	The specifics of any mitigation plan cannot be formulated in advance of detection of the unanticipated impact. In the event that monitoring should identify unanticipated impacts from construction or operation of the S/HNP, the significance of the impact will be evaluated, mitigation measures will be considered, and any required reporting obligations will be satisfied.
Discuss the significance of population changes of threatened and sensitive species from construction and operation of the S/HNP.	See new Table 4.1-4.
Aquatic Biological Resources	
Provide site specific data on aquatic biota.	See new Appendix K.
Provide information on sport and commercial fisheries in the Hanford Reach.	See new Section 2.2.2.6.4.

SUBJECT/COMMENT	APPLICANT RESPONSE
Compare data on phytoplankton and periphyton in the Hanford Reach and other parts of the Columbia River.	See revised Section 2.2.2.
Provide common names along with scientific name for macrophytes.	See revised Table 2.2-16.
Provide a map showing areas of macrophyte assemblages.	These areas are generally described in revised Section 2.2.2.3.
Clarify statements regarding variations in macrobenthic fauna and Figure 2.2-16.	See revised Section 2.2.2.5.
Provide criteria for designating fish as important and add species to list of important fish.	See revised Section 2.2.2.6.
Provide additional information regarding Chinook Salmon.	Current information on annual variability in data is in Section 2.2.2.6.1.1. Precise maps of migration routes and feeding areas do not exist; however, the primary migration route for adult salmonids is along the eastern shoreline of the Hanford Reach and returning adults have shown a preference for shoreline and surface areas. See Section 5.1.3.2.4.1. The ASC/ER does account for the work done by Coutant, References 74 and 124 cited in Section 2.2.2.6.1.1. Section 2.2.2.6.1.1 has been revised to discuss chlorine sensitivities of Chinook Salmon.
Provide additional information regarding sensitivities of various fish species to chlorine and heat.	See revised Section 2.2.2.6.1.2 and 2.2.2.6.1.3. Data on sensitivity of Sockeye Salmon to chlorine is not available.
Discuss the planktonic nature of the Shad larvae.	See revised Section 2.2.2.6.1.5..

SUBJECT/COMMENT	APPLICANT RESPONSE
Discuss the nature of White Sturgeon eggs.	See revised Section 2.2.2.6.2.2.
Discuss additional factors limiting productive capacities of fish species of interest.	See revised Section 2.2.2.7.
Discuss water allocation as a pre-existing environmental stress for anadromous salmonids.	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 effect of lower river flows upon salmonid resources is uncertain.
Discuss potential effects of thermal discharges on predator-related mortality.	See revised Section 5.1.3.2.4.1.
Correct text based upon answers to Questions E290.10 and E290.23.	See revised Section 2.2.2.9.
Discuss contour of river bottom in relation to design and location of the intake structure and alternative intake locations.	See Sections 3.4 and 4.1.2 and Appendix B for information on the river bottom contours in relation to intake location. See new Section 10.10 for alternative intake locations.
Provide contour maps showing proposed shoreline changes.	See revised Section 4.1.2.2.
Provide dilution isopleths.	See new Figures 5.3-1 through 5.3-4.
Provide detailed design specifications for the intake and discharge structure.	Final design has not been completed on the intake and discharge structures. Preliminary design information is presented in revised Section 4.1.2 of the ASC/ER and the figures referenced therein.
Provide a figure of the discharge nozzle.	See new Figure 4.1-9.

SUBJECT/COMMENT	APPLICANT RESPONSE
Discuss "relative" contributions to the effluent of the concentrating effects of the operation of the plant and of added chemicals.	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.
Provide information on placement, operation and removal of temporary intake system.	See new Section 4.1.2.1.
Provide information on construction techniques for the intake and discharge structures.	See new Section 4.1.2.2.
American Shad have pelagic eggs and should be listed as potentially vulnerable to the intake system.	American Shad ichthyoplankton are not expected in the area of the proposed intake structure in any significant number. See revised Section 2.2.2.6.1.5.
Discharge of chlorine may affect aquatic biota.	See revised Section 5.3.1.2.

SUBJECT/COMMENT	APPLICANT RESPONSE
Discuss mitigation program for aquatic biota.	The mitigation program for aquatic biota during construction is discussed in Section 4.1.2. In particular, it should be noted that no channel improvements have been proposed, the river bed contour will be restored and construction will occur between July 15 and October 15 to minimize impacts on aquatic biota. The monitoring program described in Section 6.1.1.1.2 will be implemented to determine water quality changes which may occur during construction. The impacts expected as a result of construction are expected to be transient and limited in area. See Section 4.1.2. The mitigation program for aquatic biota during operation is discussed in various places throughout Section 3. For example, the radwaste system is designed to obviate the need for discharges of liquid radwaste (Section 3.5.1.2), S/HNP will have a closed cycle cooling system to minimize discharges of heat to the river (Section 3.4.1.1), and the discharge will be located offshore to maximize dispersion and avoid shoreline oriented species and will be located away from known spawning areas. No significant impacts on aquatic biota are expected as a result of operation (Sections 5.1 and 5.3).
Discuss impacts and mitigation of the intake and discharge system.	See new Section 4.1.2.2.
Discuss entrainment of fish eggs, larva and prey organisms taken into the cooling water system.	See Sections 5.1.2.1 and 5.1.3.1.
Discuss thermal stress on the aquatic biota.	See revised Sections 5.1.3.2. et seq
Discuss impingement of adult and juvenile fish on the intake screen.	See revised Section 5.1.3.1.

SUBJECT/COMMENT	APPLICANT RESPONSE
Discuss impacts from toxic chemical discharges, especially impacts associated with chlorine, mercury, zinc, cadmium and iron.	See revised Section 5.3.1.2.
<u>Noise and Glare</u>	
Provide intake pump noise levels.	See revised Section 5.6.
Provide additional information on rail and vehicular traffic noise levels.	See revised Section 5.6.
Discuss light and glare.	See revised Sectioon 4.1.1.
Provide additional information on construction worker hearing protection.	The Project contracting philosophy has been to make the individual contractors solely responsible to take such measures as may be necessary to assure that the safety and health of those performing work and of the public are safeguarded. Thus, it is the responsibility of the contractor to provide hearing protection and testing for workers, in addition to other safety and health precautions. The Applicant does not believe that specific safety measure requirements should be written into the construction contracts. See also revised Section 4.5.4.1.
Discuss the times, locations and relevance of the noise measurements in Section 2.7.	See revised Section 2.7.
Add Sections 2.7 and 3.9 to the EFSEC Cross Reference Index/Matrix.	See revised EFSEC Cross Reference Index/Matrix.

SUBJECT/COMMENT	APPLICANT RESPONSE
Land Use	
The Counties of Franklin, Yakima, Grant and Adams and the Cities of Kennewick, Richland, West Richland, Pasco, Benton City, Prosser and Mesa land use plans and zoning ordinances should be included in the ASC/ER to meet the guidelines of WAC 463-42-485.	The Applicant will request a waiver of this guideline.
Health and Safety	
Describe methods of compliance with Federal, State and local health and safety standards.	See revised Section 4.5.4.1.
Socioeconomics	
Incorporate information from Questions tions and Answers into Chapter 8.3.	See revised Section 8.3.
Figure 8.3-1 was cited in the text but was not provided.	The citation of Figure 8.3-1 was revised to Figure 2.1-1.
Provide references for work force residing in Yakima County.	See revised Section 8.3.2.
ISO ratings for fire districts were not included.	See revised Section 8.3.1.4.1 and Table 8.3-17.

SUBJECT/COMMENT	APPLICANT RESPONSE
Provide additional information on revenue effects.	See revised Section 8.3.5.1.
Provide a reference for secondary job effects.	See revised Section 8.3.6.1.
Provide additional information on property values.	See revised Section 8.3.11.
Provide additional information on references.	See revised Section 8.3.
Table 8.2-1 does not provide useful socio-economic data.	Table 8.2-1 is not intended to describe variables for Section 8.3. See Tables in Section 8.3.
Annual costs should be provided in dollars per year rather than cost per kWh.	See Section 8.3.7 and Section 8.3.8 for annual employment and income in dollars per year.
Provide additional information on tax revenues.	See revised Section 8.3.5.
Personal property taxes are not addressed.	See footnote to Table 8.3-2.
The information using dollar values is inconsistent with respect to price level used.	See revised Section 8.3.
Provide additional information on the effect of the Project on the local economy.	See revised Section 8.3.8.
There is a difference in years for plant life used in Sections 8.3.8 and 8.2.2.	See revised Section 8.3.8.

SUBJECT/COMMENT	APPLICANT RESPONSE
Provide additional information on government costs as a result of the Project.	See revised Section 8.3.9.
The development of the S/HNP would stimulate local business activity and provide tax revenues; however, the activities would not be maintained at the 1981 level.	See revised Section 8.3.17.
Transportation	
Provide a more cohesive discussion on transportation.	See revised Section 8.3.10.
Discuss the status of the considerations being given to the improvements to SR 240.	Design and implementation decisions about roadway improvements require the joint efforts of the Applicant, WSDOT, DOE, EFSEC and local agencies and these efforts are currently being pursued.
Provide additional information on future travel patterns for construction workers.	See revised Section 8.3.10.
Provide estimated future construction traffic volumes with and without the Project.	See revised Section 8.3.10.
Provide additional details about carpooling and staggered work hours.	See revised Section 8.3.10.
Provide information on the intersection design.	See revised Section 8.3.10.

SUBJECT/COMMENT	APPLICANT RESPONSE
Provide information on the final disposition of new facilities and maintenance responsibilities.	See revised Section 8.3.10.
Discuss conformance with existing transportation plans or transportation elements of the comprehensive plan.	See revised Section 8.3.10.
Identify specific waste product transportation routes.	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 revised Section 4.5.4.1, the Applicant will prepare and submit a solid waste disposal plan as part of the Construction Impact Control Program for EFSEC's review and approval prior to commencement of Site construction activities.
Energy Consumption	
Provide additional information on construction electrical energy requirements.	See revised Section 4.1.1.
Provide additional information on fuel usage.	Fuel utilized for equipment is discussed in Section 7.3.3 and Figure 3.1-1 shows the location of the standby diesel generator fuel oil storage tanks. No additional information on fuel usage is available.
Solid Waste Disposal	
Provide additional information on solid waste disposal.	As indicated in Section 4.5.4.1, the Applicant will prepare and submit a solid waste disposal plan as part of the Construction Impact Control Program for EFSEC's review and approval prior to commencement of Site construction activities.
Revise the EFSEC Guidelines Cross Reference Index/Matrix.	See revised EFSEC Guideline Cross Reference Index/Matrix.

SUBJECT/COMMENT	APPLICANT RESPONSE
Aesthetics	
Provide additional information on the type of texture and color that will be used for the Project.	A decision regarding the final textures and colors for the S/HNP facilities has not been made by the Applicant.
Provide additional information on potential aesthetic impacts from transmission facilities.	See revised Sections 4.2 and 5.5.
Cultural Resources	
Provide information on the completed Phase 2 literature, archival and records review.	Section 2.6 discusses the results on the completed Phase 2 study including the results of its literature, archival, and records review.
Provide additional information on the Project impacts on archaeological and historical sites.	See revised Section 4.1.1.
Provide a schedule for completion of cultural resource studies.	A schedule showing cultural resource studies in relation to other Project activities is presented in Figure 2.6-1.
Table 1 of Amendment 5 should be revised.	Table 1 was provided in response to Question N200.10 and is 1977 testimony of the Nuclear Regulatory Commission regarding candidate site comparisons for the Skagit Nuclear Power Plant. Subsequent information, as provided in response to Question N200.01, has identified an archaeological site (45-WH-23) within the boundaries of the alternate Cherry Point site.

SUBJECT/COMMENT	APPLICANT RESPONSE
Analyses of Alternatives	
The comparison of alternative sites is inconsistent because different criteria were used for the two sets of alternative sites proposed.	As indicated in Section 9.3, the site selection and review process for this Project began in 1970 and the analyses presented in regard to the Hanford site should not be construed as starting a new site selection process because it would ignore the record developed in this proceeding to date.
Provide additional information on why the Goshen and Hanford 23 sites were eliminated from further consideration by the Applicant.	See Section 9.3.4.
Provide a discussion on the removal of approximately a six mile segment of existing 500 kV transmission line in the comparison of transmission line alternatives.	See revised Section 10.9.1.2.
Provide additional information on the criteria used for transmission line route selection and if other alternative routes were considered.	Criteria used for transmission line route selection is discussed in Section 10.9.1. No other alternative routes were considered.
Provide information on an alternative intake/discharge location.	See new Section 10.10.
Provide information on solid waste disposal alternatives.	Solid waste disposal alternatives will be discussed in the Solid Waste Disposal Plan of the Construction Impact Control Program which will be submitted to EFSEC for its review and approval prior to commencement of Site construction activities.
Provide information on alternative construction power sources.	See revised Section 4.1.1.

DISTRIBUTION OF APPLICATION TO EFSEC
PUGET SOUND POWER & LIGHT COMPANY
SKAGIT/HANFORD NUCLEAR PROJECT
APPLICATION NO. 81-1

COPY NO.

#1 & 2 Mr. William L. Fitch
Executive Secretary
Energy Facility Site
Evaluation Council
Mail Stop PY-11
Olympia, WA 98504

#3 Mr. Nicholas D. Lewis
Chairman
Energy Facility Site
Evaluation Council
Mail Stop PY-11
Olympia, WA 98504

#4 Mr. Fred D. Hahn
Department of Ecology
Olympia, WA 98504
PV-12

#5 Mr. David H. Guier
Dept. of Emerg. Services
4220 East Martin Way
Olympia, WA 98504
PT-11

#6 Mr. Merlin Smith
Comm. & Economic Develop.
General Administration Bldg.
Olympia, WA 98504
AX-13

#7 Mr. R. Wallis
Utilities & Trans. Comm.
Highways Licenses Building
Olympia, WA 98504
PB-02

#8 Dr. Charles Woelke
Department of Fisheries
General Administration Bldg.
Olympia, WA 98504
AX-11

#9 Mr. Art Scheuneman
Department of Agriculture
General Administration Bldg.
Olympia, WA 98504
AX-41

#10 Mr. John L. Chambers
Department of Natural Resources
Public Lands Bldg.
Olympia, WA 98504
QW-21

#11 Mr. Claude E. Lakewold
Office of Fin. Management
Olympia, WA 98504
AL-01

#12 Mr. Joe Bell
Dept. of Transportation
Highway Administration Bldg.
Olympia, WA 98504
KF-01

#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

EFSEC GUIDELINE CROSS REFERENCE
INDEX/MATRIX

EFSEC Guidelines	ASC/ER Section
WAC 463-42-012 GENERAL - ORGANIZATION-INDEX. Except as may be otherwise approved by the council and except as otherwise provided below with respect to applications covering nuclear power plants, the contents of the application shall be organized in the same order as these guidelines. In the case of an application covering a nuclear power plant, the environmental report prepared for the Nuclear Regulatory Commission may be substituted for the comparable sections of the site certification application, provided that the environmental report is supplemented as necessary to comply with this chapter and that an index is included listing these guidelines in order and identifying where each applicable guideline is addressed.	
WAC 463-42-015 GENERAL - DESCRIPTION OF APPLICANT. The applicant shall provide an appropriate description of the applicant's organization and affiliations for this proposal.	Application and 1.0 and 4.5
WAC 463-42-025 GENERAL - DESIGNATION OF AGENT. The applicant shall designate an agent to receive communications on behalf of the applicant.	Application
WAC 463-42-035 GENERAL - FEE. The statutory fee shall accompany an application and shall be a condition precedent to any action by the council. Payment shall be by a cashier's check payable to the state treasurer.	p. EFSEC-3

EFSEC Guidelines	ASC/ER Section
WAC 463-42-045 GENERAL - WHERE FILED. Applications for site certification shall be filed with the council at the council office.	Letter from R. V. Myers to Energy Facility Site Evaluation Council dated December 21, 1981
WAC 463-42-055 GENERAL - FORM AND NUMBER OF COPIES. Applications shall be on 8-1/2 by 11" sheets, in loose-leaf form with a hard cover binder. Thirty-five copies of the application shall be supplied to the council, and two copies to each county, and one copy to each port district in which the site is located at the time that the original is filed. In addition, one copy shall be supplied to each intervenor on admission to the proceedings. Information later submitted shall be by page-for-page substitutions suitable for insertion in the application binder.	Application for Site Certification/ Environmental Report and Application Distribution List
WAC 463-42-065 GENERAL - FULL DISCLOSURE BY APPLICANTS. It is recognized that these guidelines can only be comprehensive in a relative sense. Therefore, and in addition to the other guidelines contained herein, the council adopts the basic guideline that an applicant for site certification must identify in the application all information known to the applicant which has a bearing on site certification.	All appropriate sections
WAC 463-42-075 GENERAL - ASSURANCES. The application shall set forth insurance, bonding or other arrangements proposed in order to mitigate for damage or loss to the physical or human environment caused by project construction or operation.	3, 4, 5
WAC 463-42-085 GENERAL - MITIGATION MEASURES. The application shall describe the means to be utilized to minimize or mitigate possible adverse impacts on the physical or human environments.	3, 4, 5

EFSEC Guidelines	ASC/ER Section
WAC 463-42-095 GENERAL - SOURCES OF INFORMATION. The applicant shall disclose sources of all information and data and shall identify all pre-application studies bearing on the site and other sources of information.	All appropriate sections
WAC 463-42-105 GENERAL - GRAPHIC MATERIAL. It is the intent that material submitted pursuant to these guidelines shall be descriptive and shall include illustrative graphics in addition to narration. This requirement shall particularly apply to subject matter that deals with systems, processes, and spacial relationship. The material so submitted shall be prepared in a professional manner and in such form and scale as to be understood by those who may review it.	All sections
WAC 463-42-115 GENERAL - SPECIFIC CONTENTS AND APPLICABILITY. It is recognzed that not all sections of these guidelines apply equally to all proposed energy facilities. If the applicant deems a particular section to be totally inapplicable the applicant must justify such conclusion in response to said section. The applicant must address all sections of this chapter and must substantially comply with each section, show it does not apply or secure a waiver from the council. Information submitted by the applicant shall be accompanied by a certification by applicant that all EFSEC application requirements have been reviewed, the data have been prepared by qualified professional personnel, and the application is substantially complete.	p. EFSEC-4
WAC 463-42-125 PROPOSAL - SITE DESCRIPTION. The application shall contain a description of the proposed site indicating its location, prominent geographic features, typical geological and climatological characteristics, and other information necessary to provide a general understanding of all sites involved,	2

EFSEC Guidelines	ASC/ER Section
including county or regional land use plans and zoning ordinances.	
WAC 463-42-135 LEGAL DESCRIPTIONS AND OWNERSHIP INTERESTS. The application shall contain a legal description of the site to be certified and shall identify the applicants and all nonprivate ownership interests in such land.	2.1.1
WAC 463-42-145 CONSTRUCTION ON SITE. The applicant shall describe the characteristics of the construction to occur at the proposed site including the type, size, and cost of the facility; description of major components and such information as will acquaint the council with the significant features of the proposed project.	3, 4.1, 4.2, 8.2
WAC 463-42-155 ENERGY TRANSMISSION SYSTEMS. The applicant shall describe the routing, conceptual design, and construction schedule of all proposed associated facilities to be constructed.	3.9, 4.1, 4.2 5.5
WAC 463-42-165 WATER SUPPLY. The applicant shall describe the location and type of water intakes and associated facilities.	3.3.1, 3.4.2 4,1.1, 4.1.2
WAC 463-42-175 SYSTEM OF HEAT DISSIPATION. The applicant shall describe both the proposed and alternative systems for heat dissipation from the proposed facilities.	3.4, 10.1
WAC 463-42-185 CHARACTERISTICS OF AQUATIC DISCHARGE SYSTEMS. Where discharges into a watercourse are involved, the applicant shall identify outfall configurations and show proposed locations.	3.4.2.2, 4.1.2
WAC 463-42-195 WASTEWATER TREATMENT. The applicant shall describe each wastewater source associated with the facility and for each source, the applicability of all known, available, and reasonable methods of wastewater control and treatment. Where wastewater control	3.5.2, 3.6.2, 3.7, 10.3, 10.4, 10.5, 10.6, 10.7

EFSEC Guidelines	ASC/ER Section
involves collection and retention for recycling and/or resource recovery, the applicant shall show in detail the methods selected, including at least the following information: waste source(s), average and maximum daily amounts and composition of wastes, storage capacity and duration, and any bypass or overflow facilities to the wastewater treatment system(s) or the receiving waters. Where wastewaters are discharged into receiving waters, the applicant shall provide a detailed description of the proposed treatment system(s), including appropriate flow diagrams and tables showing the sources of all tributary waste streams, their average and maximum daily amounts and composition, individual treatment units and their design criteria, major piping (including all bypasses), and average and maximum daily amounts and composition of effluent(s).	
WAC 463-42-205 SPILLAGE PREVENTION AND CONTROL. The applicant shall describe all spillage prevention and control measures to be employed regarding accidental and/or unauthorized discharges or emissions, relating such information to specific facilities, including but not limited to locations, amounts, storage duration, mode of handling, and transport.	3.2.1, 3.5, 3.7.1.2, 4.5, 5.4, 7.1, 7.2, 7.3
WAC 463-42-215 SURFACE-WATER RUNOFF. The applicant shall describe how surface-water runoff and erosion are to be controlled during construction and operation to assure compliance with state water quality standards.	4.1, 4.5
WAC 463-42-225 EMISSION CONTROL. The applicant shall demonstrate that the highest and best practicable treatment for control of emissions will be utilized in facility construction and operation. In the case of fossil fuel power plants and petroleum refineries, the applicant should deal with products containing sulphur and particulates. In the case of a nuclear-	3.5, 3.6, 3.7, 4.1, 4.5, 5.1 5.2, 5.3, 5.4 5.5

EFSEC Guidelines	ASC/ER Section
fueled plant, the applicant should deal with optional plant designs as these may relate to gaseous emissions.	
WAC 463-42-235 CONSTRUCTION AND OPERATION ACTIVITIES. The applicant shall: Provide the proposed construction schedule, identify the major milestones, and describe activity levels versus time in terms of craft and noncraft employment; and describe the proposed operational employment levels.	4.1
WAC 463-42-245 CONSTRUCTION MANAGEMENT. The applicant shall describe the organizational structure including the management of project quality and environmental functions.	4.1, 4.5
WAC 463-42-255 CONSTRUCTION METHODOLOGY. The applicant shall describe in detail the construction procedures, including major equipment, proposed for any construction activity within watercourses, wetlands and other sensitive areas.	4
WAC 463-42-265 PROTECTION FROM NATURAL HAZARDS. The applicant shall describe the means employed for protection of the facility from earthquakes, flood, tsunami, storms, avalanche or landslides, and other major natural disruptive occurrences.	3.10
WAC 463-42-275 SECURITY CONCERNS. The applicant shall describe the means employed for protection of the facility from sabotage, vandalism and other security threats.	3.11
WAC 463-42-285 STUDY SCHEDULES. The applicant shall furnish a brief description of all present or projected schedules for additional environmental studies. The studies descriptions should outline their scope and indicate projected completion dates.	2, 6
WAC 463-42-295 POTENTIAL FOR FUTURE	1.4

EFSEC Guidelines	ASC/ER Section
ACTIVITIES AT SITE. The applicant shall describe the potential for any future additions, expansions, or further activities which might be undertaken by the applicant on or contiguous to the proposed site.	
WAC 463-42-305 PHYSICAL ENVIRONMENT - CONTOUR MAPS. The applicant shall include contour maps showing the original topography and any changes likely to occur as a result of energy facility construction and related activities. Contour maps showing proposed shoreline or channel changes shall also be furnished.	2.1.1, 3.1, 4.1
WAC 463-42-315 PHYSICAL ENVIRONMENT - EARTH REMOVAL. The applicant shall describe all procedures to be utilized to minimize erosion and other adverse consequences during the removal of vegetation, excavation of borrow pits, foundations and trenches, disposal of surplus materials, and construction of earth fills. The location of such activities shall be described and the quantities of material shall be indicated.	4.1, 4.5
WAC 463-42-325 PHYSICAL ENVIRONMENT - LANDSCAPE RESTORATION. The applicant shall describe the procedures to be utilized to restore or enhance the landscape disturbed during construction (to include temporary roads).	4.1, 4.5
WAC 463-42-335 PHYSICAL ENVIRONMENT - ENVIRONMENTAL SAFEGUARDS - GEOLOGIC AND HYDROLOGIC SURVEY. The applicant shall include the results of a comprehensive hydrologic and geologic survey showing conditions at the site, the nature of foundation materials, and potential seismic activities.	2.4, 2.5
WAC 463-42-345 PHYSICAL ENVIRONMENT - AIR POLLUTION CONTROL. The applicant shall identify all pertinent air pollution control standards. The application shall contain adequate data showing air quality and meteorological conditions at the site.	2.3, 3.5.4, 4.1, 4.5, 5.2, 5.3 5.4, 5.5

EFSEC Guidelines	ASC/ER Section
Meteorological data shall include, at least, adequate information about wind direction patterns, air stability, wind velocity patterns, precipitation, humidity, and temperature. The applicant shall describe the means to be utilized to assure compliance with air quality and emission standards.	
WAC 463-42-355 PHYSICAL ENVIRONMENT - AIR POLLUTION IMPACT. The applicant shall describe the extent to which facility operations may cause visible plumes, fogging, misting, icing, or impairment of visibility, and changes in ambient levels caused by all emitted pollutants.	5.1, 5.2, 5.3
WAC 463-42-365 PHYSICAL ENVIRONMENT - DUST CONTROL. The applicant shall describe for any area affected, all dust sources created by construction or operation of the facility and shall describe how these are to be minimized or eliminated.	4.1, 4.5
WAC 463-42-375 PHYSICAL ENVIRONMENT - ODOR CONTROL. The applicant shall describe for the area affected, all odors caused by construction or operation of the facility and shall describe how these are to be minimized or eliminated.	3.7, 4.1, 4.5, 5.4
WAC 463-42-385 PSD APPLICATION. The applicant shall include a completed Prevention of Significant Deterioration permit application.	Determination of nonsignificance pending
WAC 463-42-395 PHYSICAL ENVIRONMENT - WATER SOURCE AND USAGE. The applicant shall indicate the source and the amount of water required during construction and operation of the plant and show that it is available for this use and describe all existing water rights, withdrawal authorizations or restrictions which relate to the proposed source.	2.1.4.8, 2.4.1, 3.3, 3.4.2, 4.1

EFSEC Guidelines	ASC/ER Section
WAC 463-42-405 PHYSICAL ENVIRONMENT - COMPATIBILITY WITH WATER QUALITY STANDARDS. The applicant shall demonstrate that facility construction and/or operational discharges will be compatible with and meet state water quality standards.	4.1.2, 5.1.1, 5.1.2, 5.1.4, 5.2, 5.3.1, 5.4
WAC 463-42-415 PHYSICAL ENVIRONMENT - HYDROGRAPHIC STUDY OF WATERS. The application shall set forth all background water quality data pertinent to the site, and hydrographic study data and analysis of the receiving waters within one-half mile of any proposed discharge location with regard to: Bottom configuration; minimum, average and maximum water depths and velocities; water temperature and salinity profiles; anticipated effluent distribution and dilution, and plume characteristics under all discharge conditions; and other relevant characteristics which could influence the impact of any wastes discharged thereto.	2.4, 5.1, 5.3, Appendix B, Appendix C
WAC 463-42-425 PHYSICAL ENVIRONMENT - GROUND-WATER ACTIVITY. The applicant shall describe any changes in ground-water activity or quality which might result from project construction or operation.	2.4.2, 3.5.2, 4.1, 5.2
WAC 463-42-435 PHYSICAL ENVIRONMENT - NPDES APPLICATION. The applicant shall include a completed National Pollutant Discharge Elimination System permit application.	Appendix F
WAC 463-42-445 PHYSICAL ENVIRONMENT - INVENTORY OF POTENTIALLY AFFECTED VEGETATION, ANIMAL LIFE, AND AQUATIC LIFE DESCRIBED. The applicant shall describe all vegetation, animal life, and aquatic life which might reasonably be affected by construction and/or operation of the energy facility and any associated facilities. Any endangered species or noteworthy species or habitat shall receive special attention. Assessment of these factors shall include density and distribution information.	2.1, 2.2, 2.4 6.1, 10.2, Appendix K

EFSEC Guidelines	ASC/ER Section
WAC 463-42-455 PHYSICAL ENVIRONMENT - IMPACT OF CONSTRUCTION AND OPERATION ON VEGETATION, ANIMAL LIFE, AND AQUATIC LIFE. The applicant shall describe the projected effect of facility construction and/or operation upon vegetation, animal life, and aquatic life.	3.4, 3.6, 4, 5
WAC 463-42-465 PHYSICAL ENVIRONMENT - DESCRIPTION OF MEASURES TAKEN TO PROTECT VEGETATION, ANIMAL LIFE, AND AQUATIC LIFE. The application shall contain a full description of each measure to be taken by the applicant to protect vegetation, animal life, and aquatic life from the effects of facility operation and construction.	3.0, 4.1, 4.2, 4.5, 6
WAC 463-42-475 PHYSICAL ENVIRONMENT - NOISE AND GLARE. The applicant shall describe the impact of lights, noise, and glare from construction and operation and shall describe the measures to be taken in order to eliminate or lessen this impact.	2.7, 3.9 4.1, 4.2, 4.5, 5.6
WAC 463-42-485 PHYSICAL ENVIRONMENT - LOCAL LAND USE PLANS AND ZONING ORDINANCES. As part of the application, the applicant shall furnish copies of adopted land use plans and zoning ordinances, including the latest land use regulation and a survey of present land uses within the following distances of the immediate site area: (1) In the case of thermal power plants, 25 miles radius; (2) In the case of petroleum refineries, 10 miles radius; (3) In the case of petroleum or LNG storage areas or underground natural gas storage, 10 miles radius from center of storage area or well heads; (4) In the case of pipe lines and electrical transmission routes, 1 mile either side of center line.	2.1.4.9 Appendix I The Applicant will request a waiver of this guideline
WAC 463-42-495 PHYSICAL ENVIRONMENT - MULTI-PURPOSE USE OF TRANSMISSION ROUTES. The applicant shall indicate consideration of multi-purpose utilization of rights-of-	3.9, 4.2, 5.5

EFSEC Guidelines	ASC/ER Section
way and describe the measures to be employed to utilize, restore, or rehabilitate disturbed areas.	
WAC 463-42-505 PHYSICAL ENVIRONMENT - SAFETY STANDARDS COMPLIANCE. The applicant shall identify all federal, state, and local health and safety standards which would normally be applicable to the construction and operation of a project of this nature and shall describe methods of compliance therewith.	2.1.2, 2.8, 3.12, 3.3.4, 3.5, 3.8 4.4, 4.5, 5.2, 7.1, 7.2, Appendix H
WAC 463-42-515 PHYSICAL ENVIRONMENT - SAFETY WHERE PUBLIC ACCESS ALLOWED. The applicant shall describe the means proposed to insure safe utilization of those areas under applicant's control to which public access will be granted.	2.1.2, 3.5, 4.5, 7.1, 7.2, Appendix H
WAC 463-42-525 PHYSICAL ENVIRONMENT - EMERGENCY PLANS. The applicant shall describe emergency plans which will be required to assure the public safety and environmental protection on and off the site in the event of a natural disaster or other major incident relating to or affecting the project and further, will identify the specific responsibilities which will be assumed by the applicant.	3.12
WAC 463-42-535 HUMAN ENVIRONMENT - SOCIOECONOMIC IMPACT. The applicant shall submit a detailed socioeconomic impact study which identifies primary and secondary and positive as well as negative impacts on the socioeconomic environment with particular attention and analysis of impact on population, work forces, property values, housing, traffic, health and safety facilities and services, education facilities and services, and local economy.	8
WAC 463-42-545 HUMAN ENVIRONMENT - ACCESS. The applicant shall describe existing roads, railroads, and other transportation facilities and indicate what	2.1, 3.1, 4.1, 8.3.10

EFSEC Guidelines	ASC/ER Section
additional access, if any, will be needed during planned construction and operation.	
<u>WAC 463-42-555</u> HUMAN ENVIRONMENT - <u>TRANSPORTATION</u> IMPACT. The applicant shall identify all permanent transportation facilities impacted by the construction and operation of the energy facilities, the nature of the impacts and the methods to mitigate impacts. Such impact identification, description and mitigation shall, at least, take into account: (1) Expected traffic volumes during construction, based on where the work force is expected to reside; (2) Access routes for moving heavy loads, construction materials or equipment; (3) Expected traffic volumes during normal operation of the facility; (4) For transmission facilities, anticipated maintenance access; and (5) Consistency with local comprehensive transportation plans.	4.1, 4.2, 5.5, 8.3.10
<u>WAC 463-42-565</u> HUMAN ENVIRONMENT - <u>TRANSPORTATION</u> FACILITY CONSTRUCTION. The applicant shall indicate the applicable standards to be utilized in improving existing transportation facilities and in constructing new permanent or temporary access facilities, and shall indicate the final disposition of new access facilities and identify who will maintain them.	3.1, 4.1, 4.5 8.3.10
<u>WAC 463-42-575</u> HUMAN ENVIRONMENT - <u>TRANSPORTATION</u> OF FUELS AND WASTE PRODUCTS. Except where security restrictions are imposed by the federal government, the applicant shall indicate the manner in which fuels and waste products are to be transported to and from the facility, including a designation of the specific routes to be utilized.	3.2.1, 3.8, 7.2 8.3.10
<u>WAC 463-42-585</u> HUMAN ENVIRONMENT - <u>ENERGY CONSUMPTION</u>. The applicant shall generally describe the energy consumption during both construction and operation of	3.1, 3.8, 3.9, 4.1.1, 7.3.3, 8.2

EFSEC Guidelines	ASC/ER Section
the proposed facilities as to sources of supply, locations of use, types, amounts, and new delivery facilities.	
WAC 463-42-595 HUMAN ENVIRONMENT - SOLID WASTES DISPOSAL. The applicant shall describe the disposition of all solid or semisolid constructon and operation wastes including spent fuel, ash, sludge, and bottoms, and show compliance with applicable state and local comprehensive solid waste disposal plans.	3.7.3, 4.1, 4.5, 5.4, 3.5.4
WAC 463-42-605 HUMAN ENVIRONMENT - RADIATION LEVELS. For facilities which propose to release any radioactive materials, the applicant shall set forth information relating to radioactivity. Such information shall include background radiation levels of appropriate receptor media pertinent to the site. The applicant shall also describe the proposed radioactive waste treatment process, the anticipated release of radionuclides, their expected distribution and retention in the environment, the pathways which may become sources of radiation exposure, and projected resulting radiation doses to human populations. Other sources of radiation which may be associated with the project shall be described in all applications.	2.8, 3.3.4, 3.5, 3.8, 4.4, 5.2, 7.1, 7.2
WAC 463-42-615 HUMAN ENVIRONMENT - AESTHETICS. The applicant shall describe the aesthetic impact of the proposed energy facility and associated facilities and any alteration of surrounding terrain. The presentation will show the location and design of the facilities relative to the physical features of the site in a way that will show how the installation will appear to its surroundings.	3.1, 4.2, 5.5
WAC 463-42-625 HUMAN ENVIRONMENT - CRITERIA, STANDARDS, AND FACTORS UTILIZED TO DEVELOP TRANSMISSION ROUTE. The applicant shall indicate the federal, state, and industry criteria used in the energy	3.9, 4.2, 10.9

EFSEC Guidelines	ASC/ER Section
transmission route selection and construction factors considered in developing the proposed design and shall indicate how such criteria are satisfied.	
WAC 463-42-635 HUMAN ENVIRONMENT - HISTORICAL, ARCHAEOLOGICAL, AND RECREATIONAL SITE PRESERVATION/ CREATION. The applicant shall list all historical, archaeological, and recreational sites within the area affected by construction and operation of the facility and shall then describe how each will be impacted by construction and operation.	2.6, 4.1, 4.2, 4.5, 5.6
WAC 463-42-645 ANALYSIS OF ALTERNATIVES. The applicant shall provide an analysis of alternatives for site, route, and other major elements of the proposal.	9, 10

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

FEDERAL

Advisory Council on Historic Preservation
Washington, D.C.
Atomic Industrial Forum, Washington, D.C.
Bonneville Power Administration, Portland, Oregon
U.S. Bureau of Reclamation, Boise, Idaho
U.S. Army Corps of Engineers, Seattle, Washington
U.S. Department of Commerce, Washington, D.C.
U.S. Department of Energy, Richland, Washington
U.S. Department of Energy, Washington D.C.
U.S. Department of Health and Human Services
Washington, D.C.
U.S. Department of Housing and Urban Development
Seattle, Washington
U.S. Department of Interior, Washington, D.C.
U.S. Department of Transportation, Washington, D.C.
U.S. Department of Transportation, Seattle, Washington
U.S. Department of Transportation, Yakima, Washington
U.S. Environmental Protection Agency, Arlington, Virginia
U.S. Environmental Protection Agency, Seattle, Washington
U.S. Geological Survey, Denver, Colorado
U.S. National Oceanographic Data Center, Washington, D.C.
U.S. Nuclear Regulatory Commission, Washington, D.C.
Atomic Safety and Licensing Appeal Board

STATE

Washington State Department of Labor and Industries
Washington State Department of Natural Resources
Washington State Energy Facility Site Evaluation Council
Washington State Parks and Recreation Commission
Washington State Radiation Control Program

LOCAL

Benton County Board of Commissioners, Prosser, Washington
Benton-Franklin Governmental Conference
Richland, Washington

LIBRARIES

Brookhaven National Laboratories Library, New York
Seattle Public Library, Seattle, Washington
University of Washington Library, Seattle, Washington
Washington Public Power Supply System Library
Richland, Washington

LEGAL

Hovis, et. al, Yakima, Washington
Lowenstein, et. al., Washington, D.C.
Office of Executive Legal Director, Washington, D.C.
Oregon Assistant Attorney General, Portland, Oregon
Perkins, et. al., Seattle, Washington
Robert C. Lathrop, Portland, Oregon
Stoel, Rives, et. al., Portland, Oregon
Washington Assistant Attorney General, Olympia, Washington

UTILITIES

City of Los Angeles, Department of Water & Power
Los Angeles, California
Pacific Power & Light Company, Portland, Oregon
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
Construction Impact Group, Richland, Washington
Natural Resources Defense Council
San Francisco, California
Pacific Northwest Resources Center, Eugene, Oregon
URS Company, Seattle, Washington

CHAPTER 2.0

THE SITE

CONTENTS

CHAPTER 2.0

THE SITE

TABLES

CHAPTER 2.0

THE SITE

FIGURES

2.0 THE SITE

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 SITE LOCATION AND DESCRIPTION

2.1.1.1 Location

The Skagit/Hanford Nuclear Project (S/HNP) Site is located in the southeast area of the U.S. Department of Energy's (DOE) Hanford Reservation in Benton County, Washington.
The S/HNP Site is approximately 5 miles west of the 4
Washington Public Power Supply System's (Supply System) Nuclear Project No. 2 (WNP-2) unit. It is approximately 8 miles west of the Columbia River, 7 miles north of the Yakima River at Horn Rapids Dam, and 12 miles northwest of
the City of North Richland. Figures 2.1-1, -1a and -1b and 5
2.1-2 show the S/HNP location with respect to roads, highways, rivers, and population centers within the Site Region and Site Area.

The following table lists the approximate geographical coordinates for the reactor containment structure centroids:

Unit	Latitude and Longitude	Universal Transverse Mercator	Lambert Coordinates (State of Washington) (ft)
1	46° 29' 15" 119° 26' 4"	N 5150900 m E 313200 m	N 422710 E 2268390
2	46o 29' 15" 119o 25' 51"	N 5150900 m E 313400 m	N 422710 E 2269290

4

2.1.1.2 Site Area

Figure 2.1-2 shows the S/HNP Site and its topographic features, and the location and orientation of the principal Plant structures. No public roads or railroads cross the Site.

The S/HNP land requirements consist of the Site and Associated Areas. The major S/HNP facilities will be located on the Site, and other supporting facilities (e.g., transmission lines, intake and discharge pipeline, railroad and access roads) will be located on the Associated Areas.

The Site and Associated Areas are shown on Figure 2.1-3. The Site will consist of 1200 acres. Title will be acquired to 640 acres (the owned land) and easements will be obtained for the remaining 560 acres (the easement area). Owned land will be comprised of Section 33 of Township 12 North, Range 27 East of the Willamette Meridian. The easement area will be the south half of Section 28, the west quarter of Section 34 and the west half of the southwest quarter of Section 27 of Township 12 North, Range 27 East of the Willamette Meridian.

The Associated Areas will be made up of the following easements and totaling approximately 420 acres on land outside of the Site:

Facility	Easement Width	Estimated Acres Outside Site
1. Intake and discharge pipelines	150 feet (200 feet at pump-house)	134
2. Railroad	100 feet	42
3. Transmission Lines	600 feet	192
4. Access Roads		
a. North	100 feet	19
b. South*	100 feet	33
	TOTAL	420

4

* An alternative access road route totalling 17 acres identified as South Alternative Access Road in 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. Final intake and discharge line routes inside this corridor will be determined based on soil borings and pipeline hydraulic studies and will be reviewed by the Environmental Surveillance Team discussed 6
in Section 4.5.6 to ensure the environmental impacts of the N210.07
specific routes are minimized.

The raw water pumphouse will be located near the west bank of the Columbia River, approximately 75 feet downstream of River Mile 361.5. 4

Facility	Easement Width	Estimated Acres Outside Site
1. Intake and discharge pipelines	150 feet (200 feet at pumphouse)	134
2. Railroad	100 feet	42
3. Transmission Lines	600 feet	192
4. Access Roads		
a. North	100 feet	19
b. South	100 feet	33*
	TOTAL	420

4

* An alternate access road, totalling 17 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.

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. 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. 4 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 laboratory chemical wastes, and some asbestos pipe 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 hazardous waste disposal site to be located in Section 15 T11N, R27E approximately 2.5 miles south-southeast of the S/HNP Site. This facility is not expected to be operational as long as the Arlington, Oregon site continues to accept shipments from Washington (Ref 40).

5
N260.02
4

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 private residences.

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 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. 6

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

Phytoplankton in the Hanford Reach are derived from reservoirs and periphyton upstream of the intake/discharge site. Because of the unimpounded nature of the Reach and the rapid transport through the Reach, phytoplankton are 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. 6 E290.04

Diatoms are the dominant algae in the Columbia River, usually representing over 90 percent of the population (Figure 2.2-10). The main genera in the vicinity of the S/HNP intake/discharge 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 phytoplankton 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. 4 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 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.

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).

4

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.

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 6
per volume of Columbia River phytoplankton occurred on only N210.08
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.

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, 58). 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 4,659 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, 58, 60).

2.2.2.3 Macrophytes

Fluctuating water levels, strong currents, and rocky 4
substrate inhibit the development of a rooted macrophyte
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 down- 6
stream in the vicinity of the S/HNP discharge. Where they E290.06
exist, macrophytes are of great significance. Aquatic vegetation 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,
<u>Potomogeton</u> <u>crispus</u>. Pondweed is common among quiet pools,
and is most visible at reduced flows after summer growth.
Emergent macrophytic vegetation, including rushes (<u>Juncus</u> 4
spp), sedges (<u>Carex</u> spp) and cattails (<u>Typha</u> <u>latifolia</u>),
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
summer and early fall. <u>Bosmina</u> 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. 4

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, 64-66).
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
constitute a major component of the diet of 0 age chinook
salmon during some years. The best scientific judgment is 6
that at Hanford, juvenile salmonids are opportunistic
feeders and they may occasionally take advantage of E290.07

zooplankton blooms. Evidence does not indicate that 6 zooplankton populations at Hanford are critical to the E290.0 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).

2.2.2.5 Benthos 4

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. With few exceptions, numbers are lowest in June and July, increase dramatically in September and October 6 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 (Refs 53, 57-59, 64-66). E290.0

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 from June 1973 through March 1980 (Refs 49, 53, 57, 58, 59, 60, and 64) and indicate that benthic invertebrates are important food items. Tables in these references contain macro and microscopic stomach content and analysis includ- 6 ing percent volume and percent frequency of food items E290.08 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.

2.2.2.6 Fish

Forty-four species of fish (Table 2.2-19), thirty-nine resident and five anadromous, have been identified in the Hanford Reach of the Columbia River (Refs 56, 68). None of these species are presently considered rare or endangered (Refs 63, 69, 70). Several species of salmon are considered as species of concern. Twelve fish species have been identified for this document as important species in the Hanford Reach (Table 2.2-20). 4

Criteria for designating a species as important were taken from (a) U.S. NRC Regulatory Guide 4.2, Rev 2 and (b) 316(a) Technical Guidance Manual, May 1, 1977, Draft, EPA, which respectively state the following: 6 E290.19

a. "A species is 'important' (for the purposes of this guide) if a specific causal link can be identified between the nuclear power station and the species and if one or more of the following criteria applies: (a) the species is commercially or recreationally valuable, (b) the species is threatened or endangered, (c) the species affects the well-being of some important species within criteria (a) or (b), or (d) the species is critical to the structure and function of the ecological system or is a biological indicator of radionuclides in the environment."

b. Representative, important species are those species which are: representative, in terms of their biological requirements, of a balanced, indigenous community of shellfish, fish, and wildlife in the body of water into which the discharge is made. Specifically included are those species which are: 6

   1. Commerically or recreationally valuable

   2. Threatened or endangered

   3. Critical to the structure and function of ecological system (e.g., habitat formers);

   4. Potentially capable of becoming localized nuisance species;

   5. Necessary (e.g., in the food chain) for the well being of species determined in (1) through (4); or

6. Representative of the thermal requirements of important species but which themselves may not be important.

Although other species of fish found in the Hanford Reach may arguably qualify for the designation as "important," the twelve species listed in Table 2.2-20 more closely conform with the above criteria and provides an adequate basis for analyzing any impacts of S/HNP. 6

Hanford Slough is located upstream of the proposed intake and discharge structures for S/HNP and is one of four large backwater areas found in the Hanford Reach. Characteristics unique to the slough environment include weak currents, mud substrate, and resultant rooted aquatic macrophytes. Hanford Slough provides important spawning and rearing habitat for a variety of fish species. Smallmouth bass utilize gravel and rock areas for spawning. Since bass move from the sloughs to downstream areas including the Yakima River, fish reared in Hanford Slough contribute to the area sport fishery. Sand and mud bottom areas at the upper end of Hanford Slough are used for spawning by 6
largemouth bass and brown bullhead. N210.09
In addition, smaller centrachids, including bluegill and pumpkinseed, spawn in the shallow shoreline areas. Aquatic vegetation provides food and shelter for juvenile fish. Hanford Slough provides important rearing habitat for juvenile salmon in the spring because of generally warmer water and lack of current.

Chinook salmon fry reside in all Hanford area sloughs during their out-migration. Observations over the years by Battelle-Northwest biologists indicate that chinook salmon fry emerging from redds in the Hanford Reach of the Columbia Rier are observed in the sloughs generally from March through June. Length of residence is dependent upon river flows and water temperatures. Chinook salmon released from upstream hatcheries have been observed in the Hanford Slough as late as mid-July.

2.2.2.6.1 Important Anadromous Fishes

Anadromous fish utilizing the Hanford Reach include chinook (Oncorhynchus tshawytscha), coho (O. kisutch) and sockeye salmon (O. nerka), steelhead trout (Salmo gairdneri) and American shad (Alosa sapidissima). These species are of 4
regional and international importance as recreational and commercial resources. Within the Hanford Reach, the Columbia River serves as a migration route for the salmon, trout and shad which spawn upstream. In addition, the

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 Chinook salmon. Fall chinook (Oncorhynchus tshawytscha) 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. Estimates of fall chinook utilizing the Hanford Reach are presented 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). 6 E290.12

The upstream portion of this spawning habitat is located 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 4 average of 20,000 fish, or approximately 15 to 20 percent of the total fall chinook escapement to the river (Ref 73).

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.

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. 4

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).

Based on frequency of occurrence and volume, various stages of aquatic insects, mainly caddisfly (Trichoptera) and midge flies (chironomidae) are the major food items of 0-age class chinook salmon fry (Refs 94, 96). Feeding trends are related to seasonal availability of various food items. As the fry increase in size, they select larger food items. Caddisfly adults and cladocerans are important components of the diets of juvenile fall chinook salmon 50-80 mm long.

Because smolts are larger than fry, their food habits can be expected to differ. Adult caddisflies and midge fly pupae represent the greatest food items by number and volume of spring chinook smolts (Refs 84, 95, 96).
Caddisfly larvae, fish, spiders and midge fly larvae and 4
adults are also taken. Predation by salmon smolts on salmon fry occurs (Refs 84, 94, 96).

Salmonids are the most thermally sensitive species near the S/HNP (Ref 50). Preferred temperatures reported for chinook salmon range between 53.6 and $55.4^{\circ}F$ for juveniles acclimated at $68^{\circ}F$ (Ref 121), and 60.0 to $63.0^{\circ}F$ for adults (Ref 62, 120). For fall chinook juveniles the upper lethal threshold ranges from 75.8 to $76.1^{\circ}F$ at acclimation temperatures between 52.0 and $68.0^{\circ}F$ (Ref 123). Experiments with chinook salmon adults suggest that the incipient lethal temperature is lower than for juveniles, 70.0 to $71.6^{\circ}F$ (Ref 124).

Toxicity of chlorine to the chinook salmon and other sensi- 6
tive fish species found in the Hanford Reach is presented in Table 2.2-23.

2.2.2.6.1.2 Rainbow/steelhead trout. While adult steelhead (*Salmo gairdneri*) migration into the Hanford Reach occurs in all months of the year, peak movements over McNary and Priest Rapids Dams occur in August and September. Watson (Ref 76) presents data suggesting that adult steelhead hold over in the Hanford Reach during late fall and winter before continuing over Priest Rapids Dam to
spawn upriver in the spring. Numbers of adult steelhead 4
trout passing Priest Rapids Dam (April-October only) from 1962 to 1977 have ranged from 2,500 to 13,000 fish (Ref 82), and average approximately 9,700 fish (Ref 76). The annual estimated 1963-1968 sport catch in the section of river from Ringold to the mouth of the Snake River (a distance of about 30 miles) was approximately 2,700 fish. Watson estimates that up to 10,000 steelhead are available to spawn in Hanford Reach between Ringold Springs and Priest Rapids Dam (Ref 76). However, actual spawning
grounds for rainbow/steelhead trout have not been 6
documented in the Hanford Reach. High river flows and E290.14

reduced visibility during the spawning season hinder aerial observations. Fickeisen et al. (Ref 63) reported probable spawning areas at Vernita Bar, Coyote Rapids, Locke Island 6
and Ringold based on aerial sightings by D. Watson of E290.14
Battelle. Substrate in the vicinity of the proposed intake and discharge area is considered unlikely spawning habitat.

Spawning occurs from January through May and egg incubation takes place in the gravel from February through June (Ref 83). Fickeisen et al. (Ref 63) estimate the annual natural steelhead production for the Hanford Reach at 1.6 million juveniles. Another 0.2-0.4 million juveniles are estimated to be produced from areas above Priest Rapids Dam (Ref 75). In addition to natural production, the Washington State Department of Game releases approximately 0.2 million steelhead at the Ringold Rearing facilities (RM 354). Therefore, the total number of juvenile steelhead trout passing through the Hanford Reach each year is estimated to be approximately 2.0 million. This production, however, has recently increased. The Federal Energy Regulatory Commission (FERC) settlement agreement (Ref 125) with the Mid-Columbia Public Utility Districts has requested increased upriver steelhead production.

Most young wild steelhead trout spend from one to three years in fresh water and move seaward from March through June. Most releases from the Ringold Rearing Pond remain in the general area for about a month and a few may overwinter in the Hanford Reach (Ref 84). Downstream 4
migration of juvenile steelhead trout past Priest Rapids Dam from 1965 through 1967, and in 1976 and 1977 occurred from mid-April to early July with peak movement in mid-May (Refs 75, 85).

Stomach content analyses of rainbow trout collected in the Hanford Reach showed caddisfly larvae, pupae and adults, midge fly pupae, other insects, and fish are major food items (Refs 94, 95, 96). An increase in caddisfly adults in summer stomach samples coincides with emergence of these insects.

It is uncertain whether adult steelhead trout feed during their upstream migration, although they will take salmon eggs, worms or shrimp on hook and line. Stomachs of all adult steelhead trout examined near WNP 1, 2 and 4 were empty and atrophied (Refs 94, 95, 96, 84).

Adult and juvenile rainbow trout prefer temperatures ranging from 55.4 to 70.0°F (Refs 122, 126), and 51.0-72.5°F (Ref 49), respectively. Preferred temperatures of rainbow trout at acclimation temperatures potentially 6
present in the Columbia River are presented in Table 5.1-4.

The upper lethal temperature for juvenile rainbow trout ranges from 75.2 to 79.7°F (Ref 127). Coutant (Ref 124) reported a lethal threshold for adult steelhead trout of 70.0°F. 4

Toxicity of chlorine to the steehead trout and other sensitive fish species found in the Hanford Reach is presented in Table 2.2-23. 6

2.2.2.6.1.3 Coho salmon. The adult migration of coho salmon (Oncorhynchus kisutch) generally occurs in the Hanford Reach from July through October and peaks the last week of August. Fish passage counts from Priest Rapids Dam since 1960 indicate that the annual upriver spawning run of this stock has ranged from 29 to 13,212 and averaged 3,334 fish (Ref 77). 4

Spawning normally occurs in November and December; fry emerge from the gravel the following April. The freshwater residence period varies, but the majority of juveniles migrate during the spring of their second year as yearlings (1+ age class fish). Downstream migrating juveniles pass Priest Rapids Dam between April and September, with peaks in May and June (Refs 80, 86).

Coho salmon are not main stem spawners. Spawning grounds are located in tributaries to the Columbia River upstream of Priest Rapids Dam. Likewise, fry rearing areas are located upstream of the Hanford Reach. The 1+ juvenile coho migrate through the Reach. Exact vertical or horizontal distribution of the coho out-migrants is unknown. Because of their size (80-180 mm) coho are anticipated to migrate somewhat further offshore than the 0-age chinook salmon. 6 E290.16 6 E290.17

Coho salmon yearlings feed mainly on aquatic insects, including Diptera, Trichoptera, Plecoptera and Coleoptera. Their diet also includes oligocheates, spiders and fish, including salmonid fry.

Coho salmon adults prefer temperatures between 56.3 and 62.0°F (Refs 121, 122) and coho juveniles prefer temperatures of 53.6 to 66.2°F (Ref 128). Blahm and McConnell (Ref 78) report the lethal threshold for juvenile coho ranges from 57.2 to 74.7°F for fish acclimated at temperatures of 50.0 to 57.2°F. Brett (Ref 121) reported upper lethal temperatures of 73.2 to 77.0°F for coho salmon accliminated at temperatures of 41.0 to 73.4°F. 4

Toxicity of chlorine to the coho salmon and other sensitive fish species found in the Hanford Reach is presented in 6

Table 2.2-23. Cherry, et al. (Ref 139) found a threshold avoidance of 0.05 mg/liter of total residual chlorine by coho salmon. 6

2.2.2.6.1.4 Sockeye salmon. The adult migration of sockeye salmon (*Oncorhynchus nerka*) occurs through the Hanford Reach from June through August and peaks in mid-July (Figure 2.2-17). These fish pass Priest Rapids Dam on their way to spawn in tributaries or outlets of lakes in the Wenatchee and Okanogan River systems. Fish passage 4 counts from Priest Rapids Dam since 1960 show that the annual spawning run of this stock has ranged from 17,529 to 170,071, and averaged 63,228 fish (Ref 77).

Spawning occurs in September and October, and fry emerge from the gravel the following spring. Juvenile sockeye spend one to three years in the lakes prior to migrating to the ocean. Downstream migrating juveniles pass through the mid-Columbia River area in April and May, and occasionally in June (Refs 86-88). Precise distribution of sockeye 6 migrants in the river is unknown. E290.18

Unlike other species of Pacific Salmon, sockeye reportedly feed on small plant and animal organisms strained from the water by numerous fine gill rakers (Ref 119). Insects are also taken. Microscopic analyses of gut contents from downstream migrant sockeye salmon collected near WNP 1, 2 and 4 showed that midge fly and caddisfly pupae are major food items (Ref 84).

Temperature preference of sockeye salmon ranges from 50.0 to 59.0°F for adults (Ref 102) and 53.6 to 57.2°F for juveniles (Ref 121). Upper lethal temperatures range from 70.7 to 76.5°F for juvenile sockeye acclimated at 41.0° to 73.4°F (Refs 121, 123, 124). Bouck et al. (Ref 129) show that adult sockeye can survive an average of 3.2 days at 72.0°F and 11.7 days at 68.0°F. 4

2.2.2.6.1.5 American shad. American shad (*Alosa sapidissima*) is a recreationally important species that in recent years has increased in abundance in the Hanford Reach. Shad were introduced into the Columbia River from the Atlantic Coast almost a century ago. They became abundant as far as Celilo Falls, which may have prevented their upstream dispersion. The upriver portion of the shad run increased immensely following the construction of The Dalles Dam in 1957, and again following construction of the John Day Dam in 1966. Impounding the Columbia River for hydroelectric purposes has been an aid to the proliferation of the shad runs. Shad are not strong swimmers, and the 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 species. Shubel et al. (Ref 131) state that the lethal 4
limit for juvenile American shad is $83.3^{\circ}F$.

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.

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). 4

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, 58-60). Although specific spawning sites in the Hanford Reach have not been documented, areas outlined in Figure 2.2-19 appear to have suitable flow and bottom type.

Fry emergence occurs annually in the Hanford Reach in early April (Refs 53-55, 58-60). The Hanford Slough slackwater 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. 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. 4

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

2.2.2.6.2.2 White Sturgeon. White sturgeon (*Acipenser transmontanus*) are recreationally important fish in the Columbia River between Priest Rapids and McNary Dams. Sturgeon are bottom dwellers, primarily scavengers, that feed on crustaceans and molluscs, most notably the crayfish and freshwater mussels present in the Hanford Reach (Ref 93). White sturgeon have been collected near the Hanford Generating Project (RM 382) in 1973 and 1974 (Ref 89), and throughout the year near WNP 1/4 and 2 (RM 352) from 1974 through 1978 (Refs 84, 94-97).

Data indicate that temperature may directly affect sturgeon activity (Refs 98, 99). As temperatures move above 55.0°F in June each year, long distance movements and localized shallow movements begin. Movements cease by late October 4
as temperatures fall below 55.0°F (Ref 98). Thermal tolerance data are generally lacking for this species.

Sturgeon usually spawn between May and July (Refs 83, 100-102) in swift currents over rocky or gravel substrates (Refs 101, 103-105) (Figure 2.2-20). Size characteristics of sturgeon taken in the Hanford Reach indicate the presence of a viable spawning population (Ref 63).

Sturgeon eggs hatch in one to two weeks depending on the water temperature (Refs 104-106). Although the Hanford Slough and other backwater sloughs are similar in description to known nursery areas, no fry have been collected in the Hanford Reach. Ichthyoplankton samples in the area of the proposed intake and discharge location for 6
S/HNP did not detect any white sturgeon eggs or larvae (Appendix K).

Although seasonal migration patterns may exist for lower Columbia River populations and land-locked populations, existence of anadromous upper Columbia River populations is not documented. Haynes et al. (Refs 98, 99) monitored movement of 29 white sturgeon in the Hanford Reach by radio tag and found no interdam movement. Bajkov (Ref 140) 6
reported that Bonneville Dam was nearly an impassible E290.20
barrier to sturgeon migration. Data from Hanford suggests that the land-locked population is sustaining itself.

2.2.2.6.2.3 Smallmouth Bass. Smallmouth bass (*Micropterus dolomieui*) are recreationally important fish throughout the Columbia and Snake River basins. Bass spawning occurs in at least three backwater sloughs of the Hanford Reach (Ref 107): Hanford Slough, 100-F Slough and White Bluffs 4
Slough (Figure 2.2-21). Spawning occurs in April through July and gravid females have been collected as late as

August. Nests are built in shallow water over gravel and rock substrate and seldom are located near perceptible 4
currents (Ref 107). Fry disperse among nearshore aquatic plants shortly after they emerge in July (Appendix K). 6

Montgomery and Fickeisen (Ref 107) conclude that minimal river fluctuations during nesting and a 45 day post-nesting 4
period is critical for the successful hatch and survival of bass fry. Hanford Slough experiences the most severe water level fluctuations of the three sloughs where spawning has been observed. The presence of mud and silt and the lack of available cover may also limit smallmouth bass spawning 6
in the Hanford Slough in comparison to other sloughs in the Hanford Reach (Appendix K). Although very few smallmouth bass nests have been observed in the Hanford Slough, some spawning does occur, and the slough provides important habitat for fry and juveniles (Ref 63). Adults typically return to the river in late summer. Smallmouth bass produced in the Hanford Reach provide stocks throughout the river at least as far south as the confluence of the Snake River and perhaps to McNary Dam (RM 292) (Ref 63).

Munther (Ref 118) noted diurnal changes in smallmouth bass distributions in the Snake River. At night the fish were motionless in quiet water, whereas in the early morning, bass would position themselves at the edge of the current for feeding. The fish would move with changing currents, staying at a vantage point for feeding at the edge of the 4
faster current.

Smallmouth bass fry eat crustaceans such as copepods and cladocerans. As they grow, the diet changes to insects and small fishes. Adult bass have been reported to eat insects, crayfish and fishes (Ref 115).

Adult smallmouth prefer water temperatures between 68.5 and 83.0°F (Refs 133, 134). Spawning temperatures are typically between 55.0 and 68.0°F (Ref 134). The upper

Largescale suckers spawn in the spring over a bottom of fine gravel or sand in shallow water (Refs 115, 119). 4 6
Data from the Hanford Reach (Ref 138) suggest that suckers initiate spawning at water temperatures of 43.0 to 50.0°F in April and peak in late May when temperatures are 54.0 to 59.0°F.

Hatching occurs about two weeks after spawning, at which time the fry are pelagic (Ref 115). During the summer, the mouth gradually moves to a subterminal position and the fry become demersal.

At the Hanford Reach, fry of 0.5 to 0.7 in. appear in shallow, nearshore areas in July. Fry less than 0.8 in. are found primarily in shallow protected pools out of the main river channel (Ref 50). Similarly, more yearling largescale suckers are collected in slough areas than in the main river (Ref 138).

Sucker fry eat small zooplankton when they are pelagic. After they become bottom dwellers, they feed on diatoms and plant remnants, cladocerans, copepods and aquatic insect larvae associated with the substrate (Refs 115, 119). Microscopic stomach content analysis of adult suckers in the Hanford Reach showed they ingest primarily periphyton 4
(Ref 94).

Block (Ref 127) reports a median lethal temperature of 85.0°F for juvenile largescale sucker acclimated at 59.0°F. Critical thermal maximum for adults ranged from 82.0 to 92.0°F at acclimation temperatures of 40.0 to 70.0°F (Ref 138).

Most female largescale suckers at Hanford mature in six to seven years when they each 40 cm FL. Males apparently mature one year earlier at approximately 37 cm FL (Ref 94). The growth rate declines rapidly after maturity.

2.2.2.6.2.7 Northern Squawfish. Northern squawfish (*Ptychocheilus oregonensis*) are highly prolific and are abundant residents of slow to moderate moving coastal streams and rivers. They are abundant throughout the Columbia River System. This long-lived species is present throughout the year at the Hanford Reach and has been the third most abundant resident species collected by all sampling methods (Ref 84, 94, 95, 96). Commercially and recreationally important fish species compose a large portion of their diet. By virtue of their large numbers, long life and predatory diets, northern squawfish are important in the structure and function of the aquatic ecosystem near the S/HNP intake/discharge location.

Nearshore gill net catches of squawfish are highest in spring and summer and lowest during winter. The seasonal 4 change in abundance may suggest that squawfish may become relatively inactive and overwinter offshore in deep water (Refs 94, 95).

No spawning or rearing data exist for northern squawfish in the Hanford Reach. Squawfish have been reported to spawn in a wide variety of areas in lakes and streams. They generally prefer rock substrate including cobble 5.75 cm in diameter, (Ref 141), wave-washed rubble imbedded in sand 6 and clay (Ref 142), or granite rubble (Ref 143). Ripe E290.21 squawfish have also been collected near shoal areas of sand and silt or by gravel and rubble near lake outlets (Ref 144). Reported spawning depths vary from lake shallows (Ref 142) to three meters (Ref 144).

Northern squawfish spawning occurs from late June to early August when water temperatures range from 57.0 to 65.0°F. No nest is constructed. The female broadcasts small, demersal, adhesive eggs over gravel or rocky substrates (Refs 83, 115, 119). The eggs hatch in about one week and 4 the young become free swimming in two weeks (Ref 115).

Squawfish fry first appear in late July in shallow vegetated pools. Large numbers of fry are routinely collected in slough areas at Hanford throughout the spring and summer. Juvenile squawfish are typically found in shallow nearshore areas along gravel or rubble shores or 6 near areas of submerged vegetation (Ref 144). Adults have E290.21 been collected throughout the river cross-section at Hanford (Ref 50).

Small squawfish feed primarily on insects both aquatic (mayflies, caddisflies, damselflies, water boatmen and dipterans) and terrestrial (grasshoppers and beetles). As the fish grows it becomes piscivorous. Squawfish are highly predacious on small fish, including their own species, cyprinids, yellow perch, stickleback, sculpin, suckers, and young salmon and trout (Ref 50). They additionally feed on crayfish and midge flies during all seasons. 4

Thermal tolerance data for juvenile northern squawfish indicate an upper lethal temperature of 84.7°F (Ref 50). Northern squawfish exposed to various thermal increments for 24 hours survived at 79.5°F and died at 91.0°F (Ref 127).

Female northern squawfish at the Hanford Reach mature in five to six years at about 32 cm FL. Males typically mature one year earlier at approximately 25 cm FL. Most

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

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 unidentified ichthyoplankton was incidentally collected in 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 6
samples resulting in one minute sampling time at each of N210.03
three depths; surface, mid-water column and within 1m of the bottom. Only a single species, <u>Cottus asper</u> 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 tows were made twice monthly for 5 and 15 minutes 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). Tows were made with a metered 550 micron mesh net having a mouth diameter of 30 cm and a length of 1m.

Five species of fish were captured in midstream ichthyoplankton 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 (<u>Cottus asper</u>). Two shad larvae (<u>Alosa</u>
<u>sapidissima</u>) and a single carp lavae (<u>Cyprinus carpio</u>) were 6
also identified in ichthyoplankton samples. Two chinook 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 ($\alpha = 0.05$) 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 $0.0630 \pm 0.0626/m^3$ N210.08 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 6 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 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 white-fish near Vernita, and 4,000 angler days for resident warm water species, primarily in sloughs and backwater areas for bass, walleye and sunfish.

2.2.2.7 Aquatic Food Chains

In general, the Columbia River consists of five trophic levels ending with man:

Primary Producer (eg, algae)	—>	Primary Consumer (eg, aquatic insects and herbivorous fish)	—>	Secondary Consumer (eg, fish)	—>	Tertiary Consumer (eg, piscivorous fish)	—>	Ultimate Consumer (eg, man)

Large rivers, particularly the Columbia River because it is of series of lentic reservoirs, contain a significant population of autochthonous (internal) primary producers (phytoplankton and periphyton) that provide the basic energy needs. The dependence of the free-flowing Columbia River in the Hanford Reach upon an autochthonous food base is reflected by the faunal constitutent, particularly herbivores in the second trophic level.

Filter-feeding insect larvae such as caddisfly larvae (Hydropsyche), and periphyton grazers such as limpets and 4
some mayfly larvae, are typical second trophic forms present. Absent are shredders and large detrital feeders (such as stonefly larvae) which are typical of smaller streams. The presence of large number of herbivorous suckers also attests to a significant periphytic population. Carnivorous species are numerous, as would be expected in a system of this size.

Most resident Hanford Reach fish species are opportunistic feeders, utilizing food items from different trophic levels. Primary food items for salmonids include juvenile and adult aquatic insects, mainly midge flies (Diptera) and caddisflies (Trichoptera), smaller fish and occasionally zooplankton. Generally there is an increased dependence on adult insect forms during the insect emergence period in summer (Refs 54-57, 60, 67, 108). Larval drift of the yellow perch and other resident fish (including catostomids) may constitute an important food item (Ref 109). Relatively few terrestrial insects are ingested by salmonids (Ref 67).

Zooplankton, juvenile fish and crayfish are important food items for other larger predatory fish, especially bass and squawfish. Conversely, suckers and chiselmouth ingest mainly periphyton (Ref 110).

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 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. 6

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

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.

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 4
reduced benthic production and loss of rooted macrophytes in littoral zones. Dams influence the survival of 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 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 (Ref 113).

2.2.2.8.3 Wastewater Discharges

Domestic sewage and miscellaneous industrial wastes have little direct effect on Columbia River fish stocks - (Ref 114). The problems typically associated with domestic sewage discharge, high nutrient additions and depressed oxygen values from organic decomposition, show little effect on the Columbia River, presumably due to the tremendous quantities of dilution water (Ref 113). The effects of industrial thermal discharges in the Hanford Reach, however, have been extensively documented. The previous effect of heated discharges in the Hanford Reach consisted of an approximate 1.8°F rise above ambient river temperature at Lake Wallula (Ref 114). No long term thermal effects on biological resources have been reported 4
(Ref 50, 120). Futhermore, previous reactor discharges contained trace levels of radioactive materials. To date no definite biological effects of radioactive releases have been observed in Columbia River fisheries resources.

No major infestations, epidemics or catastrophies have been reported to affect the aquatic biota of the Hanford Reach. Fish and other aquatic fauna have been subject to diseases such as frunculosis and columnaris in their natural populations during most years. The probability of disease enhancement is low (Ref 50, 120).

2.2.2.9 Threatened or Endangered Aquatic Species

No federally listed threatened or endangered aquatic organisms are known to occur within the Hanford Reach. 6
The Hanford Reach provides important habitat for several species of concern. Species dependent on free-flowing waters of the Columbia River have no other habitat available. The giant Columbia River limpet (*Fisherola nuttalli*) and the great Columbia River spire snail (*Lithoglyphus columbiana*) were once found throughout the Columbia and Snake Rivers. Their range is now apparently restricted to the Hanford Reach (Ref 61). In addition, all 4
species of Pacific salmon (*Oncorhynchus* spp.) and the steelhead trout (*Salmo gairdneri*) are considered important species (Section 2.2.2.6). Several races of salmon depend on the Hanford Reach, which includes the last remaining main stem spawning areas for fall upriver bright Chinook salmon (*O. tshawytscha*).

References for Section 2.2

1. R. F. Daubenmire, "Steppe Vegetation of Washington," Technical Bulletin 62, Washington Agricultural Experiment Station (February 1970).

2. D. H. Fickeisen, R. E. Fitzner, R. H. Sauer, and J. L. Warren, "Wildlife Usage, Threatened and Endangered Species and Habitat Studies of the Hanford Reach, Columbia River, Washington," Prepared for the U.S. Army Corps of Engineers, Seattle District, by Battelle, Pacific Northwest Laboratories (1980).

3. J. F. Franklin and C. T. Dyrness, "Natural Vegetation of Oregon and Washington," USDA Forest Service Technical Report PNW-8, Pacific Northwest Forest and Range Experiment Station (1973).

4. J. F. Cline, D. W. Uresk, and W. H. Rickard, "Plants and Soil of a Sagebrush Community on the Hanford Reservation," Northwest Science, 51 (1977), pp. 60-70.

5. B. F. Hajek, Soil Survey - Hanford Project in Benton County, Washington, BNWL-243, Battelle, Pacific Northwest Laboratories, Richland, Washington (April 1966), 16 pp. 4

6. J. F. Cline, D. W. Uresk, and W. H. Rickard, "Plants and Soil of a Sagebrush Community on the Hanford Reservation," Northwest Science, 51, 1 (1977), pp. 60-70.

7. J. B. Glad, Preoperational Terrestrial Monitoring Studies Near WNP 1, 2 and 4, Project D2671, Beak Consultants, Inc., Portland, Oregon (March 1981), 39 pp.

8. R. E. Fitzner, W. H. Rickard, L. L. Cadwell and L. E. Rogers, Raptors of the Hanford Site and Nearby Areas of Southcentral Washington, PNL-3212, Battelle, Pacific Northwest Laboratories, Richland, Washington (1981), 61 pp.

9. R. R. Olendorff, Raptorial Birds of the U.S.A.E.C. Hanford Reservation, South-central Washington, BNWL-1790, Battelle, Pacific Northwest Laboratories, Richland, Washington (1973), 45 pp.

salmon subjected to sudden increases in water temperature (draft). Seattle Biological Laboratory, U.S. Bureau of Commercial Fisheries, Seattle, WA, unpublished data. (1970) (Cited in EPA, 1973a).

124. C. C. Coutant, (1970). Thermal resistance of adult coho, Oncorhynchus kisutch, and jack chinook, O. tshawytscha, salmon and adult steelhead trout, Salmo gairdneri, from the Columbia River. BNWL-1508. Battelle, Pacific Northwest Laboratories, Richland, WA (1970).

125. Federal Energy Regulatory Commission, Order Settlement, Docket #E95 PUD #2 of Grant County, WA, PUD #1 of Chelan County, WA, PUD #1 of Douglas County, WA, and State Department of Fisheries vs. PUD of Grant County, WA (1979).

126. D. S. Cherry, K. L. Dickson and J. Cairns, Jr, 1975, Temperatures Selected and Avoided by Fish at Various Acclimation Temperatures, J. Fish Res. Board Can., 32:485-491, (Cited in Coutant, 1977).

127. E. C. Black, Upper Lethal Temperatures of Some British Columbia Freshwater Fishes, J. Fish. Res. Board Can, 10(4):196-210 (1953).

128. R. A. Stein, P. E. Reumers and J. D. Hall, Social Interaction Between Juvenile Coho (oncorhynchus kisutch) and Fall Chinook Salmon (O. tshawytscha) in Sixes River, Oregon, J. Fish. Res. Board Can, 29(12):1737-1748 (1972). 4

129. G. Bouck, G. Chapman, P. Schneider, D. Stevens and J. Jacobson, 1970b, Initial Studies of Tmperature Rquirements of Adult Sockeye Salmon, Oncorhynchus nerks, Adult Coho Salmon, Oncorhynchus kisutch, and Thermal-Chemical Requirements of Juvenile Steelhead Trout, Salmo gairdneri, in the Columbia River, (Cited in EPA, 1971).

130. M. B. Dell, personal communication, Fisheries Biologist for Grant County Public Utility District, Ephrata, Washington, (October 1981).

131. J. R. Schubel, et al,. Thermal Effects of Power Plant Entrainment on Survival of Larval Fishes; a Laboratory Assessment, Chesapeake Science 18(290) (1977).

132. T. H. Blahm, and W. D. Parente, Effects of Temperature on Chinook Salmon, Threespine Stickleback

and Yellow Perch in the Columbia River, Seattle Biological Laboratories, U.S. Bureau of Commercial Fisheries, Seattle, Unpublished data (1970) (Cited in EPA, 1973a).

133. W. B. II Horning, R. E. Pearson. Growth, Temperature Requirements and Lower Lethal Temperature for Juvenile Smallmouth Bass (Micropterus dolomieu Lacepede), Draft manuscript, U.S. National Water Quality Laboratory, Duluth, Mn. (1972).

134. Technical Advisory and Investigations Branch, Federal Water Pollution Control Administration, Temperature and Aquatic Life, Laboratory Investigations Series, Cincinnati, OH. (1967).

135. Water Quality Criteria, Environmental Studies Board, National Academy of Sciences, National Academy of Engineering, Washington, D. C. (1972).

136. S. E. Peterson, and R. M. Schutsky. Temperature Tolerance Studies on Freshwater Fishes, in: Proceedings of the Northwest Fish and Wildlife Conference, New Haven, Connecticut (February 23-26, 1975). 12 pp.

137. V. A. Cvancara, Studies on the Tolerance of Young of the Year Mississippi River Fish to Heated Waters, OWRT-C-4251(9037). (1973) 121 pp. (Cited in Talmage, 1978).

138. D. D. Dauble, Comparative Ecology of Two Sympatric Catostomids, Catostomus macrocheilus and Catostomus columbianus in the Middle Columbia River, Masters Thesis, Washington State University, Pullman, WA (1978) 98 pp.

139. D. S. Cherry, S. R. Larrich, J. O. Giattina, K. L. Dickson, J. C. Cairns, Jr., "Avoidance and Toxicity Responses of Fish to Intermittent Chlorination," Environ. Internat., 2 (1979), pp. 85-90.

140. A. D. Bajkov, "Migration of the White Sturgeon (Acipenser transmontanus) in the Columbia River," Ore. Fish. Comm. Res. Briefs, 3(2):8-21 (1951).

141. P. W. Jeppson, The Control of Squawfish by Use of Dynamite, Spot Treatment, and Reduction of Lake Levels. Prog. Fish. Cult. 19:168-171 (1957).

142. P. W. Jeppson and W. S. Platts, Ecology and Control of the Columbia Squawfish in Northern Idaho Lakes. Trans. Am. Fish. Soc. 88(3):197-201 (1959).

143. B. G. Patten and D. T. Rodman, Reproductive Behavior of the Northern Squawfish (Ptychocheilus oregonensis). Trans. Am. Fish. Soc. 98(1):108-111 (1969).

144. C. W. Hill, Observations on the Life Histories of the Peamouth (Mylocheilus caurinus) and the Northern Squawfish (Ptychocheilus oregonensis) in Montana. Proc. Mont. Acad. Sci. 22:27-44 (1962).

145. U.S. Army Corps of Enineers. Annual Fish Passage Report; Columbia River and Snake River Projects; Oregon and Washington. North Pacific Division. U.S. Army Corps of Engineers, Portland and Walla Walla Districts (1980).

146. Washington State Game Department, Fisheries Management Division. Project Report 81-19. 1980-1981 Columbia River and Tributary Tag Recovery. Mark L. Schuck, Project Leader.

TABLE 2.2-16

MACROPHYTES IDENTIFIED IN THE HANFORD REACH

Family	Species	Common Name	
Ceratophyllaceae	Ceratophyllum demersum	Coontail	
Cruciferae	Rorippa calycina	Rorippa (watercress)	
	R. islandica	Rorippa (watercress)	
	R. nasturtium-aquaticum	Rorippa (watercress)	
Cyperaceae	Carex athrostachya	Carex (sedge)	
	Scirpus validus	Bulrush	
Halogaceae	Myriophyllum spp.	Water milfoil	
Hydrocharitaceae	Elodea canadensis	Elodea, waterweed	
Juncaceae	Juncus articulatus	Rush	6
	J. balticus	Rush	
Lemnaceae	Lemna spp.	Duckweed	
Najadaceae	Potomogetan crispus	Curly pondweed, curled leaf pondweed	
	P. pectinatus	Pondweed	
Polygonaceae	Polygonum persicara	Buckweat	
Typhaceae	Typha latifolia	Cattail	

TABLE 2.2-17

ZOOPLANKTON TAXA COLLECTED IN THE HANFORD REACH

Coelenterata
- Hydra. spp.

Ectoprocta
- Bryozoa
  - Paludicellidae
    - Paludicella articulata

Nematoda

Rotifera
- Brachionidae
  - Kellicottia longispina
  - Keratella cochlearis
  - Kerratella (? quadrata)
  - Brachionus spp.
  - Euchlanis spp.
  - Kellicottia spp.
- Lecanidae
  - Lecane spp.
- Synchaetidae
  - Synchaeta spp.
  - Polyarthra sp.
- Testudinellidae
  - Testudinella spp.

Tardigrada

Annelida
- Oligochaeta
- Hirudinea

Arthropoda
- Cladocera
  - Leptodoridae
    - Leptodora kirdtii
  - Sididae
    - Sida crystallina
    - Latona spp.
    - Diaphanosoma spp.
  - Daphnidae
    - Daphnia spp.
    - Daphnia pulex
    - Daphnia middendorffiana
    - Ceriodaphnia spp.
  - Bosminidae
    - Bosmina longirostris
  - Macrothricidae
    - Macrothrix spp.
    - Dyocryptus spp.
  - Chydoridae
    - Pleuroxus spp.
    - Pleuroxus denticulatus
    - Alona costata
    - Alona quadrangalaris
    - Alona gutlata
    - Alona rectangula

4

TABLE 2.2-21

ESTIMATED NUMBERS OF ADULT AND JUVENILE ANADROMOUS FISHES UTILIZING THE HANFORD REACH

	Hanford Adults		Juveniles	
	Migrants[1]	Spawners	Outmigrants (Ref 63)	Yr. Class
Chinook Salmon				
Spring race	10,000	-	1.6 million	1
Summer race	22,000	-	1.8 million	0
Fall race	12,500	20,000	6.2 million	0
Coho Salmon	4,000	-	0.6 million	1,2
Sockeye Salmon	65,000	-	1.6 million	1,2,3
Steelhead Trout	10,000	10,000	2.2 million	1,2
American Shad	8,500	-	NA	NA
TOTAL Anadromous Species	132,000	30,000	14.0 million	

[1]Average number of fish migrating through the Hanford Reach and counted at Priest Rapids Dam since 1960 (Ref 77).

4

TABLE 2.2-21a

ESTIMATE OF ADULT FALL CHINOOK UTILIZATION OF THE HANFORD REACH

Year	McNary Dam Count (Ref 145)	Ice Harbor Dam Count (Ref 145)	Yakima River Escapement (Ref 73)	Priest Rapids Dam Count (Ref 77)	Interdam Population (Estimate)	Peak Hanford Redd Count (Ref 72)
1960	47,337			10,687		295
1961	41,200		87	11,108		939
1962	44,116	30,049	15	10,082	3,970	1,261
1963	57,363	13,537	324	17,563	25,936	1,303
1964	58,593	11,097	120	14,760	32,616	1,477
1965	76,326	12,354	198	21,149	42,625	1,789
1966	75,119	15,018	405	18,821	40,875	3,101
1967	73,087	19,022	531	12,375	41,159	3,267
1968	72,757	24,377	186	11,031	37,163	3,569
1969	79,375	17,507	2,487	12,367	47,014	4,508
1970	61,554	10,385	1,830	16,372	32,967	3,813
1971	69,718	11,004	2,090	10,591	46,033	3,600
1972	49,307	9,436	1,480	5,782	32,611	876
1973	73,253	8,353	2,200	10,083	52,617	2,965
1974	62,009	2,814	1,860	7,618	49,717	728
1975	68,719	2,558	2,060	13,365	50,736	2,683
1976	87,991	1,474	2,640	10,774	73,103	1,951
1977	84,370	1,756	2,531	6,856	73,227	3,240
1978	44,145	1,609	1,324	6,523	34,689	3,028
1979	49,961	2,074	1,499	7,727	38,661	2,983
1980	38,910	1,744	1,167	8,442	27,557	1,487
1981	N.A.	N.A.	N.A.	N.A.	N.A.	4,866

N.A. = Data not available.

6
E290.12

TABLE 2.2-21b

CALCULATION OF AVERAGE FALL CHINOOK INTERDAM POPULATION AND ESTIMATE OF THE NUMBER OF FISH UTILIZING HANFORD REACH 1962-1978

Dam Counts		
McNary	68,354	(1)
Ice Harbor	11,921	(1)
Priest Rapids	12,474	(1)
Interdam Population	42,649	(1)
Yakima spawners	1,319	(1)(2)
Hanford spawners	17,376	(1)(3)
Ringold Springs	500	
Priest Rapids (volunteers)	380	
Unaccounted (Including sports catch and natural mortalities	23,083	(1)(4)

6
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 34 percent of the McNary count.

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						1982		Total	%
	Apr	May	June	July	Aug	Sept	March	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

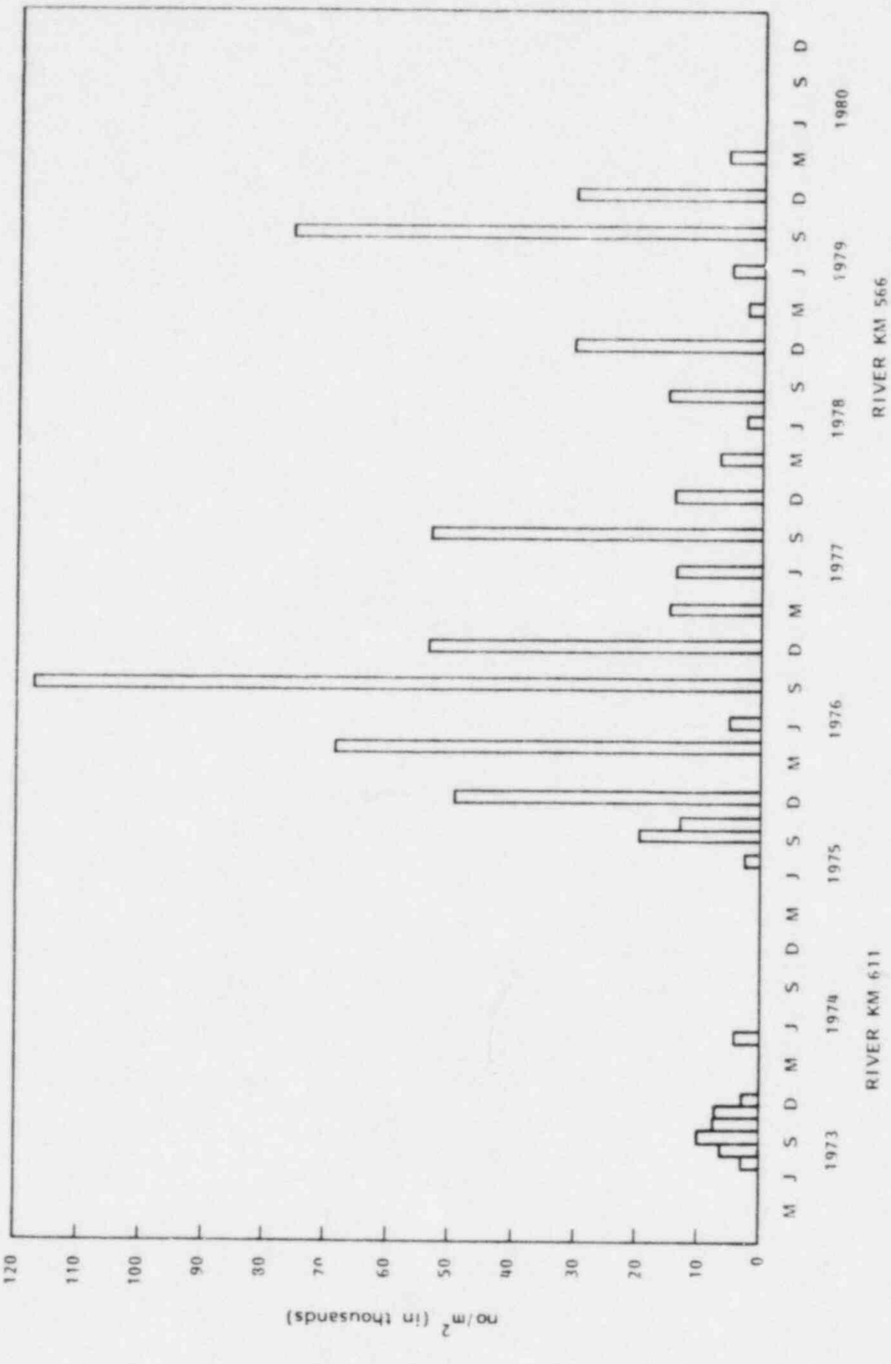
4

TABLE 2.2-23

TOXICITY OF CHLORINE TO 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
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

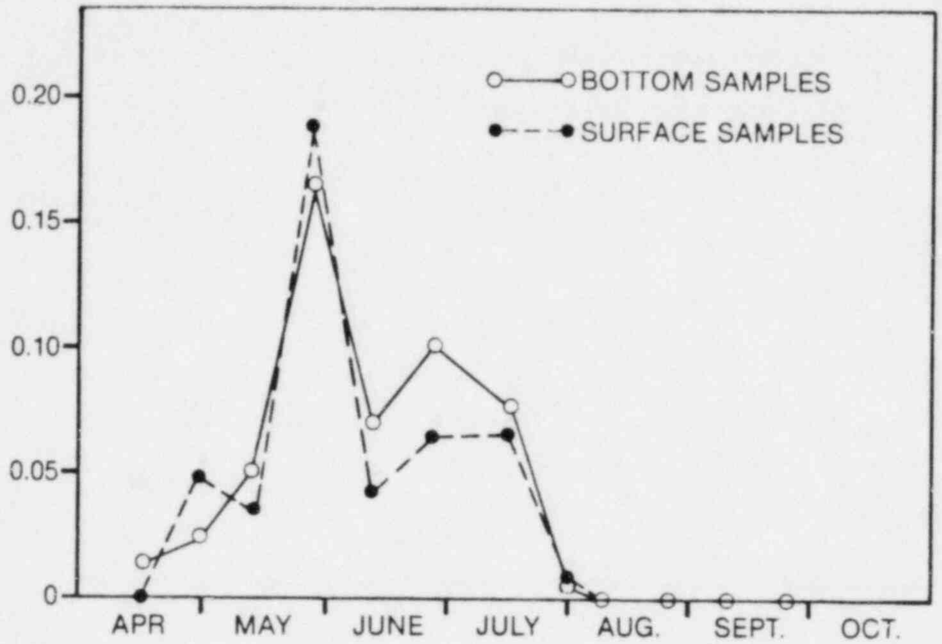
6



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

SEASONAL DENSITIES OF COLUMBIA RIVER MACROBENTHIC FAUNA

FIGURE 2.2-16



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

SPATIAL DISTRIBUTION OF ICHTHYOPLANKTON (APPENDIX K)

FIGURE 2.2-22a

transported is probably small, perhaps on the order of 10 percent of the total sediment load exclusive of dissolved materials. This estimate is based on the small amount of sediment transported on the bed of Bonneville Reservoir as calculated from rates of sand wave movement. Sediment transported as bedload is estimated at less than 10^9 kg per yr. In 1914, Van Winkle estimated that 6.4 x 10^9 kg of suspended matter were transported past Cascade Locks (Bonneville) in 1910-1911. In 1966, Hidaka et al. stated that the Columbia River transported 7.6 x 10^9 kg of suspended sediment past Vancouver, Washington, near the mouth of the Willamette River in 1962-1963 (Cited in Ref 11).

Table 2.4-7 gives particle size data for eight of the reservoirs of the Columbia River, based on 152 samples from near the center of the channel. Table 2.4-8 shows the mineral composition of the sediment while Table 2.4-9 shows the chemical composition (Ref 12).

Results from cation-exchange-capacity (CEC) determinations on sized sediments from the Columbia River and major tributaries are shown in Table 2.4-10 (Ref 13). A comparison of these data with data for streams throughout the continental United States indicates that sediments from the Columbia River and major tributaries have CEC values that generally are comparable to CEC values for other stream sediments in western and midwestern areas (Ref 13). The CEC values provide a measure of the capacity of the sediments to adsorb positively charged species in the water, including various radionuclides. 4

2.4.1.1.3 Intake/Discharge Locations

The location selected for the intake-discharge structure is River Mile 361.5. Intake and discharge points will remain at approximately mid-stream during mean and minimum flows of the river. An examination of the shoreline at the minimum flow shows the river to be the widest at the selected location, placing the intake and discharge locations farther from the shoreline than other locations in the vicinity (See Appendix B). The river channel geometry as obtained from the field survey program conducted for the S/HNP at the intake and discharge locations is presented in Figure 5.1-1. The vertical velocity distribution surveyed on May 8, 1981 at River Mile 361.5 is shown in Figure 2.4-7.

In March, 1981, SCUBA divers made visual observations of the river bottom substrate in the vicinity of the proposed S/HNP intake/discharge site. Divers reported a fairly 6 E290.24 E290.36

uniform bottom without significant topographic relief, consisting mostly of cobble (64-256 mm) and a few boulders (greater than 256 mm). Some gravel (2-4 mm) was reported in interstitial spaces. No major substrate differences were reported within the area observed. Analysis of this and other topographic data indicates a relatively smooth bottom profile and homogenous substrate. 6 E290.24 E290.36

Information obtained from geologic holes drilled near the intake location shows that the substrate consists of uncemented sands, gravels and silts to a depth well below the deepest excavation required for the installation of the intakes and discharge. 6 E290.28

2.4.1.1.4 Water Use

The primary uses of the Columbia River water for 50 miles downstream of the Skagit/Hanford Nuclear Project Site are for irrigation, and industrial and municipal water supplies of Richland, Pasco, and Kennewick. Water use is discussed and water users within 50 miles downstream of the Site are inventoried in Section 2.1.4. 4

2.4.1.1.5 Floodplain 6

The S/HNP Site is located about 7 miles southwest of the Columbia River in a small semi-arid drainage, upgradient of and separated from the Columbia River floodplain. There are no water bodies, including intermittent water courses, within or adjacent to the Site. The pumphouse is located at RM 361.5 on the Columbia River approximately seven miles from the Site and at an elevation of 390 ft. The elevation of the Columbia River 100-year regulated flood (one-percent or greater chance of flooding in any given year) is about 374 ft at the location of the intake structure (RM 361.5). Figure 2.4-7a is a copy of the USGS Hanford quadrangle. This figure shows the contours between RM 361 and 362. 6 N250.02(a

The floodplain analysis was based upon studies by the U.S. Army Corps of Engineers and Battelle Memorial Institute, Pacific Northwest Laboratories, and determined by the following steps:

1. The 100-year flood discharge rate was determined from the flood frequency curves in Figure 2.4-6. 6 N250.01(b

2. The elevation of the 100-year flood was determined from Figure 2.4-5.

Flood hazard boundary maps for Benton County have been prepared by the Department of Housing and Urban Development 6 (HUD), Federal Insurance Administration, but do not include N250.01(b the Columbia River near the intake and discharge structures.

The raw water pumphouse (elevation 390 msl) is about 16 6 feet higher than the 100-year floodplain elevation N250.01(c (elevation 374 msl). The intake and discharge structures present a total cross-sectional area of about 55 sq ft. The placing of the intake and discharge structures within the river cross-section means that the cross-sectional area of the river at that location would be increased by about 6 55 sq ft (cross-sectional area of the intake and discharge N250.01(d structures). With a river width of about 1,950 ft, this N250.01(e means that the river stage will increase by about 0.3 inches. Since these structures are on the river bottom and always under water, debris is not likely to accumulate.

2.4.1.2 Columbia River Temperatures

Water temperatures of the Columbia River have been studied both above and below the Site for many years (Refs 14, 15). Tables 2.4-11 and 2.4-12 present the monthly average and extreme daily temperatures just below Priest Rapids Dam at Vernita Bridge (1960-1980) at River Mile 388.1 and at Richland (1965-1980) at River Mile 340.8, respectively. A comparison of monthly average temperatures between the two locations is shown in Figure 2.4-8. Despite their separation by approximately 48 miles, the mean monthly temperatures for these two stations are nearly identical. They 4 differ at most by 1.0°C (1.8°F) in April and in August. In all instances, except for November and December, the mean monthly temperatures are less at Vernita Bridge than at Richland.

A slight warming trend from Vernita Bridge along the 48 miles of the Columbia River to Richland is suggested by the data plotted in Figure 2.4-8. The overall mean water temperature at Vernita Bridge is 10.8°C (51.4°F), which compares with a slightly higher value of 11.3°C (52.34°F) at Richland.

The long term monthly average temperatures at these locations range from a low of 3.2°C (37.8°F) in February to a

high of 19.3°C (66.7°F) in August. The minimum daily and monthly values are 0.0°C (32.0°F) and 0.9°C (33.6°F) and the maximum daily and monthly values are 21.5°C (70.7°F) and 20.2°C (68.4°F) (Tables 2.4-11 and 2.4-12). A diurnal variation in water temperature of about 1.2°C (2.2°F) in the spring and summer, and 0.6°C (1.1°F) in fall and winter, can be expected to occur as a result of diurnal 4
reservoir discharge variations from Priest Rapids Dam (Ref 15).

Upstream impoundments have influenced water temperatures by delaying the arrival of peak summer water temperatures, reducing summer water temperatures, and increasing winter water temperatures (Ref 16). The change in average annual silts and gravels from the Hanford formation; the unconfined aquifer, made up of lower Hanford and Ringold units; and the confined aquifer, made up of lower Ringold sediments and interbeds within the upper basalt flows.

The unsaturated (vadose) zone lies between the ground surface and the water table. Characteristically, this zone contains liquid water under less than atmospheric pressure, and water vapor and air or other gases usually at atmospheric pressure. In parts of this zone, interstices may be temporarily or permanently filled with water.

Within the Hanford Reservation, the unsaturated zone ranges in thickness from less than one foot near the Columbia River to over 350 feet beneath the 200 Area plateau and is bounded by the land surface and the water table. The unsaturated zone beneath the S/HNP Site is approximately 140 feet thick. The unsaturated zone is composed of sediments of the Hanford and/or Ringold Formations, depending on the position of the water table in a given area at a given time.

The unconfined aquifer consists of the Hanford and Ringold Formations, except along the Columbia River where Holocene alluvium is thick enough to extend below the water table. Table 2.4-22 shows the representative hydraulic properties
of the unconfined aquifer. Large differences in hydraulic 4
conductivity appear between the Hanford Formation and the middle Ringold unit, the two major geologic units of the unconfined aquifer. The Hanford Formation normally exhibits a hydraulic conductivity between 1,000 and 10,000 feet per day; whereas the middle Ringold averages 130 feet per day. Large differences in the range of conductivities found in the Ringold Formation may be due in part to the reworking of older Ringold sediments by streams of Hanford or glaciofluvial age which removed finer grained sediments and cementation thereby increasing the overall hydraulic conductivity of the Ringold Formation. This situation may exist at Wells 699-31-31 and 699-24-33 (Figure 2.4-10) where hydraulic conductivities are in excess of 7,000 feet per day. These permeable channels are reflected in the groundwater flow pattern of the region. Field-measured hydraulic conductivity values were determined from pump tests on wells in the vicinity of the S/HNP Site and are shown in Table 2.4-22.

There are little data available on storage coefficients and specific yields at the Hanford Reservation. Those presented in Table 2.4-22 are extracted from reports and are estimates for the unconfined aquifer. Reference 23 provided an areal estimate of 0.11 for the storage coefficient in the 200 West Area. This estimate was based on the

growth of the groundwater mounds between 1948 and 1953 and
the water disposal rate during this period. The range of
values was estimated as 0.006 to 0.35 for the unconfined
aquifer for the Hanford Area, but the quality of measure- 4
ment is poor.

Figure 2.4-11 shows water table contours for 1980.
Artificial recharge to the unconfined aquifer occurs near
the Hanford 200 East and 200 West Areas due to cooling
water disposal to ponds and liquid waste disposal to cribs.
Although these discharges have occurred primarily in U-
Pond, B-Pond, and Gable Mountain Pond (Figure 2.4-11a), the
effects on the water levels and flow system have been
widespread. Beneath Hanford, two groundwater mounds have
formed when more water has been discharged than could be
transported away in the same amount of time through the
unconfined aquifer. Beneath the 200 West Area, centered 6
below U-Pond, the water table has risen approximately 85
feet since the start of disposal operations in the mid-
1940's. The peak of the eastern mound beneath B-Pond
indicates that the water table in this area has risen in
excess of 20 feet. These two groundwater mounds indicate
that water, more or less continuously applied to ponds,
substantially recharges the unconfined aquifer. This
dramatic rise in the groundwater table over the last 35
years is evident in Figure 2.4-11b (Ref 22).

The combination of effects from the groundwater mounds has
raised the groundwater table approximately 20 feet near the
Site since 1945. B-Pond is about 5.5 miles northwest of 6
the S/HNP Site and U-Pond is about 10 miles west-northwest. E240.02
Disposal to U-Pond produces a groundwater mound on the
water table with an elevation greater than 480 feet MSL,
Figure 2.4-11. It would be difficult to separate out the
influences between the two mounds. Inspection of the
hydrograph of Well 699-20-20, Figure 2.4-11c, near the Site
shows the long-term trends produced by the disposal to the
ponds.

Decreased disposal to the U-Pond after 1972 has not reduced
groundwater elevations significantly. This may be due in
part to increased irrigation in Cold Creek Valley just west
of the Hanford boundary which recharges into this area.

The base of the aquifer is defined by either the silt and
clay sediment of the lower Ringold unit or the basalt
surface. The thickness of the aquifer ranges from zero to 4
30 feet. Where the Hanford formation extends below the
water table, it is generally composed of coarse sand,
gravel, and cobbles with occasional finer grained sedi-
ments. The Ringold Formation is divided into an upper,
middle, and lower unit, each having different textures.

The unconfined aquifer is dominated by the middle Ringold, which composed of sorted sands and gravels of varying cementation. The degree of cementing properties of this unit affects the hydraullic conductivity; the less the unit is cemented, the higher its hydraulic conductivity.

The lateral boundaries of the unconfined aquifer are identified by the anticlinal basalt structures which rim the Pasco Basin. These include the Saddle Mountains to the north, Umtanum and Yakima Ridges on the west, Rattlesnake and Horse Heaven Hills on the south, and on the east a broad monocline. The water table lies within the basalt in areas where the unconfined aquifer thins over bedrock; the most notable of these sites are Gable Mountain and Gable Butte located on the Hanford Reservation.

The confined aquifers within the basalt under the Hanford Reservation have been lumped into three major groups according to the basalt flow in which they lie: Saddle Mountains, Wanapum, or Grand Ronde basalts. The aquifers lying, within each basalt group tend to have similar hydrologic properties. Groundwater flows occur horizontally in the interbeds between the individual basalt flows and vertically where fractures of faulting occur. Although
understanding the confined aquifer system is essential to 4
understanding the regional hydrology, these aquifers play a relatively minor role in the safety analysis of S/HNP. For this reason, comments on the confined system are restricted to the uppermost group of confined aquifers, those of the Saddle Mountains basalt.

Groundwater in the Saddle Mountains confined aquifers occurs principally in the interbeds and interflows separating individual basalt flows. Flow rates are relatively small; hydraulic conductivities range between 1 and 100 feet per day (Ref 22). The groundwater flow in these aquifers is generally to the southeast across the Pasco Basin with discharge into the Columbia River between the Tri-Cities and Wallula Gap. Figure 2.4-12 is a piezometric or hydraulic potential map for the uppermost confined aquifer based on data through 1970. This map depicts the general groundwater flow and also shows that in places the hydraulic potential in the confined aquifer is greater than
in the overlying unconfined aquifer. The main exception is 5
in the vicinity of the Hanford 200 Area recharge mounds E240.03
which have raised the unconfined potential significantly.

The historical trend revealed, by the water table data, an
increase in groundwater levels near the 200 East and West 4
Areas these levels have, to a small degree, subsided in the last 10 years. Generally, the elevated groundwater table has spread down the hydraulic gradient to the south and

east raising the water table in the vicinity of S/HNP approximately 13 feet. Recharge from irrigation in Cold Creek Valley has contributed to the water table in the last 10 years. Recharge sources, waste disposal, and irrigation have all increased the slope of the hydraulic gradient from the Plant eastward toward the Columbia River. The contour spacing in the 1980 water table map shows gradients of 7 to 8 feet per mile. 4

There are several circumstances that could alter groundwater flow patterns in and around the S/HNP Site. Large groundwater withdrawals on-Site could change patterns and locally reverse the flow. Table 2.4-23 lists groundwater uses in the Pasco Basin. Wells used on the Hanford Reservation were discussed earlier in this section. The largest production wells located on the Hanford Reservation are at the WNP-1, 2, and 4 building sites. The reported usage of well water from WPPSS is 250,000 gallons per month. The major part is pumped from a well in the confined aquifer in the basalt. This figure represents less than 6 gpm. Because of the enormous volume of the unconfined aquifer, no measurable influence would be expected. 6 E240.04

FFTF is the closest facility (about 5 miles) to the S/HNP Site. The water table maps indicate the FFTF to be downgradient from the S/HNP Site and the water table elevation is approximately 15 feet lower. Groundwater usage is reported to be about 175 gpm. A high percentage of this is returned to the ground locally. Only a small local effect would be expected because of the enormous volume of the aquifer. 6 E240.05

The Purex Plant uses and disposes of large volumes of water imported from the Columbia River. A large percentage of this water is used as cooling water and disposed to B-Pond and Gable Mountain swamp. The effect is the increase in the water table evident in the hydrographs of the various wells, as discussed above. No groundwater is pumped for Purex Plant usage.

There are presently four monitoring wells and four piezometers that will be used to sample groundwater beneath the S/HNP Site. Table 2.4-24 lists the holes, the ground surface elevation, the depth to water and results of the field tests conducted on the four monitoring wells. 6

References for Section 2.4

1. Water Resources Data for Washington, Volume 2, Eastern Washington, U.S. Geological Survey Water-Data Report WA-79-2 (1979).

2. Pacific Northwest River Basin Commission, Hydrology and Hydraulic Committee, River Mile Index--Main Stream Columbia River, July 1962.

3. Pacific Northwest River Basin Commisison, Main Report, "Comprehensive Framework Study of Water and Related Lands," Vancouver, WA (September 1972).

4. Columbia River Instream Resources Protection Program (Program Document, Environmental Impact Statement and Proposed Regulation), State of Washington, Department of Ecology (June 1980).

5. G. H. Fernald, Jr., U. S. Department of the Army, Corps of Engineers, North Pacific Division, Portland, OR, Letter to M. J. Hroncich, Burns and Roe, Inc., Hempstead, NY (Feb. 7, 1972).

6. U.S. Army Corps of Engineers, Columbia River Treaty Flood Control Operating Plan, North Pacific Division, Portland, OR (October 1972). 4

7. R. G. Rickel, U.S. Department of the Army, Corps of Engineers, Walla Walla District, Walla Walla, WA, letter to R. Amish, NUS Corporation, Redmond, WA (Sep. 24, 1981).

8. N. E. Hutchinson, U.S. Geological Survey, Water Resources Division, letter to J. O'Brien, NUS Corporation, May 14, 1981, Computer Listing for Peak Flow Tables for USGS Gauging Station 12472800, Columbia River below Priest Rapids Dam, WA.

9. Columbia-North Pacific Region Comprehensive Framework Study of Water and Related Lands, Appendix VII, Flood Control, Pacific Northwest River Basins Commission (June 1971).

10. L. O. Merkle, U.S. Department of the Army, Corps of Engineers, Seattle District, Seattle, WA, Letter to R. Skaggs, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA (July 5, 1979).

11. J. T. Whetten, J. C. Kelly, and L. G. Hanson, Characteristics of Columbia River Sediment and Sediment Transport, Journal of Sedimentary Petrology, Vol. 39, No. 3, pp 1149-1166 (September 1979).

12. J. A. Stottlemyre, A Summary Report on the Geology and Hydrology of the Hanford Region, BNWL-2406, Battelle, Pacific Northwest Laboratories, Richland, WA (1972).

13. J. L. Glenn and R. O. Van Atta, Relations Among Radionuclide Content and Physical, Chemical, and Mineral Characteristics of the Columbia River Sediments, USGS Professional Paper 433-M, prepared in cooperation with the U.S. Atomic Energy Commission (1973).

14. R. T. Jaske, and M. O. Synoground, Effect of Hanford Plant Operations on the Temperature of the Columbia River 1946 to Present, BNWL-SA-845, Pacific Northwest Laboratories, Battelle Memorial Institute, Richland, WA (November 1970).

15. Nuclear Project No. 2, Environmental Report, Operating License Stage, Docket No. 50-397, Washington Public Power Supply System (1978).

16. R. T. Jaske, and D. G. Daniels, Simulation of the Effects of Hanford at the Washington-Oregon Border, BNWL-1344, Battelle Pacific Northwest Laboratories, Richland, WA (1970) 4

17. Pacific Northwest River Basin Commission, Water Quality and Pollution Control, Comprehensive Framework Study of Water and Related Lands, Appendix XII, Vancouver, WA (December 1971).

18. Environmental Surveillance Reports at Hanford, Battelle Northwest Laboratories, (1972-1979).

19. Unpublished data collected by the Environmental Surveillance Group, Battelle Northwest Laboratories, Richland, WA.

20. E. M. Greger, UNC Nuclear Industries Reactor and Fuels Production Facilities 1980 Effluent Release Report, UNI-1701, United Nuclear Industries, Richland, WA (March 1981).

21. National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit for the Hanford Generating Project (HGP), Washington Public Power Supply System, Permit No. WA 002487-2, Department of Ecology, State of Washington (March 10, 1981).

22. R. E. Gephart, et al. 1979. Hydrologic Studies Within the Columbia Plateau Washington: An Integration of Current Knowledge. RHO-BWI-ST-5, Rockwell Hanford Operations, Richland, WA.

23. R. C. Newcomb, J. R. Strand, and F. J. Frank. 1972. Geology and Groundwater Characteristics of the Hanford Reservation of the U.S. Atomic Energy Commission. USGS Geological Survey Professional Paper 717. Prepared in cooperation with the U.S. Atomic Energy Commission.

24. W. H. Walters, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. Letter to J. O'Brien, NUS Corporation, Rockville, MD (July 7, 1981).

25. W. H. Bierschenk, 1959. Aquifer Characteristics and Groundwater Movements at Hanford. HW-60601, General Electric Company, Richland, WA.

26. R. A. Deju, 1974. The Hanford Field Testing Program: ARH-C-4, Atlantic Richfield Hanford Company, Richland, WA.

27. K. L. Kipp, and R. D. Mudd. 1973. Selected Water Table Contour Maps for the Well Hydrographs on the Hanford Reservation, 1944-1973. BNWL-B-360, Battelle, Pacific Northwest Laboratories, Richland, WA.

28. V. L. McGhan, and D. W. Damschen. 1979. Hanford Wells, PNL-2894, Battelle, Pacific Northwest Laboratories, Richland, WA.

29. R. E. Gephart, Hydrologic Studies Within the Columbia Plateau Washington: An Integration of Current Knowledge, RHO-BWI-ST-5, Rockwell Hanford Operations, Richland, WA (1979).

TABLE 2.4-21

LOW VOLUME WASTE SAMPLED AT THE HANFORD GENERATING PROJECT
(March 1980-February 1981)

Sample Parameters		Max.	Ave.	Min.
pH	--	--	--	--
	--	8.7	--	6.2
Suspended Solids	#/day	4.46	0.43	--
	mg/l	3.1	0.93	0.5
Oil & Grease	#/day	1.01	0.31	--
	mg/l	1.8	0.59	0.5
Total Iron	#/day	0.2	0.041	--
	mg/l	0.25	0.082	0.05
Total Copper	#/day	0.1	0.029	--
	mg/l	0.2	0.058	0.01

Source: Reference 21

4

TABLE 2.4-22

RESULTS OF PUMPING TESTS COMPLETED WITHIN THE UNCONFINED AQUIFER

Source of Data[(a)]	Hanford Test Site Coordinates	Test Interval[(c)]	Hydraulic Conductivity (ft/day)	Transmissivity (ft^2/day)	Remarks
1	699-17-5	MR	17	750	8-hour test
3	699-20-20	MR	150	30,000	No drawdown data 3-hour recovery
1	699-24-33	MR-H	8,600	386,000	Data as reported
2	699-26-15	MR	200	9,500	8-hour test
3	699-15-26[(d)]	MR	320	71,000	8-hour test
1	699-31-31	H	7,100	247,000	8-hour test

(a) Sources of Data:
  1) Reference 25
  2) Reference 26
  3) Reference 27

(b) Reference 28

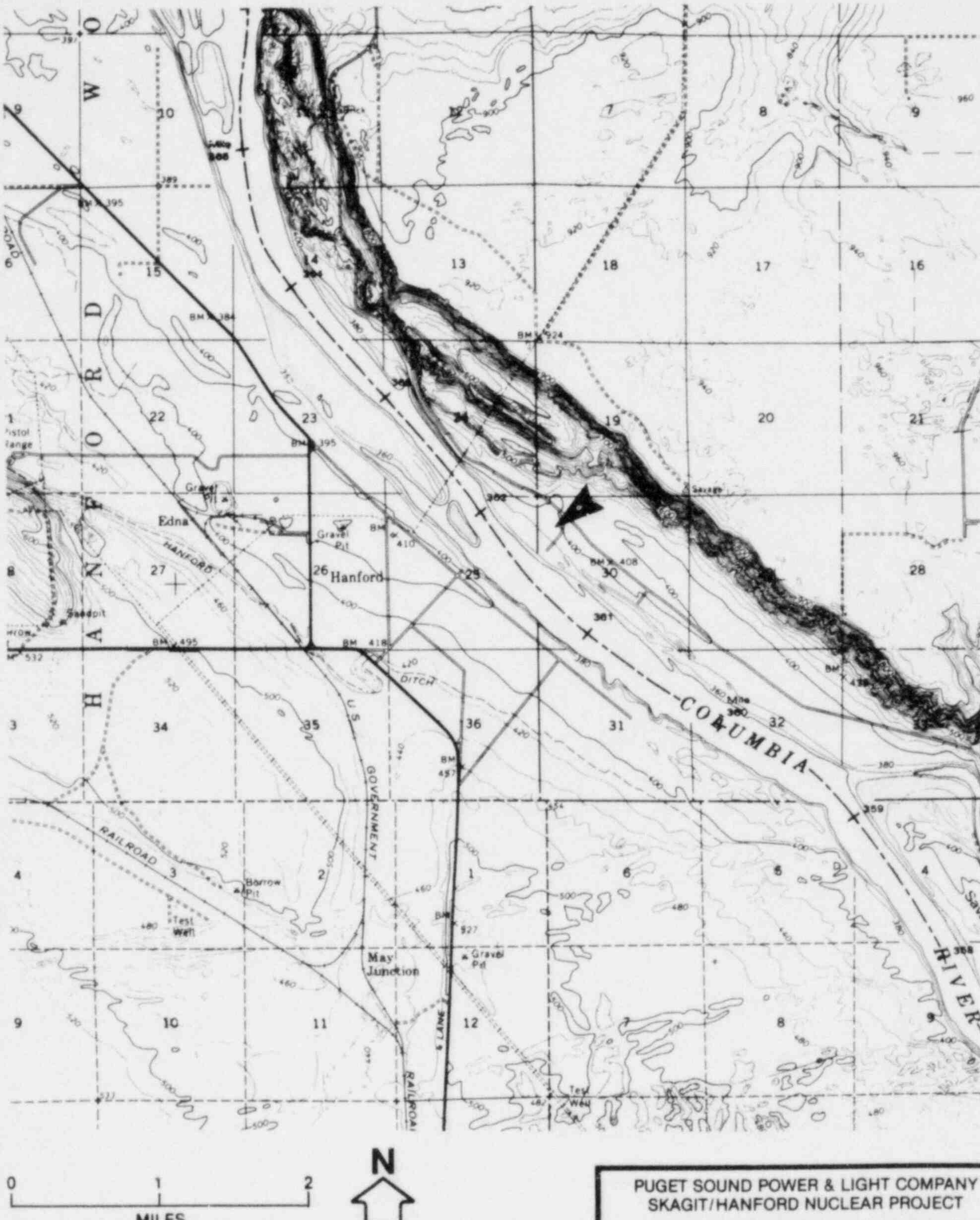
(c) Tested Interval:
  H - Hanford Formation
  MR - Middle member of Ringold Formation
  LR - Lower member of Ringold Formation

(d) Former designation 699-14-27.

4

6

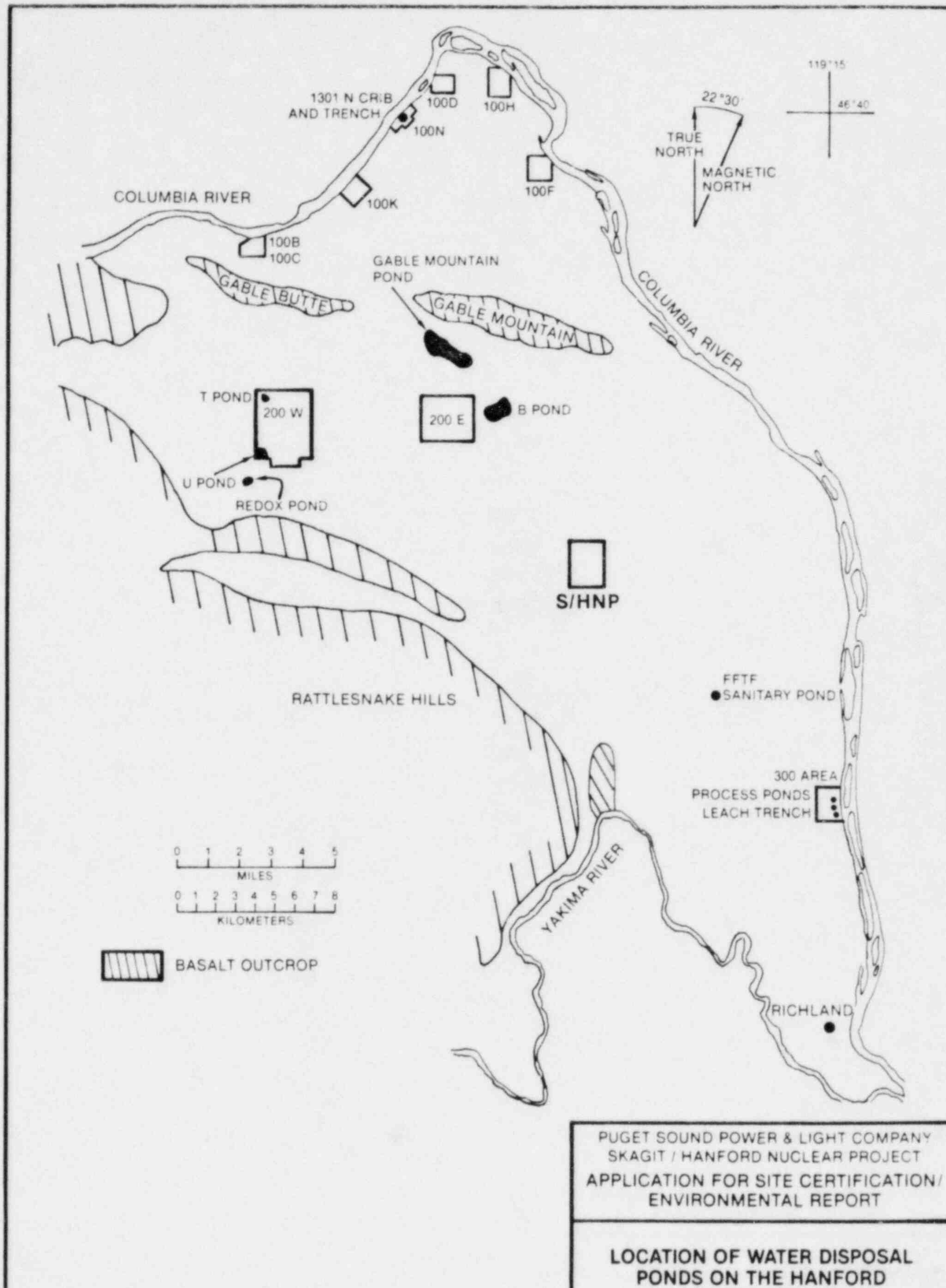
4



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

SHORELINE ELEVATION CONTOURS BETWEEN RIVER MILE 361 AND 362

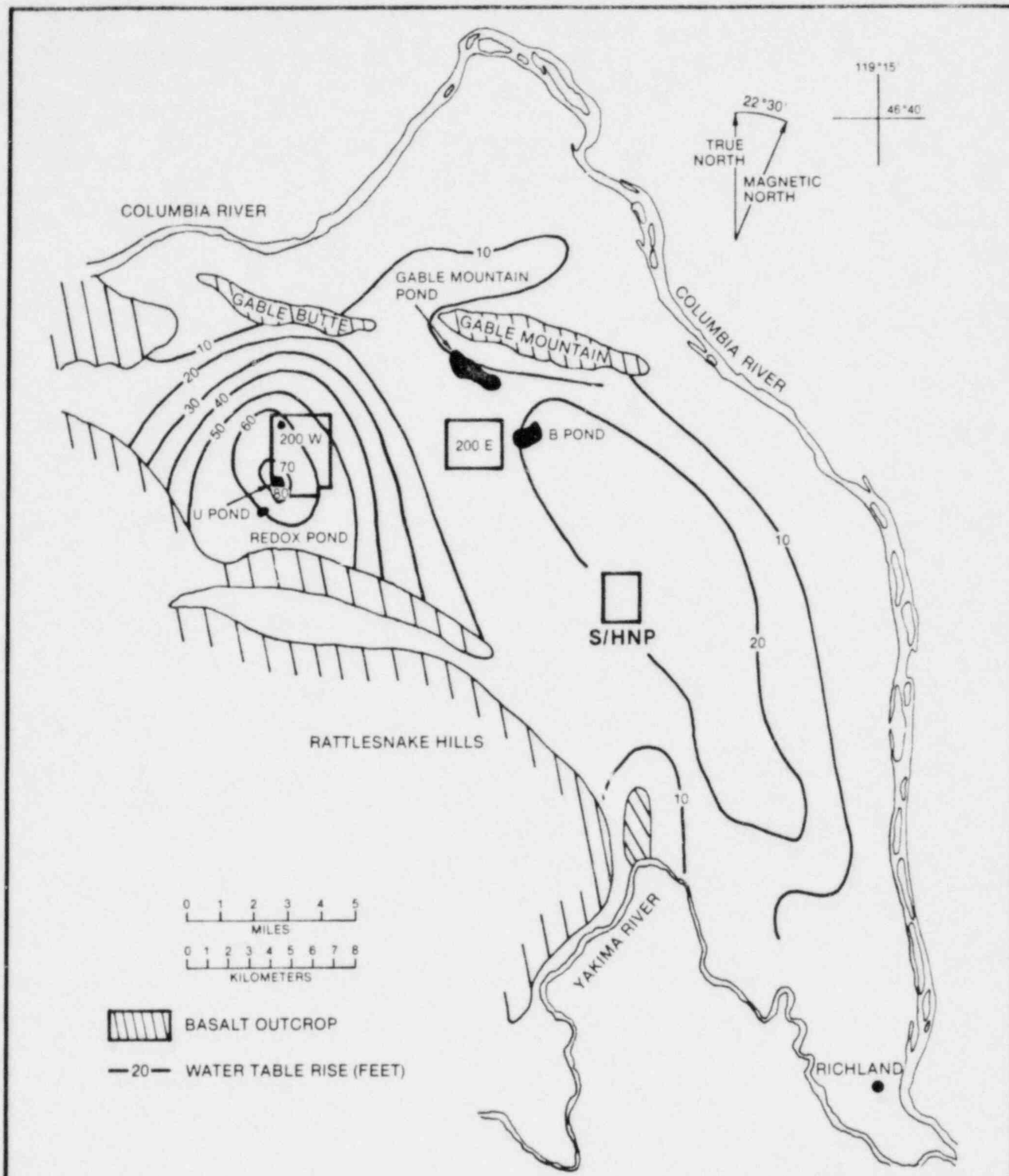
FIGURE 2.4-7a



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

LOCATION OF WATER DISPOSAL PONDS ON THE HANFORD RESERVATION

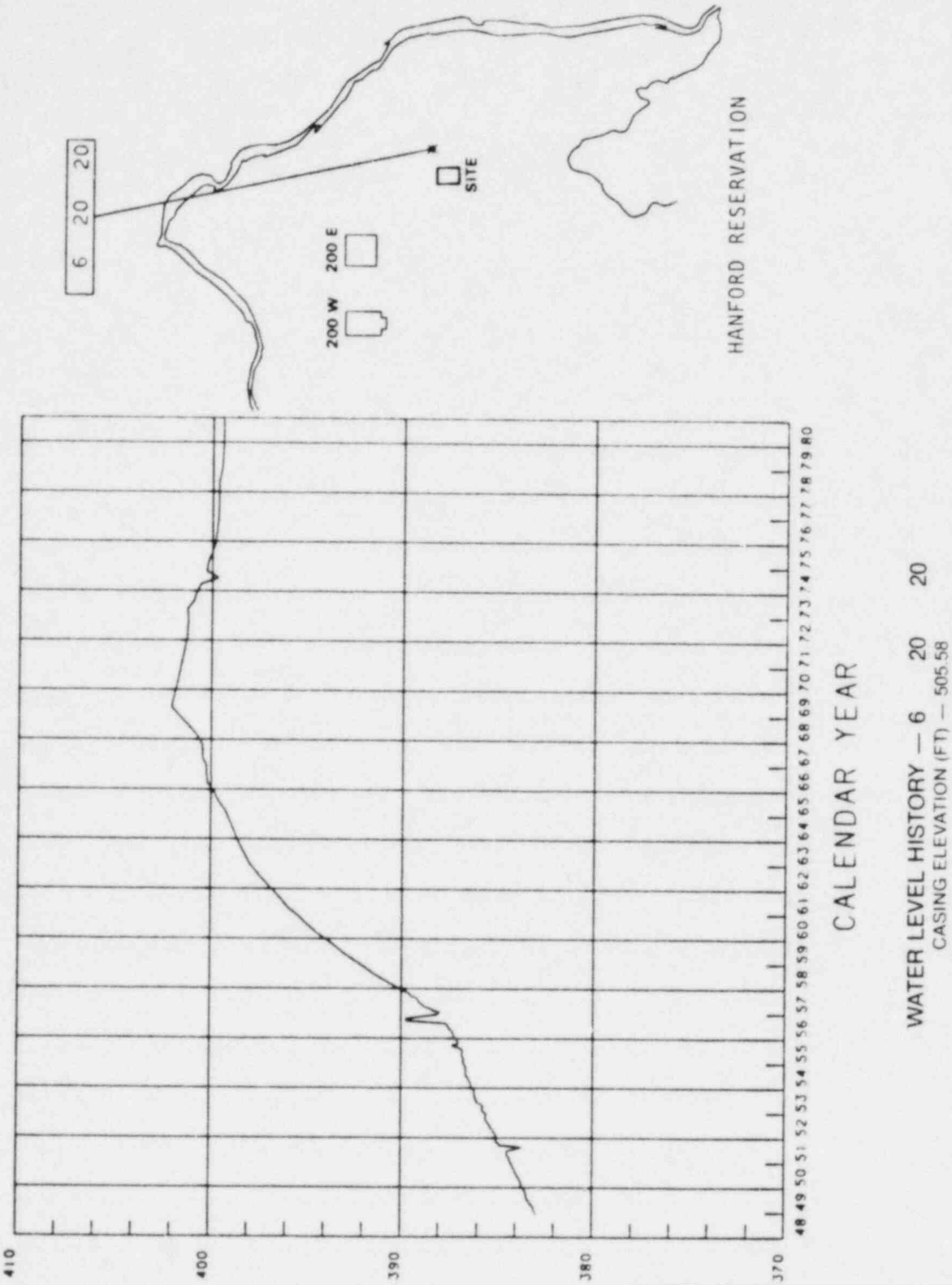
FIGURE 2.4-11a



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

WATER TABLE RISE BENEATH THE HANFORD RESERVATION

FIGURE 2.4-11b



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

WATER TABLE ELEVATION AT HANFORD WELL 699-20-20 FOR 1948 - 1980

FIGURE 2.4-11c

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. 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 have been carried out by Ertec Northwest, Inc., in order to provide information on cultural resources for this report. 4

2.6.1.2 Archaeological and Historical Methods

A study was carried out for the first two phases of the 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,
consultations with agency and academic personnel familiar
with the area, and interviews of long time residents of the
area. 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). 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.

The level of fieldwork appropriate for Phase 2 of the cultural resources program was a field reconnaissance of the areas most likely to contain cultural resources. Because the S/HNP facilities are located primarily within the Columbia River hinterlands which have not produced many cultural resources, this level of reconnaissance should provide data sufficient for a general environmental impact assessment, especially when combined with the results of the intensive survey of Section 33 (Ref 1).

The field reconnaissance, which included a survey along the
river and field checks at locations of other facilities, 4
was conducted between May and July 1981 (Figure 2.6-3).
Literature reviewed and agencies and personnel contacted
are listed in the reference section (Ref 2). An intensive
field survey of the areas to be impacted by the construction of the Plant and associated facilities will be performed during Phase 3 of the culural resource program. The methodology proposed for this intensive survey will be presented to the Washington State Office of Archaeology and Historic Preservation staff for their comments.

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 microenvironments 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 area were recorded.

historic information is unknown; it has been disturbed by construction and dismantling activities and may lack the 4
degree of integrity necessary to provide interpretation.

Additionally, some prehistoric and historic remains have been detected at the proposed location for the raw water pumphouse. Further investigations and evaluations will be
undertaken in consultation with the Washington State 6
Historic Preservation Officer to determine whether the remains have any archaeological significance.

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 repre- 4
sented 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.

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 seasonal and locational limitations, and for hiking and wildlife observations. 4

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 workers from the Hanford Reservation.

References for Section 2.6

1. D. Rice, Archaeological Transects through Interior Dunes on the Hanford Reservaton. Report Submitted to the U.S. Department of Energy, Richland, Washington (1981).

2. Sheila Stump, State of Washington Office of Archeology and Historic Preservation, Letter to Gail Thompson, Northwest Inc., dated July 13, 1981.

3. C. Relander, Drummers and Dreamers, Caxton Printers, Caldwell, Idaho (1956).

4. D. Rice, Overview of Cultural Resources on the Hanford Reservation in South Central Washington. Report Submitted to the U.S. Department of Energy, Richland, Washington (1980).

5. D. Rice, Archaeological Reconnaissance, Ben Franklin Reservoir Area, Washington State University, Laboratory of Anthropology, Pullman (1968).

6. D. Rice, Archaeological Reconnaissance, Hanford Atomic Works, Report Submitted to the U.S. Atomic Energy Commission (1968). 4

7. J. B. Jackson and G. Hartmann, Archaeological Survey from Lower Monumental Substation to Ashe Substation, Report No. 38, Washington Archeological Research Center, Pullman, Report No. 38 (1977).

8. United States Department of the Interior, National Registry of Natural Landmarks, Federal Register 45(232) (1980).

9. National Park Service, List of Sites in Washington State Listed on or with Potential for the National Registry of Natural Landmarks. On file, National Park Service, Seattle (1981).

10. Shapiro and Associates, Inc., et al., Relationship of the Ben Franklin Dam Alternative to Water and Land Uses, Plans, Policies, and Controls for the Hanford Reach of the Columbia River, Report Submitted to the Army Corps of Engineers, Seattle District (1980).

11. United States Department of Agriculture, National Wild and Scenic Rivers System, Notice of Selection of Rivers as Potential Additions, Federal Register 35 (210) (1970).

12. Heritage Conservation and Recreation Service, Nationwide Rivers Inventory: A Report on Natural and Free Flowing Rivers in the Northwestern United States, U.S. Department of the Interior (1980).

13. G. Lavoy, South Columbia Habitat Management Area, private communication (August 1981).

14. ERTEC Northwest, Inc. A Cultural Resources Overview and Scenic and Natural Resources Assessment for the Skagit/Hanford Nuclear Power Project, submitted to Northwest Energy Services Company (1981).

2.7 NOISE

The S/HNP is located in the unpopulated Hanford Reservation which is surrounded by a sparsely settled area. A survey of the general background noise levels in the Hanford area was made on July 7 and 8, 1981. The American National Standard Institute recommended methods (ANSI Standard S-1.13-1971, revised 1976) were utilized for the survey. These data are presented in Table 2.7-1. The test locations are identified in Figure 2.7-1 and can be correlated to Table 2.7-1, which gives the measured Equivalent Noise Level, L_{eq}, and the estimated Day-Night Noise Level, L_{dn}, for each of the 15 test locations. 4

In making environmental noise measurements, several factors should be kept in mind. First, it is important to cover as wide a geographical area as possible, and second, it is useful to make measurements over as representative a period of time, as is practical. Measurements made at the S/HNP location stressed the former of these approaches.

The evaluation of land use in the vicinity of the proposed S/HNP for the purpose of evaluating the acoustical (noise) environment indicated that the Site was in a rural, unsettled semi-arid steppe. The only manmade sources of noise in the area are transportation sources, such as highway traffic that penetrate the area on controlled access roadways, or aircraft that fly over it. The remote test and power plant sites on the Hanford reservation are so far from inhabited areas, that they do not create audible sounds at the inhabited locations surrounding the reservation. 6 E260.05

Because of the nature of the region, the acoustical environment is predictable on the basis of relatively short term measurements, such as those made for this study. These observations and predictions are listed in Table 2.7-1.

The principal operational sources of noise at the Site are the fans that will circulate cooling air for the removal of excess heat from the facilities. The noise generated by these fans can be described as broad-band random noise. This type of noise is indistinguishable to the inexperienced observer from wind noise, water noise (in swiftly running water), or tire noise from distant automobiles. Secondary sources of noise are pump noise from the cooling water pumps on the Columbia River and noise from the 500kV transmission lines. Noise generated by transmission lines is dependent on the voltage that is used, and not on the current, or the amount of power that the lines carry. Thus, no new noise source will be created along the transmission corridor as a result of the proposed action. Furthermore, the transmission line is entirely on the Hanford Reservation and, therefore, no effect will be experienced by any resident of the area from transmission line operations of the S/HNP. 6 E260.05

Weather will have some effects on the transmission line noise, but, as detailed above, there will be no change from the existing conditions as a result of the proposed action.

The background noise levels show a general trend toward higher levels in populated areas, or in areas that are used for water-related sports, principally boating. Flow noise is created by the current of the Columbia River passing obstacles such as the buoys that mark the inlets and outlets of the Supply System plant cooling water system. 4

As indicated in Figure 2.7-1, existing noise levels at residences along the bypass highway and Highway 240 near the Horn Rapids Dam are 58 dBA and 56 dBA, respectively. 6 E260.04

Applicable State and Federal noise standards are set forth in References 1 through 3. 4

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, Implementation Responsibilities and Standards, Circular 1390.2 (July 16, 1971).

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).

CHAPTER 3.0

THE PLANT

CONTENTS

CHAPTER 3.0

THE PLANT

TABLES

4

CHAPTER 3.0

THE PLANT

FIGURES

3.3 PLANT WATER USE

There are three potential sources of water for the S/HNP:
the Columbia River, the Yakima River and groundwater. The
Yakima River was not selected as a water source because of
its lower water quality and limited water availability. 6
Groundwater is not a suitable source because the quantity E220.03
of water required for plant use even with reinjection of
plant discharge, would have a significant effect on the
water movements in the aquifer. The energy required to
transport water from any of these sources does not differ
significantly.

Water to meet Plant operating requirements will be with-
drawn from the Columbia River by the Raw Water Supply 4
System pumps. There are no planned usages of groundwater
for the S/HNP during construction or operation for any
purpose. Hydrological data for the river are presented in 6
Section 2.4.1. The quantity of makeup water is primarily N250.02
dependent upon water losses from the Circulating Water
System in the form of cooling tower evaporation, drift and
blowdown. Other systems in the water balance include:

a. Circulating Water System
b. Raw Water Pretreatment System
c. Makeup Demineralizer System
d. Domestic Water System
e. Standby Service Water System
f. Fire Protection System
g. Plant Irrigation System
h. Liquid Radwaste System.

Each of these systems is described below: 4

Figure 3.3-1 is a water use diagram for normal operation. Table 3.3-1 tabulates the water uses during various operating conditions. Average consumptive water use (water withdrawn but not returned to the Columbia River) with both units at 100 percent load is approximately 25,200 gpm, which is 0.05 percent of the regulated annual average flow and 0.16 percent of the minimum river water flow. Since the maximum design water intake from the Columbia River, about 42,000 gpm (93.6 cfs), is only 0.26 percent of the minimum regulated Columbia River flow, it is not expected that any unit outages or emergency systems use will result from insufficient supply of operational cooling water.

3.3.1 CIRCULATING WATER SYSTEM

The cooling towers will dissipate the heat from the power generation facility to the atmosphere primarily through the evaporation of part of the 468,000 gpm per unit of water circulating in the cooling systems. This evaporation will increase the concentration of chemicals and solids in the Circulating Water System and necessitate continuous blowdown to limit the concentrations to the desired levels. About 28,000 gpm of makeup water to the cooling towers will replenish water lost by evaporation, drift, and blowdown. The consumptive losses will average about 25,200 gpm, of which about 50 gpm will be due to the drift loss.

Most of the cooling tower makeup water flows directly from the Raw Water Supply System to the cooling tower basins. The remaining makeup water is supplied via the Service Water System. This water absorbs the heat dissipated in the Turbine Building Closed Cooling Water System heat exchangers, radwaste system components, the Central Chilled Water System chillers, and the Turbine Building Chilled Water System water chillers before being discharged to the cooling tower basins (Figure 3.3-1). 4

3.3.2 RAW WATER PRETREATMENT SYSTEM

The Raw Water Pretreatment System provides clarified and filtered water to makeup demineralizers and the Domestic Water System.

3.3.3 MAKEUP DEMINERALIZER SYSTEM

The makeup demineralizers provide demineralized water to closed cooling water systems, the Condensate and Refueling Water Storage and Transfer System, and other Plant Systems, as required.

The average flow from the makeup demineralizers will be about 20 gpm. The demineralized water will be supplied from the demineralized water storage tank to the systems mentioned above.

The flows of waste discharged from the Raw Water Pretreatment System and the demineralizers are given in Section 3.6.

3.3.4 DOMESTIC WATER SYSTEM 4

The Domestic Water System supply of 7 gpm will be 6
clarified, filtered, and disinfected Columbia River water.
This water will be used for human consumption and for 4
sanitary purposes.

Sanitary sewage (approximately 7 gpm) will be conveyed to 6
the on-Site package sewage treatment plant. Effluent from 4
the sewage treatment plant will be discharged to a
percolation pond.

3.3.5 STANDBY SERVICE WATER SYSTEM

The Standby Service Water System is supplied from the Ultimate Heat Sink (Section 3.4.3) by Standby Service Water System pumps for each unit.

The maximum evaporation loss from the UHS due to the normal shutdown heat load will be approximately 525 gpm per unit and will occur for a short duration. The drift loss will be about 1.5 gpm per unit, (approximately 0.005 percent of Standby Service Water flow per unit). Because the basin is enclosed, there will be no evaporation loss due to solar energy. The basin is not susceptible to tornado water loss, therefore a high capacity makeup capability is not required.

3.3.6 FIRE PROTECTION SYSTEM

The Raw Water Supply System will be the main source of water for the Fire Protection System (FPS). The minimum
required capacity (for two units) of water storage for fire 4
protection will be about 600,000 gallons. This is based on the requirements of the American Nuclear Insurers (ANI), which requires that the supply of water for the FPS be based on the maximum automatic sprinkler demand of 1500 gpm or fixed water-spray system demand with simultaneous flow of 1000 gpm for hose streams. The total of these two demands will be 2500 gpm per unit, and a storage of 300,000 gallons per unit of water will provide a continuous supply of water to the FPS for a period of two hours.

The main cooling tower basins will be the alternate source of water for the Fire Protection System (Fig. 3.3-1).

3.3.7 PLANT IRRIGATION SYSTEM

The source of water for Plant irrigation will be the Columbia River. Water will be supplied for Plant irrigation at a flow rate of 50 gpm for about 2 hr/day seasonally.

3.3.8 LIQUID RADWASTE SYSTEM

The Liquid Radwaste System will be designed for total recycling of liquid radwastes generated during Plant operation. Routine releases of radioactive liquids to the Columbia River are not planned. However, the design will permit the infrequent release to the Columbia River of excess Plant water inventory resulting from non-routine maintenance and refueling activities. This infrequent release will be less than 350 gpm. In addition, a small quantity of water may be used during the solidification process in the Solid Radwaste System. 6 N240.02 4

For Appendix I purposes, a conservative estimate of non-routine releases was made based on the expected released fractions of the WNP-2 plant. Table 3.3-2 is a comparison of the WNP-2 and S/HNP release data.

Although discharge of liquid radwaste to the Project discharge line is not expected, should it be required, the Table 3.3-2 values for Appendix I purposes can serve as a conservative basis for estimating the volume of water discharged via this non-routine release to be 382,000 gallons per year. The source, flow-rate and composition of this discharge was developed from Tables 3.5-1 and 3.5-3, and is shown below:

Liquid Radwaste Processing

$$17{,}540\ \frac{\text{Gal}}{\text{Day}} \times 365\ \frac{\text{Days}}{\text{Year}} \times 0.01\ \text{DF} = 64{,}021\ \text{gal}$$

6 N240.02

Liquid Radwaste Chemical Processing

$$600\ \frac{\text{Gal}}{\text{Day}} \times 365\ \frac{\text{Days}}{\text{Year}} \times 0.10\ \text{DF} = 21{,}900\ \text{gal}$$

Condensate Demin. Backwash

$$8100\ \frac{\text{Gal}}{\text{Day}} \times 365\ \frac{\text{Days}}{\text{Year}} \times 0.10\ \text{DF} = \underline{295{,}650\ \text{gal}}$$

$$= 381{,}571\ \text{gal}$$

Total Composite Flow Approx. 382,000 gal

The Applicant estimates that if such a discharge takes place, it would be during or after a refueling outage or other major maintenance period. It would be essentially a continuous batching operation, the yearly duration of which would be governed by the discharge flow rate, but which would be expected to range from 18 to 127 hours (350 to 50 gpm), or less if the licensed discharge limit is approached.

An estimate of when the releases will occur cannot be reliably made as some circumstances, e.g., draining of the suppression pool, cleanup from pipe ruptures, etc., are impossible to predict, and may in fact never happen.

Any liquid radwaste discharge will be condensate quality
and essentially chemically pure. It is expected that the
radwaste discharge will contain less than 1 ppm total
suspended solids and 1 micromho/cm conductivity and will 6
have a pH between 6.5 and 8.5. Plant requirements specify
that combined metal concentrations for condensate quality
water shall not exceed 15 parts per billion (ppb) and that
concentrations of copper shall not exceed 2 ppb. These
concentrations in the liquid radwaste discharge are far
lower than those expected for coolling tower blowdown and
the low volume waste discharge.

3.3.9 PLANT WATER USE: WATER TREATMENT 4

Descriptions of water treatment processes for various Plant systems, as well as the identity and quantities of chemicals used, are given in Section 3.6. Treatment of sanitary wastes and Plant facility floor drainage is discussed in Section 3.7.

TABLE 3.3-1

S/HNP WATER USE
ESTIMATE OF FLOW RATES
(gpm)

Item	Maximum(1)	Average(2)	25% Power(3)	One-Unit Shutdown (maximum)(4)	Both Units Shutdown(5)	
						4
Cooling Tower Evaporation & Drift	33,400	25,200	6,300	16,700	0	
Cooling Tower Blowdown	5,500	2,800	700	2,800	0	
Cooling Tower Makeup Water	38,900	28,000	7,000	19,500	0	
Primary Treatment	510	39	39	510	510	6
Plant Irrigation	50	4	4	4	4	4
Domestic Water	10	7	7	90	180	6
Low Volume Waste	60	17	17	60	17	
Makeup for Ultimate Heat Sink	---	---	---	525	1,050	4
Makeup Demineralizers	450	20	20	420	330	

TABLE 3.3-1

(1) Maximum: Summer condition during Plant operation at maximum thermal output of NSSS.

(2) Average: Weighted average during Plant operation at maximum thermal output of NSSS.

(3) 25% Power: Average values based on both units operating at 25% power. Evaporation assumed to be 0.25 times average evaporation. 4

(4) It is assumed that when one unit is shut down, the flow rates given are for maximum capacity NSSS operation of the other unit.

(5) Maximum requirements that exist shortly after shutdown - minimum two-unit shutdown withdrawal rate is 500 gpm.

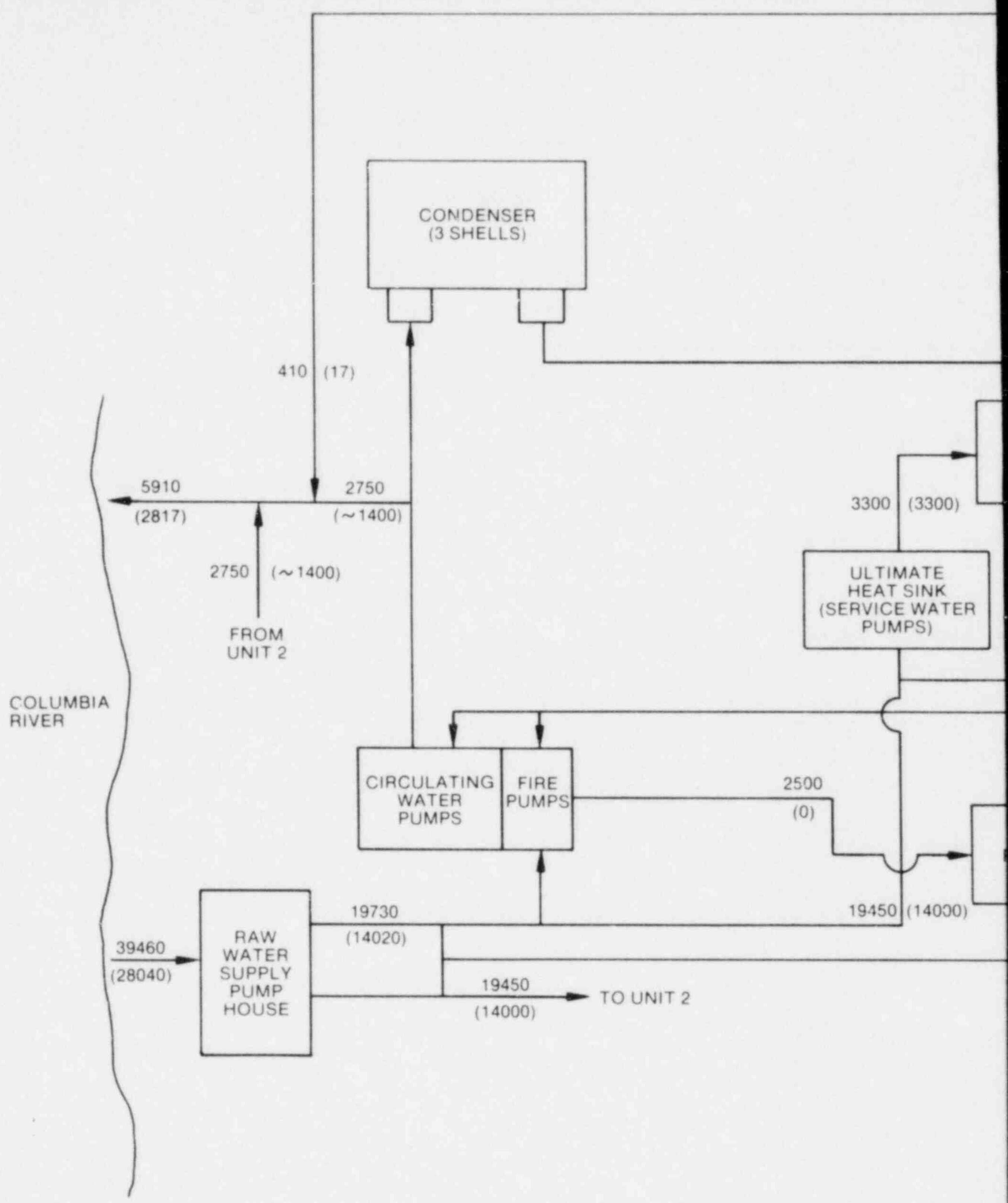
TABLE 3.3-2

COMPARISON OF WNP-2 AND S/HNP
LIQUID RADWASTE RELEASE DATA

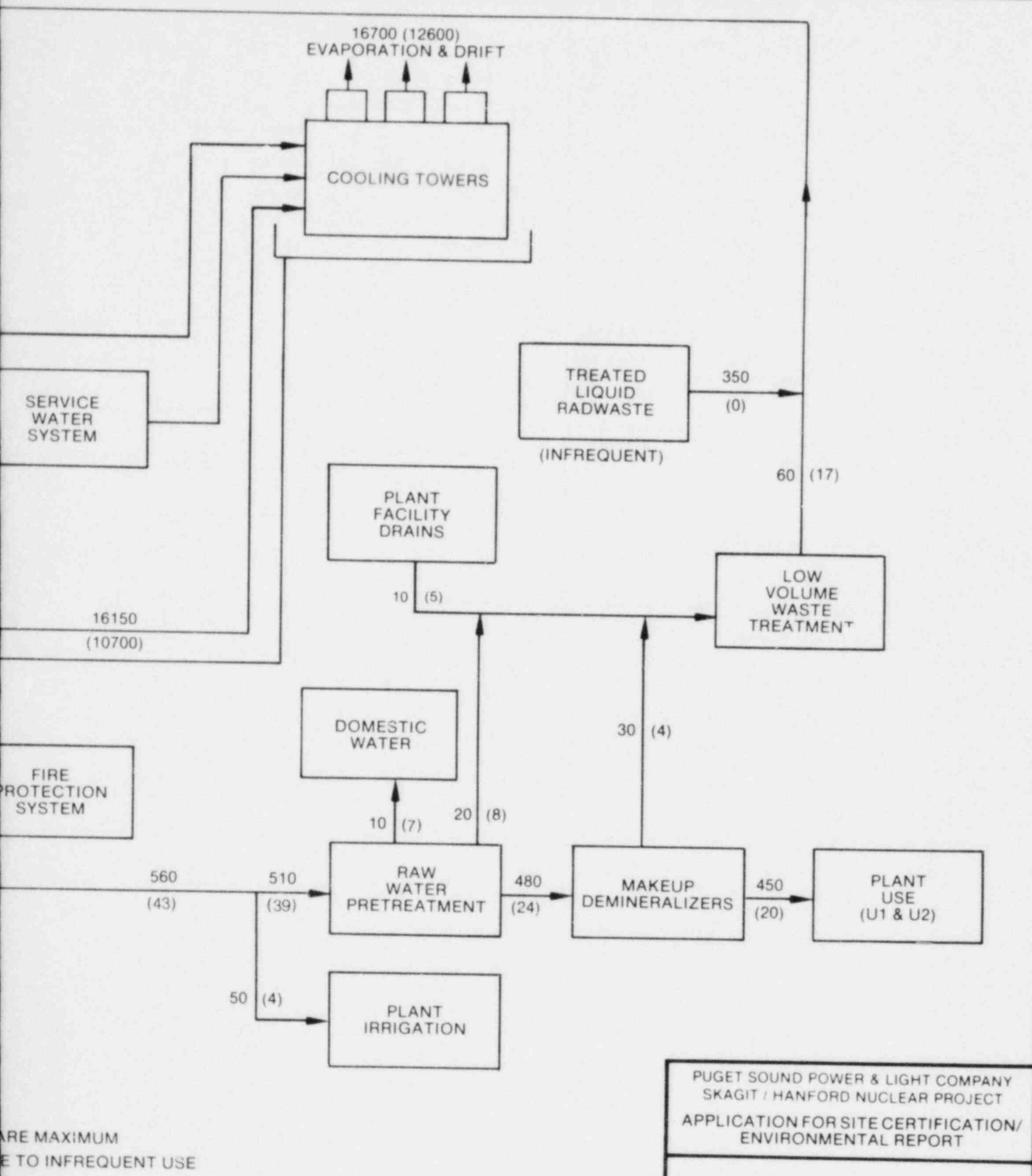
WNP-2			S/HNP		
Source	Input Flow Rate (GPD)*	Fraction Discharged	Fraction Discharged	Input Flow Rate (GPD)*	Source
High Purity Waste System	18,380	0.01	0.01	17,540	Liquid Radwaste Processing System
Low Purity Waste System	5,700	0.10	0.10	8,100	Condensate Demineralizer Backwash
Chemical	1,400	0.10	0.10	600	Liquid Radwaste Chemical Processing System

6
N240.02

*Input flow rate is the quantity of process fluids being delivered to the Liquid Radwaste System for treatment and disposition.



NOTES: 1) ALL VALUES ARE IN GPM. VALUES IN PARENTHESIS ARE AVERAGE. OTHERS
2) FIRE PROTECTION FLOW NOT INCLUDED IN MAXIMUM RAW WATER FLOW DU



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

WATER USE DIAGRAM

FIGURE 3.3-1

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.

4

3.4.2.1 Intake System

The Raw Water Supply System pumphouse will be constructed
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 6
to be approximately 400 ft, with an associated energy E220.04
requirement of approximately 1.1 MWe per pump. Two 500 gpm
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 4
inlets, 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. N210.07

The water inlets will be designed to limit openings to a
maximum of 3/8 in. and intake velocity to a maximum of 0.5
fps. This design velocity is expected to be well below the 4
acceptable limit required for suitable protection of small
fish when water is being taken into the system (see Section
5.1.2.1). 6

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.

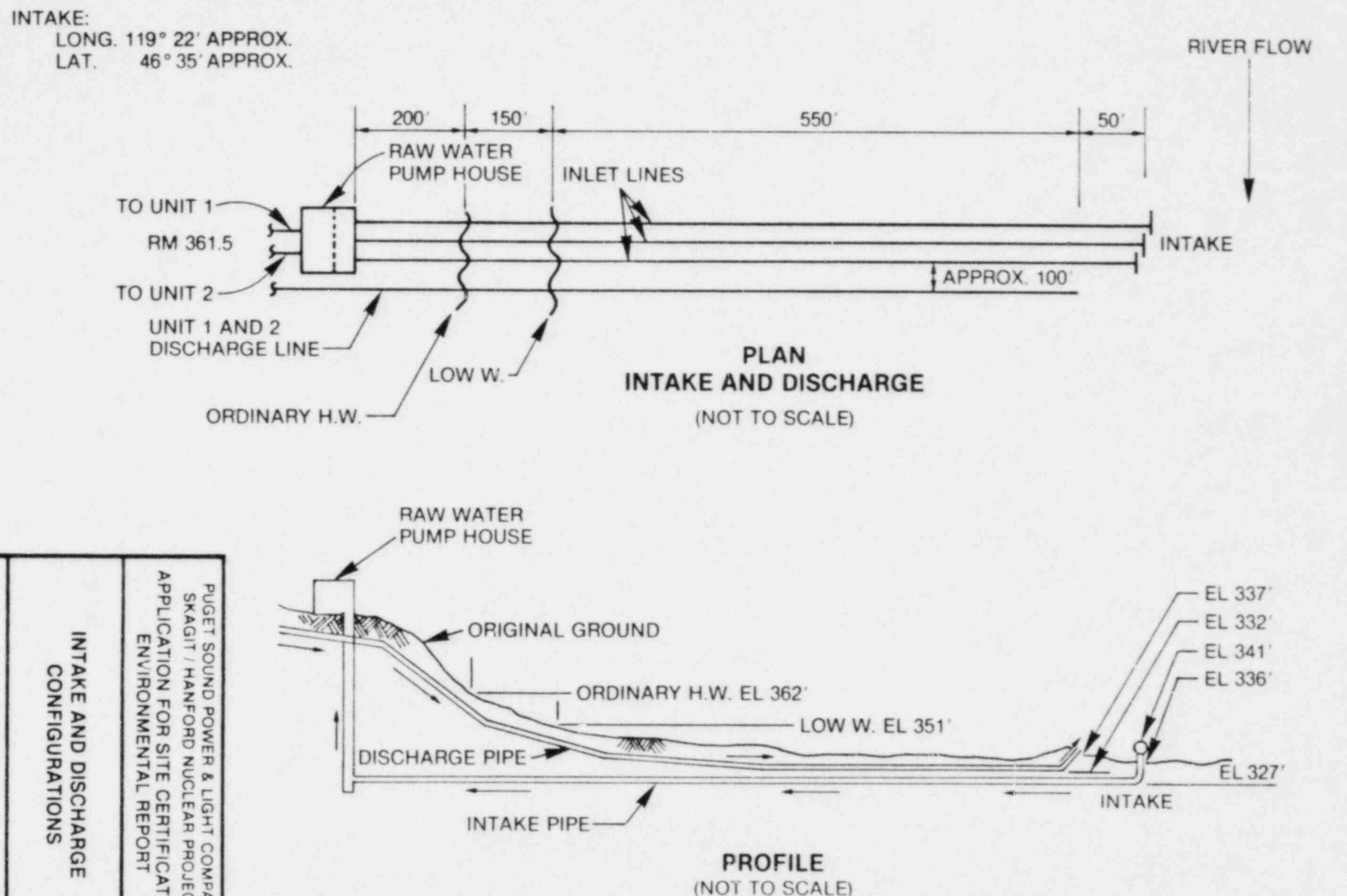
4

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.

The raw water supply pipeline has not been completely designated at this time; final design will be a function of detailed layout, hydraulic analysis, foundation support characteristics, geology, and ecological and economical analyses. Based on preliminary considerations, the pipe will be approximately 3 ft in diameter. It will probably be a concrete or steel pressure pipe conforming to American Water Works Association specifications. The minimum fill cover will be 3½ feet. The average cover will probably be 5 to 6 feet, therefore, the average trench depth will be approximately 9 to 10 feet. The best estimate, at this time, of supply line head loss is about 200 feet. 6 E220.07

3.4.2.2 Discharge System

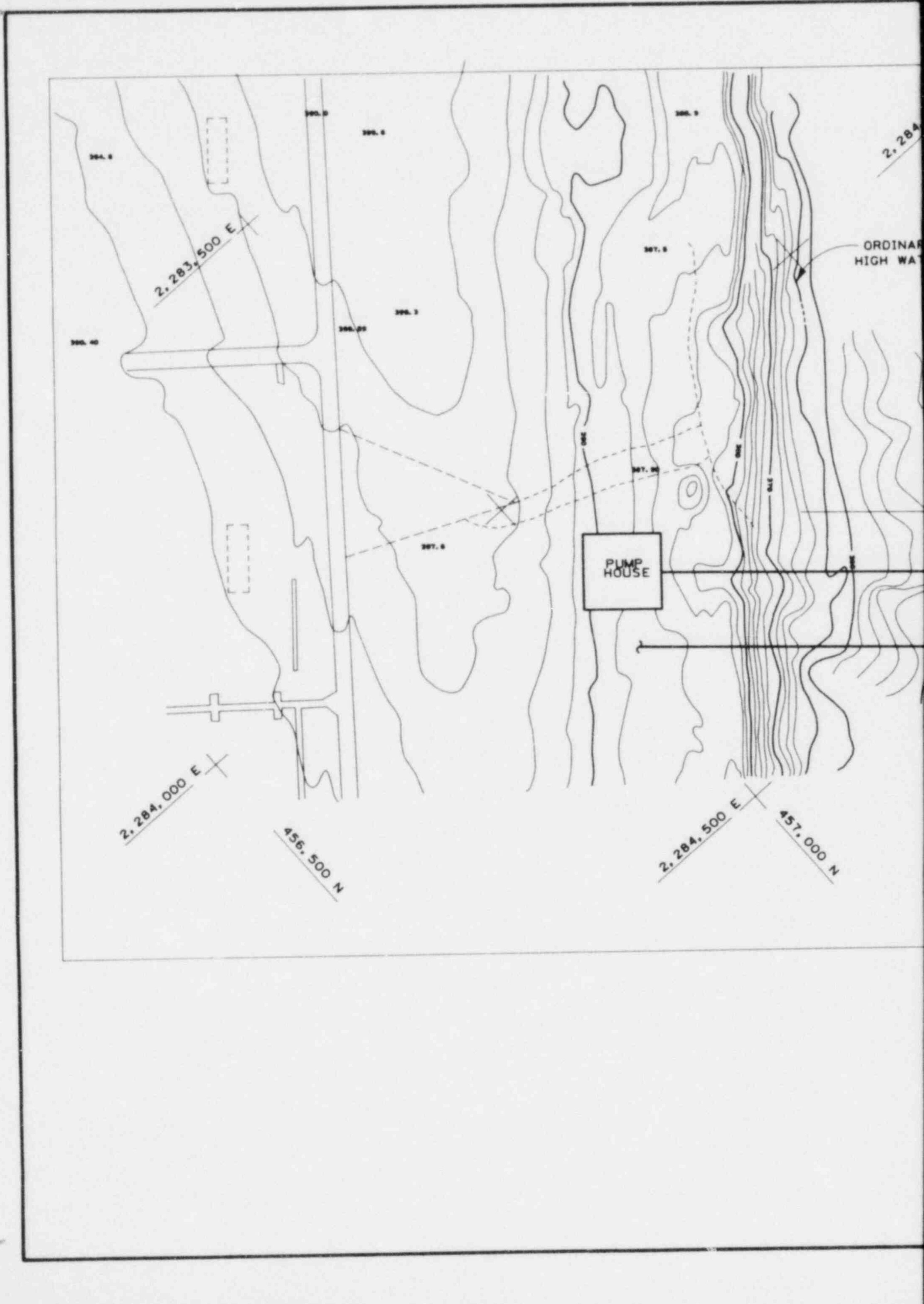
The S/HNP discharge system will be a single pipe running adjacent and parallel to the makeup lines, from the two 4

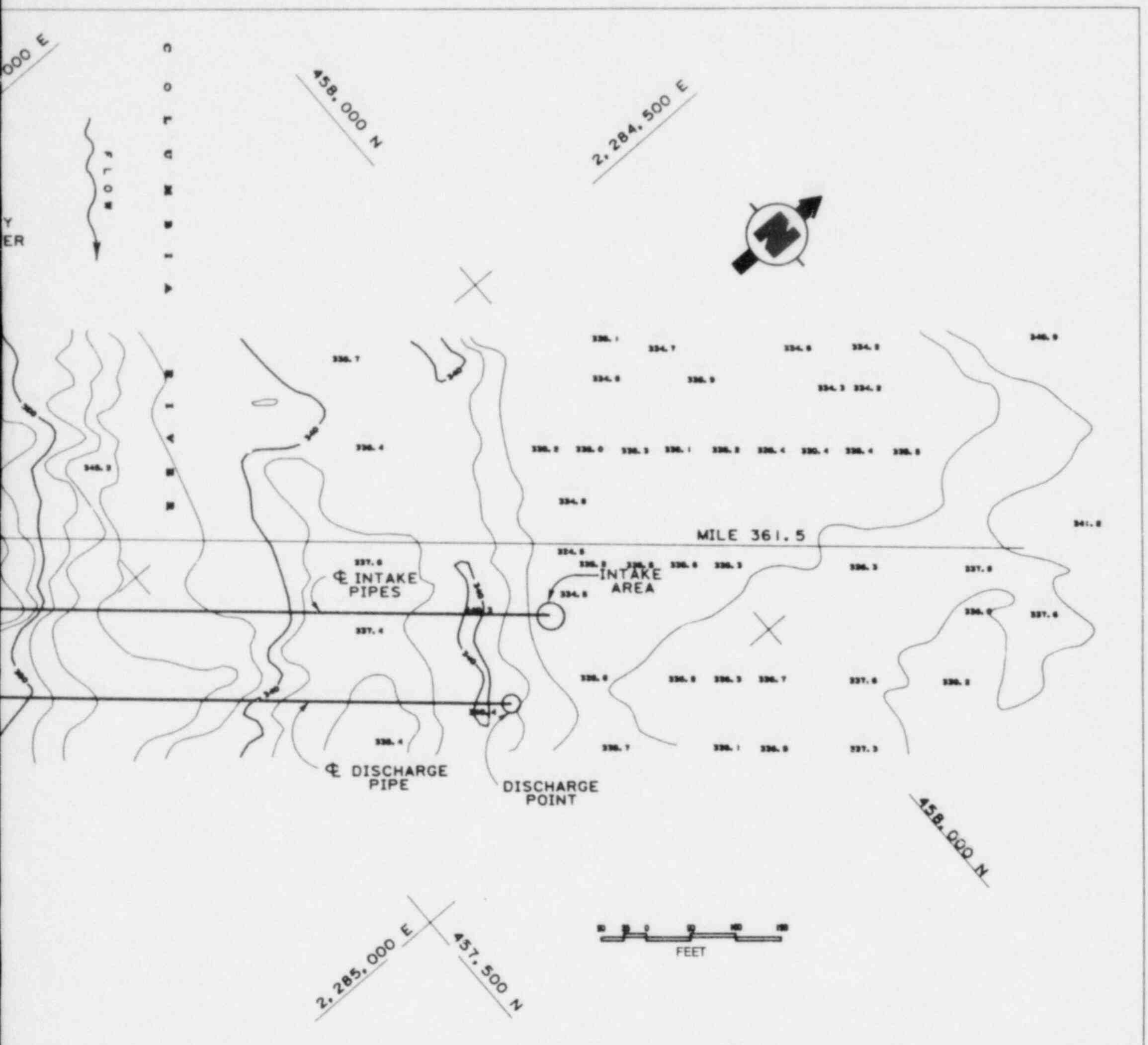


PUGET SOUND POWER & LIGHT COMPANY
SKAGIT / HANFORD NUCLEAR PROJECT
APPLICATION FOR SITE CERTIFICATION/
ENVIRONMENTAL REPORT

INTAKE AND DISCHARGE
CONFIGURATIONS

FIGURE 3.4.3


2,283,500 E
2,284,000 E
456,500 N
2,284,500 E
457,000 N
PUMP HOUSE
ORDINAR
HIGH WAT
2,284



PUGET SOUND POWER & LIGHT COMPANY
SKAGIT/HANFORD NUCLEAR PROJECT

APPLICATION FOR SITE CERTIFICATION/ ENVIRONMENTAL REPORT

TOPOGRAPHIC INFORMATION IN THE VICINITY OF THE INTAKE AND DISCHARGE STRUCTURES

FIGURE 3.4-4

TABLE 3.5-5

DECONTAMINATION FACTORS USED FOR EVALUATION OF RADIOACTIVE RELEASES (1)

1. Liquid Radwaste Processing System

	Filter	Demineralizer	Total DF
Halogens	1	100	100
Cs, Rb	1	10	10
Other Nuclides	1	100	100

2. Liquid Radwaste Chemical Processing System

	Radwaste Evaporator	Filter	Deminer-alizer	Total DF	
Halogens	1,000	1	100	100,000	
Cs, Rb	10,000	1	10	100,000	
Other Nuclides	10,000	1	100	1,000,000	4

3. Condensate Demineralizer Backwash

	Phase Separator	Filter	Deminer-alizer	Total DF
Halogens	1	1	100	100
Cs, Rb	1	1	10	10
Other Nuclides	1	1	100	100

(1) From NUREG-0016, Rev. 1.

TABLE 3.5-6

EXPECTED YEARLY ACTIVITY RELEASED FROM
LIQUID WASTE MANAGEMENT SYSTEMS (1)
USED FOR EVALUATION OF COMPLIANCE WITH
APP. I OF 10 CFR 50 (per unit) 4

NUCLIDE	ANNUAL RELEASES TO PROJECT DISCHARGE LINE				
	LRW (curies)	BACKWASH (curies)	CHEMICAL (curies)	TOTAL LWS (curies)	ADJUSTED TOTAL (2) (curies/yr)
Corrosion and Activation Products					
Na-24	.00131	.00000	.00000	.00131	.00519
P-32	.00008	.00000	.00000	.00008	.00033
Cr-51	.00257	.00000	.00000	.00257	.01022
Mn-54	.00003	.00000	.00000	.00003	.00012
Mn-56	.00080	.00000	.00000	.00080	.00318
Fe-55	.00044	.00000	.00000	.00044	.00176
Fe-59	.00001	.00000	.00000	.00001	.00005
Co-58	.00009	.00000	.00000	.00009	.00035
Co-60	.00018	.00000	.00000	.00018	.00071
Ni-65	.00000	.00000	.00000	.00000	.00002
Cu-64	.00337	.00000	.00000	.00337	.01341
Zn-65	.00009	.00000	.00000	.00009	.00035
Zn-69M	.00024	.00000	.00000	.00024	.00096
Zn-69	.00026	.00000	.00000	.00026	.00102
W-187	.00006	.00000	.00000	.00006	.00023
Np-239	.00210	.00000	.00000	.00210	.00834

6

4

NUCLIDE	ANNUAL RELEASES TO PROJECT DISCHARGE LINE				
	LRW (curies)	BACKWASH (curies)	CHEMICAL (curies)	TOTAL LWS (curies)	ADJUSTED TOTAL (2) (curies/yr)
Fission Products					
Br-83	.00010	.00000	.00000	.00010	.00038
Br-84	.00000	.00000	.00000	.00000	.00001
Sr-89	.00004	.00000	.00000	.00004	.00018
Sr-90	.00000	.00000	.00000	.00000	.00001
Sr-91	.00034	.00000	.00000	.00034	.00134
Y-91M	.00021	.00000	.00000	.00021	.00085
Y-91	.00003	.00000	.00000	.00003	.00011
Sr-92	.00017	.00000	.00000	.00017	.00069
Y-92	.00043	.00000	.00000	.00043	.00171
Y-93	.00036	.00000	.00000	.00036	.00142
Zr-95	.00000	.00000	.00000	.00000	.00001
Nb-95	.00000	.00000	.00000	.00000	.00001
Nb-98	.00001	.00000	.00000	.00001	.00003
Mo-99	.00064	.00000	.00000	.00064	.00253
Tc-99M	.00155	.00000	.00000	.00155	.00616
Ru-103	.00001	.00000	.00000	.00001	.00003
Rh-103M	.00001	.00000	.00000	.00001	.00003
Ru-105	.00007	.00000	.00000	.00007	.00027
Rh-105M	.00007	.00000	.00000	.00007	.00027
Rh-105	.00006	.00000	.00000	.00006	.00025
Te-129M	.00002	.00000	.00000	.00002	.00007

6

4

TABLE 3.5-6

NUCLIDE	ANNUAL RELEASES TO PROJECT DISCHARGE LINE				
	LRW (curies)	BACKWASH (curies)	CHEMICAL (curies)	TOTAL LWS (curies)	ADJUSTED TOTAL (2) (curies/yr)
Te-129	.00001	.00000	.00000	.00001	.00004
Te-131M	.00002	.00000	.00000	.00002	.00009
Te-131	.00000	.00000	.00000	.00000	.00002
I-131	.00177	.00000	.00000	.00177	.00704
Te-132	.00000	.00000	.00000	.00000	.00001
I-132	.00089	.00000	.00000	.00089	.00355
I-133	.01036	.00000	.00000	.01036	.04118
I-134	.00020	.00000	.00000	.00020	.00078
Cs-134	.00013	.00000	.00000	.00013	.00053
I-135	.00325	.00000	.00000	.00325	.01291
Cs-136	.00008	.00000	.00000	.00008	.00033
Cs-137	.00036	.00000	.00000	.00036	.00141
Ba-137M	.00033	.00000	.00000	.00033	.00132
Cs-138	.00004	.00000	.00000	.00004	.00015
Ba-139	.00005	.00000	.00000	.00005	.00021
Ba-140	.00016	.00000	.00000	.00016	.00065
La-140	.00007	.00000	.00000	.00007	.00028
La-141	.00003	.00000	.00000	.00003	.00012
Ce-141	.00002	.00000	.00000	.00002	.00006
La-142	.00004	.00000	.00000	.00004	.00016

6

4

TABLE 3.5-6

NUCLIDE	ANNUAL RELEASES TO PROJECT DISCHARGE LINE				
	LRW (curies)	BACKWASH (curies)	CHEMICAL (curies)	TOTAL LWS (curies)	ADJUSTED TOTAL (2) (curies/yr)
Ce-143	.00001	.00000	.00000	.00001	.00003
Pr-143	.00002	.00000	.00000	.00002	.00007
ALL OTHERS	.00001	.00000	.00000	.00000	.00005
TOTAL (except tritium)	.03361	.00000	.00000	.03361	.13361
Tritium release: 14 Curies per year					

6

(1) Estimated releases based on NUREG-0016, Rev. 1, GALE Code evaluation.

(2) Adjusted total includes an additional 0.1 Ci/yr using the same isotopic distribution as the calculated source term to account for anticipated operational occurrences such as operator errors that result in unplanned releases (NUREG-0016, Rev. 1, Section 2.2.20.1), despite the fact that the system design precludes such releases (see Section 3.5.2.1).

4

TABLE 3.5-7

CALCULATED EFFLUENT ACTIVITY CONCENTRATIONS
FOR EVALUATION OF RADIOACTIVE RELEASES TO
COLUMBIA RIVER

ISOTOPE	CONCENTRATION (microcuries/ml)	MPC (microcuries/ml) 10 CFR 20 TABLE II COL. 2	FRACTION OF MPC
Corrosion and Activation Products			
Na-24	1.9E-09	2.0E-04	9.3E-06
P-32	1.2E-10	2.0E-05	5.9E-06
Cr-51	3.6E-09	2.0E-03	1.8E-06
Mn-54	4.3E-11	1.0E-04	4.3E-07
Mn-56	1.1E-09	1.0E-04	1.1E-05
Fe-55	6.3E-10	8.0E-04	7.8E-07
Fe-59	1.8E-11	5.0E-05	3.6E-07
Co-58	1.2E-10	9.0E-05	1.4E-06
Co-60	2.5E-10	3.0E-05	8.4E-06
Ni-65	7.1E-12	1.0E-04	7.1E-08
Cu-64	4.8E-09	2.0E-04	2.4E-05
Zn-65	1.2E-10	1.0E-04	1.2E-06
Zn-69M	3.4E-10	6.0E-05	5.7E-06
Zn-69	3.6E-10	2.0E-03	1.8E-07
W-187	8.2E-11	6.0E-05	1.4E-06
Np-239	3.0E-09	1.0E-04	3.0E-05

4

3.6 CHEMICAL AND BIOCIDE WASTES

3.6.1 IDENTIFICATION OF CHEMICALS AND THEIR USES

Discharges from the S/HNP to the river will be controlled by the National Pollutant Discharge Elimination System Permit issued by the State of Washington in compliance with Chapter 155, Laws of 1973 (RCW 90.48), as amended, and the Federal Water Pollution Control Act Amendment of 1972 (PL92-500). The above incorporates by reference State of Washington Water Quality Criteria contained in Washington Administrative Code 173-201.

Wastewaters discharged to the Columbia River will meet the requirements given in 40 CFR 423, "Effluent Limitations, Guidelines and Standards for the Steam Electric Power Generating Point Source Category."

Chemicals will be used in the Plant for the control of water quality, scale control, corrosion inhibition, regeneration of demineralizers, and the control of biological fouling. The chemicals, systems, and amounts are listed in Table 3.6-1. The principal chemicals and their uses are:

a. Aluminum sulfate and a polyelectrolyte, such as Separan (Dow), will be added for treatment of raw water. The treated raw water then will be used for process water makeup and domestic purposes. 4

b. Sulfuric acid and sodium hydroxide will be used for makeup water demineralizer regeneration.

c. Sodium hypochlorite and sulfuric acid will be added to the Circulating Water System for biological fouling, pH, and scale control.

d. Sodium hypochlorite will be added to disinfect the domestic water supply.

e. Sodium hypochlorite will be added to the Service Water System to prevent biological fouling.

f. Sodium nitrite, sodium hydroxide, or other chemicals may be added to the Reactor Component Cooling Water and Turbine Building Closed Cooling Water Systems to prevent corrosion.

g. Borax and boric acid will be used to produce
sodium pentaborate in the Standby Liquid Control 4
System to provide a backup for reactivity control
in the event of an emergency.

Boron is used at S/HNP in the Standby Liquid Control System. There will be no circumstances whereby Boron from this system will be intentionally released to surface waters. The SLC System is a Seismic Category I system which is required to be available during reactor operation as a means of inserting negative reactivity in the reactor in the unlikely event that the normal reactivity shutdown
system is inoperable. Dissolving stoichiometric quantities 6
of borax and boric acid in demineralized water yields N220.01
sodium pentaborate, the desired neutron absorber solution.

The SLC System is located in the Containment and a curb is provided which encircles all components which normally contain sodium pentaborate. SLC tank level is monitored frequently and leakage is expected to be essentially zero. All drainage from piping and equipment drains and the floor drain is piped to a drumming station for disposal in 55 gallon drums.

None of the water treatment chemicals proposed for use at
the S/HNP will contain any of the 129 priority pollutants
listed in Appendix B to proposed 40 CFR Part 423 (45 6
Federal Register 68355-56, October 14, 1980).

3.6.2 SYSTEM DESCRIPTION AND CHEMICAL ADDITIVES

Sources of chemicals discharged by the Plant are broken
down according to the waste categories specified in
40 CFR 423, "Effluent Guidelines and Standards for the
Steam Electric Power Generating Point Source Category,"
issued by the Environmental Protection Agency. These waste 4
streams are as follows:

a. Low volume wastes

b. Auxiliary boiler blowdown

c. Circulating Water System wastes.

3.6.2.1 Low Volume Wastes

The clarifier blowdown (sludge), filter backwash, neutralized regenerant waste, and Plant facility floor drainage (Section 3.7) will be treated for suspended solids, oil and grease, and pH in the Low Volume Waste Treatment System to meet current EPA guidelines and standards. A lined sedimentation settling basin will be used to remove suspended solids. The treatment of oily waste is discussed in Section 3.7. 4

The effluent from the sedimentation basin, depending on pH, will be treated with acid or alkali to a pH of 6.5-8.5 and pumped to the Plant discharge line. The sedimentation basin will be periodically drained, and accumulated solids will be disposed of by a scavenger operator. Each of the low volume waste streams is addressed in detail below.

3.6.2.1.1 Raw Water Pretreatment

The Raw Water Pretreatment System will consist of a clarifier and filters. This system will provide clarified and filtered water to the domestic water supply and sanitary
facility, and the demineralization system. The 5
clarification step (which involves the addition of aluminum 4
sulfate,

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). 4

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).

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.

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 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 12.5×10^6 Btu/hr per unit to 112.5×10^6 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

3.6.3.1 Dissolved Solids

The S/HNP discharge to the river will consist of river water modified by the addition of chemicals and by evaporation of circulating water in the cooling towers.

The chemical treatments which will cause the change in the constituent concentrations are described in Table 3.6-3. Table 3.6-4 gives the estimated maximum and nominal (average) daily discharges due to chemicals added to various systems. 4

3.6.3.2 Corrosion Products

To avoid an adverse impact on the aquatic ennvironment, corrosion inhibitors will not be used for the water which will be discharged to the Columbia River. It is not expected that any detectable amount of corrosion products from the stainless steel condenser tubes will be present in the S/HNP discharge. The metals present in the river water, such as copper, zinc and chromium, will be concentrated in the cooling towers and returned to the river via the S/HNP discharge.

3.6.3.3 Cooling Tower Drift 4

Based on an expected drift rate of 0.005 percent of the 468,000 gpm per unit circulating water flow rate for the cooling towers, the total drift from the cooling towers will be approximately 25 gpm/unit. This drift will have the same composition as the cooling tower blowdown (Table 3.6-6). The maximum quantity of salts released from the cooling towers per unit will be 9.48×10^4 lb/yr. The effects of chemicals in cooling tower drift on the environment are addressed in Section 5.3.2.

3.6.3.4 Residual Chlorine

Cooling tower blowdown will be the only source of residual chlorine in the S/HNP discharge. To ensure that minimal 5
residual chlorine will be discharged to the Columbia River, cooling tower blowdown will be terminated during the addition of sodium hypochlorite solution, and will not be 4
resumed until total residual chlorine in the circulating water has dropped to less than 0.14 mg/l for 15 minutes. 5
Chlorination of the two units will not occur simultaneously.

The effluent from the Sanitary Sewage Treatment Facility 4
will have an estimated free available chlorine concentration of 1 mg/l. This effluent, however, will be discharged to a percolation pond and not to the Columbia River.

TABLE 3.6-5

WATER QUALITY PARAMETERS

(Maximum Values)

Constituent	Unit	Columbia[1] River Analysis	Low Volume Waste Treatment Effluent	Cooling[2] 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
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
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
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
Total Phosphorus, as P	mg/l	0.11	0.15	1.43	1.42

4

5

4

5

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.
(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.

4

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	15	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

6

4

3.7 SANITARY AND OTHER WASTE SYSTEMS

This section discusses sanitary wastes and nonradioactive solid, liquid, and gaseous wastes not covered in Section 3.6.

3.7.1 SANITARY WASTES AND PLANT FACILITY FLOOR DRAINAGE

3.7.1.1 Sanitary Wastes

The operational sanitary waste collection system will collect nonradioactive wastes from sanitary facilities such as toilets, showers, sinks, and food dispensing facilities.

Expected per capita and total flow loadings are shown in Table 3.7-1. The quantity of sanitary wastewaters is expected to average 10,325 gpd during normal S/HNP operations. During the refueling periods as well as during unscheduled Plant shutdowns, this flow is expected to reach 17,325 gpd. The flow rate during refueling periods will serve as the design basis for sizing the Sanitary Sewage System of the S/HNP. 4

Sanitary waste disposal during the operating phase will be by means of a package sewage treatment plant with a percolation pond. The percolation pond preliminary size will be 80 ft by 80 ft by 4 ft deep, and its exact size will be determined after the soil tests for percolation characteristics have been performed. Wastewater in the aerated treatment plant will be treated and odorless prior to discharging into the pond.

A typical package activated sludge system consists of a primary sedimentation tank, an aeration tank and a secondary sedimentation tank. The raw sewage water enters the primary sedimentation tank where settleable solids are removed. This effluent then enters the aeration tank and is subject to treatment by activated-sludge organisms. The effluent, containing suspended and dissolved organic wastes, is aerated for a few hours. During this time period, adsorpton, flocculation, and various oxidation reactions take place. The effluent from the aeration tank is passed to the secondary sedimentation tank where the flocculant microorganisms settle out. The final effluent from the secondary sedimentation tank is clear and low in BOD. Estimated chemical concentrations in the treatment plant effluent are shown in Table 3.7-2.

Sludge in the treatment plant will be disposed of off-Site by a licensed contractor. A monitoring system on the sewage inlet to the treatment plant will determine if the waste is radioactive. On detection of radioactivity, an alarm will be annunciated in the control room and the wastewater will be diverted to a holding tank. The treatment plant efficiency and effluent quality will comply with the guidelines of 40 CFR 133, "Secondary Treatment Information."

Sanitary facilities used during construction are discussed in Section 4.1. 4

3.7.1.2 Plant Facility Floor Drainage

Plant facility floor drainage is wastewater collected by floor drains in nonradioactive areas throughout the Plant. It includes drainage from areas or activities such as laboratories, the water treatment plant, and startup and cleaning operations. The Plant facility floor drainage system will meet the applicable EPA guidelines for low volume wastes.

The Plant facility floor drainage flows during normal Plant operation are estimated to be 10 gpm maximum and 5 gpm average. Oil is expected to be the primary contaminant of this waste. Other constituents include acids and alkaline chemicals and detergents (cleaning chemicals) of the nontoxic and nonphosphate type. The total annual addition of these cleaning chemicals is expected to be approximately 1000 lb. Waters contaminated with cleaning chemicals will be disposed of off-Site by a contractor in a site specifically licensed for that purpose. It is assumed that the contractor would select between licensed sites based on economics. 6 E221.05

Wastewater from floor drains and equipment drains in potentially radioactive areas such as the Service and Turbine Buildings will be pumped or routed from a collection sump to a monitoring tank. After sampling and analysis to confirm that the waste is nonradioactive, the wastewater will be treated in accordance with the processes described below. Section 3.5 describes the treatment of radioactive wastewater. 4

3.7.1.2.1 Treatment of Plant Facility Floor Drainage

A treatment system for the nonradioactive wastewater consisting of the following sequential unit processes will be used:

a. Equalization and oil and solids separation: The collected floor drainage will flow into the equalization basin. The detention time in the basin will be sufficiently long to accomplish equalization and separation of floating oil and settleable solids.

Effluent from the equalization basin will flow
through an oil separation channel where floating 4
oil will be skimmed at regular intervals and
discharged along with sludge settled at the bottom
into a sludge holding tank. Effluent from the oil
separation channel, containing approximately 50 to
100 mg/l of oil, will be pumped into the secondary
oil separation system for oil de-emulsification.

b. Secondary oil separation: Secondary oily waste treatment will be accomplished in a two-stage oil de-emulsification system consisting of a parallel plate separator and a cartridge-type emulsion breaker. The de-oiled effluent is expected to contain less than 20 mg/l of oil.

c. pH adjustment: pH adjustment equipment consisting
of acid and alkali feeders will be located at the
downstream end of the secondary oil separation
stage. The pH adjustment system will maintain pH 6
values of treated Plant facility floor drainage
effluent within a range of from 6.5 to 8.5. 4

The sludge generated from treatment of Plant facility floor
drainage will amount to approximately 5 lb/day. This 4
sludge and waste oil will be disposed of by a licensed 6
scavenger operator in accordance with applicable Federal
and State requirements. The treated Plant facility floor
drainage effluent flows into the S/HNP discharge line. The
oil concentration in the S/HNP discharge will be
negligible.

4

3.7.2 STORM WATER AND ROOF DRAINS

A separate roof drain system will collect and route the precipitation from roofs to a percolation and evaporation area. All other precipitation will be allowed to disperse locally by percolation and evaporation without being routed to the above area.

3.7.3 SOLID WASTES

S/HNP operation will generate approximately 1600 lb/day of miscellaneous solid wastes consisting mainly of ordinary trash from office work and packing materials. The waste (aluminum hydroxide sludge) from the water treatment system is discussed in Section 3.6. These solid wastes will be collected and disposed of in accordance with Federal and State requirements. The disposition of solid construction wastes is addressed in Section 4.1.

3.7.4 NONRADIOACTIVE GASEOUS EFFLUENT

Nonradioactive gaseous effluent will be emitted from fossil fuel-burning components in the form of exhaust gases in small quantities. These components consist of four emergency standby diesel generators, two High Pressure Core Spray (HPCS) diesel generators, and one fire pump diesel unit. The standby diesel generators and the HPCS diesel generators are installed to provide a reliable source of standby ac power for essential services. The standby diesel generators are rated at 9700 bhp each, the HPCS diesel generators are rated at 4610 bhp each, and the fire pump diesel is rated at 300 bhp. 4

Two emergency standby diesel generators and one HPCS diesel generator serve each unit and are located in the Diesel Generator Building of the unit they serve. The fire pump diesel is common to both units and is located in the fire pump house.

The emissions produced by the diesel engines will be controlled through proper operation and maintenance in accordance with the manufacturers' design standards. This will minimize emissions and any odors resulting from these emissions. Estimates of emissions in terms of constituents from the diesel generators and the fire pump diesel, as well as the total annual discharge of these constituents, are given in Table 3.7-3.

Nonroutine operation of the diesel generators is required only in the event of failure of offsite power. Physical separation, breaker and supply line redundancy and transmission system design make failure of offsite power a very low probability event. Therefore, no significant non-routine operation of the diesel generators is expected. 6 E280.04

The four auxiliary boilers will not emit gaseous effluent and will use electricity as the source of energy. 6 4

Emissions of hydrocarbons as a result of fuel storage tank
breathing and working losses will be insignificant.
Breathing losses consist of vapor released from the tanks 4
because of thermal expansion, barometric pressure changes,
and vaporization. Working losses consist of hydrocarbon
vapor released from the vessel as a result of emptying or
filling operations.

3.9 TRANSMISSION FACILITIES

3.9.1 GENERAL DESCRIPTION OF FACILITIES 4

This section discusses the transmission facilities associ-
ated with the S/HNP including the BPA Ashe-Hanford No. 2
line. 5

3.9.1.1 500-kV Transmission Line

Figures 3.9-1 and 3.9-2 show the existing transmission 4
system in the Site vicinity.

Four 500-kV single circuit transmission lines will be
constructed from the S/HNP Substation in a 600 ft wide
Right-of-Way (ROW), extending northeasterly 3.2 miles to
BPA's Ashe-Hanford ROW. Two of the four single circuit 500-
kV lines will be constructed, one on the extreme northern
boundary and one on the southern boundary of the corridor,
for Unit 1, thereby looping the Ashe-Hanford No. 1 through
the Plant Substation. The two remaining single circuit 500- 5
kV lines will be constructed between the first two 500-kV
lines to serve Unit 2, looping the proposed Ashe-Hanford
No. 2 line through the Plant Substation. BPA's proposed
Ashe-Hanford No. 2 line will be constructed on an as-needed 4
basis as the load in the Hanford area increases (Ref 1).
The BPA Ashe-Hanford No. 2 transmission line will be
approximately 17.5 miles long and constructed in the 5
existing right-of-way parallel to the Ashe-Hanford No. 1
using the design criteria of Ref 7. Figures 3.9-3 and 3.9- 6
4 show the proposed transmission system after construction
of the S/HNP. Figure 3.9-5 shows the line spacing on the
ROW. 4

Steel lattice, single circuit, delta configuration, 500-kV
towers will be used for the lines (Figure 3.9-6). The
towers will average 125 ft in height and 52 ft in width. 6
The average spacing between towers will be 1,150 ft. Three-
conductor bundles will be used for each phase of each line,
with the average conductor to ground clearance being 51 ft.
Land requirements for each tower will average 400 sq ft.
Table 3.9-1 lists conductor characteristics.

4

3.9.1.2 Plant Substation

The Plant Substation will be configured for looping through
the Ashe-to-Hanford No. 1 and No. 2, 500-kV lines. It will

also contain two 500/69-kV transformers to provide the two off-Site sources of power for each unit. The Substation will be located approximately 1,500 ft north of the units, and will occupy an area approximately 1,100 ft by 750 ft (19 acres). Access to the Substation will be from an S/HNP access road.

3.9.1.3 69-kV Distribution Lines to Pumping Plant 4

The makeup water pumping plant will be supplied power by two 69-kV distribution lines. These lines will parallel the intake and discharge pipelines (Figure 3.9-7) and will utilize armless construction. Initially, the lines will be used to supply 115-kV construction power to the S/HNP. They will be converted to 69 kV at a later date to deliver power to the pumphouse. Figures 3.9-8 and 3.9-9 show arm- 6
less construction standards.

3.9.2 ENVIRONMENTAL PARAMETERS

4

3.9.2.1 Non-Electrical

Approximately 230 acres will be required for the ROW for the S/HNP 500-kV lines; the BPA Ashe-Hanford No. 2 line follows an existing BPA right-of-way. However, the actual 5
land area impacted by removing vegetation for tower sites, access roads, and lay-down areas will total less than 50 4
acres for the S/HNP lines and 75 acres for the BPA Ashe-Hanford No. 2 line. The land to be crossed by the 5
transmission lines is shown in Figures 3.9-3 and 3.9-4. Detailed discussions of the system's impact on land, vegetation, wildlife, railways, water-bodies, areas of archeological, historical and recreational interest are presented in Sections 4.2 and 10.9.

3.9.2.2 Electrical

4

Radiated electrical interference should be insignificant beyond 1,000 ft from the ROW, and no receptors are anticipated within this range due to the land classification (Ref 2).

The 500-kV lines will be designed to minimize acoustic noise. Acoustic and electrical noise can result in environmental annoyance, and can cause operational line losses. Because the design of the S/HNP 500-kV lines (operating

voltage will range from 510- to 540-kV, depending on system
conditions) will be similar to those constructed by the
BPA, the associated noise characteristics should be approxi- 4
mately the same. BPA has found that radio interference,
television interference, and audible noise may result from
a 500-kV line (Ref 4). The severity is greater in foul
weather (Ref 8). For additional information, see the 6
response to Question E260.07.

Ground currents in normal operation, both induced and
conducted, are insignificant. The magnitude of such
currents is determined by the magnitude and balance of the 4
load current in the conductors. Procedures for grounding
metal structures and equipment, along with other pre-
cautions, substantially eliminate the possible hazard and
nuisance from these sources. Under phase-to-ground fault
conditions, the current can reach 40 kA in the immediate
vicinity, for a maximum of four cycles until the line
protection devices operate.

The magnitude of induced currents beneath the transmission
lines can be estimated from BPA design criteria. One
design criterion is that the electrical field strength, as
measured one meter above the ground, not exceed 9 kV/m
under typical maximum operating conditions. It is
additionally specified that the field strength at the edge
of the right-of-way not exceed 5kV/m. In a 9 kV/m
electrical field the short-circuit current under the line,
or a person 6 feet tall, could cause an imperceptible
current flow of up to 0.2 mA. The mean perception level
through the hand for a 180 pound, 6 foot tall person, is
approximately 1.0 mA (Reference 4). Induced currents below 5
the level of perception are not unique to transmission line
environment. Standards developed by the American National
Standards Institute limit the leakage current for portable
appliances (e.g., electric drill, hair dryer) to 0.5 mA.
This limit is twice that which a person would be exposed to
under a 500 kV transmission line. Induced current effects
then fall into two classes: (1) perceptible short-term
shocks; and (2) possible effects of long-term exposure to
electrical fields.

The perceptible short-term shocks can be annoying. The
feeling is similar to what one would experience after
crossing a carpet and touching a doorknob. To prevent this
kind of shock, large objects such as fences near 500 kV
lines are grounded in accordance with the National
Electrical Safety Code.

The question of possible effects of long-term exposure to imperceptible electrical fields has increased since the 1970s. The controversy arose largely because of reports from the Soviet Union which indicated that electrical substation workers were adversely affected. Such effects, however, have not been documented by substation personnel or linemen in the United States or other countries (Reference 4). The scientific data collected as of this date indicate that there is little reason to be concerned 5
over the possible long-term health effects of transmission line electric and magnetic fields. The numerous scientific studies initiated as a result of the growing concern of possible health effects have been summarized in a BPA booklet entitled, Electrical and Biological Effects of Transmission Lines: A Review (Reference 4), and the BPA, Hot Springs Bell Environmental Impact Statement (Reference 5). The BPA biological effects booklet is at this time being up-dated.

High voltage transmission lines exhibit corona discharge, which is associated with the formation of ozone. Because corona discharge represents a power loss, transmission lines are designed to minimize this loss for economic reasons.

The ozone formation per three-phase mile of 500-kV transmission line will be approximately 0.9 lb/day. The effects 4
of this ozone formation are difficult to evaluate because the natural formation rate is high in comparison. Over the ROW, the natural ozone generation is one or two orders of magnitude above that caused by corona discharge from transmission lines. Field measurements of ozone concentrations in the vicinity of transmission lines have failed to record any increases that were attributable to the power lines. For these reasons, ozone formation is not expected to cause any significant environmental effect.

References for Section 3.9

1. BPA Personal Communication, Dean Perry, April 2, 1981.

2. Washington Public Power Supply System, The Proposed Hanford Number Two Nuclear Power Plant, Final Environmental Statement, Docket No. 50-317 (December 1977).

3. Department of the Interior (FED 73-13) - Final Environmental Statement Fiscal Year 1974 Proposed Program (April 3, 1973).

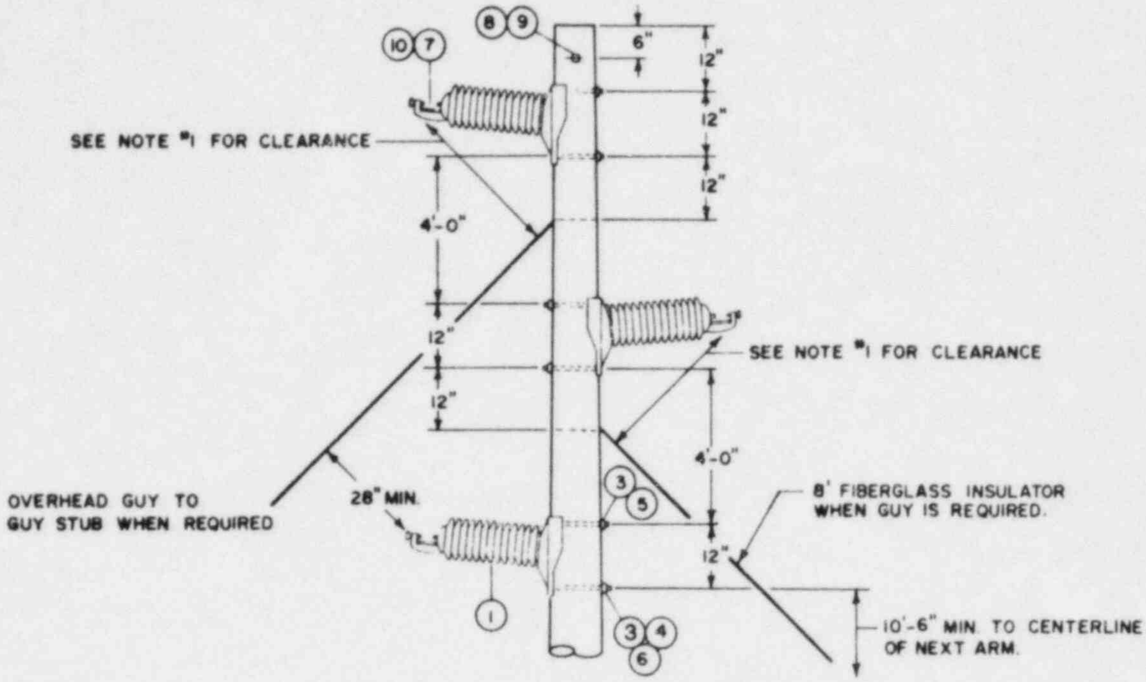
4. Electrical and Biological Effects of Transmission Lines: A Review; Bonneville Power Administration, U.S. Department of Energy, June 1977 and November 1978.

5. The Hot Springs - Bell Environmental Statement (Section 7); Bonneville Power Administration, January 10, 1981.

6. BPA, Personal Communication, J. M. Lee, Jr., February 1982.

7. Bonneville Power Administration, Transmission Specifications 1978.

8. Bonneville Power Administration, Draft Environmental Impact Statement Appendix B on the Role of the Bonneville Power Administration in the Pacific Northwest Power Supply System, July 22, 1977.



GENERAL:

1. Minimum clearance from conductor:
   To fiberglass strain insulator - - - - 28"
   To guy wire (urban guying)- - - - - 47"
2. Wind and ice loading limit - - - 700 lbs per conductor
3. Type of construction:
   a. HPA = Tangent Structure
   b. HPB = Small Angles, using One Down Guy
4. See Standard 2121.0283 for pole drilling
5. Guys shall be installed in accordance with Standard 2124.1231 and 2124.1295

**6. Line guards are not required on spans of 400' or less.

BILL OF MATERIAL

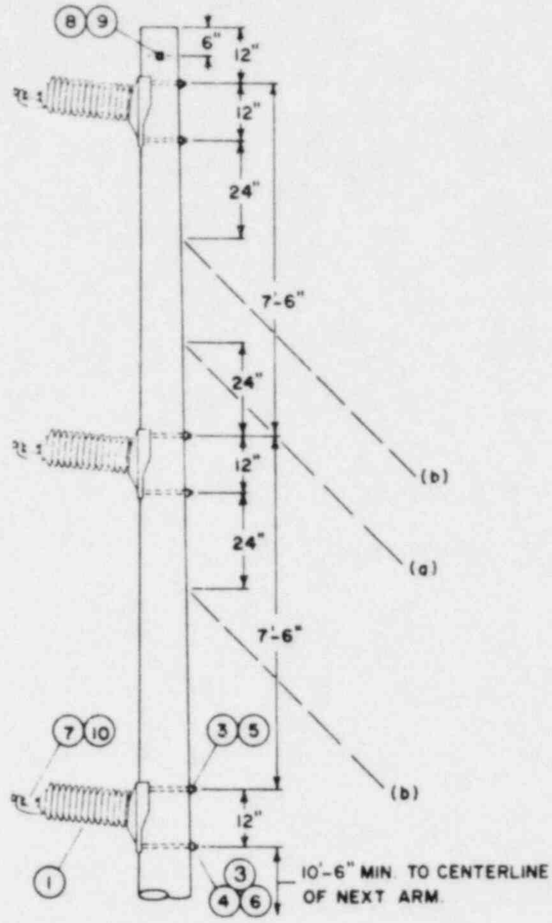
ITEM	DESCRIPTION	STANDARD	ASS'Y.	QUAN.	PUGET CODE
1	* INSULATOR, HORIZONTAL POST TYPE 115 kV	2131.1017	50	3	93815
3	Bolt, Machine 3/4" x 16"	2123.3021		6	12460
4	Washer, #1 Curved 2¼" x 2¼"	2124.1061		3	91000
5	Washer, #2 Curved 3" x 3"	2124.1061		3	91001
6	Washer Spring type	2142.0501		3	91039
7	* CLAMP, POST INSULATOR (State conductor size & mat.)	2131.2113	None	3	——
8	* BOLT, MACHINE 5/8" x 12"	2123.3021	None	1	12419
9	* WASHER, SQUARE 2-1/4"	2123.3071	None	2	91026
**10	* LINE GUARD (State Size)	2142.0344	None	3	——

* WRITE-IN ITEMS as applicable

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

115 kV HORIZONTAL POST CONSTRUCTION TANGENT AND SMALL ANGLES (TYPES HPA & HPB)

FIGURE 3.9-8



GENERAL:

1. Guys shall be installed in accordance with Standards 2124.1231 and 2124.1295.
2. One guy required in position "a" for conductor pull up to 150# per conductor. Two guys required in position "b" for conductor pull over 150# per conductor.
3. Spacing between conductors to be 7'-6" except when adjacent pole or poles are suspension vertical turns and spans are over 250', then spacing shall be 8'-6".
4. Wind and ice loading limit - 700 lbs per conductor.
5. Type of construction:
   (a) HPC - One Down Guy
   (b) HPD - Two Down Guys
6. See Standard 2121.0283 for pole drilling.

**7. Line guards are not required on spans of 400' or less.

BILL OF MATERIAL

ITEM	DESCRIPTION	STANDARD	ASS'Y.	QTY.	PUGET CODE
1	*INSULATOR, HORIZONTAL POST TYPE 115 kV	2131.1017	50	3	93815
3	Bolt, Machine 3/4" x 16"	2123.3021		6	12460
4	Washer, #1 Curved 2-1/2" x 2-1/2"	2124.1061		3	91000
5	Washer, #2 Curved 3" x 3"	2124.1061		3	91001
6	Washer, Spring type 5/8"	2142.0501		3	91039
7	*CLAMP, POST INSULATOR (state conductor size & mat.)	2131.2113	None	3	——
8	*BOLT MACHINE 5/8" x 12"	2123.3021	None	1	12419
9	*WASHER, SQUARE 2-1/4"	2123.3071	None	2	91026
**10	*LINE GUARD (State Size)	2142.0344	None	3	——

*WRITE-IN ITEM as applicable.

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

115 kV HORIZONTAL POST CONSTRUCTION SMALL ANGLES (TYPES HPC & HPD)

FIGURE 3.9-9

CHAPTER 4.0

ENVIRONMENTAL EFFECTS OF SITE PREPARATION, PLANT AND TRANSMISSION FACILITIES CONSTRUCTION

CONTENTS

CHAPTER 4.0

ENVIRONMENTAL EFFECTS OF SITE PREPARATION, PLANT AND TRANSMISSION FACILITIES CONSTRUCTION

TABLES

CHAPTER 4.0

ENVIRONMENTAL EFFECTS OF SITE PREPARATION, PLANT AND TRANSMISSION FACILITIES CONSTRUCTION

FIGURES

by Puget or the Department of Energy. An alternate access road, the Alternate South Access, from the southeast corner 4
of the Site to Route 10, is also being considered for construction workforce access.

DOE advised, in an April 15, 1982 meeting with the Applicant, that it will require use of the Alternate South
Access Road instead of the Preferred South Access Road 6
shown in Figures 2.1-1b, 2.1-2 and 2.1-3 and that, regardless of whether the Project is built or not, DOE will improve Route 10 by bringing it up to State highway standards for a two-lane road. Therefore, the Applicant will be using the Alternate South Access Road. Traffic impacts discussed in Section 8.3.10 will not be significantly changed.

In addition to these Site access roads, Puget is considering improvements to State Route 240 from its intersection with the Preferred South Access to the Bypass Highway and intersection improvements on the Bypass Highway. 4

The road system in the Tri-Cities area has proven capable of handling traffic during the previous large construction projects on the Hanford Reservation and will adequately serve the S/HNP.

Additional information on transportation is provided in Section 8.3.10. 6

Because access to the Site is controlled, recreational opportunities do not normally exist at or near the Site. While the river is open to the general public up to approximately 8 miles north of the Site, public use of land areas
within the perimeters of the S/HNP Site will be nonexistent. 4
On the average, 1,500 to 2,000 people presently visit the Supply System Hanford Generating Plant No. 1 each year. Each visitor is badged and escorted and appointments are required. Identification badges will be issued to all regularly assigned Puget personnel and contractor personnel.

Earthwork, involving excavation and fill activities, will begin after clearing and grubbing. Calculations indicate that approximately 6,865,000 yd^3 of material will be excavated during plant construction. Approximately 3,355,000 yd^3 of this material is unsuitable for reuse as fill material and excess excavated material will be
disposed of in the spoils area located within the Site 6
Boundary south of the principal Plant structures (see Figure 3.1-1a for locations of borrow and spoil areas). The balance of the material, 3,510,000 yd^3, will be used as fill for structures and other work. Because the soil in
the Site area is porous, no significant runoff is expected. 4

It is expected that all refuse or debris will be transported to a disposal area and covered with earth backfill; however, if permitted, some construction debris may be burned.

Blasting for excavation work is not anticipated at the S/HNP. Should blasting be required it will be in accordance with the Guides and Specifications for Military and Civil Works Construction, CE-203.

4

Final yard grading, roads and landscaping to enhance the appearance of the Plant will be completed at the end of the construction period of each unit.

A batch type concrete mix plant will be erected on the Site
with storage facilities for gravel, sand and cement. The 6
batch plant will be capable of a continuous 24 hour rate of
production of 150 cubic yards per hour and will have a peak
capability of 200 cubic yards per hour for 8 hours.

An appropriately sized-collecting system will be provided
to prevent emissions of cement, pozzolan, or dust from any
part of the plant to the atmosphere. Emissions from the
batch plant will conform to the standards of the Benton- 6
Franklin-Walla Walla Counties Air Pollution Control E280.01
Authority. Appropriate ductwork will direct air from all
the producing locations into the dust collecting system. A
power driven shaker will be provided to prevent build-up of
dust particles on the replaceable filters. Hoppers will be
provided to collect the accumulated dust in one location.
Provisions will be made to control dust from aggregate
during stockpiling or rehandling by a sprinkling system or
other methods of control.

Approximately 445,000 yds^3 of concrete is required for the S/HNP. Gravel and sand will be obtained from gravel pits located in Sections 22 and 27 of T13N R27E. Existing rail facilities may be used to transport the sand and gravel to the S/HNP Site. Stone crushing equipment, conveyors, graders and loaders will be used in the gravel pits. Stockpiles of sand and gravel will be provided for a one-month supply.

Cement will be delivered to the Site in bulk in water-tight
carriers and unloaded by weather-tight conveyors into dry, 4
weather-tight storage bins which are properly vented.

Construction water will be supplied from the Columbia River via a temporary intake, and the permanent S/HNP discharge line which will be installed early to serve this purpose. Prior to installation of the temporary intake, construction water will be supplied via tank truck. No ground water will be used during the construction of the S/HNP. Figures 4.1-5 through 4.1-7 provide additional information on the temporary water intake.

There are two possible sources of construction power: the Hanford-Pasco 115 kV line and the Washington Water Power 115 kV line. Presently, there is no contract in place for either of these two alternatives. A contract will not be negotiated until the time of construction. The conversion process from 115 kV to 69 kV line will be completed after
the 500 kV lines have been looped into the completed S/HNP 6
substation. At that time the construction substation will no longer be needed. The 115 kV line which had been suppying construction power would then be extended to the S/HNP substation and the pumping plant and converted to 69 kV power (see Figure 3.9-7). A portion of the two lines that will serve as the power supply for the river pumps will be constructed early to supply construction power for the Site.

During the initial phase of construction, chemical toilets will be provided and serviced by a contractor. These toilets do not use an external water supply, nor do they discharge any liquids or solids. The units are self-contained, unbreakable, and leak resistant. The waste from the toilets will be disposed of off-Site by a licensed sanitary disposal contractor. The package sewage treatment plant described in Section 3.7.1.1 will be installed during the initial stages of construction and used to process the majority of the construction sanitary waste. Chemical toilets will continue to be provided for outlying areas.

Drinking fountains will flow to French drains and percolate
into the sandy soil. Waste flow from all sanitary and 4
drinking facilities is estimated at 13.5 gallons per day per person.

Chemicals from initial cleaning of installed piping systems and equipment will be discharged to a disposal pit in the vicinity of the Plant. Measures will be taken to prevent chemicals from being dispersed by wind.

The S/HNP Site location is well within the boundary of the Hanford Reservation so that the nearest inhabited area is more than seven miles away from the proposed construction activities. Industrial facilities in proximity to the proposed construction site are the FFTF and WNP-2 (approximately 5 miles away), and WNP-1/4 (over 5 miles away).

Because the S/HNP Site is remote from residential areas, highways, and other human activities, it is expected that
off-Site impacts of noise, dust, odor, light, glare, or 6

E250.05

other emission from construction activities will not present an adverse impact to the local population. Because of the remote location of the Site, construction activities will have no significant adverse impact on aesthetics. 4 6

Earthmoving normally will be the time of maximum continuous use of emission producing equipment during a construction day for any given time period. Listed below is the probable earthmoving equipment in use for this period based on the available preliminary data:

- 26 scrapers
- 19 bulldozers
- 2 fuel trucks
- 5 water trucks
- 5 pickup trucks
- 5 graders

6 E280.02

Other on-site equipment peaks do not usually occur simultaneously with the excavation period. These emission peaks are normally significantly less than those occurring during the excavation period. Table 4.1-3 provides estimated construction equipment emissions. Section 4.5.5.2 discusses emission control. 6

A detailed analysis of construction site noise requires specific information concerning construction equipment and activities which has not been established. Such information includes the type, size and number of equipment, usage factors, location, schedule, etc. Once this information is available, noise levels of the different construction equipment must be added statistically since all equipment will not operate simultaneously and will not always produce maximum noise when in use (e.g. full load operation vs idling).

Bechtel completed such a study in 1977 for another nuclear plant construction site. Those predictions did indicate that for comparable distances from major construction activities (batch plant, building excavation, etc.) to the site boundary, Leq's would not exceed approximately 65 dBA. (Note that Leq is the equivalent sound level which is an energy average sound level, in this case over an 8-hour working day). Peak noise levels will be higher. Nighttime construction noise was not considered insofar as nighttime construction activity is not anticipated. 6 E260.06

The S/HNP Site is well within the boundary of the Hanford Reservation. The nearest inhabited area is more than seven miles away from the proposed construction activities. Industrial facilities in proximity to the proposed construction site are the FFTF and WNP-2 (approximately 5 miles away), and WNP-1/4 (over 5 miles away). It is believed 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. 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. 6 E260.01 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. All other traffic routes should experience a reduction in noise levels due to reduced traffic as construction of WNP-1, 2 & 4 is completed. 6 E260.02

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.

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. 6 E260.03

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 of the cultural resources program 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 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 plan. Phase 4 will implement the 6

plan through avoidance of significant resources or scientific data recovery prior to construction and through 6
monitoring of construction activities. An archaeologist will be retained to inspect the Site during the excavation phase and report on the uncovering of any potential 4
archaeological or historical sites. In addition, the consulting archaeologist will recommend means to preserve or interpret any historical or archaeological sites or artifacts uncovered.

One archaeological site (45BN266) is known to be located within the S/HNP Site. This site has been recorded and collected and is discussed in Section 2.6. Additionally, indications of prehistoric and historic remains have been 6
detected at the proposed location of the raw water pumphouse. Based upon the mitigation plan committed to in Phases 3 and 4, no significant adverse impacts are anticipated on this site and the other five 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 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 4
area in which a population of the proposed threatened species <u>Rorippa</u> <u>calycina</u> var. <u>columbiae</u> was found (Section 2.2.1.7). Based on field reconnaissance (see Section 2.2.1), it is probable that the population of <u>Rorippa</u> 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.

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 4
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.

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 antici-
pated. Little data exists to predict how these birds will 4
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.

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 dur-
ing 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 sup- 6
ply water needed for construction of S/HNP and to later
construct a permanent structure for operation of S/HNP.

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 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 3/8 of an inch will be flanged and 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. 6

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 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 4
placed just above the river bottom 600 ft offshore at low 6

flow conditions. Three pipes running along the bottom will
connect the inlet sections to an on-shore pumphouse set
back approximately 200 ft from the river bank at ordinary 4
high water. The discharge pipe will parallel the intake
pipes along the river bottom, terminating in a single point
discharge approximately 100 ft downstream and 50 ft closer 6
to shore than the screened inlet sections (Figure 3.4-3). 4

Work riverward of the ordinary high water level will be conducted between July 15 and October 15 of each year. However, installation of the intake screens may occur after October 15.

The preliminary plan is to excavate a trench for the intake pipes from the pumphouse on the west river bank to a point in the river approximately 750 feet out from the ordinary high water line. Hydraulic dredging will not be used as a method of excavation. The excavation will be accomplished using clam shell buckets, draglines or backhoes, depending on the nature of the material found in the riverbed. Initially, the equipment will be located on shore and will excavate to a depth allowed by the size of the equipment, the river water velocity and the bank slope. The equipment will then be transferred to a barge which will be anchored over the excavation route, where the excavation will be completed. Concrete anchors will be used during the construction to position the work barge. These anchors will be removed upon completion of the work.

Refueling of machinery will be done on the barge or on land 6
areas sufficiently away from the waters edge to ensure that spilled fuel will not seep into the Columbia River. Refueling will be carried out using normal procedures and a high degree of care. Underwater equipment exhausts are not anticipated. Quantities of grease and oil may leach from shafts, gears, pulleys and cables of equipment which will be immersed in the river during this construction. It is expected that such quantities will be small and will have an insignificant impact at most.

Preparation of the trench to receive the pipes may include lining the trench with sand bags and/or selected gravels to provide adequate bedding for the pipes. The pipes will be placed in the trench by floating the pipes into position and flooding them under controlled conditions, or by pulling them into position from shore by a winch on the opposite shore or a winch located on the barge.

Intake screen assemblies will be installed on the end of the pipes. This will be accomplished either before the pipes are placed in the trench or afterwards by means of lowering the assemblies into position by a barge-mounted crane and having divers connect them to the pipes.

A separate trench will be contemporaneously excavated to receive the smaller Project discharge line. The trench will be similar to that made for the intake pipes but smaller in dimension. The discharge trench will follow the bottom contour at approximately five feet beneath the river bed to a point in the river about 700 feet from the ordinary high water line. The discharge pipe trench will be located about 100 feet downstream from the intake pipe trench.

Approximately 41,000 cubic yards of material will be excavated for the intake and discharge pipes. The excavated material is expected to consist of mostly cobble, a few boulders and some gravel.

When the pipes are finally positioned in the trench, selected fill will be placed around them and the trench backfilled. The backfill will consist of imported sand and gravel around the pipe envelope. A three-foot thick blanket of imported riprap will be placed over the backfill with the top of the riprap matching the original river bottom contour. Some of the excavated cobbles and boulders may be used to supplement the imported riprap. The balance of material, between the sand and gravel envelope and the 6
riprap, will consist of excavated native material. The material placed as backfill in the river will consist of 12,500 cubic yards of sand and gravel, 12,500 cubic yards of riprap and 16,000 cubic yards of native material. The material may be placed in the trench by a clamshell bucket mounted on a barge. Piling may be required to support the intake header pipes. Shoreline contours will be restored as closely as is practicable to original conditions upon completion of construction of the intake and discharge structures.

Sedimentation ponds are not expected to be required due to the nature of the excavated material and the pervious ground upon which it will be stockpiled. However, if any significant runoff develops, diked sedimentation ponds will be constructed to prevent any contamination to the river. The excavated material which is not used as backfill will be placed in an appropriate non-wetland land fill area and graded to drain.

Figures 4.1-8 and 4.1-9 provide additional details concerning design and installation of the intake and discharge structures.

Excavation of the premanent facility's intake and discharge
trenches will release some suspended and settleable mate-
rials derived from the river bottom fines. The extent of
this release cannot be precisely assessed until the river
bed materials are known. However, it is presently antici-
pated that the short duration of the excavating period and 6
the apparent absence of layers of silting materials on the
river bed will result in minimal impact on the river
itself. Moreover, since it is planned to construct the
permanent in-river facilities between July 15 and
October 15, which is coincident with the historical period
of lowest river flow, release and dispersion of suspended
material from in-river construction should be limited,
thereby further reducing any impacts.

Increases in suspended and settleable material from excava-
tion and backfill activities may affect water quality in
several ways. Materials carried in suspension may create
turbid waters with a subsequent reduction in light penetra-
tion. Microbial decomposition of organic material asso-
ciated with suspended sediments could impose a short-term
oxygen demand and thereby decrease dissolved oxygen levels
downstream. However, organic content of Hanford Reach
bottom sediment is low. The material is mostly mineral and
any increased oxygen demand resulting from suspended sedi-
ments would be minimal. Suspended materials may also
release or absorb dissolved substances affecting pH, nutri-
ents, trace metals and pesticide concenrations in the water
(Ref 1).

Studies performed by Page (Ref 2) on excavation operations 4
in the Hanford Reach indicate that elevated levels of
suspended solid concentrations were infrequently observed
500 ft downstream from the construction site during excava-
tion. Deposition of settleable material reduced numbers of
periphyton and macroinvertebrates for about 500 ft down-
stream; however, there were no observable effects on these
organisms 2,000 ft downstream from construction. The
impacts were expected to be transient and the affected area
represented approximately 13 percent of the river cross-
section. Other conclusions of this study included:
suspended solids and turbidity values never exceeded limits
considered safe for aquatic communities; sand deposits,
resulting from excavation and backfill, covered a small
area of river bottom (about 7 acres) downstream from the 6
construction site; and sand deposits were transient and
expected to dissipate shortly after backfill activities
ended, sand deposits reduced periphyton growth and
macroinvertebrate numbers; recolonization of periphyton and
macroinvertebrates began as soon as sand was washed from
the area; and no long-term biological impacts were observed
during this study.

Since the nearest known salmon spawning area is 7.5 miles
downstream, no siltation or oxygen effects on redds are 4
expected from construction. Construction will occur
between July 15 and October 15, which is after the emer-
gence of juvenile chinook salmon and prior to adult spawn-
ing, thereby minimizing any impacts upon this species.

Construction of the intake and discharge structures is not 6
expected to affect boat traffic on the Columbia River.

Boat traffic is very light in the area of the proposed
intake and discharge structures and consists entirely of
small pleasure craft/sport fishing boats. Commercial
traffic generally does not go beyond the City of Pasco,
although an occasional barge will be off-loaded at The Port
of Benton dock (approximately RM 340).

Sufficient navigable waters exist beyond the construction 4 E220.06
zone so that upstream or downstream boat traffic will not
be interrupted. Boat traffic will be excluded from the
immediate construction area which may extend from the
Benton County shoreline to approximatley mid-channel.
Navigation markers complying with U.S. Coast Guard stan-
dards will be provided where required. 6

The raw water pumphouse construction is at an on-shore loca-
tion and will not adversely affect river conditions. The
riverbank at RM 361.5 is considered stable and slope protec-
tion requirements are not anticipated. During excavation,
a dewatering system will discharge water into a nearby fil- 4
tration pond. The local groundwater elevation will be tem-
porarily lowered during dewatering operations. No ground-
water users are within the proposed zone of influence. The
pumphouse operating floor will be above the Standard Regu-
lated Project Flood elavation.

Construction of the raw water pumphouse is not expected to
adversely impact the Columbia River. Material excavated
for the pumphouse will be disposed of in appropriate non-
wetland land fill areas above the ordinary high water line
and graded to drain such that runoff will not reach the 6
river. Stockpiled backfill material will be stored at the
pumphouse location with dikes provided around the piles to
prevent runoff from cascading into the Columbia River.

4.1.2.3 Construction of the Plant

The Site is located in a shrub steppe region consisting of 4
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/yr) and sandy granular soil type, precipitation readily infiltrates into the soil and is not expected to increase runoff volumes from the Site. There are no storm sewers included in the Plant design. Runoff from a severe storm will be controlled by grading away from the power block area and by constructing ditches. During construction, contractors will be required to maintain drainage and erosion control around construction areas and especially in areas of excavation or fill. Dewatering is not expected to be necessary because the water table is below any anticipated excavation point. 4

4.1.2.4 Hydrostatic Testing and Flushing Waste

After completion of construction of the permanent intake/discharge facilities, water used in hydrostatic testing and flushing of piping systems may be discharged to the Columbia River through the Project discharge pipe. Water used for hydrostatic testing and flushing will be demineralized water, and the wastewater produced as a result of hydrostatic testing and flushing is expected to have chemical concentrations which are less than the maximum concentrations in the Project discharge shown in Table 5.3-1. Wastewater from hydrostatic testing and flushing of piping systems during the construction period will be routed to one of various possible collection points to allow settlement of any solids. This water will be sampled for total suspended solids and pH and will be discharged to the Columbia River if it meets the specifications of the NPDES Permit. 6

Since the physical and chemical characteristics of the hydrostatic testing and flushing waste will not be expected to exceed those of the Project discharged during operation, the impacts of discharge of this wastewater will not exceed those described in Section 5 for the Project discharge.

References for Section 4.1

1. A. J. Cordone and D. W. Kelly, "The Influences of Inorganic Sediment on the Aquatic Life of Streams," California Fish and Game, 47, (2), (1961).

2. T. L. Page, Sedimentation and Turbidity Effects From Excavation in the Columbia River at WNP-2, August Through October 1975, Battelle, Pacific Northwest Laboratories, Richland, WA (August 1976).

TABLE 4.1-3

PREDICTED CONSTRUCTION EMISSIONS[1]

	lb/hr	ton/yr
Carbon Monoxide, CO	160.0	270.5
Hydrocarbons, HC	33.4	56.5
NO_x	412.6	697.3
Aldehydes	7.7	13.0
SO_x	29.3	49.4
Particulates	20.8	35.1

6

[1]The information presented is preliminary and based on a simplified construction schedule, a rough estimate of hauling distance, and estimates of excavation volumes.

TABLE 4.1-4

Sheet 1 of 4

SUMMARY OF POTENTIAL IMPACTS TO ENDANGERED, THREATENED, SENSITIVE AND SPECIAL INTEREST TERRESTRIAL SPECIES WHICH MAY OCCUR IN THE VICINITY OF THE S/HNP SITE AND ASSOCIATED AREAS

SPECIES	FEDERAL STATUS	STATE STATUS	HABITAT	DISTRIBUTION NEAR THE SITE AND ASSOCIATED AREAS	POTENTIAL IMPACT
Persistentsepal Yellowcress (Rorippa calycina var. columbiae)	Candidate	Threatened	Gravelly and sandy soil, especially riverbanks.	Occurs on cobble riverbank at the intake/discharge location.	Habitat disturbance and loss of a small portion of the local population.
Dalles Milk-Vetch (Astragalus sceloсarpus)	None	Sensitive	Dunes and sandy barrens. Often found in association with bitter-brush and sand-dune penstemon.	Occurs in sandy barrens along pipe-line route and railroad access.	Habitat disturbance and loss of a small portion of the local population. This may result in a temporary reduction in the local population but will not threaten the continued existence of the local population.
Gray Cryptantha (Cryptantha leucophaea)	None	Sensitive	Dry habitat, especially sandy barrens. Often found in association with rabbitbrush.	Occurs in sandy areas along pipe-line route and railroad access.	Habitat disturbance and loss of a small portion of the local population. This may result in a temporary reduction in the local population but will not threaten the continued existence of the local population.
Ring-Billed Gull (Larus delawarensis)	None	Special Interest	Nests on islands of the Columbia River and feeds throughout the river ecosystem.	River area near the intake/ discharge location. Permanent resident.	None, because only a small portion of the available feeding habitat will be disturbed.
California Gull (Larus californicus)	None	Special Interest	Nests on islands of the Columbia River and feeds throughout the river ecosystem.	River area near the intake/ discharge location. Permanent resident.	None, because only a small portion of the available feeding habitat will be disturbed.
Forster's Tern (Sterna forsteri)	None	Special Interest	Nests on islands of the Columbia River and feeds throughout the river ecosystem.	River area near the intake/ discharge location.	None, because only a small portion of the available feeding habitat will be disturbed.

6

TABLE 4.1-4

SPECIES	FEDERAL STATUS	STATE STATUS	HABITAT	DISTRIBUTION NEAR THE SITE AND ASSOCIATED AREAS	POTENTIAL IMPACT
Swainson's Hawk (Buteo swainsoni)	None	Special Interest	Nests throughout the sagebrush plains and grasslands. Feeds on rodents and rabbits.	Hunts throughout the Site and Associated Areas; nests at the old Hanford townsite. Migrant; spring and summer resident.	Potential disturbance to nesting at old Hanford townsite and disturbance of a small portion of the local prey base. Any impact should be temporary and should subside upon completion of construction.
Rough-Legged Hawk (Buteo lagopus)	None	Special Interest	Feeds on rodents throughout the desert shrub-steppe.	Although they are infrequently sighted on the Reservation, no sightings were recorded during Site reconnaissances or monitoring efforts. Migrant; winter resident.	Potential disturbance to winter residents; however, no reductions in the local populations is anticipated.
Golden Eagle (Aquila chrysaetos)	None	Special Interest	Hunts for rabbits and rodents throughout the shrub-steppe and roosts on most any tall structures within the foraging area.	Winter resident on the Hanford Reservation; roosting birds are common at the old Hanford townsite. Migrant; winter resident.	Potential disturbance to winter residents; however, no reductions in the local populations is anticipated.
Bald Eagle (Haliaeetus leucocephalus)	Threatened	Sensitive	Columbia River ecosystem where they feed on waterfowl and salmon. Roosts on trees along the river bank.	Winter residents roosts at the old Hanford townsite and one nesting attempt has been recorded for this area. Migrant; winter resident (may be one year-round resident pair).	Potential disturbance to winter residents; however, no reductions in the local population is anticipated.
Marsh Hawk (Circus cyaneus)	None	Special Interest	Occurs in broad, open fields, marshlands, damp meadows and grasslands. Nests are in brush or tall grass bordering more open areas.	The open grassland/marsh area adjacent to the Columbia River and west of the old Hanford townsite supports up to two pair of marsh hawks. These birds occasionally feed in the old Hanford townsite near the intake/discharge location. Migrant; summer and winter resident.	None, because only a small portion of the available feeding habitat will be disturbed.

6

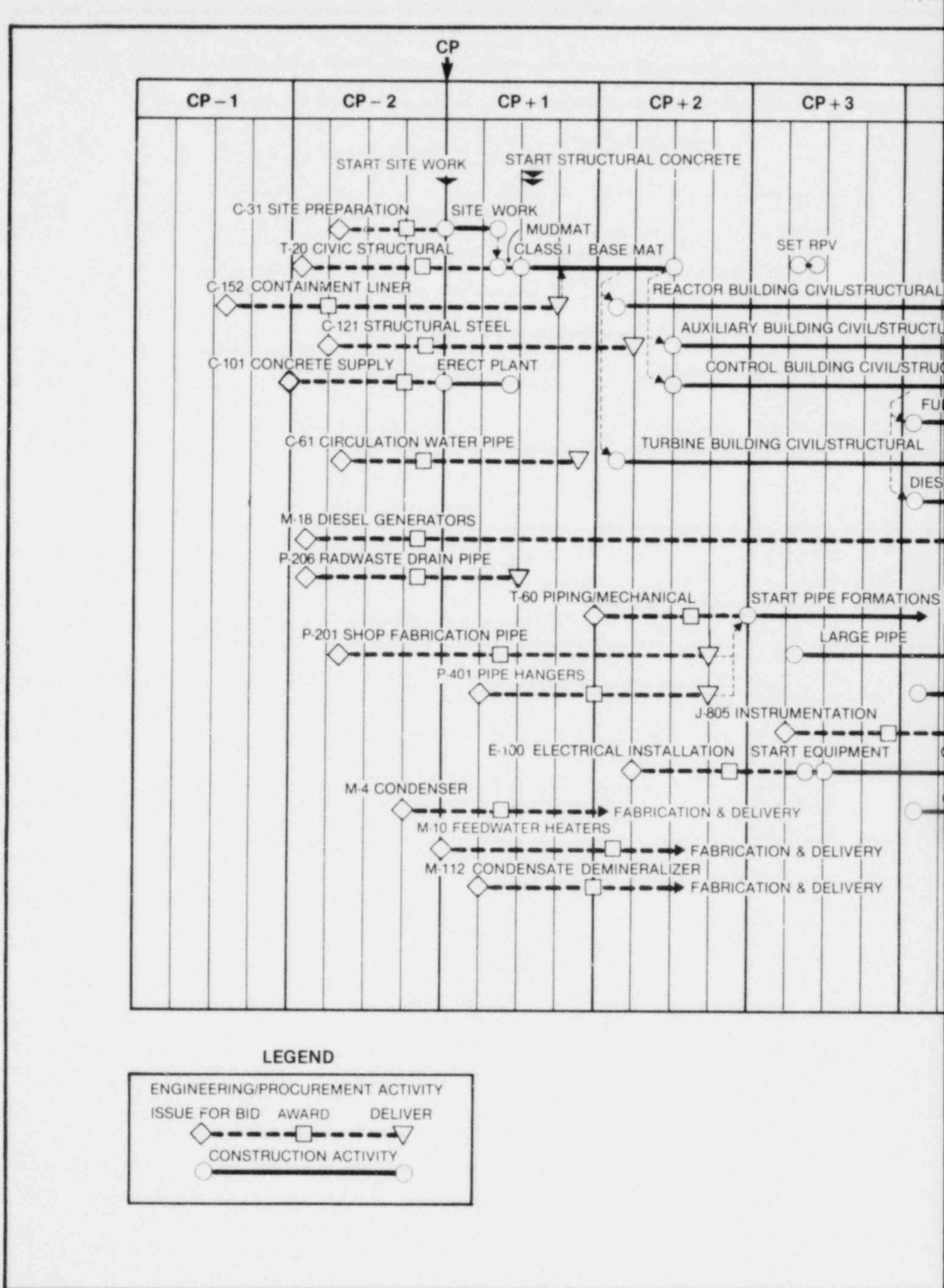
SPECIES	FEDERAL STATUS	STATE STATUS	HABITAT	DISTRIBUTION NEAR THE SITE AND ASSOCIATED AREAS	POTENTIAL IMPACT
Peregrine Falcon (<u>Falco</u> <u>peregrinus</u>)	Endangered	Endangered	Nests in cliffs greater than 30 meters in height and hunts over great distances feeding primarily on birds taken in mid-air.	Rare sightings have been recorded for the Tri-Cities area; however, this falcon has not been observed near the Site and Associated Areas.	None, because they are rarely seen on the Reservation and the the available habitat is marginal for this species.
Long-Billed Curlew (<u>Numenius</u> <u>americanus</u>)	Status Undetermined (1973) (Potential Candidate Species)	Special Interest	Nest in flat areas within cheatgrass fields. Only occur on Hanford Reservation during nesting season. They feed upon insects found within their home territory.	Nesting occurs within the Site and Associated Areas, especially in cheatgrass fields on the railroad access route and the east side of of the Plant Site. Migrant; spring and summer residents.	Because known nesting habitat will be disturbed, a small reduction in the local breeding population might occur. The continued existence of the local population will not be threatened.
Burrowing Owl (<u>Athene</u> <u>cunicularia</u>)	Status Undetermined (1973) (Potential Candidate Species)	Special Interest	Nests and hunts throughout the shrub-steppe where it uses abandoned badger dens and feeds on small rodents and insects.	Nesting occurs throughout the Site and Associated Areas; four burrowing owl nests were found in 1981. Migrant; spring and summer resident.	Because known nesting habitat will be disturbed, a small reduction in the local breeding population might occur. The continued existence of the local population will not be threatened.
Loggerhead Shrike (<u>Lanius</u> <u>ludovicanus</u>)	None	Special Interest	Open sagebrush and cultivated fields. Feeds on insects, small mammals and birds; nests in densely foliged trees and shrubs.	Nesting occurs throughout the Site and Associated Areas; several nesting pair were found on the Plant Site. Migrant; spring and summer residents.	Because known nesting habitat will be disturbed, a small reduction in the local breeding population might occur. The continued existence of the local population will not be threatened.
Sage Sparrow (<u>Amphispiza</u> <u>belli</u>)	None	Special Interest	Shrub steppe, especially areas dominated by sagebrush.	Occurs throughout the Site and Associated Areas where sagebrush is abundant. Migrant; spring and summer resident.	Because most of the Site and Associated Areas is potential habitat for this species, a small reduction in the local population might occur. The continued existence of the local population will not be threatened.

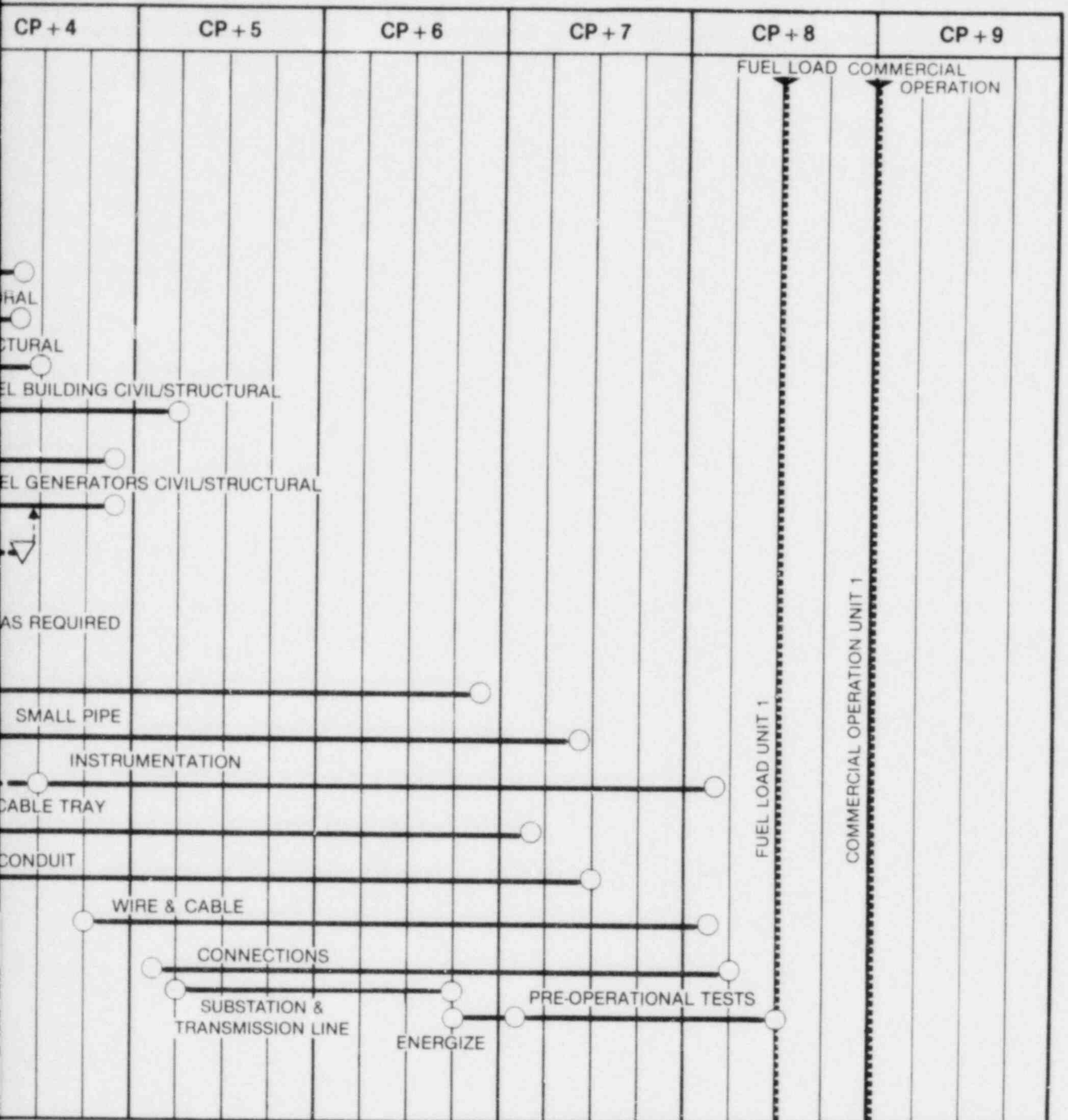
6

TABLE 4.1-4

SPECIES	FEDERAL STATUS	STATE STATUS	HABITAT	DISTRIBUTION NEAR THE SITE AND ASSOCIATED AREAS	POTENTIAL IMPACT
Townsend Ground Squirrel (*Spermophilus townsendii*)	None	Special Interest	Grasslands and shrub-steppe where they feed mainly on new growth shoots of grasses and forbs.	Occurs throughout the Site and Associated Areas.	Because most of the Site and Associated Areas is potential habitat for this species, a small reduction in the local population might occur. The continued existence of the local population will not be threatened.
Northern Pocket Gopher (*Thomomys talpoides*)	None	Special Interest	Grasslands and shrub-steppe where they feed on a variety of grasses and forbs.	Occurs throughout the Site and Associated Areas.	Because most of the Site and Associated Areas is potential habitat for this species, a small reduction in the local population might occur. The continued existence of the local population will not be threatened.
Sagebrush Lizard (*Sceloporus graciosus*)	None	Special Interest	Restricted mainly to sandy areas scattered throughout the shrub-steppe.	Occurs in sandy areas, especially along pipeline route and railroad access.	Because some of the preferred habitat for this species will be destroyed, a small reduction in the local population might occur. The continued existence of the local population will not be threatened.
Oregon Swallowtail Butterfly (*Popilio oregonius*)	None	Special Interest	Occurs throughout the shrub-steppe wherever its host plant, tarragon, is abundant.	Old Hanford townsite.	Because some of the preferred habitat for this species will be destroyed, a small reduction in the local population might occur. The continued existence of the local population will not be threatened.

6


CP
CP – 1
CP – 2
CP + 1
CP + 2
CP + 3
START SITE WORK
START STRUCTURAL CONCRETE
C-31 SITE PREPARATION
SITE WORK
MUDMAT
T-20 CIVIC STRUCTURAL
CLASS I BASE MAT
SET RPV
C-152 CONTAINMENT LINER
REACTOR BUILDING CIVIL/STRUCTURAL
C-121 STRUCTURAL STEEL
AUXILIARY BUILDING CIVIL/STRUCTU
C-101 CONCRETE SUPPLY
ERECT PLANT
CONTROL BUILDING CIVIL/STRU
FU
C-61 CIRCULATION WATER PIPE
TURBINE BUILDING CIVIL/STRUCTURAL
DIES
M-18 DIESEL GENERATORS
P-206 RADWASTE DRAIN PIPE
T-60 PIPING/MECHANICAL
START PIPE FORMATIONS
P-201 SHOP FABRICATION PIPE
LARGE PIPE
P-401 PIPE HANGERS
J-805 INSTRUMENTATION
E-100 ELECTRICAL INSTALLATION
START EQUIPMENT
M-4 CONDENSER
FABRICATION & DELIVERY
M-10 FEEDWATER HEATERS
FABRICATION & DELIVERY
M-112 CONDENSATE DEMINERALIZER
FABRICATION & DELIVERY
LEGEND
ENGINEERING/PROCUREMENT ACTIVITY
ISSUE FOR BID
AWARD
DELIVER
CONSTRUCTION ACTIVITY



CP ± X = YEARS BEFORE OR AFTER ISSUANCE OF A CONSTRUCTION PERMIT

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

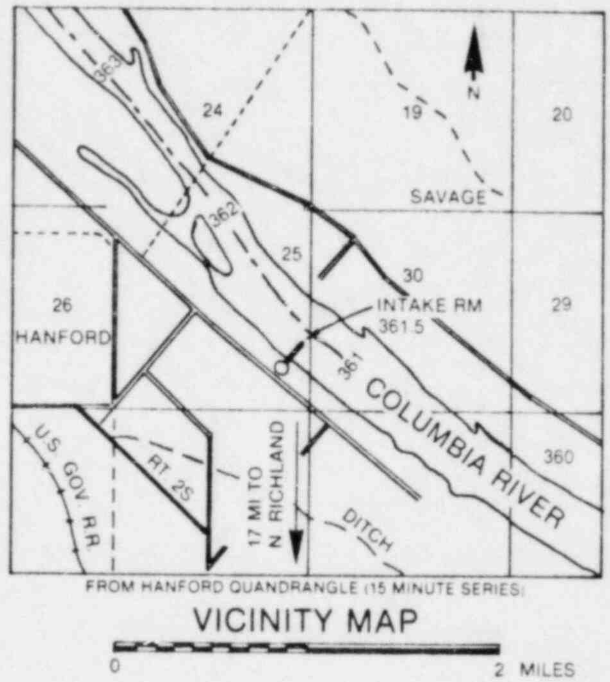
S/HNP MILESTONE SCHEDULE
UNIT 1 AND COMMON

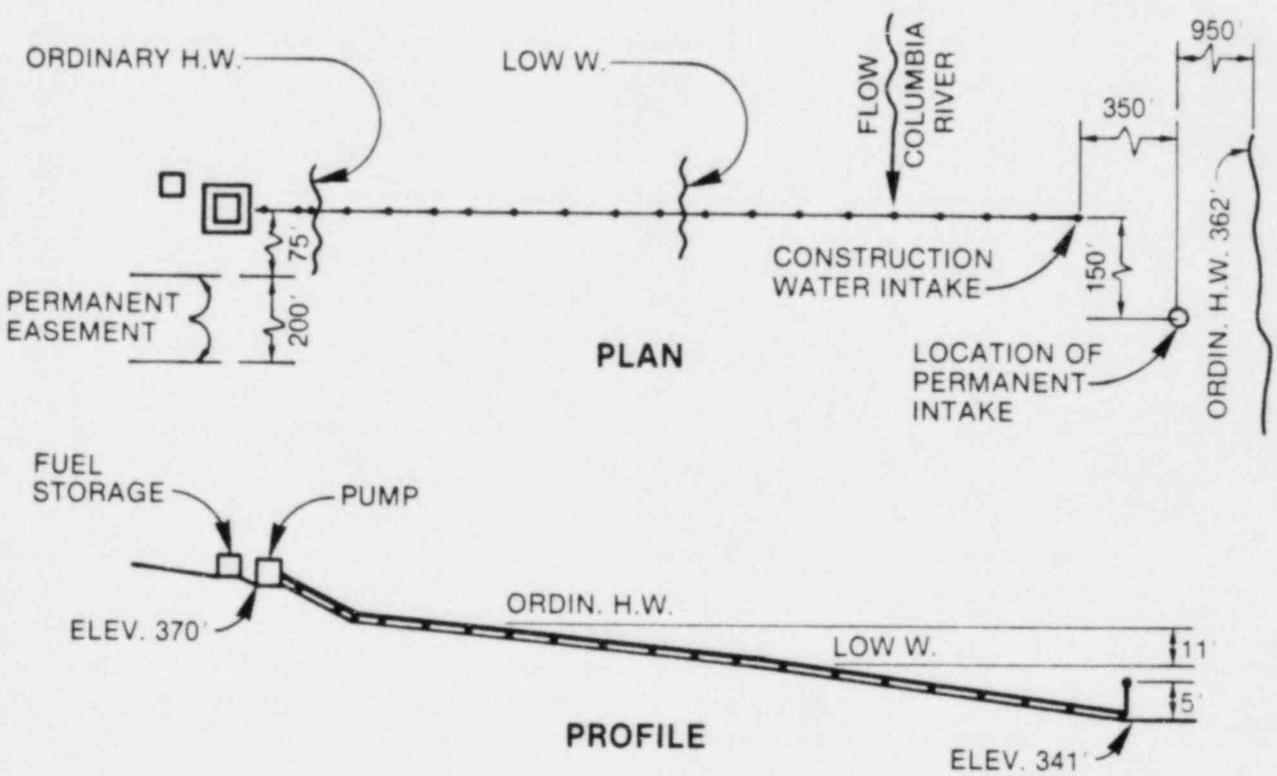
FIGURE 4.1-3

INTAKE:
LONG. 119° 22′ APPROX.
LAT. 46° 35′ APPROX.

NOTES:

1. MAXIMUM PUMPING RATE: 750 GPM
2. NORMAL DAILY USAGE: 100,000 GAL/DAY
3. LAND IS U.S. GOVERNMENT OWNED, UNDER JURISDICTION OF DEPARTMENT OF ENERGY.





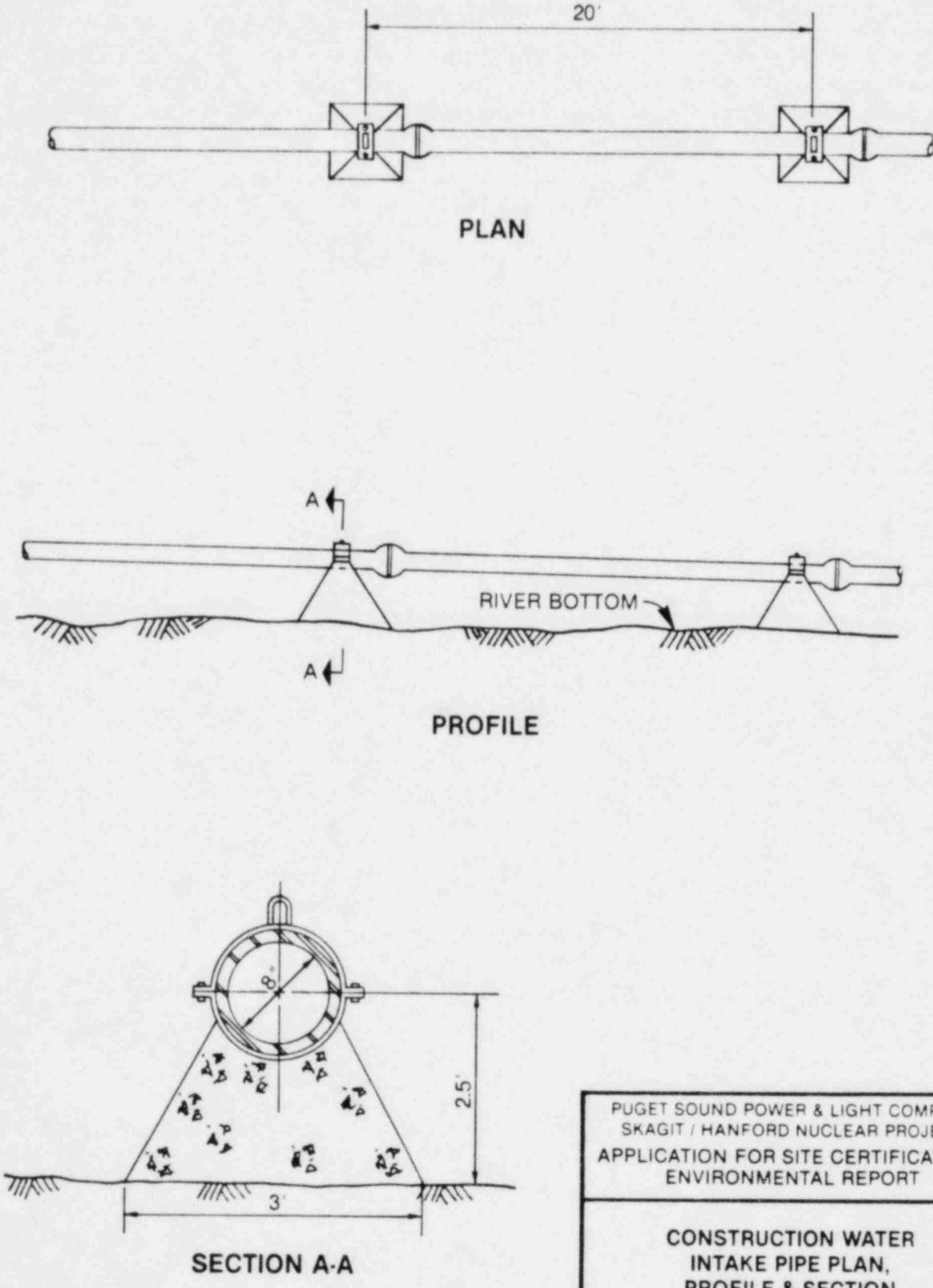
PURPOSE: OBTAIN WATER FOR CONSTRUCTION USE AND FIRE PROTECTION

NATIONAL GEODETIC VERTICAL DATUM = 0.00
DATUM PLANE: a. ORDINARY HIGH WATER: EL 362′
b. LOW WATER: EL 351′

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

CONSTRUCTION WATER INTAKE ARRANGEMENT & LOCATION

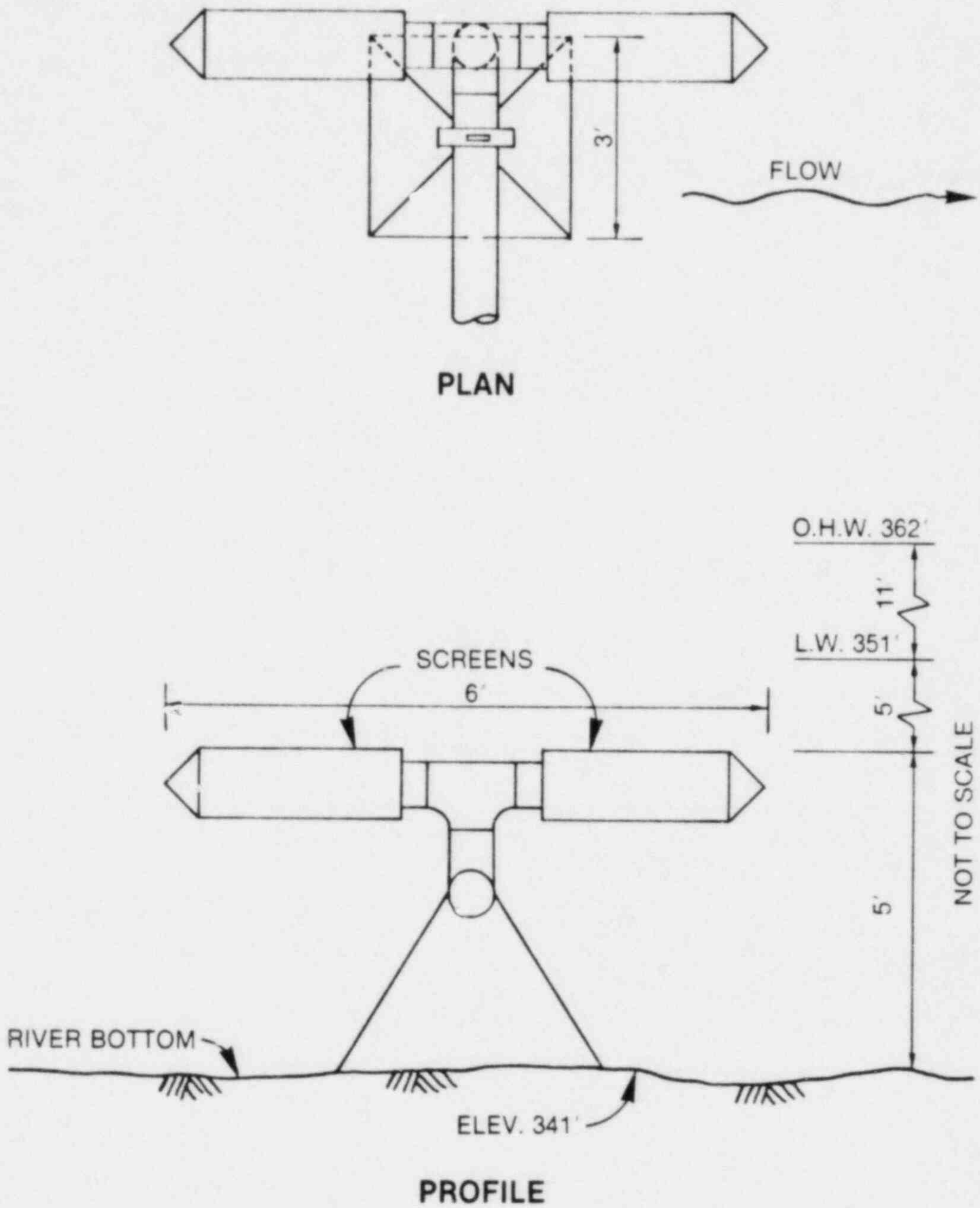
FIGURE 4.1-5



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

CONSTRUCTION WATER INTAKE PIPE PLAN, PROFILE & SECTION

FIGURE 4.1-6

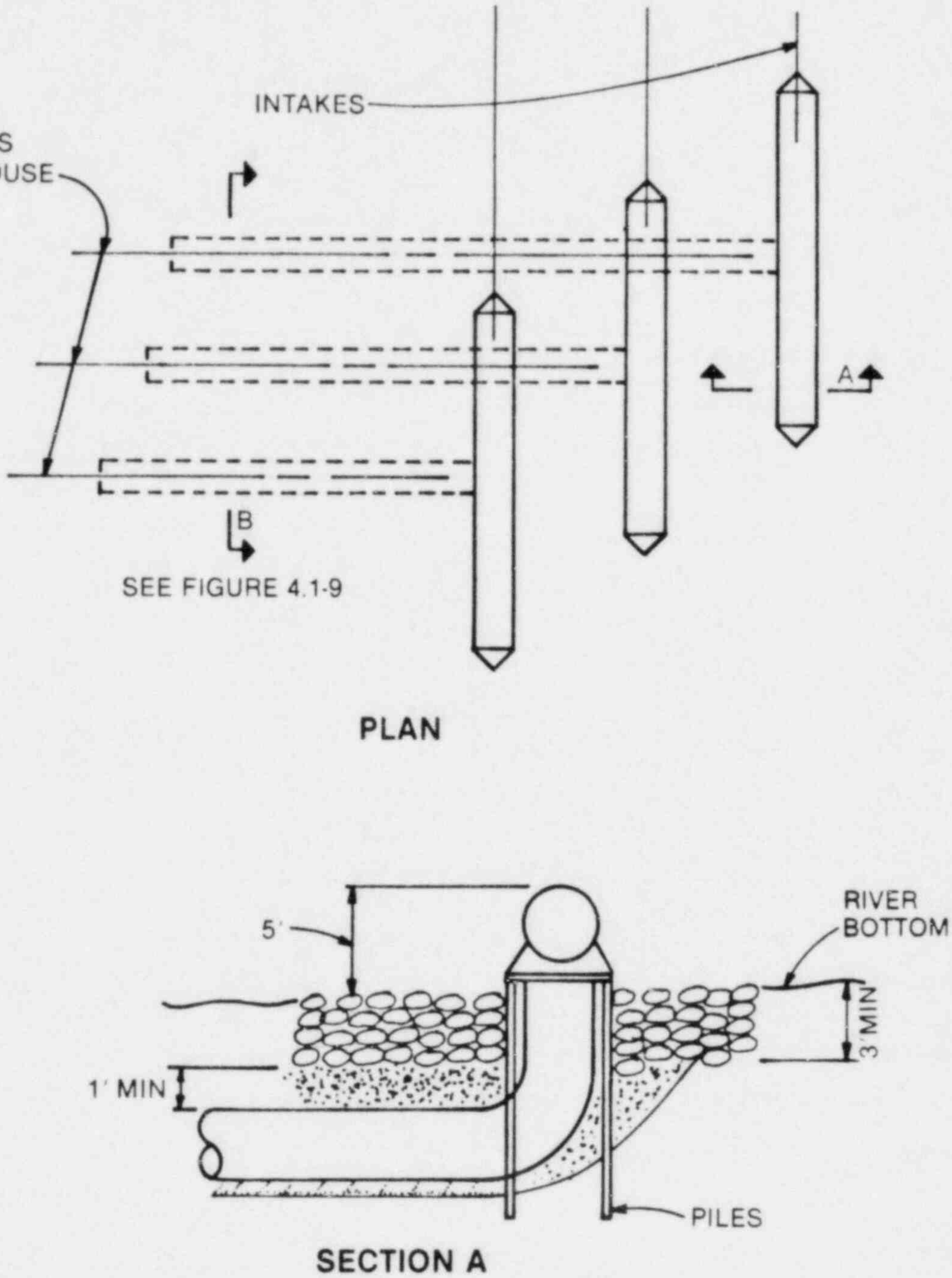


NOTES:
1. MAXIMUM PIPE INTAKE FLOW VELOCITY: 4.8 FPS
2. SCREEN INTAKE VELOCITY: 0.5 FPS AT MAX FLOW
3. MAXIMUM SCREEN SIZE OPENING: 0.375 INCH

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

CONSTRUCTION WATER
INTAKE PLAN & PROFILE

FIGURE 4.1-7

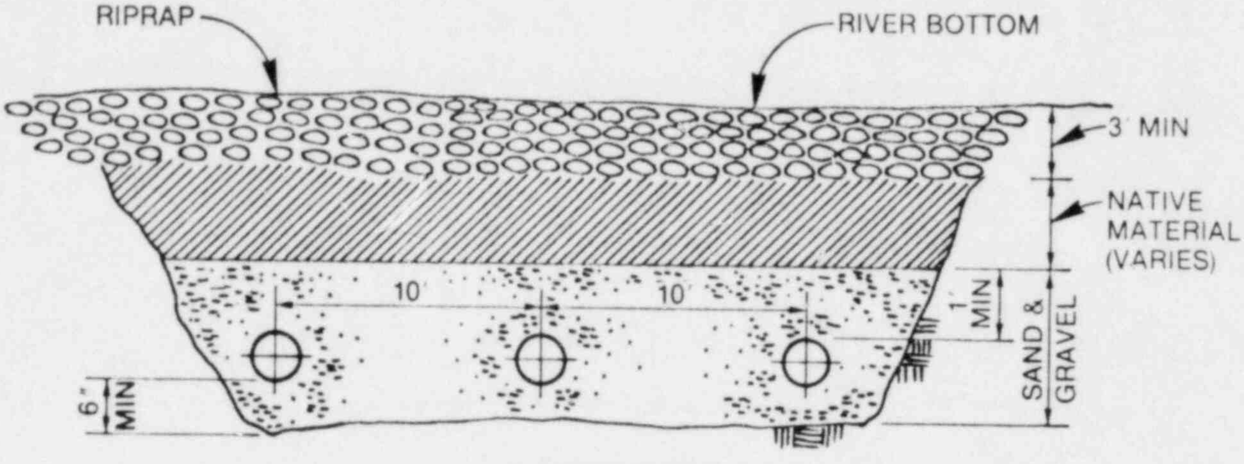


NOTES:
1. MAXIMUM INTAKE PUMPING RATE: 42,000 GPM
2. NORMAL DAILY INTAKE USAGE: 40.4M GAL/DAY
3. SCREEN INTAKE VELOCITY: 0.5 FPS MAX
4. MAXIMUM SCREEN SIZE OPENING: 0.375 INCH
5. MAXIMUM DISCHARGE RATE: 5910 GPM
6. NORMAL DAILY DISCHARGE: 4.06M GAL/DAY
7. MAXIMUM TEMPERATURE OF EFFLUENT DISCHARGE: 85° F

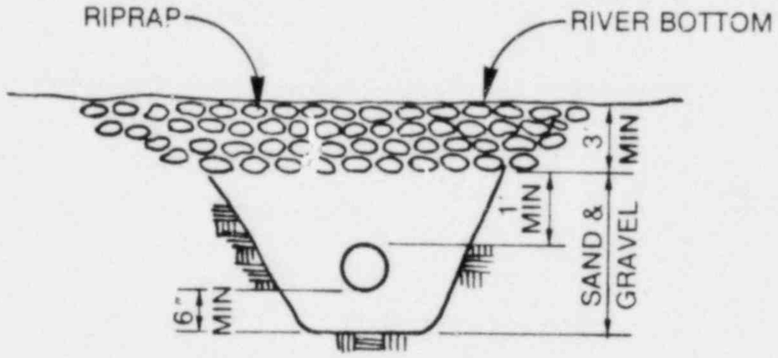
PUGET SOUND POWER & LIGHT COMPANY
SKAGIT / HANFORD NUCLEAR PROJECT
APPLICATION FOR SITE CERTIFICATION/ ENVIRONMENTAL REPORT

INTAKE PIPES PLAN & SECTION

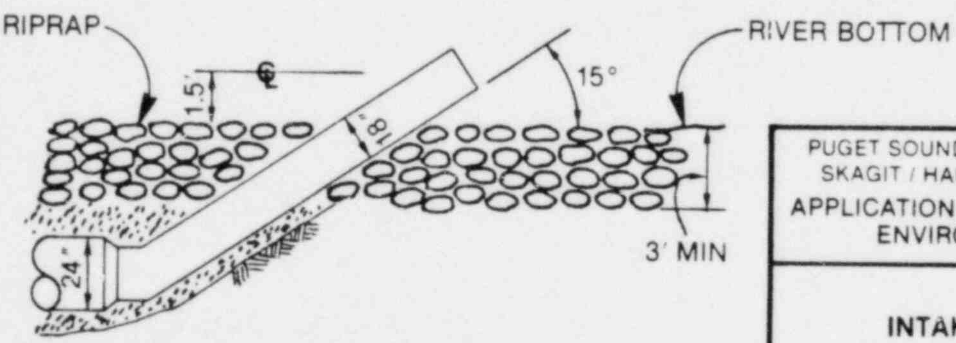
FIGURE 4.1-8



INTAKE PIPES
SECTION B



DISCHARGE PIPE
TYPICAL SECTION



DISCHARGE PIPE

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

INTAKE & DISCHARGE PIPE SECTIONS

FIGURE 4.1-9

4.2.5 NOISE

Due to the isolation of the transmission system, noise resulting from construction activities should not impact the general public. 4

No wildlife displacement is anticipated due to construction noise *per se*; however, construction noise in the old Hanford townsite area might be a contributing factor to displacing nesting raptors during the breeding season. 6 E260.08

4.2.6 HISTORICAL AND ARCHAEOLOGICAL SITES

The transmission system will not impact any known historical or archeological sites. 4

4.2.7 AESTHETICS

Because of the remote location of the Site and its associated transmission facilities, there will be no significant adverse impacts on aesthetics. 6

References for Section 4.2

1. Bonneville Power Administration, Environmental Statement: General Construction and Maintenance Program (August 1974). 4

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 5
to ensure contract adherence, and NESCO will audit the 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 6
and the Puget Vice President, Generation Resources have the 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 5
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 5
Control, Environmental Monitoring, and Restoration.

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

b. Erosion Control

c. Dust Control

d. Noise Control 5

e. Waste Disposal

f. Vegetation Removal/Restoration 6

g. Solid Waste Disposal

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.

4.5.4.3 Restoration Plan 5

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 storm will be controlled by grading away from the power 4 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,
crushed stone or pavement, as necessary, to decrease the 4
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
complied with, and precautions will be taken to prevent 4
accidental fires. Smoke which may occur during open

burning is not expected to restrict visibility on any public road.

The batch plant, fuel depot(s), sewage plant, welding shop(s) and other such facilities will be constructed and operated to conform with the applicable environmental standards.

Due to the remote location of the Project, which is more than seven miles removed from any inhabited area and nearly five miles removed from the nearest organized human activity (WNP-2 and FFTF complexes), there should be no off-Site impacts of noise, dust, odor or other emissions resulting from construction activity.

4.5.5.3 Disposal of Construction Waste, Debris & Sanitary Waste

Solid wastes will be generated daily by virtually all phases and elements of construction at the Site. Containers will be located throughout the jobsite and appropriately identified for collection of such items as trash, combustible materials, etc. Combustible materials will be burned or buried on-Site. Salvageable non-combustible materials (scrap metal, etc.) will be accumulated and removed periodically from the Site for recycling. Wastes not burned, buried, or recycled will be collected and stored in containers before removal to an approved disposal area. 4

Liquid wastes, such as fuels, lubricants, bitumens, and some flushing solutions will be deposited or discharged into tanks for salvage or subsequent removal to off-Site locations.

The concrete batch plant, which will be dismantled and removed from the Plant Site after completion of construction, will have an oil-trap concrete retention tank and a sedimentation box installed to control any inadvertent drainage of batch plant effluent. Washings from concrete transporting equipment will be processed in a waste concrete separator which will provide aggregate recovery and will control the quality of the effluent. Washings from other construction equipment will also be controlled to minimize surface water contamination.

Sanitary sewage during most of construction and during operation will be self-contained within the boundary of the Site by means of a package sewage plant and percolation pond.

Sanitary sewage during Site preparation and early stages of construction will be handled by chemical toilets provided and maintained by a licensed contractor. Chemical toilets will be used during later stages of construction only at remote and non-sewered locations to serve as supplemental facilities.

These toilets do not use an external water supply, nor do they discharge any liquids or solids. The waste from these toilets will be collected periodically and disposed of off-Site by a licensed disposal contractor.

4.5.5.4 Protection of Plant, Animal and Aquatic Life 4

Throughout the design, construction, and operation of this Project, every effort will be made to achieve an environmental balance which results in minimal damaging effect upon wildlife, fish or other aquatic species. Removal of vegetation will be minimized. Although the habitat of some animal life will be affected by the construction activities, the surrounding populations will not be adversely affected. Trenching in the Columbia River will be required to bed raw water supply and project discharge lines. Work on these installations will be scheduled to minimize turbidity and endangerment of aquatic life.

4.5.5.5 Landscaping

After construction has been completed, remaining excess spoils material will be disposed of on-Site. The spoils materials will be graded to conform, where possible, to the natural topography. Site areas disturbed by construction of the permanent facilities will be graded to provide adequate drainage.

Vegetation in the area of the construction activity is
sparse and has little or no visual significance. The upper 6
layers of the site soils are largely sands and are not
conducive to vegetation programs.

Areas adjacent to Project buildings will be enhanced with native species of plants for aesthetic purposes. Project graded areas contain no reusable soil and required topsoil for landscaped areas will be imported.

During removal of temporary facilities, the superstructures 4
will be completely removed, and the foundations will either

be razed flush with the ground or covered with soil which has been suitably placed to blend with area contours. 4

4.5.6 AUDIT AND INSPECTION

It is the responsibility of the Northwest Energy Services Company (NESCO), Director of Quality Assurance, to conduct audits and surveillances of the Construction Impact Control Program to assure that the program is effectively implemented.

An Environmental Surveillance Team will periodically 5
monitor construction activities and prepare inspection reports noting any discrepancies from established environmental control measures. Team membership will include the Puget Site Environmental Compliance representative, NESCO Resident Engineer, a representative from Bechtel's field construction management, and terrestrial and aquatic ecologists as appropriate.

CHAPTER 5.0

ENVIRONMENTAL EFFECTS OF PLANT OPERATION

CONTENTS

CHAPTER 5.0

ENVIRONMENTAL EFFECTS OF PLANT OPERATION

TABLES

CHAPTER 5.0

ENVIRONMENTAL EFFECTS OF PLANT OPERATION

FIGURES

(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.

5.1.2.1 Intake Effects 4

The intake for the makeup water of the cooling system
consists of three torpedo shaped tubes placed parallel to
the river flow above the river bottom (Section 3.4.2). The
top of the tubes will be submerged about 10 ft below the 6
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 percent of 4
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 6
necessitates the highest intake flow. On this peak temperature 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 perforations at these low velocities.

Biological effects of the intake structure are described in
Section 5.1.3. The critical intake approach velocity will 4
be maintained below 0.5 fps, thereby reducing impingement, 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 structures (within 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 6
flow problems would occur due to nonparallel flow. Also E290.35
because of the level of turbulence in the river (random 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
The net generation per cfs of flow for the four facilities E220.02
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 indistin- 4
guishable from ambient conditions.

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

River. Experimental evidence (Ref 8), approximately 14 miles upstream, confirms this rapid vertical mixing.

These regions neglect an intermediate region where mixing is a result of both ambient and discharge momentum. The neglect of this region leads to an underestimate of mixing and, therefore, an overestimate of excess temperatures, as well as other physical and chemical parameters.

Various input parameters (Table 5.1-1) are required for the model. The minimum regulated low river flow is 36,000 cfs. While this flow may be attained for short durations at Priest Rapids Dam, it will rarely if ever occur at the discharge location 35.6 miles downstream. Median river flow was taken as 115,752 cfs. The water depth in the vicinity of the discharge used to determine boundary effects was taken as 14 ft (bottom elevation 337 ft, MSL) during low flow, and 21 ft at median flow. These depths are based on Figure 5.1-1, which shows four cross-sections, 4
looking upstream, that bracket the discharge location. The lateral diffusion coefficient, which determines lateral far field mixing, was chosen as 4.0 ft^2/sec. This value compares with a range of 3.0-7.0 ft^2/sec for heated effluent measured approximately 19 miles upstream (Ref 9), and a mean value of 7.0 ft^2/sec measured 10 miles downstream from the S/HNP discharge location (Ref 10).

The ambient river temperature was assumed to be 20^{o}C (68^{o}F). Maximum discharge, 5,910 gpm, was assumed to have a temperature of 29.2^{o}C (84.5^{o}F). This temperature corresponds to a wet bulb of 24.4^{o}C (76^{o}F).

River velocities in the vicinity of the discharge were measured during May 1981. Maximum velocities of 7.0 fps were recorded over the discharge location near mid-stream at river flows of 143,000 cfs (see Appendix B). Calculations from these measurements indicate that average velocities will range between 2.32 and 4.37 fps for low and 5
median river flows.

Both the Plant effluent and ambient river conditions are temporal in nature. The former is described in Section 3.4 and the latter in Section 2.4.1. To account for seasonal changes, yet assure compliance with Washington State Water Quality Standards (Ref 5) under all conditions, three cases were analyzed: 4

- Case 1 - Regulatory Limiting Case

  This case would occur with a combination of extreme discharge temperature and flow (5,910 gpm), regulated extreme low river flow, and ambient river temperature resulting in the most restrictive regulatory criterion.

- Case 2 - Average Case

  This case would occur with a combination of the average discharge temperature and flow, discharged into the average water temperature and median river flow. It is used to illustrate the normal characteristics of the discharge plume.

- Case 3 - Large Excess Temperature Case

  This case is defined as the average discharge temperature and flow in conjunction with the regulated extreme low river flow and winter (January, February, and March) average river ambient temperature. It is used to illustrate the plume characteristics during a period of high excess temperature, that may occur during the winter when the weather suddenly turns warm. This warming would result in an almost immediate change in the discharge parameters, but a much slower change in the river temperature due to the higher volume to surface ratio of the river.

The S/HNP discharge, ambient river and regulatory limits corresponding to the three cases are shown in Table 5.1-1. 4

Results of the mathematical simulations are shown in Figures 5.1-2 to 5.1-10. Figures 5.1-2, 5.1-3 and 5.1-4, respectively, illustrate the downstream penetration, surface area and volume of the plume as a function of excess temperature for the three study cases. Case 3 results in the highest ($6.33^{\circ}F$) and Case 2 results in the lowest excess temperature ($2.45^{\circ}F$) after plume surfacing. However, the plumes will need to travel an additional 22, 0, and 8.0 ft to comply with thermal regulatory criteria for Cases 1, 2 and 3 respectively. The average case results in the greatest plume penetration downstream due to the relatively large water depth and river velocity. The difference in penetration between Case 1 and 3 is accounted for by the difference in buoyant effects. The Case 3 discharge is less buoyant than that of Case 1. To achieve compliance, surface areas of 390, 0 and 14.0 ft^2, and total volumes of 2,000, 150 and 240 ft^3 will be required for mixing in each of the three cases, respectively. The results reflect the fact that Case 1 will occur at high ambient temperatures when regulations assume that the river is already thermally stressed. Under the assumed critical conditions, the temperature increase 300 ft downstream of the discharge is estimated to be $0.09^{\circ}F$, well below the $0.54^{\circ}F$ limit specified by the State Water Quality Standards.

Surface isotherms for Cases 1, 2 and 3 are shown in Figures 5.1-5, 5.1-6 and 5.1-7, respectively. Subsurface isotherms 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. 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. 4

Worst case anticipated dilution at the centerline of the plume is 190:1 at the downstream boundary of a 300 ft 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. Variables presented in Table 5.1-1, dilution factors and concentration factors can be calculated 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

For example, Figure 5.1-5 for the worst case scenario would be: 6 E290.27

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. 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 4 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 drift-
ing 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-
tivity can be expected to be naturally mitigated in a short 4
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
of the regulated minimum river flow (36,000 cfs) and since 6
consumption will not cause a measurable difference in water
elevations and river velocities. E290.22

Of greater concern is the potential for impingement or
entrainment of the eggs, larvae or juveniles of important
fish species. Sport and commercial fish species conceiv- 4
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
percent of the minimum regulated river flow of 36,000 cfs. 6
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
gravel are not strong swimmers and are carried downstream.
Some of these fry may pass the intake structure and may be 4
vulnerable to entrainment or impingement. Only those small
fish unable to escape the approximate maximum intake
velocity of 0.5 fps at the 3/8 in. intake screen openings
will be impinged and lost. Laboratory tests, conducted to

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 were capable of surviving impingement at approach velocities of 2.5 fps for up to six minutes (Ref 12).

The design of the intake, similar to the WNP 1/4 and 2 intakes (Section 3.4.2.1), and its offshore location should reduce interaction with downstream 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. 4
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 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 the shear velocity of greater than 2.3 fps, impingement of 6
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. 4

The Washington Public Power Supply System has conducted 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. Inspections of intake structures by scuba observation likewise revealed no incidents of fish impingement, damage or other irregularities. Since the S/HNP intake will be similiar in design to 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

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 WNP-2 blowdown discharge are expected to be negligible from either a thermal increase effect or from cold shock, the sudden cessation of thermal discharge at Plant shutdown.

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. 4

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 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 resources are anticipated to occur. 4

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 growth may be negated by loss from swift and turbulent river flows. Algal diversity is decreased and biomass is affected when temperatures rise above or below the optimum. Patrick (Ref 6) observed that temperatures exceeding 86.0 to 93.2°F caused a measurable decrease in the number of species and the population size when compared to temperatures between 64.4 and 72.2°F. In Columbia River studies by Coutant and Owen (Ref 20), thermal increments of 18.0°F increased the standing crop of periphyton only during a short winter period. Such data indicate that adverse impacts of the thermal discharge upon periphyton communities near the outfall are not anticipated to occur.

5.1.3.2.3 Thermal Effects on Benthos 4

The S/HNP thermal discharge to the Columbia River is not
expected to adversely affect the benthic invertebrate
community in the Hanford Reach. Maximum discharge tempera-
ture is 84.5°F. The river bottom area receiving heated
water is small. Maximum percentage of the cross-sectional
area of the river bottom receiving heated water is less
than 1.2 percent. Because the S/HNP discharge is oriented 5
at an angle 15° above horizontal, and because the thermal
plume is buoyant, little attachment of the plume to the
river bottom is anticipated. Maximum excess temperature
along the river bottom is projected to be only 0.45°F
(Section 5.1.2); 40 ft downstream from the discharge point.
The benthic community in the Hanford Reach is comprised
primarily of insect larvae; caddisflies and mayflies are
the predominant taxa (Section 2.2.2.5).

Jensen et al. (Ref 15) report that the upper-temperature limits for the majority of benthic organisms occurring in the Hanford Reach appear to be in the range of 85.0 to 92.0°F. Tolerance is dependent upon species, stage of development and acclimation temperature. 4

Becker (Ref 21) reported that caddisfly larvae acclimated to 67.0°F river water had a 50 percent mortality after a 68-hour exposure to an 18.0°F increment, whereas, temperatures 13.5°F above ambient were insignificant. A two-week earlier emergence of insects in heated zones, as compared to water at ambient temperatures, was found by Coutant (Ref 22). These thermal tolerance data and the expected small area of river bottom receiving heated water indicates the benthic community will not be adversely impacted by the S/HNP discharge.

5.1.3.2.4 Thermal Effects on Fishes

Temperature is one of the most important parameters influencing the fishery resources in the Columbia River. Temperatures may reduce the success or efficiency of fish in its various life processes. Stress is proportionate to the extent and duration of the thermal input. Any temperature increase may increase the vulnerability of fish to the harmful effects of toxicants or susceptibility to disease. Conversely, cold shock may stress fish acclimated to the thermal increase.

Discharge of heated effluent into the Columbia River may affect both resident and anadromous fish populations. Considerations of thermal requirements, however, vary according to life history stages, differences in physiology, and a variety of other biological characteristics. In Section 5.1.2, the physical effects of the plant effluent are described and a thermal model presented for three cases. Plume characteristics are given according to differences in discharge temperatures, discharge flows, river water temperatures, and river flows. The area encompassed by different isotherms in these models can be related to potential effects on fish behavior and survival. Calculations and assumptions derived from the model were used to determine possible exposure time of fish to various temperature increments (Tables 5.1-2 and 5.1-3). 4

<u>5.1.3.2.4.1 Important species</u>. An extensive review of the thermal tolerance of important resident and anadromous fish species indicated salmonids are the most sensitive species to thermal discharges (Ref 23). However, because of their presence near the discharge location, other important fish are discussed in the following sections as well.

<u>Anadromous Salmonids</u>

The Hanford Reach is used extensively by fall chinook salmon and steelhead trout for spawning and rearing. In addition, coho, sockeye, and other of chinook salmon migrate through as juveniles and again as adults (Table 2.2.2-7).

The following temperature ranges are recommended as optimum for the maintenance of salmonid fish resources in the Columbia Basin (Ref 17):

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).

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. 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 4
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 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
juvenile chinook salmon acclimated at 66.2°F and subjected 6
to ΔT up to 10.8°F for four hours.

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 4
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.

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 4
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). Potential exposures for a fish drifting through the plume centerline are less than 18 percent of the duration causing equilibrium loss (Ref 38).

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 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 4
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 ΔT = 16.5°F. Even during low flow conditions and ambient river temperatures of 68.0°F, temperatures in the receiving water would be below lethal temperatures after a time interval of a very few seconds. A thermal differential of

2.0°F would occur at the surface approximately 40 ft
downstream of the discharge location and the corresponding 4
surface area for a 2.0°F isotherm would consist of 100 sq 5
ft. A differential of only 0.09°F would occur 300 ft
downstream of the outfall (Section 5.1.2). 4

The maximum cross sectional area of the river which would
experience thermal increases greater than 0.5°F is less
than 1.2 percent of the main channel during worst case
conditions. Since approximately 99 percent of the river 5
cross section is available for passage at ambient tempera-
tures, 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.

The frequency of fish disease may increase with increased 4
water temperature. Infectious diseases appear less likely
to cause mortalities in adult salmonids at temperatures
below 60.0°F (Ref 17). There is no evidence of increased
incidences of infection by <u>Chondrococcus columnaris</u> in
areas below the thermal discharges of early Hanford reac-
tors 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 E290.15
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 4
no adverse effects on different developmental stages of
salmon eggs and fry when thermal increments were less than
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 4
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 performance 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 vulnerability to predation relative to controls almost exponentially. 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). Preferred spawning temperatures are near 50.0°F (Ref 13).

Although mountain whitefish are known to be present near
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 4
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 the
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.

Because sturgeon remain near the river bottom, they should
not be influenced significantly by the rising plume. Maxi- 4
mum 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.

38. Q. J. Stober, D. L. Mayer and E. O. Salo, "Thermal Effects on Survival and Predation for Some Puget Sound Fishes," Third National Symposium on Radioecology, U.S. Atomic Energy Commission, Oak Ridge National Laboratory and the Ecological Society of America (1971).

39. C. C. Coutant, Effect of Thermal Shock on Vulnerability to Predation in Juvenile Salmonids. Vol. 2, A Dose Response by Rainbow Trout to Three Shock Temperatures. BNWL-1519. Battelle, Pacific Northwest Laboratories, Richland, WA. 12 pp. (1972).

40. C. C. Coutant, Effect of Thermal Shock on Vulnerability of Juvenile Salmonids to Predation. J. Fish. Res. Bd. Canada 30:965-973 (1973).

TABLE 5.1-9

RELATIVE HUMIDITY EXCESS, AT PLUME LEVEL, CAUSED BY OPERATION OF S/HNP COOLING TOWERS

Ambient Condition	Ambient Relative Humidity	Excess Relative Humidity (%)			
		1 km Downwind	3 km Downwind	5 km Downwind	10 km Downwind
Average winter morning	86.1	10.8	5.2	3.5	2.0
Average summer morning	58.5	7.0	3.1	2.0	1.0

4

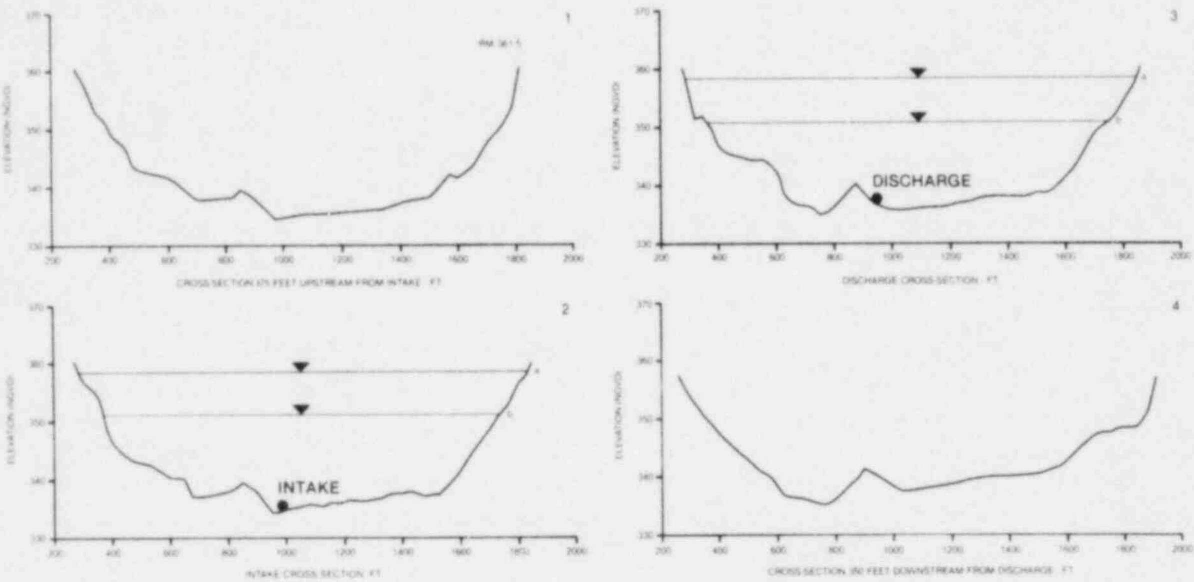
TABLE 5.1-10

GENERATION CHARACTERISTICS
LOWER COLUMBIA DAMS

Dam	Location Columbia River RM	Installed Capacity Kilowatts*	Kilowatts Per cfs*
McNary	292.0	1,127,000	5.5
John Day	215.6	2,484,800	7.7
The Dalles	191.7	2,047,000	6.4
Bonneville	145.5	654,000	4.2
			23.8

*Northwest Power Pool Operations Review 1980-1981.

6
E220.02



a) Regulated Average Discharge that is Equalled or Exceeded 50% of the Time -115,752 CFS.

b) Administratively Established Minimum Discharge - 36,000 CFS.

c) Cross-Sectional views looking upstream. Distances are in feet from the west bank (Benton County shoreline).

PUGET SOUND POWER & LIGHT COMPANY
SKAGIT / HANFORD NUCLEAR PROJECT

APPLICATION FOR SITE CERTIFICATION/ ENVIRONMENTAL REPORT

RIVER CROSS-SECTIONS IN THE VICINITY OF THE DISCHARGE

FIGURE 5.1-1

5.3 EFFECTS OF CHEMICAL AND BIOCIDE DISCHARGES

5.3.1 LIQUID DISCHARGES

The S/HNP wastewater discharge will contain constituents originally present in the river water, as well as chemicals and biocides added for normal Plant operation and other treated wastes generated during operation. An NPDES Application has been filed with the Washington State Energy Facility Site Evaluation Council (EFSEC) for a permit to discharge wastewaters (Appendix F). The following section discusses the environmental impact of the chemicals and biocides of the S/HNP discharge.

Ambient water quality data are presented in Section 2.4. The expected chemical releases to the Columbia River via the S/HNP discharge are described in Section 3.6 and summarized in Tables 3.6-5 and 5.3-1. Discharge concentrations and resulting concentrations in the river at a distance representing the mixing zone boundary are compared to Federal Effluent Limitation Guidelines (Ref 1), to Washington State Water Quality Standards (Ref 2) and to U.S. Environmental Protection Agency Water Quality Criteria (Ref 3) in Table 5.3-1.

4

5.3.1.1 Point Of Discharge

The S/HNP will discharge a maximum of 5910 gpm (13.2 cfs) of water to the Columbia River. Of this amount, approximately 99 percent will be cooling tower blowdown. The remaining 1 percent will be miscellaneous treated wastes from demineralizer regenerant wastes, pretreatment wastes, filter backwash, and Plant Facility floor drainages. The expected discharge levels of the specifically regulated parameters, such as pH, free available chlorine, total suspended solids, and oil and grease, are less than the Federal Effluent Limitation Guidelines (Ref 1) for new source performance standards.

5.3.1.2 Downstream from the Point of Discharge

A preliminary study was conducted to determine the plume characteristics of the S/HNP discharge when two units are in operation (Section 5.1.2). A description of the computational methodologies is presented in Appendix C. Projected chemical concentrations at the edge of a 300 ft mixing zone are provided in Table 5.3-1.

The dissolved solids concentration in the S/HNP discharge will be higher than ambient concentrations in the river as a result of:

a. Concentration in the cooling tower.

b. Sulfuric acid and sodium hypochlorite addition in
the circulating water system. 4

c. Regenerant chemicals (sulfuric acid and sodium hydroxide solution) used in ion exchange regeneration.

Most of the dissolved solids concentrations in the S/HNP
discharge (Table 5.3-1) are expected to be greater than the
ambient river water by a factor of about ten. Maximum and
average concentrations isopleths for these dissolved solids
are presented on Figures 5.3-1 through 5.3-4. Exceptions 6
are sodium, bicarbonate, sulfate, and chloride. Bicarbonate concentrations in the S/HNP discharge will be less
than ambient river water due to the depletion of bicarbonate through the addition of sulfuric acid. The maximum
sodium, sulfate and chloride concentrations in the S/HNP
discharge are expected to be greater than ambient water by
factors of 38, 57 and 33, respectively. The incremental
increases in sodium, sulfate and chloride concentrations in
the river at the edge of the mixing zone are not expected
to cause detrimental effects to aquatic biota. Increases 4
in any of the dissolved solid concentrations should not
cause long-term build up in the sediments or in the biota.
The maximum concentration of total dissolved solids (TDS)
in the S/HNP discharge (1602 mg/liter) will require dilution on the order of only 3.8:1 to comply with the receiving water TDS criterion (500 mg/liter) established by
Washington State Department of Social and Health Services
(Ref 6). No osmotic stress on migrating juvenile salmonids 6
or adverse effects on other biota are expected.

In view of the negligible increases in chemical constituents near the discharge location, as described in this section, there will be no anticipated chemical or biocide contamination of downstream domestic or agricultural water supplies.

A comparison between Washington State Water Quality 4
Standards (Ref 2) for Class A-Excellent waters and the
chemical concentrations at the mixing zone boundary
indicates that all regulated parameters are in compliance.
A similar comparison of Columbia River water quality at the

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 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 neutralized to maintain pH levels between 6.5 and 8.5. As a result, no change in metal toxicity will occur in the receiving water. 4 6 N220.06

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.

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. 6

Copper concentrations in undiluted discharge water may be in the range of the 96-hr LC_{50} for some species. Within 40 ft downstreem of the discharge, copper concentrations would be below the 96-hr LC_{50} for salmon. This area represents approximately one percent of the river cross section. It 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 differences 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.

The toxicity of zinc, like copper, is greatly affected by water hardness. The 96-hr LC_{50} for fathead minnows, in water of similar hardness as the Columbia, was 33 mg/l. Reference 8 reports that for rainbow trout in waters with hardness greater than 200 mg/l $CaCO_3$, the 48-hr LC_{50} was greater than 2,000 μg/l of zinc. As exhibited by Table 5.3-1, the presence of zinc in the discharge plume is not expected to have a significant adverse effect on the Columbia River ecosystem. 6

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 complex 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 bioavailability 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.

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 6
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,
as specified by U.S. Environmental Protection Agency 4
(Ref 3). Assuming worst case conditions, 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). 5

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
S/HNP plume may be adversely affected within a relatively 4
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 below the discharge. Under high discharge and low river
flow conditions, maximum chlorine concentrations are 6
rapidly diluted to <0.01 mg/l within 50 feet downstream of the discharge. Under average conditions, the plume is not dissipated until further downstream. However, chlorine levels are reduced to <0.004 mg/l at a point 150 feet downstream of the discharge.

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 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 (*Ictalurus punctatus*). 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 $20^{\circ}C$, 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) 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. 6

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. In addition, Dandy (Ref 17) suggests that fish in conact with chlorine may lose respiratory 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 discharges 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 these conditions for sufficient duration to cause mortality.

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). Although the S/HNP 6 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. Because of this rapid dilution, the synergistic effects of TRC, heat and suspended solids could only cause mortality to fish maintaining position on the midstream water column directly below the plant discharge for a significant period of time. Fish could not maintain their position there without considerable energy costs and it is unlikely that fish would choose to remain in the discharge plume for a significant period of time. Consequently, the potential for combined effects represents minimal incremental 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 circulating water will contain about 829 mg/l of dissolved solids. Drift from the cooling towers will be controlled 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 4 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 nutrients as shown in Table 4, (2) the expected peak deposition beyond the site boundary is less than 20 kg/ha-yr (no more 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." 4

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.

References for Section 5.3

1. U.S. Environmental Protection Agency, Effluent Guidelines and Standards for Steam-Electric Power Generating Point Source Category, Code of Federal Regulations, 40 CFR 423 (October 1974).

2. Washington State Department of Ecology, Washington State Water Quality Standards, WAC-713-201, Water Quality Planning, Office of Water Programs, Department of Ecology, Olympia, WA (December 1977).

3. U.S. Environmental Protection Agency, Quality Criteria for Water, EPA 440/9-76-023, U.S. EPA, Washington D.C. 20460 (1976).

4. U.S. Environmental Protection Agency, Ambient Water Quality Criteria for Selected Toxic Chemicals, EPA 440/5-80-001 to 079, Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. (October 1980).

5. T. L. Page and E. J. Hulsizer, Biofouling Control in Open Recirculation Cooling Water Systems - A Review, Battelle Pacific Northwest Laboratories, Richland, WA (June 1977).

6. Washington State Department of Social and Health Services, Rules and Regulations of the State Board of Health Regarding Public Water Supply, Health Services Division, DSHS, Olympia, WA (March 1973).

7. R. R. Rucker and W. J. Whipple, Effect of Bactericides on Steelhead Trout Fry, (Salmo gairdneri), Progr. Fish-Cult. 13(1): 43-44. (1951).

8. National Academy of Sciences and National Academy of Engineers (NAS-NAE), Water Quality Criteria 1972. A Report of the Committee on Water Quality Criteria, Environmental Studies Board. EPA.R3.73.033. Washington, D. C. (March 1973).

9. D. S. Cherry, S. R. Larrick, J. O. Giattina, K. L. Dickson, J. C. Cairns, Jr., "Avoidance and Toxicity Responses of Fish to Intermittent Chlorination," Environ. Internat., 2 (1979), pp. 85-90.

10. M. C. Bell, Fisheries Handbook of Engineering Requirements and Biological Criteria, Fish-Eng., Eng. Prog. Corps of Engineers, North Pacific Div., Portland, OR (1973).

11. Washington Public Power Supply System (WPPSS), Supplemental Information on the Hanford Generating Project in Support of a 316(a) Demonstration, prepared by Battelle, Pacific Northwest Laboratories for Washington Public Power Supply System, Richland, WA (1978).

12. P. S. Trefethan, Sonic Fish Tracking, Int. Comm. Northwest Alt. Fish, Spec. Pub. 4 (1963), pp. 81-83.

13. G. E. Monan, K. L. Liscom, J. K. Smith, Sonic Tracking of Adult Steelhead in Ice Harbor Reservoir, 1969. Final Report, Biological Laboratory Bureau Commercial Fisheries, Seattle, WA (1970).

14. C. C. Coutant, Behavior of Ultrasonic Tagged Chinook Salmon and Steelhead Trout Migrating Past Hanford Thermal Discharges (1967), BNWL-1530, Pacific Northwest Laboratory, Richland, WA (1975).

15. T. O. Thatcher, M. J. Schneider, E. G. Wolf, "Bioassay on the Combined Effects of Chlorine, Heavy Metals and Temperature on Fishes and Fish Food Organisms," Part I. Effects of Chlorine and Temperature on Juvenile Brook Trout (Salvelinus fontinalis). Unpublished report available from USAEC at (45-1) - 1830 (1975) (cited in Page and Hulsizer 1979).

16. Q. J. Stober and C. H. Hanson, "Toxicity of Chlorine and Heat to Pink," (Onchorhynchus gorbuscha) and Chinook Salmon (O. tshawytscha), Trans. Am. Fish. Soc., 103 (1974), pp. 569-576.

17. J. W. T. Dandy, "Activity Response to Chlorine in the Brook Trout, (Salvelinus fontinalis) (Mitchill)," Can. Jour. Zool., 50 (1972), pp. 405-410.

18. J. D. Giattina, D. S. Cherry, J. Cairns, Jr., S. R. Larrick, "Comparison of Laboratory and Field Avoidance Behavior of Fish in Heated Chlorinated Water," Trans. Am. Fish. Soc., 110(4) (1981), pp. 526-535.

19. P. Ray, "Evaluation of Toxicity of Some Industrial Effluents to Fish by Bioassay," Ind. Jour. Fish., 8 (1961), pp. 233-240.

20. D. L. Latimer, The Toxicity of 30-Minute Exposures of Residual Chlorine to the Copepods (Limnocalanus macrurus) and Cyclops (Bicuspidatus thomasi), Master of Science Thesis, University of Wisconsin, WI (1975).

21. A. S. Brooks and G. L. Seegert, The Effects of Intermittent Chlorination on the Biota of Lake Michigan, Special Report No. 31, Center for Great Lakes Studies, University of Wisconsin, Milwaukee, WI (1977).

22. H. S. Davis, Culture and Diseases of Game Fish. Univ., Cal. Press, Berkeley, CA (1970).

23. J. L. Sykora, E. J. Smith and M. Synak, Effect of Lime Neutralized Iron Hydroxide Suspensions on Juvenile Brook Trout (*Salvelinus fontinalis*). Water Research 6: 935-950 (1972).

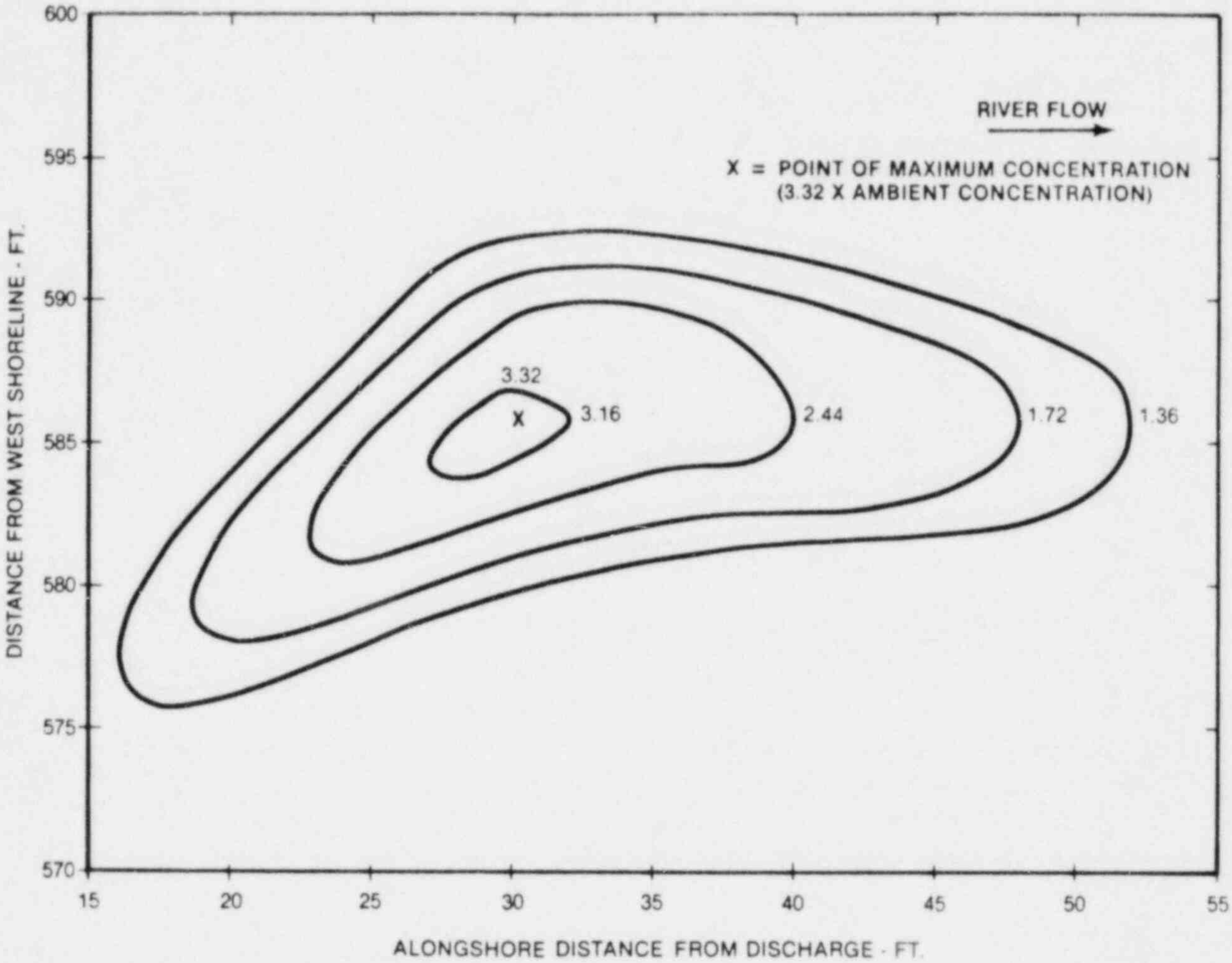
24. G. A. Chapman and D. G. Stevens, Acutely Lethal Levels of Cadmium, Copper and Zinc to Adult Male Coho and Steelhead, Trans. Am. Fish Soc. 107: 837 (1978).

TABLE 5.3-1

CHEMICAL CONCENTRATIONS IN THE PROJECT DISCHARGE BEFORE AND AFTER DILUTION COMPARED TO AMBIENT LEVELS

Chemical Constituent	Units	Ambient Conditions: Columbia River[a] Ambient Conditions Avg	Max	End of Pipe Conditions: Combined Project Effluent Concentrations[b] Avg	Max	Federal Point Source Effluent Limitations[k] Avg	Max	Receiving Water Conditions: Concentrations[h] At Edge of Dilution Zone Avg	Max	Washington State WQ Standards For Class A Waters (Ref 2)	U.S. Environmental Protection Agency WQ Criteria (Refs 3 and 4) 24 hr. Avg	Max
Calcium, as Ca	mg/l	19.7	24.0	156.2	309.4			20.0	25.5			
Magnesium as Mg	mg/l	4.3	5.7	42.8	73.4			4.37	6.1			
Sodium, as Na	mg/l	2.3	3.1	31.3	116.6[c]			2.35	3.7			
Potassium, as K	mg/l	0.8	1.1	7.7	13.9			0.8	1.17			
Bicarbonate, as HCO_3	mg/l	67.5	82.0	16.9	14.6[d]			67.4	81.6			
Sulfate, as SO_4	mg/l	12.8	19.0	659.0	1,088.5[d]			14.0	24.6	250.0[i]	-	250.0[j]
Chloride, as Cl	mg/l	1.5	5.4	23.2	179.1[c]			1.53	6.3	250.0[i]	-	250.0[j]
Silica, as SiO_2	mg/l	4.8	6.6	47.8	85.3			4.88	7.0			
Total Alkalinity, as $CaCO_3$	mg/l	55.3	67.0	13.8	12.1[d]			55.2	66.7			20.0[j]
Hardness, as $CaCO_3$	mg/l	66.9	82.0	666.0	1,076.0			68.0	87.2			
Non-carbonate Hardness, as $CaCO_3$	mg/l	11.4	22.0	-	-			-	-			
Specific Conductance	umho/cm	135.0	170.0	1,382.0	2,498.0			137.3	182.3			
pH	Units	-	8.8	6.5-8.5	6.5-8.5			-	8.8	6.5-8.5	-	6.5-9.0[j]
Dissolved Solids	mg/l	81.5	109.0	834.0	1,602.0			82.87	116.9	-	1,000.0[j]	
Color	(Pt-Co Units)	10.0	15.0	-	-			-	-			
Suspended Solids	mg/l	3.7	24.0	36.9	309.7[e]			3.76	25.8			
Turbidity	NTU	1.7	4.9	-	-			-	-	5.0 over background		
Fecal Coliform	#/100ml	2.0	13.0	-	-			-	-	100		200.0[j]
Dissolved Oxygen	mg/l	11.9	15.8	8.52[f]	7.74-9.69			11.9	15.8	8.0	5.0	
Total Cadmium, as Cd	ug/l	1.3	3.0	12.9	38.4			1.32	3.19		0.016	2.5
Total Chromium, as Cr	ug/l	3.0	20.0	29.9	257.4			3.05	21.2		-	100.0[j]
Total Copper, as Cu	ug/l	10.3	28.0	102.6	360.4			10.5	29.7	1,000.0[i]	5.6	18.4
Total Iron, as Fe	ug/l	117.0	290.0	1,165.3	3,735.0			118.9	308.1		-	300.0[j]
Total Lead, as Pb	ug/l	16.9	73.0	168.3	939.7			17.2	77.6		1.49	135.0
Total Mercury, as Hg	ug/l	0.17	1.0	1.69	12.87			0.177	1.06		0.00057	0.0017
Total Zinc, as Zn	ug/l	38.2	90.0	380.5	1,159.2			38.8	95.6	5,000.0[i]	47.0	272.6
Ammonia Nitrogen, as N	mg/l	0.01	0.07	0.099	0.9			0.01	0.074			0.5[j]
Nitrate Nitrogen, as N	mg/l	0.1	0.14	0.996	1.8			0.10	0.15	10.0[i]	-	10.0[j]
Ortho-Phosphate, as P	mg/l	0.01	0.04	0.099	0.51			0.01	0.04		-	0.1[j]
Total Phosphorus, as P	mg/l	0.03	0.11	0.299	1.42			0.03	0.12			
Total Residual Chlorine	mg/l	0.0	0.0	-	0.14			0.0002	0.0007		-	0.002[j]
Oil and Grease	mg/l	0.0	0.0	-	-							

NOTES:
(a) Concentrations of Columbia River water are developed from USGS data, October 1977 to October 1980, for Vernita Bridge near Priest Rapids Dam, Washington.
(b) Effluent concentrations developed by Bechtel, Inc. (see ER Section 3.6).
(c) Includes increase in sodium and chloride due to addition of sodium hypochlorite.
(d) Addition of sulfuric acid increases sulfate and reduces bicarbonate and alkalinity.
(e) Does not include air-borne dust and suspended solids settled in the cooling tower basin.
(f) Dissolved oxygen figure based on 68.9F time weighted average blowdown water temperature.
(g) Dissolved oxygen figures based on 84.5F and 59.4F, corresponding to maximum and minimum blowdown water temperatures.
(h) At a point 300 feet downstream of the discharge (edge of the mixing zone).
(i) Washington State Department of Social and Health Services, Board of Health regarding public water supply, Health Service Division (Ref 5).
(j) Values from the U.S. E.P.A. "Red Book," 1977 (Ref 3).
(k) Values subject to NPDES Permit, pending before the Washington State Energy Site Evaluation Council (EFSEC).



MINIMUM RIVER DISCHARGE: 36,000 cfs

MAXIMUM PLANT DISCHARGE: 13.2 cfs

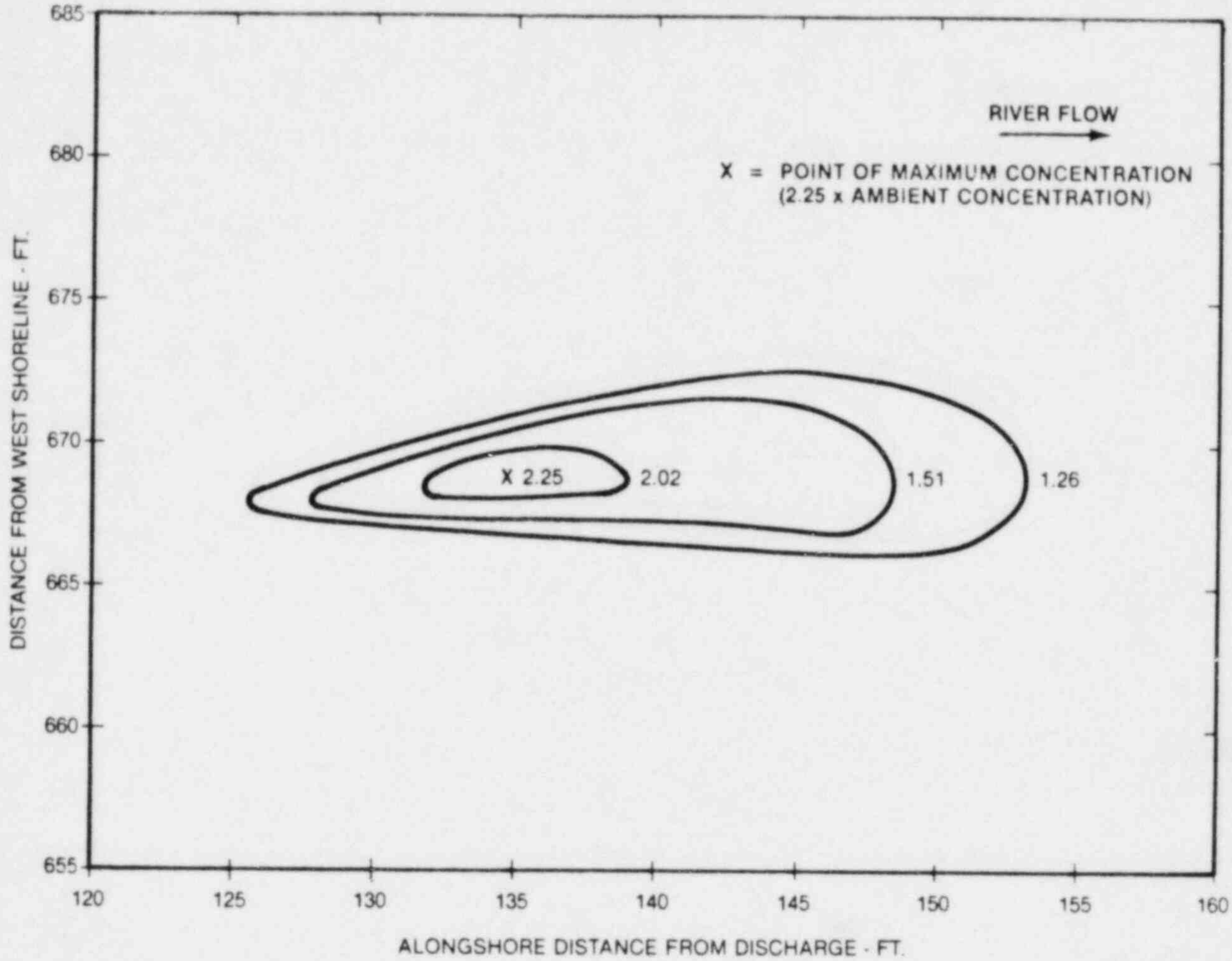
13 CYCLES OF CONCENTRATION

PUGET SOUND POWER & LIGHT COMPANY
SKAGIT/HANFORD NUCLEAR PROJECT

APPLICATION FOR SITE CERTIFICATION/
ENVIRONMENTAL REPORT

SURFACE ISOPLETHS CONCENTRATION FACTORS REGULATORY LIMITING CASE (1)

FIGURE 5.3-1

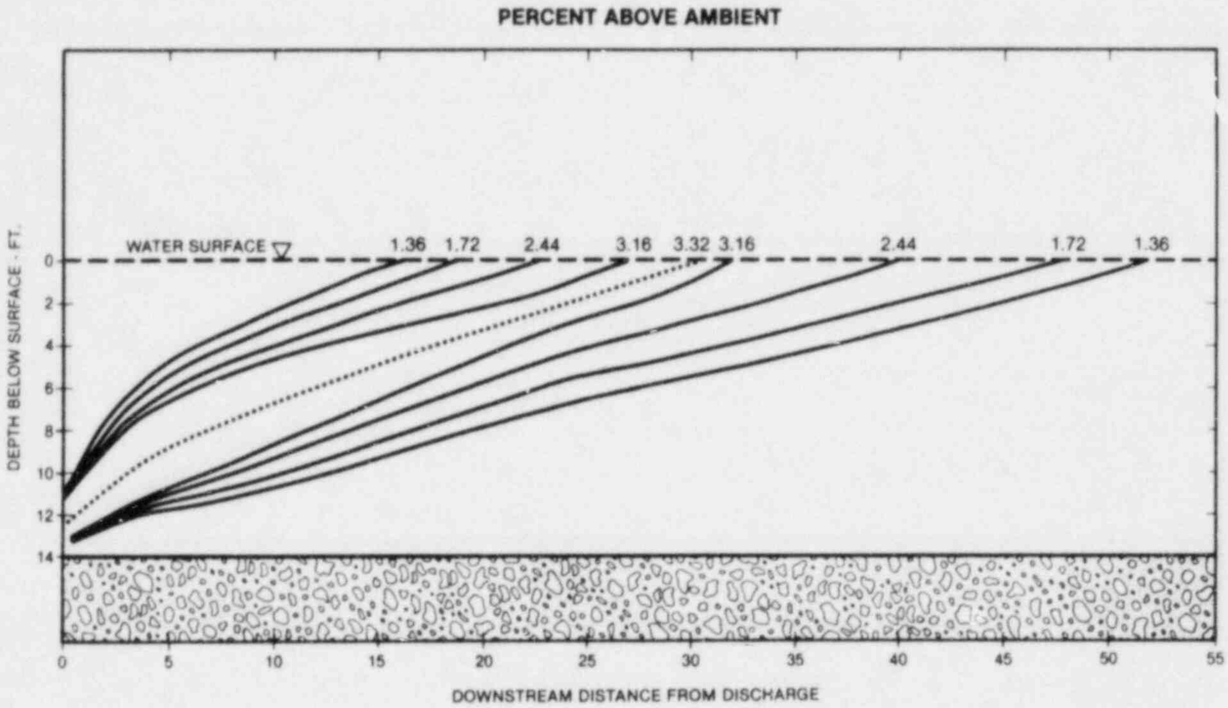


MEDIAN RIVER DISCHARGE: 115,752 cfs
AVERAGE PLANT DISCHARGE: 6.28 cfs
10 CYCLES OF CONCENTRATION

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

SURFACE ISOPLETHS CONCENTRATION FACTORS AVERAGE CASE (2)

FIGURE 5.3-2



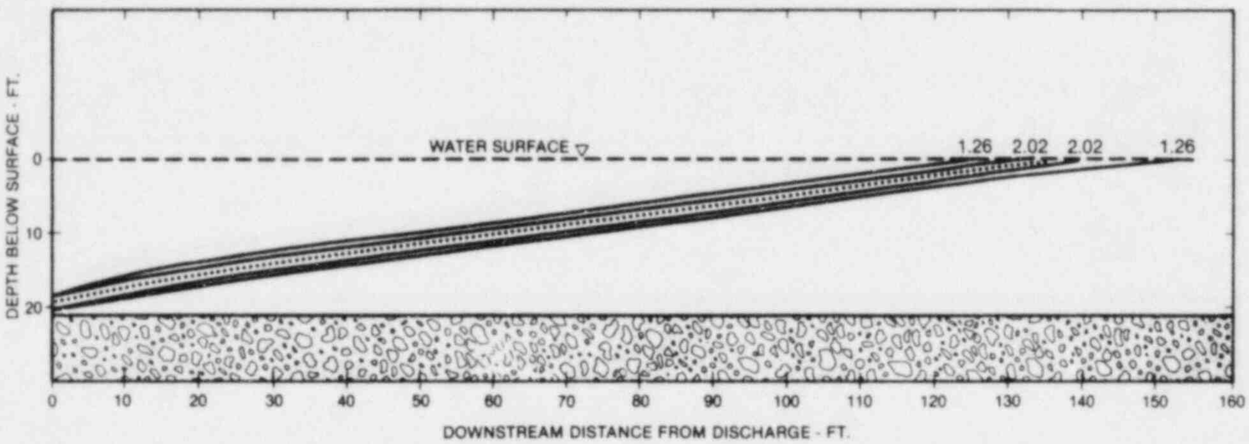
PUGET SOUND POWER & LIGHT COMPANY
SKAGIT/HANFORD NUCLEAR PROJECT

APPLICATION FOR SITE CERTIFICATION/
ENVIRONMENTAL REPORT

CONCENTRATION ISOPLETHS FOR MOST CONSTITUENTS - ALONG PLUME CENTERLINE - REGULATORY LIMITING CASE (1) (13 CYCLES OF CONCENTRATION)

FIGURE 5.3-3

PERCENT ABOVE AMBIENT



PUGET SOUND POWER & LIGHT COMPANY
SKAGIT/HANFORD NUCLEAR PROJECT

APPLICATION FOR SITE CERTIFICATION/ ENVIRONMENTAL REPORT

CONCENTRATION ISOPLETHS FOR MOST CONSTITUENTS - ALONG PLUME CENTERLINE - AVERAGE CASE (2) (10 CYCLES OF CONCENTRATION)

FIGURE 5.3-4

5.4 EFFECTS OF SANITARY DISCHARGES

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

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 sanitary wastes 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 to be 37.6 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 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 4 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.

References for Section 5.4

1. Washington Public Power Supply System, WNP #2 Environmental Report-Operating License Stage, Docket No. 50-397 Amendment #4 (October, 1980).

5.5 EFFECTS OF OPERATION AND MAINTENANCE OF THE TRANSMISSION SYSTEM

The environmental effects of operation and maintenance of 4
the S/HNP transmission system and BPA Ashe-Hanford No. 2
line are expected to be minimal. The vegetation on the 5
right-of-way is principally sagebrush, bitterbrush and
cheatgrass. Chemical control will not be required. Once
established, the access roads should require very minimal
maintenance.

The transmission lines will be entirely within the Hanford Reservation, and thus, the general public will not have uncontrolled access to any new transmission access roads. Therefore, resident wildlife should receive little additional exposure.

In accordance with the recommendations in Reference 1, and
as described in Section 3.9, armless construction will be
utilized for the 69-kV distribution lines supplying power
to the pumping plant. Due to the physical separation and
orientation of the conductors, and lack of suitable perches 4
with armless construction, the electrocution hazard to
raptors will be minimal.

As discussed in Section 3.9, the acoustic and electrical noise, ground currents, and ozone production resulting from the operation of the transmission system will be insignificant.

Because of the remote location of the Site and its
associated transmission facilities, there will be no 6
significant adverse impact on aesthetics.

References for Section 5.5

1. D. Miller, E. L. Boeker, R. S. Thorsell and R. R. Olendorff, Suggested Practices for Raptor Protection on Powerlines, Raptor Research Foundation, Provo, Utah, and Edison Electric Institute, Washington, D. C. (June 1975). 4

5.6 OPERATIONAL NOISE

The operational noise generated at the S/HNP Site will not be measurable at the nearest residential area, more than 7 miles away, and thus will not present an adverse impact or nuisance to the local population. 4

Typical predicted noise levels generated by mechanical draft cooling towers are 60 to 90 dBA at 50 feet, and at 2.5 miles 15 to 44 dBA (Ref 1).

Figure 5.6-1 shows noise level contours for operational noise from S/HNP Units 1 and 2. As shown, the maximum level at the Site Boundary due to normal plant operation is approximately 60 dBA. This is significantly less than the limit imposed (70 dBA) by WAC 173-60-040(2)(a). 6 E260.06

These predictions are based on normal operation of a two unit base load plant. No significant reduction in plant noise is expected during nighttime operation.

Other industrial facilities in proximity to the S/HNP Site are the FFTF, WNP-2, WNP-1, and WNP-4, all about 5 miles away. 4

Design of the raw water pumphouse is incomplete and the equipment has not been specified. However, the present design provides for 3 pumps per unit, 2 operating at any given time, and the following assumptions can be made:

1. Noise from pumps equivalent to that of previous intake
2. Two 50% fan units equivalent to previous fan units
3. Pumphouse is insulated metal siding 6 E260.09
4. All pumps and fans in a single building/room

Noise from the raw water pumphouse is estimated to be 58 dBA Leq adjacent to the pumphouse and 32 dBA Leq at the river bank (approximately 200 ft away).

The pumphouse noise should not be detectable at the river or any residence.

The sound level from the WPPSS intake pump, location 5, Table 2.7-1, Figure 2.7-1, was barely audible over the flow noise created by the current of the Columbia River, flowing by the inlet and outlet marker buoys. It is expected that the S/HNP pumps, which will be of similar design, will have 4 about the same noise levels. The levels will be well below any existing regulation (WAC 173-60) as well as the guidelines proposed by the U.S. Environmental Protection Agency. 4

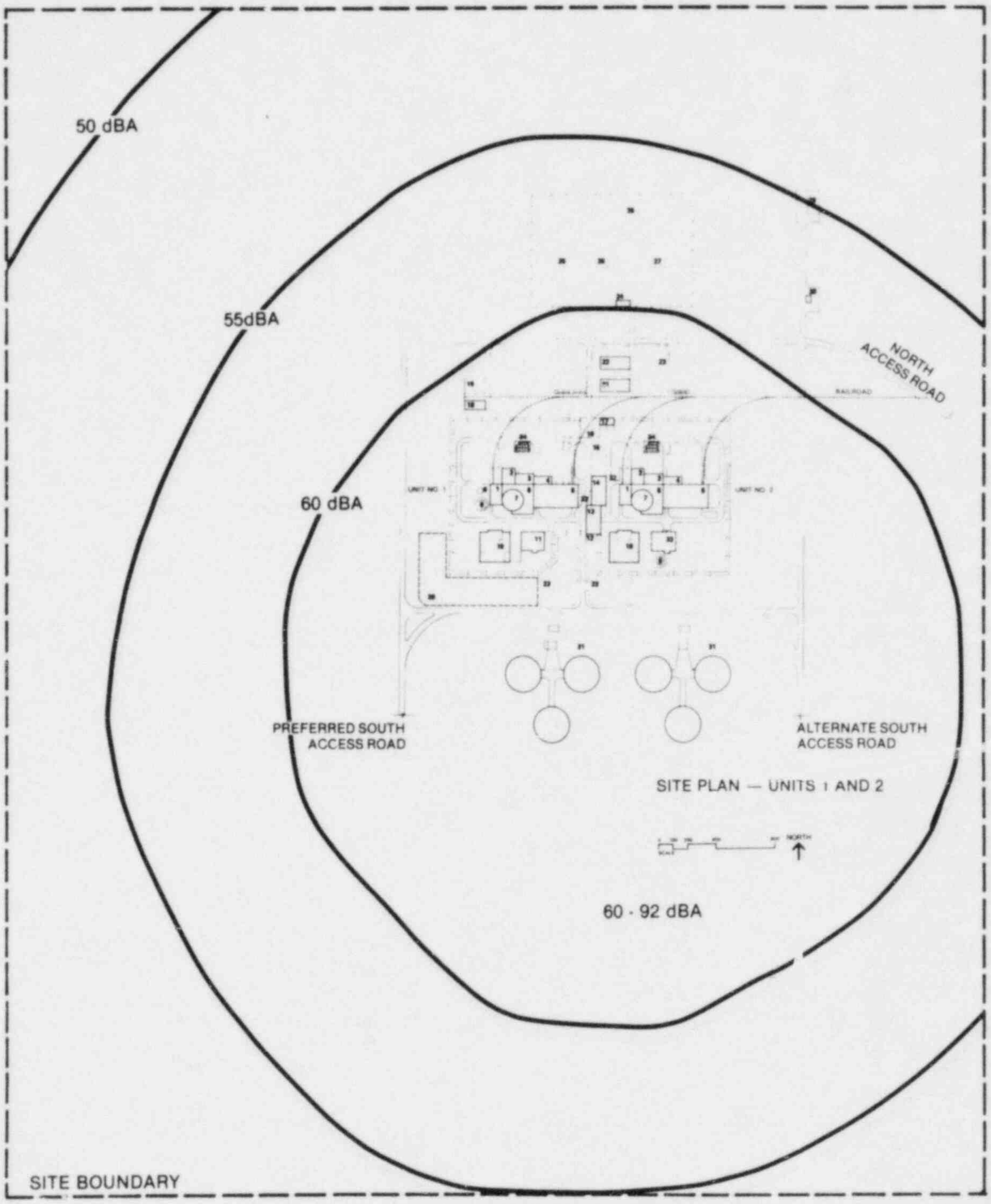
Transmission line noise is discussed in Section 3.9.2. Due to the remote location of new transmission lines, there will be no increased noise levels experienced by the public. 6 E260.02

Operational traffic will normally consist of less than 200 cars per day. These vehicles will be split between Route 4 and SR240. Since traffic volumes on these routes in 1981 were between 4100 and 6100 cars per average working day, the operational traffic for S/HNP will not affect traffic related noise. 6 E260.02

The operational noise will be well below the applicable Federal and State standards discussed in Section 2.7. 4

References for Section 5.6

1. Hanford Number Two Environmental Report, Amendment 4.



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

DAYTIME/NIGHTTIME OPERATIONAL NOISE S/HNP UNITS 1 AND 2

FIGURE 5.6-1

CHAPTER 6.0

EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

FIGURES

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. 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, pump- 4
house, 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

As previously mentioned, this monitoring effort will determine the distribution of important species within the Site and Associated Areas and monitor the abundance of these important species or areas of special concern (as indicated from preapplication studies): bald eagles, long-billed curlews, and the old Hanford townsite. As shown in Figure 6.1-4a, this monitoring effort will begin 6
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 monitoring program. 4

<u>Important Plant Species</u>. The listing status of persistant sepal yellow cress, <u>Rorippa</u> <u>calycina</u>, var. <u>Columbiae</u>, will

be monitored in case of a change from its present status as a candidate for listing as threatened or endangered on the Federal list, and threatened on the Washington State list. The area occupied by the population along the riparian zone will be determined during the time of low water levels in the spring. The percentage of the population which will be disturbed by construction will be estimated. An additional check of the population during the low water period in late summer or fall will be conducted to help determine the ability of the species to resist disturbance.

Important Wildlife Species. A reconnaissance of the Site and associated areas will occur twice each spring and winter to map the distribution of important species. Occurrence data will be recorded and no effort will be made to estimate population levels. The objective of this investigation is to determine if the distribution of important species changes during construction activities.

Bald Eagles. Bald eagles primarily are found during the winter at the old Hanford townsite. This area will be surveyed monthly during the winter to determine the number of eagles present. An attempt will be made to determine habitat usage within the Site and associated areas. Observation regarding prey selection, preferred roosting sites and sensitivity to disturbance will be recorded.

Long-billed Curlews. Curlews are found during the breeding period (March-June) and at least two pairs have been found within the Site and associated areas. Potential nesting habitat within or adjacent to the Site and associated areas will be surveyed monthly (during the breeding period) for signs of breeding activity. Territories actively defended will be mapped and nesting success will be determined whenever possible. In addition, the breeding chronology will be monitored to assist in scheduling construction activities. 4

Old Hanford Townsite. The townsite is an area of special concern for wildlife. The objective of this portion of the monitoring program is to develop a data base on wildlife occurrence and monitor the impacts of construction activities upon wildlife at the townsite. Raptors, landbirds, and deer will be monitored.

Wildlife abundance will be monitored in the spring and fall/winter to sample breeding adults and winter residents, respectively. Spring sampling will occur in April and May; fall/winter sampling will occur from November through January. The procedures for this monitoring effort are outlined in Table 6.1-14.

6.1.4.3.3 Preoperational Monitoring

Site preparation and construction monitoring will supply an adequate data base for monitoring the effects of Plant operation on *Rorippa calycina*, var. *Columbiae*, bald eagles, long-billed curlews and wildlife at the old Hanford townsite. Monitoring other wildlife species or wildlife use areas is not deemed necessary at this time. 4

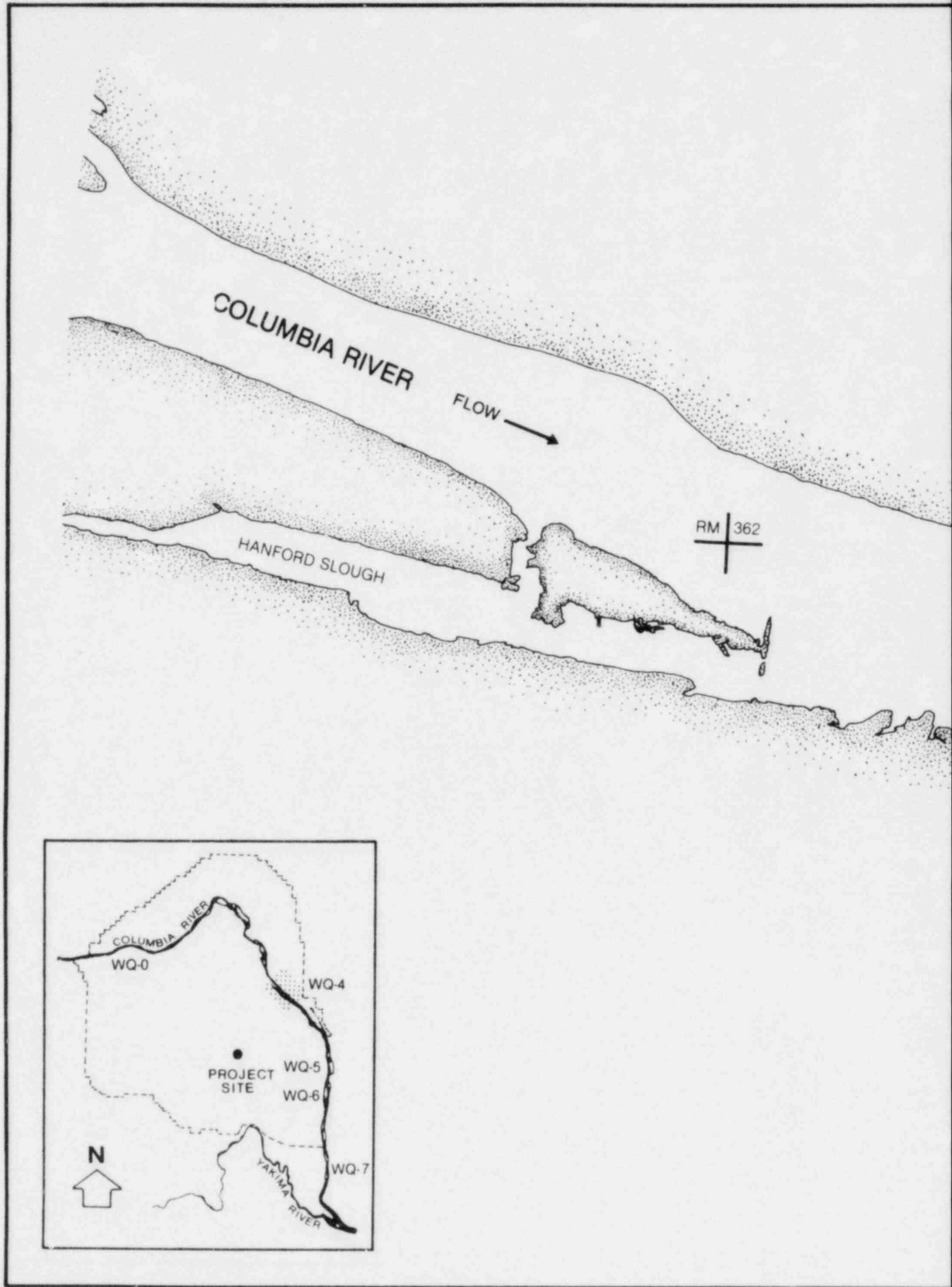
Data regarding the land area altered or rendered unsuitable for biological productivity will be measured near the end of construction. A map showing all areas of disturbance will be developed.

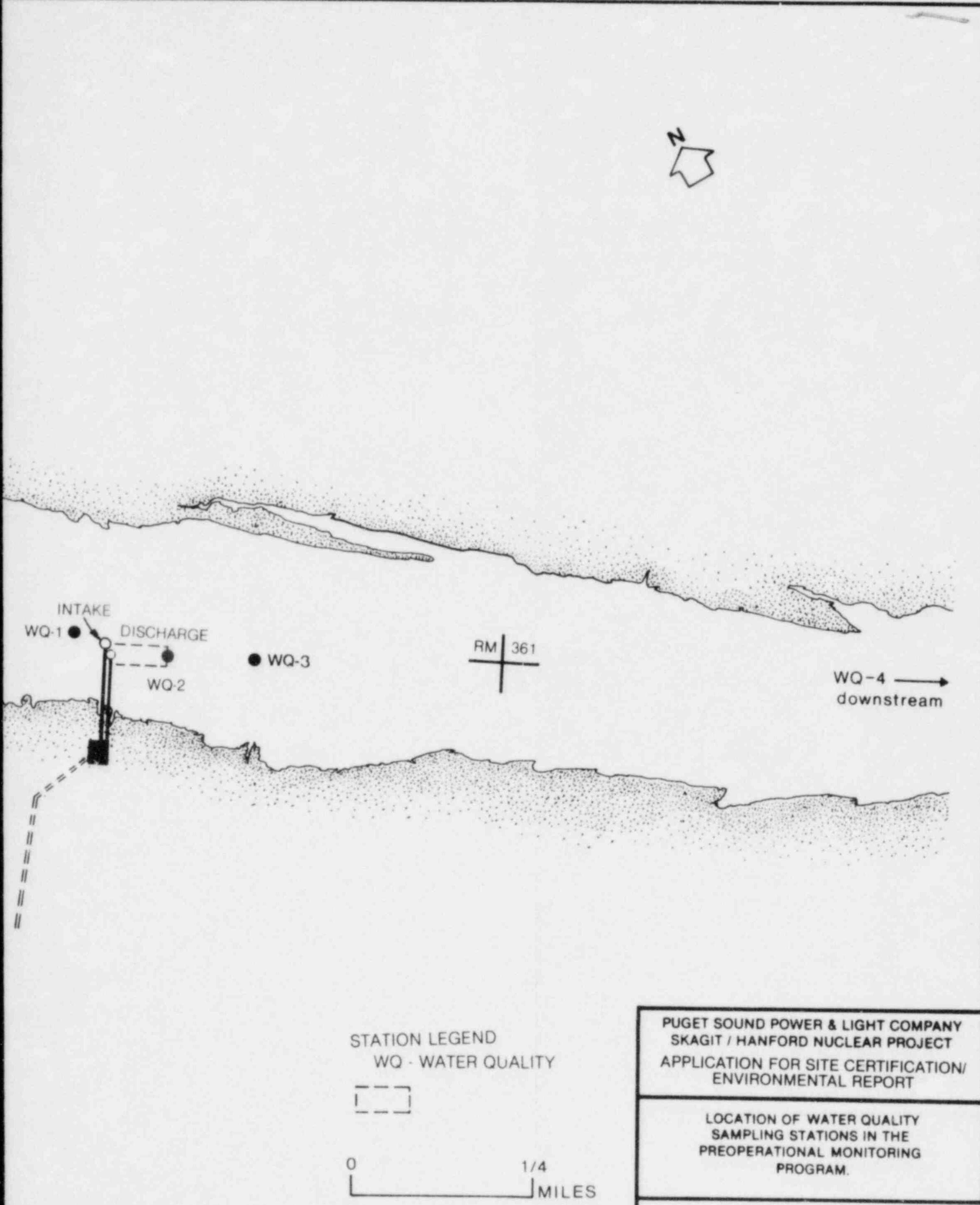
The Supply System is studying the effects of drift on vegetation and wildlife. 6 As discussed in Section 5.3.2, the drift effects associated with the S/HNP do not require monitoring and will be less than those found at the Supply System units because of a much reduced particulate ratio. 4 Therefore, the Supply System study will serve as a conservative estimate of the drift effects which might result from the S/HNP and will be reviewed by the Applicant. 6 N200.05

6.1.5 RADIOLOGICAL MONITORING

The S/HNP preoperational radiological environmental monitoring program (REMP) is designed to provide measurements of radiation and radioactive materials in those exposure pathways, and for those radionuclides which are expected to lead to the highest radiation exposures of individuals from the operation of the S/HNP. The preoperational program objectives are to measure background levels and their variations in exposure pathways surrounding the Site; to train personnel; and to evaluate procedures, equipment, and techniques.

The S/HNP preoperation REMP is based on a combination of airborne, terrestrial and aquatic monitoring stations. 4 Airborne sample stations have been chosen based on the projected population distribution around the Site, adjacent land use, and meteorological data presented in Chapter 2. The area within a ten-mile radius of the Site is of primary interest in the terrestrial monitoring part of the program. Attention is given to the area of Franklin County which uses Columbia River water for irrigation and is in the prevailing downwind direction. Aquatic sampling locations have been chosen based on the need to determine the S/HNP impact on the aquatic environs separately from other facilities on the Hanford Reservation.

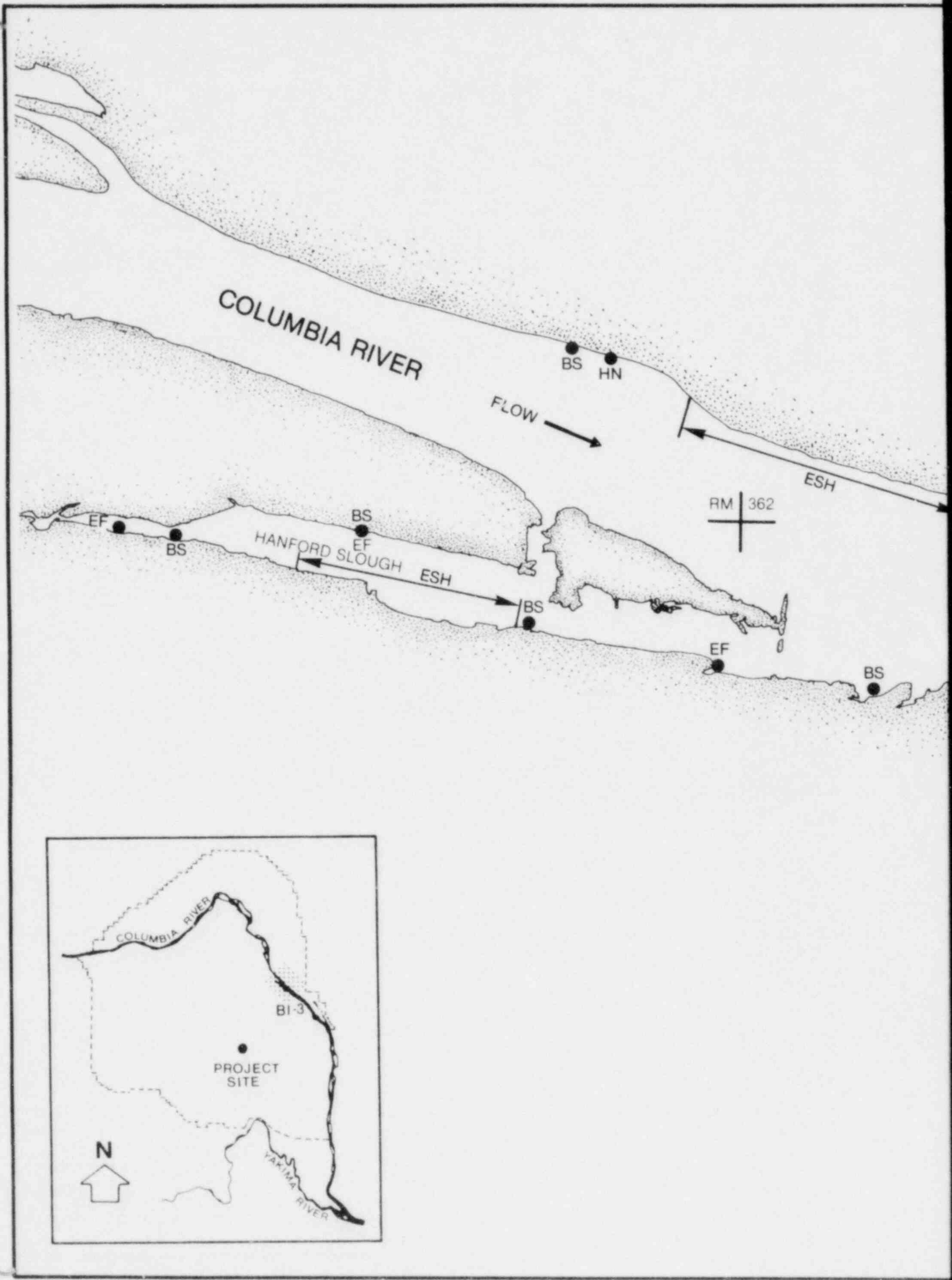

COLUMBIA RIVER
FLOW
RM 362
HANFORD SLOUGH
COLUMBIA RIVER
WQ-0
WQ-4
PROJECT SITE
WQ-5
WQ-6
N
WQ-7
YAKIMA RIVER

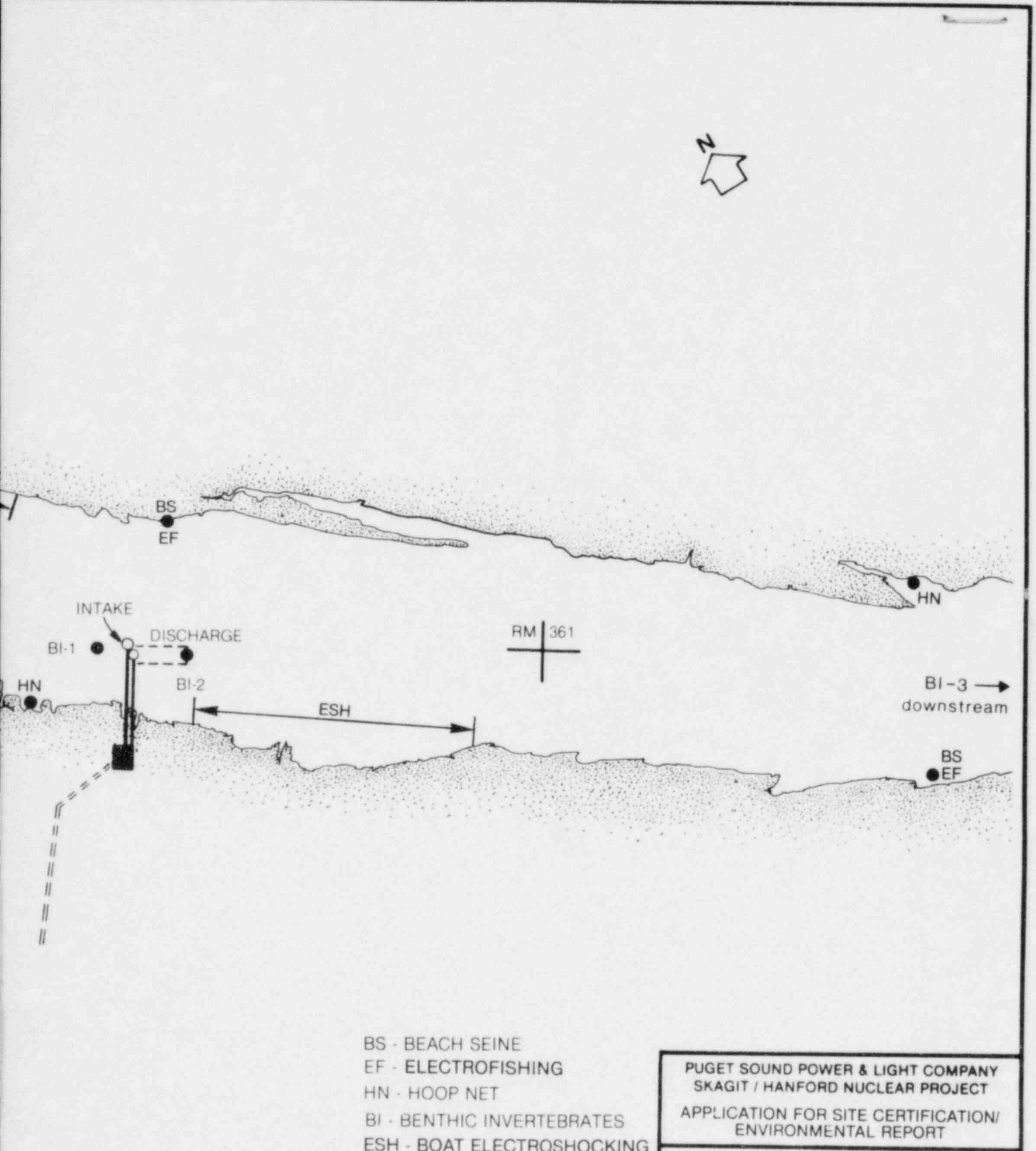


PUGET SOUND POWER & LIGHT COMPANY
SKAGIT / HANFORD NUCLEAR PROJECT
APPLICATION FOR SITE CERTIFICATION/ ENVIRONMENTAL REPORT

LOCATION OF WATER QUALITY SAMPLING STATIONS IN THE PREOPERATIONAL MONITORING PROGRAM.

FIGURE 6.1—1

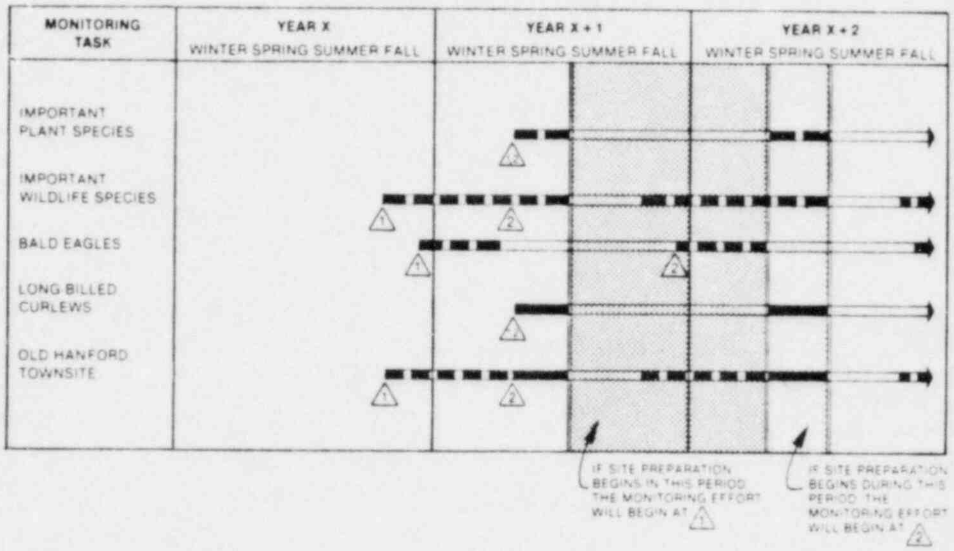

COLUMBIA RIVER
FLOW
BS
HN
ESH
RM 362
EF
BS
BS
EF
HANFORD SLOUGH
ESH
BS
EF
BS
COLUMBIA RIVER
BI-3
PROJECT SITE
N
YAKIMA RIVER



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

AQUATIC BIOLOGICAL SAMPLING STATIONS FOR THE PREOPERATIONAL MONITORING PROGRAM.

FIGURE 6.1—2



- DARKENED SECTIONS INDICATE PERIODS OF FIELD EFFORT
- EXAMPLE 1 IF SITE PREPARATION BEGINS IN THE SUMMER OF YEAR X + 1 THE MONITORING EFFORT WILL BEGIN IN THE FALL OF YEAR X
- EXAMPLE 2 IF SITE PREPARATION BEGINS IN THE SPRING OF YEAR X + 2 THE MONITORING EFFORT WILL BEGIN IN THE SPRING OF X + 1

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

SCHEDULE FOR S/HNP TERRESTRIAL ECOLOGY MONITORING PROGRAM

FIGURE 6.1-4a

CHAPTER 8.0

ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

CONTENTS

CHAPTER 8.0

ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

TABLES

CHAPTER 8.0

ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

FIGURES

TABLE 8.2-1

COST INFORMATION FOR NUCLEAR ($000)

1.	Interest During Construction	%/Year	9%	
		Compound Rate	N/A	
2.	Length of Construction Workweek	Hours/Wk	40	4
3.	Estimated Site Labor Requirement	Manhours/KWe	17.02	
4.	Average Site Labor Pay Rate (Incl. Fringe Benefits) Effective at Month and Year of NSSS Order	$/Hour	11.53(*)	5
5.	Escalation Rates: Site Labor	%/Year	N/A	
	Materials	%/year	N/A	
	Composite Esc Rate	%/year	10% 1980 and 1981; 8% 1982 and beyond	4
6.	Power Plant Costs (Nuclear Units 1 & 2)			

Direct Costs		Unit 1	Unit 2	
a.	Land and Land Rights	$ 3,000	$ 0	5
b.	Structures and Site Facilities	464,962	294,584	
c.	Reactor Plant Equipment	331,413	330,446	
d.	Turbine Plant Equipment	226,375	241,431	
e.	Heat Rejection System	-------	-------	
f.	Electric Plant Equipment	114,093	86,582	
g.	Miscellaneous Equipment	21,732	13,820	
h.	Spare Parts Allowance	6,882	3,304	
i.	Contingency Allowance	Incl Above	Incl Above	
	Subtotal	1,168,457	970,167	
Indirect Costs				4
a.	Construction Facilities, Equipment, and Services	201,564	154,977	
b.	Engineering and Construction Management Services	298,815	101,183	
c.	Other Costs	142,164	54,473	
d.	Interest During Construction (@ 9%/year)	925,833	489,588	
Escalation				
	Escalation During Construction (@ 8%/year)	1,512,067	1,789,212	
Total Cost				
	Total Plant Cost @ Start of Commercial Operation	4,248,900	3,559,600	

(*) May 1973 dollars. 5

TABLE 8.2-2

ESTIMATED COSTS OF ELECTRICAL ENERGY GENERATION
NUCLEAR UNITS 1 & 2

	Mills/ Kilowatt-Hour (1)	
Fixed Charges (2)		
Operating Income	31.4	
Depreciation	16.6	
Interim Replacements	----	
Taxes	21.3	
Total Fixed Charges (FCR at 13.88%)	69.3	4
Fuel Cycle Costs (3)		
Cost of U_3O_8 (Yellowcake)	12.9	
Cost of Conversion and Enrichment	6.6	
Cost of Conversion and Fabrication of Fuel Elements	4.3	
Cost of Processing Spent Fuel	----	
Carrying Charge on Fuel Inventory	8.6	
Cost of Waste Disposal	5.5	
Credit for Plutonium or U-233	0	
Total Fuel Cycle Costs	37.9	
Costs of Operation and Maintenance		
Fixed Component	23.1	
Variable Component	8.5	
Total O & M Costs	31.6	
Costs of Insurance		
Property Insurance	1.9	
Liability Insurance	.2	
Total Insurance Costs	2.1	
Total Bus Bar Costs	140.9	

(1) Levelized over a 30-year book life operating period;
plant design life is 40 years. 6

(2) Assumed capacity factor is 70%. Assumed cost of money
is 10.67%. 4

(3) Shipping charges included. Assumed heat rate of 10,215 6
BTU/kwh. 4

8.3 SOCIAL AND ECONOMIC IMPACTS

8.3.1 DESCRIPTION OF THE PROJECT IN THE CONTEXT OF THE TRI-CITIES AREA 4

The location of the Site in relation to the Tri-Cities and surrounding communities and counties is shown in Figure 2.1-1. 6

The early development of Richland, Kennewick and Pasco was tied to the agriculture and transportation industries. Until World War II, for example, Richland (founded in 1910) was a small farming community of several hundred people. At the same time, Pasco and Kennewick developed economies integrally related to the railroad industry. By 1940 the populations of Pasco and Kennewick had grown to 3,913 and 1,918, respectively. The combined population of the three cities in 1940 was 6,078 (Ref 1). 4

In 1942, the town of Richland was taken over by the United States Government through condemnation proceedings as part of a 600 square mile reservation for the Hanford Engineering Works. From 1943-1945 the city of Richland was built to house the personnel and administrative offices associated with the plutonium production facilities on the Reservation. While the character of Pasco and Kennewick was less dramatically affected during this period, they too, grew and changed due to war-time activities and operation of the Hanford Works (Ref 2).

By 1950 the population of the Tri-Cities was over 50,000 and the economy of the area had become closely linked to nuclear technology. By the 1960's corporations such as Westinghouse, Battelle, North American Rockwell, United 5 Nuclear Corporation, Boeing and Exxon located nuclear operations in the Tri-Cities area. The Tri-Cities Nuclear Industrial Council has been an active force in promoting the development of nuclear industries.

By the 1970's construction of the Fast Flux Test Facility 4 (USDOE) and WPPSS Nuclear Plants (WNPs) 1, 2, and 4 by Washington Public Power Supply System (Supply System) provided a dramatic stimulus to the local economy. Over the 1978-1979 period, for example, the Tri-Cities SMSA had the <u>ninth</u> largest increase in personal income of the 273 SMSAs in the United States (Ref 3).

From 1970-1980 the population of the Tri-Cities Standard Metropolitan Statistical Area (SMSA) grew 54 percent, from 93,356 to 144,469 (Ref 1).

Much of this increase in economic and demographic activity was related to nuclear facility construction on the Hanford Reservation. For example, in 1970 there were approximately 1,756 construction workers in the Tri-Cities SMSA but by 1979 this figure had grown to 11,110 on an average annual basis, of which 7,630 were employed by the Supply System. 4
By June of 1981, monthly employment in the Tri-Cities SMSA reached 13,880 construction workers.

8.3.2 DELINEATION OF IMPACT AREA

Nuclear related construction over the past generation has changed the socioeconomic character of the Tri-Cities Area. The great bulk of the new activity generated by this construction - from population growth to traffic congestion - has occurred in the SMSA and particularly within Richland, Pasco, Kennewick, West Richland and Benton City.

School enrollment data presented in Table 8.3-1 illustrate the localized nature of construction related in-migration. In May of each year school districts in the area conduct a 5
survey to identify "construction pupils," i.e., students whose parents are employed at WNP-2 or 1/4 and whose date of residence in the school district was subsequent to May 1, 1972 (for WNP-2) and May 1975 (for WNP-1/4).

Table 8.3-1 depicts the results of the May 1980 survey. As these data demonstrate, construction pupils, both in terms of absolute and relative impact, are concentrated in the school districts closest to the Site and the core of the SMSA. For example, the Richland, Kennewick and Kiona- 4
Benton districts accounted for approximately 83 percent of all construction pupils identified by the Supply System audit.

Such data as the school enrollment figures in Table 8.3-1 strongly suggest that the impacts of S/HNP - both positive and adverse - will be centered within Benton and Franklin Counties in general and particularly in the following five communities: (1) Benton City, (2) Kennewick, (3) Pasco, (4) Richland, and (5) West Richland. Other communities in Benton and Franklin Counties (e.g., Prosser) will only be modestly affected by S/HNP construction and operation.

According to an analysis of the Supply System surveys under- 6
taken between 1975 and 1978, daily commuters residing in 4

Yakima County accounted for 8.5-12.5 percent of the 4
construction work force at WNP-1/4 (Ref 11). Estimates 6
based on the survey for the 1979-1980 period of daily 4
commuters residing in Yakima County were 10 percent of the
construction workforce on WNP-1/4. (Ref 11, pp 26, 28, 29, 6
57 and 70; Ref 4; Dean Schau, Labor Market Economist, E230.01
personal communication, December 4, 1981). This percentage
may be lower for the total Supply System construction
workers since WNP-2 began construction earlier and could
draw more heavily on locally available labor.

During the 1980 labor-management dispute, it was estimated
that about 18 percent of the 6,600 job loss belonged to
Yakima County. This may over estimate commuters in the
total workforce since the possibility exists that local
hires may be protected at the expense of commuters and the 4
fact that commuters become a proportionately larger share
of the workforce as the peak year approaches. Therefore,
estimates of commuters residing in Yakima County are
probably in the range of 10-15 percent of the total con-
struction workforce. If this pattern continues through the
S/HNP construction period, several hundred residents of
such communities as Grandview, Sunnyside and Mabton would
obtain jobs on the Project. The economies of the outlying
communities can be expected to be enhanced through the
S/HNP employment and income effects. The fact that these
community work forces have extensive nuclear construction
experience suggests that these workers will benefit from
the S/HNP job opportunities, although such communities as
Grandview, Sunnyside and Mabton generally are not
considered part of the Tri-Cities impact area (Refs 11 and
26). 6

8.3.3 ALTERNATIVE SCENARIOS

Over the past decade the Tri-Cities SMSA has been one of
the most dynamic socioeconomic settings in the United
States (Ref 4). During the period 1970-1980, for example,
the population increased by 54.8 percent compared to an
11.4 percent rate for the nation. 4

Dependence upon energy related construction, operation and research makes the area vulnerable to marked changes in business conditions and particularly subject to the impacts of external decisions regarding energy development.

The range of alternative futures does not appear to be decreasing in the 1980's. For example, the following external decisions will each have a major role in determining the short-term (1982-1990) future of the Tri-Cities area:

1. Decisions of if and when construction of WNP-4 will re-commence.

2. Decisions permitting construction of S/HNP.

3. Decisions of courts on the constitutionality of Initiative 394. This Initiative could have an effect upon WNP 1, 2 and 4, as well as a proposed powerhouse at Priest Rapids Dam.

4. Decisions by USDOE to (a) decrease, (b) maintain or (c) increase activities on the Hanford Reservation. At the present time approximately 12,000 jobs are accounted for by USDOE and its contractors.

Given the uncertainty associated with these decisions as well as the magnitude of their potential impact upon the future of the Tri-Cities, a "scenario" approach is appropriate for the present analysis. Four scenarios are utilized:

Scenario 1 - Construction of WNP-4 resuming as scheduled in 1983 and peaking in 1985 with S/HNP not constructed.

Scenario 2 - Construction of WNP-4 resuming in 1983 and peaking in 1985 coupled with construction of S/HNP commencing in 1983 and peaking in 1988. 4

Scenario 3 - Construction of S/HNP commencing in 1983, peaking in 1988 and WNP-4 cancelled.

Scenario 4 - No major construction projects after the completion of WNP-1 and WNP-2 for the period 1980-2000.

Scenarios 1 and 4 are presented as alternative baseline scenarios to indicate the socioeconomic character of the area without construction of the Project. In this study "impacts" are conceptualized as the difference between the projected socioeconomic condition of the Tri-Cities without as compared to with S/HNP.

8.3.4 ROLE OF THE SOCIO-ECONOMIC MONITORING PROGRAM

Previous research has demonstrated that nuclear power stations may have a range of socio-economic impacts upon local communities.

Accordingly, Puget will develop and implement a two-phase program: (1) where adverse socio-economic impacts can be identified on an <u>a priori</u> basis, appropriate mitigation 4 measures will be taken; and (2) a socio-economic monitoring program will be utilized. The monitoring program will employ standard methodologies, which will identify baseline data, in order to compare socioeconomic conditions "with" S/HNP against conditions "without" S/HNP. Where it is evident that such conditions are worsened by the Project's existence, vis-a-vis its nonexistence (baseline), then it would be Applicant's intention to mitigate the negative deviation from baseline conditions. The actual 6 nature of mitigating actions can only be addressed on a E231.11 case-by-case basis with reference to specific circumstances. They could include such possibilities, for example, as direct compensation for costs; upgrading of facilities; expansion of capacities, etc.

8.3.5 TAX REVENUES ASSOCIATED WITH CONSTRUCTION AND OPERATION

8.3.5.1 Tax Revenues

Significant tax revenues would be generated by the construction and operation of S/HNP for local jurisdictions and the State of Washington. Table 8.3-1a depicts the tax systems associated with the S/HNP. These revenues would emerge from the following:

1. <u>Property taxes on the facility</u>. According to Washington Tax Law, private electric utilities are subject to 4 a property tax imposed by the county (Ref 5). In the case of the S/HNP, Benton County would collect the property tax and disburse part to the State for inclusion in the General Fund for public education. The remaining portion would accrue to Benton County for disbursement within the County.

   The exact amount of tax revenues generated depends on the assessments, levies and laws in effect at the time the Project goes on the tax rolls. Table 8.3-1b represents the 1981 levies but the average levy rate will probably decrease because of the Project. The following data, therefore, are presented as examples only and are subject to change. They do, however, place the magnitude of the potential tax revenues in perspective.

   The estimated value of property to be purchased is $450,000 (in 1980 dollars). This value is based on a 6 1981 appraisal of land value for the specific property E231.02

to be purchased. (This amount differs from that shown
in Table 8.2-1, since the latter value was based on a 6
previous estimate (or allowance) for land cost). E231.02
Table 8.3-2 presents projected costs of construction
by year, estimates of cumulative assessed value and
estimates of potential property taxes accruing to the 4
State and Benton County during the construction
period. As these data indicate, substantial property
tax revenues could be paid to both Benton County
(total $150 million in current dollars) and the State 6
(total $114 million in current dollars) during the
construction period from 1983-1992. 4

The value of inventories of supplies and materials and
mobile equipment are estimated at $11.2 million for
both units, in 1980 dollars. However, the major 6
increases would come from the assessed value of the E231.08
site facilities. Potential property tax revenues during operation of the facility will be of even greater
magnitude and will have dramatic effects upon the tax
base of local taxing jurisdictions (Table 8.3-3). 4
These tax base increases could be translated into
major revenues for each jurisdiction. In the first
year of operation of both units, for example, the
following situation would exist if (a) 1981 tax rates
were in effect and (b) the facility was assessed at 80
percent of [illegible]lue.

Example:

Year	Assessed Value (1980$)	Property Tax (1980$) State	Benton County	Total	
					6
1994	$2.4 billion	$8,250,000	$11,250,000	$19,500,000	5

Over the lifetime of the Plant, therefore, several
hundred million dollars in taxes could be paid to
Benton County for distribution within the county as 4
well as to the State. To put the impact of the S/HNP
in perspective, the total valuation of all property in
Benton County in 1981 was just over $2.7 billion and
taxes collected for the State, county, roads and
schools were $25.9 million. The assessed value of
S/HNP (in 1980 dollars) alone would be almost double 5
the valuation of all assessable county property at the
current time. If the present tax base remained 4
constant until 1994, this would mean that the S/HNP
would account for about 47 percent of the property tax 5
base when assessed at 80 percent of full value (see
Table 8.3-3). 4

2. Sales and use taxes of 5.3 percent are collected by
the State and disbursed as follows: 4.5 percent to 4
the State, 0.3 percent for the local transit district
and 0.5 percent to local jurisdiction.

Sales and use tax analysis are estimates only and are subject to change. These estimates were derived from (a) projections of purchases during construction and operation and (b) review of the document "Taxation of Energy Generation Facilities During Construction and Operation," Washington State Department of Revenue (June, 1977).

6
The assumption was made that approximately 50 percent E231.03
of purchases during construction would be subject to
local (Tri-Cites area) sales tax with the remaining 50
percent subject to sales tax in other jurisdictions.

It should be recognized that the 50 percent figure is highly conservative in estimating potential revenues to local jurisdictions. Preliminary analysis of historical data from WPPSS purchases, for example, suggest 90 percent may be a more appropriate figure.

It was assumed that all fuel purchases would be subject to sales and use taxes by the State of Washington, Benton County and the Benton-Franklin Transit Authority. It was also assumed that during operation, purchase of 10 to 20 percent of supplies and materials would be subject to sales tax in Benton County.

Recent fiscal conditions in the State of Washington 4
have resulted in increased sales taxes at the state
level. At the time of this analysis, such proposals 5
were being considered and the following discussion is
based on taxes in effect as of October, 1981. 4

The sales and use tax effects are applied to an
assumed construction cost of about $5.3 billion (in 6
current dollars). This amount is about $2.5 billion
less than the estimated final value of the facility 4
($7.8 billion in current dollars) because it excludes 6
a number of costs, such as the value of the 4

property, the allowance for funds during construction, 4
transmission costs, fuel costs, and various tax 5
payments. The example shown here assumes that one-
half of the purchases were liable for Benton County 4
sales/use taxes. The year 1987 is displayed to
demonstrate an annual year effect of these revenues.

Annual Revenues (in current dollars)

Recipient	Total Rev. 1983-1992	Average Annual Revenues	Example Yr. 1987	
				6
State	238,500,000	23,850,000	39,480,000	
Benton County	13,250,000	1,325,000	2,190,000	
Other Counties	13,250,000	1,325,000	2,190,000	
Benton-Franklin Transit District	7,950,000	795,000	1,300,000	

During operation, the sales and use tax is particu-
larly 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 $322.1 million 5
in 1980 dollars. Purchase of these cores could 6
provide $14,494,000 in revenues to the State;
$1,610,000 to Benton County and $966,000 to the Benton-
Franklin Transit Authority (in 1980 dollars). 5

The following revenues would be generated if annual
fuel costs were $132.4 million in 1980 dollars: 6

Entity	Annual Revenues due to Nuclear Fuel Costs Only (in 1980 $)	
State	$5,958,000	
Benton County	662,000	5
Benton-Franklin Transit District	397,000	
Total	$7,017,000	

In addition to these fuel costs, the tax on local
purchases will produce revenues each year during the
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.

3. Business and occupational taxes are collected by the State during construction. On 5.3 billion dollars of 4 tax base, taxes would be over $23,000,000 (in current dollars). 6

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 5 (1980 dollars). In 1979, the average annual wages in the Tri-Cities SMSA were $15,962.

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 4 during construction:

	Estimated Revenues During Construction
State	$380 million
Benton County	$150 million
Benton-Franklin Transit District	$ 8 million
	$538 million

During S/HNP operation Benton County would annually receive $29.3 million in property taxes and over $700,000 in sales tax. The State would receive $21.5 million and $5.9 5 million respectively. The Benton-Franklin Transit District 4 would receive nearly $400,000 per year from sales tax on nuclear fuel alone. 5

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.

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

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
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 high rates of in-migration. Much of this in-migration was 4
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-Cities SMSA over the next two decades are reflective of dramatic population increases in the 1970's and project 4
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 planned, (2) there is a high 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 are constructed the workforce is already in place (see Table 8.3-5) and (4) no other new large construction projects are 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 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, DOE, personal communictions, December 18, 1981; James 6 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 year, or similar to the national growth rate projections 4
(James Skubic, Economist, Social Impact Research, Inc., December, 1981). 6 E230.02
However, these intrinsic growth rates will not compensate for the fact that population will be lost as nuclear construction is completed and workers and families migrate to other sites. 4
Therefore, population under every scenario is expected to decline at some point during 1981-1993.

For Scenarios 1, 2, 3 and 4, it was assumed that when total
construction jobs on the Reservation declined, 70 percent 4
of all resident construction workers who lost jobs would
leave the area within the year (Kenneth W. Bracken,
Director - Facilities and Site Services Division, DOE, 6
personal communications, December 18, 1981; James Skubic, E230.02
Economist, Social Impact Research, Inc., December 20,
1981), that the secondary jobs associated with the lost
construction jobs (secondary jobs = 0.8 times construction
jobs) would also disappear and that 40 percent of the 4
resident secondary workers would leave the area within one
year (Ref 22). For other sectors of the population, it is 6
projected that in-migration rates will equal out-migration E230.02
rates. It was assumed that 15 percent of the construction 4
work force and secondary jobholders were daily commuters
residing outside the SMSA (Ref 4; Dean Schau, Labor Market
Economist, personal communication, December 4, 1981). It 6
was assumed that the average family size of construction E230.02
and secondary workers is 3.2 and 2.5, respectively, 4
(Ref 23), and that there are 1.3 jobs per household
(Refs 1, 24). In-migration rates for the operations work 6
force are assumed to be 25 percent (Frank Clemente, E230.02
Socioeconomic Analysis, December, 1981). Finally, it is
assumed that the population associated with DOE activity
increases at one percent per year and that no other major
construction projects will occur in the area before 1990.

Table 8.3-6 depicts the projected population by the State over the 1982-1993 period as well as the potential population based on the four scenarios. Some anomalies in the projections are present in the table. Scenario 4 has the largest population in 1993, which is not what would be expected. The reason for this is two-fold: the fact that the intrinsic growth rates of 1 percent per year operate on a larger base in Scenario 4, as compared to the other 4 scenarios, and that out-migration is assumed to be the same for all scenarios. Scenario 4 actually might be expected to have higher out-migration rates and lower in-migration rates and therefore, even a lower population than that projected here.

8.3.6.2 Projected Population Conditions Under Alternative Scenarios

No population growth is projected due to construction of S/HNP. As the following data indicate, loss of construction and secondary workers is projected in all four scenarios:

Number of Persons Leaving SMSA

Year	Scenario 1 (WNP1,2,4*)	Scenario 2 (WNP1,2,4 and S/HNP)	Scenario 3 (WNP1,2 and S/HNP	Scenario 4 (WNP1,2)	
1982	-	-	-	-	
1983	2268	1141	4719	5839	4
1984	928	-	3729	5095	
1985	-	-	-	1236	
1986	1306	-	-	26	
1987	1375	-	-	-	
1988	2349	1706	-	-	
1989	900	2013	49	-	
1990	-	2166	1775	-	
1991	-	693	696	-	
1992	-	735	739	-	
1993	-	-	-	-	
Total	9126	8454	11,707	12,196	

* Estimates of WNP-4 construction work force are contained in a letter dated August 27, 1981 from Ms. Alice Lee, Socioeconomic Coordinator of WPPSS, to Dr. F. Clemente. 6 E230.04

In both of the baseline scenarios a decline in population and the rate of growth is projected in the Tri-Cities SMSA. In Scenario 1, for example, it is projected that almost 4,402 construction workers and secondary workers will leave the area over the period 1982-1990. Taking into account other departing family members, Scenario 1 projects a loss of over 9,000 people during the nine year period even with construction of WNP-4. 4

Scenario 4 projects even greater population out-migration with over 12,000 persons leaving the area between 1982-1986.

Given the projections of out-migration in the baseline scenarios, construction of S/HNP will not be a stimulant for further population increases.

In both Scenarios 1 and 2 out-migration of construction and secondary workers will be reduced in the short-term (1983-1987) but is still projected to occur in the 1988-1992 period.

By 1994, it is estimated that slightly more than 600 people will be added to the population under Scenario 2, as a result of operation, amounting to about 0.4 percent of the projected population of the SMSA. Under Scenario 1, about 400 people will be added to the population by 1994 as a result of operation of nuclear plants.

As of June, 1981, the Tri-Cities SMSA had a resident labor force of 79,360 of whom 73,510 (92.6%) were employed and 5,850 (7.4%) were unemployed. The labor force participation rate for the total population was 48.7 percent (Ref 8). 4

Data on income indicate that approximately 81 percent of the income in the area is directly earned, 10 percent comes from dividends, rent and interest and 9 percent from transfer payments. Average monthly payroll data for the first quarter of 1981 are shown in Table 8.3-6a. 6 E231.06

The convergence of construction and high technology workers in the area made the Tri-Cities the ninth fastest growing SMSA in the United States in terms of personal income (Ref 3).

The two largest contributors to these increases in employment and income are USDOE and the Supply System. In 1980, approximately 12,100 jobs were accounted for by USDOE and its contractors (Ref 4). An additional 12,174 persons were employed by the Supply System in 1981. 4

Efforts are being made locally to diversify the economy. Three independent municipal corporations, the Port of Pasco, the Port of Kennewick, and the Port of Benton, each manage shipping facilities and commercial and industrial properties, including industrial parks for the siting of new heavy and light industries. For example, the Port of Pasco manages Big Pasco Industrial Park, composed of 600 acres and 1.5 million square feet of buildings which are leased to firms, and also operates the Tri-Cities Airport. All of the ports engage in industrial promotional activities, including the provision of financing and construction assistance to encourage new firms to locate in the area. Chambers of commerce in each of the three cities, as well as the Tri-City Nuclear Industrial Council in Richland, are actively engaged in attempting to attract new industries to the area.

Finally, the Washington Department of Commerce and Industrial Development maintains a Development Services Division office in Kennewick, providing a source of information and research data to assist local organizations and to encourage new firms to locate in Tri-Cities.

To at least some degree such efforts have been successful and in 1981 Kanegafuchi Chemicals and American Steel announced plans to build plants within the SMSA.

Future economic conditions in the Tri-Cities are particularly difficult to predict because of the major external decisions regarding USDOE funding, Initiative 394 and the situation of the Supply System, particularly WNP-4. 4

The Bureau of Economic Analyses projects increases in employment over the next several decades (Ref 10). These projections are generally based on recent trends and overestimate increases in such areas as contract construction by a considerable degree. For example, all four scenarios project varying degrees of <u>outmigration</u> of construction workers rather than an influx.

8.3.8.2 Projected Economic Conditions Under Alternative Scenarios

Construction of S/HNP will have a beneficial impact upon the economy by providing employment for construction and secondary workers who would otherwise migrate from the area during 1983-1992.

Both Scenarios 1 and 4 reveal a declining economy in the Tri-Cities area without the construction of S/HNP. In Scenario 4, the loss of jobs and income would be most severe amounting to a loss of over 8,000 construction and operations workers between 1982-1985.

Based on potential payroll data, lost income opportunities in both baseline scenarios would run into the hundreds of millions of dollars. Construction workers are among the most highly paid employees in the Tri-Cities area and their local expenditures are a significant driving variable in the local economy.

As compared to the two potential baseline conditions, the impacts of S/HNP can be delineated:

(1) Employment - Construction will provide employment 4
ranging from 563 in 1983 to 4,446 in 1988 to 1386 in 1991. Over the 1983-1991 period S/HNP will provide almost 24,000 person years of employment.

Secondary employment will also be maintained during the construction period. Previous research has indicated a multiplier of 1.8 for nuclear construction in the Tri-Cities (Ref 11). After taking commuters into account, it is projected that construction will support over 16,000 person years of employment in other sectors of the local economy.

Operations will provide employment for 295 individuals
over the 40 year technical design life of the facil- 6
ity - 11,800 person years of work. Assuming each operation job maintains 0.8 secondary jobs, S/HNP will mean employment for approximately 236 persons in other sectors of the economy. In addition, 200 workers will be employed during periodic refueling operations.

None of this employment would take place in either of 4
the baseline scenarios.

(2) Income - During construction, it is projected that annual income per worker will average approximately $37,000 in 1980 dollars for a total of $949 million over the construction period (See Table 8.3-8). During operation, the total payroll on an annual basis will be $8,141,000 in 1980 dollars or an average of
$23,600 per worker (see Table 8.3-20). 5

These relatively high income levels will stimulate
other sectors of the economy and produce expanded 4
business activity throughout the SMSA. Table 8.3-8a presents estimates of potential expenditures by the
workforce in the local area during the construction 6
and operations stages. These data lend insight into the role S/HNP might play in the local economy.

None of this income would be generated in the baseline
scenarios. 4

(3) Purchase of local materials and services - During construction Puget expects to purchase local supplies and services when they are readily available and competitively priced. Given the extent to which the local economy has developed in tandem with nuclear power, it is expected that a number of local firms will be available to provide materials and services at a reasonable cost.

During operation, it is assumed that purchases of materials and services will be approximately $5 million per year in 1981 dollars. Over the 40 year operating life of the facility, this totals to $200 million spent in the local area.

None of these purchases would occur under the baseline scenarios. 4

8.3.9 GOVERNMENT AND FISCAL

8.3.9.1 Existing and Developing Conditions

Both Benton and Franklin Counties have an elected county commission governmental structure, with each county maintaining its own independent planning department. Benton County employs four professional planners and one planner/draftsman, while Franklin County employs two professional planners. In addition, both counties have such customary departments as county assessor, auditor, clerk, prosecutor, engineer, extension agent, and court facilities. Coordination and cooperation between the two county structures is facilitated by the Benton-Franklin Governmental Conference in Richland.

Each of the Tri-Cities municipalities is governed by a council-manager system, with the mayor elected by council in each city. Other municipalities in the counties also maintain city council governments. Municipal planning staffs include 5 positions in Kennewick, 3 in Pasco, 10 in Richland, and 2 in West Richland.

Budgetary data for selected municipalities and the two county units in the Tri-Cities SMSA are summarized in Tables 8.3-9 through 8.3-11. Locally-collected taxes combine with intergovernmental revenues transfers to represent the primary sources of operating revenues for both the counties and the impact area municipalities (Tables 8.3-9 and 8.3-10). The two county governments concentrate their operating expenditures on general-governmental services and transportation programs. Municipal expenditures as displayed in Table 8.3-11 tend to be concentrated in the areas of (a) general government 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 year of operation, if tax rates remain at 1981 levels. 5

These revenues would have a sustained and significantly positive impact on the fiscal condition of Benton County 4 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
only occur if tax revenues generated by the Project in some 6
jurisdictions were insufficient to pay for government E231.10
services necessitated by the Project in those same 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 Pasco (also within the immediate impact area) would receive
any property-tax revenues emanating from the Project under 4
the existing tax system.

Recent amendments to the Washington State tax laws (55B 4859) RCW 82.04, 82.08 and 82.12 make it possible for local jurisdictions to redistribute sales taxes from large scale energy projects within a local impact area. Such a redistribution would address the questions of equal distribution of population effects and public service
demand in the impact area. Since this law has not been 6
used in a specific case as yet, it is not clear how the distribution of revenues might be accomplished. However, it could serve as a means of mitigating negative impacts during 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 obtained from the Questions and Responses on pages E-52 through E-64.

The transportation related analyses and conclusions
contained in this section are based upon the assumption 6
that access to the S/HNP will be provided by a new access road connecting the southwest corner of the Project Site to SR 240. This access alternative is described in more

detail as Alternative A in Section 8.3.10.5. Another access alternative is also being considered, in which access to the S/HNP would be provided through construction of a new road connecting the southeast corner of the Project Site to SR 10. This access alternative is described in more detail as Alternative B in Section 8.3.10.5. The transportation related impacts associated with Alternative B have been separately evaluated, and it has been found that these impacts are not significantly different from those expected to occur under Alternative A. Therefore, the transportation analysis and conclusions contained within this section are equally applicable to both access alternatives.

DOE advised, in an April 15, 1982 meeting with the Applicant, that it will require use of the Alternate South Access Road (Alternative B) instead of the Preferred South Access Road (Alternative A) shown in Figures 2.1-1b, 2.1-2 and 2.1-3 and that, regardless of whether the Project is built or not, DOE will improve Route 10 by bringing it up to State highway standards for a two-lane road. Therefore, the Applicant will be using the Alternative B access road. 6

8.3.10.1 EXISTING CONDITIONS

8.3.10.1.1 Street Network

Figure 8.3-1 shows the locations of existing major streets and highways serving Hanford Reservation traffic. Regional highway access to and from the area is possible via U.S. Route 12, connecting the Tri-Cities to Yakima and the Seattle area to the west and Lewiston, Idaho, to the east; U.S. 395 north to Spokane, and SR 14 west to Vancouver, Washington. I 84 connects the area to Salt Lake City and Portland. SR 240 is a key route that passes near the proposed S/HNP, becomes Bypass Highway in Richland, and crosses the Yakima River on a pair of two-lane bridges popularly called the "Causeway". A key intersection on Bypass Highway is with Van Giesen Street, which in turn becomes SR 224 west of Bypass Highway. Routes 10 and 4 provide access to the Hanford Reservation. Route 4 becomes Stevens Drive in Richland, and a branch from Route 4 to the southeast connects to Richland's George Washington Way.

Most of the arterials shown in Figure 8.3-1 are two lanes wide. Exceptions are Route 4 on the Hanford Reservation, George Washington Way, Stevens Drive, and Bypass Highway. These arterials are four and five lanes wide.

8.3.10.1.2 Traffic Volumes

Existing travel patterns and characteristics in the Tri-Cities area are heavily influenced by commuter travel generated on and near the Hanford Reservation. Figure 8.3-2 shows the 1981 traffic volumes on the existing street network that are currently available.

The recent history of traffic volumes on streets in the impact area has been one of growth since the mid-1970's, generally in parallel with the pattern of employment on and associated with the Hanford Reservation. Traffic growth on the Causeway, as shown below, mirrors the year-by-year trend of combined DOE and WPPSS even to the "notch" occuring in 1980.

Summary of Traffic Counts for State Highway 240 on the Yakima River Bridge (Causeway) 6

	May 76	Oct 77	Nov 78	Apr 79	Jun 79	Feb 80	Apr 81
NB	18,690	21,640	24,000	24,290	19,480	na	25,550
SB	18,700	20,310	23,680	24,430	28,410	na	24,990
TOTAL	37,390	41,950	47,680	48,720	47,890	44,120	50,540

Traffic volume trends on Stevens Drive and the Bypass Highway are similar. The volumes in 1981 were at the all-time peak (Washington State Department of Transportation, 1981).

Traffic along these routes exhibits some unusual and extreme characteristics. Peak hour traffic near the Hanford Reservation forms a much larger portion of daily traffic (15 to 20 percent) than is usually found in urban areas. Peak volumes (3:30 to 4:30 p.m.) on Stevens Drive south of the Reservation represent 15 percent of daily traffic with 95 percent in the heavy direction. On George Washington Way at the same time south of the Reservation, the peak hour percentage approaches 19 percent with 96 percent in the predominant direction. At the critical Causeway across the Yakima River, the peak hour volume on Highway 240 amounts to 9.6 percent of the daily volume with 75 percent in the peak direction. These high percentages, particularly those near the Reservation, show the dominance of commuter traffic to and from Hanford.

Average vehicle occupancy in this same area varies from 1.5 to 1.7 persons per car, well above the more usual 1.2 values. The following northbound a.m. peak hour vehicle occupancies, measured in 1980, indicate a relatively efficient usage of vehicle capacity:

George Washington Way	1.47 persons per vehicle
Stevens Drive	1.34 persons per vehicle
Route 10	1.72 persons per vehicle

Traffic congestion is heaviest in the evening peak hours. The most significant problems are along Highway 240 at and near the Causeway, along Bypass Highway, and along Stevens Drive. During the initial surge of the afternoon peak, very heavy traffic volumes move well from the Reservation south. Speeds leaving the Reservation are around 50 mph, slowing to around 35 mph on the approach to the Bypass Highway. The initial peak hour traffic also moves at 50 mph along Bypass Highway. Later in the peak, however, speeds southbound along Stevens Drive drop to between 20 and 30 mph, a queue ranging in length up to 0.2 to 0.3 mile forms on Bypass Highway at Van Giesen, and long queues form at the merging area leading to the Causeway. 6

The 1981 p.m. peak hour southbound volumes of 3,100 on Stevens Drive and 3,810 on the Causeway represent traffic flows that approach or exceed normal capacity standards for the two lanes that must carry these volums. The most serious street capacity deficiencies were observed on Bypass Highway at its intersection with Van Giesen, and just north of the Causeway where traffic from Bypass Highway and George Washington Way merges. A measure of congestion was calculated in terms of the ratio between traffic volume and street capacity at key intersections. When this ratio, called the V/C ratio, approaches and exceeds a value of 1.0, congestion is indicated. The higher the ratio, the more severe the congestion. For example, a V/C ratio of 1.09 is shown below for the intersection of Bypass Highway and Van Giesen under existing conditions for the 3:00 to 4:00 p.m. hour. This 9 percent overload reflects existing congestion at that location.

	1981 Volume/Capacity Ratios	
	3-4 p.m.	4-5 p.m.
Highway 240/Stevens Drive	0.77	0.87
Bypass Highway/Van Giesen	1.09	1.04

In addition to the above V/C ratios, the existing congested merge north of the Causeway for southbound traffic is estimated to have a V/C ratio of 1.09.

8.3.10.1.3 Other Modes of Transportation

Three airports are available with the Tri-Cities Airport in Pasco being the primary commercial airport. Republic Airlines provides flights to major airports throughout the Western states Cascade Airlines utilizes both the Tri-Cities and Richland Airports to provide regional commuter service. Horizon Air has recently initiated additional commuter service to Tri-Cities (Ref 12-3). Charter service is available at the Tri-Cities Airport as well as at the airports in Richland and Kennewick. Pacific Southwest Airlines has applied to provide additional regional jetliner service to the Tri-Cities Airport beginning in 1982.

Present transit service is provided by crew buses serving the Hanford Reservation area (but not including construction workers) and a local charter bus operation that also serves the Reservation. The charter bus operator has recently begun limited intra-City transit within the Tri-Cities area. The Ben Franklin Transit System is a new publicly owned urban transit operation, created in the Spring of 1981, that will begin operation in the near future. 6

8.3.10.2 Projected Growth in Background Traffic Volumes

The growth of nonproject traffic within the region is a key ingredient for the estimation of future impacts. This data was available in the form of a forecast of 1985 daily traffic volumes on the street and highway network of the region that was prepared by the Washington State Department of Transportation for the Benton-Franklin Governmental Conference (BFGC). Several revisions of raw data were made in this forecast. Since the forecast included the North Richland Toll Bridge (a facility that is not likely to exist during the impact period of S/HNP for reasons that are more fully explained in Section 8.3.10.3), travel allocated to that facility was reallocated to other streets and highways in the system. Also, since the forecast included as a constant employment on the Hanford Reservation, the estimated pattern of this travel was deducted from the regional forecasts and replaced by a specific estimate of employment for nonconstruction activities on the Hanford Reservation (Community Development Services, 1979; Wilbur Smith and Associates, 1979). Following these two steps, the forecasted volume of traffic moving through various corridors in the region was compared to existing traffic volumes so that traffic growth could be assessed.

8.3.10.2.1 Population and Employment Growth

The 1985 travel forecast discussed above was based on continuing population and employment growth throughout the Tri-Cities region. As discussed in Ref 28, a more detailed evaluation of short-term cycles in population and employment shows that employment is expected to decline through 1985 and then start to increase again parallel to the growth predicted by the BFGC. The difference between this declining pattern and the continued growth predicted by the BFGC is important since the 1985 travel forecast was based on a higher employment level than that predicted by the more detailed analysis. The dip in population and employment would be reflected in daily travel volumes throughout the region. 6

The differences between the two population and employment forecasts (and their subsequent impact on travel forecasts) can be explained. The governmental conference forecast is based on the anticipated success of the Tri-Cities in diversifying its economy as well as new construction projects related to energy development. The S/HNP would provide construction employment that partially fills the gap between the two forecasts during the period 1983 to 1993. Another project of similar magnitude would come close to realizing the predicted 1990 employment levels of the BFGC. However, at this time, it must be considered doubtful that the BFGC predicted 1985 levels of employment would be reached in view of the declining work force at the WPPSS projects and the later growth of employment at the S/HNP.

By comparing existing and forecasted employment levels, it was concluded that a reasonable estimate of 1988 travel conditions without the project could be developed by subtracting WPPSS trips from existing traffic. Only trips directly asociated with the WPPSS construction project were deducted, because it is estimated that trips generated by WPPSS secondary employment would also be lost but would be balanced by the background growth in regional employment. Figure 8.3-3 shows the resulting 1988 baseline travel forecast across the Columbia and Yakima Rivers. These travel volumes represent 1988 traffic conditions if S/HNP is not constructed.

8.3.10.2.2 Traffic Trends

Figure 8.3-3 shows these changes in travel patterns in the context of growth trends for a 20 to 25 year period. The historical trends of average daily traffic on the Causeway are shown from 1968 through 1981. Then, the predicted decline is shown from 1981 to 1988 as both primary and secondary employment associated with the WPPSS projects is lost and partially replaced by growth in other sectors of regional employment. Note that the traffic volumes from 1986 onward represent the sum of traffic forecasted for both the Causeway crossing of the Yakima River and the Columbia River crossing of I-182.

Also shown in Figure 8.3-3 is the estimated component of traffic that would be added by construction workers at S/HNP. This component increases the estimated 1988 daily traffic volume from 46,200 to 50,100. It is this increased traffic that represents the direct impact of the project, and the mitigating measures that are discussed in later sections are based on this increment of traffic growth. 6

In addition to traffic volumes directly attributable to S/HNP, there is a component of traffic that would be generated as a result of secondary employment growth. This is also shown in Figure 8.3-3 and increases the total estimated 1988 traffic on the Causeway and on I-182 to 55,400.

This component of daily traffic was estimated to be equivalent to approximately half of the difference between existing volumes and the 1985 daily volumes developed from the regional forecast discussed earlier.

8.3.10.3 Future Network Improvements

A number of highway system improvements are included in the adopted Transportation Improvement Program of the Benton-Franklin Governmental Conference, the Washington State Department of Transportation, and local agencies for completion over the next few years. These projects are shown in Figure 8.3-4. By jurisdiction, they include:

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 6
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.

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.

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 will provide two interchanges and three additional lanes in each direction for a traffic volume with only moderate predicted growth by 1988. 6

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

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. 6

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. 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.

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, as 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 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. 6

Construct a new Site access roadway for non-construction traffic connecting the southeast corner of the S/HNP Site to Route 10, as 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.

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 used only during the peak periods by high occupancy vehicles carrying a minimum of two persons. The HOV lanes would be used between 6:00 and 9:00 a.m. by traffic traveling to the Site; and between 3:30 and 6:00 p.m. by traffic traveling away from the Site. At all other times, the road would operate as a two-lane facility, with one lane in each direction. This improvement includes two 12-foot travel lanes with 12-foot shoulders to be used as HOV lanes, modifications of the railroad grade crossing near the Bypass Highway, widening of intersections, additional embankment to accommodate the shoulder lanes, and appropriate pavement markings and signing to assure safe and efficient operation. Temporary signals or officer control may be required at the intersection with Grosscup Road and the intersections serving the Richland industrial areas west of Bypass Highway.

Alternative B

This alternative is identical in concept, design, and operation to Alternative A, but uses a different construction worker access route: a new two-lane reversible operation Site access road would be constructed for construction-worker traffic between the east side of the Site and Route 10. This access road would replace the access road connecting the southwest corner of the Site to Highway 240 under Alternative A. 6

Route 10 would be improved to state standards for a 2-lane highway, and would operate as a reversible facility during both the morning and afternoon peak hours between the new Site access road and Higwhay 240. During these peak hours, reverse-flow Site-related traffic (outbound during the morning peak hour and inbound during the evening peak hour) would be accommodated via Route 4. Throughout the off-peak hours, Route 10 would continue to operate as a two-way facility with one lane in each direction. The section of Highway 240 between Route 10 and Bypass Highway would be improved as under Alternative A.

3. Improve the intersection of Highway 240 and Bypass Highway to provide a dual right-turn lane for east-bound to southbound traffic, and a matching dual left-turn lane for northbound to westbound traffic. Traffic signal modifications, including a seprate left-turn phase, would be made as required to assure safe and efficient operation.

4. Improve the intersection of Bypass Highway and Van Giesen to provide a dual left-turn lane for northbound to westbound traffic. Both approaches on Van Giesen would be widened to provide for two through travel lanes. Also, two westbound lanes would be provided on the west leg across the railroad tracks. Signal modifications would be made as required to assure safe and efficient operation.

Puget Power would also be willing to consider participating in an ongoing rideshare matching, promotion, and an incentive program with other agencies on the Hanford Reservation. The purpose of this program would be to increase the average vehicle occupancy above current levels. It is expected that this program would include special incentives such as preferred parking for carpools and exclusive high-occupancy vehicle (HOV) lanes.

The transportation improvements identified above are in conformance with the following documents recently adopted by the Benton-Franklin Governmental Conference:

1. Transportation Improvement Program for Calendar Years 1982, 1983 and 1984. 6

2. The Regional Land Use Design Map.

3. The Highway Functional Classification Map.

These documents are currently being incorporated into the BFGC's Comprehensive Plan, which is expected to be adopted by the first of 1983.

All traffic control measures will be implemented in a manner that is consistent with the State Highway Commission's adoption of the 1978 Manual on Uniform Traffic Control Devices (MUTCD), and interpretations thereof. All new roadway facilities will be designed in accordance with applicable local, county, state, and federal design standards. Maintenance of the new/improved facilities will be the responsibility of the appropriate jurisdiction.

The mitigating measures listed above and the estimated impacts on the V/C ratios of these measures as identified in Figure 8.3-6 are based on a street network including I-82 and I-182 freeways as well as the improvement of Grosscup Road and Twin Bridges. I-182 alters construction worker travel patterns by providing an alternative and shorter pathway to Pasco and Franklin County. The improvement of Grosscup Road and Twin Bridges facilitates access to the west Richland area (but is not estimated to attract a significantly increased volume of commuter trips). If, in addition to these improvements, the Horn Rapids Bypass is implemented in time to serve S/HNP commuter traffic, it could serve as a viable alternative route (via I-82 and I-182) for traffic desiring to cross the Columbia River on I-182 or the Yakima River on the Causeway. It is estimated that this route could divert as much as half of the S/HNP commuter traffic away from Route 240 and Bypass Highway. From this standpoint, the Horn Rapids Bypass is a viable mitigating measure. However, the estimated cost of the new Bypass Highway would be two to five times that of the mitigating measures listed above. 6

Specific mitigating measures associated with travel by modes other than the automobile have not been listed. It is doubtful that scheduled transit service would be available to the S/HNP Site during construction, but special charter bus operations have proven successful in transporting workers to major employment centers.

8.3.11 HOUSING

8.3.11.1 Existing and Projected Housing Infrastructure

The recent population growth trends in the Tri-Cities have been accompanied by a corresponding expansion of the housing stock. The total number of housing units in Benton County rose from 21,826 in 1970 to 42,651 in 1980, a 95 percent increase. In Franklin County, the number of housing units rose by 58 percent, from 8,425 in 1970 to 13,316 in 1980 (Ref 1). 4

This trend is evident by referring to the data in Table 8.3-12. Between 1976 and 1980, the total number of housing units in the combined Richland-Kennewick-Pasco urban area increased by 39 percent. Apartments comprise over one-half of all new units. The greatest increases in housing stock occurred in Kennewick, where total units increased by 52 percent in four years.

Vacancy rates for recent years are reported in Table 8.3-13. As these data indicate, there is a general trend toward an increased number of vacancies.

Total residential building permits dropped from 1,813 in 1979 to 553 in 1980. Only 178 residential building permits were issued during the first quarter of 1981 (Ref 15). If that level of activity were maintained throughout the remainder of the year, total 1981 building permits would amount to about 10 percent of the 1979 total. Given prior rapid housing construction, the local residential construction industry is presently operating far below capacity, a situation which is unlikely to be reversed while interest rates remain high (Ref 15).

8.3.11.2 Projected Housing Conditions Under Alternative Scenarios

All four scenarios posit out-migration of construction and secondary workers over the 1982-1991 period. Coupled with decreased growth rates and diminished in-migration, increased housing vacancies are projected in each case with 4
the highest vacancies occurring in Scenario 4. For example, it is projected that approximately 4,255 households would leave the area between 1982-1986 under Scenario 4.

The scenarios projecting construction of S/HNP suggest that over the next decade a number of individuals who would have otherwise migrated from the area during 1982-1992 will remain and provide support for the housing market. For example, in the case of Scenario 3 as compared to Scenario 4, it is projected that construction of S/HNP will enable approximately 3,000 construction and secondary workers to <u>remain</u> in the Tri-Cities area over the period 1983-1986. This diminished outmigration of 4,615 households would have a significant positive impact upon the housing market.

One major factor in housing values is the demand, and the increased employment and income effects of the project would increase the demand. The available data on Benton and Franklin Counties real estate sales during the four year period, 1975 to 1978, show increasing values as the WPPSS construction work force increased. The number of sales increased from 6,967 in 1975 to 9,779 in 1978, a 40 percent increase for the period. The amount of sales increased from $160 million in 1975 to almost $377 million (in current dollars) in 1978, a 136 percent increase during 6
the period. The average value of each sale increased from about $23,000 to over $38,500 (Ref 25, p. 16). Such increases in property values in communities with nuclear power stations have also been documented in the research literature (see, for example, Ref 28). While the increase in property values can be considerably less in the future, especially in an area with a decline in demand, the added employment and income from the project will support those values. This means that property values will tend to be higher with the project than without it.

During operation, it is estimated that less than 100 new families would move into the area and, consequently, the 4
positive impacts on housing and property values due to project related in-migration will be quite small. 6

Richland and West Richland are provided with electrical supplies by Richland Energy Services, which is currently operating at about 80 percent of capacity but is being expanded. About 9 percent of the electric utility customers in outlying areas of Benton County are services by the Benton REA. In Franklin County, most localities, including Pasco, are supplied by the Franklin Public Utility District.

The primary supplier of telephone services in the Tri-Cities vicinity is the General Telephone Company of the Northwest, which supplied service to over 90 percent of all Benton County customers, including those in Richland, Kennewick, West Richland and Benton City. The remaining Benton County telephone customers are served by United Telephone Company of the Northwest. In Franklin County, Pasco is provided telephone services by the Pacific Northwest Bell Telephone Company.

8.3.13.2 Projected Utility Service Conditions Under Alternative Scenarios 4

Under the baseline scenarios, out-migration and decreased growth rates are projected. Further, declines in employment, income and the local economy are anticipated. This economic slowdown would result in decreased revenues and force local jurisdictions to forego planned utility expansions and improvements in service. There would be less demand on the current capacities of utility services. Finally, with the lower population in the baseline scenarios, special levy rates may increase.

The construction scenarios depict a more dynamic economy with higher tax revenues at present tax rates. Local jurisdictions would be able to improve services when compared to the no-project scenarios. In all cases except Scenario 2, a decline in population is estimated and, therefore, a decline in demand for services. For Scenario 2, a slight increasing trend (0.6 percent average annual growth rate) is shown to the year 1987, declining thereafter.

8.3.14 PUBLIC SAFETY

8.3.14.1 Existing and Developing Conditions

Police protection is provided by sheriff's departments in 4
Benton and Franklin Counties, local municipal police
departments and the Washington State Patrol division
headquartered in Kennewick. Table 8.3-16 provides descrip-
tive data on the staff size and number of patrol cars
available to each of the counties and the municipal police
departments in the immediate Tri-Cities vicinity. Table
8.3-17 shows the 1980 crime rates for the area. 6

Jail facilities in the impact area include county jails in
both Benton and Franklin counties, as well as separate city
jails in Richland, Kennewick and Pasco.

Both property and violent crime rates are below those
experienced in other parts of Washington. During 1979, for 4
example, the rate of violent crime per 100,000 residents
was 370.2 in the Tri-Cities, compared with 659.5 in Yakima,
395.5 in Spokane, and 434.6 for the state (Ref 18). Table 6
8.3-16a lists crime rates for the Tri-Cities SMSA in 1980. E230.06

Current jail facilities are inadequate and state-mandated
improvements in Benton County jail facilities have resulted
in the recently-initiated construction of a new 109-bed
county jail, scheduled to replace the existing 33-bed jail
in 1983. The new facility will also house an expanded
county justice center comprised of courtrooms and the
county sheriff offices. With completion of this facility,
prisoner overloads currently experienced at the Benton
County, Franklin County, and Richland and Kennewick jails 4
will be eliminated. In addition, a new juvenile detention
and court facility operated jointly by Benton and Franklin
counties in Kennewick opened in 1980.

Fire protection in the Tri-Cities area is provided by
municipal fire departments, and by fire protection units
for specific service areas in Benton and Franklin counties.
The various departments serving the impact area are listed
in Table 8.3-17 along with data on staff size, number of
volunteer fire fighters, the service area covered, and the 6
ISO rating. Only Pasco and Richland maintain exclusively
full-time non-volunteer fire departments. These
independent departments are engaged in mutual aid programs 4
to insure cooperation in emergency situations.

of the Tri-City hospitals as a trauma center to facilitate emergency care of critical injuries and illnesses (Ref 12-9). A proposal to expand Our Lady of Lourdes Hospital would include new medical surgical and patient care beds, improved emergency facilities, pediatrics, radiology, radiation therapy and special care departments, as well as an intensive alcohol-abuse treatment center.

8.3.15.2 Projected Health Care Conditions Under Alternative Scenarios

Both baseline scenarios depict out-migration of construction and secondary workers. For example, in Scenario 4 over 12,000 persons are projected to leave the area between 1982 and 1986. This out-migration will result in excess capacity in the health care system and potentially lead to lower levels of care as finances are strained. Further, in either of the baseline scenarios out-migration of secondary workers is projected. Some of these individuals will be in the health care field - physicians, technicians and nurses.

In the construction scenarios, out-migration is expected to be reduced through the 1980's. In Scenario 3, for example, it is estimated that over 8,000 persons would leave the SMSA between 1982 and 1986 and that the excess capacity in the mid-1980's under Scenario 4 would be minimized. The population effects of the S/HNP will help utilize the health care facilities and services that will already be in place. 4

8.3.16 HUMAN SERVICES

8.3.16.1 Existing and Developing Conditions

The Tri-Cities area exhibits a range of public human services agencies. Both Benton and Franklin counties provide cooperative extension programs, health services programs through their district health departments, and separate emergency service departments. Each of the Tri-Cities has a senior citizens center.

State human service offices in the Tri-Cities include the job services offices of the Employment Security Department, Food Stamp offices, the Division of Developmental Disabilities, Financial and Medical Assistance, the Child Protective Service, Emergency Medical Service, a Senior Companion Program, Vocational Rehabilitation and various

Farm Workers Programs. The Federal Government maintains local Social Security offices.

In addition to these public human service programs, the area is also served by a large number of private agencies 4 and voluntary human service organizations ranging from special interest clubs to civic groups to service-oriented organizations such as the Salvation Army.

Focusing specifically on organizations providing for the service needs of specific disadvantaged or distressed population groups, Table 8.3-19 gives examples of the human 6 service facilities and organizations available to local residents ranging from the Retarded Citizens Association to legal services for relief for victims of rape and abuse. Various organizations provide counseling programs on family problems, family planning, alcohol abuse, legal aid, behavioral difficulties and child placement. Services exist to aid persons affected by various physical, emotional, and learning disabilities. Assistance and counseling programs are available not only for the distressed and disadvantaged, but also for persons wishing to start a new business.

8.3.16.2 Projected Human Service Conditions Under Alternative Scenarios 4

Baseline scenarios project a declining economy and population out-migration. Human services may be adversely affected due to (a) fewer financial contributions and (b) out-migration of volunteer staff. At the same time, economic conditions in the area may lead to increased need for both personal and vocational counseling.

Under the construction scenarios, out-migration will be reduced, employment and income opportunities will be enhanced. Fewer persons, e.g. volunteers, will leave the area and the economy will permit more individuals to contribute to service and charitable organizations.

The operation period effects of the facility will contribute to the economy and thereby have a positive impact upon the level and quality of human services.

8.3.17 PRIVATE SECTOR 4

8.3.17.1 Existing and Developing Conditions

Many of the employment and income effects of S/HNP have been discussed in Section 8.3.8. 6 The impacts resulting from these effects can be put in perspective by reference to the private sector capacity that has been built up over the past decade. The Tri-Cities is characterized by a well developed private business sector:

Type of Business	Number of Establishments
Building Supplies and Garden Supplies	44
General Merchandise Stores	19
Food Stores	88
New and Used Car Dealers	20
Gasoline Service Stations	60
Apparel and Accessory Stores	68
Eating Places	135
Drinking Places	36
Drug Stores and Proprietary Stores	30
Banking Establishments	24
Real Estate Establishments	137
Business Services	94
Automobile Repair Shops	46
Amusement and Recreation Establishments	19
Health Services	181
Personal Services	95

There are over 2,300 hotel and motel rooms in the immediate 4 Tri-Cities vicinity with an average occupancy rate of 65 percent (Ref 21).

There are over 4,000 service establishments and 32 shopping centers and malls in the Tri-Cities area.

Expansion of the private sector continues to occur, as evidenced by a recent proposal to construct a $40 million shopping mall in Richland (Ref 12-10).

8.3.17.2 Projected Private Sector Conditions Under Alternative Scenarios

Under the baseline scenarios a declining economy is projected. Out-migration of workers, declines in per capita income and less business activity would result in lost

sales, layoffs, business closings and in some cases,
bankruptcy.

The construction scenarios would result in jobs and income 4
for both construction and secondary workers. This con-
tribution to the economy would stimulate local purchases
and support business activity. The economic support for
the local economy would be a significant addition to the
conditions that would be expected to exist without the
S/HNP. Further, the tax revenues provided by the facility 6
would enable local jurisdictions to maintain their budgets,
avoid lay-offs and purchase goods and services from the
private sector in the Tri-Cities.

None of these economic contributions to the private sector
would occur under the baseline scenarios. 4

During operation, it is anticipated that over $5 million
per year in purchases from local businesses would be made.
The S/HNP would make a continuing contribution to the local 6
economy that would not occur with the baseline scenarios.

8.3.18 RECREATION AND LEISURE

8.3.18.1 Existing and Developing Conditions

Recreational and leisure facilities and opportunities
covering a broad spectrum of participant and spectator
activities are available in the Tri-Cities area under the 4
administration of municipalities, county governments, the
State of Washington, federal entities, and private firms
and organizations. There are 36 city parks located in the
Tri-Cities, operated under the supervision of the three
municipal Parks and Recreation departments (Ref 16).

Benton County Parks and Recreation Department manages Columbia Park, providing a four-mile waterfront area, camping areas, boating facilities, picnic areas, hiking, swimming, golf, an archery range, and access to swimming, fishing, and picnicing facilities at Two Rivers, Hover, Horn Rapids and Plymouth Parks. There are approximately 1,400 acres of developed public park lands and 3,650 undeveloped acres in Benton County (Ref 17).

The State of Washingon maintains facilities for swimming, fishing, boating, picnic areas and other uses at Sacajawea State Park, located near the juncture of the Snake and Columbia rivers in Franklin County. Other state parks, including the 3,710 acre Sun Lakes State Park, are also

accessible from the Tri-Cities. Similar activities and
facilities plus overnight camping facilities are locally
available in Levy Park and Fishhook Park, both administered 4
by the U.S. Army Corps of Engineers and the Corps maintains
recreation and tourist facilities at Ice Harbor Lock and
Dam.

Table 8.3-20 provides an overview of physical and par- 6
ticipant recreation opportunities for Tri-City residents.

Spectator sports and leisure activities available in the area include movie theatres, a full range of television and radio stations, several forms of racing and amateur sports teams. Cultural attractions include the Benton County Historical Museum, several art galleries, and performing arts productions.

Expansion of recreational and leisure opportunities include
a new city park in Kennewick, a proposal to re-open a
swimming park under the management of Benton County, a
baseball field developed by the Kennewick American Legion,
and a water amusement park to be developed by a private 4
firm in Kennewick. The availability of such activities
will expand with the development of a planned multi-use
arts and entertainment center in Kennewick (Ref 12-11), and
a proposed $16 million arts center in Richland (Ref 12-12).
Several innovative park facilities have been proposed,
including an off-road vehicle (ORV) park under construction
by the city of Richland (Ref 12-13).

8.3.18.2 Projected Conditions Under Alternative Scenarios

The baseline scenarios project decreased population levels and thus suggest decreased use of recreational facilities in the area. This lower usage may result in decreased hours of operation and/or the closing of some recreational facilities.

Under the construction scenarios, a more dynamic economy and reduced out-migration are projected. Both of these conditions would provide support for recreational facilities in the area.

8.3.19 LIBRARIES

8.3.19.1 Existing and Developing Conditions

The Tri-Cities area contains several library facilities, the most extensive of which are operated by the Mid-Columbia Library. Richland and Prosser have their own public libraries. The Mid-Columbia Library is centered in Kennewick and maintains branches and services throughout the SMSA. At the end of 1980, Mid-Columbia had a total of 218,086 volumes.

8.3.19.2 Projected Conditions Under Alternative Scenarios

The major impact of the Project on the Mid-Columbia Library will be to provide a significant source of new revenue. 4
Mid-Columbia depends upon property tax revenues to develop and maintain its services. For example, in 1980, $386,715 in revenues were obtained via Real and Personal Property Taxes. This figure represented over 43 percent of all revenues for the year. Given the fact that the S/HNP is within the taxing purview of the Library (through Benton County), it can be expected that the proposed facility will generate significant tax revenues and enable the Library to improve and expand services. For example, if the Project was to be valued at $6.24 billion and taxed at 1981 rates, an annual total of $1.8 million would potentially be received by Mid-Columbia Library.

Under the baseline scenarios none of these funds would be available to the Library.

21. Tri-Cities Hotel-Motel Information for 1981, Tri-Cities Visitor & Convention Bureau, Tri-Cities, Washington (no date).

22. Construction Worker Profile, Mountain West Research, Inc., December 1975.

23. Migration and Residential Location of Workers at Nuclear Power Plant Construction Sites, Volume II: Profile Analysis of Worker Surveys. Suresh Malhotra and Diane Manninen, Battelle Pacific Northwest Laboratories, September 1980.

24. Employment by Type and Broad Industrial Sources, 1976-1979, U.S. Department of Commerce, Bureau of Economic Analysis, April 1981.

25. RERC, 1979, Tri-Cities Real Estate Research Report. Tri-Cities Real Estate Research Committee, Kennewick, WA., Autumn 1979.

26. Potential Site Study, Proposed Skagit/Hanford Nuclear Project at the Hanford Reservaton, by URS Engineers for the State of Washington Energy Facility Site Evaluation Council, December 15, 1981.

27. Draft Environmental Statement related to the Construction of Skagit/Hanford Nuclear Project, Units 1 and 2. April 1982.

28. H. B. Gamble, et al, Effects of Nuclear Power Plants on Community Growth and Residential Property Values. U.S. Nuclear Regulatory Commission, NUREG/CR-0454, Washington, D.C., November 1978.

TABLE 8.3-1

CONSTRUCTION PUPILS FOR WNP 1/4 AND 2, IDENTIFIED BY SCHOOL DISTRICT SURVEYS AND CONFIRMED BY WASHINGTON PUBLIC POWER SUPPLY SYSTEM AUDIT, 1980

School District	Total Number Of Pupils	Number of Construction Pupils	Percent of Construction Pupils	Percent Construction Pupils Comprise of Total Enrollment
Columbia[a]	886	38	1.6	4.2
Finley[b]	902	33	1.4	3.6
Grandview	2,175	49	2.2	2.2
Kennewick	10,604	971	42.9	9.1
Kiona-Benton[c]	1,163	168	7.5	14.4
Pasco	5,535	152	6.8	2.7
Prosser	2,007	93	4.2	4.6
Richland	8,308	736	32.5	8.8
Sunnyside	3,412	22	.9	.6
Mabton	591	0	--	--
Total	33,992	2,262	100.0	--

[a]Burbank (Pasco) area

[b]Kennewick Area

[c]Benton City - West Richland Area

Source: Construction Pupil Survey, 1980, Washington Public Power Supply System, Richland, WA

4

TABLE 8.3-1a

TAXES ASSOCIATED WITH S/HNP

	Government Receiving Revenues			
Revenues	State	County	City	Other
Direct				
Property Tax	X	X		X
Sales/Use Tax	X	X		
Business & Occupation Tax	X			
Public Utility	X			
Indirect				
Property Tax	X	X	X	X
Sales/Use Tax	X	X	X	
Business & Occupation Tax	X			
Real Estate Excise Tax	X	X		
Other		X	X	

6

Source: "Taxation of Energy Generating Facilities During Construction and Operation" Washington State Department of Revenue, Olympia, WA July 1977.

TABLE 8.3-1b

1981 LEVIES FOR PROPERTY TAXES IN
BENTON COUNTY

Taxing Distribution	1981 Levy(1)	Limit set by Law(1)
State	$ 3.5743	$ 3.60
County	.9800	1.80
County Road	1.3619	2.25
Rural Library	.2955	.50
Port of Benton	.3238	N/A
School District 400	1.7217	N/A
TOTAL	$ 8.2571	$ 8.15(2)
Regular(3)	6.4886	
Special	1.7686	

6

(1) In dollars per $1,000 of assessed value. Increase in taxes on regular levies limited annually to 6% of previous year tax receipts, exclusive of new construction.

(2) Limit for unincorporated areas is 9.15; may be exceeded by special vote.

(3) Includes state, county (0.9331), county road, Port of Benton, and rural library.

Source: Benton County Assessor, 1981.

 4

TABLE 8.3-2

ESTIMATED CONSTRUCTION COST AND POTENTIAL PROPERTY TAX REVENUES DURING CONSTRUCTION(1) (in current dollars)

Year	Plant[a]	Fuel	Transmission	Total Cost of Construction(2) ($000)	Cumulative Cost ($000)	Potential Revenue to:(3) State ($000)	Potential Revenue to:(3) Benton County ($000)	Potential Revenue to:(3) Total ($000)
through 1979	$ 231,519	$ --	$ --	$ 231,519	$ --	$ --	$ --	$ --
1980	24,295	--	--	24,295	255,814	--	--	--
1981	21,550	--	--	21,550	277,364	--	--	--
1982	55,390	--	--	55,390	332,754	--	--	--
1983	178,729	--	--	178,729	511,483	--	--	--
1984	273,672	--	--	273,672	785,155	2,806	3,677	6,483
1985	426,993	--	--	426,993	1,212,148	4,333	5,676	10,009
1986	693,550	--	--	693,550	1,905,698	6,812	8,924	15,736
1987	877,469	--	--	877,469	2,783,167	9,948	13,033	22,981
1988	912,100	206,275	1,220	1,119,595	3,902,762	13,950	18,276	32,226
1989	580,811	74,255	13,997	669,063	4,571,825	16,341	21,409	37,750
1990	494,684	242,301	3,352	740,301	5,312,126	18,987	24,876	43,863
1991	301,756	87,225	7,569	396,550	5,708,676	20,405	26,733	47,138
1992	228,739	--	886	229,625	5,938,301	21,225	27,808	49,033
Total	$5,301,221	$610,056	$27,024	$5,938,301	$5,938,301	$114,807	$150,412	$ 265,219

6

[a]Includes personal property liability.

TABLE 8.3-2

Year	Plant[a]	Fuel	Transmission	Total Cost of Construction(2) ($000)	Cumulative Cost ($000)	Potential Revenue to:(3) State ($000)	Benton County ($000)	Total ($000)

6

(1) All values for demonstration only are subject to change. The number are escalated to account for inflation.

(2) The total value of the Plant includes the cost of construction plus the value of the property and allowance for Funds during Construction (AFDC), Sales Tax, Property Tax, which total the $8 billion plant valuation (in current dollars). 4 6

(3) Based on 1980 levies (1981 taxes):

(a) State = $3.5743 per M

(b) Benton County: $4.6829 per M

(1) County: $.98 per M

(2) Library: $.2955 per M

(3) Port Benton: $.3238 per M

(4) Road District: $1.3619 per M 4

(5) Richland School District: $1.7217 per M

TABLE 8.3-3 4

TAX BASE INCREASES FROM S/HNP (ASSESSED VALUATION INCREASES IN 1980 DOLLARS) 6

Taxing Jurisdiction	1981 Assessed Valuation ($000)	Total Assessed Valuation with S/HNP (1980 dollars)	Increase in Valuation	S/HNP as as Percent of Total	
					4 6
Benton County	$2,720,630	$5,120,630	88 %	46.9 %	
Library	853,018	3,253,018	281 %	73.8 %	
Port of Benton	1,303,086	3,703,086	153 %	64.8 %	
Road District	853,018	3,253,018	281 %	73.8 %	5
Richland School District	1,186,743	3,586,743	202 %	66.9 %	

NOTE: Data presented as illustrations only and subject to change. The "Increased in Valuation due to S/HNP" column is based on 1981 valuation levels and an assumed plant value of 2.4 billion (80 percent of three billion).

TABLE 8.3-4

LOCAL POPULATION, 1940-1980

	1940	1960	1970	1980	1970-1980 Percent Growth
Benton County	12,053	62,070	67,540	109,444	62.0
Unincorporated Areas	7,529	18,958	20,907	32,655	56.2
Incorporated Areas	4,524	43,112	46,633	76,789	64.7
Benton City	640	1,210	1,070	1,980	85.0
Kennewick	1,918	14,244	15,212	34,397	126.1
Prosser	1,719	2,763	2,954	3,896	31.9
Richland	247	23,548	26,290	33,578	27.7
West Richland	--	1,347	1,107	2,938	165.4
Franklin County	6,207	23,342	25,816	35,025	35.7
Unincorporated Areas	1,650	7,520	10,153	14,619	44.0
Incorporated Areas	4,557	15,822	15,663	20,406	30.3
Pasco	3,913	14,522	13,920	17,944	28.9
Tri-Cities SMSA	--	--	93,356	144,469	54.8

Sources: Bureau of the Census. 1980 Census of Population and Housing, Advance Reports. Final Population and Housing Unit Costs: U.S. Department of Commerce. U.S. Government Printing Office: Washington, D.C.

Bureau of the Census. 1940, 1960, 1970 Census of Population, Characteristics of the Population. U.S. Department of Commerce. U.S. Government Printing Office: Washington, D.C.

4

TABLE 8.3-5

PROJECTED NUCLEAR RELATED CONSTRUCTION WORKFORCE ON THE HANFORD RESERVATION BY YEAR

Year	S/HNP(1)	WNP 2	WNP 1/4	WNP 4	Total	Percent of 1981 Workforce	
1981	--	3,280	6,510	--	9,790	100	
1982	--	3,370	5,630	--	9,000	91.9	
1983	563	1,940	3,520	1,800	7,823	79.9	
1984	1,227	--	2,120	3,906	7,253	74.1	
1985	2,202	--	840	5,243	8,285	84.6	
1986	3,298	--	--	4,638	7,936	81.1	4
1987	4,168	--	--	3,293	7,461	76.2	
1988	4,446	--	--	1,490	5,936	60.6	
1989	3,888	--	--	351	4,239	43.3	
1990	2,433	--	--	--	2,433	24.9	
1991	1,386	--	--	--	1,386	14.2	

(1) Excludes security and Puget Operations and Maintenance workers who are shown in Table 8.3-7. 6 E230.05

Source: Dr. Frank Clemente, 1981; Puget Sound Power & Light Company, 1981.

TABLE 8.3-6

POPULATION PROJECTIONS BY SCENARIO

Year	State Projection of Tri-Cities SMSA Population	Scenario 1 (WNP,1,2,4)	Scenario 2 (WNP 1,2, 4, SHNP)	Scenario 3 (WNP 1,2, and S/HNP)	Scenario 4 (WNP 1,2 only)
1981	148,251	148,251	148,251	148,251	148,251
1982	152,104	149,402	149,402	149,402	149,402
1983	155,956	147,134	148,261	144,683	143,563
1984	159,809	146,206	148,693	140,954	138,468
1985	163,662	147,573	151,993	141,653	137,232
1986	168,508	146,267	152,850	143,782	137,206
1987	174,354	144,892	153,200	146,874	138,572
1988	178,201	142,543	151,494	148,798	139,952
1989	183,047	141,643	149,481	148,749	141,345
1990	187,895	142,366	147,315	146,974	142,752
1991	191,653	143,783	146,622	146,278	144,173
1992	195,411	145,215	145,887	145,539	145,609
1993	199,241	146,661	146,719	146,368	147,059

4

Sources: Annual Planning Report, 1981, for Richland-Kennewick-Pasco SMSA. Washington State Employment Security Dept. July 1981; Dr. Frank Clemente, 1981; Social Impact Research, Inc., 1981. 6

TABLE 8.3-6a

NON-AGRICULTURAL WAGE AND SALARY WORKERS,
TRI-CITIES SMSA BY INDUSTRY, JULY 1981

AVERAGE MONTHLY NON-AGRICULTURAL PAYROLL
WITHIN TRI-CITIES SMSA, FIRST QUARTER, 1980

Industry	Number of Workers	Average Monthly Payroll per Employee
Total Manufacturing	8,680	$ 1,557
Food and Kindred Products	1,560	924
Printing and Publishing	340	956
Chemicals	5,850	1,945
Primary and Fabricated Metals	320	1,964
Other Manufacturing	610	1,563
Mining	80	1,916
Contract Construction	12,930	1,928
Transportation, Communications and Utilities	2,380	1,379
Wholesale and Retail Trade	12,140	775
Finance Insurance, Real Estate	1,790	999
Services	15,570	1,397
Government	10,090	1,310
Total	63,660	Aver. $1,432

6
E231.06

TABLE 8.3-7

SKAGIT/HANFORD NUCLEAR PROJECT
ESTIMATED ON-SITE PERSONNEL[1]

Year	Manual	Bechtel Non-Manual	NESCO Non-Manual	Security	Puget[2] O & M	Total
1983[3]	500	50	13	6	2	571
1984	1,085	125	17	26	4	1,257
1985	2,005	175	22	34	6	2,242
1986	3,020	250	28	66	9	3,373
1987	3,810	330	28	90	29	4,287
1988	4,035	380	31	116	55	4,617
1989	3,450	405	33	116	104	4,108
1990	2,075	330	28	116	168	2,717
1991[4]	1,155	212	19	116	175	1,677
1992	200	87	19	116	179	601
1993[5]	--	--	--	116	179	295

NOTES:
(1) All entries are annual averages.
(2) Additional personnel to support refueling outages is estimated to be 200 people.
(3) Start of Construction - 1/83.
(4) Commercial Operation Unit 1 - 1/91.
(5) Commercial Operation Unit 1 - 1/93.

Source: Puget Sound Power & Light Company, 1981.

4

6

TABLE 8.3-8

CONSTRUCTION PERIOD PAYROLL BY YEAR ($000)

	Manual	Bechtel Non-Manual	NESCO Non-Manual	Security	Puget O & M	Total
1983	$ 19,760	$ 1,400	$ 382	$ 101	$ 54	$ 21,697
1984	42,879	3,499	500	437	108	47,423
1985	79,238	4,898	647	571	162	85,516
1986	119,350	6,998	823	1,108	244	128,523
1987	150,571	9,237	823	1,511	785	162,927
1988	159,463	10,636	911	1,948	1,488	174,446
1989	136,344	11,336	970	1,948	2,814	153,412
1990	82,000	9,237	823	1,948	4,546	98,554
1991	45,646	5,934	558	1,948	4,735	58,821
1992	7,904	2,435	558	1,948	4,843	17,688
Total	$843,155	$65,610	$ 6,995	$13,468	$19,779	$949,007

NOTE: Data in 1980 dollars.

4

TABLE 8.3-8a

POTENTIAL EXPENDITURE PATTERNS OF S/HNP WORKFORCE

Commodity	National Average % Expended	1980 Dollars	
		Construction (1983-1992 annual average)	Operation (annual average)
Food, beverages, tobacco	21.3	11,521,894	988,399
Housing	16.0	8,654,944	742,459
Household operation	14.5	7,843,543	672,854
Transportation	14.1	7,627,169	654,292
Medical care	9.7	5,247,060	450,116
Clothing accessories, jewelry	7.8	4,219,285	361,949
Other	16.6	8,979,504	770,301
Total	100.0	54,093,399	4,640,370

Note: Assumes disposable income is 57% of gross income.

Source: "Personal Consumption Expenditures for U.S." U.S. Department of Commerce, Bureau of Economic Analysis, Washington, D.C. 1979.

6

TABLE 8.3-9

SUMMARY OF 1979 OPERATING REVENUES AND SELECTED EXPENDITURES IN BENTON AND FRANKLIN COUNTIES IN CURRENT DOLLARS

	Benton County		Franklin County	
	Amount	%	Amount	%
REVENUES				
Total Taxes	$ 6,704,449	55	$ 2,340,749	42
General Property Taxes	(2,813,577)	(23)	(1,835,182)	(33)
Retail Sales and Use Taxes	(3,762,410)	(31)	(376,224)	(7)
Business Taxes	(--)	(--)	(--)	(--)
Licenses and Permits	113,684	1	67,266	1
Intergovernmental Revenues	2,849,377	23	2,376,951	42
Charges for Services	582,545	5	318,980	6
Fines and Forfeits	350,548	3	120,727	2
Miscellaneous	1,630,800	13	376,092	7
TOTAL	$ 12,231,403	100	$ 5,600,765	100

4
6
4

	Benton County		Franklin County	
	Amount	%	Amount	%
SELECTED EXPENDITURES				
General Government Services	$ 3,216,657	32	$ 2,196,403	40
Security of Persons and Property	1,715,513	17	794,586	15
Physical Environment	343,304	4	107,586	2
Transportation	3,160,173	32	2,075,883	38
Economic Environment	10,771	*	9,448	*
Mental and Physical Health	1,197,734	12	165,590	3
Intellectual Environment	311,051	3	85,222	2
TOTAL	$ 9,955,203	100	$ 5,434,718	100

*Less than 1 percent

Source: Local Government Comparative Statistics, Washington State Auditor, Olympia, 1980.

4

TABLE 8.3-10

SUMMARY OF 1979 OPERATING REVENUES, LOCAL MUNICIPALITIES IN CURRENT DOLLARS | 4 | 6

	Richland		Pasco		Kennewick		Benton City	
	Amount	%	Amount	%	Amount	%	Amount	%
Total Taxes	$ 3,766,0[illegible]	46	$ 2,383,516	45	$ 3,923,358	49	$ 90,272	14
General Property Taxes	(1,273,024)	(16)	(836,240)	(16)	(1,312,753)	(16)	(28,112)	(4)
Retail Sales and Use Taxes	(812,398)	(10)	(958,878)	(18)	(1,424,573)	(18)	(43,756)	(7)
Business Taxes	(1,511,556)	(19)	(521,031)	(10)	(911,709)	(11)	(18,404)	(3)
Licenses and Permits	215,914	3	176,334	3	296,447	4	16,167	3
Intergovernmental Revenue	2,571,855	32	2,141,725	41	2,902,706	36	488,278	76
Charges for Services	3[illegible],114	5	174,199	3	367,009	5	3,915	1
Fines and Forfeits	124,934	2	114,360	2	172,155	2	6,834	1
Miscellaneous	1,082,598	13	292,709	6	354,600	4	30,835	5
TOTAL REVENUES	$ 8,138,426	101*	$ 5,282,843	100	$ 8,016,275	100	$ 636,301	100
Per Capita Taxes	$ 112		$ 144		$ 114		$ 46	
Per Capita Revenues	$ 242		$ 294		$ 233		$ 321	

NOTE: The city of West Richland did not submit a report to the State Auditor's Office.

Source: Local Government Comparative Statistics, Washington State Auditor, Olympia, 1980.

* Over 100 due to rounding

4

TABLE 8.3-11 4

SUMMARY OF 1979 SELECTED EXPENDITURES, LOCAL MUNICIPALITIES IN CURRENT DOLLARS 6

	Richland		Pasco		Kennewick		Benton City	
	Amount	%	Amount	%	Amount	%	Amount	%
General Government Services	$ 2,510,074	28	$ 873,068	16	$ 1,290,467	16	$ 103,679	21
Security of Persons and Property	2,735,389	30	1,816,328	34	2,772,625	33	87,773	18
Physical Environment	1,679,238	19	699,532	13	1,450,946	17	10,811	2
Transportation	1,178,969	13	1,811,849	34	2,542,659	31	217,034	44
Economic Environment	58,289	1	--	--	--	--	62,704	13
Mental and Physical Health	373,091	4	36,505	1	68,710	1	3,483	1
Intellectual Environment	481,886	5	94,090	2	203,233	2	--	--
TOTAL	$ 9,016,936	100	$ 5,331,372	100	$ 8,328,640	100	$ 485,484	100
Per Capita Expenditures	$ 268		$ 297		$ 242		$ 245	

4

NOTE: The city of West Richland did not submit a report to the State Auditor's Office

Source: Local Government Comparative Statistics, Washington State Auditor, Olympia, 1980.

TABLE 8.3-16

POLICE PERSONNEL IN TRI-CITIES AREA

Type	Staff	Patrol Cars
Benton City Municipal	5	2
Kennewick Municipal	56	17
Pasco Municipal	37	10
Richland Municipal	55	9
West Richland Municipal	9	3
County Sheriff (Benton) County	25	16
County Sheriff (Franklin) County	32	N/A

4

TABLE 8.3-16a

TYPE AND NUMBER OF CRIMES BY AREA, TRI-CITIES SMSA, 1980

6
E230.06

Area	Type and number of crimes						
	Murder and Manslaughter	Rape	Robbery	Assault	Burglary	Larceny-Theft	Mtr. Veh. Theft
Tri-Cities SMSA	6	39	76	314	1,973	5,957	422
Kennewick	-	8	20	36	525	2,176	115
Pasco	4	10	39	111	560	1,510	115
Richland	1	4	8	83	400	1,369	70

Source: Uniform Crime Reports, 1980, U.S. Federal Bureau of Investigation, Department of Justice, Washington D.C. (September 1981).

TABLE 8.3-17

FIRE PROTECTION PERSONNEL WITHIN TRI-CITIES AREA

Fire Protection Unit	ISO Rating	Staff			Service Area
		Full-Time	Volunteers	Total	
Kennewick	5	33	15	48	City
Pasco	5	26	0	26	City
Richland	3	42	0	42	City
BCRFD#1	819	1	126	127	Kennewick Area
BCRFD#2	819	1	17	18	Benton City
BCRFD#3	819	1	11	12	Prosser Area
BCRFD#4	819	1	17	18	West Richland
BCRFD#5	9	1	68	69	Southeast of Prosser
FCRFD#3	819	3	65	68	Surrounds City of Pasco

NOTE: There are "Mutual Aid Agreements" between all fire districts in the area. The "Tri-Cities Mutual Aid Agreement" (September 15, 1980) includes the cities of Pasco, Kennewick, Richland, BCRFDs #1, #2, #3, FCRFD#3, Walla Walla County and the Rockwell Hanford Fire Protection Department. ISO ratings are reported in Public Protection Classification Manual: Washington State (1981).

6

TABLE 8.3-18 Sheet 1 of 2

EXAMPLES OF HUMAN SERVICES FACILITIES AND ORGANIZATIONS IN THE TRI-CITY SMSA

Facility or Organization	Descriptive Comments
911 Emergency Dispatch Cntr	Provides immediate referral to emergency information and dispatch of ambulance, fire, police, etc., services.
Benton-Franklin Association for Retarded Citizens	Counseling, recreation, transportation and referral services for learning-disabled individuals.
Benton-Franklin Developmental Center	Provides services and programs for developmentally disadvantaged children.
Catholic Family Services	Provides foster care programs, family and individual counseling programs and adoptive services.
Children's Home Society of Washington	Residential treatment facilities and programs for emotionally disturbed children.
Benton-Franklin Council on Aging	Programs to provide meals, household assistance, health care and information and transportation services.
Evergreen Legal Services	Free legal aid program for civil cases involving low-income persons.
Good Shepherd Home	A residential treatment program for adolescent girls with behavior problems.
Women's Resource Center	Broad range of information, education, support and referal services for women.

4

TABLE 8.3-18 Sheet 2 of 2

Facility or Organization	Descriptive Comments
Planned Parenthood of Benton-Franklin Counties	Family planning education, information and assistance programs. 4
Tri-Cities Chaplaincy	Chaplaincy service to those with life-threatening illnesses and their families, including a hospice program.
Women's Resource Center	Broad range of information, education, support and referral services for women.

TABLE 8.3-19

EXAMPLES OF PHYSICAL RECREATIONAL FACILITIES AVAILABLE IN THE TRI-CITIES AREA

Physical Activity	Descriptive Comments
Tennis	62 outdoor courts (e.g., Sylvester Park, Amon Park, Pasco High School). Indoor courts at Tri-City Court Club.
Golf	Six courses including Tri-City Country Club, Canyon Lakes and West Richland Municipal Golf Course. Several driving ranges and pro shops are also available.
Bowling	Lanes in each city including Atomic Bowling Center, Clover Leaf Lanes and Columbia Lanes.
Swimming	Private (e.g., Ranchette Estates) and public (e.g., Kennewick) swimming pools in the area. Boating, waterskiing and swimming on the Columbia River in the Tri-Cities area.
Ball	Baseball fields and basketball courts are located throughout the Tri-Cities including such places as Badger Canyon, Craighill Playgrounds, Stevens Playground and Lewis and Clark School. Soccer and football fields are also located in various areas.
Skating	Rollerskating, ice-skating and skateboard facilities.
Camping	Several hundred campsites within driving distance from the Tri-Cities area including Levy Park, Fishook Park and Sun Lakes.
Fishing	Steelhead, sturgeon, trout, and crappie fishing in the lakes and rivers near the Tri-Cities area.
Hunting	Duck, geese, pheasant and quail hunting. Deer and elk hunters in the Blue Mountains and the Cascade Range.

4

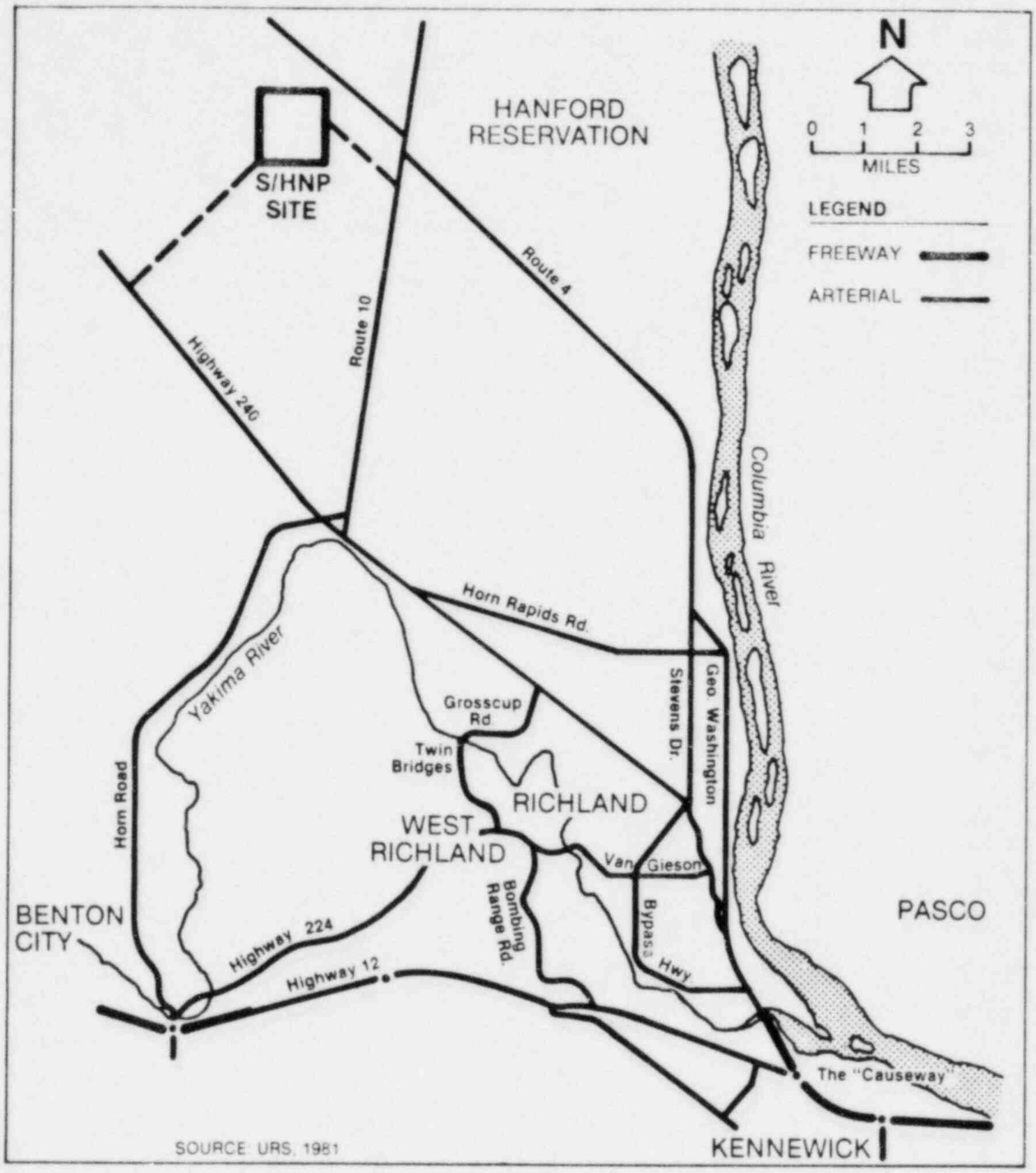
TABLE 8.3-20

OPERATIONS PAYROLL BY YEAR, 1991-2020
($000)

	Puget O&M	Puget O&M Refeuling	Security	Total	
1991	$ 4,843	$ 1,353	$ 1,948	$ 8,144	
1992	4,843	1,353	1,948	8,144	
1993	4,843	1,353	1,948	8,144	
1994	4,843	1,353	1,948	8,144	
25 year	121,080	33,825	48,703	203,608	6 E231.09
2020	4,843	1,353	1,948	8,144	
Total	$ 145,295	$ 40,590	$ 58,433	$ 244,328	

NOTE: These costs are in 1980 dollars for both units.

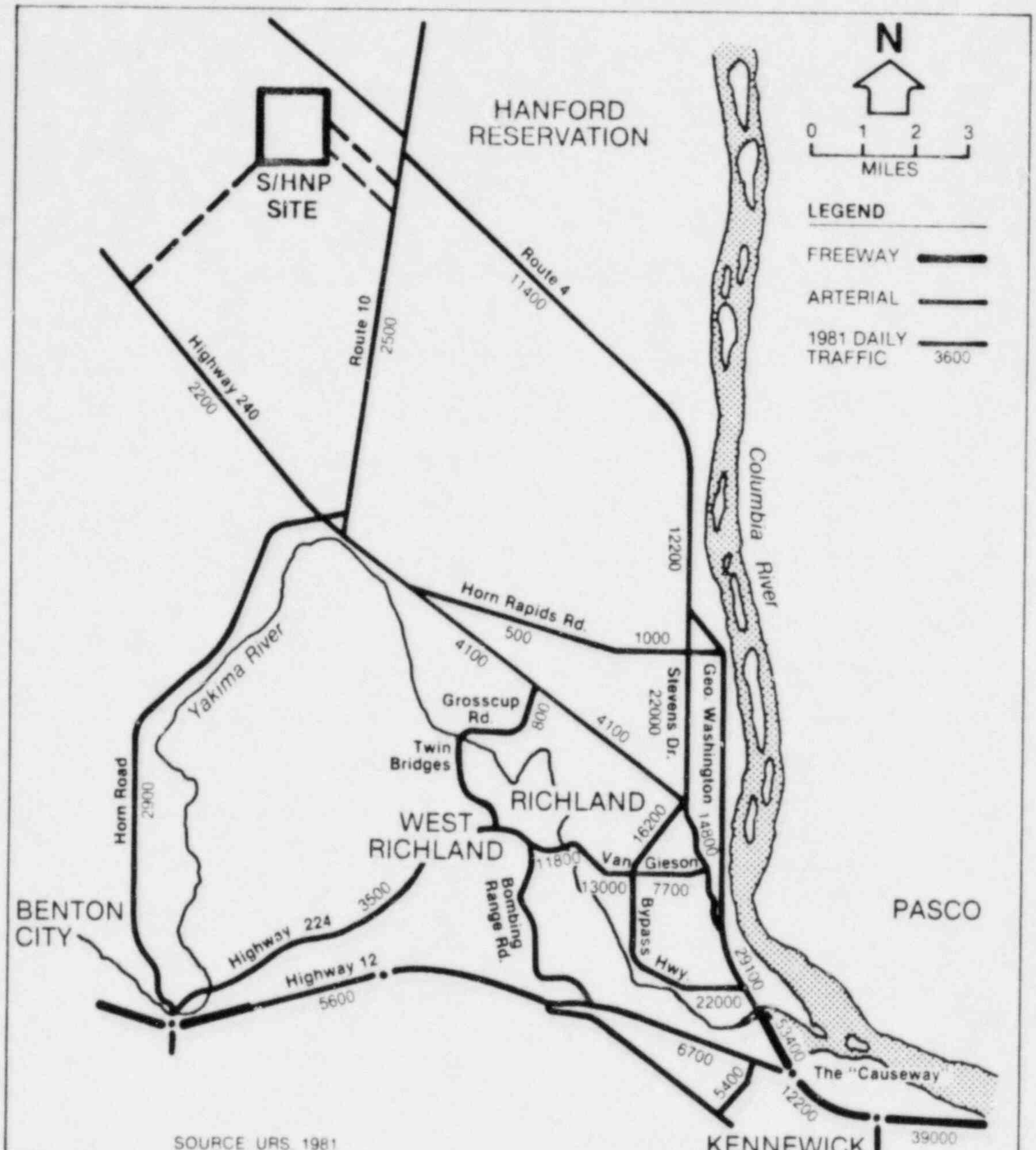
Source: Puget Sound Power and Light Company, 1982.



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

EXISTING MAJOR STREETS AND HIGHWAYS SERVING HANFORD RESERVATION TRAFFIC

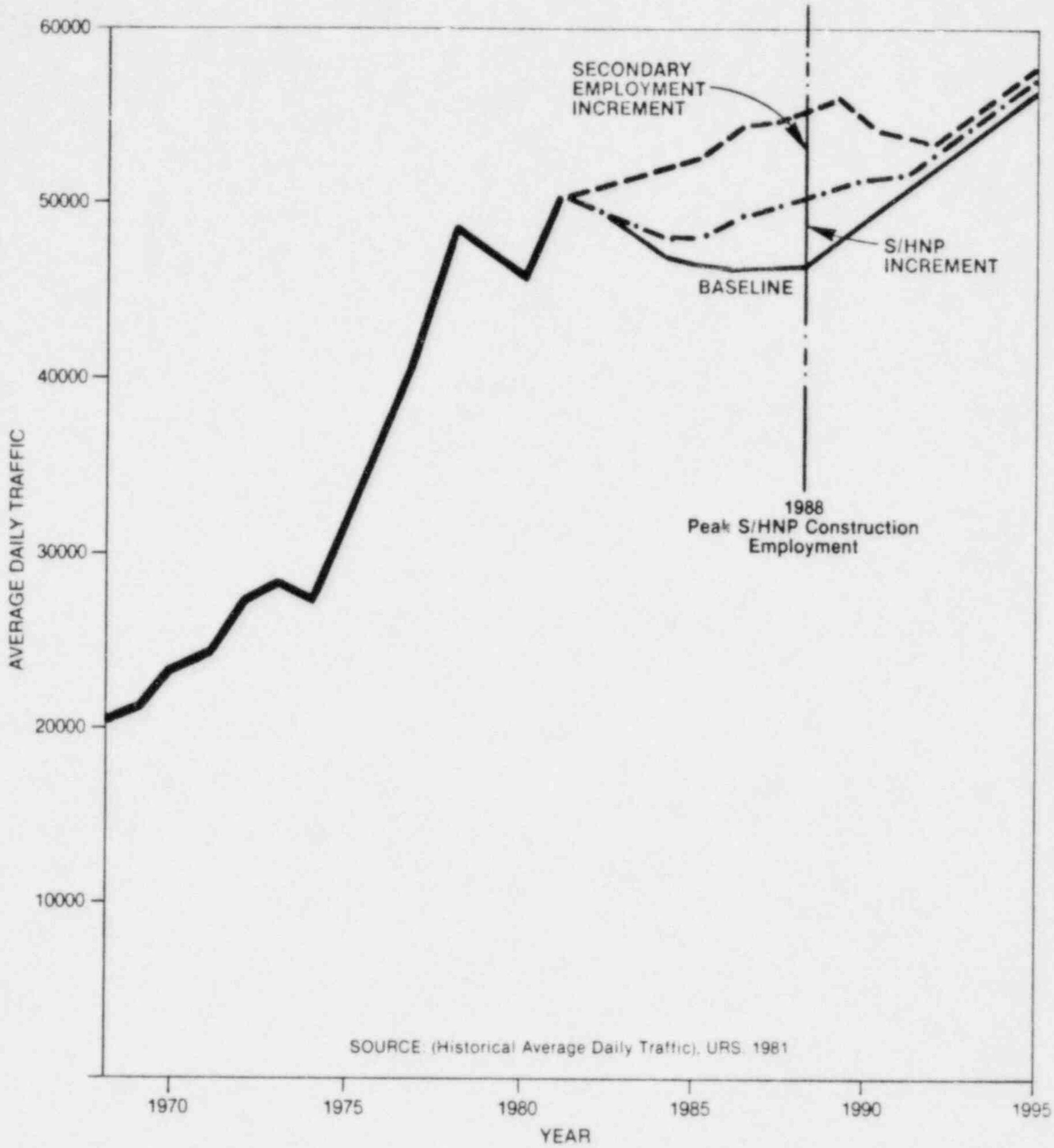
FIGURE 8.3-1



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

1981 DAILY TRAFFIC

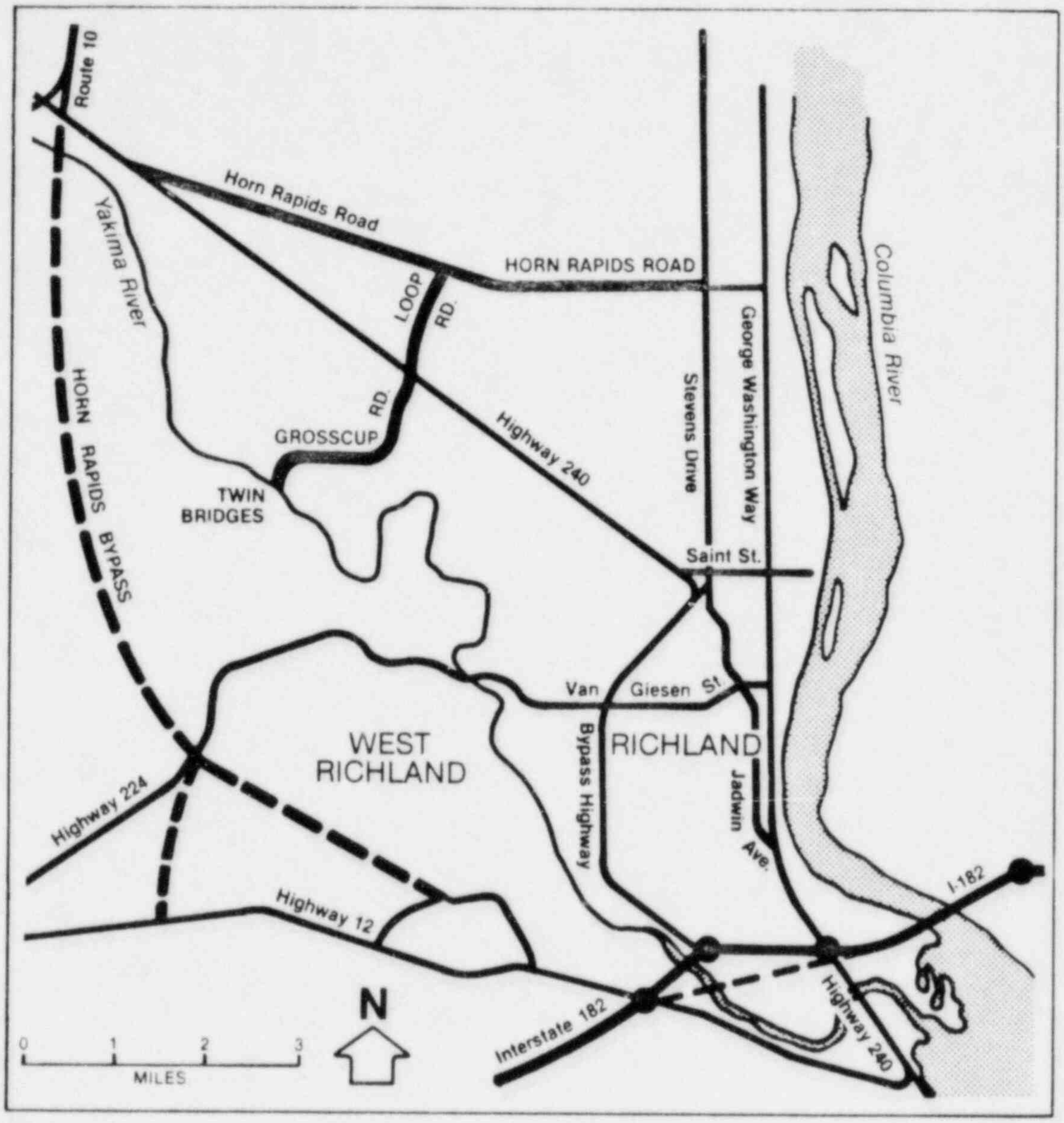
FIGURE 8.3-2



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

TRENDS AND PROJECTIONS OF AVERAGE DAILY TRAFFIC ON THE CAUSEWAY

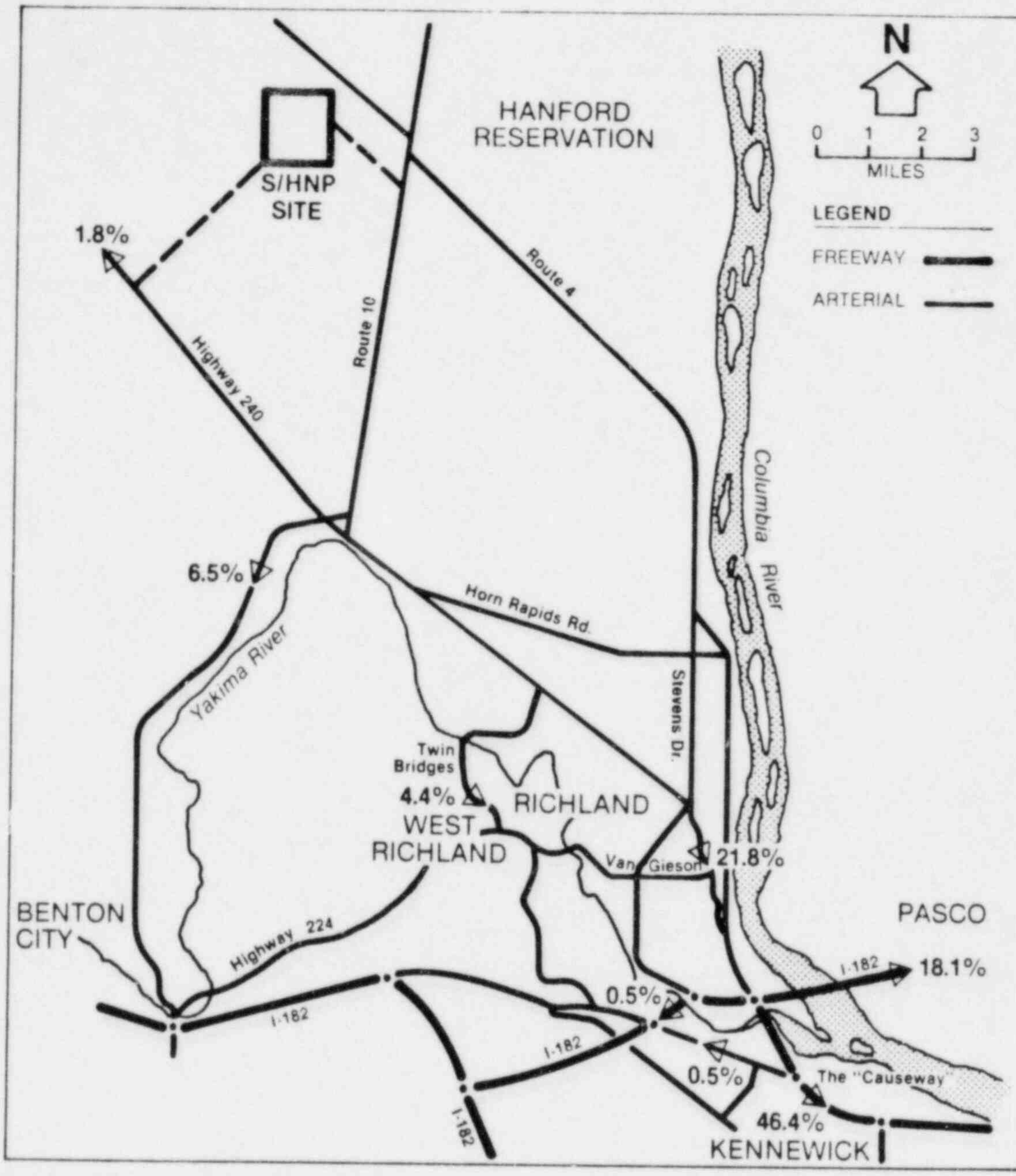
FIGURE 8.3-3



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

PROGRAMMED HIGHWAY IMPROVEMENTS

FIGURE 8.3-4



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

ESTIMATED DISTRIBUTION OF S/HNP CONSTRUCTION WORKER TRAVEL

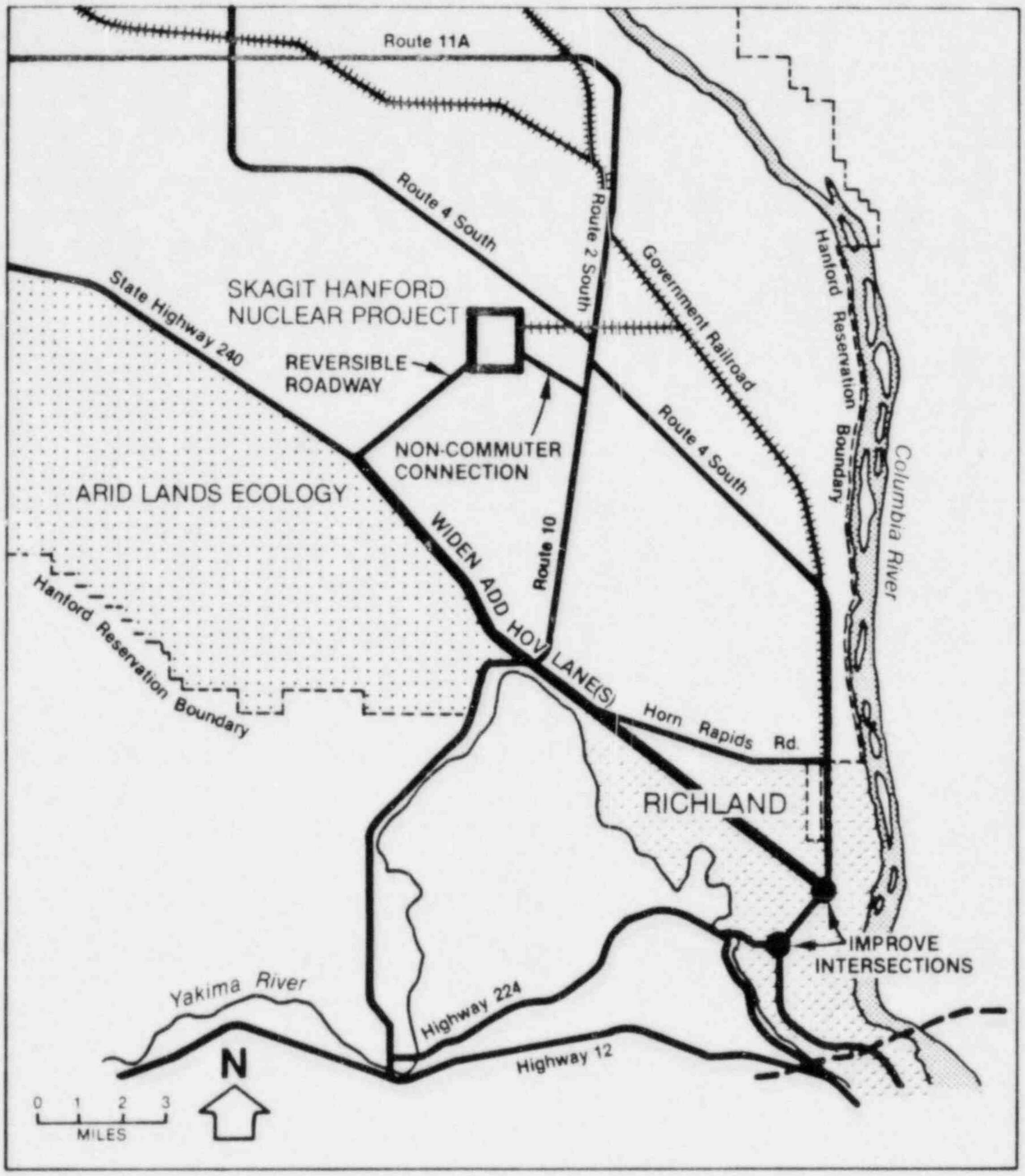
FIGURE 8.3-5

		1981 EXISTING CONDITIONS	1988 BASELINE	1988 WITH S/NHP	1988 WITH MITIGATING ACTIONS	1988 WITH SECONDARY TRAFFIC
3-4 PM	S/HNP ACCESS & ROUTE 240	N.A.	N.A.	1.09	0.83	0.99
	ROUTE 240/HORN ROAD/ROUTE 10 (WEST)	0.43	0.29	1.70	0.89	0.92
	ROUTE 240/ROUTE 10 (EAST)	0.31	0.31	1.61	0.92	0.95
	ROUTE 240 & STEVENS DRIVE	0.77	0.36	1.44	0.79	0.82
	BYPASS HIGHWAY & VAN GIESEN	1.09	0.81	1.34	0.92	1.12
4-5 PM	S/HNP ACCESS & ROUTE 240	N.A.	N.A.	0.35	0.56	
	ROUTE 240/HORN ROAD/ROUTE 10 (WEST)	0.49	0.49	0.80	0.74	
	ROUTE 240/ROUTE 10 (EAST)	0.35	0.35	0.64	0.57	
	ROUTE 240 & STEVENS DRIVE	0.87	0.77	0.98	0.87	
	BYPASS HIGHWAY & VAN GIESEN	1.04	0.94	1.14	0.90	

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

VOLUME/CAPACITY RATIOS AT CRITICAL LOCATIONS EXISTING AND WITHOUT/WITH S/HNP

FIGURE 8.3-6



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

POSSIBLE SKAGIT/HANFORD ROADWAY IMPROVEMENTS

FIGURE 8.3-7

8.5.2 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. 4

The greatest amount of commuter traffic will occur under 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
improvements are described in detail in Section 8.3.10.5. 6

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
may generate as much as $8 million for the Transit 4
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.

References for Section 8.5

1. John McConnaughey, Bonneville Power Administration, Power Requirements Branch (December 9, 1981). 4

2. Socioeconomic Impact Study WNP 1 & 4, Volume 4: Final Report, prepared by Community Development Services, Inc. for Washington Public Power Supply System, Seattle, Washington (May 1979).

CHAPTER 9.0

ALTERNATIVE ENERGY SOURCES AND SITES

CONTENTS

identified, the licensing and permitting requirements may render it unusable.

The Corps of Engineers and others have identified a large potential for small hydro in the Pacific Northwest (Ref 8). For the reasons outlined above, from their own experience, Applicants believe only a small fraction of this identified potential is economically and environmentally suitable for development. The small-scale hydro projects which Applicants are reasonably sure will be constructed were included in the planned resources when Applicants assessed the need for the S/HNP. Applicants believe that they will need the output of additional small-scale hydro projects that probably will be developed by themselves or others, as well as the output of the S/HNP.

9.2.1.2.5 Solar Energy

Solar energy may provide an alternative energy source in the Pacific Northwest. Currently, Applicants are evaluating the role solar can play in reducing the demand for electricity, which is continually increasing. These measures are discussed in Section 9.1.4. Solar energy can also be used to produce electricity utilizing solar photovoltaic cells or solar thermal energy conversion cycles. However, neither of these technologies is expected to make a significant contribution to energy supply until well after 1990 (Ref 9). Further, initial development probably will not to begin in the Pacific Northwest because of the relatively lower availability of solar energy. 4

9.2.1.2.6 Fusion Reactors

The research on the fusion reaction faces decades of problem solving connected with the construction of a reliable, safe, and economical fusion power plant (Ref 7). Thus, fusion reactors are not available as an alternative to the S/HNP.

9.2.1.2.7 Breeder Reactors

A breeder reactor, while generating electricity, produces excess fissionable fuel from abundant uranium and thorium resources. Research in the United States has been delayed by the debate surrounding the future of nuclear energy. Construction of the nation's first large-scale demonstration project, a 380-MW Liquid Metal Fast Breeder Reactor (LMFBR) at Clinch River, will not begin until the early to mid-1980s. Most observers agree that LMFBRs will not be commercially available in time to meet the baseload power requirements that are proposed to be met by the S/HNP (Ref 10). 4

9.2.1.2.8 Cogeneration

The planned cogeneration projects in the region have been included in the resource base when assessing the need for power from the S/HNP as indicated in ASC/ER Table 1.1-7. The amount of additional energy available from cogeneration in the future beyond those is difficult to forecast, because cogeneration projects cannot proceed without the willing cooperation of industrial partners. Although the utilities participating in the S/HNP encourage cogeneration, they cannot control its development.

Estimates of cogeneration in the region have not included any factor which indicates the probability of development and, thus, are not a useful measure of available cogeneration. 6 N230.11

Thus, any potential additional resource available from cogeneration beyond those already accounted for cannot be realistically predicted. Should any be developed, they will likely be needed in addition to the output of the proposed S/HNP.

9.2.1.3 Advanced Energy Conversion Methods

Increased efficiency and reduced emission of pollutants may be achieved through the use of newly developed combustion methods, and combined in coal-fired plants.

9.2.1.3.1 Fluidized Bed Combustion

Implementation of boiler construction, based on fluidized bed combustion techniques, may provide an alternative to fuel gas desulfurization, thereby allowing more economical use of coal within air quality regulations. Savings in plant capital investment can be realized from reduced pollution-control equipment requirements and boiler costs. 4

The U.S. Department of Energy and the Electric Power Research Institute (EPRI) are supporting phased projects which are aimed at demonstrating both pressurized and atmospheric fluidized combustion techniques in utility-scale applications (Refs 11, 12). Applicants are participating in these demonstration projects through their mutual support of EPRI.

Until development is completed, and reliable electric power generation is demonstrated, fluidized bed combustion cannot be considered as an alternative to conventional design fossil boilers, or to the S/HNP.

4

9.2.1.3.2 Fuel Cells

The main advantage of fuel cells is that they can be located closer to the load center, with potentially less impact on the environment than gas turbines. In addition, they convert energy to electricity more efficiently than gas turbines.

The disadvantages of fuel cells is that they currently have a high cost, and must currently depend on oil or natural gas for fuel. These two fuels have a relatively high cost,

CHAPTER 10.0

PLANT DESIGN ALTERNATIVES

TABLES

4

CHAPTER 10.0

PLANT DESIGN ALTERNATIVES

FIGURES

TABLE 10.2-1
COMPARISON OF ENVIRONMENTAL FACTORS BETWEEN THE PROPOSED AND ALTERNATIVE INTAKE SYSTEMS

Primary Impact	Units of Measure	Relative Effects of Each Alternative: Inlets Above River Bed	Conventional Intake	Infiltration Beds in River	Inlets in Diversion Canal	
1. NATURAL SURFACE WATER BODY						
1.1 Impingement or Entrapment by Cooling Water Intake Structure						
1.1.1 Fish Affected	% Loss					
Anadromous salmonid adults		NI	NI	NI	NI	
Anadromous salmonid juveniles		N	MO	NI	SI	
Other adult game fish		NI	N	NI	NI	
Other juvenile game fish		NI	MO	NI	SI	
1.2 Passage Through or Retention in Cooling Systems						
1.2.1 Phytoplankton or Zooplankton Affected	% Change	.26	.26	NI	N	4
1.2.2 Fish Affected (fish eggs or larval forms)	% Loss	.26	.26	NI	NI	
1.3 Plant Construction Effects						
1.3.1 Water Quality Affected (physical)						
Volume Affected	Statement	ST	ST	ST	ST	
1.3.2 Water Quality Affected (chemical)						
Volume	Statement	ST	ST	ST	ST	
2. LAND						
2.1 Site Selection						
2.1.1 Land Affected (amount)	Acres Pre-empted	1.5	2	6	15	6
2.2 Construction Activities						
2.2.1 People Affected (amenities)						
Total population affected Duration of impacts	No. of People Yr.	NI	NI	NI	NI	4
2.2.2 People Affected (historical site accessibility)	Visitors/Yr.	NI	NI	NI	NI	

TABLE 10.2-1

Primary Impact	Units of Measure	Relative Effects of Each Alternative: Inlets Above River Bed	Conventional Intake	Infiltration Beds in River	Inlets in Diversion Canal
2.2.3 People Affected (archaeological site accessibility)	Qualified Opinion	NI	NI	NI	NI
2.2.4 Wildlife Affected	Statement Habitat will be Disturbed	Some Riparian Habitat will be Disturbed	Some Riparian Habitat will be Disturbed	Some Riparian Habitat will be Disturbed	Permanent Loss of Valuable Plant and Wildlife Habitat
2.3 Station Operation					
2.3.1 People (amenities) Affected by Noise	No. of People	NI	NI	NI	NI
2.3.2 People Affected (aesthetics)	Qualified Opinion	NI	NI	NI	NI
2.3.3 Wildlife Affected	Statement	NI	NI	NI	Muskrat and Beaver Might Try to Use Area
2.3.4 Land Affected (flood control)	Compliance with Flood Control District	NI	NI	NI	NI

N = Negligible SI = Significant
MI = Minimal ST = Short Term
MO = Moderate NI = No Impact

4

10.5 BIOCIDE TREATMENT SYSTEMS

Treatment of the circulating cooling water is necessary to control the growth of algae and bacteria which may be present in the makeup water or introduced to the circulating water by airborne organisms. Condenser tube fouling due to unchecked biological activity can result in metal corrosion, loss of heat exchange efficiency, and ultimately may require unit shutdown for cleaning.

10.5.1 RANGE OF ALTERNATIVE BIOCIDE TREATMENT SYSTEMS

The following biocide systems have been considered to prevent biofouling of the condenser tubes and Circulating Water System:

a. Sodium hypochlorite and mechanical cleaning (Amertap)

b. Chlorination (liquid or gaseous)

c. Ozonation

d. Organic biocide. 4

None of the alternatives has any effect on the Plant capacity factor, nor any significant impact on the power consumption.

10.5.1.1 Sodium Hypochlorite and Mechanical Cleaning (Amertap)

Treatment with sodium hypochlorite and mechanical cleaning is the preferred system for control of fouling organisms in the Circulating Water System. This system is discussed in Section 3.6. The advantages of the system are:

a. Prevents fouling of heat exchanger tubes

b. Maintains cleanliness and consequently high heat exchange rates and low corrosion rates

c. Provides savings on heat exchanger tube chemical cleaning and prevents loss of Plant energy output

d. Provides safer chemical handling compared with liquid or gaseous chlorine.

The disadvantage of the system is that it requires addi- 4
tional system cost and maintenance.

The environmental costs associated with the preferred
system, a mechanical Amertap system with sodium hypo-
chlorite treatment, are presented in Section 5.3. Residual 4
chlorine has been identified as acutely toxic to aquatic
biota in concentrations in excess of 0.0060 mg/l. The U.S. 6
Environmental Protection Agency has established a water 4
quality criterion of 0.0020 mg/l for freshwater aquatic 6
life (Ref 1). Chlorine values at the end of the mixing 4
zone are estimated to be 0.0020 mg/l only under worst case 6
conditions. Productivity of benthic invertebrates within
the S/HNP dilution zone, however, probably will be reduced
in comparison to adjacent areas. This reduction is not
expected to affect the productivity of the Columbia River.
No impacts upon juvenile fish traversing or temporarily 4
entrained in the discharge plume are projected.

10.5.1.2 Chlorination

Although chlorine is an effective biocide, the hazardous nature of liquid and gaseous chlorine and its detrimental effect on the environment in case of chlorine tank rupture reduces the advantages of using these forms of chlorine as a biocide. Furthermore, the handling of chemicals for the selected system is safer compared with that of liquid or gaseous chlorine. For these reasons, the use of liquid or gaseous chlorine was not chosen for the preferred biofouling control system. 4

10.5.1.3 Ozonation

The use of ozone has been considered for control of biofouling, and the environmental advantages of ozone are numerous (Ref 2, 3, 4). Ozone (O_3) is a powerful oxidizing agent well known for its disinfectant and biocidal properties. Aquatic biota exposed to ozone residuals in the range of 10.0 to 100.0 micrograms O_3 per liter may be adversely affected (Ref 5).

Ozone residuals or aquatic impacts will not be expected in the Columbia River after dilution of the S/HNP discharge. Similarly, no impacts upon aquatic biota in the mixing zone are expected.

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.

10.9.1.1 Proposed Route 4

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.

10.9.2 MONETIZED COSTS

The proposed route requires approximately 12.8 miles of 4
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.

10.10 ALTERNATIVE INTAKE/DISCHARGE LOCATIONS

10.10.1 SELECTION OF ALTERNATIVES FOR COMPARISON

The Plant Site is situated such that the Project intake and discharge could conceivably be located in either the Columbia River or the Yakima River. In order to minimize aquatic impacts attributable to water consumption and to the Project discharge, the Columbia River was selected as the preferred location for the intake and discharge due to its substantially greater flows.

A range of possible intake/discharge locations in the Columbia River was investigated. Locations in proximity to known spawning areas (see Figures 2.2-18 to 2.2-21) were eliminated from consideration to avoid potential impacts upon fish. Similarly, locations near the discharges of the N-Reactor and Hanford Generating Project (approximately RM 380) and of WNP-1, 2 and 4 (approximately RM 351) were eliminated to minimize the potential for cumulative impacts. Portions of the Columbia River adjacent to the sand dunes east northeast of the Plant Site (see Figure 2.6-4) were discarded because of the environmental and technical problems associated with construction of the intake and discharge pipelines in the sand dunes. Finally, those areas of the Columbia River within the Savage Island District (see Figure 2.6-5), which is a National Register District, were also discarded.

As a result of this process of elimination, it was 6
determined that the optimum intake/discharge location would generally be found in the area around RM 361.5. This area is about ten miles from the nearest discharge from another project and is about seven miles upstream from the nearest known spawning habitat. Furthermore, this area is downstream of 96 percent and 100 percent of the known and probable salmonid and smallmouth bass spawning habitats in the Hanford Reach.

This part of the Columbia River is characterized by a nearly straight segment of river channel that extends from RM 364.0 to about RM 359.0. The cross-section width of the river varies from about 1400 ft to about 1800 ft across the water surface which are representative of flows varying from 55,000 to 133,000 cfs. At RM 364.0 the low water channel is located along the eastern bankline because of a large channel bar along the opposite bank. About RM 361.5 the low water channel crosses over to the western bankline for the remainder of the river reach length (Figure 10.10-1). The lower water channel trough at RM 361.0 is relatively narrow (about 500 ft) and deep in comparison to RM 361.5 (see Figures 10.10-2 and 10.10-3), and the substrate at RM 361.0 is coarser than that at RM 361.5.

Selection of specific locations for the Project intake/discharge was predicted upon three primary and somewhat contradictory considerations. First, it was desired to locate the intake and discharge a sufficient distance offshore to minimize encounters with shore oriented fish, especially salmonids, and fish utilizing the Hanford Slough. Second, it was desired to locate the intake in a deep and swift portion of the river to minimize encounters with surface oriented fish and to maximize dilution of the Project discharge. Third, it was desired to locate the intake and discharge close to shore to reduce the amount of in-river construction.

Given these criteria, three specific locations were chosen for the purpose of analysis. Alternative A is located at RM 361.5 with an intake 750 feet off the Benton County shore during minimum regulated flow (36,000 cfs). Alternative B is located at RM 361.0 with an intake 475 feet off the Benton County shore during minimum regulated flow. Alternative C is located at RM 361.5 with an intake 600 feet off the Benton County shore during minimum regulated flow.

These alternative locations are depicted on Figures 10.10-1 to 10.10-3 and 10.10-5 and river parameters for each are listed in Table 10.10-1. 6

10.10.2 COMPARISON OF ALTERNATIVES

The three alternatives were initially compared with respect to aquatic impacts connected with construction, intake and discharge.

As discussed in Section 4.1.2.2, aquatic impacts as a result of construction are expected to be limited to the area immediately downstream from construction and are expected to be temporary in duration and thus not significant. Therefore, although Alternatives B and C entail less construction than Alternative A, this factor weights only very slightly in favor of these alternatives because of the nature of the construction impacts.

Impacts from water intake are attributable to entrainment and impingement of aquatic biota. Locations further offshore (Alternatives A and C) are preferable due to the lower densities of juvenile fish expected at these locations, and locations with swifter river current (Alternative B) are preferable in order to sweep biota from the face of the intake. However, all three locations are sufficiently far from shore and are situated in sufficiently swift current so that any differences among them are anticipated to be minor at most.

Additionally, Alternatives A and C may be more susceptible to local changes in river flow direction than Alternative B, due to the deeper and narrower channel at Alternative B. However, Alternative B may be more susceptible to turbulence due to its coarser substrate. In any case, nonparallel flow past the intake as a result of these factors is not expected to affect significantly the performance or the impacts of the intake (see Section 5.1.2.1).

Differences in the impacts from the different discharge locations are primarily influenced by differences in dilution. Since Alternative B entails somewhat faster and deeper currents and therefore greater dilution, impacts at this location might be marginally less than at the other alternative locations. However, this slight advantage is partially offset by the fact that Alternative B is closer to shore and closer to shore oriented fish and by the fact that the narrow river channel at Alternative B allows lesser area for discharge plume avoidance for those fish which utilize deep waters. Consequently, no significant difference in discharge effects is expected among the three locations. 6

Alternatives A, B, and C were also compared with respect to terrestrial and cultural resources impacts and costs.

Alternatives A and C would utilize the same pipeline corridor, as shown in Figures 10.10-1 and 10.10-4. This corridor takes advantage of existing roadways in the old Hanford townsite, thereby minimizing ecological impacts. Three pipeline corridors (B1, B2 and B3) were postulated for Alternative B (see Figures 10.10-1 and 10.10-4). Corridor B1 was discarded because it would require extensive construction along the riverbank with its concomitant environmental impacts. Although corridor B3 is the shortest, it would require extensive excavation for a 30 to 40 foot trench to accommodate the gravity-flow discharge pipe. The economic and environmental costs of such excavation were determined to be sufficiently high to warrant elimination of this corridor from consideration (see Table 10.10-2). Therefore, Corridor B2 was selected as the preferred pipeline corridor.

The terrestrial impacts of construction of Corridor B2 and the pipeline corridors for Alternatives A and C were found to be generally equivalent. The corridor for Alternatives A and C approaches ecologically important trees in the old Hanford townsite. Corridor B2 does not parallel existing roadways in the townsite thereby requiring greater disruption of vegetation. However, neither factor is considered to be of overriding importance since the impacts are not expected to be significant.

Alternative B may be slightly preferable to Alternatives A and C from the standpoint of preserving cultural resources. Some prehistoric and historic remains have been detected at the proposed location of the raw water pumphouse for Alternatives A and C. Further investigations will be undertaken to evaluate the significance of these remains. A consulting archaeologist will recommend means to mitigate any adverse effects of the Project. Given these mitigation measures and the relatively high potential for discovering similar remains throughout this general area, including the pipeline corridor for Alternative B, these detected remains do not weigh greatly in favor of Alternative B.

Finally, the costs of each of the three alternatives are roughly equivalent. Although the cost estimate for Alternative C is the lowest (see Table 10.10-2), the difference between the alternatives is small and within the uncertainties associated with the cost estimates.

10.10.3 CONCLUSION 6

While marginal differences do exist among the alternatives, none of the differences are significant and the differences tend to be offsetting. Thus, each of the alternatives are generally acceptable, and none is obviously superior.

It was decided to select an intake/discharge location at RM 361.5 (e.g., Alternatives A or C), since detailed information is available for this location, whereas only reconnaissance level information exists for RM 361.0 (e.g., Alternative B). Between the two alternatives at RM 361.5, Alternative C was chosen due to the lesser amounts of in-river construction required for this alternative.

TABLE 10.10-1

COLUMBIA RIVER PARAMETERS FOR ALTERNATIVE INTAKE/DISCHARGE LOCATIONS

	Alternative A	Alternative B	Alternative C
Columbia River Mile	361.5	361.0	361.5
Distance of Intake off Benton County Shore* (ft)	750	475	600
Distance of Discharge off Benton County Shore* (ft)	550	375	550
River Depth of Intake* (ft)	15	18	15
River Depth of Discharge* (ft)	14	19	14
River Cross Section* (ft^2)	16,200	10,190	16,200
River Velocity* (fps)	2.3	3.5	2.3

*During minimum regulated flow (36,000 cfs)

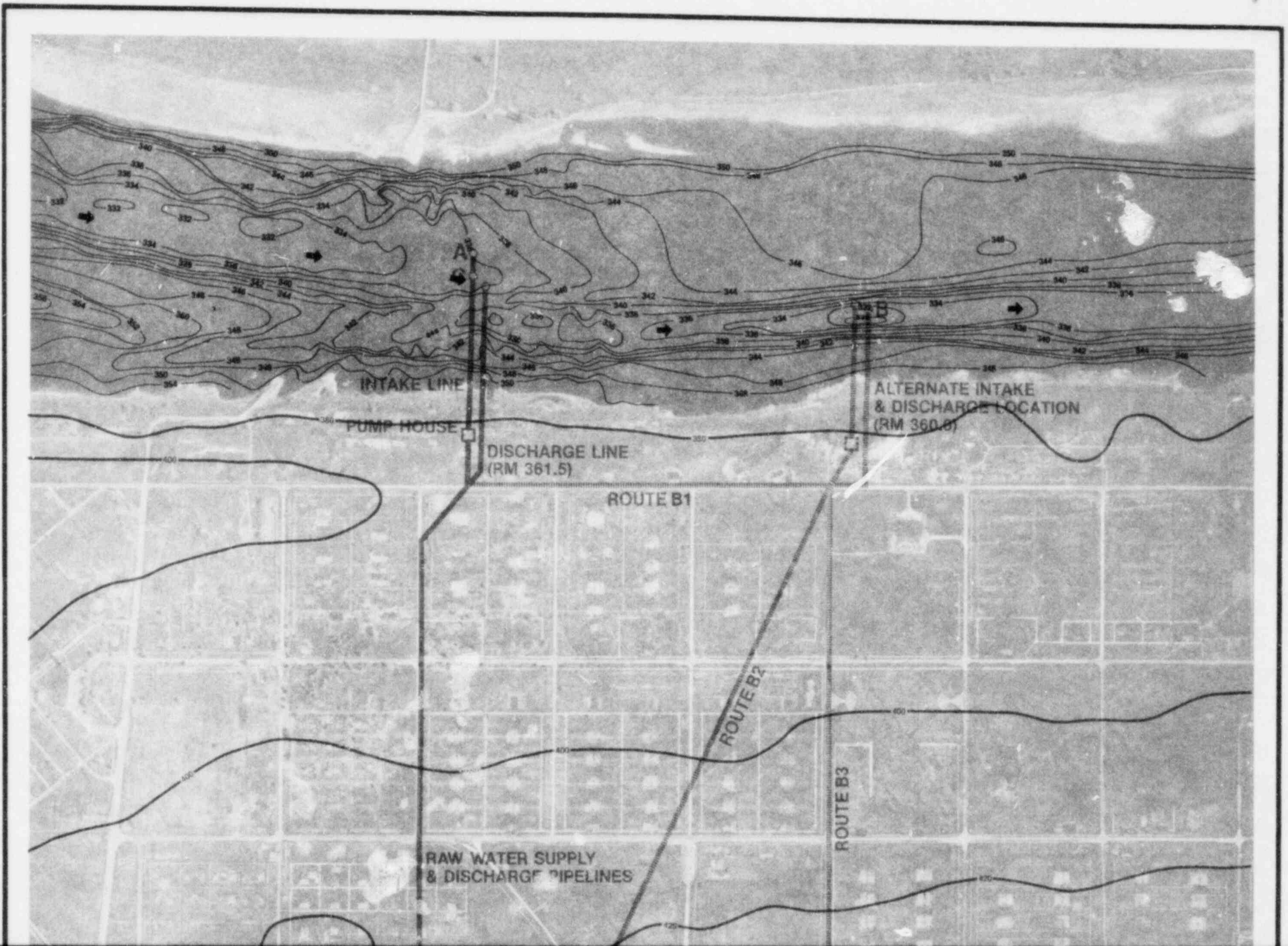
6

TABLE 10.10-2

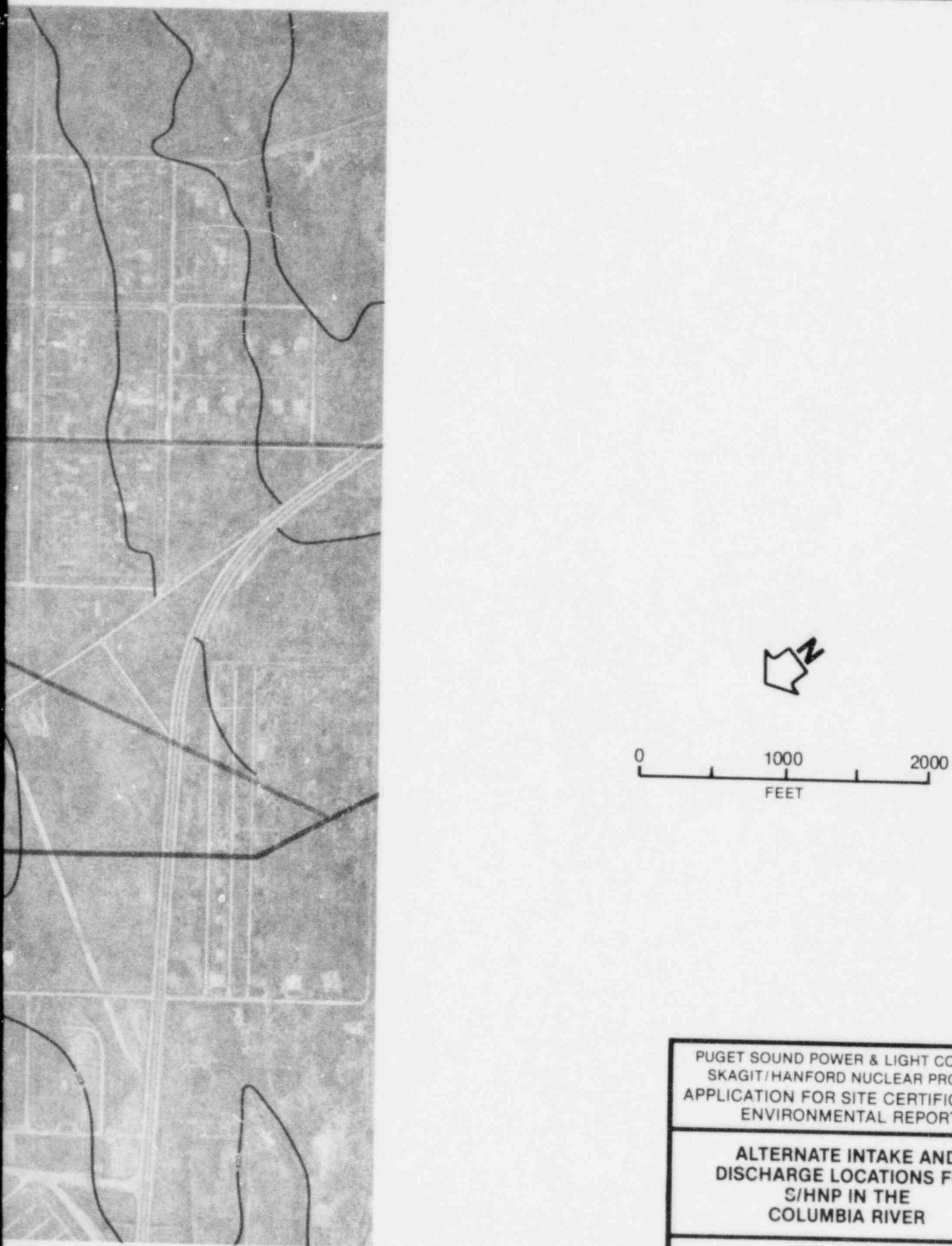
ESTIMATED COSTS FOR ALTERNATE INTAKE
AND DISCHARGE LOCATIONS

Alternate No.	Cost in Thousand Dollars		
	Construction On Land	Construction In River	Total
A	$ 5,325	$ 2,192	$ 7,517
B1	5,951	1,972	7,923
B2	5,387	1,972	7,359
B3	10,099	1,972	12,071
C	5,325	1,752	7,077

6



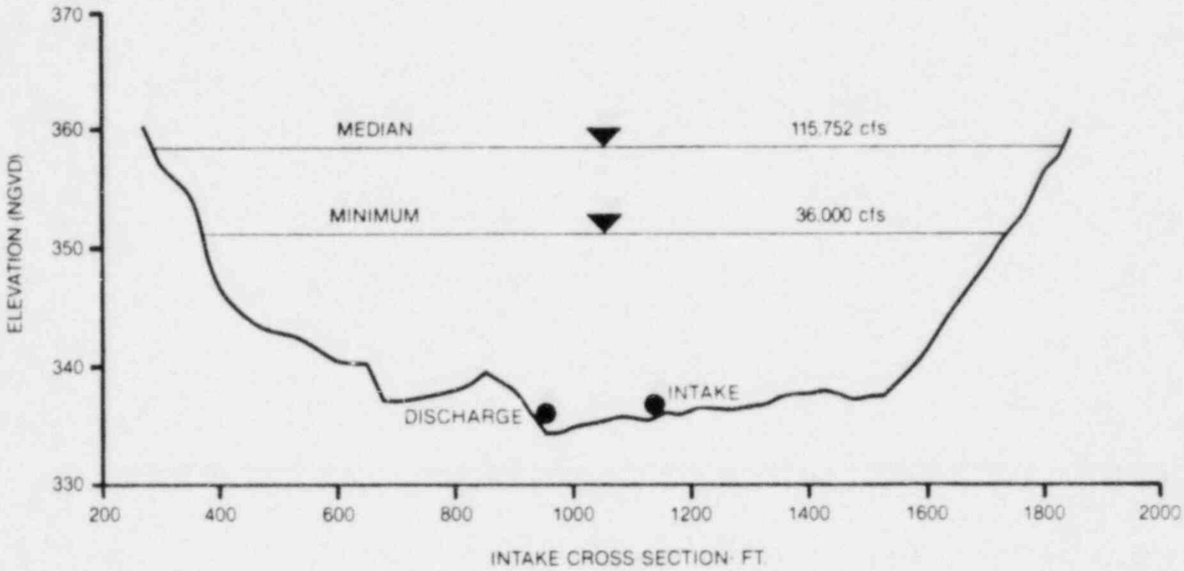
INTAKE LINE
PUMP HOUSE
DISCHARGE LINE
(RM 361.5)
ALTERNATE INTAKE
& DISCHARGE LOCATION
(RM 360.0)
ROUTE B1
ROUTE B2
ROUTE B3
RAW WATER SUPPLY
& DISCHARGE PIPELINES



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

ALTERNATE INTAKE AND DISCHARGE LOCATIONS FOR S/HNP IN THE COLUMBIA RIVER

FIGURE 10.10-1



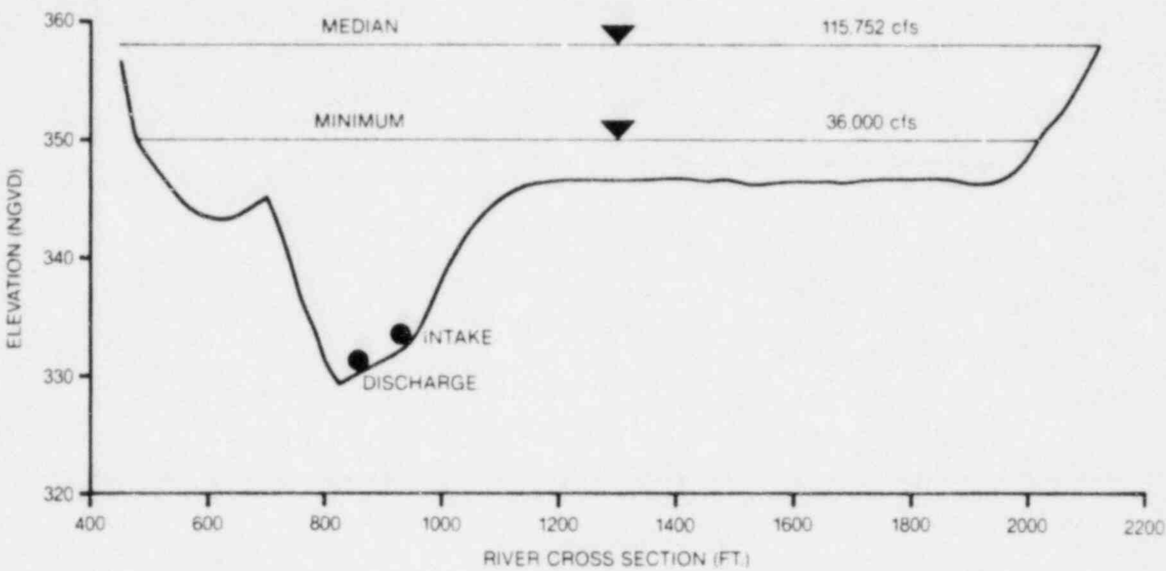
RM 361.5

LOOKING UPSTREAM

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

RIVER CROSS SECTION IN THE VICINITY OF ALTERNATE "A" INTAKE AND DISCHARGE LOCATION

FIGURE 10.10-2



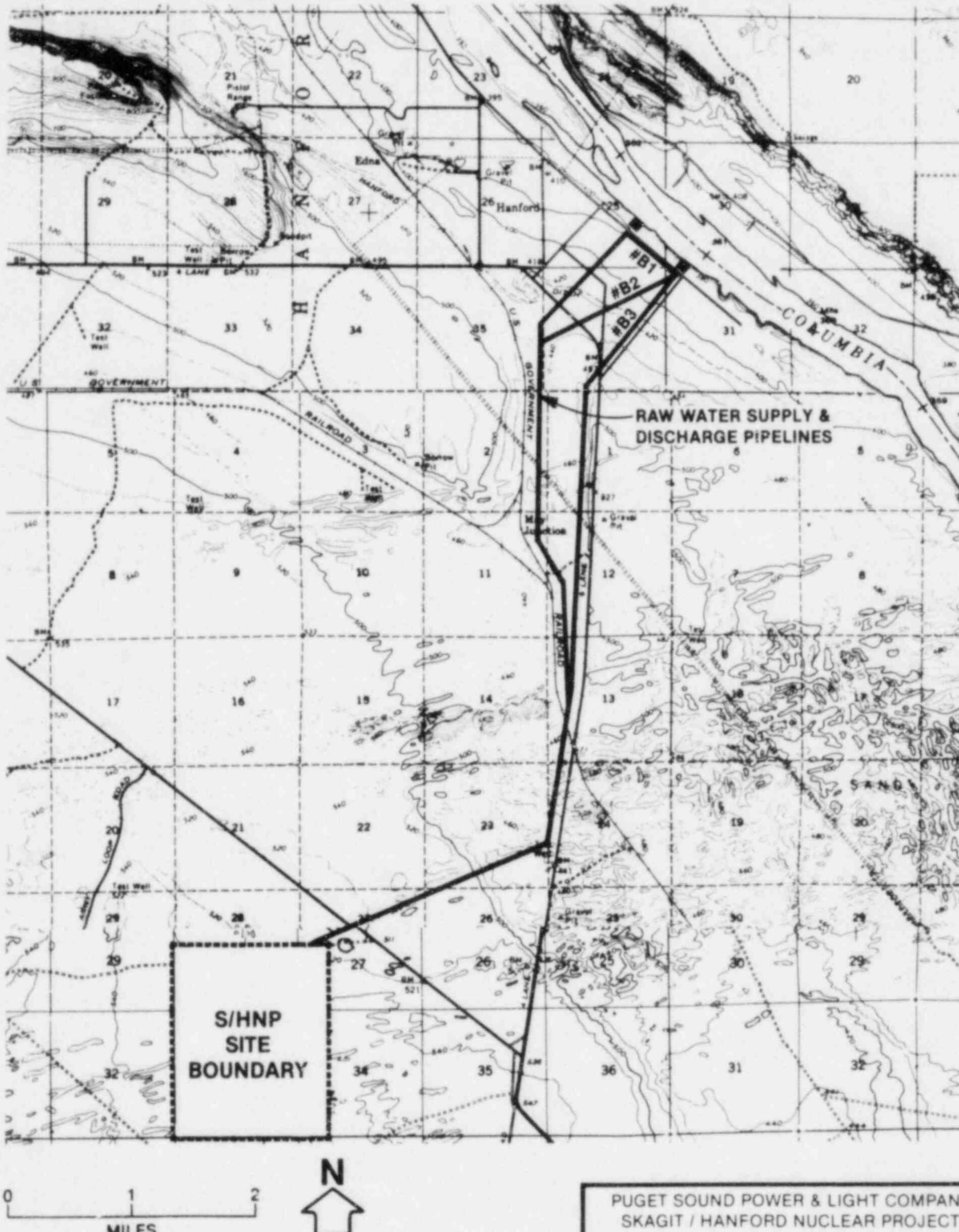
RM 361.0

LOOKING UPSTREAM

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

RIVER CROSS SECTION IN THE VICINITY OF ALTERNATE "B" INTAKE AND DISCHARGE LOCATION

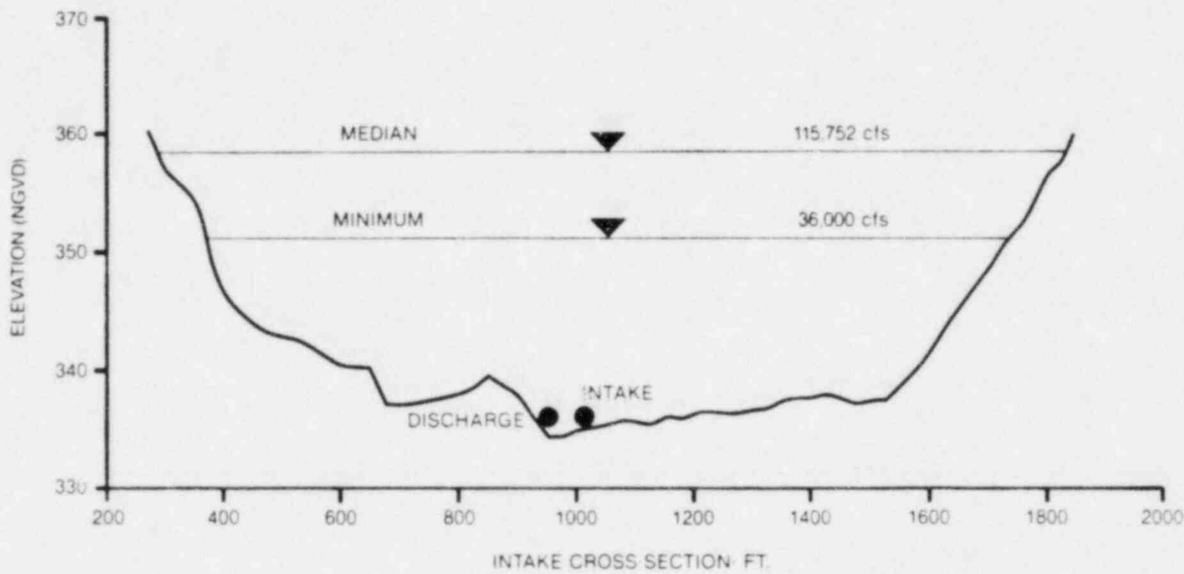
FIGURE 10.10-3



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

ALTERNATE PIPELINE CORRIDORS TO RM 361.0

FIGURE 10.10-4



RM 361.5

LOOKING UPSTREAM

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

RIVER CROSS SECTION IN THE VICINITY OF ALTERNATE "C" INTAKE AND DISCHARGE LOCATION

FIGURE 10.10-5

INTRODUCTION

A hydrographic survey was conducted and current velocity profiles were
obtained in the vicinity of the proposed intake and discharge structures at
the S/HNP Site on the Columbia River. The work was performed by Battelle 6
Northwest and Towill, Inc. from May 8 through May 11, 1981.

The purpose of this program was to provide data as input to thermal plume and radionuclide dispersion modeling to be performed by others. The bathymetric and current velocity data can also be used in the design of the intake and discharge structures, and will be applicable to the aquatic ecology studies being performed by Battelle Northwest.

A preliminary description on the intake and discharge structures is
provided in Figures 3.4-3, 3.4-4 and 4.1-8 to 4.1-9. The intake structure 6
(pumphouse) and the intake pipe(s) will be located approximately at Columbia
River RM 361.5. The length of the intake pipe(s) is approximately 600 ft,
measured from the Benton County Shore during minimum regulated flow. The 6
discharge pipe will be located 100 ft downstream from, and is parallel to,
the intake pipe. The length of the discharge pipe is approximately 550 ft
measured from the Benton County Shore during minimum regulated flow. The 6
river depth at the intake and discharge points was estimated to be about 15
ft and 14 ft respectively during minimum flows of 36,000 ft^3/sec (cfs).

DESCRIPTION OF WORK

The Instream Data Collection Program included gathering hydrographic data, collecting current velocity profiles at Columbia RM 361.5 and preparing a photo base map from aerial photography. The study site is shown on Figure 1.

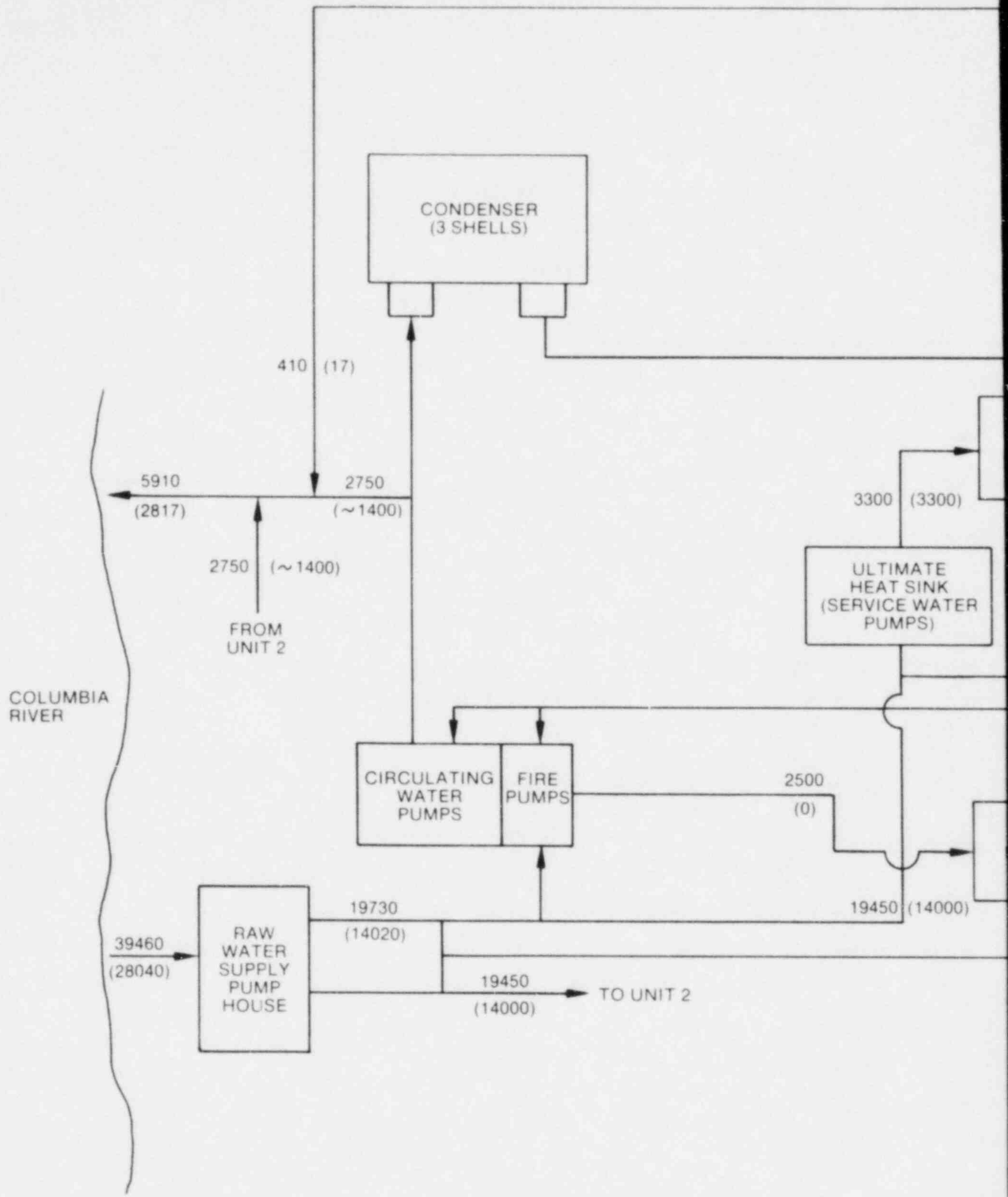
Depth profiles were surveyed at 66 river cross-sections along approximately a 2.5 mile reach of the Columbia River, extending from 2875 ft upstream of the intake-discharge location (R.M. 361.5) to 10,625 ft downstream. The cross-sections extended from the waters edge at both bank-lines. A Raytheon continuous recording fathometer was used to obtain the hydrographic data. Horizontal positioning was accomplished with a Motorola Mini-Ranger III Navigation System and data processor. A 23-ft MonArk survey vessel was used to collect the instream data.

Temporary river staff gages were installed at R.M. 361.5 and tied in vertically and horizontally with the Hanford benchmark and coordinate system. River stages were recorded at regular intervals during the collection of instream data.

A base map to a scale of one inch equals 200 ft was prepared from aerial photogrammetry. The base map was used to define the river banks, used as a base sheet for plotting hydrographic data, and used to tie in all cross-sections with the Hanford coordinate system.

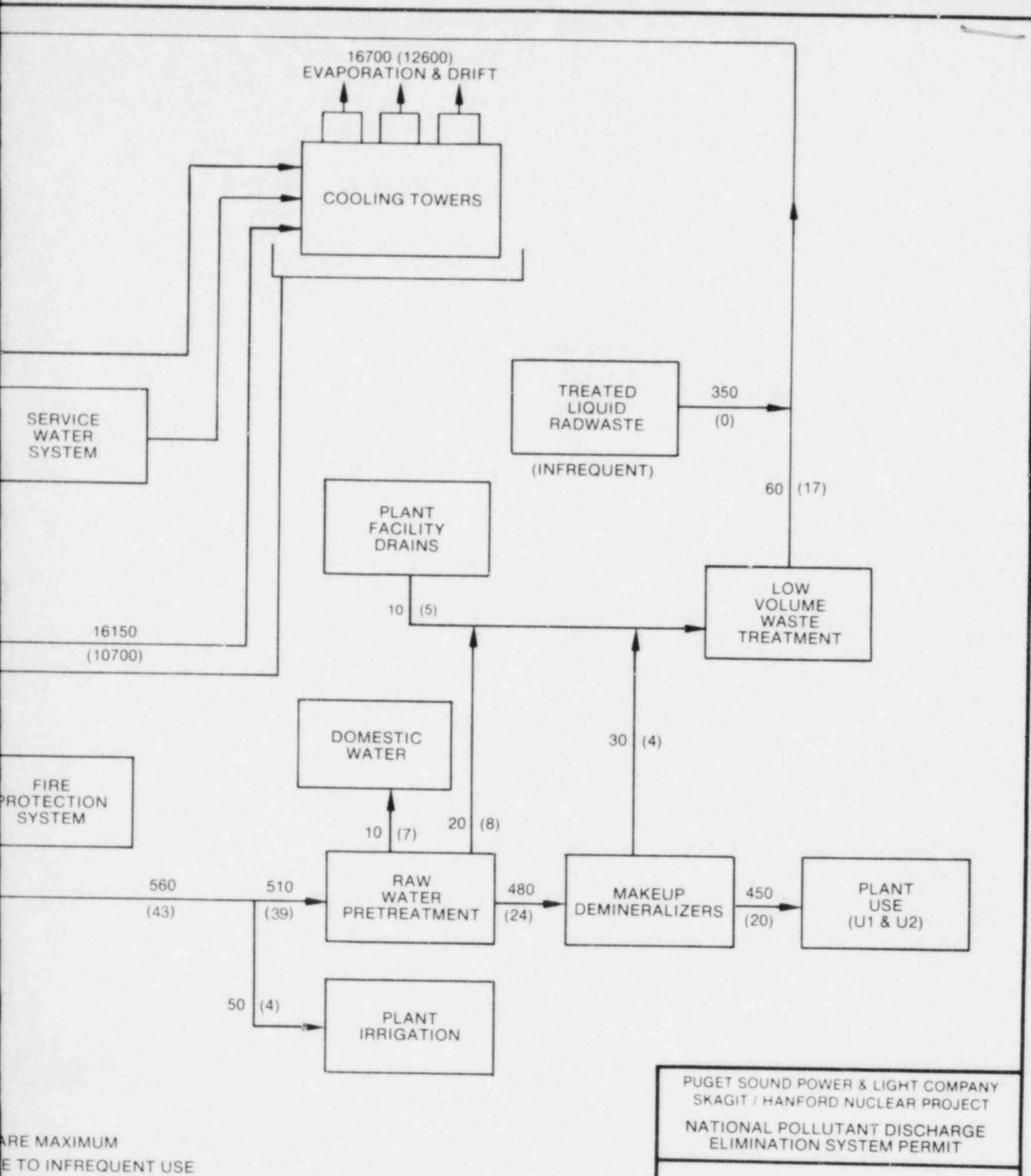
Vertical velocity profiles, using a Bendix Q-15 current meter, were obtained for the cross-section at R.M. 361.5. Current velocity measurements were taken at 10 stations along the cross-section with a minimum of 10 depth measurements at each station. The depth intervals for taking velocity measurements varied from 0.5 ft to 2.5 ft, depending on the water depth. The survey vessel was positioned on station with the Motorola Mini-Ranger III Navigation System during the current profile measurements.

A river bed contour map to a scale of one inch equals 50 ft and contour interval of two feet was prepared for a 450-ft reach of river at the intake and discharge structures. The contour map extended from river bank to river bank for the existing river stage during the survey period.



NOTES 1) ALL VALUES ARE IN GPM. VALUES IN PARENTHESIS ARE AVERAGE, OTHERS

2) FIRE PROTECTION FLOW NOT INCLUDED IN MAXIMUM RAW WATER FLOW DU

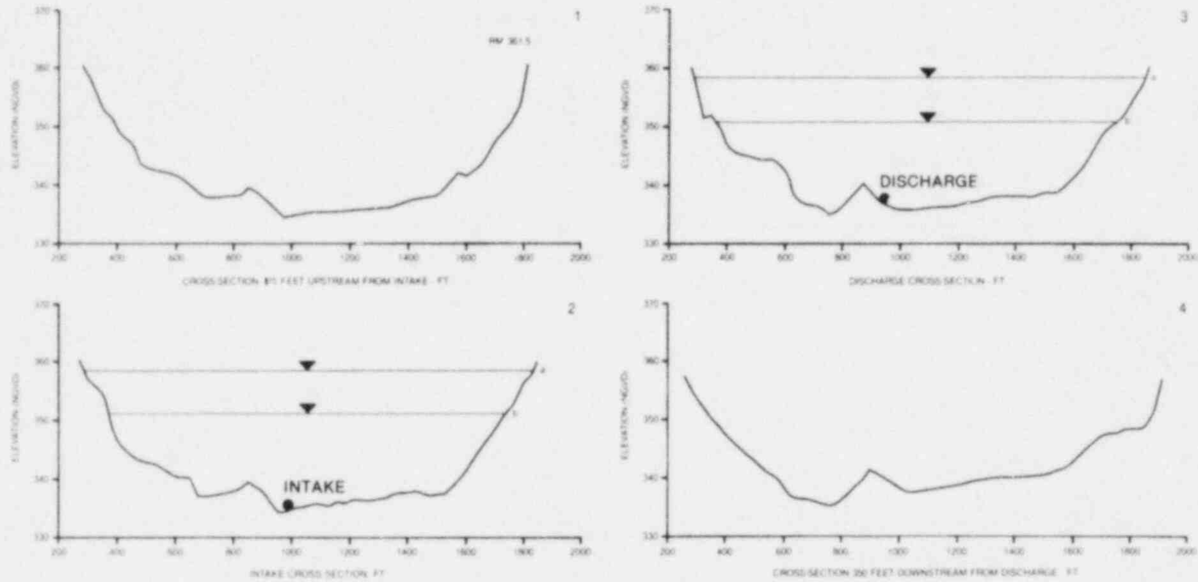


PUGET SOUND POWER & LIGHT COMPANY
SKAGIT / HANFORD NUCLEAR PROJECT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

SCHEMATIC OF WATER FLOW

FIGURE F-2



a) Regulated Average Discharge that is Equalled or Exceeded 50% of the Time -115,752 CFS.

b) Administratively Established Minimum Discharge - 36,000 CFS.

c) Cross-Sectional views looking upstream. Distances are in feet from the west bank (Benton County shoreline).

PUGET SOUND POWER & LIGHT COMPANY
SKAGIT / HANFORD NUCLEAR PROJECT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

RIVER CROSS-SECTIONS IN THE VICINITY OF THE DISCHARGE

FIGURE F-3

APPENDIX J

CORPS OF ENGINEER PERMIT APPLICATIONS

Original Applications to be deleted. Information from these Applications have been included in ASC/ER Sections 3.4 and 4.1. 6

APPENDIX K

SKAGIT/HANFORD NUCLEAR PROJECT

COLUMBIA RIVER AQUATIC ECOLOGICAL STUDIES NEAR THE SKAGIT/HANFORD NUCLEAR PROJECT: FINAL REPORT

FOREWORD

This report has been prepared for Northwest Energy Services Company by Battelle, Pacific Northwest Laboratories. The following personnel had primary responsibility for data collection, analysis and interpretation:

Staff Member	Responsibility
Dr. Thomas L. Page	Project Manager
Mr. Dennis D. Dauble	Task Leader - Fish Studies
Mr. Duane A. Neitzel	Task Leader - Benthic Studies
Mr. R. William Hanf, Jr.	Field Leader - Fish Studies
Mr. E. W. (Bill) Lusty	Field Leader - Benthic Studies
Mr. Donald C. Klopfer	Aquatic Biologist
Mr. C. Scott Abernethy	Field Support Biologist
Mr. Dennis W. Crass	Field Support Biologist
Mr. Steven A. Barraclough	Field Support Biologist

ACKNOWLEDGMENTS

We thank Carolynn Novich for her patience and dedication during organization and editing of this report. Bruce C. Mundy, Oregon State University, confirmed identification of ichthyoplankton samples. Drs. C. E. Cushing of Battelle, Pacific Northwest Laboratories, S. D. Smith of Central Washington State University, and G. W. Courtney and C. P. Hawkins of Oregon State University assisted in identification of benthic organisms. Dave W. Carlile and M. A. Simmons provided statistical assistance. Trade names are provided to assist the reader and do not necessarily represent endorsement by Northwest Energy Services Company or Battelle, Pacific Northwest Laboratories.

SUMMARY

This report contains a presentation and summary of fish and benthic data collected in the Columbia River from March 1981 through April 1982 near the proposed Skagit/Hanford Nuclear Project (S/HNP) site. The study confirmed that the fish and benthos communities at the S/HNP site (river mile 361.5) are similar to communities reported for other mid-Columbia River studies, and it also provided baseline data on community composition and temporal and spatial distribution. No unique biological communities were identified.

Conclusions of the study are:

- Twenty-nine species of fish representing 11 families were collected and identified. All species have been previously collected at Hanford. Chinook salmon were the most abundant fish species collected. Largescale sucker, peamouth, and squawfish dominated resident fish populations.
- Smallmouth bass spawning occurred in Hanford Slough in June and July. Zero-age juveniles dispersed from the slough and adjacent nearshore river sites in December.
- Caddisfly and midge fly larvae numerically dominated benthos samples. Density estimates and gravimetric measures of dry weight and organic matter were lowest in March and June and highest in September and December.
- No significant inconsistencies were noted between these data and data reported in other mid-Columbia River aquatic studies as discussed in the S/HNP Application for Site Certification/Environmental Report.

APPENDIX K

CONTENTS

APPENDIX K

FIGURES

APPENDIX K

FIGURES (contd)

FIGURES (contd)

APPENDIX K

TABLES

APPENDIX K

TABLES (contd)

COLUMBIA RIVER AQUATIC ECOLOGICAL STUDIES
NEAR THE SKAGIT/HANFORD NUCLEAR PROJECT:
FINAL REPORT

INTRODUCTION

Aquatic field studies were conducted from March 1981 to April 1982 near Columbia River mile (RM) 361.5 to provide information in support of licensing efforts for the Skagit/Hanford Nuclear Project (S/HNP 1982). The three main objectives of the studies were to 1) confirm that the major biological communities at the proposed site were similar to those identified in previous studies at Hanford [These studies are discussed in the S/HNP Application for Site Certification/Environmental Report (S/HNP 1982)]; provide baseline data on community composition and temporal and spatial distribution, and 3) identify any unique biological properties of the site that might require further investigation.

In designing the studies, consideration was given to the potential impacts of construction and operation of the S/HNP on Columbia River biota. Hence, only the fish and benthic communities were investigated, because they were the only communities for which a significant potential impact could be postulated. Previous studies (Page et al. 1976; Gray et al. 1977; Page and Hulsizer 1979; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980) indicated that the S/HNP would not significantly affect phytoplankton and zooplankton communities.

FISH STUDIES

Field studies involving fish sampling were initiated in March 1981. Objectives of the fish sampling program were to provide baseline data on community composition, seasonal and spatial abundance, movements, and life history aspects of fish species in the main Columbia River and backwater areas near river mile (RM) 361.5. Methods were chosen to be comparable with previous aquatic ecological studies in the Columbia River at Hanford (Page et al. 1976; Gray et al. 1977; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980). Data collected in this study, however, are not always directly comparable with data from previous studies because of differences in sampling location, duration of study, and sampling gear.

METHODS AND MATERIALS

Ecological Description

Permanent sample stations were established to characterize fish populations in Hanford Slough and the main Columbia River near the proposed S/HNP intake and discharge sites (Figure 1). Sampling frequency generally coincided with periods of peak migration and residence of juvenile fall chinook, and with periods of resident fish spawning and emergence (Table 1). River and slough stations were selected to encompass a variety of habitat types; however, discrete habitat characterization was not always possible for each fish species because bottom type, shoreline cover, current, and bank slope changed seasonally for all stations due to changing river flows. A variety of methods were used to assess seasonal abundance and importance of various fish groups. Gear types were similar to previous aquatic ecological studies in the Columbia River at Hanford (Page et al. 1976; Gray et al. 1977; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980) except that gill and trammel nets were not used. Specific gear methodology for this study is outlined below.

Beach Seine

Duplicate seine hauls were made within the boundaries of each 30-meter shoreline station using a 9.1 x 1.2 meter (30 x 4 foot) net with 3-mm

(1/8-inch) mesh. Four permanent river stations and three slough stations were sampled. In addition, extra sets with a 18.2 x 1.2 meter (60 x 4 foot) net with 6-mm (1/4-inch) mesh were made at the mouth of Hanford Slough and in the river in July 1981 to assess the presence of chinook salmon smolts that were released from upstream hatcheries. Catch per unit effort (C/UE) is given as number of fish per seine haul.

Ichthyoplankton

Duplicate samples of 5 and 15 minutes duration were taken at the surface and within 1 meter of the bottom at a single midchannel station (Figure 1). Sampling was conducted twice each month from April to September 1981 and in March and April 1982. Paired 550-μm mesh ichthyoplankton nets, each 30 cm in diameter and 1 meter long, were lowered from a stationary boat. A General Oceanics Model 2030 flowmeter was attached to the mouth of each net. Sample volume was calculated from the difference in calibrated flowmeter readings prior to and at the end of each sample period. Catch per unit effort was calculated as the number of fish per cubic meter of water sampled.

Hoop Nets

Hoop nets consisted of two 3.0-meter-long tunnels with 0.6-meter diameter mouth openings that were connected by a 6.1-meter-long by 0.6-meter-high wing net. Mesh size for all netting was 13 mm (1/2 inch). Hoop nets were set parallel to the current within 5 meters of the shoreline in 1- to 2-meter depths. Weights were attached to the tunnel throats and lead bricks were placed at the cod end of each tunnel. A float was attached to the retrieval line at the downstream end of the hoop net. Four permanent stations were fished overnight (about 18 hours) at monthly intervals in the main river from May through October. Catch per unit effort is given as number of fish per overnight set.

Backpack Electroshocking

Electroshocking was conducted in the river and slough using a Smith-Root Type VII Electrofisher. The two river stations encompassed the same shoreline as two of the river beach seine stations. Three additional stations were sampled near or within Hanford Slough. One slough station encompassed the same shoreline area as a beach seine station. At each site, a single 50-meter-long transect was sampled at depths less than 1 meter. One person operated the shocker unit while the other netted stunned fish. All captured fish were identified and enumerated. Numbers and species observed but not captured were recorded using a hand-held tape recorder. Data were then transcribed in the laboratory. Catch per unit effort is given as shocking time (timer units) to complete a transect.

Boat Shocker

A boat-mounted electroshocker unit (Smith-Root Type VI Electrofisher) powered by a 240 volt generator was used to sample nearshore adult fish populations in two river transects and one slough transect once monthly during daylight hours from April 1981 through March 1982. The two river transects were sampled during the day and again that same night from April 1981 through October 1981. A single pass was conducted through each 500-meter station, and sample depths were restricted from 1 to 3 meters. Stunned fish were dipnetted and placed in a circulating, water-filled holding tank on the boat. Numbers and size of all collected fish were recorded. All live resident species larger than 20 cm fork length (FL) were tagged with individually coded Floy dart tags and released. Catch per unit effort is given as shocking time (timer units) to complete a transect.

Sample Collection

All resident fish greater than 10 cm FL were identified, measured, and released in the field. Resident fish greater than 20 cm FL were tagged with coded Floy tags prior to their release. When large sample sizes of juvenile resident fish occurred in beach seine catches, the total catch was counted. A known subsample was then preserved in formalin and taken to the laboratory for identification. Numbers of identified fish were extrapolated to provide species composition estimates for the entire catch. Juvenile salmonids were identified in the field and enumerated. All salmonids greater than 10 cm FL were measured and released. A subsample of 0-age fall chinook fry (5 to 20 fish per station) was measured and released in the field. In addition, another representative sample was preserved in formalin and retained for laboratory measurements. When mortalities occurred in boat electroshocker samples, fish were measured and returned to the laboratory for incineration.

Slough Surveys

In addition to the regular sampling program that described species composition and use of Hanford Slough by resident and anadromous fish populations, routine surveys were conducted to assess the importance of the slough to smallmouth and largemouth bass. Shoreline surveys were conducted with the boat electroshocker to document areas preferred by adult bass. No attempt was made to quantify abundance of other species during these surveys; however, species captured are listed in Table 2. Surveys for bass spawning activity were conducted in May, June, and July by SCUBA. Nest sites were mapped and bottom type and depth were described. Relative numbers and timing of fry emergence were determined by seining, backpack electroshocking, and by shoreline observations. Following bass fry emergence in July, shoreline surveys were conducted to determine habitat selection and growth of 0-age bass populations. In November 1981, slough surveys were conducted along the southwest shoreline of Hanford Slough to assess movement and overwinter residence of juvenile bass populations. These studies were coordinated with river surveys in the adjacent Columbia River.

River Surveys

Surveys of juvenile bass populations in the Columbia River adjacent to Hanford Slough were initiated in November 1981 in conjunction with winter slough surveys. Objectives were to identify habitat use and movement of 0-age bass during the winter months. Designated river sample areas were characterized by large cobble and boulders out of the main current and were located along the Benton County Shoreline from Columbia River mile 361.7 to 361.6. Although 0-age bass were only captured by backpack electroshocker, supplemental sampling was also conducted with boat electroshocker and hoop nets in January and February 1982. Bass were measured, tagged with individually coded Floy fry tags, and released in the area in which they were captured. Tagging was limited to fish greater than 50 mm FL. Subsequent sampling was conducted in the river and slough to assess residence, movement, and growth of tagged bass within the study area

RESULTS AND DISCUSSION

Relative Abundance and Distribution

Twenty-nine species of fish representing 11 families were collected in the study area from March 1981 through April 1982 (Table 2). Several species [e.g., chiselmouth (Acrocheilus alutaceus), mountain whitefish (Prosopium williamsoni), Dolly Varden (Salvelinus malma) and white sturgeon (Acipenser transmontanus)] were collected only in the main Columbia River. Sampling gear was diverse enough to capture most species at several life stages (Table 2).

The dominant fish species collected was chinook salmon, Oncorhynchus tshawytscha (Table 3). Chinook salmon comprised 45 percent of the total catch (all methods combined). Zero-age wild fall chinook comprised the majority of the catch, although hatchery-reared chinook smolts were also abundant in the study area following upstream hatchery releases. Other common species, in order of decreasing abundance, were squawfish (Ptychocheilus oregonensis), peamouth (Mylocheilus caurinus), and largescale sucker (Catostomus macrocheilus). Other species were collected less frequently. Nine species were represented by less than 10 individuals.

Different types of gear were selective for different species and sizes of fish. Hoop nets captured a wide range of species of all sizes. Numbers were generally low but catches included some species not captured in the river by electrofishing. Hoop net catches were dominated by cyprinids, followed by catostomids, and centrarchids (Table 4).

Beach seine catch totals reflected shore-oriented sampling. Zero-age chinook and resident juveniles dominated catches in both the river and slough (Tables 5 and 6, respectively). Juvenile cyprinids were also seined in large numbers, primarily from July through September. Slough beach seine catches were more diverse than river catches. Fifteen species were captured by seining in the slough; only 12 species were captured in river stations.

Seventeen fish species were captured by backpack electroshocker in both the Columbia River stations (Table 7) and Hanford Slough stations (Table 8). River and slough station catches were dominated by juvenile cyprinids (principally squawfish and peamouth) and catostomids. Sculpins were also abundant in river samples. Chinook salmon fry were important components of the catch only during April and May. Juvenile centrarchids were collected mainly in Hanford slough.

Five species of fish were captured in midchannel ichthyoplankton tows (Table 9). Peak abundance occurred in May and June 1981. About 95 percent of the fish captured were prickly sculpin (Cottus asper). Two shad larvae (Alosa sapidissima) and a single carp larvae (Cyprinus carpio) were also identified in ichthyoplankton samples. Two chinook fry (40 and 42 mm FL) were captured in bottom tows in April. Spatial distribution of larval fish collected at midstream was similar (Figure 2), and no significant difference ($\alpha = 0.05$) was noted between catches obtained at surface versus bottom tows. No ichthyoplankton were collected in March or April 1982.

Sixteen species of fish, mainly adults, were collected in river stations by the boat-mounted electroshocker (day and night totals combined). Largescale sucker (Catostomus macrocheilus) and bridgelip sucker (C. columbianus) dominated catches, comprising 81 percent of the totals (Table 10). Principal species captured in the slough (day sampling only) included carp and smallmouth bass, which together comprised 27 percent of the total (Table 11). Largemouth bass, brown bullhead (Ictalurus nebulosus), yellow perch (Perca flavescens) and pumpkinseed sunfish (Lepomis gibbosus) were collected by boat electroshocker only in the slough transect. Catch per unit effort (C/UE) at boat electroshock stations for all species combined is presented in Figure 3. Catch per unit effort for the two river transects were similar. Night catches in the river always exceeded those obtained during the day, with C/UE usually four to five times greater at night. Daytime C/UE for the single slough transect was usually about half that obtained in the river transects during the day. Catch per unit effort varied seasonally, and trends were similar for all transects. Distinct C/UE peaks were noted in June and September; wintertime catches were low in all areas. Table 12 presents seasonal measurements of water clarity, temperature, and flow, and their relationship to C/UE. Numbers of fish collected were generally greatest at higher water temperatures. Water clarity had no effect on night C/UE; however, daytime C/UE was usually highest when secchi disc depths were near or below 200 cm. There was no apparent relationship between average daily flow and boat electroshocking C/UE.

Mark-Recapture Studies of Adult Resident Fish

During all field collections, resident fish greater than 20 cm FL were tagged with individually coded Floy dart tags. Fish collected in slough surveys were also tagged whenever possible; thus, species tag totals in Table 13 may differ from those noted in Table 3. Most adult fish were collected with the boat-mounted electroshocker, and species totals reflect selective capture by this method. Largescale suckers represented 67 percent of the tag totals and 88 percent of the returns. All but three tags were recovered within the study area. A mountain whitefish (Prosopium williamsoni) was caught by a fisherman approximately 3 miles upstream. A black crappie (Promoxis nigromaculatus) and a carp were caught by fishermen about 20 miles downstream, near the Richland Yacht Club. We captured a largescale sucker in October 1981 that was tagged in July 1977 as part of a study at the Washington Public Power Supply System's Nuclear Projects 1, 2 and 4 near Columbia River mile 352 (Gray and Page 1979a). Only 7 of the 77 recaptured sucker were captured outside of their original transects.

Monthly tag totals were greatest from April through October, when electroshocking was conducted during the day and at night (Table 14). Recapture totals include four fish captured twice. Recovery of tagged fish increased according to duration of time in study area. Of the 449 fish tagged in April and May, over 7 percent were recaptured. This compares to 3.3 percent recapture for fish tagged from June through September. Most fish (65 percent) were captured witnin the first 100 days following initial tag and release (Figure 4). The decline in recaptures may be due to decreased collections during the latter part of the study period and/or to seasonal movement of fish out of the study area.

In October 1981 and again in April 1982, shoreline areas were sampled on both sides of the Columbia River from about RM 360 to 363 with the boat electroshocker at night in attempts to locate tagged fish within the general study area. We examined approximately 1000 fish in October and recovered 13 tagged fish. All recovered tags were on largescale suckers and 10 of the recapteres occurred within permanent river electroshocker transects. A final overall survey in April resulted in capture of 509 fish (>90 percent largescale suckers) and 3 tag recoveries. Overall recovery of tagged fish during the course of the study was 4.3 percent (Table 13). Largescale suckers were the only species in which more than two recaptures were made.

Use of Hanford Slough and Adjacent River Areas by Bass

Adult Spawning

Surveys for smallmouth bass and largemouth bass spawning activity were conducted in Hanford Slough, beginning in April 1981. Initially, the entire slough shoreline perimeter was sampled with the boat-mounted electroshocker to document areas of adult bass abundance. These locations were mapped and first surveyed on May 8, 1981, by SCUBA in an attempt to locate active nest sites. Water temperatures ranged from 12° to 13°C. Active nest sites (i.e., nests which exhibited recent fanning of bottom substrate by adult bass) were located. Most sites were located principally over mixed cobble and gravel near a submerged boulder pile (Figure 5a). Although these areas had been recently disturbed, no eggs were found. Several areas were found with periphyton growth on an old bottom disturbance, possibly indicating recently abandoned nests. Active nest sites were found in 2- to 4-meter depths and occurred 10 to 50 meters offshore.

A second SCUBA bottom survey conducted on June 5, 1981, coincided with peak river flows (250,000 cfs). Water depths were up nearly 2 vertical meters compared to the previous survey, and the upper portion of the slough was connected to the main river channel (Figure 5a). Water temperature was 15°C. Again, although active nest sites were located, there was no evidence of spawning. Nest sites were observed in depths ranging from 3 to 6 meters.

Spawning surveys on June 19, 1981, were concentrated near a series of boulder piles at the downstream end of the inundated slough. Water temperatures remained near 14° to 15°C. Nesting activity was noted in areas of exposed cobble and coarse sand. Physical measurements were made on 10 active nest sites and indicated a wide variation in substrate. Average substrate composition of nest sites consisted of mud, 27%; sand/gravel <1 cm

10%; cobble = 1-5 cm, 21%; cobble = 5-15 cm, 29%; and boulders >25 cm, 14%. Water depths at the nest sites ranged from 3 to 5 meters, and nests were located a mean distance of 22 ± 12 meters (n = 19) from the shoreline. Mean maximum nest width was 48 ± 15 cm by 8 ± 2 cm deep. Two nests contained eggs; one had an estimated 6000 eyed eggs, and the other an estimated 11,000 uneyed eggs. An adult smallmouth bass pair was observed near an active nest with no eggs.

Bass were observed guarding nests in the lower portion of the slough during a SCUBA survey on July 2, 1981, but nest sites could not be relocated because of reduced visibility. Bottom temperatures were 15.5°C and surface temperatures were near 18°C. Water levels had receded nearly 2 vertical meters since the previous SCUBA survey and were similar to mid-May levels. No evidence of bass spawning activity was noted in the extreme upper end of the slough in the final SCUBA survey, which was made on July 17, 1981.

Bass spawning in the upper portion of Hanford Slough may be limited due to mud and silt deposits over the cobble. Distribution of smallmouth bass nests in the lower end of the slough (Figure 5a) appeared to be influenced primarily by availability of suitable cover rather than by depth or substrate. Spawning occurred primarily around submerged boulder piles or cobble shelves. Nest depth and distance from shoreline were probably a factor of rising water levels.

Fry Emergence

Shoreline surveys were conducted in Hanford Slough from June through September to document timing of bass emergence and relative numbers. The first largemouth bass fry (30 mm FL)) was collected in the extreme upper end of the slough in inundated reed canary grass on June 25, 1981. Smallmouth bass fry were first observed in nearshore areas of upper Hanford slough on July 10, 1981, in dense localized schools. Mean size of the fish was 11 mm total length (n = 21). Based on smallmouth bass phenology discussed in Vogele (1981), SCUBA observations in mid-June probably coincided with time of first spawning. Areas of initial bass fry abundance are shown in Figure 5a. Some bass were observed over cobble substrate near the edge of submerged vegetation;

however, typical habitats in July were shallow sloping shorelines over mud bottom. Bass fry were usually within 1 meter of the shore in depths of less than 10 cm. A total of 197 bass fry were counted along an estimated 900 meters of shoreline in late July.

By late August, bass fry had dispersed along the entire slough shoreline except at the extreme upper northeast shoreline (Figure 5b). A total of 1318 0-age bass were enumerated along the slough shoreline (~1800 meters) on August 28, 1981. Relative densities were reduced near the slough edges or as river current influence increased.

The Hanford Slough perimeter was again sampled in late September 1981 with a backpack electroshocker. In contrast to the August survey, no bass were observed on the entire northeast shoreline. This area was characterized by a shallow sloping bank with silt overlying cobble substrate. At low water levels, nearshore cover was generally lacking and limited to isolated, sparse bunches of emergents such as willows and rushes (Figure 6a). Both smallmouth and largemouth bass were collected along the southwest shoreline. This shoreline was characterized largely by steep banks sloping to a 5- to 6-meter-wide cobble shelf. At low water levels, cover was provided by cobble and boulders ranging from 10 to 50 cm in diameter (Figure 6b). Bass fry numbers were reduced over areas of silt and mud. Largemouth bass were collected in limited numbers along the southwest shoreline. No largemouth bass fry were collected at the extreme lower end of the slough or adjacent river area. Of the 123 bass fry identified, 94 percent were smallmouth bass. Mean size of smallmouth bass on September 30, 1981, was 59 ± 10 mm FL (n = 90). Largemouth bass were larger, averaging 76 ± 7 mm FL (n = 5).

Other fish species collected in similar habitat as 0-age bass included pumpkinseed fry and prickly sculpin adults. Three-spined stickleback (<u>Gasterosteus aculeatus</u>), juvenile squawfish, and peamouth dominated shallow, open nearshore areas lacking in bass.

<u>Juvenile Residence</u>

Shoreline surveys of 0-age bass populations were resumed in early November 1981 to assess relative abundance and overwinter residence of bass in

Hanford Slough and adjacent river. The slough shoreline perimeter was sampled with a backpack electroshocker in early November 1981, and 180 juvenile bass were observed or collected. Forty largemouth bass ranging from 61 to 131 mm FL ($\bar{x} = 86 \pm 16$ mm) and 105 smallmouth bass ranging from 44 to 85 mm FL ($\bar{x} = 59 \pm 13$ mm) were tagged with numbered Floy fry tags and released near the original capture site.

Three river locations were also sampled in November 1981 on the Benton County Shoreline. These areas were characterized by the presence of large cobble and boulders ranging in size to over 1 meter in diameter, steep bank slope, and little current. Thirty-eight smallmouth bass, ranging from 46 to 88 mm FL, were collected and tagged. Only one 0-age largemouth bass was collected in the river stations.

A large boulder pile on the southwest shoreline of Hanford Slough was exposed due to receeding river flows, and was sampled on November 11, 1981. A total of 70 bass were observed in about 100 meters of shoreline. Smallmouth bass ($n = 61$) ranged from 38 to 83 mm FL and averaged 66 ± 13 mm in length. Largemouth bass ($n = 9$) were larger, ranging from 68 to 142 mm in length. On that same date, the upper end of Hanford Slough was surveyed for the presence of fish that had been tagged 7 days earlier, on November 4, 1982. A total of 55 smallmouth bass were collected and 11 (20 percent) had tags. Twenty-two largemouth bass were collected and 4 (18 percent) were tagged. All fish were within 40 meters of their initial release site.

Subsequent sampling in the river and slough in December and January was somewhat limited by ice in the slough and by high flows. Water levels remained near the edge of the shoreline vegetation and inundated the cobble shelf and boulder pile habitat in which juvenile bass had been collected during September and November. In early December, numbers of both smallmouth and largemouth bass collected in the slough declined dramatically (Figure 7). The only juvenile bass found in the slough were collected near pockets of cobble with wide interspaces and at about 1 meter depth. Similar habitat in shallower water contained only peamouth. Juvenile smallmouth bass were still abundant in the river stations in December. Four fish initially tagged in November were recovered in December. A single recovery was made in January of a juvenile bass tagged in December.

From January through March, offshore sampling was also conducted with boat electroshocker and hoop nets to determine if reduced backpack electroshocker C/UE was related to gear selectivity. No 0-age bass were observed or collected during this time by these methods. The decline in numbers suggests general movement out of Hanford Slough by early December and dispersal from adjacent river areas by early January. Overall recovery of tagged smallmouth bass was similar for both river and slough areas. Largemouth bass were recovered in higher percentages than were smallmouth bass (Table 15).

Descriptions of Fish Species

Certain fish species are considered important because of their commercial or sport value. Anadromous species such as salmon and steelhead trout and resident species such as smallmouth and largemouth bass are included in these categories. In addition, other resident fish groups are ecologically important because of their abundance. Fish species are organized by family and are discussed in order of observed numerical abundance within the study area. Summary data for some species complement data included in previous sections of this report.

Salmonidae

Chinook Salmon (Oncorhynchus tshawytscha). Juvenile chinook salmon, principally 0-age fall chinook fry, were collected near RM 361.5 from March through October 1981 and again in March 1982. Chinook salmon were collected by all sampling gear and in greater numbers than any other species. Approximately 97 percent of the chinook salmon were collected in nearshore areas by seining. However, the collection of two buttoned-up chinook fry in bottom ichthyoplankton tows in April indicates that the species was not entirely restricted to shoreline areas following emergence from redds. Trends in beach seine C/UE for river and slough stations are shown in Figures 8 and 9. Zero-age chinook salmon fry were present in the study area when sampling was initiated in mid-March 1981. Peak C/UE occurred in May when fish averaged 46 mm FL. Fall chinook fry were generally absent from the study area by early July 1981. Fewer numbers of fall chinook fry were collected in

March 1982 than in March 1981. Lower C/UE in 1982 may have been due to later emergence or to reduced sampling efficiency because of high river flows.

Length-frequency histograms for captured chinook salmon fry are shown in Figures 10 and 11. Patterns of fish size over time were similar in the slough and adjacent river in all sample periods from March through June 1981. The presence of chinook salmon fry less than 40 mm FL indicates that emergence occurred through early June 1981. Seasonal trends in size and abundance of 0-age fall chinook salmon near the study site were consistent with previous studies in the Hanford Reach (Becker 1973; Page et al. 1976; Gray et al. 1977; Gray and Page 1978, 1979a, 1979b; Beak 1980.)

Chinook caught in June and July reflect, in part, the presence of hatchery fish released from Priest Rapids Dam (PRD). Juvenile chinook from the June 23 PRD release were collected by seining in Hanford Slough from July 1 through 15, and in the river by boat-mounted electroshocker as late as July 22, 1981. Sizes of hatchery fish ranged from 42 to 110 mm, and overlapped with sizes of wild fish still present near the study area. Because only 200,000 (5 percent) of the four million juvenile salmon planned for release were marked (adipose clip), it was not always possible to separate hatchery fish from wild fish in the field. Five of 231 juvenile chinook salmon (2 percent) collected by all methods in July had adipose clips. Large numbers of hatchery-reared chinook salmon were collected in Hanford Slough following their release, suggesting possible selection of backwater environments during initial downstream migration. Catches of juvenile chinook salmon, 66 to 94 mm FL, were greater in nearshore slough areas as compared to nearshore main river areas in July.

Length-weight relationships were determined for 251 zero-age chinook salmon ranging from 36 to 88 mm FL. The relationship is described by the regression equation:

$$\ln \text{weight} = -(13.41 \pm 0.10) + (3.50 \pm 0.03) \ln \text{length}$$

This relationship is almost identical to an earlier study obtained for juvenile fall chinook in 1976 near WNP 1, 2, and 4 (Gray and Page 1978).

Three adult spring chinook salmon were observed in the study area along both shorelines in May and June. A female (83 cm FL) with an adipose clip was captured by boat electroshocker on May 20, 1981. A single adult fall chinook salmon (35 cm FL) was collected in late October.

Mountain Whitefish (Prosopium williamsoni). Mountain whitefish were collected from April through December, primarily by boat electroshocker (Table 3). Boat electroshocker C/UE was greatest in April, declined in early summer, and increased again in October (Figure 12). Because whitefish spawn in the Hanford Reach from November through January (Page et al. 1976; Gray et al. 1977; Gray and Page 1977, 1979a), the C/UE peaks may reflect seasonal movements relating to spawning activity. Trends in night and daytime C/UE were similar, and night catches exceeded day catches in all sample periods.

Length-frequency of whitefish caught by boat electroshocker is shown in Figure 13. Juveniles less than 20 cm FL were absent from these catches. Average size of most fish was between 30 and 35 cm FL. Two tagged whitefish, or 3.3 percent of those tagged, were recaptured during the study period. One fish tagged in April 1981 was caught in September 1981 by a fisherman approximately 3 miles upstream of the study site. Another whitefish tagged in April was recaptured in May within the same boat electroshocker transect. A single fry (11 mm FL) was collected by beach seine in the river on April 21, 1981.

Other Salmonids. Only two sockeye salmon (O. nerka) were collected. A single juvenile, 61 mm FL, was seined in Hanford Slough on June 10, 1981. An adult, 46 cm FL, was captured in the river during night electroshocking in late July. Despite upstream hatchery releases, no coho salmon (O. kisutch) smolts were collected in the study area. Adult steelhead trout (Salmo gairdneri) were observed while electroshocking in September. No 0-age steelhead (rainbow) trout fry were observed or collected in the study area. An adult Dolly Varden (Salvelinus malma), 25 cm FL, was collected at night by boat electroshocker during the final tag recapture survey in April 1982.

Cyprinidae

Northern Squawfish (Ptychocheilus oregonensis). Squawfish were collected throughout the year and with all gear except ichthyoplankton nets. Squawfish were the second most abundant species collected in the study area (Table 3). Juvenile squawfish were mainly captured by backpack electroshocker and seining within nearshore areas in the main river and Hanford Slough. Peak C/UE by seine occurred following fry emergence in late August. At that time, C/UE in slough stations was about twice that obtained in river stations (Figure 14). Numbers of juvenile squawfish captured in nearshore river transects by backpack electroshocker were highest in November (Table 7).

Adult squawfish were only captured by boat electroshocker from April through October 1981, with peak catches in June through August (Figure 15). Seasonal length-frequency plots for squawfish captured by boat electroshocker are given in Figure 16. Although squawfish up to 50 cm FL were collected, most ranged from 25 to 35 cm FL. Two tagged squawfish (3.8 percent of total tagged) were recaptured after 111 and 164 days at large, respectively. One had moved from RM 361.6 on the Benton County shoreline into Hanford Slough, and the other was captured by a fisherman at Ringold approximately 6 miles downstream of the study site.

Peamouth Chub (Mylocheilus caurinus). Peamouth were collected throughout the year and with all gear except ichthyoplankton nets. Peamouth were the third most abundant species collected in the study area (Table 3). Beach seine catches accounted for 95 percent of the totals. Peak C/UE of peamouth occurred in early August and coincided with fry emergence (Figure 17). At this time, C/UE in the slough stations was nearly seven times greater than C/UEs in river stations. Peamouth fry were present in the slough and river 2 to 4 weeks sooner than squawfish and redside shiner fry, which reflects earlier spawning. Juvenile peamouth were collected in nearshore transects by backpack electroshocker from April through November 1981 (Tables 7 and 8), with peak numbers observed in August.

Few adult peamouth were collected by boat electroshocker. Maximum catches were obtained at night in August and September (Figure 18), but included primarily juvenile peamouth (Figure 19). Only 11 peamouth were tagged, and none were recaptured.

Numerical importance of peamouth in the fish community near the study site can mainly be attributed to large catches of juveniles by seine in

Hanford Slough. Relative numbers of peamouth collected in the Columbia River stations were similar to those of previous studies (Page et al. 1976; Gray et al. 1977; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980).

Redside Shiner (Richardsonius balteatus). Shiners were collected in all months and by all gear except ichthoyplankton nets (Table 3). Greatest numbers occurred in September following fry emergence, although shiners were also abundant in May 1981 and March 1982. Seine C/UE was similar for river and slough stations (Figure 20) except in March 1982 when river C/UE was higher than that obtained in Hanford Slough. Redside shiners were about one-third as abundant as squawfish and peamouth in the study area.

Few adults were captured during the sample period, perhaps due to gear selectivity. Earlier studies (Page and Gray 1979, Beak 1980) indicated that gill nets were the most effective gear for capturing adult redside shiners in the Hanford Reach of the Columbia River.

Carp (Cyprinus carpio). Carp were collected in all months and with all gear. Carp were the only cyprinid species positively identified in midchannel ichthyoplankton samples. A single carp, 9.3 mm total length (TL), was collected on July 16, 1981, in a surface net tow.

Carp were observed spawning along the Hanford Slough shoreline when shoreline vegetation was inundated in May and June. At this time, slough water temperatures ranged from 13° to 16°C. Growth of juvenile carp was rapid. Five 0-age carp fry collected in late September 1981 ranged from 61 to 69 mm FL.

Maximum boat electroshocker C/UE values occurred for the Hanford Slough transect in June and in the river in July. Day catches exceeded night catches in the river transects (Figure 21). Length-frequencies for carp collected by boat electroshocker (including slough surveys) are shown in Figure 22. Carp were collected ranging from 30 to 60 cm FL; the median size was near 40 cm FL. A total of 139 carp were tagged; the majority were tagged in May during a slough survey. One tagged individual was observed in the slough in July and another was caught by fishermen approximately 20 miles downstream of the study site about 13 months after initial capture.

Other Cyprinids. Although several other species were collected in the study area, none were abundant. The percent composition of chiselmouth (Acrocheilus alutaceus) relative to all species collected was lower than in previous studies (Page et al. 1976; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980). This result may have been because gill or trammel nets were not used to sample the adult fish community near the study site. Chiselmouth adults were collected in small numbers by boat electroshocker; all were collected at night. Chiselmouth were collected from June through October and only in the river stations. Peak C/UE were obtained in October (Figure 23). Mature individuals collected in July were spent.

Three species of dace were collected in the river stations and at the single slough station adjacent to the river (Table 3). Speckled dace (Rhinichthys osculus) were most abundant, followed by longnose dace (R. cataractae) and leopard dace (R. falcatus). Dace were collected primarily by backpack electroshocker in August through November. Preferred habitat was nearshore areas less than 1 meter deep with cobble bottom and swift current.

Catostomidae

Largescale Sucker (Catostomus macrocheilus). Largescale sucker were collected during all months by all gear except ichthyoplankton nets. In contrast to previous studies (Gray and Page 1979b, Beak 1980), fry emergence in 1981 was not observed along the main Columbia shoreline until early July. Because largescale sucker fry constituted about 97 percent of the catch, mean lengths for both sucker species were combined (Figure 24). Beach seine C/UE remained high through early September, then declined rapidly. Catches of juvenile sucker by backpack electroshocker were greatest from August through November 1981 (Tables 7 and 8).

Adult largescale sucker comprised 63 percent of the total fish collected by boat electroshocker in regular transects (Tables 10 and 11). Boat electroshocker C/UE values remained high from May through September and declined through the winter months (Figure 25). In all cases, C/UE of adult sucker in the river exceeded C/UE in Hanford Slough. Night catches exceeded day catches, which probably reflects inshore movement of sucker at night.

Length-frequency plots of largescale sucker collected in the river are shown in Figure 26. Most individuals exceeded 40 cm FL.

A total of 1337 largescale sucker were tagged from April 1981 through March 1982, and 75 (5.6 percent) were recaptured. Four suckers were recaptured twice. One largescale sucker was captured four times in the same transect over a period of 11 months. Populations estimates were obtained for largescale sucker in the two electroshock transects (1000 m of shoreline) based on the mark-recapture ratios of the first 7 months of the study (Table 16). Although the confidence limits are quite high due to few recaptures, the trends are similar to boat electroshock C/UE. Peak population size estimates of 14,961 ± 9,422 and 12,343 ± 6,721 were obtained in June and July 1981. Based on timing of fry emergence at the study site and on reported spawning times in other parts of the Hanford Reach (Dauble 1978), peak abundance estimates may coincide with spawning of largescale sucker near the study site.

Bridgelip Sucker (*C. columbianus*). Bridgelip sucker were collected throughout the sample period by all gear except ichthyoplankton nets. They were the second most common fish species collected by boat electroshocker (Table 3). Few adult bridgelip sucker were collected in the study area until June (Figure 27). Night C/UE exceeded day C/UE except in April, when both values were low. Bridgelip suckers were virtually absent from the study area in the winter months; only five were collected by boat electroschocking from November 1981 through March 1982. This seasonal decline in electroshocking C/UE for bridgelip sucker was also noted by Beak (1980) in studies near RM 352.

Seasonal length-frequency of bridgelip sucker is shown in Figure 28. Nearly 80 percent of individuals captured by boat electroshocker ranged from 35 to 45 cm FL. Juvenile bridgelip sucker were generally absent from all samples obtained near the study site. Only two (0.7 percent) of 280 tagged bridgelip suckers were recaptured. One individual was tagged in April 1981 and recaptured within the same river transect in September. The other individual was tagged in September and recaptured in the same transect 35 days later. Based on recapture ratios, bridgelip sucker appear to be less restricted in their movements than largescale sucker.

Laboratory identification of captured catostomid fry showed that bridgelip sucker comprised only a small percentage of the large resident fish schools inhabiting shoreline areas during July and August. In addition, C/UE was generally low during the peak spawning period (Dauble 1980) and suggests that bridgelip sucker may not spawn extensively near Rm 361.5.

Cottidae

Prickly Sculpin (Cottus asper). Prickly sculpin were collected throughout the study period with all sampling gear. Sculpin larvae dominated ichthyoplankton catches, comprising more than 95 percent of the total. Peak C/UE for sculpin larvae at the single midchannel station occurred in late May (Figure 29). Sculpin larvae were collected in tows from mid-April through July at water temperatures ranging from 9° to 17°C. Twelve prickly sculpin fry ranging from 14 to 26 mm total length (TL) were captured by seining in the river on July 1, 1981.

Adult prickly sculpin were captured by electroshocking, in nearshore areas, particularly over cobble bottom. Prickly sculpin were the most abundant resident species other than smallmouth bass that were noted in shoreline slough surveys in August and September 1981.

Other Cottids. Torrent sculpins (C. rhotheus) were collected in limited numbers by backpack electroshocker in both the river and slough stations. Torrent sculpins were most abundant in habitat also preferred by dace. A single cottid larvae, collected in June 1981 by icthyoplankton tow, was tentatively identified as C. beldingi (Bruce Mundy, pers. comm.). This cottid species is known to be present in other sections of the Hanford Reach in relatively low numbers (Gray and Page 1979b).

Centrarchidae

Smallmouth Bass (Micropterus dolomieui). Smallmouth bass were collected in the study area by all gear except ichthyoplankton nets. Adult bass were collected by hoop net and boat shocker in the river and slough in small numbers. Length-frequency of smallmouth bass greater than 10 cm collected in the study area is shown in Figure 30a. Although individuals up to 50 cm FL were collected, about half of the smallmouth bass ranged from only 20 to 30 cm FL.

Juvenile bass and emergent fry were mainly collected in the slough until September 1981, when bass began appearing in main river areas. Zero-age smallmouth bass less than 26 mm long were not collected outside the main slough area. Juvenile smallmouth bass were found in distinct habitat types of cobble and boulders in Hanford Slough and the main Columbia River after they reached a size of about 50 mm FL. Studies by Munther (1970) in the Snake River also showed juvenile smallmouth bass had a preference for rubble or broken rock substrate. No juvenile smallmouth bass were collected in the study area in February or March 1981, suggesting that overwintering of 0-age bass populations is limited or does not occur near the site. A single day survey of nearby sloughs known to support sizeable bass populations (Montgomery and Fickeisen 1978) supports this contention for 100-F and White Bluffs sloughs as well.

Size of 0-age smallmouth bass collected in the study area from July through December 1981 is shown in Figure 31. The most rapid increase in size occurred from August to September. Although there was large variation in fish length, mean size of area populations remained near 60 to 70 mm FL from late September through December. The length-weight relationship for 0-age smallmouth bass (n = 48) was described by the regression equation:

$$\ln \text{weight} = -(11.0 \pm 0.11) + (2.97 \pm 0.29) \ln \text{length}$$

Thirteen smallmouth bass were tagged during the study period, and only one was recaptured. A single adult, 29 cm FL, was captured by a fisherman on October 24 just below Hanford Slough on the Benton County shoreline. The capture occurred 11 days after the bass had been initially tagged in approximately the same location. A smallmouth bass (46 cm FL) captured by boat electroshocker in late April had an old left ventral fin clip. Scale analysis indicated that it was approximately 12 years old.

Largemouth Bass (M. salmoides). Largemouth bass were collected in limited numbers during the study period. Overall, they were about one-third as abundant as smallmouth bass (Table 3). Adult largemouth bass were collected by boat electroshocker and backpack electroshocker, primarily in Hanford Slough. Size-frequency of largemouth bass greater than 10 cm collected by all gear is shown in Figure 30b. Zero-age largemouth bass fry were not as abundant as smallmouth bass fry; however, relative abundance of juvenile largemouth bass was greater in slough surveys conducted in early November than in surveys conducted in late September. Only 6 percent of juvenile bass (n = 122) electroshocked along the southwest shoreline of Hanford Slough in late September 1981 were largemouth bass. In early November of the same year, 27 percent (n = 148) of the juvenile bass collected were largemouth bass.

Size of juvenile largemouth bass collected in the study area from August through December 1981 is shown in Figure 32. Only small numbers of 0-age largemouth bass fry were collected, indicating limited spawning in Hanford Slough in 1981. Growth appeared rapid from August to November, and mean size remained near 80 mm FL in November and December 1981. The length-weight relationship for 0-age largemouth bass (n = 14) was described by the regression equation

$$\ln \text{weight} = -(11.02 \pm 0.11) \pm (2.98 + 0.29) \ln \text{length}$$

One of eight tagged largemouth bass adults was recaptured. The bass was initially tagged in the Columbia River near RM 361.5 in June 1981 and was recaptured in Hanford Slough in September 1981.

Other Centrarchids. Pumpkinseed (*Lepomis gibbosus*) were collected in limited numbers, primarily by beach seine and backpack electroshocker (Table 3). Most pumpkinseed were juveniles and were collected in Hanford Slough in September. Bluegill (*L. macrochirus*) were not abundant; only six were collected during the study period. Adult black crappie (*Pomoxis nigromaculatus*) were collected in Hanford Slough and main Columbia River by boat electrofishing both during regular sampling and slough surveys. A black crappie tagged in Hanford Slough in May 1981 was caught by a fisherman in October 1981, nearly 20 miles downstream of the study site.

Percidae. Yellow perch (*Perca flavescens*) were collected in limited numbers in the river and slough. Young-of-the-year perch, ranging from 26 to 42 mm FL, were collected in Hanford Slough in July 1981. Two walleye

(Stizostedion vitreum) were collected near the study site. An adult (34 cm FL) was collected in Hanford Slough during a boat electroshocker survey in late August 1981, and a juvenile (14 cm) was collected near Columbia River mile 363 during a tag recovery survey in late October 1981. Despite an active sport fishery for walleye near Priest Rapids Dam, relatively few walleye have been collected in monitoring studies conducted throughout the Hanford Reach (Page et al. 1976; Gray et al. 1977; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980).

Other Species

Three-spined stickleback (Gasterosteus aculeatus) were frequently abundant in nearshore areas within river and slough sample stations. Peak C/UE of stickleback occurred in September. During shoreline surveys in August and September 1981, stickleback were observed in large schools at the extreme upper end of the Hanford Slough. Brown bullhead (Ictalurus nebulosus) were abundant in the upper end of Hanford Slough from May through July, particularly over inundated reed canary grass at about 1-meter depth. Twenty-two brown bullhead (20 to 26 cm FL) were captured and tagged, primarily during slough electroshock surveys for adult bass, but none were recaptured. American shad were collected in limited numbers; two larvae were collected in midchannel ichthyoplankton tows in July, and a single spent male was captured by boat electroshocker during a slough survey in August. One white sturgeon (Acipenser transmontanus) was collected by boat electroshocker during the day in the Benton County shoreline transect. The sturgeon was 88.0 cm total length. Sandroller (Percopsis transmontana) were collected only by backpack electroshocker in Columbia River stations. All sandroller were collected in September and October; sizes ranged from 32 to 40 mm. Previous studies on age and growth of this species (Gray and Dauble 1979) indicate that these fish were probably 0-age fry.

BENTHIC STUDIES

The Benthic Studies Program provides data on relative composition of the macro-benthic community in the vicinity of the proposed S/HNP intake/discharge site. Data are presented from samples collected in April, June, September and December 1981, and March 1982.

A program to study river bottom conditions near S/HNP was initiated in March 1981. The program included SCUBA surveys of bottom topography and substrate composition, and collection of biological samples. Initial grab samples of bottom substrate were collected in April 1981 and were subsequently analyzed to characterize benthic macroinvertebrate groups present near the proposed intake/discharge site before quarterly sampling. Grab samples were necessary to provide immediate information on species composition and to confirm that planned sampling methods were appropriate. The SCUBA observations and April grab samples were used for siting of the benthic sampling station. Basket samplers were placed on the bottom on April 24, 1981. The June 1981 sample was collected after 62 days of incubation; subsequent samples were collected after approximately 90 days of incubation. The data provide baseline data on community composition, abundance, and standing crop biomass of the benthic macrofauna community near the site. The data are also compared to benthic macrofauna data collected from the Columbia River near River miles 380 and 351.

METHODS AND MATERIALS

SCUBA Observations

On March 26, 1981, SCUBA divers drifted near the proposed intake/discharge area and made visual observations of the substrate. Diver submergence and surfacing locations were sighted using theodolites from two shore locations.

Transient and theodolite points were established by referencing maps and aerial photographs. True north was established by referencing the sun. Compass azimuths were then read directly from the theodolite. Transit azimuths were read in angular degrees and converted to compass azimuths by reference to sightings of the theodolite. Diver observations were dictated in the field and later transcribed at the laboratory. Substrate composition was characterized using "Wentworth's Classification of Coarser Sediments Based Upon Size of Particles" (Welch 1948).

Grab Samples

Buddy-teams of SCUBA divers dove to the river bottom from a boat positioned 200 to 300 feet off the Benton County shore near RM 361.4. The position of the boat was determined using shoreline markers established during preliminary site investigations for benthic studies. The position of the divers when they surfaced was noted by reference to shoreline features. Approximate positions are shown in Figure 33.

Sample locations were at RM 361.4 and 500 feet up- and downstream of RM 361.4. Duplicate samples were collected at three locations. Each diver collected 14 rocks, approximately 5.1 to 7.6 cm in diameter, from the river bottom and placed them in a sample container (a three-pound coffee can) at each sample location. The can was then covered with a plastic lid and carried to the surface. All samples were labeled to indicate sample date, location, and collection method, and were then transported to the laboratory.

At the laboratory, the rocks were immediately scrubbed to remove organisms. Released material retained by a 0.5-mm screen was washed into sample jars and preserved in 70 percent isopropyl alcohol.

Preserved samples were examined microscopically. All macroinvertebrates were identified to the lowest practical taxon, segregated, and counted. Identifications were made using standard taxonomic keys (Pennak 1978, Edmunds et al. 1976, Wiggins 1977, Ward and Whipple 1959). Samples were segregated into vials of not more than 500 individuals per vial.

Portions of all samples were recounted for quality assurance purposes. If vials contained less than 500 individuals, all individuals in the vial were recounted. For vials that contained more than 500 individuals, one vial with 500 individuals was picked at random and recounted. Only the initial counts are reported here.

After recounting, up to five representatives of taxa present in a sample were preserved in a species reference collection. Each reference sample was assigned a unique designation that indicated sample date and location. The remainder of each sample was used for gravimetric measurements.

Dry mass estimates were made for each taxa sampled for which sufficient numbers were collected. Samples were dried at 105°C for 24 hours in preweighed aluminum weight boats. Dried samples were cooled in a dessicator to room temperature, and dry mass was estimated by weighing the sample. Organic mass estimates were made for each taxa for which dry mass was estimated. Dried samples were incinerated at 500°C for 1 hour. Incinerated samples were cooled in a dessicator to room temperature, and the mass of the ash was estimated by weighing. Organic mass was estimated by calculating the difference between the dry mass and the ash.

Basket Samples

The basket sample station (Figure 33) was near the proposed intake/discharge site (RM 361.5). The sample site was marked by two 220-pound steel plate anchors connected by 500 feet of 3/8-inch. diameter wire rope which held sample baskets in place and provided SCUBA divers access to the sample baskets. One anchor was near the shore (shore anchor) and the other anchor (river anchor) was 500 feet from the shore anchor at a 45° angle to the shoreline (approximately 300 feet from shore at river flows less than 50,000 cfs).

Sample baskets were constructed of 0.105-inch C-1008 nickel-chrome plated wire and were 20.32 cm square and 7.62 cm deep. Volume of the baskets was about 3150 cm^3. Mesh openings on the sides and bottom were 1.9 x 1.9 cm and 5.9 x 1.9 cm on top. Each basket contained 14 rocks (5.1 to 7.6 cm in diameter) and weighed about 227 grams. Baskets were attached to a loop at the downstream end of the river anchor. Attachment was with a 2-foot long, 3/8-inch-diameter nylon rope tied to the basket. A steel snap was used to attach the nylon rope to the river anchor.

A buddy-team of SCUBA divers swam to the sample baskets from the shore anchor using the wire rope as a guide. To protect the samples from washout of organisms by the current, baskets were transported to the surface in sailcloth bags. Laboratory procedures for removing samples from rocks, preserving samples, and examining, counting and weighing organisms were the same as described for grab samples.

Three baskets were placed in the river in April and removed in June. The incubation time was 62 days. Incubation time for subsequent triplicate quarterly samples ranged from 90 to 93 days.

RESULTS AND DISCUSSION

Divers reported a fairly uniform bottom near the proposed intake/discharge site with low relief consisting mostly of cobble (64 to 256 mm) and a few boulders (>256 mm). Some gravel (2 to 4 mm) and apparent cemented material were reported. No major substrate differences were reported within the survey area. Bottom substrate was similar to that observed at other Hanford Locations (Page et al., 1976; Gray et al. 1977; Gray and Page 1977, 1978).

This preliminary analysis of the bottom topographic features indicated that because of the observed homogeneity of the substrate and bottom profile, the bottom fauna may be characterized by a limited number of biological sampling stations from anywhere in the immediate vicinity of the proposed intake/discharge site. Previous studies of the Columbia River at Hanford (Page et al. 1976; Gray et al. 1977; Gray and Page 1977, 1978) have shown no biologically important differences among benthic samples from stations separated by as much as 915 meters (3000 feet).

Twenty-five taxa of Columbia River benthic fauna were observed in the samples collected (Table 17). The 25 taxa include three identifications to species, 14 to genera, 5 to family, and 5 to order or class. Most of the taxa have been previously identified in the Columbia River at Hanford (Page et al. 1976; Gray et al. 1977; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980; Washington Public Power Supply System 1975). The genus Ephemerella has been previously identified, but this is the first identification to species E.

inermis. The genera Serratella and Ceraclea were identified for the first time from samples collected from the Columbia River at Hanford.

Insect larvae, especially caddisfly and midge fly larvae, were numerically dominant. Midge flies accounted for about 60 percent of April grab samples, and caddisfly accounted for approximately 30 percent. These two taxa of insect larvae were also numerically dominant in the basket samples. Caddisflies and midge flies accounted for nearly 90 percent of the macrobenthic organisms collected. Midge fly larvae and caddisfly larvae constitute a primary food source for juvenile chinook salmon (Becker 1973; Dauble et al. 1980) and mountain whitefish (Gray and Page 1979a, 1979b) in the Hanford Reach of the Columbia River. In addition, these insect groups provide a significant portion of the diet of many resident fish in the Hanford Reach, including most cyprinids, juvenile catostomids, and juvenile centrarchids (Gray et al. 1977; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980).

Other taxa observed include mayflies, aquatic moths, black flies, Asiatic clams, snails and limpets, sponge, flatworms, roundworms, segmented worms, mites, hydra, and water bears. Except for black flies, which were 10.2 percent of the total density estimated in June 1981 and 12.9 percent of the total density estimated in 1982, none of these taxa constituted more than 10 percent of the estimated density during any one sample period (Table 18). This is consistent with past estimates of relative densities for Columbia River macro-benthic invertebrates at Hanford (Page et al. 1976; Gray et al. 1977; Gray and Page 1977, 1978, 1979a, 1979b; Beak 1980).

More organisms were found in the September and December samples than in the March and June samples (Table 18). This estimate is consistent with past density estimates for Columbia River benthic macrofauna. In the fall, densities began to increase and remained high for the first part of the winter. Densities decreased in the spring and were lowest in the summer. The increases and decreases probably coincide with insect rearing and emergence, respectively.

Biomass estimates were similar to density estimates (Table 19). Caddisflies dominated all samples. Midgeflies and molluscs (Gastropods) were the only other taxa that were consistently present in quantities large enough to obtain biomass estimates. The most common gastropods in these samples was Lithoglyphus sp. Lithoglyphus sp. constituted 10 percent of the biomass in some samples of macro-benthic invertebrates at RM 351 in 1979 and 1980 (Beak 1980). Biomass estimates were greatest in September and December samples, and lowest in June and March samples. The September/December peak and the March low are similar to the biomass trends observed at RM 351 in 1979 and 1980 (Beak 1980).

In summary, taxa community composition, density and biomass estimates, and seasonal trends of the benthic macrofauna observed for samples collected near the proposed S/HNP intake/discharge site are similar to those observed for samples from surveys conducted at other Hanford sites. The data reported here indicate these and previous benthic studies at Hanford may be used for predicting impacts of construction and operation of the S/HNP at Columbia River Mile 361.5.

LITERATURE CITED

Balon, E. K. 1975. "Terminology of Intervals in Fish Development." J. Fish. Res. Bd. Can. 32:1663-1670.

Beak Consultants, Inc. 1980. Preoperational Environmental Monitoring Studies Near WNP 1, 2, and 4, August 1978 through March 1980. WPPSS Columbia River Ecology Studies, Volume 7. Prepared for Washington Public Power Supply System by Beak Consultants, Inc., Portland, Oregon.

Becker, C. D. 1973. "Food and Growth Parameters of Juvenile Chinook Salmon, Oncorhynchus tshawytscha, in Central Columbia River." Fish. Bull. 72(2):387-400.

Dauble, D. D. 1978. Comparative Ecology of Two Sympatric Catostomids, Catostomus macrocheilus and Catostomus columbianus, in the Middle Columbia River. M.S. Thesis, Washington State University, Pullman, Washington.

Dauble, D. D. 1980. "Life History of the Bridgelip Sucker in the Central Columbia River." Trans. Am. Fish. Soc. 109(1):92-98.

Dauble, D. D., R. H. Gray and T. L. Page. 1980. "Importance of Insects and Zooplankton in the Diet of 0-Age Chinook Salmon (Oncorhynchus tshawytscha) in the Central Columbia River." Northwest Sci. 54(4):253-258.

Edmunds, G. F., Jr., S. L. Jensen and L. Berner. 1976. The Mayflies of North and Central America, University of Minnesota Press, Minneapolis, Minnesota.

Fickeisen, D. H., R. E. Fitzner, R. H. Sauer and J. L. Warren. 1980. Wildlife Usage, Threatened and Endangered Species and Habitat Studies of the Hanford Reach, Columbia River, Washington. Prepared by Battelle, Pacific Northwest Laboratories for the U.S. Army Corps of Engineers, Seattle, Washington.

Gray, R. H., and D. D. Dauble. 1979. "Biology of the Sand Roller in the Central Columbia River." Trans. Am. Fish. Soc. 108(6):646-649.

Gray, R. H., and T. L. Page. 1977. Aquatic Ecological Studies Near WNP 1, 2, and 4, September 1975 through March 1976. WPPSS Columbia River Ecology Studies, Volume 3. Prepared by Battelle, Pacific Northwest Laboratories for Washington Public Power Supply System, Richland, Washington.

Gray, R. H., and T. L. Page. 1978. Aquatic Ecological Studies near WNP 1, 2, and 4, March Through December 1976. WPPSS Columbia River Ecology Studies, Volume 4. Prepared by Battelle, Pacific Northwest Laboratories for Washington Public Power Supply System, Richland, Washington.

Gray, R. H., and T. L. Page. 1979a. Aquatic Ecological Studies near WNP 1, 2, and 4, January through December 1977. WPPSS Columbia River Ecology Studies, Volume 5. Prepared by Battelle, Pacific Northwest Laboratories for Washington Public Power Supply System, Richland, Washington.

Gray, R. H., and T. L. Page. 1979b. Aquatic Ecological Studies Near WNP 1, 2, and 4, January through August 1978. WPPSS Columbia River Ecology Studies, Volume 5. Prepared by Battelle, Pacific Northwest Laboratories for Washington Public Power Supply System, Richland, Washington

Gray, R. H., T. L. Page and E. G. Wolf. 1977. Aquatic Ecological Studies Conducted near WNP 1, 2, and 4, September 1974 through September 1975. WPPSS Columbia River Ecology Studies, Volume 2. Prepared by Battelle, Pacific Northwest Laboratory for Washington Public Power Supply System, Richland, Washington.

Montgomery, J. C., and D. H. Fickeisen. 1978. Spawning and Movements of Smallmouth Bass (Micropterus dolomieui) in the Mid-Columbia River. PNL-2785, Pacific Northwest Laboratory, Richland, Washington.

Munther, G. L. 1970. "Movement and Distribution of Smallmouth Bass in the Middle Snake River." Trans. Am. Fish. Soc. 99(1):44-53.

Page, T. L., R. H. Gray and E. G. Wolf. 1976. Final Report on Aquatic Ecological Studies Conducted at the Hanford Generating Project, 1973-1974, WPPSS Columbia River Ecology Studies, Volume 1. Prepared by Battelle, Pacific Northwest Laboratories for Washington Public Power Supply System, Richland, Washington.

Page, T. L and E. J. Hulsizer. 1979. Biofouling Control in Open Recirculation Cooling Water System - A Review. Prepared by Battelle, Pacific Northwest Laboratories under Contract 2311201335 to Washington Public Power Supply System, Richland, Washington.

Pennak, R. W. 1978. Fresh-Water Invertebrates of the United States, 2nd ed. John Wiley and Sons, New York, New York.

Skagit/Hanford Nuclear Project (S/HNP). 1982. Skagit/Hanford Nuclear Project--application for Site Certification/Environmental Report, Amendment No. 5. Puget Sound Power Light Company, Bellevue, Washington.

Vogele, L. E. 1981. Reproduction of Smallmouth Bass, Micropterus dolomieui, in Bull Schoals Lake Arkansas. U.S. Fish Wild. Serv. Tech. Paper 106.

Ward, H. B., and G. C. Whipple. 1959. Fresh-Water Biology. 2nd ed, ed. W. T. Edmonson. John Wiley and Sons, New York, New York.

Washington Public Power Supply System. 1975. WPPSS Nuclear Project No. 2 Environmental Report--Operating License Stage. Washington Public Power Supply System, Richland, Washington.

Welch, P. S. 1948. Limnological Methods, McGraw-Hill, New York, New York.

Wiggins, G. B. 1977. Larvae of the North American Caddisfly Genera (Trichoptera). University of Toronto Press, Toronto, Canada.

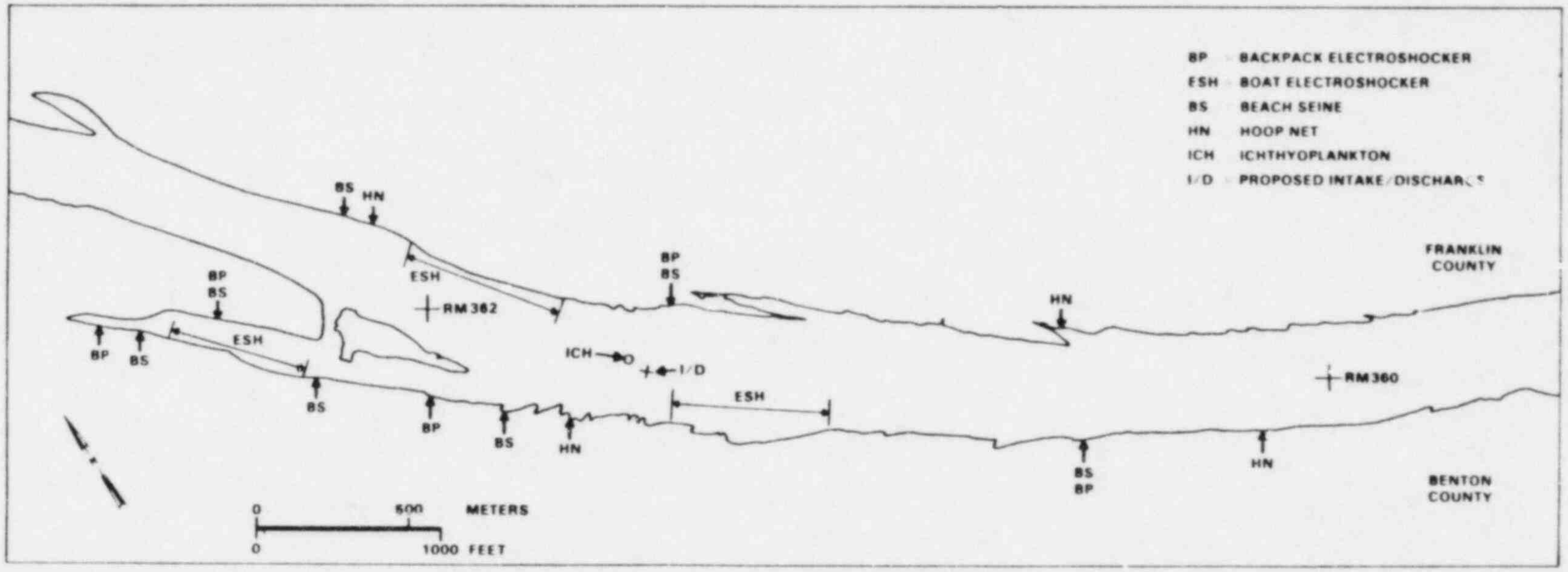


FIGURE 1. Permanent Fish Sampling Stations in the Main Columbia River and Hanford Slough, March 1981 - April 1982

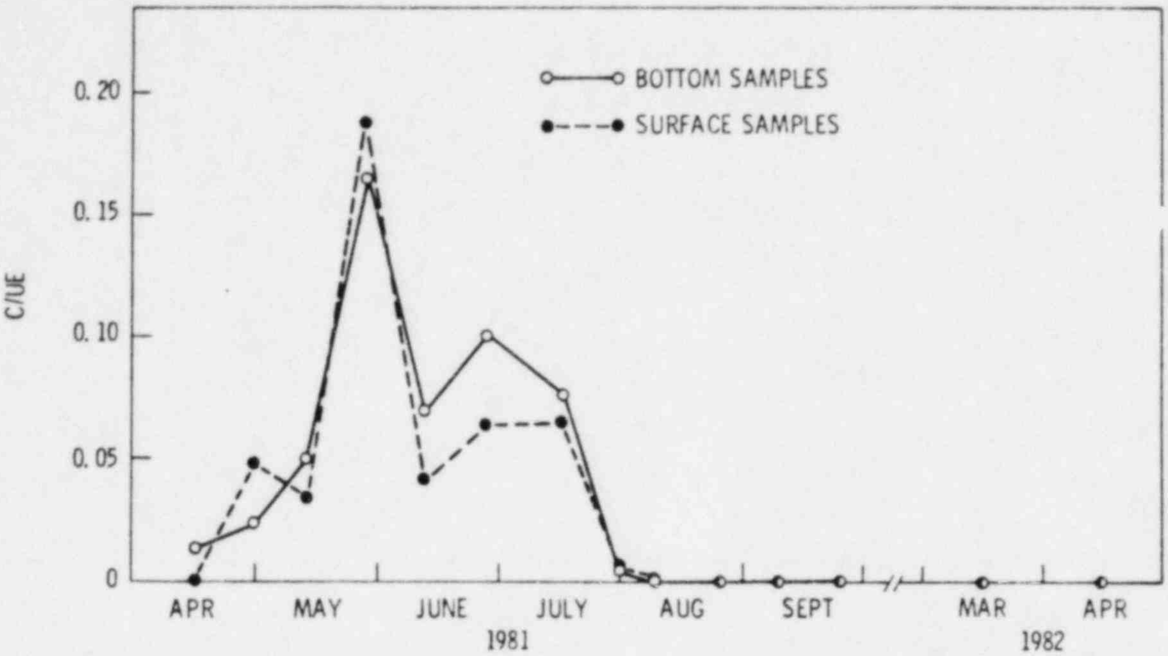


FIGURE 2. Catch per Unit Effort of Ichthyoplankton Collected at Midstream Near Columbia River Mile 361.5, April-September 1981 and March-April 1982.

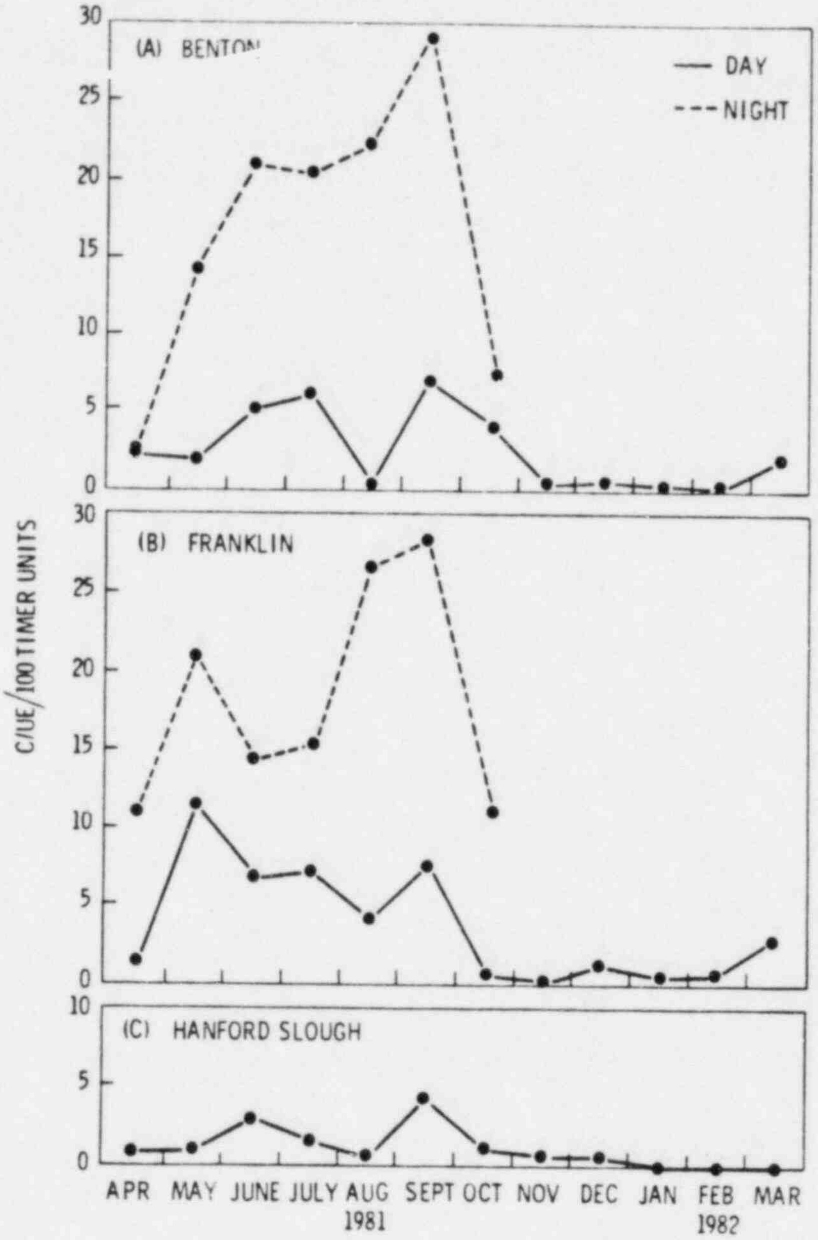


FIGURE 3. Boat Electroshocker Catch Per Unit Effort (C/UE) for (A,B) Columbia River and (C) Hanford Slough Transects, April 1981 - March 1982

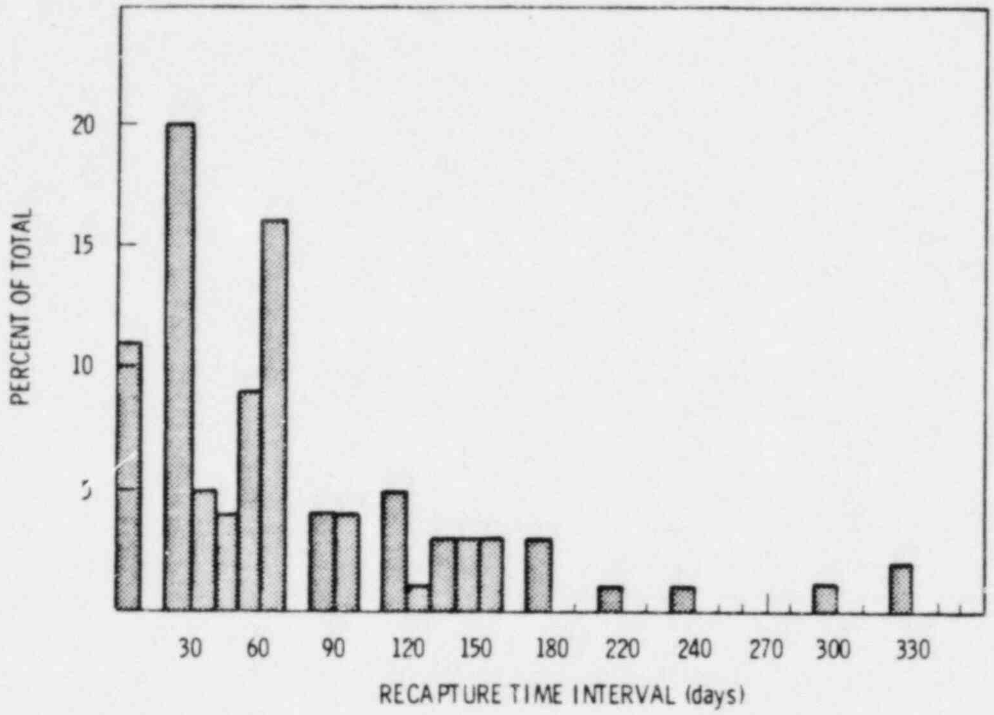


FIGURE 4. Frequency of Time-Intervals Between Recaptures for Resident Fish >20 cm FL Tagged from April 1981-March 1982 near Columbia River Mile 361.5

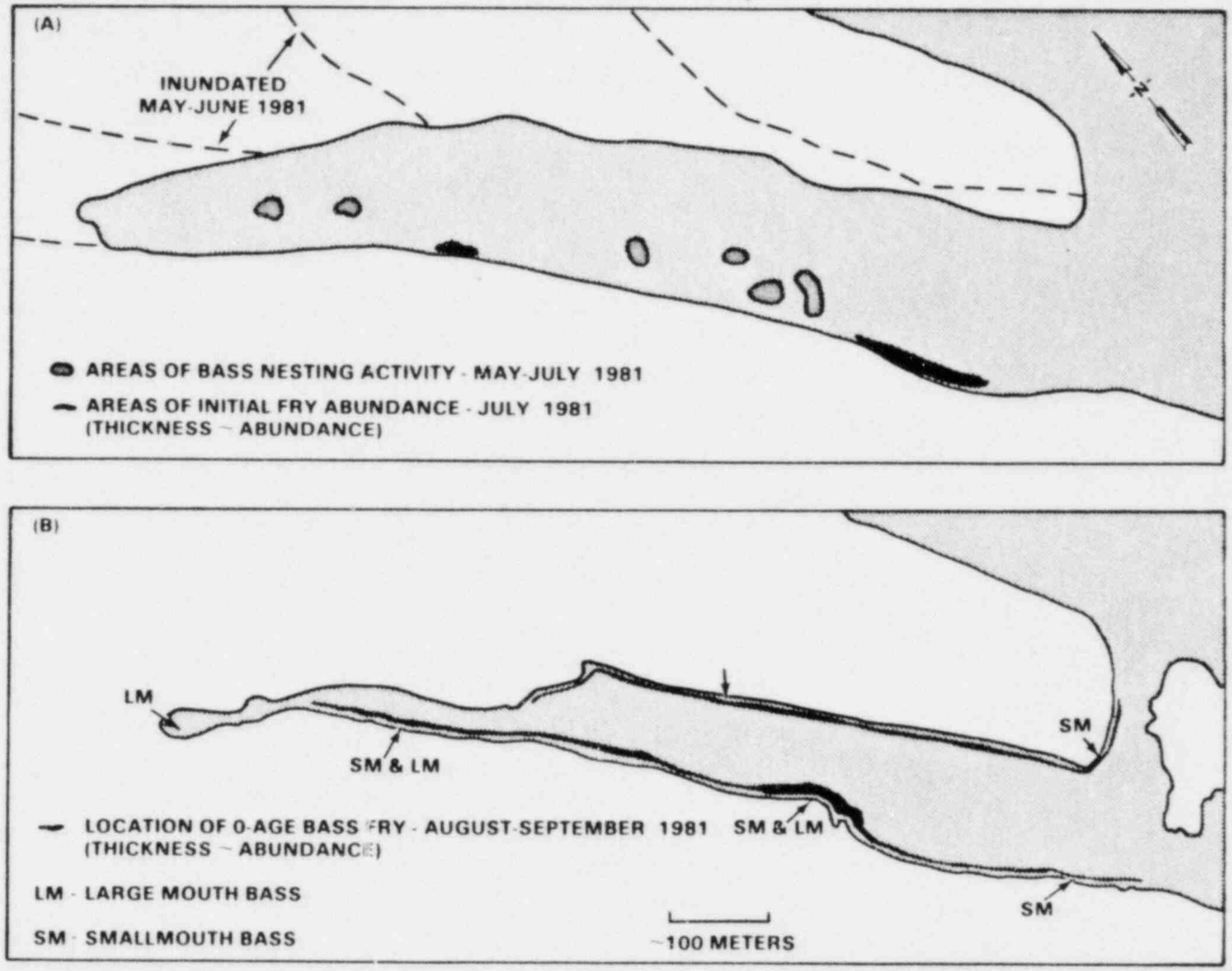


FIGURE 5. Location of (A) Adult Bass Nesting Activity and (B) Rearing Areas for Juvenile Bass in Hanford Slough, May-September 1981

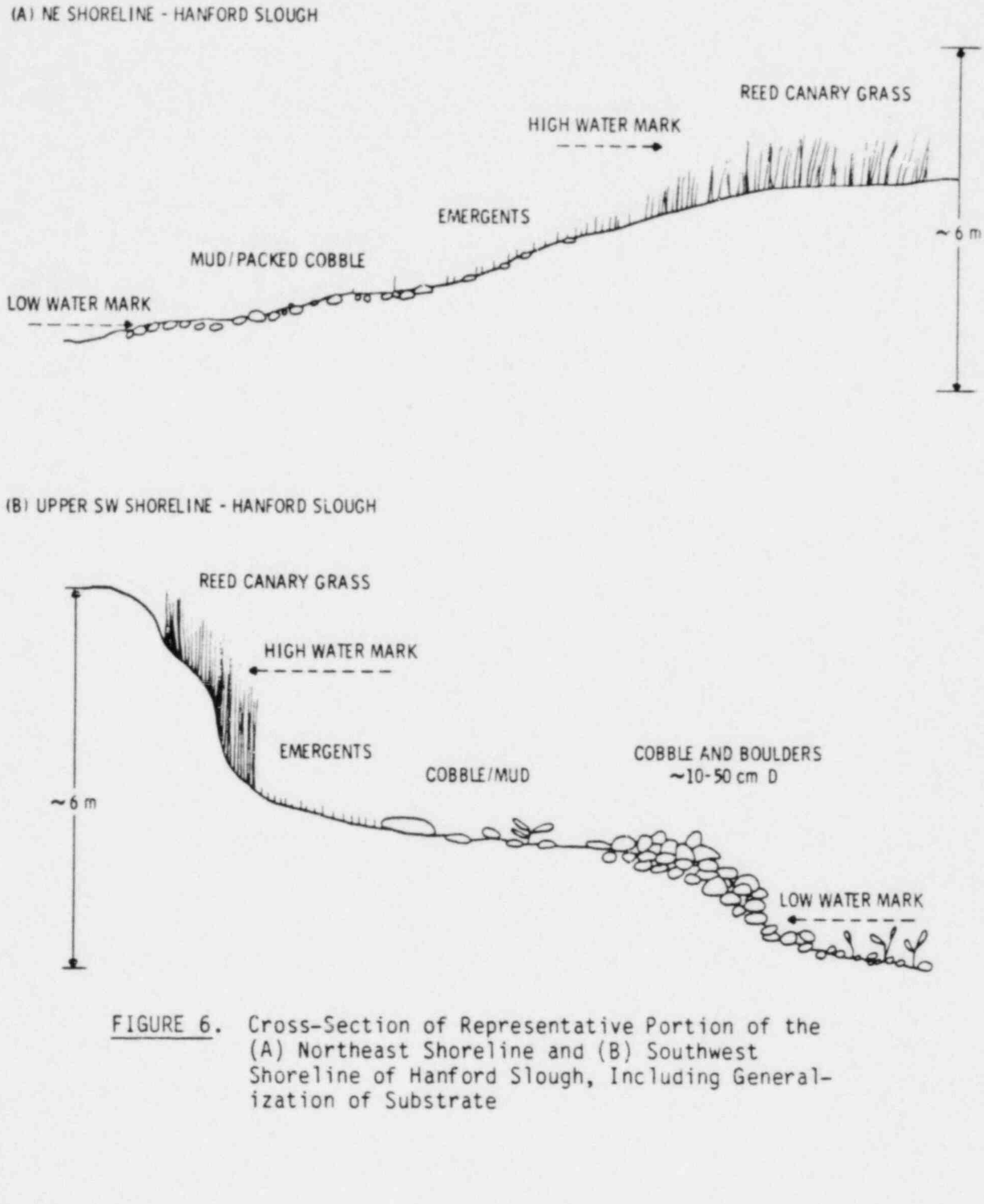


FIGURE 6. Cross-Section of Representative Portion of the (A) Northeast Shoreline and (B) Southwest Shoreline of Hanford Slough, Including Generalization of Substrate

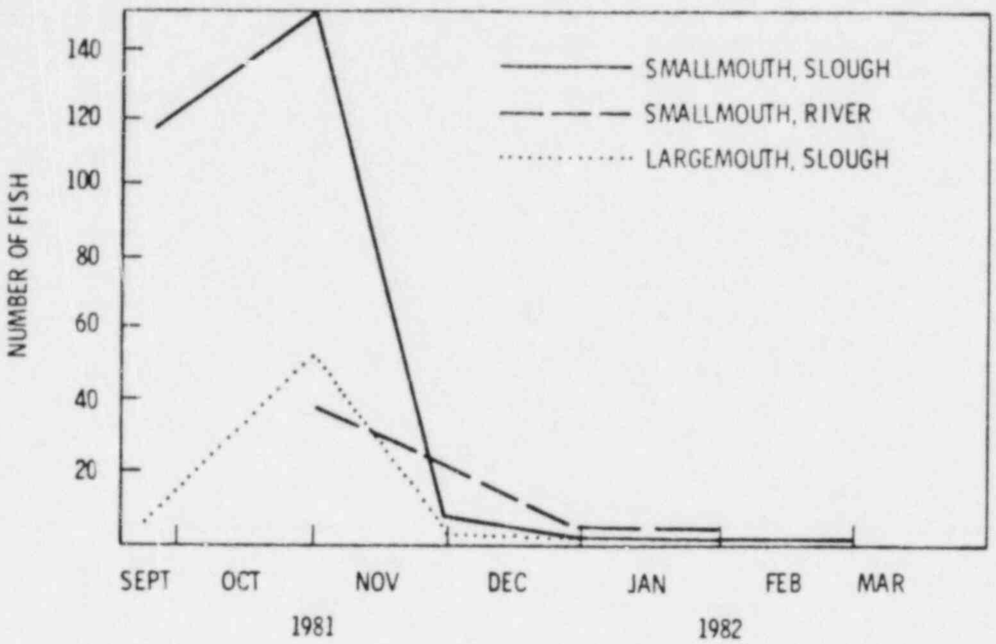


FIGURE 7. Abundance of Zero-Age Bass Populations in Nearshore Stations During Overwintering Surveys in Hanford Slough and Adjacent Columbia River, September 1981 - March 1982.

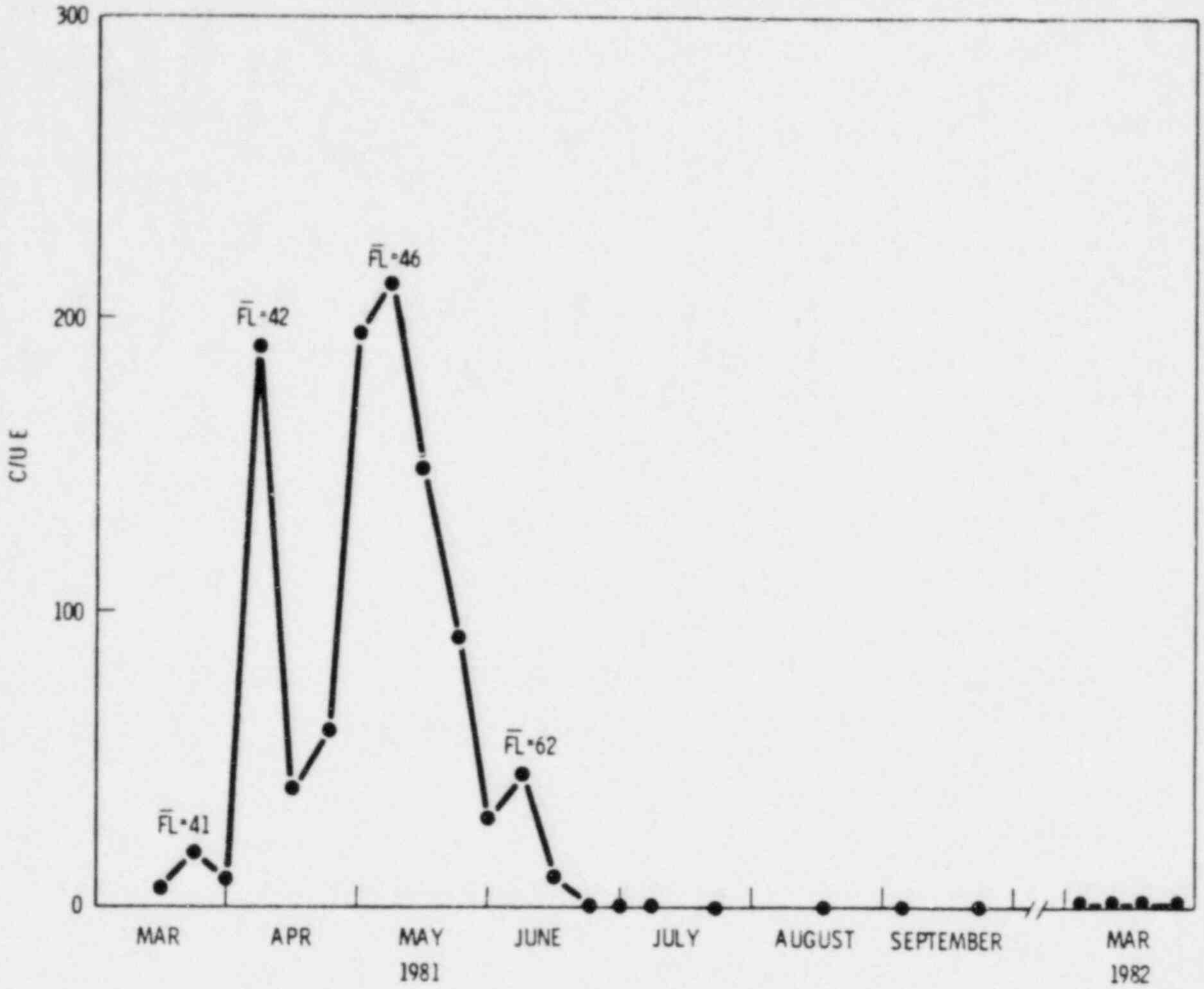


FIGURE 8. Catch Per Unit Effort (C/UE) for Chinook Salmon Seined at Columbia River Stations, March-September 1981 and March 1982. $\overline{FL}$ = mean fork length in mm.

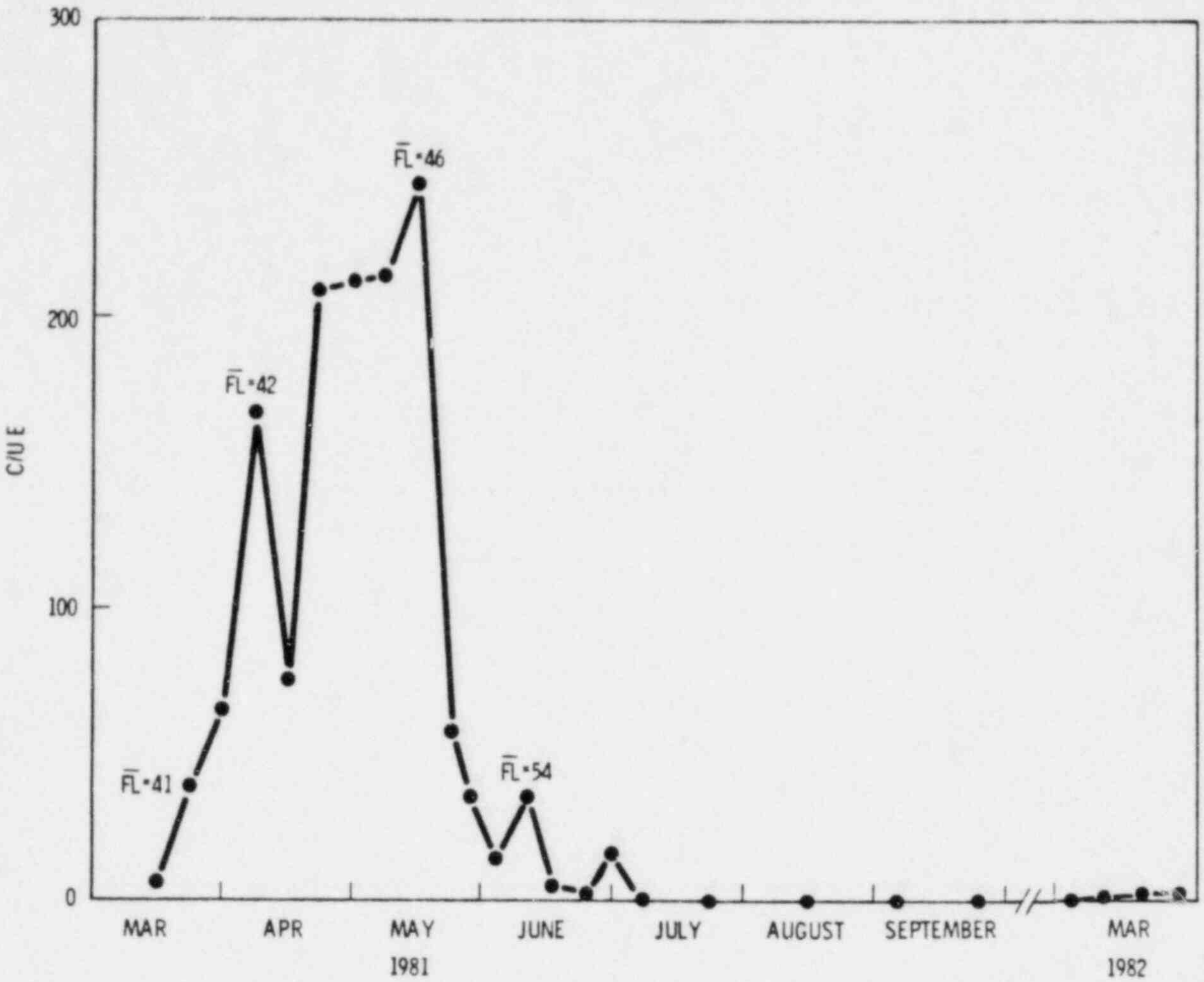


FIGURE 9. Catch Per Unit Effort (C/UE) for Chinook Salmon Seined at Hanford Slough Stations, March-September 1981 and March 1982. $\overline{FL}$ = mean fork length in mm.

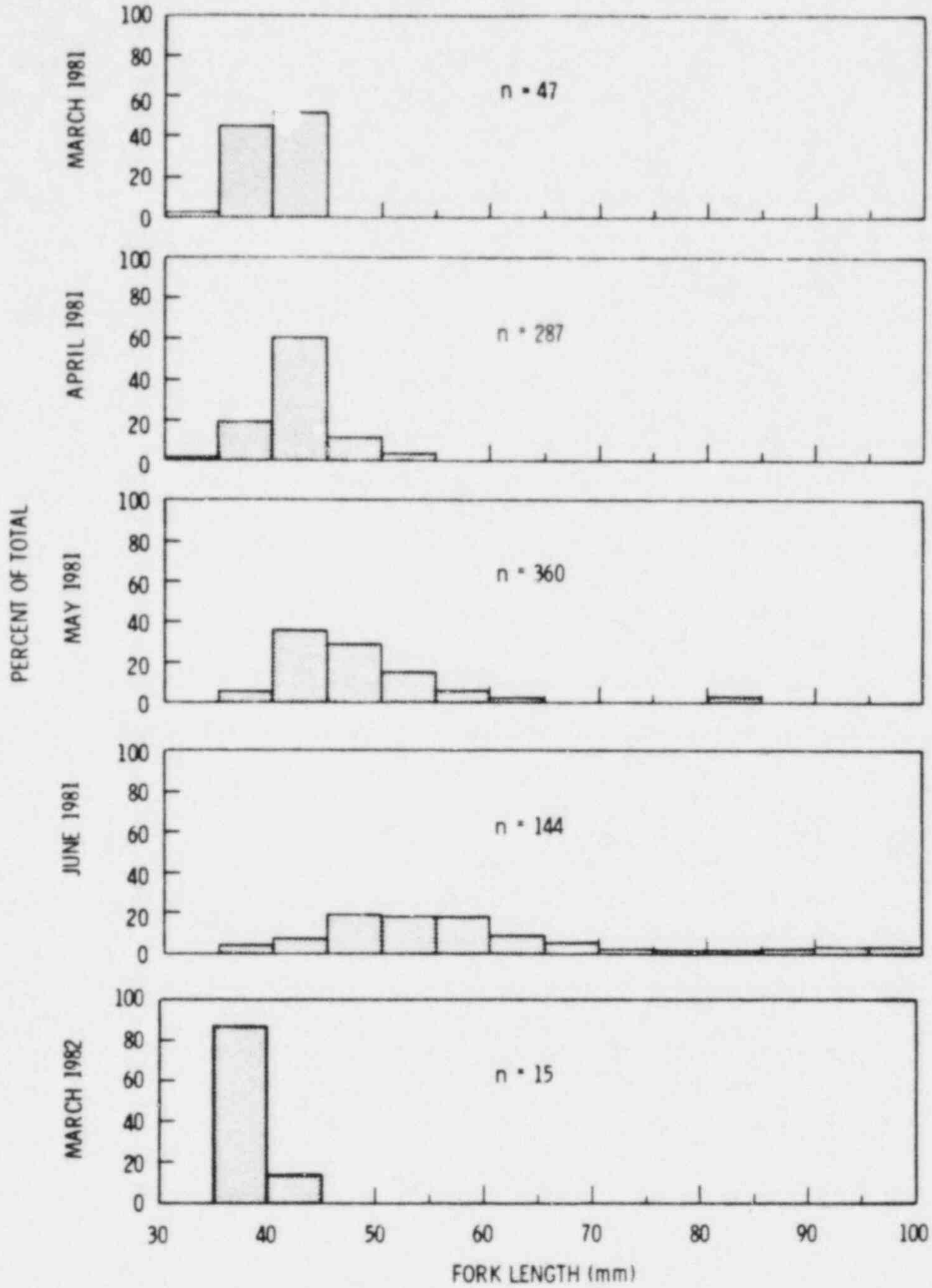


FIGURE 10. Length-Frequency of Chinook Salmon Seined at Columbia River Stations, March-June 1981 and March 1982

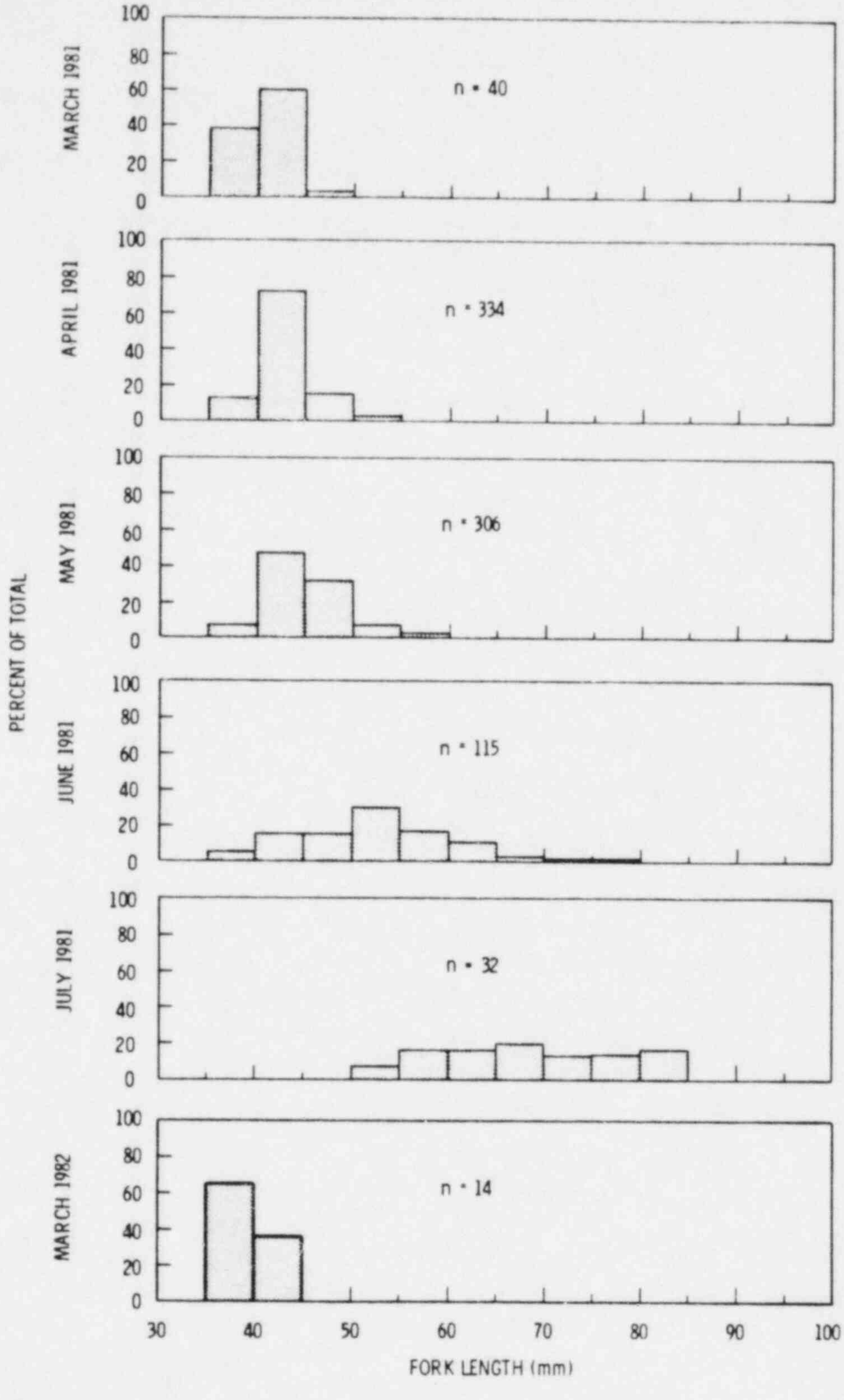


FIGURE 11. Length-Frequency of Chinook Salmon Seined at Hanford Slough Stations, March-July 1981 and March 1982

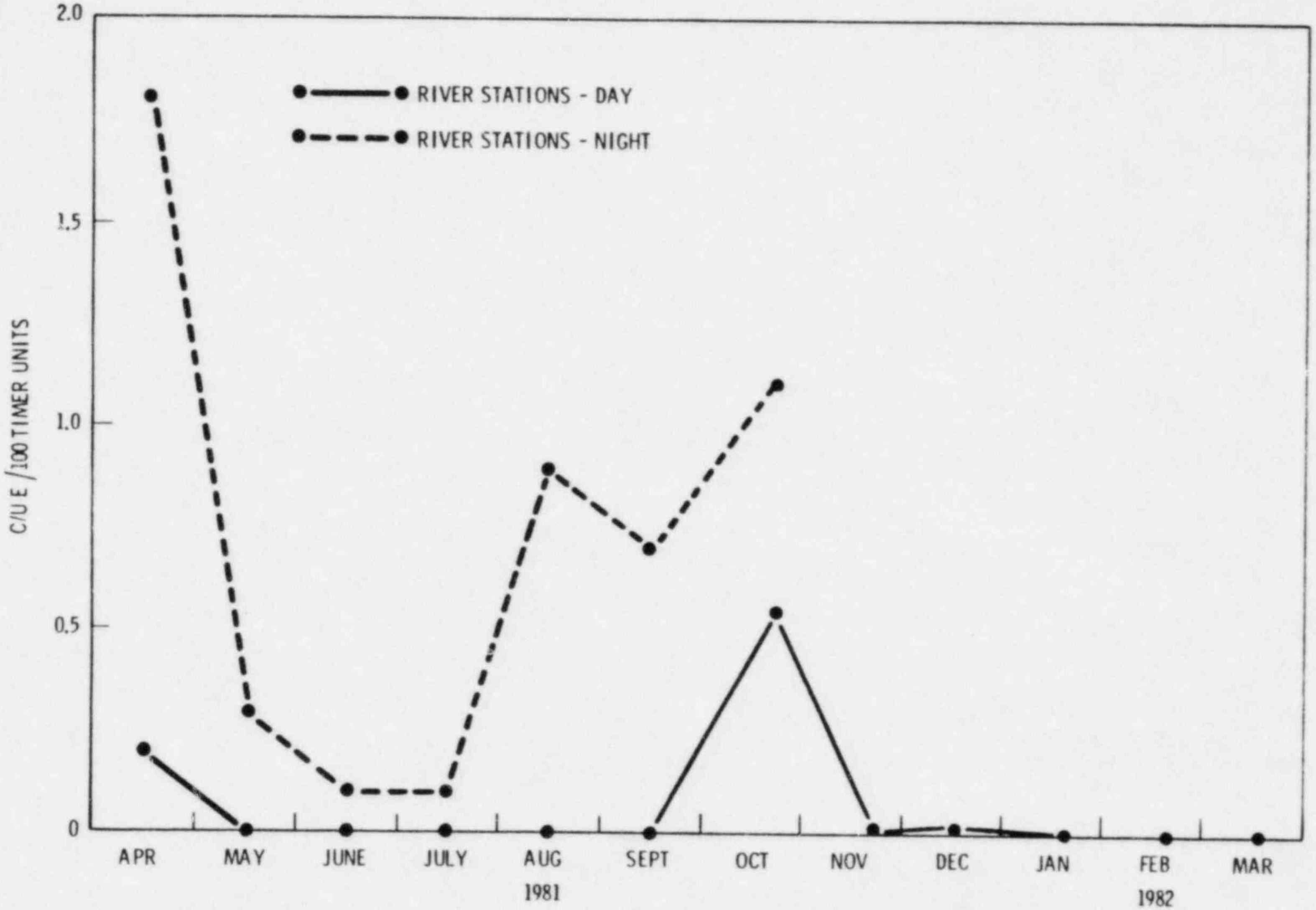


FIGURE 12. Catch Per Unit Effort (C/UE) for Whitefish Collected with Boat Electroshocker, April 1981 - March 1982

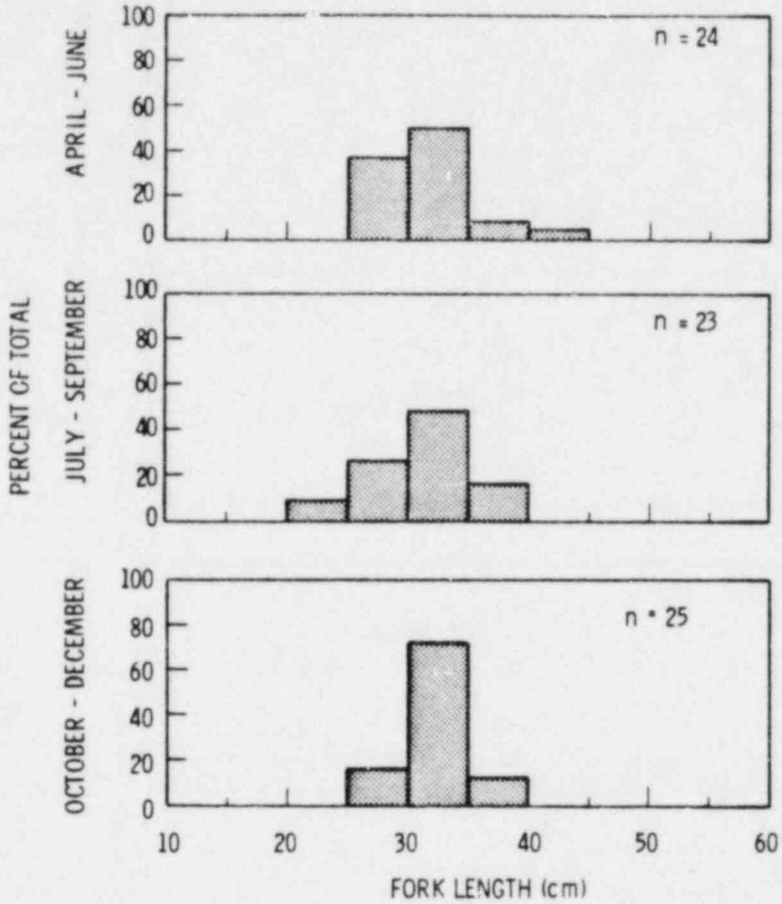


FIGURE 13. Length-Frequency of Whitefish Collected by Boat Electroshocker, April-December 1981

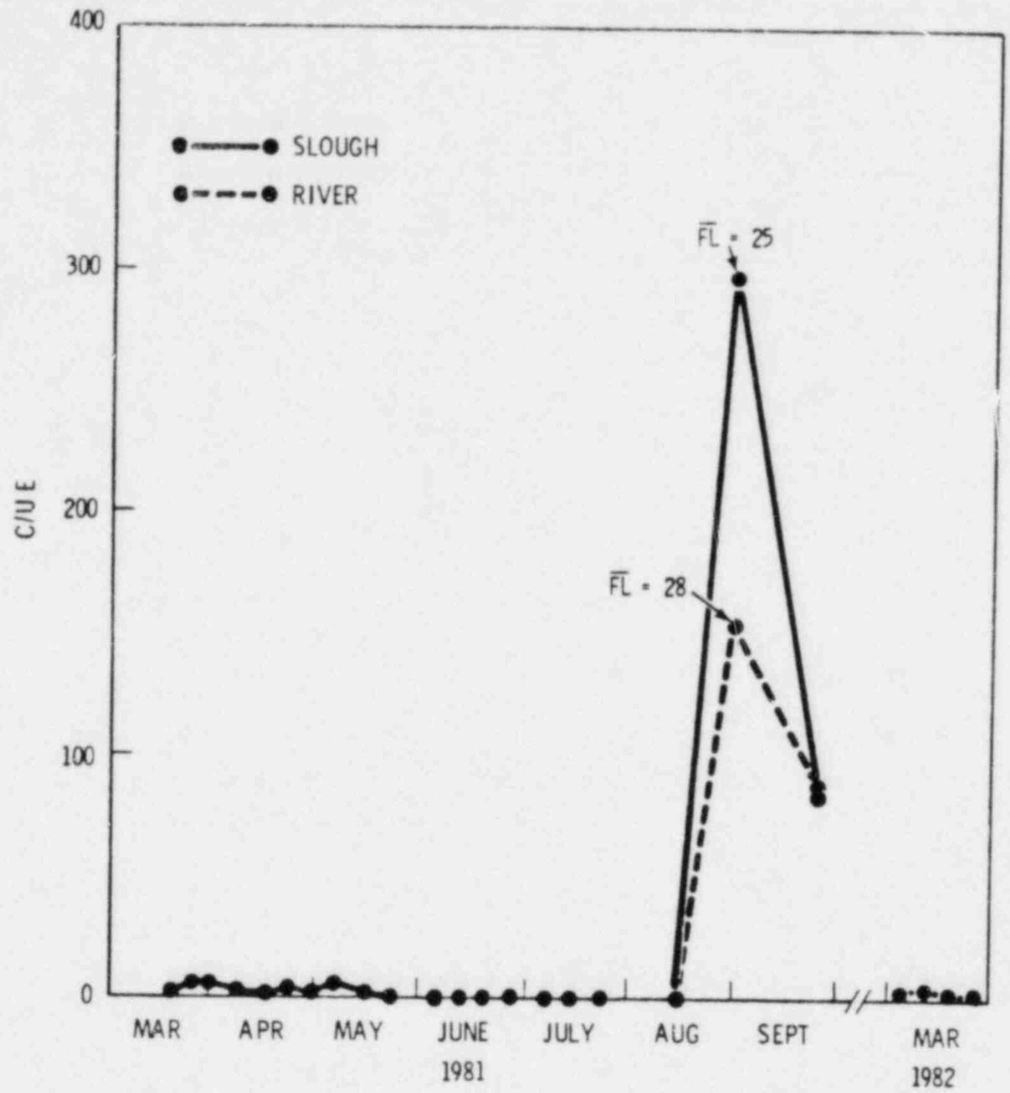


FIGURE 14. Catch Per Unit Effort (C/UE) for Squawfish Seined in Columbia River and Hanford Slough Stations, March-September 1981 and March 1982. $\overline{FL}$ = mean fork length in mm.

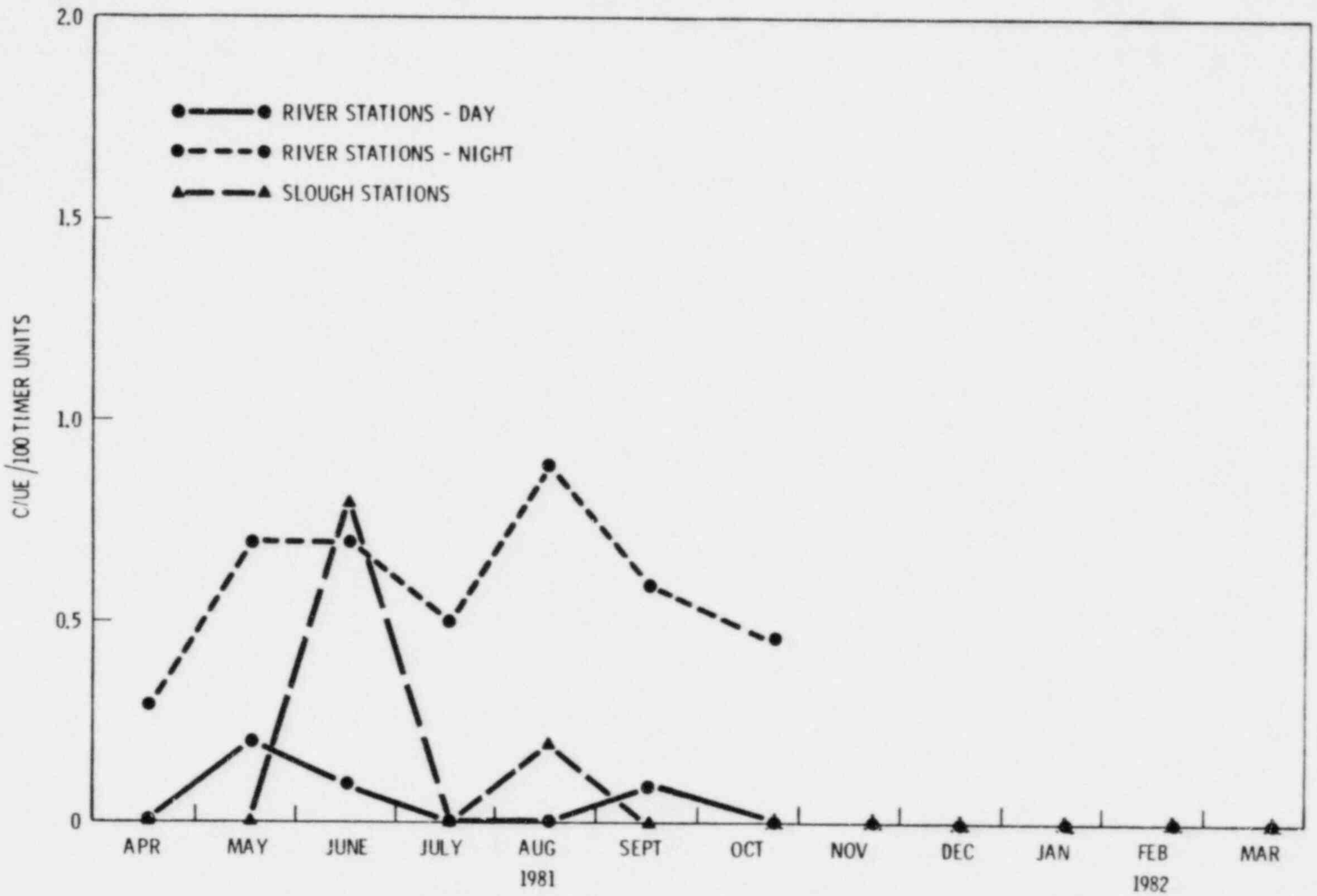


FIGURE 15. Catch Per Unit Effort (C/UE) for Squawfish Collected by Boat Electroshocker at Columbia River and Hanford Slough Stations, April 1981 - March 1982

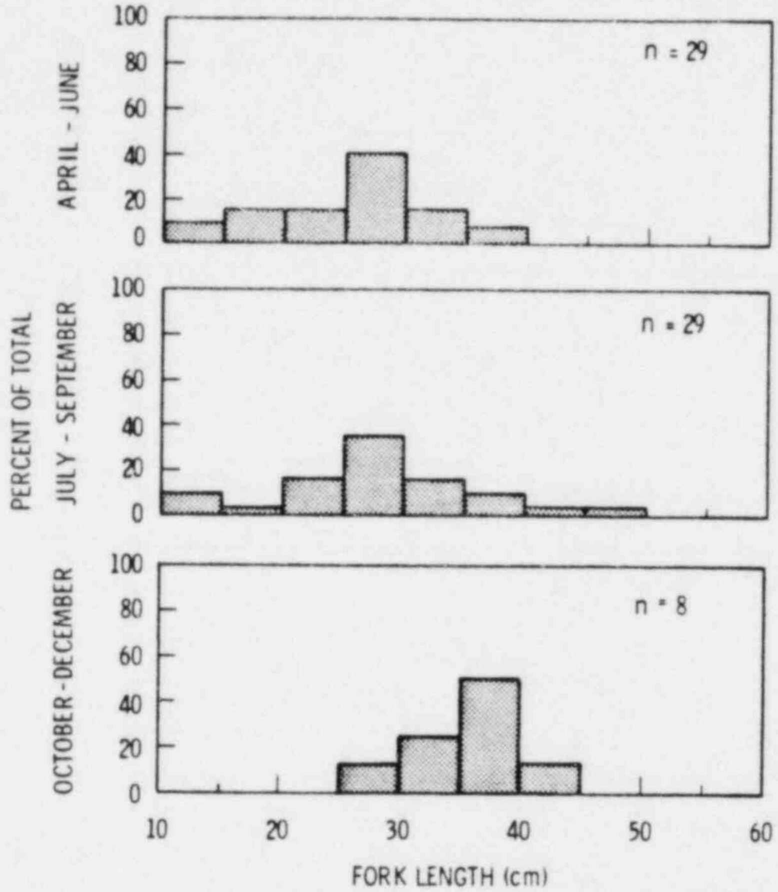


FIGURE 16. Length Frequency of Squawfish Collected by Boat Electroshocker, April-December 1981

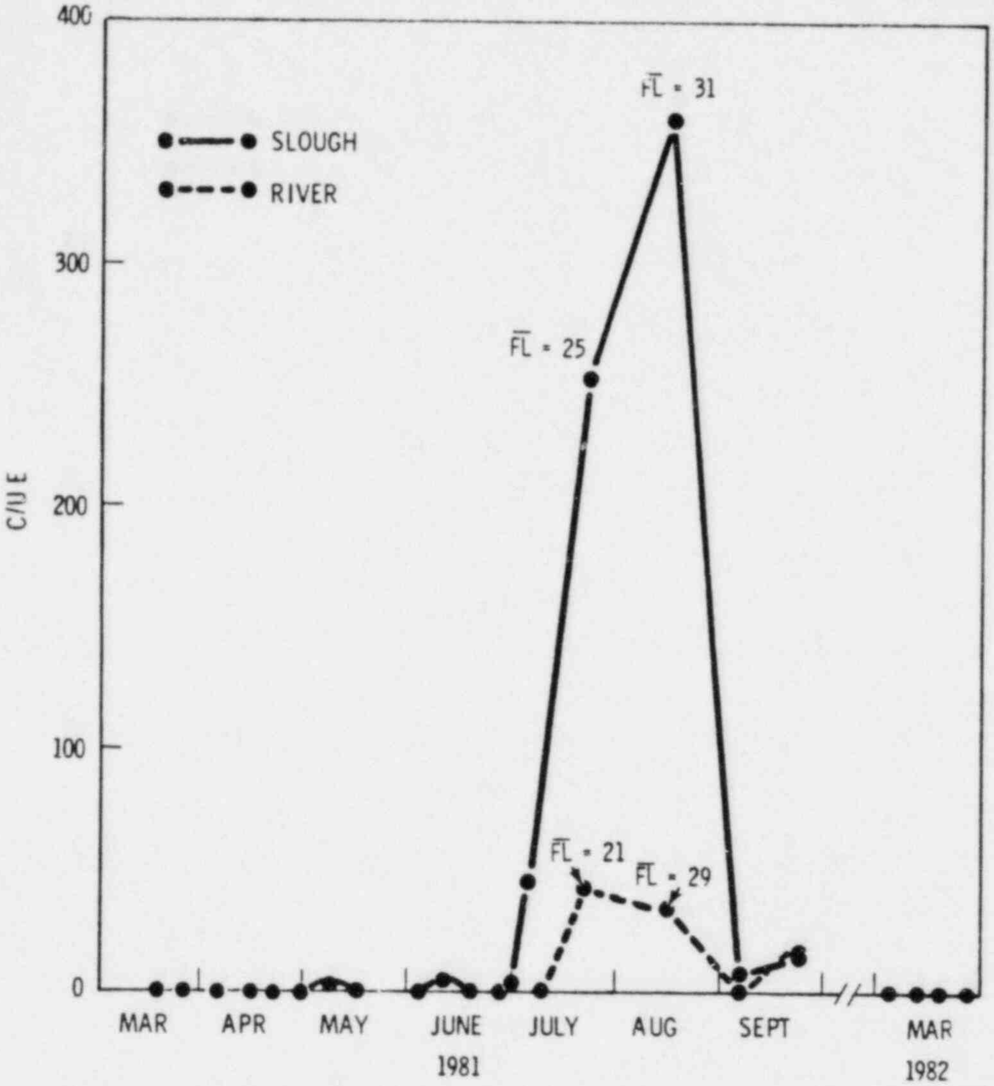


FIGURE 17. Catch Per Unit Effort (C/UE) for Peamouth Seined in Columbia River and Hanford Slough Stations, March-September 1981 and March 1982. $\overline{FL}$ = mean fork length in mm.

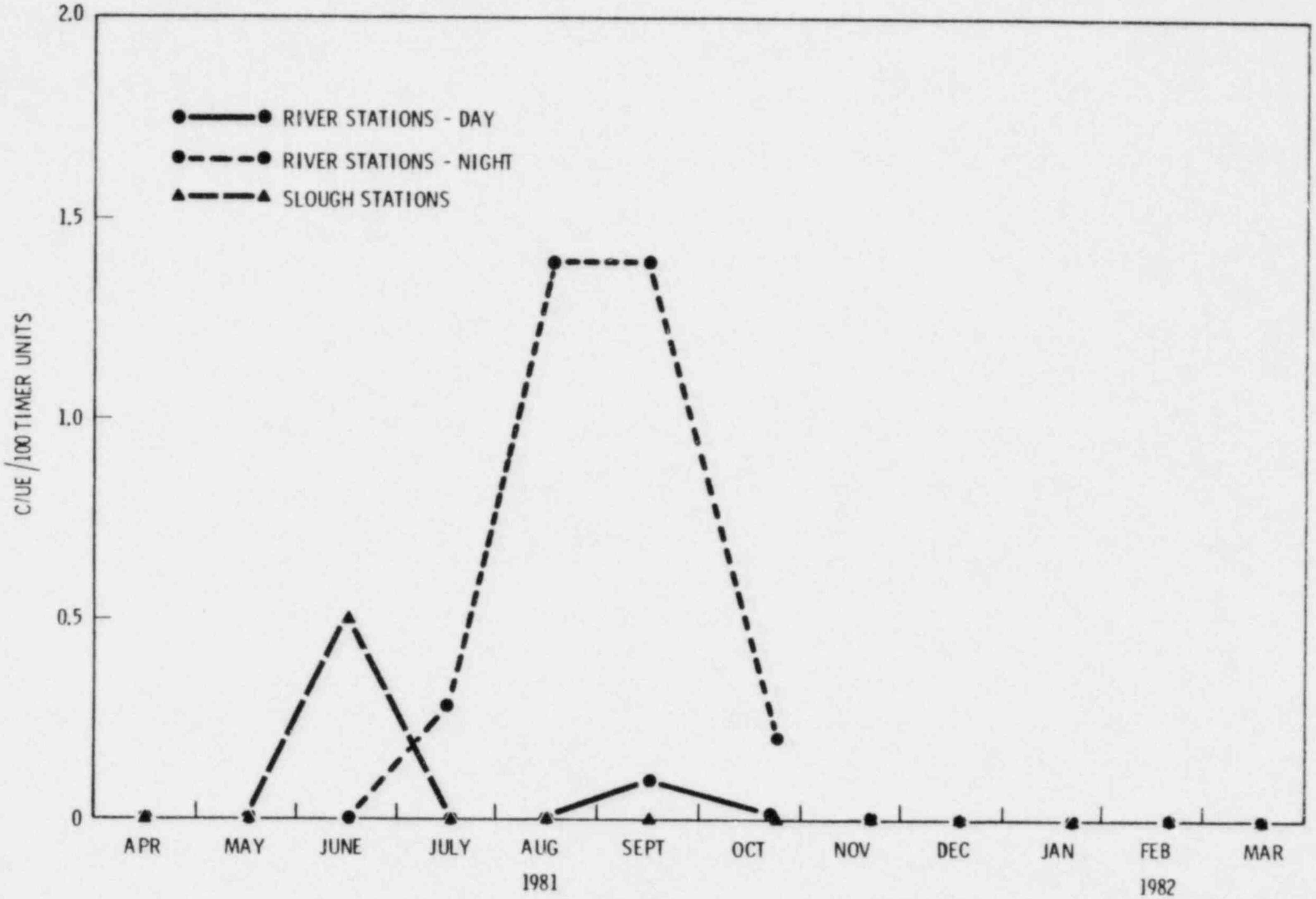


FIGURE 18. Catch Per Unit Effort (C/UE) for Peamouth Collected by Boat Electroshocker at Columbia River and Hanford Slough Stations, April 1981 - March 1982

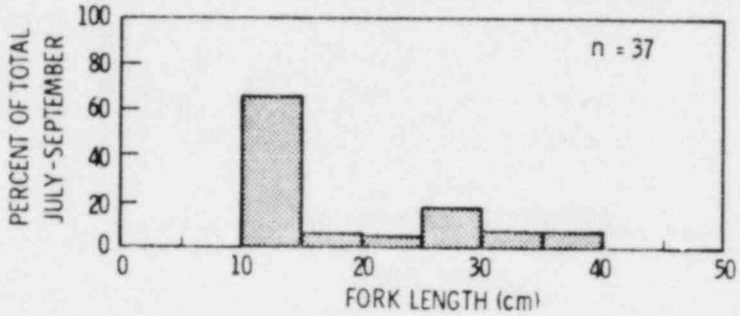


FIGURE 19. Length-Frequency of Peamouth Collected by Boat Electroshocker, July-September 1981

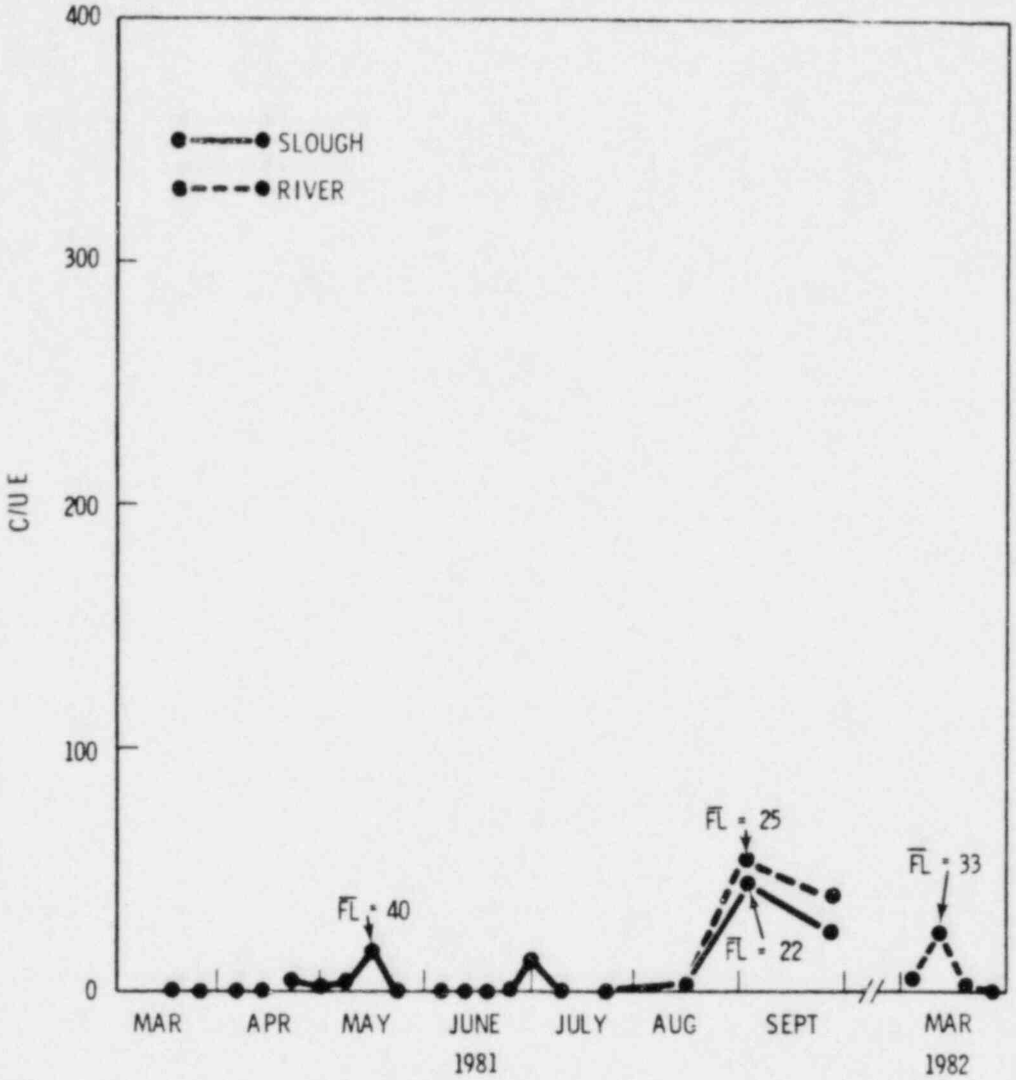


FIGURE 20. Catch Per Unit Effort (C/UE) for Redside Shiner Seined in Columbia River and Hanford Slough Stations, March-September 1981 and March 1982. $\overline{FL}$ = mean fork length in mm.

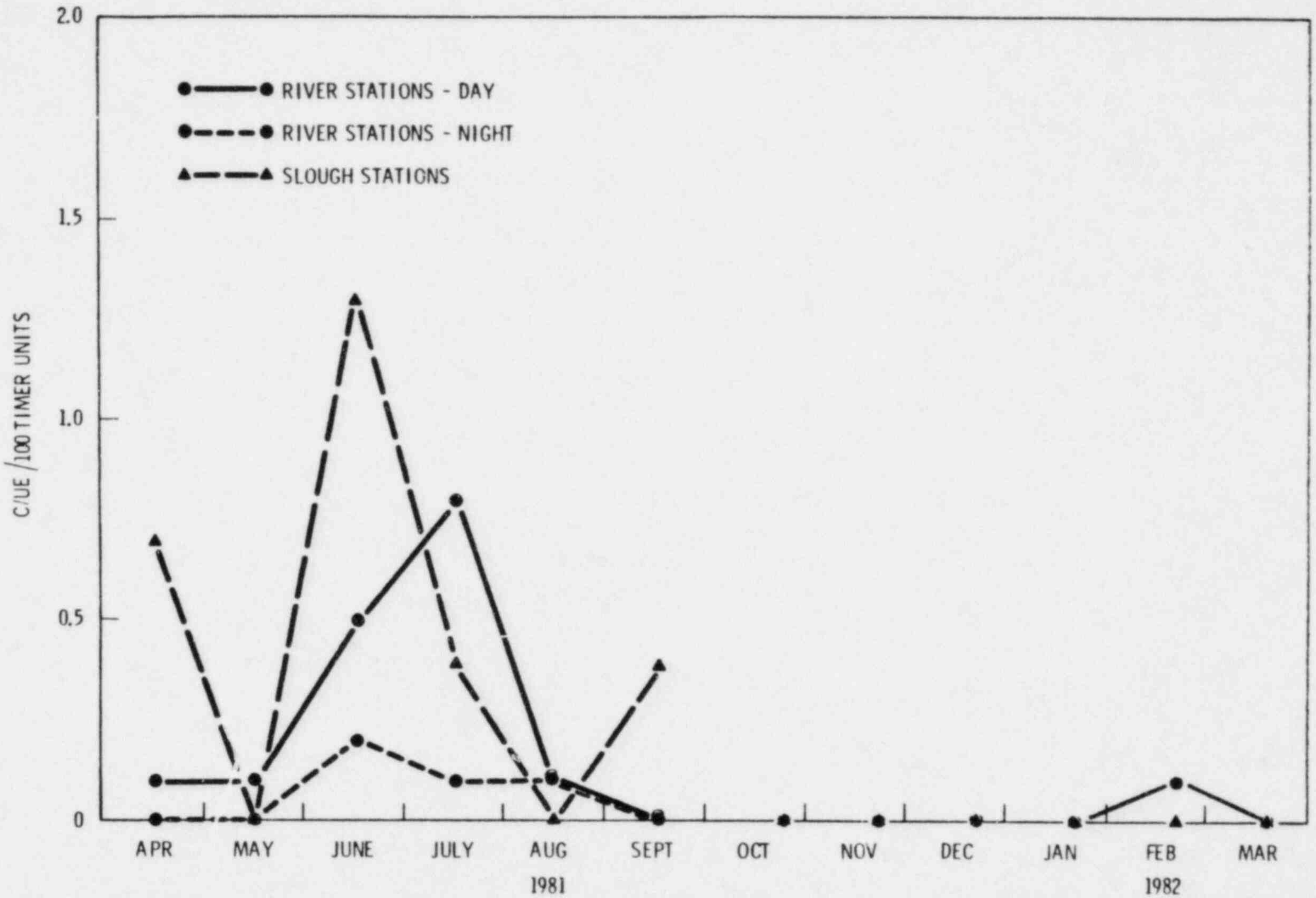


FIGURE 21. Catch Per Unit Effort (C/UE) for Carp Collected by Boat Electroshocker at Columbia River and Hanford Slough Stations, April 1981 - March 1982

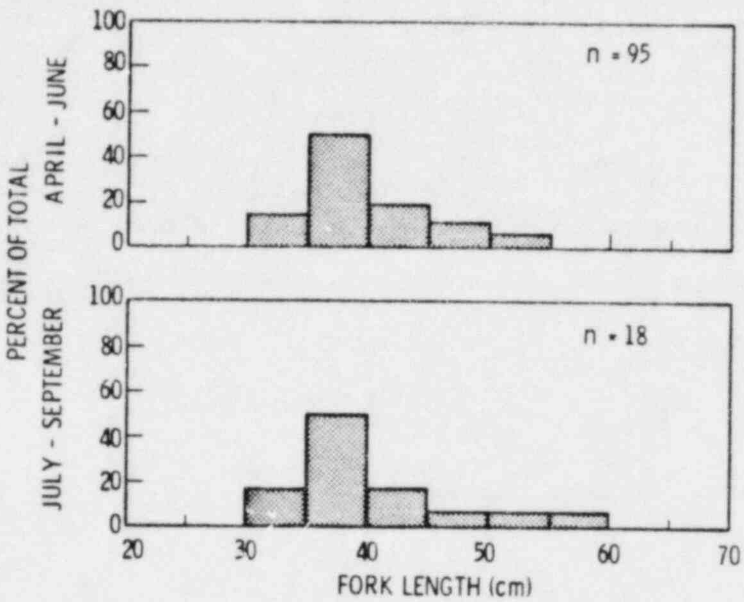


FIGURE 22. Length-Frequency of Carp Collected by Boat Electroshocker, April-September 1981

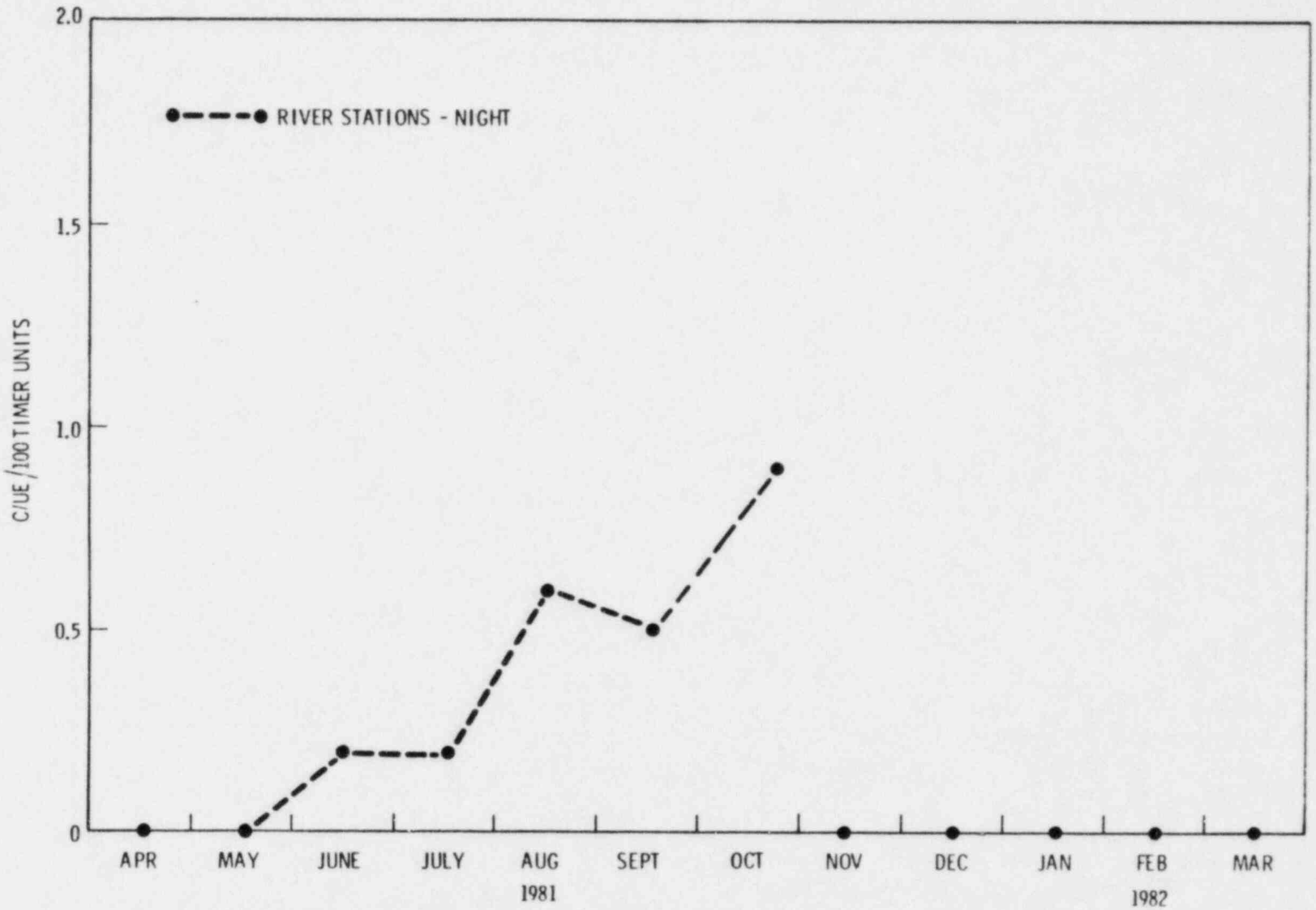


FIGURE 23. Catch Per Unit Effort (C/UE) for Chiselmouth Collected by Boat Electroshocker at Columbia River Stations, April 1981 - March 1982

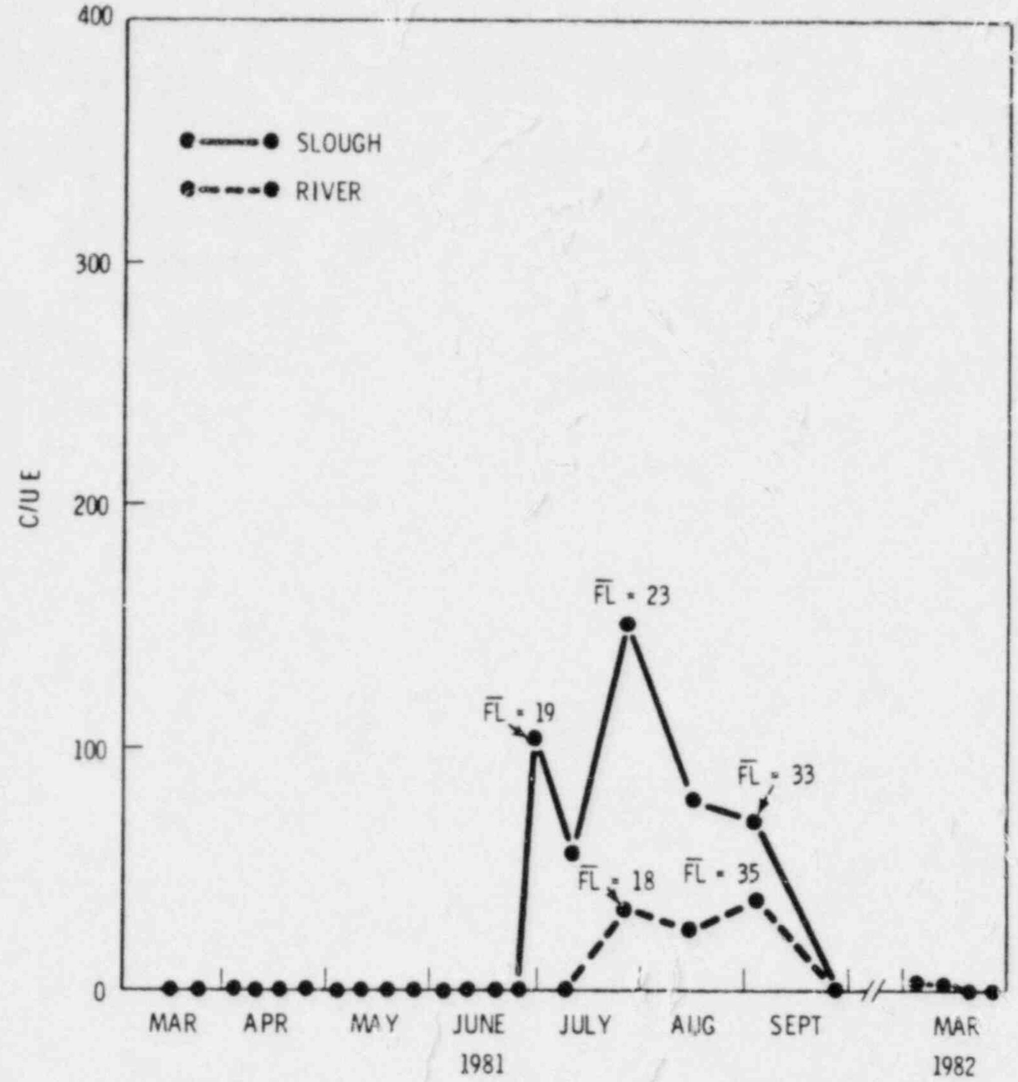


FIGURE 24. Catch Per Unit Effort (C/UE) for Sucker Seined at Columbia River and Hanford Slough Stations, March–September 1981 and March 1982. $\overline{FL}$ = mean fork length in mm.

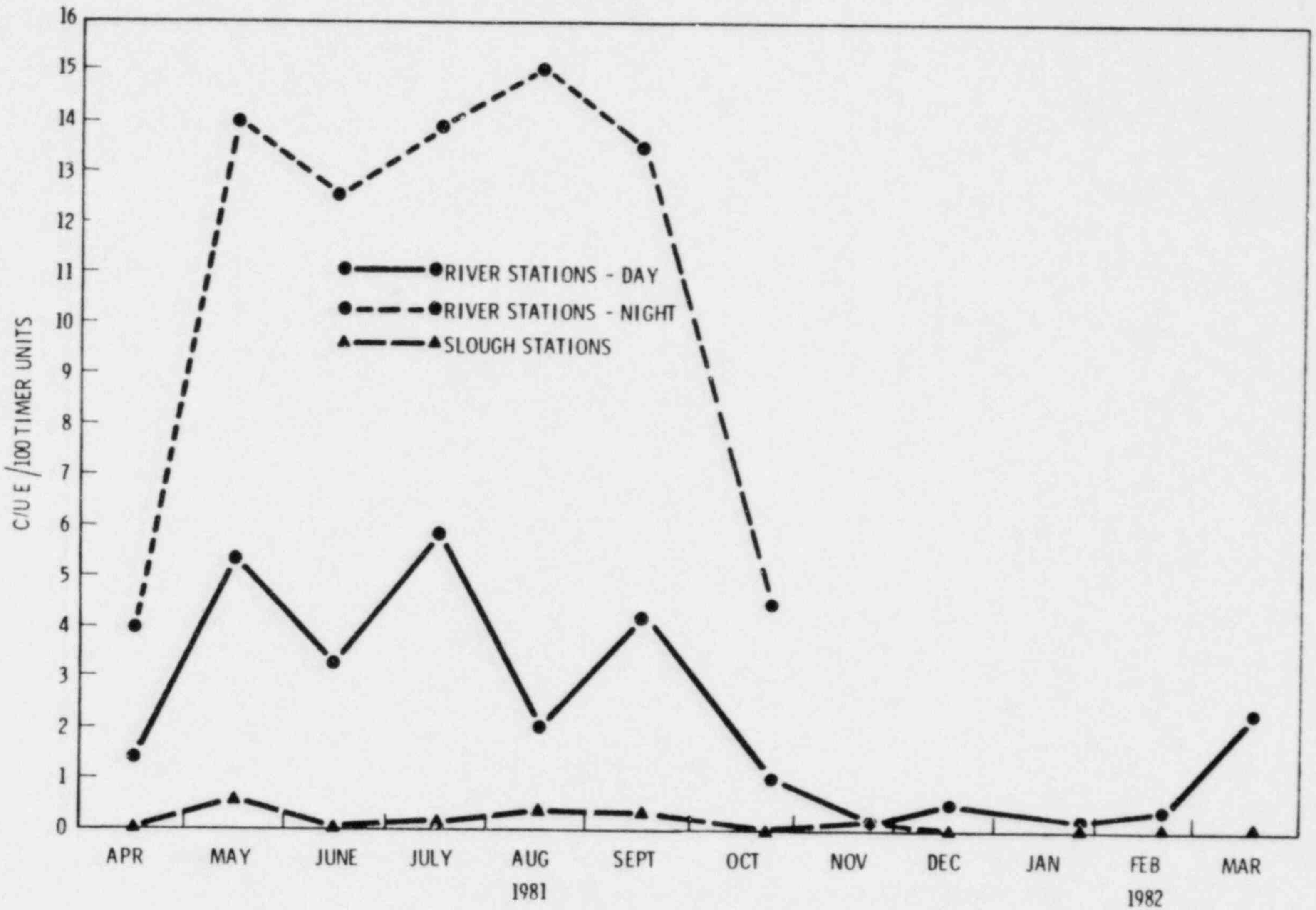


FIGURE 25. Catch Per Unit Effort (C/UE) for Largescale Sucker Collected with Boat Electroshocker, April 1981 - March 1982.

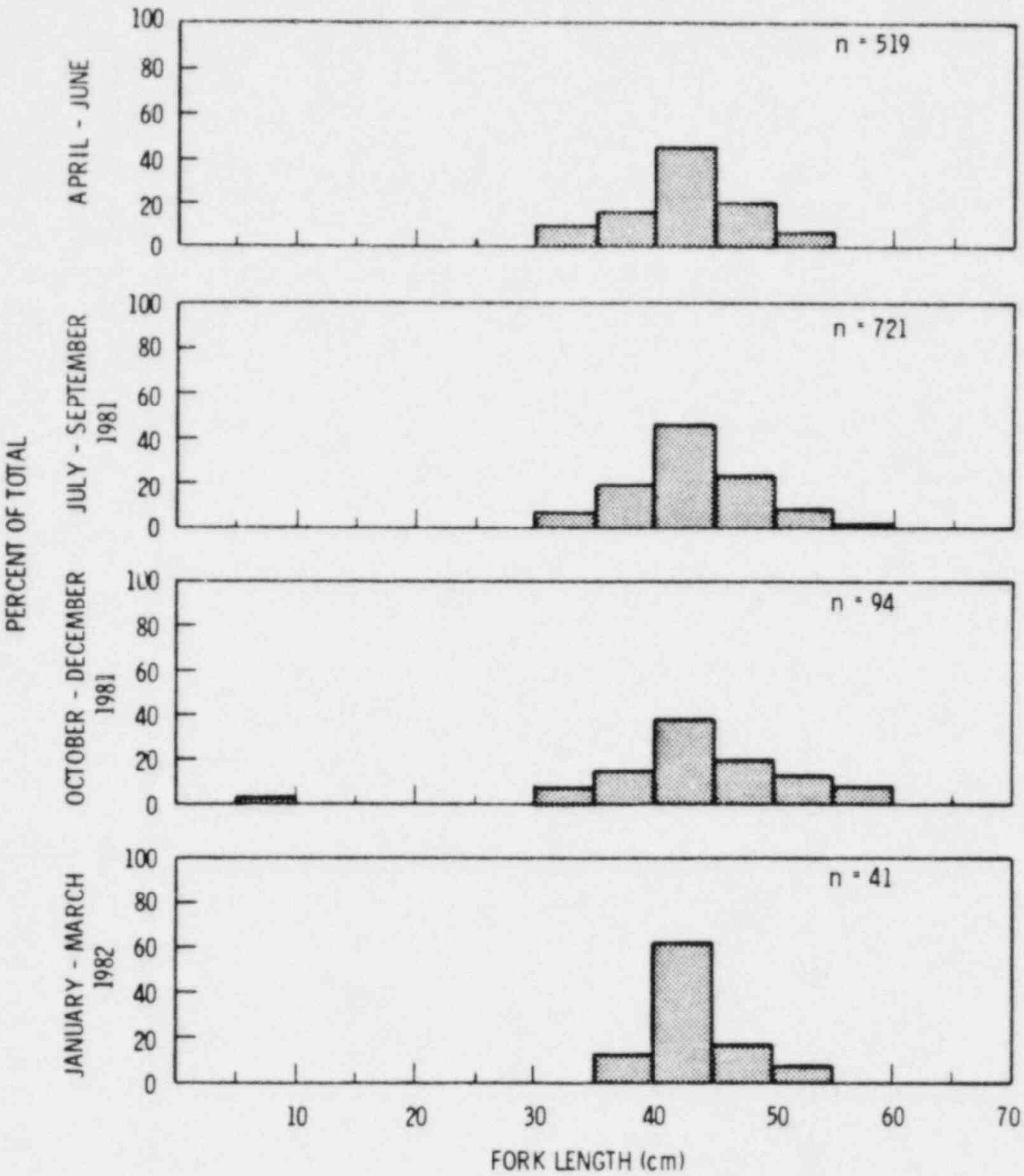


FIGURE 26. Length-Frequency of Largescale Sucker Collected by Boat Electroshocker, April 1981 - March 1982

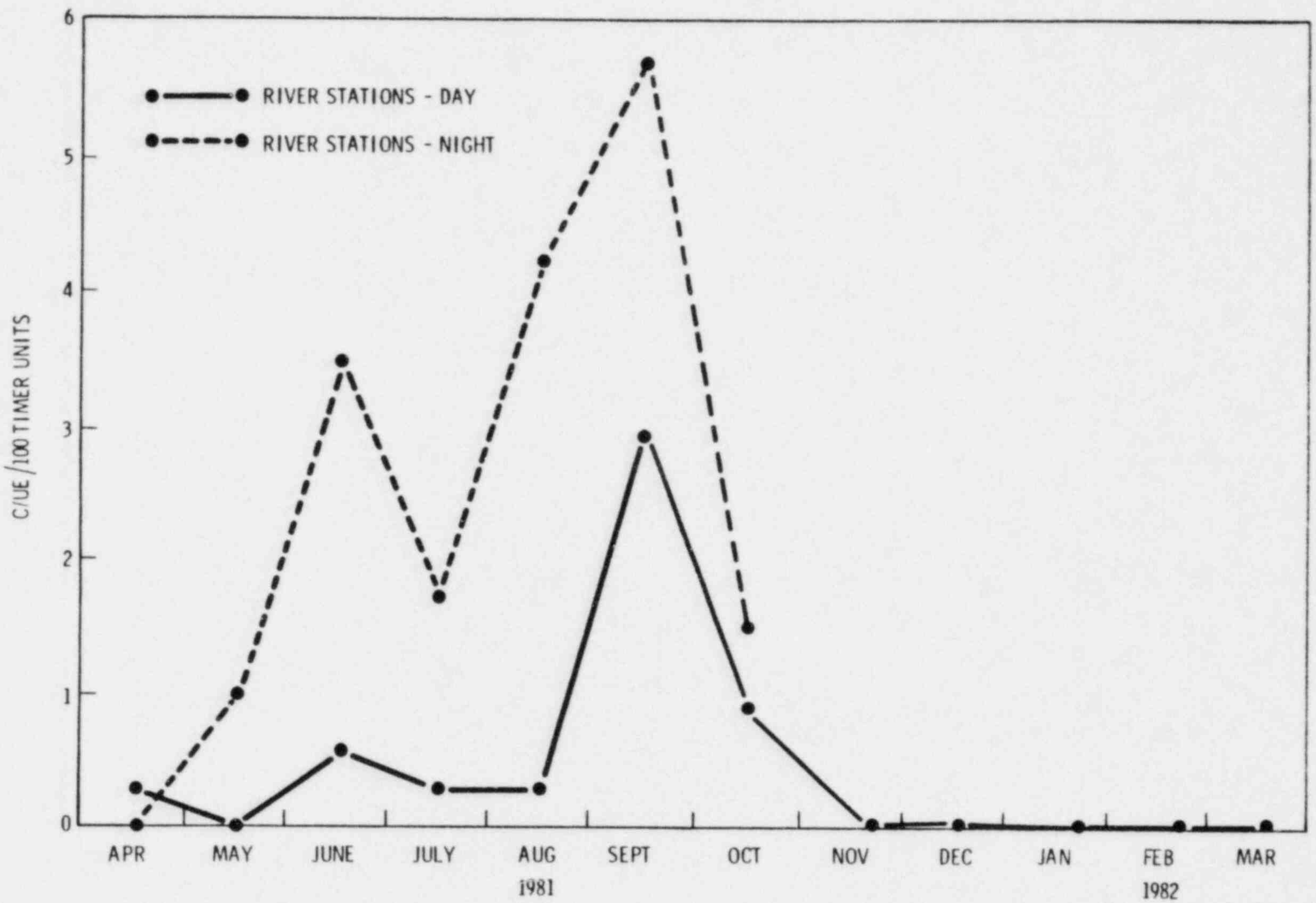


FIGURE 27. Catch Per Unit Effort (C/UE) for Bridgelip Sucker Collected with Boat Electroshocker at Columbia River Stations, April 1981 - March 1982.

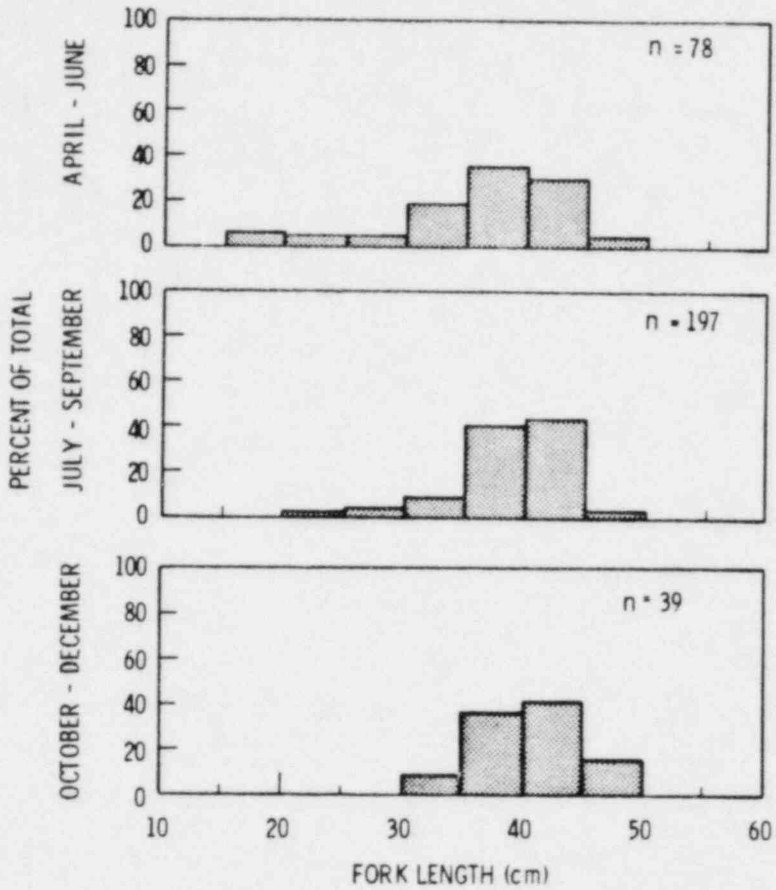


FIGURE 28. Length-Frequency of Bridgelip Sucker Collected by Boat Electroshocker, April-December 1981

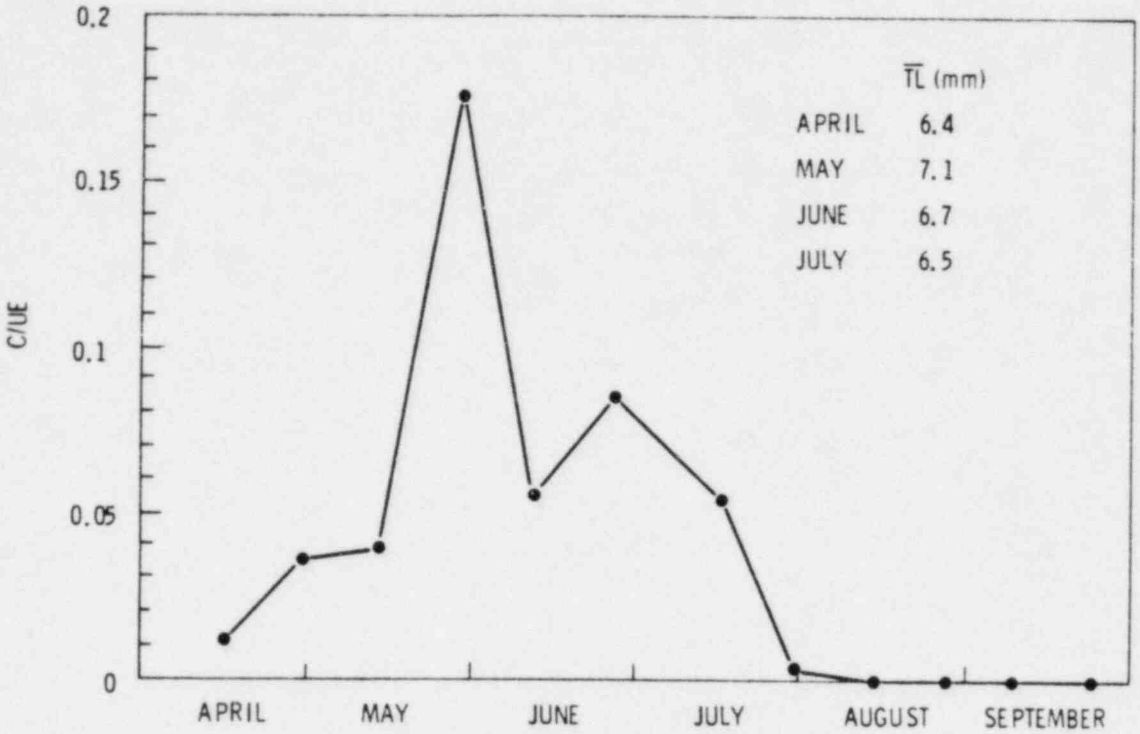


FIGURE 29. Catch Per Unit Effort (C/UE) and Mean Size for Prickly Sculpin Collected in Midchannel Ichthyoplankton Tows near Columbia River Mile 361.5, April-September 1981

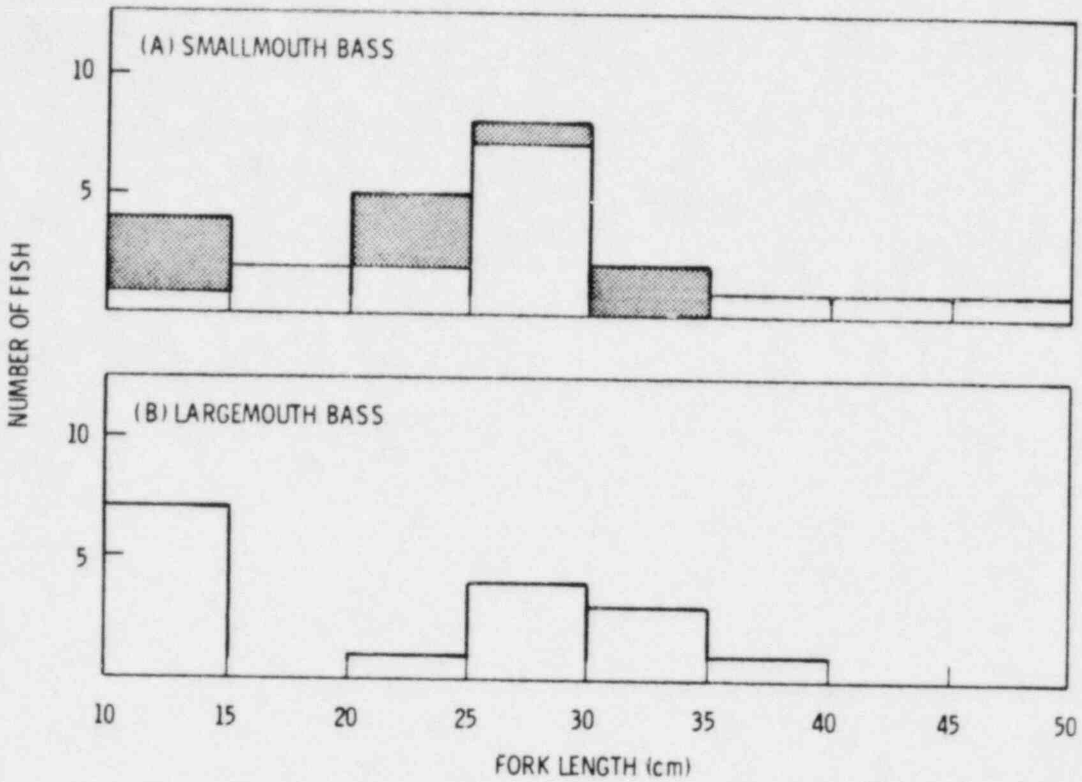


FIGURE 30. Length-Frequency of (A) Smallmouth Bass and (B) Largemouth Bass Collected in Hanford Slough (open) and Columbia River (Solid) near Rm 361.5 from April 1981 - March 1982

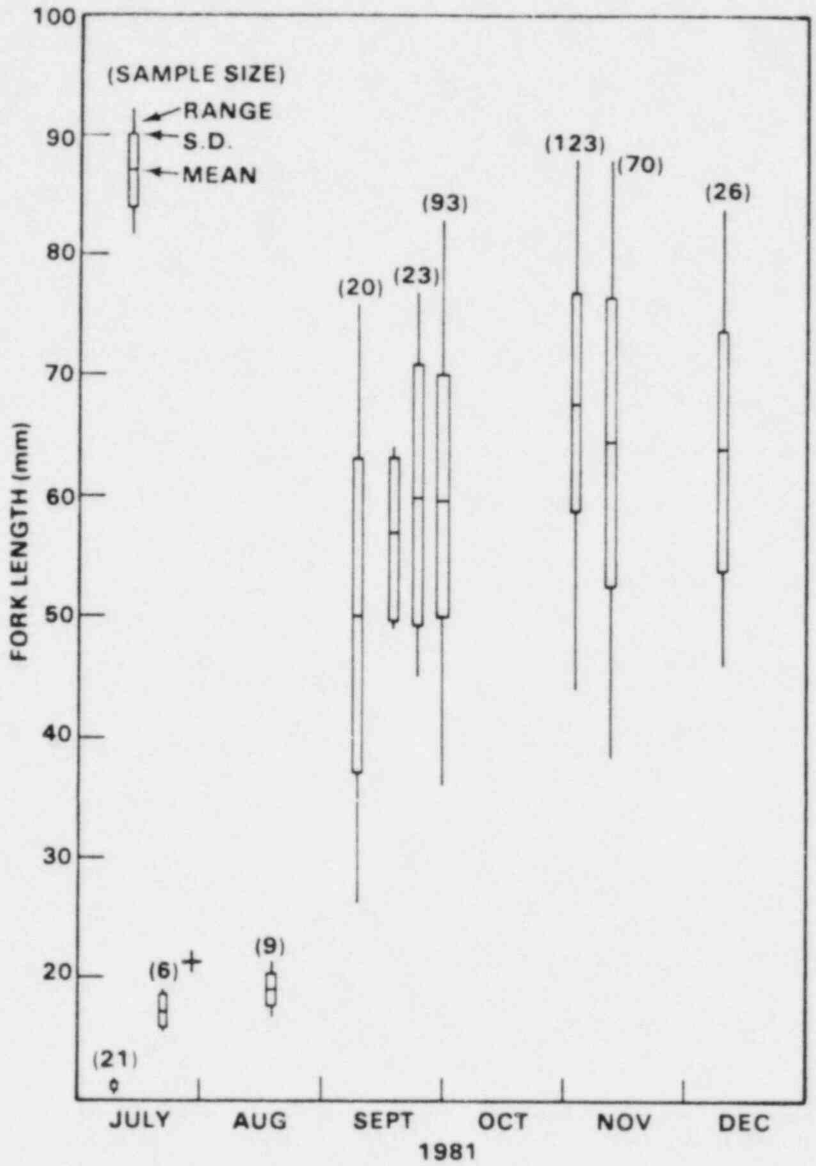


FIGURE 31. Size of Zero-Age Smallmouth Bass Collected in Hanford Slough and Adjacent Columbia River from July-December 1981

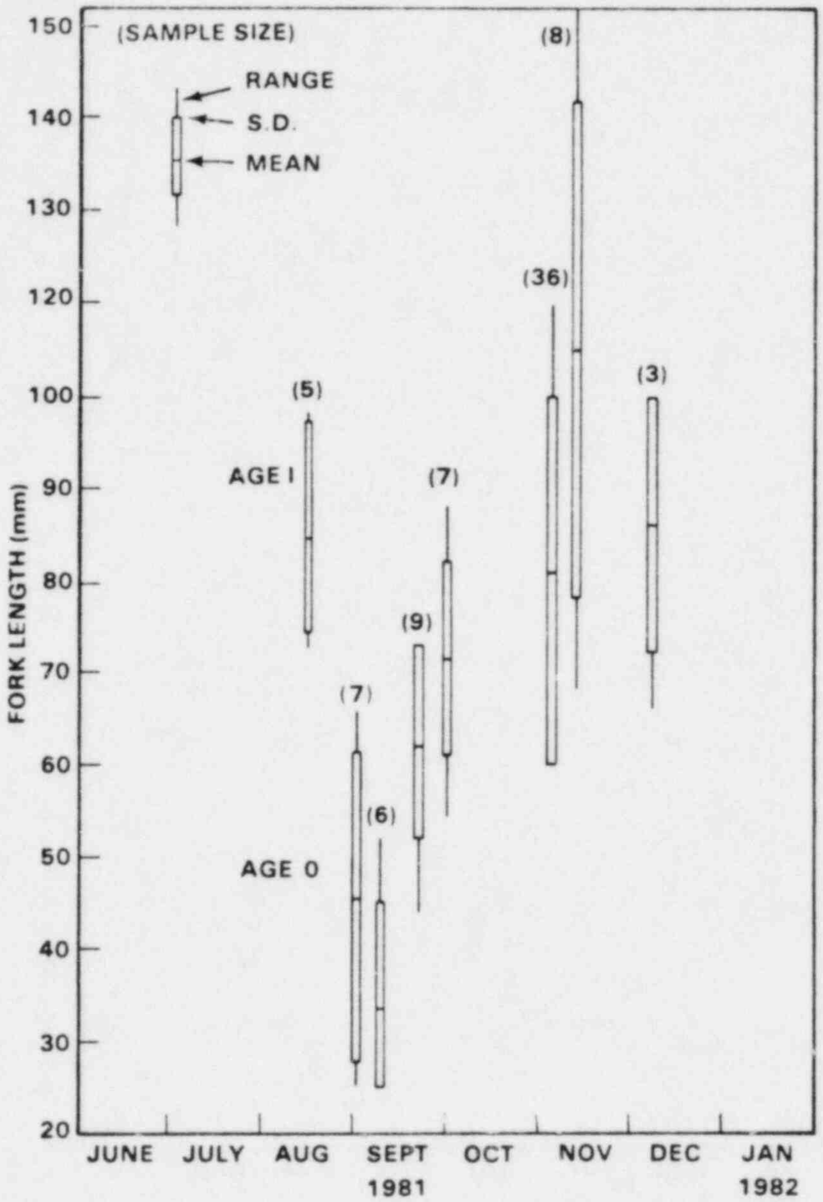


FIGURE 32. Size of Juvenile Largemouth Bass Collected in Hanford Slough and Adjacent Columbia River, July-December 1981.

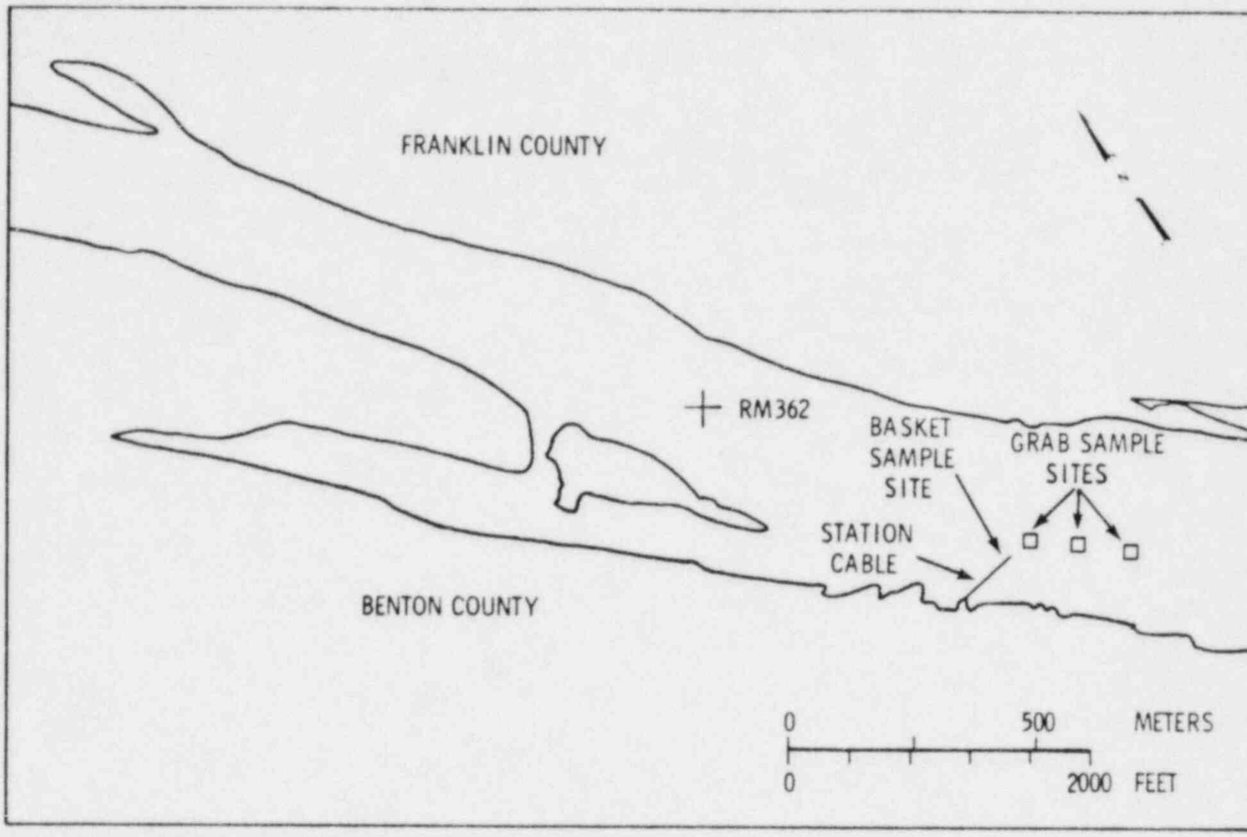


FIGURE 33. Basket and Grab Sample Sites for Benthic Collections near the S/HNP Intake/Discharge Site

TABLE 1. Fish Sampling Frequency in the Columbia River and Hanford Slough, March 1981-April 1982

Month	River Stations						Slough Stations			
	Beach Seine	Bp ESH(a)	Boat ESH(b)	Hoop Nets	ICH(c)	River Survey	Beach Seine	Bp ESH(a)	Boat ESH(b)	Slough Survey
1981										
March	2	0	0	0	0	0	2	0	0	0
April	5	1	D/N	0	2	0	5	2	D	2
May	4	1	D/N	1	2	0	4	2	D	2
June	4	1	D/N	1	2	0	4	2	D	5
July	4	1	D/N	1	2	0	4	2	D	5
August	1	1	D/N	1	2	0	1	2	D	3
September	2	1	D/N	1	2	0	2	2	D	2
October	0	1	D/N	1	0	0	0	0	D	0
November	0	1	D	0	0	2	0	0	D	2
December	0	0	D	0	0	1	0	0	D	2
1982										
January	0	0	D	0	0	1	0	0	D	2
February	0	0	D	0	0	2	0	0	D	3
March	4	0	D	0	2	1	4	0	D	1
April	0	0	N	0	2	0	0	0	0	0

(a) Backpack electroshocker.
(b) Boat electroshocker.
(c) Ichthyoplankton.
D/N = day and night sample.
D = single day sample.
N = night sample.

TABLE 2. List of Fish Species Collected in the Columbia River and Hanford Slough, March 1981-April 1982. Key to life stage: L = larval, Al = alevin, J = juvenile, Ad = adult (from Baton 1975). Locations: HS = Hanford Slough, CR = Columbia River. Includes fish collected in surveys outside of regular sampling stations.

Taxa	Common Name	Life Stage	Location
Acipenseridae			
Acipenser transmontanus	White sturgeon	J	CR
Catostomidae			
Catostomus columbianus	Bridgelip sucker	J, Ad	CR,HS
C. macrocheilus	Largescale sucker	L, J, Ad	CR, HS
C. macrocheilus x C. columbianus	Sucker hybrid	Ad	CR
Centrarchidae			
Lepomis gibbosus	Pumpkinseed	J, AD	CR, HS
L. macrochirus	Bluegill	J, Ad	CR, HS
Micropterus dolomieui	Smallmouth bass	L, J, Ad	CR, HS
M. salmoides	Largemouth bass	J, Ad	CR, HS
Pomoxis nigromaculatus	Black crappie	Ad	CR, HS
Clupeidae			
Alosa sapidissima	American shad	L, Ad	CR, HS
Cottidae			
Cottus asper	Prickly sculpin	L, J, Ad	CR, HS
C. beldingi	Piute sculpin	L	CR
C. rhotheus	Torrent sculpin	J, Ad	CR
Cyprinidae			
Acrocheilus alutaceus	Chiselmouth	Ad	CR
Cyprinus carpio	Carp	L, J, Ad	CR, HS
Mylocheilus caurinus	Peamouth chub	L, J, Ad	CR, HS
Ptychocheilus oregonensis	Northern squawfish	L, J, Ad	CR, HS
Rhinichthys cataractae	Longnose dace	J, Ad	CR
R. falcatus	Leopard dace	J, Ad	CR
R. osculus	Speckled dace	J, Ad	CR
Richardsonius balteatus	Redside shiner	L, J, Ad	CR, HS
Cyprinid hybird	Cyprinid hybrid	Ad	CR
Gasterosteidae			
Gasterosteus aculeatus	Three-spined stickleback	J, Ad	CR, HS
Ictaluridae			
Ictalurus nebulosus	Brown bullhead	Ad	CR, HS
Percidae			
Perca flavescens	Yellow perch	L, J, Ad	CR, HS
Stizostedion vitreum	Walleye	Ad, J	CR, HS
Percopsidae			
Percopsis transmontana	Sand roller	J, Ad	CR
Salmonidae			
Oncorhynchus nerka	Sockeye salmon	J, Ad	CR, HS
Oncorhynchus tshawytscha	Chinook salmon	Al, J, Ad	CR, HS
Prosopium williamsoni	Mountain whitefish	Al, J, Ad	CR
Salvelinus malma	Dolly Varden	J	CR

TABLE 3. Numerical Abundance of Fish Taxa Collected in the Columbia River and Hanford Slough at Regular Sample Stations near RM 361.5, March 1981-April 1982

Scientific Name	Totals	Rank	Beach Seine	Hoop Net	Bp ESH[a]	Boat ESH[b]	ICH[c]
Acipenser transmontanus	1	29	0	0	0	1	0
Catostomus columbianus	355	8	39	4	2	310	0
C. macrocheilus	2629	5	1167	6	95	1361	0
Catostomid hybrid	27	19	0	1	0	26	0
Catostomid fry[d]	2550	6	1937	0	613	0	0
Lepomis gibbosus	29	18	8	3	13	5	0
L. macrochirus	6	26	1	0	3	2	0
Micropterus dolomieui	108	11	44	5	38	21	0
M. salmoides	34	16	11	0	11	12	0
Micropterus spp.	34	16	6	0	28	0	0
Pomoxis nigromaculatus	3	27	0	0	0	3	0
Alosa sapidissima	2	28	0	0	0	0	2
Cottus asper	320	9	15	1	57	36	211
C. beldingi	1	29	0	0	0	0	1
C. rhotheus	32	17	0	0	31	1	0
Cottus spp.	113	10	7	0	105	0	1
Acrocheilus alutaceus	36	15	0	1	0	35	0
Cyprinus carpio	68	13	1	0	13	53	1
Mylocheilus caurinus[d]	4894	3	4664	5	174	51	0
Ptychocheilus oregonensis[d]	4972	2	4560	6	339	67	0
Rhinichthys cataractae	10	24	2	0	8	0	0
R. osculus	11	23	0	0	11	0	0
R. falcatus	6	26	1	0	5	0	0
Rhinichthys spp.	15	22	0	0	15	0	0
Richardsonius balteatus[d]	1737	7	1644	3	70	20	0
Cyprinid hybrid	3	27	0	0	0	3	0
Cyprinid fry	3286	4	148	0	3137	0	1
Gasterosteus aculeatus	66	14	40	1	25	0	0
Ictalurus nebulosus	9	25	0	1	1	7	0
Perca flavescens	24	20	16	1	3	4	0
Percopsis transmontana	16	21	0	0	16	0	0
Oncorhynchus nerka	2	28	1	0	0	1	0
O. tshawytscha	17376	1	16916	1	402	55	2
Prosopium williamsoni	74	12	0	0	1	73	0

(a) Backpack electroshocker.
(b) Boat electroshocker.
(c) Ichthyoplankton.
(d) Totals include field estimates.

TABLE 4. Hoop Net Catch Totals at Four Columbia River Stations near RM 361.5, May-October 1981

Taxa	Monthly Totals						
	May	June	July	Aug.	Sept.	Oct.	Total
Catostomidae							
Catostomus columbianus	0	2	1	0	1	0	4
C. macrocheilus	0	3	2	1	0	0	6
C. macrocheilus x C. columbianus	0	1	0	0	0	0	1
Centrarchidae							
Lepomis gibbosus	0	0	0	1	2	0	3
Micropterus dolomieui	0	0	1	1	0	3	5
Cottidae							
Cottus asper	0	0	0	0	1	0	1
Cyprinidae							
Acrocheilus alutaceus	0	0	1	0	0	0	1
Mylocheilus caurinus	0	0	0	5	0	0	5
Ptychocheilus oregonensis	0	2	1	2	0	1	6
Richardsonius balteatus	1	1	1	0	0	0	3
Gasterosteidae							
Gasterosteus aculeatus	0	0	0	0	0	1	1
Ictaluridae							
Ictalurus nebulosus	1	0	0	0	0	0	1
Percidae							
Perca flavescens	0	0	0	0	1	0	1
Salmonidae							
Oncorhynchus tshawytscha	1	0	0	0	0	0	1

TABLE 5. Beach Seine Catch Totals at Four Columbia River Stations near RM 361.5, March-September 1981 and March 1982

Taxa	1981							1982	
	Mar.	Apr.	May	June	July	Aug.	Sept.	Mar.	Total
Catostomidae									
C. macrocheilus	0	0	0	0	1	172	329	2	504
Catostomus spp.	0	0	0	0	262	3	0	0	265
Centrarchidae									
Lepomis gibbosus	0	0	0	2	0	0	1	0	3
Cottidae									
Cottus asper	0	0	0	0	12	1	0	0	13
Cottus spp.	0	0	0	0	7	0	0	0	7
Cyprinidae									
Mylocheilus caurinus	0	0	6	2	262	195	147	0	612
Ptychocheilus oregonensis	5	5	0	6	0	1	2054	8	2079
Rhinichthys cataractae	0	0	0	0	0	2	0	0	2
R. falcatus	0	0	0	0	0	0	1	0	1
Richardsonius balteatus	4	1	12	7	0	0	797	129	950
Cyprinid fry	0	0	0	0	3	10	1	0	14
Gasterosteidae									
Gasterosteus aculeatus	3	1	0	0	0	0	12	9	25
Percidae									
Perca flavescens	0	0	0	1	2	0	0	0	3
Salmonidae									
Oncorhynchus tshawytscha	209	3969	3881	440	0	0	0	15	8514
Prosopium williamsoni	0	1	0	0	0	0	0	0	1

TABLE 6. Beach Seine Catch Totals at Three Hanford Slough Stations, March-September 1981 and March 1982

Taxa	1981							1982	
	Mar.	Apr.	May	June	July	Aug.	Sept.	Mar.	Total
Catostomidae									
Catostomus columbianus	0	0	0	0	39	0	0	0	39
C. macrocheilus	0	0	0	0	8	216	439	0	663
Catostomus spp.	2	0	0	0	1441	229	0	0	1672
Centrarchidae									
Lepomis gibbosus	0	0	0	0	0	0	4	1	5
L. macrochirus	0	1	0	0	0	0	0	0	1
Micropterus dolomieui	0	0	0	0	6	2	36	0	44
M. salmoides	0	0	0	0	1	0	10	0	11
Micropterus spp.	0	0	0	0	2	4	0	0	6
Cottidae									
Cottus asper	0	0	0	0	2	0	0	0	2
Cyprinidae									
Cyprinus carpio	0	0	0	0	1	0	0	0	1
Mylocheilus caurinus	0	2	16	46	1671	2182	135	0	4052
Ptychocheilus oregonensis	50	82	30	2	0	1	2309	7	2481
Richardsonius balteatus	1	37	136	1	75	6	432	6	694
Cyprinid fry	0	0	0	0	1	133	0	0	134
Gasterosteidae									
Gasterosteus aculeatus	1	4	0	0	1	1	7	1	15
Percidae									
Perca flavescens	0	0	0	1	12	0	0	0	13
Salmonidae									
Oncorhynchus nerka	0	0	0	1	0	0	0	0	1
O. tshawytscha	267	4374	3316	340	91	0	0	14	8402

TABLE 7. Backpack Electroshocker Catch Totals for Two Columbia River Stations near RM 361.5, April-November 1981

Taxa	Monthly Totals Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
Catostomidae									
Catostomus columbianus	0	0	0	0	1	0	0	0	1
C. macrocheilus	1	0	1	0	5	17	20	11	55
Catostomus spp.	0	1	0	0	11	424	10	60	506
Centrarchidae									
Lepomis gibbosus	0	0	0	0	0	2	0	0	2
L. macrochirus	0	0	1	0	0	1	0	1	1
Micropterus dolomieui	0	0	1	0	0	1	1	0	3
Cottidae									
Cottus asper	2	0	1	0	2	8	1	2	16
C. rhotheus	5	6	0	0	4	1	7	4	27
Cottus spp.	4	0	1	0	1	15	3	2	26
Cyprinidae									
Mylocheilus caurinus	1	1	0	0	8	4	0	35	49
Ptychocheilus oregonensis	7	0	0	0	0	50	65	148	260
Rhinichthys cataractae	0	0	0	0	0	3	1	0	4
R. osculus	0	0	1	0	0	3	4	2	10
R. falcatus	0	0	0	0	0	2	1	2	5
Rhinichthys spp.	0	0	0	0	0	14	1	0	15
Richardsonius balteatus	13	9	0	0	0	21	4	6	53
Cyprinid fry	0	0	0	1	337	582	7	32	959
Gasterosteidae									
Gasterosteus aculeatus	0	0	1	0	0	0	0	2	3
Percopsidae									
Percopsis transmontana	0	0	0	0	0	2	14	0	16
Salmonidae									
Oncorhynchus tshawytscha	16	112	1	0	1	0	0	0	130
Prosopium williamsoni	0	0	0	0	0	1	0	0	1
Combined Timer Units	383	556	365	539	667	955	764	713	

TABLE 8. Backpack Electroshocker Totals for Hanford Slough Stations, April-September 1981

Taxa	Monthly Totals						
	Apr.	May	June	July	Aug.	Sept.	Total
Catostomidae							
Catostomus columbianus	0	0	0	0	1	0	1
C. macrocheilus	3	1	0	0	25	11	40
Catostomus spp.	0	1	0	32	53	21	107
Centrarchidae							
Lepomis gibbosus	0	0	0	0	1	10	11
Micropterus dolomieui	1	1	0	0	0	35	37
M. salmoides	0	0	0	0	2	9	11
Micropterus spp.	0	0	0	0	1	27	28
Cottidae							
Cottus asper	3	2	0	5	9	22	41
C. rhotheus	0	2	0	0	2	0	4
Cottus spp.	16	1	0	3	4	55	79
Cyprinidae							
Cyprinus carpio	0	0	3	0	0	10	13
Mylocheilus caurinus	0	0	8	0	101	16	125
Ptychocheilus oregonensis	6	5	0	0	20	38	69
Rhinichthys cataractae	0	0	0	1	3	0	4
R. osculus	0	0	0	0	1	0	1
Richardsonius balteatus	1	0	0	0	4	12	17
Cyprinid fry	0	0	0	122	1497	559	2178
Gasterosteidae							
Gasterosteus aculeatus	0	2	0	0	0	20	22
Ictaluridae							
Ictalurus nebulosus	0	0	0	0	0	1	1
Percidae							
Perca flavescens	0	0	0	2	1	0	3
Salmonidae							
Oncorhynchus tshawytscha	53	80	3	0	0	0	136
Combined Timer Units	1155	1812	1203	1635	2077	2415	

TABLE 9. Fish Species Collected in Midchannel Ichthyoplankton Tows at RM 361.5, April-September 1981 and March-April 1982

Scientific Name	1981						1982			%
	Apr.	May	June	July	Aug.	Sept.	Mar.	Apr.	Total	Total
Alosa sapidissima	0	0	0	2	0	0	0	0	2	<1
Cottus asper	13	95	73	30	0	0	0	0	211	95.0
Cottus beldingi	0	0	1	0	0	0	0	0	1	<1
Cyprinus carpio	0	0	0	1	0	0	0	0	1	<1
Unknown cyprinid	0	0	0	1	0	0	0	0	1	<1
Oncorhynchus tshawytscha	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

TABLE 10. Boat Electroshocker Catch Totals for Columbia River Transects near RM 361.5, April 1981 - March 1982. Totals reflect day sampling only, from November 1981 to March 1982.

Taxa	1981									1982			Total
	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	
Acipenseridae													
Acipenser transmontanus	0	0	0	0	0	0	1	0	0	0	0	0	1
Catostomidae													
Catostomus columbianus	4	11	58	24	61	112	35	1	3	1	0	0	310
C. macrocheilus	57	223	225	238	232	240	87	3	6	4	5	32	1352
Catostomid hybrid	1	4	10	2	3	4	1	0	1	0	0	0	26
Centrarchidae													
Lepomis macrochirus	0	0	1	0	0	0	0	0	0	0	0	0	1
Micropterus dolomieui	0	1	0	0	4	0	0	0	0	0	0	0	5
Pomoxis nigromaculatus	0	0	0	0	0	1	0	0	0	0	0	0	1
Cottidae													
Cottus asper	0	0	5	3	5	7	3	0	0	0	0	0	23
C. rhotheus	0	0	1	0	0	0	0	0	0	0	0	0	1
Cyprinidae													
Acrocheilus alutaceus	0	0	2	2	9	7	15	0	0	0	0	0	35
Cyprinus carpio	1	1	12	10	2	0	3	0	0	0	1	0	30
Mylocheilus caurinus	0	0	0	4	19	21	3	0	0	0	0	0	47
Ptychocheilus oregonensis	3	10	11	6	12	10	8	0	0	0	0	0	60
Richardsonius balteatus	0	0	3	3	10	3	0	0	0	0	0	0	19
Cyprinid hybrid	0	0	0	0	0	1	1	0	0	0	1	0	3
Salmonidae													
Oncorhynchus nerka	0	0	0	1	0	0	0	0	0	0	0	0	1
O. tshawytscha	1	16	23	9	2	1	2	0	0	0	0	0	54
Propsopium williamsoni	21	3	1	1	12	10	24	0	1	0	0	0	73
Combined Timer Units	2214	2335	3013	2432	2447	2462	2593	1162	1093	1295	1113	1340	

TABLE 11. Boat Electroshocker Catch Totals for the Hanford Slough Transect, April 1981 - March 1982

Taxa	1981									1982			
	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Total
Catostomidae													
Catostomus macrocheilus	0	4	0	1	1	2	0	1	0	0	0	0	9
Centrarchidae													
Lepomis gibbosus	0	0	0	0	1	1	3	0	0	0	0	0	5
L. macrochirus	0	0	0	0	0	1	0	0	0	0	0	0	1
Micropterus dolomieui	2	1	0	1	0	10	0	0	2	0	0	0	16
M. salmoides	0	0	0	1	0	8	2	1	0	0	0	0	12
Pomoxis nigromaculatus	0	0	1	0	0	0	0	0	1	0	0	0	2
Cottidae													
Cottus asper	0	0	0	1	0	9	1	0	2	0	0	0	13
Cyprinidae													
Cyprinus carpio	7	0	10	3	0	3	0	0	0	0	0	0	23
Mylocheilus caurinus	0	0	4	0	0	0	0	0	0	0	0	0	4
Ptychocheilus oregonensis	0	0	6	0	1	0	0	0	0	0	0	0	7
Richardsonius balteatus	0	0	0	0	0	1	0	0	0	0	0	0	1
Ictaluridae													
Ictalurus nebulosus	0	0	2	2	0	1	0	1	1	0	0	0	7
Percidae													
Perca flavescens	0	3	1	0	0	0	0	0	0	0	0	0	4
Salmonidae													
Oncorhynchus tshawytscha	0	0	0	1	0	0	0	0	0	0	0	0	1
Combined Timer Units	966	789	775	735	580	817	544	585	876	647	493	642	

TABLE 12. River Boat Electroshocking Catch Per Unit Effort (C/UE) in Relation to Water Clarity, Temperatures, and Average Daily Flow from April 1981 - March 1982 near Columbia River Mile 361.5

Sample Month	Station	Secchi Disc Depth, cm[a]	Water Temp., °C[a]	Average Daily Flow, CFS x 1000	C/UE[b] Day	C/UE[b] Night
1981						
April	Benton	217	9.5	95	25	27
	Franklin				13	110
May	Benton	120	12.5	161	20	144
	Franklin				117	211
June	Benton	185	14.0	225	53	211
	Franklin				70	145
July	Benton	177	18.3	200	63	193
	Franklin				73	155
August	Benton	187	19.0	162	6	226
	Franklin				43	268
September	Benton	207	17.5	90	71	202
	Franklin				77	284
October	Benton	—	13.3	100	41	77
	Franklin				7	111
November	Benton	255	10.0	103	5	—
	Franklin				2	—
December	Benton	300	7.2	108	7	—
	Franklin				14	—
1982						
January	Benton	492	4.0	138	4	—
	Franklin				4	—
February	Benton	282	3.3	162	3	—
	Franklin				11	—
March	Benton	154	4.5	229	22	—
	Franklin				27	—

(a) Values measured at mid stream.
(b) Based on 1000 timer units.

TABLE 13. Summary of Mark-and-Recapture Data of Fish >20 cm by Species, April 1981 - April 1982. Totals include recaptures through June 1982.

Species	# Tagged	# Recaptured	% Recaptured	At-Large Time Interval, days
Catostomus macrocheilus	1337	75[a]	5.6	0-324
C. columbianus	280	2	0.7	35,147
hybrid catostomid	25	0	0	—
Cyprinus carpio	139[b]	1	0.7	404
Ptychocheilus oregonensis	53	2	3.8	111, 164
Acrocheilus alutaceus	25	0	0	—
Mylocheilus caurinus	12	0	0	—
hybrid cyprinid	3	0	0	—
Micropterus salmoides	8[b]	1	12.5	91
M. dolomieui	13[b]	1	7.7	11
Pomoxis nigromaculatus	5[b]	1	20.0	157
Perca flavescens	3	0	0	—
Ictalurus nebulosus	22	0	0	—
Prosopium williamsoni	61	2	3.3	27, 156
Totals	1986	85	4.3	—

(a) Includes recovery of tag with coded portion missing.
(b) Totals include fish tagged during slough surveys.

TABLE 14. Summary by Month of Mark-and-Recapture Data of Fish >20 cm. Totals include recaptures through June 1982.

Release Month	# Tagged	# Recaptured	% Recaptured
1981			
April	101	7	6.9
May	348	26	7.5
June	340	14	4.1
July	279	8	2.9
August	316	14	4.4
September	367	7	1.9
October	170	8	4.7
November	5	0	0
December	11	0	0
1982			
January	5	0	0
February	8	0	0
March	36	0	0
Totals	1986	84	4.2

TABLE 15. Recapture Summary for Juvenile Bass Tagged with Floy Fry Tags in Hanford Slough and Adjacent Columbia River Survey Areas. All fish were captured within original release location.

Species	Location	# Tagged	% Recaptured	At-Large Time Interval, days
Micropterus dolomieui	Hanford Slough	153	7.8	7-35
	Columbia River	57	7.0	29-34
M. salmoides	Hanford Slough	41	12.2	7-35

TABLE 16. Estimates of Combined Largescale Sucker Population Size in the Two Columbia River Boat Electroshocker Transects Based on Jolly-Seber Stochastic Mark-Recapture Method, May-October 1981

Month	Population Size Estimate, N_i	Standard Error of Estimate, SE_{N_i}
May	2,108	1,969
June	14,961	9,422
July	12,343	6,721
August	10,549	5,625
September	7,061	4,918
October	3,263	2,981

TABLE 17. Columbia River Benthic Macrofauna Taxa in Samples Collected near the S/HNP Intake/Discharge Site, April 1981 - March 1982

Taxa[a]	Occurrence in Samples				
	Apr. '81[b]	June '81[c]	Sept. '81[c]	Dec. '81[c]	Mar. '82[c]
Ephemeroptera—Mayflies	X	X	X	X	X
Ephemerella inermis					
Serratella sp.					
Baetis insignificans					
Stenonema sp.					
Trichoptera—Caddisflies	X	X	X	X	X
Hydroptila sp.					
Psychomyia sp.					
Ceraclea sp.					
Glossossoma sp.					
Hydropsyche sp.					
Cheumatopsyche sp.					
Lepidoptera—Aquatic moth larvae					
Pyralidae	X				
Diptera—True flies					
Chironomidae	X	X	X	X	X
Simuliidae		X		X	X
Mollusca					
Pelecypoda—Clams					
Corbicula sp.		X	X	X	X
Gastropoda—Snails and limpets	X	X	X	X	
Limnaea sp.					
Parapholyx sp.					
Lithoglyphus sp.					
Fisherola sp.					
Porifera—Sponge					
Spongilla lacustris	X		X	X	
Turbellaria—Flatworms	X	X	X	X	X
Nematoda—Roundworms			X	X	
Annelida—Segmented worms					
Oligochaeta	X	X	X	X	X
Arachnida					
Hydracarina—Water mites			X	X	
Coelenterata—Hydroids					
Hydra sp.			X		
Tardigrada—Water bears				X	

(a) Occurrence is noted for major taxonomic groups only.
(b) RM 361.3, RM 361.4, and RM 361.5.
(c) RM 361.5.

TABLE 18. Average Density (No/m^2) and Relative Abundance (% of Total) Estimates for Columbia River Macrofauna Collected near the S/HNP Intake/Discharge Site, April 1981 - March 1982

Taxa	April[a,b] % Total	June[c] No/m²	June[c] % of Total	September[c] No/m²	September[c] % of Total	December[c] No/m²	December[c] % of Total	March[c] No/m²	March[c] % of Total
Ephemeroptera	0.2	57	2.5	533	0.8	3342	5.3	32	1.0
Ephemerella inermis									
Serratella sp.									
Baetis insignificans									
Stenonema sp.									
Trichoptera	29.7	1453	63.2	42,157	64.3	32,187	51.4	573	17.6
Hydroptila sp.									
Psychomyia sp.									
Ceraclea sp.									
Glossosoma sp.									
Hydropsyche sp.									
Cheumatopsyche sp.									
Lepidoptera									
Pyralidae	0.2	—	—	—	—	—	—	—	—
Diptera									
Chironomidae	62.5	323	14.0	21,918	33.4	25,155	40.2	2075	63.8
Simuliidae	—	234	10.2	—	—	89	0.1	420	12.9
Mollusca									
Pelecypoda									
Corbicula sp.	—	16	0.7	8	<0.1	8	<0.1	8	<0.2
Gastropoda	6.7	137	6.0	605	0.9	452	0.7	—	—
Limnaea sp.									
Parapholyx sp.									
Lithoglyphus sp.									
Fisherola sp.									
Porifera—Sponge									
Spongilla lacustris	(d)	—	—	(d)	—	(d)	—	—	—
Turbellaria	0.2	8	0.4	40	0.1	24	<0.1	8	0.2
Nematoda	—	—	—	129	0.2	218	0.3	—	—
Annelida									
Oligochaeta	0.5	73	3.2	145	0.2	1033	1.7	137	4.2
Arachnida									
Hydracarina	—	—	—	65	0.1	65	0.1	—	—
Coelenterata									
Hydra sp.	—	—	—	8	<0.1	—	—	—	—
Tardigrada	—	—	—	—	—	32	<0.1	—	—
Total		2,301		65,608		62,605		3,253	

(a) No estimate of number/m² for grab samples.
(b) RM 361.3, RM 361.4, and RM 361.5.
(c) RM 361.5.
(d) Presence noted.

TABLE 19. Gravimetric Estimates of Biomass (dry mass and organic mass) for Columbia River Benthic Macrofaura Collected near the S/HNP Intake/Discharge Site, April 1981 - March 1982

Taxa	April, gm[a,b]		June, gm/m²[c]		Sept., gm/m²[c]		Dec., gm/m²[c]		March, gm/m²[c]	
	Dry matter	Organic matter	Dry matter	Organic matter	Dry matter	Organic matter	Dry matter	Organic matter	Dry matter	Organic matter
Ephemeroptera	(d)	(d)	(d)	(d)	<0.1	<0.1	0.1	0.1	(d)	(d)
Ephemerella inermis										
Serratella sp.										
Baetis insignificans										
Stenonema sp.										
Trichoptera	0.3	0.2	52.2	3.0	18.3	8.1	22.1	14.8	0.3	0.2
Hydroptila sp.										
Psychomyia sp.										
Ceraclea sp.										
Glossossoma sp.										
Hydropsyche sp.										
Cheumatopsyche sp.										
Lepidoptera										
Pyralidae	(d)	(d)	—	—	—	—	—	—	—	—
Diptera										
Chironomidae	<0.1	<0.1	(d)	(d)	1.1	0.5	0.3	0.2	0.2	0.1
Simuliidae	—	—	(d)	(d)	—	—	(d)	(d)	0.1	0.1
Mollusca										
Pelecypoda										
Corbicula sp.	—	—	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
Gastropoda	0.6	0.1	(d)	(d)	1.2	0.2	5.0	0.9	—	—
Limnaea sp.										
Parapholyx sp.										
Lithoglyphus sp.										
Fisherola sp.										
Porifera—Sponge										
Spongilla lacustris	(d)	(d)	—	—	(d)	(d)	(d)	(d)	—	—
Turbellaria	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
Nematoda	—	—	—	—	<0.1	(d)	<0.1	<0.1	—	—
Annelida										
Oligochaeta	(d)	(d)	(d)	(d)	<0.1	(d)	<0.1	<0.1	<0.1	<0.1
Arachnida										
Hydracarina	—	—	—	—	(d)	(d)	(d)	(d)	—	—
Coelenterata										
Hydra sp.	—	—	—	—	(d)	(d)	—	—	—	—
Tardigrada	—	—	—	—	—	—	(d)	(d)	—	—

(a) No estimate of weight/m² for grab samples.
(b) RM 361.3, RM 361.4, and RM 361.5.
(c) RM 361.5.
(d) Sample quantity too small for gravimetric measurement.

APPENDIX L

SKAGIT/HANFORD NUCLEAR PROJECT

EFFECT OF CHLORINATED DISCHARGE FROM THE SKAGIT/HANFORD NUCLEAR PROJECT ON COLUMBIA RIVER BIOTA

SKAGIT/HANFORD NUCLEAR PROJECT

EFFECT OF CHLORINATED DISCHARGE FROM THE SKAGIT/HANFORD NUCLEAR PROJECT ON COLUMBIA RIVER BIOTA

D. A. Neitzel
D. D. Dauble
T. L. Page

August 1982

Prepared for
Northwest Energy Services Company
P.O. Box 1090
Kirkland, Washington 98033

Battelle
Pacific Northwest Laboratories
Richland, Washington 99352

CONTENTS

APPENDIX L

EFFECT OF CHLORINATED DISCHARGE FROM SKAGIT/HANFORD NUCLEAR PROJECT ON COLUMBIA RIVER BIOTA

INTRODUCTION

This report supplements the Skagit/Hanford Nuclear Project (S/HNP) Application for Site Certification/Environmental Report (ASC/ER) Sections 5.1.2, 5.1.3, and 5.3.1 (Ref 1) and briefly describes the physical characteristics of the S/HNP discharge. Included are brief reviews of journal articles and technical reports describing impacts of chlorine discharges into aquatic environments. The possibility of impact due to S/HNP discharge was evaluated based on: 1) maximum total residual chlorine (TRC) concentrations expected at low river flow/maximum project discharge and at average flow/average discharge, 2) the varying sensitivity of biotic communities in the Columbia River near the S/HNP discharge to chlorinated water, and 3) the possible proportion of each community that is expected to be exposed to the discharge. Biotic categories examined include phytoplankton, zooplankton, fish, periphyton, and benthic invertebrates.

PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE PLUME

Model conditions used to calculate estimated concentrations of TRC for the plume centerline 300 feet downstream from the discharge are presented in Table 1. Potential exposure durations for passively drifting organisms were determined by dividing the effluent mixing zone by river velocity. Exposure to TRC will be intermittent. Chlorination is expected to occur twice each 24 hours for less than two hours each time (Ref 1).

Thermal plume characteristics have been previously modeled [ASC/ER Section 5.1.2 (Ref 1)], and the data were used to estimate the impact zone relating to chlorine discharge. Equivalent dilution profiles for chlorine were generated from excess temperature isotherms according to the mathematical model in ASC/ER Section 5.2.2.1.1.1 (Ref 1). Maximum downstream extent of the 0.5°

TABLE 1. Model Parameters Under Worst-Case and Average-Case Conditions

Parameter	Worst Case	Average Case
River flow	36,000 cfs	115,752 cfs
Discharge flow	13.17 cfs	6.28 cfs
Effluent (TRC) concentration	0.14 mg/l	0.14 mg/l
Concentration at 300 ft	0.0008 mg/l (190:1 dilution)	0.0002 mg/l (630:1 dilution)
River width	~1400 ft	~1600 ft
River velocity	2.32 fps	4.37 fps
Travel time through the 300-ft plume	130 sec	70 sec

to 3.0°F vertical isotherms was determined from ASC/ER Figure 5.1-8 for worst-case conditions. For average conditions, maximum downstream extent of the 0.5° to 2.0°F isotherms was determined from ASC/ER Figure 5.1-9 (Ref 1). These values were used to estimate chlorine concentrations in the discharge mixing zone. As distance below discharge increases, TRC concentration decreases (Figure 1). From Figure 1 and river velocities, incremental time/dose exposures to drifting organisms can be estimated under worst-case (minimum river flow and maximum discharge) and average conditions (average river flow and average discharge).

The discharge plume is not fully mixed from surface to bottom, therefore any exposure estimate based on isopleth distribution would be conservative in that it assumes an organism is entrained in the plume centerline. Exposures would be less for organisms passing through only portions of the plume.

Using the discharge plume characteristics (Table 1) and the estimated points downstream of the discharge at which the plume will intersect the river bottom [ASC/ER Section 5.1.2 (Ref 1)], it is possible to determine the area of Columbia River Bottom that may be exposed to chlorinated water. At low river

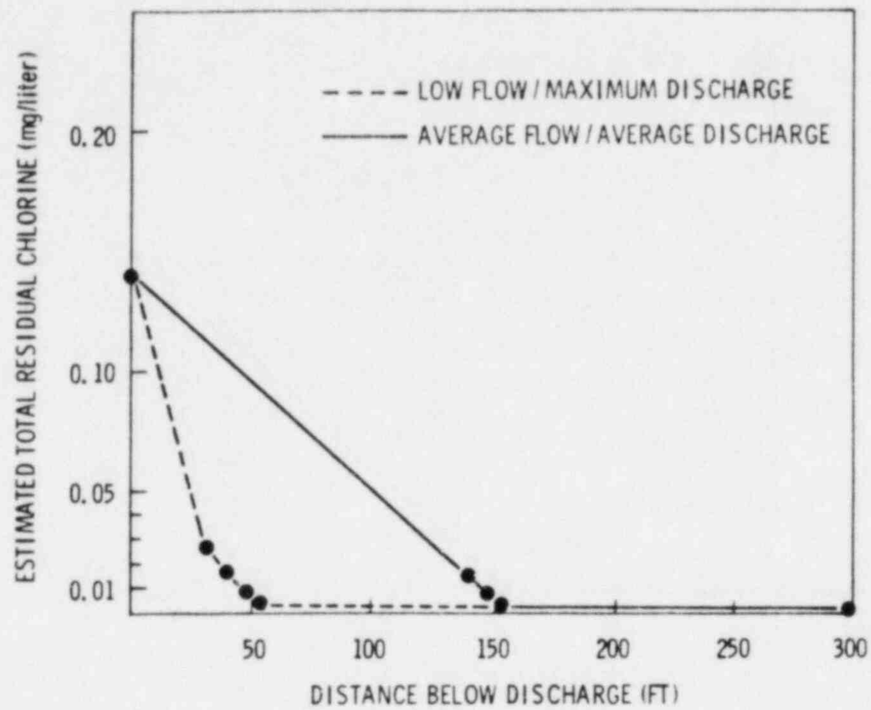


FIGURE 1. Estimated Total Residual Chlorine of Receiving Waters Below the Project Discharge

flow and maximum plant discharge (worst-case conditions), the plume will intersect the bottom approximately 40 feet downstream of the discharge and will be about 17 feet wide (Figure 2). At low river flow, the Columbia River is about 1400 feet wide at the discharge site. Three hundred feet downstream of the discharge the TRC is fully mixed within the plume. Therefore, the bottom area exposed to chlorinated water is 4420 square feet [(300 ft - 40 ft) x 17 ft]. This area is about 1 percent of the river bottom 300 feet downstream of the discharge [(4420 ft^2) ÷ (1400 ft x 300 ft)]. Maximum TRC concentration expected to intersect the river bottom will be 0.0038 mg/liter. Three hundred feet downstream of the discharge, the TRC concentration will be diluted to less than 0.0008 mg/liter.

At average river flow and average discharge (average-case conditions), the plume will intersect the bottom about 145 feet downstream of the discharge and be about 7 feet wide (Figure 2). At average river flow, the Columbia River is about 1600 feet wide at the discharge site. Three hundred feet downstream of

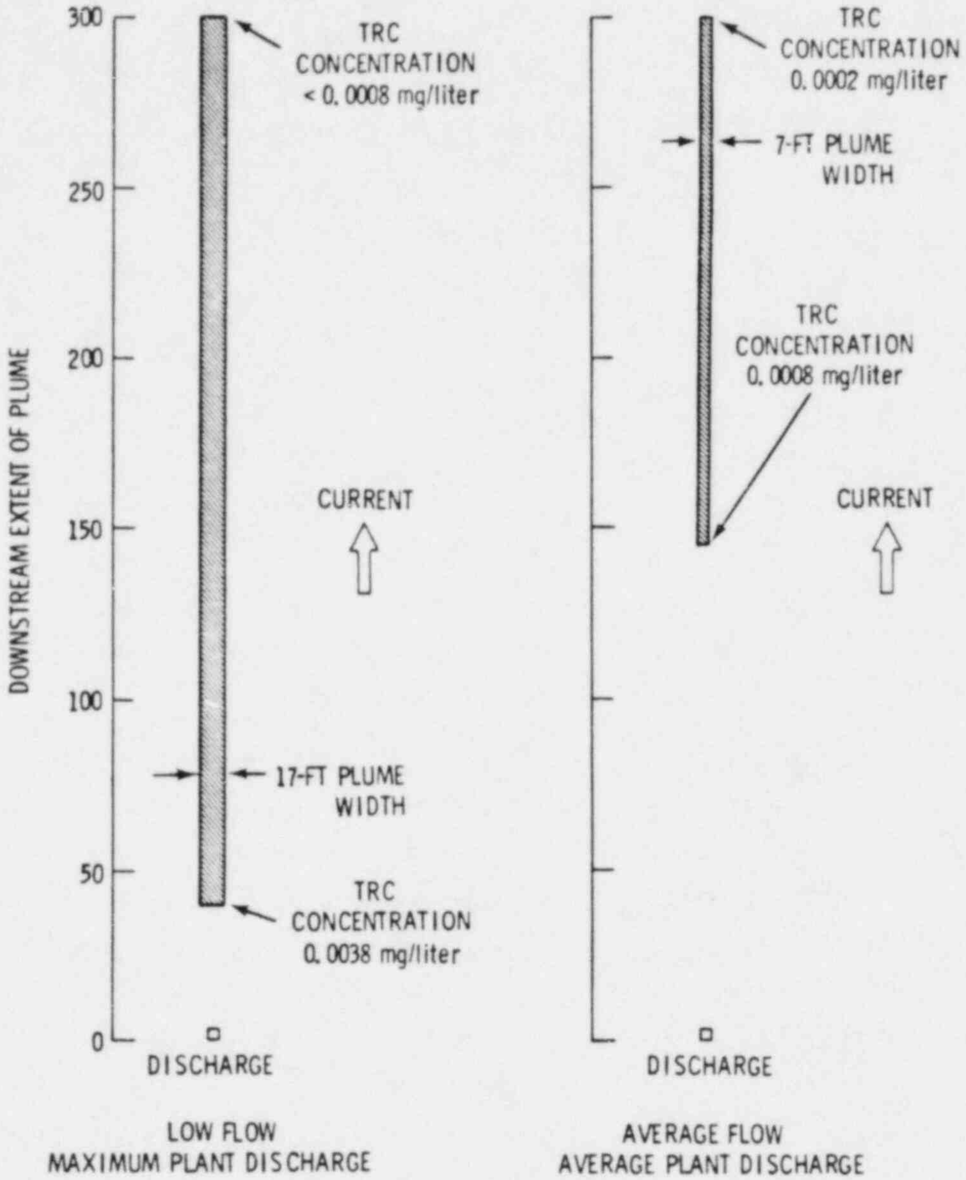


FIGURE 2. Area of River Bottom Affected by S/NHP Discharge and Predicted TRC Concentrations for Two Columbia River Flow Conditions

the discharge the TRC is fully mixed within the plume. Therefore, the bottom area exposed to chlorinated water is 1085 square feet [(300 ft - 145 ft) x 7 ft]. This area is about 0.2 percent of the river bottom 300 feet downstream of the discharge [(1085 ft^2) ÷ (1600 ft x 300 ft)]. Maximum TRC concentration expected to reach the river bottom will be 0.0008 mg/liter. Three hundred feet from the discharge, the TRC concentration will be diluted to about 0.0002 mg/liter.

EFFECTS OF CHLORINE ON COLUMBIA RIVER BIOTA

Actual impact of chlorinated discharge waters on aquatic biota is dependent on effluent concentration, dilution factors, and other physical characteristics of the discharge. Although initial discharge concentrations may be toxic to some aquatic organisms over extended exposure periods, chlorine levels will be quickly diluted due to midstream location of the discharge, discharge pipe design, and mixing characteristics of the river. Even under worst-case conditions, chlorine levels will be reduced to less than 0.001 mg/liter at a point 300 feet downstream of the discharge. When the plume centerline, or area of greatest concentration, intersects the surface (30 to 130 feet downstream from the point of discharge), concentrations are well below any level that would be expected to cause acute mortalities. In addition, because of the reactivity and degradaton of chlorine and its byproducts (Ref 2), actual downstream concentrations of TRC are expected to be even lower. In either case, the concentrations downstream of the 300-foot discharge plume will be well below the 3 to 5 μg/liter criteria recommended for the protection of freshwater life (Ref 3).

To further examine the probable impact of chlorine in the project plume, two general equations for predicting acute toxicity thresholds for dose and time combinations of chlorine were examined (Refs 4, 5). Model conditions were conservative in assuming continuous exposure to maximum effluent concentrations through the mixing zone (Chlorination at S/HNP will be intermittent). Results of both model conditions indicated that no acute mortality will occur to freshwater flora and fauna exposed while passively drifting through the discharge plume.

The possibility for chronic toxicity resulting from long-term exposure to chlorine exists only for organisms voluntarily residing in the discharge plume for extended periods of time. As noted earlier, rapid mixing reduces this potential for toxicity downstream of the plume. Sessile organisms may be chronically exposed in areas where the discharge plume intersects the bottom, but the area of potential impact is small. Because of discharge design and thermal characteristics, the plume is buoyant and does not intersect the river bottom until chlorine concentrations are reduced to 0.0038 mg/liter and 0.0008 mg/liter under worst-case and average conditions, respectively.

Plankton and Nekton Communities

The plankton community consists of the plants and animals drifting with the surrounding water, including animals with weak locomotory power. The nekton community includes the organisms swimming actively in water. These communities are discussed in ASC/ER Sections 2.2.2.1, 2.2.2.4, and 2.2.2.6 (Ref 1). For this discussion, the effects of S/HNP discharge will be examined by assuming all plankton and nekton passively drift through the discharge plume. This method of examination results in greater exposure times than would be expected if actively swimming organisms, such as fish, avoided the excess heat and chlorine of the discharge. Therefore, the impacts predicted are greater than what will actually occur during blowdown of the S/HNP cooling system.

Phytoplankton

Hamilton et al. (Ref 6) studied photosynthesis of entrained phytoplankton. Photosynthetic rates of plankton samples taken in the discharge were 50 to 91 percent lower than those obtained in the intake at a stream electric station in Maryland. The reductions in photosynthesis were attributed to chlorine, which was added intermittently to the cooling water for biofouling control. Carpenter et al. (Ref 7) also studied productivity of entrained phytoplankton. At chlorine concentrations of 0.4 ppm, they observed an 83 percent decrease in production. At concentrations less than 0.1 ppm, they observed a 79 percent reduction. Brook and Baker (Ref 8) observed a 50 percent decrease in photosynthetic and respiratory rates for phytoplankton in chlorine concentrations of 0.32 ppm. No productivity was observed at 2.7 ppm chlorine. Gentile et al. (Ref 9) measured primary production for 11 species of phytoplankton in the laboratory. A 50 percent reduction was observed over a range of chlorine concentrations from 0.075 to 0.33 ppm. Fox and Moyer (Ref 10) compared primary production of entrained phytoplankton at a power plant during chlorination and nonchlorination operation. Without chlorine, productivity was reduced 13 percent; with chlorine, productivity was reduced 57 percent. Jolley (Ref 11) studied productivity of Lake Michigan phytoplankton. He observed a 25 to 100 percent decrease in photosynthetic rates in chlorine concentrations ranging from 0.01 to 1.38 ppm. The point of signficant reduction in photosynthesis and chlorophyll a concentrations appeared to be 0.05 ppm. Jolley (Ref 11) concluded that the reduction in photosynthesis appeared to result from the destruction of chlorophyll a in the phytoplankton. Toetz (Ref 12) measured nitrate uptake of freshwater phytoplankton exposed to chlorine concentrations ranging from 0.01 to 0.1 ppm. Reduction in uptake was observed for exposure concentrations as low as 0.028 ppm. Brooks and Seegert (Ref 13) studied the effects of intermittent chlorine exposures to Lake Michigan aquatic environments. Chlorine concentrations greater than 0.5 ppm caused the most drastic reductions in productivity.

The studies reviewed here indicate that phytoplankton populations are affected by exposure to chlorinated water. Measureable effects are reported for concentrations ranging from less than 0.01 ppm for phytoplankton entrained in power plant cooling systems (Ref 7) to 2.7 ppm (Ref 8). The toxicity concentrations reported by Paje and Hulsizer (Ref 2) were similar. In all cases, observed effects occurred after exposures of 5 to 15 minutes (Refs 6, 7) and up to exposures of 24 hours (Ref 12) or in combination with exposure to excess heat. The expected TRC concentration for the S/HNP discharge is 0.14 mg/liter. This concentration is expected to dissipate less than 1 minute after discharge. In addition, less than 1.2 percent of the phytoplankton community will pass through the discharge plume. Data from studies on the effects of TRC on phytoplankton and on the characteristics of the S/HNP indicate no adverse impact to Columbia River phytoplankton is expected.

Zooplankton

Chlorine toxicity to zooplankton varies with such factors as chlorine concentration, water temperature, exposure time, and species. Page and Hulsizer (Ref 2) summarized several chlorine toxicity studies with microcrustacean zooplankton. Toxicity varied from 0.001 mg/liter to greater than 15.61 mg/liter.

Toxic concentrations varied with species tested, water temperature, and exposure time. Most studies summarized by Page and Hulsizer (Ref 2) included copepods and cladocerns found in mid-Columbia River zooplankton samples [ASC/ER Section 2.2.2.4 (Ref 1)].

Grossnickle (Ref 14) exposed the rotifer <u>Keratella cochlearis</u> to chlorine concentrations for 1 to 4 hours and observed median lethal concentration (LC_{50}) values that ranged from 0.01 to greater than 0.03 mg/liter. Beeton (Ref 15) reported LC_{50} values for freshwater copepods and rotifers ranging from 0.019 mg/liter to greater than 0.084 mg/liter chlorine, depending on the species and exposure conditions. Brooks and Seegert (Ref 13) tested the tolerance of two zooplankton invertebrates, <u>Cyclops biscuspidatus thomasi</u> and <u>Limnocalanus macrurus</u>, to chlorinated water. The majority of the test organisms survived 30-minute exposures to chlorine concentrations between 0.5 and 1.0 mg/liter.

The data reviewed above indicate zooplankton are adversely affected by exposure to chlorinated water. However, measureable impacts occur only after extended exposures or in combination with other impacts. The discharge plume for S/HNP will have a maximum TRC concentration of 0.14 mg/liter, which will be diluted to less than 0.001 mg/liter in less than 3 minutes within 300 feet of the discharge. Additionally, because the volume of water discharged to the river is low relative to total river flows, less than 1.2 percent of the zooplankton will pass through the discharge plume. The exposure durations to zooplankton that are predicted for the S/HNP discharge are not expected to adversely affect mid-Columbia River zooplankton.

<u>Fish</u>

Previously discussed data based on plume model characteristics used in conjunction with Mattice and Zittel's (Ref 5) equation support the assumption that acute mortality to passively drifting fish entrained in the discharge plume is unlikely. Therefore, plant discharge should have minimal impact on either ichthyoplankton or downstream-migrating juvenile salmonids.

Potentially lethal conditions exist only in the area directly below the discharge. Under high discharge and low river flow conditions (Figure 1), maximum chlorine concentrations are rapidly diluted to <0.01 mg/liter within 50 feet downstream of the discharge. Under average conditions, the plume is not dissipated until further downstream; however, chlorine levels are reduced to <0.004 mg/liter at a point 150 feet downstream of the discharge.

A comparison of toxicity thresholds for several fish species found near the project site (Table 2) 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 the

TABLE 2. Toxicity of Chlorine to Sensitive Fish Species Found in the Hanford Reach (Refs 16, 2)

Species	Concentration (mg/liter)	Parameter	Source
Oncorhynchus kisutch	0.01 - 0.04	est. 96 h LC_{50}	Rosenberger (Ref 17)
	0.083	7 day-TLm, acute	Arthur (Ref 18)
O. tshawtyscha	0.3	100% kill, 85 min	Collins and Deaner (Ref 19)
Salmo gairdneri	0.01	lethal at 12 days exposure	Sprague and Drury (Ref 20)
	0.023	96 h LC_{50}	Basch et al. (Ref 21)
	0.1	lethal at 4 days exposure	Sprague and Drury (Ref 20)
	0.3	100% kill, 2-5 h	Taylor and James (Ref 22)
Micropterus dolomieui	0.5	median mortality, 15 h	Pyle (Ref 23)
Perca flavescens	0.365	12 h TL-50, acute	Arthur et al. (Ref 24)

discharge zone would probably be excessive. Further reduction of impact would result if fish detected and avoided the discharge plume. Cherry et al. (Ref 25) 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/liter TRC for coho salmon (Oncorhynchus kisutch) and spotted bass (Micropterus punctulatus) to 0.41 mg/liter TRC for channel catfish (Ictalurus punctatus). 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 26), 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 27). In addition, adult salmonids generally show a preference for shoreline areas during migration (Refs 28, 29, 30), 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/liter chlorine) 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/liter 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.

Macrophytes

There are no macrophytes in the immediate area of the S/HNP discharge [ASC/ER Section 2.2.2.3 (Ref 1)]. Conditions that favor growth of a macrophyte communities (Ref 31) are not expected near the S/HNP site. No impact to macrophytes of the S/HNP discharge can be expected in the Columbia River.

Benthic Communities

The benthic community includes plants and animals living on the river bottom. Some of the plants and animals are sessile (i.e., attached to the bottom substrate) and others are free-living and move and swim within the interstices of the substrate. The Columbia River benthos communities near S/HNP are described in ASC/ER Sections 2.2.2.2 and 2.2.2.5 (Ref 1).

Periphyton

Studies describing the effects of residual chlorine on periphyton populations indicate that S/HNP blowdown will not affect Columbia River periphyton. Eiler and Delfino (Ref 32) studied the effects of nuclear power plant discharges on the Mississippi River. They concluded that periodic concentrations of chlorine in the heated effluent appeared to have a more signficant impact on the biotic communities than did the increased water temperatures. Productivity of periphytic algae was reduced downstream of the discharge.

Observed effects of chlorinated water on periphyton varies with TRC concentration and other associated impacts. The maximum expected TRC concentration that will reach the Columbia River bottom is 0.0038 mg/liter. This exposure will occur intermittently and will intersect a small area (approximately 1 percent) of river bottom. This projected area of impact is small enough, and the TRC concentration is low enough, that no adverse impact can be expected to the total periphyton community.

Benthic Invertebrates

No adverse impact is expected to the benthic invertebrate community of the Columbia River near the S/HNP discharge. Brungs (Ref 33) and Levin et al. (Ref 34) reviewed the effects of chlorinated discharges on benthic communities. The observed effects vary with species, discharge temperatures, life stages, and physicochemical conditions. Gregg (Ref 35) reported results of studies with several aquatic invertebrate species (mayflies, stoneflies, sowbugs, amphipods, caddisflies, water beetles and snails) exposed continuously and intermittently to different chlorine concentrations and different water temperatures. Temperature influenced chlorine toxicity, although effects were variable among species. The LC_{50} values for continuous exposure were intermediate between LC_{50} values for high and low intermittent exposures. Toxicity thresholds ranged from 0.01 and 0.10 mg/liter.

The toxic thresholds reported by Gregg (0.01 to 0.1 mg/liter, Ref 35) are several times higher than concentrations expected in the S/HNP discharge (0.0002 to 0.0008 mg/liter). The area of the discharge at S/HNP is relatively small (Figure 2). The relative number of benthic invertebrate adversely affected will be small. Therefore, no adverse impact to the Columbia River benthic invertebrate community can be expected at S/HNP.

POTENTIAL INTERACTIVE TOXICITY OF CHLORINE

Plant effluent will be heated as much as 24.5°F above ambient river temperatures. In addition, increased levels of suspended and dissolved solids, including metals, will be discharged. Total impact of the chlorinated discharge waters on aquatic biota will depend on exposure to the combined conditions. The concentrations of TRC and other constituents within the plume will dissipate rapidly. For example, under worst-case conditions, temperatures within the discharge plume 300 feet downstream of the discharge will be elevated 0.09°F above ambient, and metal concentration will be 6 percent above ambient. The effects of all possible interactions are not known because most studies report on only two variables.

The combined effects of heat and chlorine on aquatic biota has been studied by several authors. Thatcher et al. (Ref 36) reported mean 96-hr LC_{50} values ranging from about 0.13 to 0.18 mg/liter TRC for brook trout (Salvelinus fontinalis) exposed at 10°C to 15°C. Mean LC_{50} values for brook trout exposed at 20°C were significantly lower, ranging from 0.10 to 0.12 mg/liter TRC. Stober and Hanson (Ref 37) and Seegert and Brooks (Ref 38) also observed an inverse relationship between temperature and resistance to chlorination.

If plant discharge is intermittent, potential impacts of the S/HNP plant discharge would be dramatically reduced. For example, Seegert and Brooks (Ref 38) determined that chlorine concentrations <0.42 mg/liter and <0.21 mg/liter were nonlethal to coho salmon at 10°C and 20°C, respectively, provided daily exposures did not exceed 30 minutes. Additionally, Giattina et al. (Ref 39) recently showed that most fish species avoided intermittent heated chlorinated discharges 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 these conditions for sufficient duration to cause mortality.

Increased temperature has also been shown to increase chlorine toxicity to zooplankton. Both Latimer (Ref 40) and Brooks and Seegert (Ref 13) noted lower LC_{50}s for Cyclops spp. exposed to chlorine at 20°C than at 15°C. As noted previously, however, exposure durations would be relatively short for passively drifting organisms, even those that pass through the plume centerline. Therefore, acute mortalities to zooplankton would not be expected from the combined effects of heat and chlorine. In any case, because of the relatively low volume of water removed from the river by the S/HNP intake, less than 1 percent of the total zooplankton population would be affected.

The presence of suspended colloidal matter in effluents has also been found to increase toxic effects of TRC to fish (Ref 41). Additionally, lethal effects of temperature may be synergistically increased when combined with sublethal concentrations of metals (Refs 42, 43). 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. Because of this rapid dilution, the synergistic effects of TRC, heat, and suspended solids would only be potentially lethal to fish maintaining position in the midstream water column directly below the plant discharge. Because of feeding and energy maintenance requirements, fish would not be expected to reside in this area for sufficient time for mortality to occur. Therefore, the potential for combined effects would be greatly diminished and should represent minimal risk. As previously discussed, the incremental addition of heat, TRC, and dissolved solids to the portion of the plume that intersects with the river bottom is small; therefore, combined effects on benthic organisms are also expected to be minimal.

CONCLUSIONS

No measurable adverse impacts on Columbia River biota are expected from the TRC concentrations predicted for the S/HNP discharge. In general, estimated exposure durations of passively drifting organisms to TRC are too brief to expect acute mortality. Maximum exposure time (130 seconds) for passively drifting organisms will occur only during low river flow and maximum plant discharge (0.14 mg/liter TRC). Since the maximum width of the discharge plume is 17 feet, only 1.2 percent of the cross-sectional area of the river will be affected. The maximum TRC that will affect the benthic community is 0.0038 mg/liter. The maximum bottom area affected is less than 4500 $feet^2$. Intermittent chlorination is expected to result in less impact than continuous discharge at the same TRC concentration.

ACKNOWLEDGMENT

We thank Carolynn Novich for her patience and dedication during organization and editing of this report.

REFERENCES

1. Skagit/Hanford Nuclear Project--Application for Site Certification/ Environmental Report, Amendment No. 4, Volume 2. Puget Sound Power & Light Company, Bellevue, WA (1981).

2. T. L. Page and E. J. Hulsizer, Biofouling Control in Open Recirculation Cooling Water Systems - A Review. Prepared by Battelle, Pacific Northwest Laboratories under Contract 2311201335 to Washington Public Power Supply System, Richland, WA (1979).

3. R. V. Thurston, R. C. Russo, C. M. Fetterolf, Jr., T. A. Edsall, Y. M. Baker, Jr. (Eds.), A Review of the EPA Red Book: Quality Criteria for Water, Water Quality Section, American Fisheries Society, Bethesda, MD (1979).

4. U.S. Environmental Protection Agency, Water Quality Criteria, 1972. Washington, DC (1973).

5. J. S. Mattice and H. E. Zittel, "Site Specific Evaluation of Power Plant Chlorination: A Proposal," Presented at Conference on the Environmental Impact of Water Chlorination, Oak Ridge National Laboratory, Oak Ridge, TN (October 22-24, 1975).

6. D. H. Hamilton, Jr., D. A Flemer, C. W. Keefe, J. A. Mihursky, "Effects of Chlorination in Estuarine Primary Production," Science, 169 (1970), pp. 37-40.

7. E. J. Carpenter, B. B. Peck, S. J. Anderson, "Cooling Water Chlorination and Productivity of Entrained Phytoplankton," Mar. Biol., 16 (1972), pp. 37-40.

8. A. J. Brook and A. L. Baker, "Chlorination at Power Plants: Impact on Phytoplankton Productivity," Science, 176 (1972), pp. 1414-1415.

9. J. H. Gentile, National Marine Water Quality Laboratory, U.S. Environmental Protection Agency, The Environmental Import of Water Chlorination, R. L. Jolly (ed.), CONF-751096, Oak Ridge National Laboratory (1972).

10. J. L. Fox and M. S. Moyer, "Effect of Power Plant Chlorination on Estuarine Productivity," Cheasapeake Sci., 16 (1975), p. 66.

11. R. L. Jolley, "The Environmental Impact of Water Chlorination," Proceedings of the Conference on the Environmental Impact of Water Chlorination, Oak Ridge, TN (1976), pp. 277-298.

12. D. Toetz, "Effects of Chlorine and Chloramine on Uptake of Inorganic Nitrogen by Phytoplankton," Effects of Wastewater and Cooling Water Chlorination of Aquatic Life, W. A. Brungs (ed.), PB-257 700, Duluth, MN (1976).

13. A. S. Brooks and G. L. Seegert, The Effects of Intermittent Chlorination on the Biota of Lake Michigan, Special Report No. 31, Center for Great Lakes Studies, University of Wisconsin, Milwaukee, WI (1977).

14. N. E. Grossnickle, The Acute Toxicity of Residual Chloramine to the Rotifer Keratella cochlearis (Gosse) and the Effect of Dechlorination with Sodium Sulfite, Master of Science Thesis, University of Wisconsin, Milwaukee, WI (1974).

15. A. M. Beeton, Effects of Chlorine and Sulfite Reduction on Lake Michigan Invertebrates, Ecological Research Series EPA-600/3076-036, U.S Environmental Protection Agency, Duluth, MN (1976).

16. C. D. Becker and T. O. Thatcher, Toxicity of Power Plant Chemicals to Aquatic Life, WASH-1249, National Technical Information Service, Springfield, VA (1973).

17. D. R. Rosenberger, The Calculation of Acute Toxicity of Free Chlorine and Chloramine to Coho Salmon by Multiple Regression Analysis, Thesis, Michigan State University, Eat Lansing, MI (1971).

18. J. W. Arthur, Progress Reports, National Water Quality Laboratory, Environmental Protection Agency, Duluth, MN (1971-72) (cited in Page and Hulsizer 1979).

19. H. F. Collins and D. G. Deaner, "Sewage Chlorination Versus Toxicity - A Dilemma" J. Environ. Eng. Div. ASCE, 99 (1973), pp. 761-772.

20. J. B. Sprague and D. E. Drury, "Avoidance Reactions of Salmonid Fish to Representative Pollutants," Advances in Water Pollution Research, Vol. 1, S. H. Jenkins (ed.), Pergamon Press, New York (1969), pp. 169-179.

21. R. E. Basch, M. E. Newton, J. G. Truchan, C. M. Fetterolf, Chlorinated Municipal Waste Toxicities to Rainbow Trout and Fathead Minnows, Res. No. 18050 G.Z.Z., Environmental Protection Agency (October 1971).

22. R. S. Taylor and M. C. James, Treatment for Removal of Chlorine from City Water for Use in Aquaria, U.S. Bureau of Fisheries, Doc. No. 1045, Rept. U.S. Comm. Fish (1928), Appendix B, pp. 322-327.

23. E. A. Pyle, "Neutralizing Chlorine in City Water for Use for Fish Distribution Tanks," Prog. Fish-Cult., 22 (1960), pp. 30-34.

24. J. W. Arthur, R. W. Andrew, V. R. Mattson, D. T. Olson, G. E. Glass, B. J. Halligan, C. T. Walbridge, Comparative Toxicity of Sewage-Effluent Disinfection to Freshwater Aquatic Life, EPA-600/3-75-012, Environmental Research Laboratory, Duluth, MN (1975).

25. D. S. Cherry, S. R. Larrick, J. O. Giattina, K. L. Dickson, J. C. Cairns, Jr., "Avoidance and Toxicity Responses of Fish to Intermittent Chlorination," Environ. Internat., 2 (1979), pp. 85-90.

26. M. C. Bell, Fisheries Handbook of Engineering Requirements and Biological Criteria, Fish-Eng., Eng. Prog. Corps of Engineers, North Pacific Div., Portland, OR (1973).

27. Washington Public Power Supply System (WPPSS), Supplemental Information on the Hanford Generating Project in Support of a 316(a) Demonstration, Prepared by Battelle, Pacific Northwest Laboratories for Washington Public Power Supply System, Richland, WA (1978).

28. P. S. Trefethan, Sonic Fish Tracking, Int. Comm. Northwest Alt. Fish, Spec. Pub. 4 (1963), pp. 81-83.

29. G. E. Monan, K. L. Liscom, J. K. Smith, Sonic Tracking of Adult Steelhead in Ice Harbor Reservoir, 1969. Final Report, Biological Laboratory Bureau Commercial Fisheries, Seattle, WA (1970).

30. C. C. Coutant, Behavior of Ultrasonic Tagged Chinook Salmon and Steelhead Trout Migrating Past Hanford Thermal Discharges (1967), BNWL-1530, Pacific Northwest Laboratory, Richland, WA (1975).

31. H. B. N. Hynes, The Ecology of Running Waters, University of Toronto Press, Canada (1970).

32. H. O. Eiler and J. J. Delfino, "Limnological and Biological Studies of the Effects of Two Modes of Open-Cycle Nuclear Power Station Discharge on the Mississippi River (1969-1973)," Water Research (G.B.), 8 (1974), p. 995.

33. W. A. Brungs, Effects of Wastewater and Cooling Water Chlorination on Aquatic Life, PB-247 700, Environmental Research Laboratory, Duluth, MN (1976).

34. A. A. Levin, T. J. Birch, R. E. Hillman, G. E. Raines, A Comprehensive Appraisal of the Effets of Cooling Water Discharge on Aquatic Ecosystems, PB-223 662, Battelle Columbus Laboratories, Columbus, OH (1970).

35. B. C. Gregg, The Effects of Chlorine and Heat on Selected Stream Invertebrates, Ph.D. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, VA (1974).

36. T. O. Thatcher, M. J. Schneider, E. G. Wolf, "Bioassays on the Combined Effects of Chlorine, Heavy Metals and Temperature on Fishes and Fish Food Organisms," Part I. Effects of Chlorine and Temperature on Juvenile Brook Trout (Salvelinus fontinalis). Bull. Environm. Contam. Toxicol., 15 (1976), pp. 40-48.

37. Q. J. Stober, and C. H. Hanson, "Toxicity of Chlorine and Heat to Pink (Onchorhynchus gorbuscha) and Chinook Salmon (O. tshawytscha), Trans. Am. Fish. Soc., 103 (1974), pp. 569-576.

38. G. L. Seegert and A. S. Brooks, "The Effects of Intermittent Chlorination on Coho Salmon, Alewife, Spottail Shiner, and Rainbow Smelt," Trans. Am. Fish. Soc., 107(2) (1978), pp. 346-353.

39. J. D. Giattina, D. S. Cherry, J. Cairns, Jr., S. R. Larrick, "Comparison of Laboratory and Field Avoidance Behavior of Fish in Heated Chlorinated Water," Trans. Am. Fish. Soc., 110(4) (1981), pp. 526-535.

40. D. L. Latimer, The Toxicity of 30-Minute Exposures of Residual Chlorine to the Copepods Limnocalanus macrurus and Cyclops bicuspidatus thomasi, Master of Science Thesis, University of Wisconsin, Milwaukee, WI (1975).

41. P. Ray, "Evaluation of Toxicity of Some Industrial Effluents to Fish by Bioassay," Ind. Jour. Fish., 8 (1961), pp. 233-240.

42. C. L. McKenney, Jr. and J. M. Dean, "Effects of Acute Exposure to Sub-lethal concentrations of Cadmium on the Thermal Resistence of the Mummichog," Thermal Ecology, J. W. Gibbons and R. R. Sharitz (eds.), CONF-730505, National Technical Information Service, Springfield, VA (1974), pp. 43-53.

43. T. O. Thatcher, "Combined Effects of Mercury and Temperature on the Mortality of Rainbow Trout," Thermal Ecology, J. W. Gibbons and R. R. Sharitz (eds.), CONF-730505, National Technical Information Service, Springfield, VA (1974), pp. 54-58.

RESPONSES TO NRC QUESTIONS

Question N200.01 (Terrestrial Ecology, Land Use and Transmission Lines - Question 1)

Need a copy of Bonneville Power Authority's "Environmental Statement General Construction and Maintenance Program 8/74".

Response:

A copy of the above document was supplied by letter number NLN-13 from J. E. Mecca to J. A. Norris dated February 5, 1982.

RESPONSES TO NRC QUESTIONS

Question N200.02 (Terrestrial Ecology, Land Use and Transmission Lines - Question 2)

Reference to ER page 4.5-1 - Specifically what type of stabilizing methods will be employed to prevent wind erosion.

Response:

See revised Section 4.5.5.2. 6

RESPONSES TO NRC QUESTIONS

Question N200.05 (Terrestrial Ecology, Land Use and Transmission Lines - Question 5)

ER page 6.1-28, Section 6.1.4.3.3, third paragraph - Who and why was the determination made that drift on vegetation and wildlife did not need to be monitored.

Response:

The reason why monitoring is not required is explained in Section 5.3.2. See also revised Section 6.1.4.3.3. 6

RESPONSES TO NRC QUESTIONS

Question N200.06 (Terrestrial Ecology, Land Use and Transmission Lines - Question 6)

Reference ER page 6.3-15. Would like a copy of Reference 25.

Response:

A copy of the above document was provided by letter number NLN-13 from J. E. Mecca to J. A. Norris dated February 5, 1982.

RESPONSES TO NRC QUESTIONS

Question N210.03 (Aquatic Biology - Question 3)

Provide any information available on ichthyoplankton densities by species in the vicinity of the proposed intake and discharge structures.

Response:

See revised Section 2.2.2.6.3. 6

FIGURE N210.03

Figure deleted

NOTE: This information is now included in Figure 2.2-22a. 6

TABLE N210.03

Table deleted

6

NOTE: This information is now included in Table 2.2.21c.

RESPONSES TO NRC QUESTIONS

Question N210.04 (Aquatic Biology - Question 4)

Provide a detailed topographic map of the Columbia River with bottom contours in the vicinity of the intake and discharge and for several miles up and downstream. Indicate on the map the location of the intake and discharge pipelines, their associated in-river structures and the shoreline pumphouse.

Response:

Figures 9 and 10 of ASC/ER Appendix B provide detailed information on Columbia River bottom elevations in the vicinity of the intake and discharge structures. These figures have been revised to show bottom contours. Figure 3.4-4 has been included in Section 3.4 to provide detailed topographic information in the immediate vicinity of the intake and discharge structures.

RESPONSES TO NRC QUESTIONS

Question N210.05 (Aquatic Biology - Question 5)

Provide a more detailed description of the intake water inlets. Provide detailed drawings from several aspects indicating the physical measurements of various components and their placement. Provide drawings showing the position of the intake in relation to the bottom and shoreline.

Response:

See new Section 4.1.2.2. 6

RESPONSES TO NRC QUESTIONS

Question N210.06 (Aquatic Biology - Question 6)

Provide a more detailed description of the discharge structure. Provide detailed drawings from several aspects indicating the physical measurements and various components and their placements. Provide drawings showing the position of the discharge in relation to the bottom and shoreline.

Response:

See new Section 4.1.2.2. 6

RESPONSES TO NRC QUESTIONS

Question N210.07 (Aquatic Biology - Question 7)

Show in detail the actual route of the intake and discharge pipelines from the Columbia River shoreline to the plant site.

Response:

The centerline of the 1000 ft wide intake and discharge corridor used to determine the environmental impacts was determined by site surveys and is shown in ASC/ER Figure 2.1-3. Topographic information on this corridor and corridors for other plant accesses has been provided as new Figure 3.1-1a. Final intake and discharge line route selection is discussed in revised Section 2.1.1.2. 6

RESPONSES TO NRC QUESTIONS

Question N210.08 (Aquatic Biology - Question 8)

The statement made on page 5.1-7 and 5.1-8 that plankton is uniformly distributed in the Columbia River. Provide a discussion supporting this statement with particular reference to data pertaining to the distribution of ichthyoplankton in the vicinity of the intake structure.

Response:

See revised Section 2.2.2.1 and new Section 2.2.2.6.3. 6

RESPONSES TO NRC QUESTIONS

Question N210.09 (Aquatic Biology - Question 9)

Discuss the aquatic significance particularly in reference to fishes of the backwater area upstream of the proposed intake and discharge structures.

Response:

See revised Section 2.2.2.6. 6

RESPONSES TO NRC QUESTIONS

Question N210.10 (Aquatic Biology - Question 10)

Provide a discussion of the actual or anticipated seasonal and procedural constraints on construction of the intake and discharge facilities that are or will be required by the State of Washington Site Certification.

Response:

See new Section 4.1.2.2. 6

RESPONSES TO NRC QUESTIONS

Question N210.11 (Aquatic Biology - Question 11)

Provide an estimate (round weight and number) of the yearly commercial and recreational harvest of finfish, shell fish and mollusks taken from water within an 80 kilometer (50 miles) radius of the station. The harvest estimate should be summarized by species and location of capture (water body segment) and provide an explanation of how the estimate was obtained.

Response:

See revised Section 2.1.4.6 for fish catch statistics.

For the individual and population dose calculations from the ingestion of sportfish (Appendix G, Section III.2.1), it was conservatively assumed that all salmon and steelhead caught in the Upper Columbia River (above Bonneville Dam) were caught in or near the Ringold Fish Hatchery and lived in water with a dilution factor of 1900 (10 percent of full river dilution). This assumption will result in extremely conservative population and individual doses from the ingestion of sportfish.

RESPONSES TO NRC QUESTIONS

Question N220.01 (Water Quality - Question 1)

Reference page 3.6-1. Will there be any circumstances under which boron might be released to surface waters?

Response:

See revised Section 3.6.1. 6

RESPONSES TO NRC QUESTIONS

Question N220.02 (Water Quality - Question 2)

Reference page 2.2-35. The information on existing water quality stresses may be out of date. Have you checked with State agencies to identify contemporary issues for the upper Columbia?

Response:

Information presented in ASC/ER Section 2.2.2.8.3 (page 2.2-35) concerning pre-existing environmental stresses of wastewater discharges was based upon existing literature. In addition, we have consulted with state (EFSEC) and federal (US FWS, US EPA and NMFS) agencies regarding current water related issues. As a result of these meetings, concerns about chlorination of wastewaters and priority pollutants were identified. However, because of the lack of information, pre-existing stresses from these parameters could not be quantified.

RESPONSES TO NRC QUESTIONS

Question N220.03 (Water Quality - Question 3)

Reference page 3.6-1. At how many cycles of concentration does it become necessary to add acid to control scaling? Discuss the alternative of operating at lower cycles of concentration without acid addition.

Response:

See revised Section 3.6.3. 6

RESPONSES TO NRC QUESTIONS

Question N220.06 (Water Quality - Question 6)

Reference page 5.3-2. Will acidification of cooling water alter the form and thus, the toxicity of those metals which are already in excess of water quality standards?

Response:

See revised Section 5.3.1.2. 6

RESPONSES TO NRC QUESTIONS

Question N230.01 (Need for Facility - Question 1)

How does the possibility of purchasing WPPSS 4 & 5 impact your analysis of alternatives?

Response:

It doesn't at this time. Whether the acquisition of WNP 4 and/or WNP 5 is feasible and would be preferable to completion of Skagit/Hanford 1 and/or 2 is a complex question that cannot be answered at this time. For example, we do not know whether either of the WPPSS units will be offered to us or on what terms: price? date of turn-over? guarantee of clear title? protection against claims? warranties as to quality and licensability of work performed and equipment on hand and on order? quantities and price of uranium, nuclear fuel and fuel services included? payment schedule? financing? We do not know whether the WPPSS units will be needed on-line consistent with their scheduled completion dates. We do not know how feasible it would be for us to own and operate one unit of a twin unit project, sharing the common facilities with the Supply System. Until these and the other questions involved are answered, it will not be possible to make reliable economic comparisons between the various alternatives, such as the comparative cost of power over the anticipated operating lives of the respective units, or the comparative cost to the ratepayers of the region of the various alternatives. Puget Power is willing to explore these questions in cooperation with the other parties in interest. It seems only realistic, however, to suggest that developing reliable answers may be a rather time consuming process. It should also be noted that the key answers are dependent upon parties and events beyond the control of Puget Power. Pending the emergence of reliable answers, we intend to continue on schedule with our efforts to license the Skagit/Hanford units.

RESPONSES TO NRC QUESTIONS

Question N230.10 (Need for Facility - Question 10)

What is the basis for the 8% escalation factor for 1982 and beyond?

Response:

The 8% escalation factor is the rate used for estimating this project by our A/E (Bechtel Power Corp.).

This rate is a "standard rate" applied to all jobs within their thermal power organization. This was the rate that was in effct at the time our estimate was updated (1980).

RESPONSES TO NRC QUESTIONS

Question N230.11 (Need for Facility - Question 11)

How will cogeneration affect the need for the facility? Is it an alternative? What is the cogeneration potential in the region?

Response:

See new Section 9.2.1.2.8. 6

RESPONSES TO NRC QUESTIONS

Question N240.01 (Radiological Assessment - Question 1, Cont'd)

Items: g and h, are to be found in Section 2.1.4.5 and Appendix G, Section III.1.1, page G-6.

RESPONSES TO NRC QUESTIONS

Question N240.02 (Radiological Assessment - Question 2)

Section 3.3-8 states that the design will permit the infrequent release to the Columbia River of excess plant water. This significant release will be less than 350 gpm. Provide the duration of each release and the total number of releases per year and estimate when the releases will occur.

Response:

See revised Section 3.3.8. 6

RESPONSES TO NRC QUESTIONS

Question N240.02 (Radiological Assessment - Question 2, Cont'd)

Page deleted 6

Table N240.02
Comparison of WNP-2 and S/HNP
Liquid Radwaste Release Data

Page deleted

6

NOTE: This information is now included in Table 3.3-2.

RESPONSES TO NRC QUESTIONS

Question N250.01(a) (Hydrology - Question 1a)

Provide descriptions of the floodplains of all water bodies, including intermittent water courses, within or adjacent to the site. On a suitable scale map provide delineations of those areas that will be flooded during the one-percent chance flood in the absence of plant effects (i.e., pre-construction floodplain).

Response:

See new Section 2.4.1.1.5 6

FIGURE N250.01

Figure deleted

6

NOTE: This information is now included in Figure 2.4-7a.

RESPONSES TO NRC QUESTIONS

Question N250.01(b) (Hydrology - Question 1b)

Provide details of the methods used to determine the floodplains in response to (a) above. Include your assumptions of and bases for the pertinent parameters used in the computation of the one-percent flood low and water elevation. If studies approved by Flood Insurance Administration (FIA), Housing and Urban Development (HUD) or the Corps of Engineers are available for the site or adjoining area, the details of analyses need not be supplied. You can instead provide the reports from which you obtained the floodplain information.

Response:

See new Section 2.4.1.1.5. 6

RESPONSES TO NRC QUESTIONS

Question N250.01(c) (Hydrology - Question 1c)

Identify, locate on a map, and describe all structures and topographic alterations in the floodplains.

Response:

Please refer to Figure 3.4-3, Amendment 4, for the location of the intake and discharge structures. See also new Section 2.4.1.1.5. 6

RESPONSES TO NRC QUESTIONS

Question N250.01(d) (Hydrology - Question 1d)

Discuss the hydrological effects of all items identified in (c) above. Discuss the potential for altered flood flows and levels, both upstream and downstream. Include the potential effect of debris accumulating on the plant structures. Additionally, discuss the effects of debris generated from the site on downstream facilities.

Response:

See new Section 2.4.1.1.5. 6

RESPONSES TO NRC QUESTIONS

Question N250.01(e) (Hydrology - Question 1e)

Provide the details of your analysis used in response to (d) above, the level of detail similar to that identified in item (b) above.

Response:

The placing of the intake and discharge structures within the river cross-section means that the cross-sectional area of the river at that location would be increased by about 55 sq ft (cross-sectional area of the intake and discharge structures). With a river width of about 1,950 ft, this means that the river stage will increase by about 0.3 inches.

See also new Section 2.4.1.1.5. 6

RESPONSES TO NRC QUESTIONS

Question N250.02 (Hydrology - Question 2)

Provide a discussion on planned present or future use of groundwater on the site and whether for potable or other uses. If there is any planned potable use of groundwater, including during construction, then provide detailed discussions relevant to the potential radiological contamination of groundwater supplies. Provide locations of any radioactive waste burial grounds near the site both upgradient and downgradient and discuss potential problems at the site. Also, discuss other radioactive plumes on the Hanford Reservation and possible effects on plant operation.

Response:

There are no planned usages of groundwater for the S/HNP during construction or operation for any purpose. The Columbia River is the source of all water to be used on the S/HNP Site. See also Section 3.3. 6

RESPONSES TO NRC QUESTIONS

Question N260.01 (Demography - Question 1)

In Section 9.3 insufficient information is provided for the staff to review the environmental rating of candidate sites in the area of demography and land use. For each of the alternative sites, provide your basis for: a) population density including weighted transient population projected at the time of initial operation would not exceed 500 persons per square mile, averaged over any radial distance up to 30 miles from each site (cumulative population at a distance divided by the area at that distance), and the projected population density over the lifetime of the nuclear power plant would not exceed 1,000 persons per square mile (similarly weighted and measured), b) the site is not in an area where additional safety consideration (industrial, military and transportation facilities) would result in the reasonable likelihood of having to expend substantial additional sums of money (cumulative expenditures in excess of about 5% of total project capital costs) to make the project licensable from a safety standpoint.

Response:

(a) Projected population densities within a 30-mile radius for the ten alternative sites are presented in the Table N260.01. Please note the data presented do not include transient population which would have an insignificant impact upon population densities for these sites.

Two methods were used for population calculations: One method for determination of population located in the U.S. and another method for population located in Canada.

The U.S. population distribution was based on the 1970 U.S. Census results (Ref 1) as determined by the POPRING computer code. The 1970 census data were used because the 1980 Census results on an Enumeration District (ED) or block level are not currently available. ED/block level census data (i.e., 1970 census data) must be used because it is not valid to assume a uniform population distribution over an entire county as would have to be done if only 1980 census data were used.

RESPONSES TO EFSEC QUESTIONS

Question E220.02 (Water Supply - Question 2)

Because of evaporation in the cooling water system, 20-70 cfs, what will be the corresponding loss in hydroelectric generation from the downstream hydroelectric power dams?

Response:

See revised Section 5.1.2.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E220.03 (Water Supply - Question 3)

Other than the Columbia River, what alternative sources of water are available, and will they require less energy to transport? Why was groundwater not considered as a water source?

Response:

See revised Section 3.3. 6

RESPONSES TO EFSEC QUESTIONS

Question E220.04 (Water Supply - Question 4)

Regarding the intake system, what is the designed head that the pumps are selected for, and its associated energy requirements?

Response:

See revised Section 3.4.2.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E220.05 (Water Supply - Question 5)

How were the low and medium river flow velocities as mentioned on page 5.1-5 calculated?

Response:

After a river cross-section was established at RM 361.5 and river velocities were recorded at various flows (see ASC/ER Appendix B), the data were incorporated into the US Corps of Engineers HEC-2 model to establish the river stage/discharge relationship. Low and median river flow velocities were then computed from a known discharge and corresponding cross sectional area.

RESPONSES TO EFSEC QUESTIONS

Question E220.06 (Water Supply - Question 6)

Will boat traffic be affected during the construction of intake and discharge systems?

Response:

See new Section 4.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E220.07 (Water Supply - Question 7)

What are the design specifications for the water supply pipe lines (e.g. diameter, material, trench depth and head loss in the pipe)?

Response:

See revised Section 3.4.2.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E221.01 (Water Quality - Question 1)

What is the path and rate of travel of effluent and other plant chemicals discharged into a percolation pond? Could these discharges reach the river? How much of the chemicals will accumulate in the ground?

Response:

See revised Section 5.4.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E221.02 (Water Quality - Question 2)

What is the estimated runoff resulting from on-site facilities and access roads?

Response:

The on-site runoff for the one hour and six hour thunderstorm PMP are discussed in PSAR Section 2.4.3.2.

RESPONSES TO EFSEC QUESTIONS

Question E221.03 (Water Quality - Question 3)

What are the on-site runoff characteristics during high intensity storms and frozen ground conditions?

Response:

The PSAR analysis of flooding due to the PMP assumed 100% imperviousness (see PSAR Section 2.4.3.2.2). PSAR Section 2.4.3.2 discusses in detail the Project watershed PMF.

RESPONSES TO EFSEC QUESTIONS

Question E221.04 (Water Quality - Question 4)

Regarding sanitary waste, were percolation tests conducted and if so, what were their results? Are there any local well fields that might be affected by the percolation pond?

Response:

As indicated in Section 3.7, percolation tests have not been completed at this time. Percolation tests will be conducted prior to and their results incorporated in the final percolation pond design. See also revised Section 5.4.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E221.05 (Water Quality - Question 5)

Specifically, where would water contaminated with cleaning chemicals be disposed of offsite by a contractor?

Response:

See revised Section 3.7.1.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E221.06 (Water Quality - Question 6)

Has a drainage plan for the plant site and access roads been developed? If yes, is it a gravity system? What is the size of the pipe?

Response:

A drainage plan utilizing open ditches has been developed for the S/HNP Site. Please refer to revised Figure 4.1-2 for a grading plan and details of Site drainage patterns.

RESPONSES TO EFSEC QUESTIONS

Question E230.01 (Socioeconomics - Question 1)

The 8.5 to 12.5 percent of the WPPSS construction work force residing in Yakima County as referenced in the application cannot be located in that reference. What is the source of this reference?

Response:

See revised Section 8.3.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E230.02 (Socioeconomics - Question 2)

What is the source of the multipliers and coefficients identified in the last two paragraphs on page 8.3-10 and 8.3-11?

Response:

See revised Section 8.3.6.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E230.02 (Socioeconomics - Question 2 Cont'd)

Page deleted 6

RESPONSES TO EFSEC QUESTIONS

Question E230.03 (Socioeconomics - Question 3)

What are the sources of information contained in the tables referenced in Sections 8.3.6 and 8.3.7?

Response:

See revised Sections 8.3.6 and 8.3.7. 6

RESPONSES TO EFSEC QUESTIONS

Question E230.04 (Socioeconomics - Question 4)

What is the source of the work force for WPPSS Nuclear Project Unit 4?

Response:

See revised Section 8.3.6.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E230.05 (Socioeconomics - Question 5)

Why did the applicant not include security and Puget Operations and Maintenance personnel in Table 8.3-5?

Response:

See revised Table 8.3-5. 6

RESPONSES TO EFSEC QUESTIONS

Question E230.06 (Socioeconomics - Question 6)

With regard to police protection, what are current rates of crime by type and by area?

Response:

See revised Section 8.3.14.1. 6

Table E230.06 Sheet 1 of 1

Type and Number of Crimes by Area, Tri-Cities SMSA, 1980

Page deleted

6

NOTE: This information is now included in Table 8.3-16a.

RESPONSES TO EFSEC QUESTIONS

Question E230.07 (Socioeconomics - Question 7)

What are the Insurance Service Organization (ISO) ratings of the local fire departments?

Response:

See revised Table 8.3-17. 6

RESPONSES TO EFSEC QUESTIONS

Question E231.01 (Economics/Revenue Distribution - Question 1)

What is the anticipated schedule of construction expenditures including all amounts expected to be subject to property tax assessment and sales/use taxation?

Response:

See new Table 8.3-2. 6

RESPONSES TO EFSEC QUESTIONS

Question E231.02 (Economics/Revenue Distribution - Question 2)

What is the estimated value of the property to be purchased for the project in Benton and other surrounding counties, including transmission and water line corridors?

Response:

See revised Section 8.3.5.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E231.03 (Economics/Revenue Distribution - Question 3)

What were the methods, assumptions and basis of assumptions for sales and use tax estimates?

Response:

See revised Section 8.3.5.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E231.06 (Economics/Revenue Distribution - Question 6)

What are the current employment characteristics of the Tri-Cities SMSA Labor Force by Industrial Category? What is the current personal income by industry source for the Tri-Cities SMSA?

Response:

Employment characteristics and personal income by industry are presented in revised Section 8.3.8.1. 6

Table E231.06A

Non-Agricultural Wage and Salary Workers, Tri-Cities SMSA by Industry, July 1981

Table deleted

6

NOTE: This information is now included in Table 8.3-6a.

Table E231.06B

Average Monthly Non-Agricultural Payroll within Tri-Cities SMSA, First Quarter, 1980

Table deleted

6

NOTE: This information is now included in Table 8.3-6a.

RESPONSES TO EFSEC QUESTIONS

Question E231.07 (Economics/Revenue Distribution - Question 7)

What is the value of annual purchases of fuel and supplies and materials that would be subject to local taxation during plant operations?

Response:

The value of supplies and materials purchased during plant operation is within the range of $3.2 - 3.6 million for both units. These costs are in 1981 dollars. It is estimated that 10 - 20% of this will be purchased locally. The purchases of fuel are discussed in the response to Question E231.04.

RESPONSES TO EFSEC QUESTIONS

Question E231.08 (Economics/Revenue Distribution - Question 8)

What is the value of inventories of supplies and materials and mobile equipment that would be assessible and subject to property taxation during operations?

Response:

See revised Section 8.3.5.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E231.09 (Economics/Revenue Distribution - Question 9)

What is the annual employment by occupation and payroll classification during operations?

Response:

See revised Table 8.3-20. 6

RESPONSES TO EFSEC QUESTIONS

Question E231.10 (Economics/Revenue Distribution - Question 10)

What are the potential inequities in revenues and costs to local government as a result of the project?

Response:

See revised Section 8.3.9. 6

RESPONSES TO EFSEC QUESTIONS

Question E231.11 (Economics/Revenue Distribution - Question 11)

What mitigating measures could be employed to offset any potential adverse socioeconomic or fiscal impacts?

Response:

See revised Section 8.3.4. 6

RESPONSES TO EFSEC QUESTIONS

Question E240.01 (Groundwater - Question 1)

What is the relationship of general hydrological properties presented on page 2.4-11 paragraph 4 to the S/HNP Site?

Response:

The hydraulic conductivity in wells drilled on the S/HNP Site in the unconfined aquifer ranges from 116 to 470 ft/day as measured in short duration tests. Table 2.4-24 contains site specific data from onsite wells and piezometers (S/HNP PSAR, Appendix 2P). These values are in the same range as data from Wells 699-20, 699-26-15 and 699-15-26, shown in Table 2.4-22.

RESPONSES TO EFSEC QUESTIONS

Question E240.02 (Groundwater - Question 2)

What is the impact of the groundwater mound at U-pond to the S/HNP Site?

Response:

See revised Section 2.4.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E240.03 (Groundwater - Question 3)

What are the justifications behind the comparison of the 1980 data presented in Figure 2.4-11 to the 1970 data presented in 2.4-12?

Response:

The map in Figure 2.4-11 and Figure 2.4-12 are sufficiently spaced in time that they should not be compared directly. The statements with regard to the greater potentials in the confined system are correct; however, the words, "(Compare Figures 2.4-13 and 2.4-12)" should be deleted from paragraph two, page 2.4-13. Onsite measurements indicate potentials in the lower confined aquifer are about two feet higher than potentials in the unconfined aquifer (Ref PSAR, Appendix 2P)

RESPONSES TO EFSEC QUESTIONS

Question E240.04 (Groundwater - Question 4)

What data base and method of analysis were utilized to determine that there is no likelihood that groundwater flow patterns will be affected by groundwater production at the WPPSS Nuclear Project 1 and 2 facilities?

Response:

An extensive data base exists from the measurements taken at Hanford since 1945. Water table measurements are made semiannually and water quality samples taken periodically by Department of Energy contractors. See also revised Section 2.4.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E240.05 (Groundwater - Question 5)

What are the hydrologic effects at the S/HNP of injection and/or withdrawal of water at other locations such as the Fast Flux Test Facility (FFTF) and the Purex Plant?

Response:

See revised Section 2.4.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E240.06 (Groundwater - Question 6)

Why are the hydrologic properties at wells 69-31-31 and 69-24-33 not included in Table 2.4-22?

Response:

Well 699-24-33 is included in Table 2.4-22. Well 699-31-31 should have been included. Table 2.4-22 has been revised to include information on Well 699-31-31. 6

RESPONSES TO EFSEC QUESTIONS

Question E250.01 (Land Use - Question 1)

What is the appropriate shoreline designation for the intake and discharge systems for the proposed site?

Response:

AEC Hanford Reservation. See also the response to Land Use Question E250.02.

RESPONSES TO EFSEC QUESTIONS

Question E250.02 (Land Use - Question 2)

Is the proposed use consistent with the Shoreline Master Program and Coastal Zone Management Program?

Response:

See revised Section 2.1.4. 6

RESPONSES TO EFSEC QUESTIONS

Question E250.03 (Land Use - Question 3)

What is the current zoning Comprehensive Plan status and Shoreline Designation for the proposed and nine alternative sites?

Response:

This information has been provided under separate cover via letter from Mr. F. T. Thomsen to Mr. Grant Bailey dated February 5, 1982, (Question E200.07 Attachment 1).

RESPONSES TO EFSEC QUESTIONS

Question E250.04 (Land Use - Question 4)

Will there be any secondary land use impacts associated with either construction or operation of the project?

Response:

See revised Section 8.3.11.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E250.05 (Land Use - Question 5)

What land use impacts, if any, might be associated with increased noise, light, and glare impacts, or aesthetic impacts associated with facility construction and operation?

Response:

Noise impacts from construction activities are discussed in Section 4.1.1. Section 4.1.1 has been revised to also provide information on light, glare and aesthetic impacts from construction activities.

As indicated in Sections 3.9, 5.1.4.8.5, 5.5 and 5.6,
noise, light, and glare due to operation of the facility
will not affect land use off the Hanford Reservation
because off-Site land uses that might be impacted, such as 6
residential areas, are distant from the Site.

RESPONSES TO EFSEC QUESTIONS

Question E250.06 (Land Use - Question 6)

What effects will land use impacts have on property values?

Response:

Previous research (Ref 1) on nuclear power stations has identified and documented beneficial impacts upon property values. Generally, it is projected that such positive impacts on property values will be inversely related to distance from the facility. Under baseline scenarios, i.e. without the S/HNP potential decreases in property values are projected. Construction and operation of the facility will partially offset such declines through provision of continued employment opportunities in the community.

Reference 1:

H. B. Gamble and Associates, Effects of Nuclear Power Plants on Community Growth and Residential Property Values. U.S. NRC NUREG/CR-0454 1978.

RESPONSES TO EFSEC QUESTIONS

Question E260.01 (Noise - Question 1)

What are the potential noise impacts resulting from the increased rail and/or vehicular traffic during construction?

Response:

See revised Section 4.1.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E260.02 (Noise - Question 2)

What are the amounts and locations of population that would experience increased noise from construction traffic, rail traffic, and transmission lines? Estimate noise levels, noise increases and times of occurrence for each source of increased noise. Provide basis for these estimates (such as traffic projections) and prediction methodologies used.

Response:

Section 5.6 has been revised to discuss increased noise from transmission lines and operational traffic. 6

Section 4.1.1 has been revised to provide additional information on construction traffic noise impacts.

RESPONSES TO EFSEC QUESTIONS

Question E260.03 (Noise - Question 3)

What are the noise impacts to construction workers during construction? Are any hearing protection programs proposed?

Response:

See revised Section 4.1.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E260.03 (Noise - Question 3, Cont'd)

Page deleted 6

RESPONSES TO EFSEC QUESTIONS

Question E260.04 (Noise - Question 4a)

Provide existing noise levels at the following locations:

1. Residences along the bypass highway
2. State route 240 near Horn Rapids Dam

Response:

See revised Section 2.7. 6

RESPONSES TO EFSEC QUESTIONS

Question E260.05 (Noise - Question 4b)

Measurements should be for 24 hour weekday period, noise sources, setbacks, and weather effects should be included. Show locations on a map.

Response:

See revised Section 2.7 for additional information on noise measurement. References to setbacks are inappropriate in the scope of the project in question. 6

RESPONSES TO EFSEC QUESTIONS

Question E260.05 (Noise - Question 4b Cont'd)

Page deleted 6

RESPONSES TO EFSEC QUESTIONS

Question E260.06 (Noise - Question 5)

What are the daytime and nighttime (10 p.m. - 7 a.m.) noise contours for operational and onsite construction noise?

Response:

See revised Sections 4.1.1 and 5.6. 6

RESPONSES TO EFSEC QUESTIONS

Question E260.06 (Noise - Question 5, Cont'd)

Page deleted 6

FIGURE E260.06

Figure deleted

NOTE: This information is now included in Figure 5.6-1. 6

Both the States of Oregon and Washington have noise control regulations in effect. In Oregon, the maximum permissible noise level is 60 dB(A) for an existing commercial or industrial noise source and 55 dB(A) for a new noise source. During nighttime hours (10:00 p.m. to 7:00 a.m.) the maximum permissible noise levels are 55 dB(A) and 50 dB(A) for existing and new industrial noise sources respectively. Measurement of noise under Oregon regulations is made either at that point on the noise sensitive property line nearest the noise source, or 25 feet toward the noise source from that point on the noise sensitive building nearest the noise source, whichever is farthest from the noise source (Oregon Environmental Quality Commission, 1974).

In Washington, the maximum permissible noise level is 60 dB(A). Measurement of noise under the Washington regulations is made at the receiving property line. Under Washington regulations, the permissible noise level varies with the class of the receiving property and the noise source. The 60 dB(A) limitation assumes the most likely case where the noise source is Class C (industrial) and the receiving property is Class A (residential) (Washington State Department of Ecology, 1975). BPA's new triple-bundle conductors for its 500-kV lines are within the noise levels for both Oregon and Washington.

RESPONSES TO EFSEC QUESTIONS

Question E260.08 (Noise - Question 7)

Would wildlife displacement occur due to construction noise?

Response:

See revised Section 4.2.5. 6

RESPONSES TO EFSEC QUESTIONS

Question E260.09 (Noise - Question 8)

What are background noise levels in the vicinity of intake pumps and what are noise levels for intake pumps themselves? What is the distance to and noise level at the closest residential area?

Response:

Background noise at RM 361.5 is 34.2 dBA Leq (see Figure 2.7-1, location #2).

Section 5.6 has been revised to provide additional information on noise from the raw water pumphouse. 6

RESPONSES TO EFSEC QUESTIONS

Question E260.10 (Noise - Question 9)

What mitigating (measures) are proposed to lessen noise impacts, including measures to minimize the transmission line noise, construction traffic noise or noise impacts on construction workers?

Response:

Noise impacts are lessened by routing transmission lines and construction traffic through existing corridors for these activities whenever practical. Noise impacts on construction workers will be controlled through compliance with state and federal regulations covering noise for construction sites.

RESPONSES TO EFSEC QUESTIONS

Question E280.01 (Air Quality - Question 1)

What is the size and operating characteristics of the concrete batch plant with regards to air quality?

Response:

See revised Section 4.1.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E280.02 (Air Quality - Question 2)

What is the number and intensity of the use of heavy duty construction equipment and transport equipment that will be a major source of fugitive particulate?

Response:

See revised Section 4.1.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E280.03 (Air Quality - Question 3)

Specifically, what controls will be employed during construction to control fugitive dust?

Response:

See revised Section 4.5.5.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E280.04 (Air Quality - Question 4)

What are the design characteristics of the auxiliary and emergency diesel generators, and what are the estimates for frequency of non-routine operation of these generators?

Response:

See revised Section 3.7.4. 6

RESPONSES TO EFSEC QUESTIONS

Question E280.05 (Air Quality - Question 5)

What are the site locations of the auxiliary and emergency diesel generators?

Response:

The emergency diesel generators are located in the diesel generator building for each unit. The diesel fire pump engine is located in the Unit 1 circulating water pump-house. These buildings are located as shown on ASC/ER Figure 3.1-1.

RESPONSES TO EFSEC QUESTIONS

Question E290.01 (Aquatic Biota - Question 1)

Including salmon and steelhead, what is the relative level of sport fishing (fisherman days per year) along the Hanford Reach of the Columbia and within a reasonable area of the Project?

Response:

See new Section 2.2.2.6.4. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.02 (Aquatic Biota - Question 2)

What are the sources of data presented in most of the figures and certain tables in section 2.2.2?

Response:

Data sources include WNP 1/4 ER, WNP 2 ER, WPPSS Columbia River Ecology Studies (vol. 1-7), WPPSS 316(a) demonstration at HGP, Battelle aquatic resource studies. Specific references are as follows:

ASC/ER Table	Source
Table 2.2-15	Ref 53, 57-59, 64-66
Table 2.2-16	Ref 61, 63
Table 2.2-17	Ref 53, 57-59, 64-66
Table 2.2-18	Ref 72
Figure 2.2-10	Ref 53, 57-59, 64-66
Figure 2.2-11	Ref 53, 57-59, 64-66
Figure 2.2-12	Ref 57, 58, 60
Figure 2.2-13	Ref 57, 58, 60
Figure 2.2-14	Ref 53, 57-59, 64-66
Figure 2.2-15	Ref 53, 57-59, 64-66
Figure 2.2-16	Ref 53, 57-59, 64-66
Figure 2.2-17	Ref 53, 57-59, 64-66, Chapt. 5.1 Ref 23
Figure 2.2-22	Ref 38

RESPONSES TO EFSEC QUESTIONS

Question E290.03 (Aquatic Biota - Question 3)

What is the importance of ichthyoplankton on the aquatic ecology of the Hanford Reach of the Columbia River?

Response:

See new Section 2.2.2.6.3. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.04 (Aquatic Biota - Question 4)

Regarding aquatic ecology what is the significance of seasonal and annual fluctuations in phytoplankton and how does the significance of phytoplankton along the Hanford Reach compare to other parts of the Columbia or other river systems?

Response:

See revised Section 2.2.2.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.05 (Aquatic Biota - Question 5)

What is the size and significance of the periphyton community and fluctuations in its density to the aquatic ecology of the Hanford Reach of the Columbia?

Response:

See revised Section 2.2.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.06 (Aquatic Biota - Question 6)

What is the significance of macrophyte aggregations to habitat for fishes, especially warm water game fishes?

Response:

See revised Section 2.2.2.3. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.07 (Aquatic Biota - Question 7)

What is the significance of zooplankton to the aquatic ecology of the river, especially as a food source for juvenile salmonids?

Response:

See revised Section 2.2.2.4. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.08 (Aquatic Biota - Question 8)

What is the significance of the benthic invertebrate data presented to fishes?

Response:

See revised Section 2.2.2.5. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.09 (Aquatic Biota - Question 9)

Why does the data presented in Figure 2.2-16 not agree with the statements in the text?

Response:

The average density for all samples collected in June should be $5,944/m^2$ not $59,944/m^2$. With the correction of this typographical error, the statements in the text agree with the data presented in ASC/ER Figure 2.2-16.

RESPONSES TO EFSEC QUESTIONS

Question E290.10 (Aquatic Biota - Question 10)

Why are the salmon species identified as candidates for threatened and endangered list not identified here or in section 2.2.9.

Response:

The salmon species were not identified because the candidate list has no official standing. Included on the list were all species of Pacific Salmon. We understand that the species in question have subsequently been dropped from the list.

RESPONSES TO EFSEC QUESTIONS

Question E290.11 (Aquatic Biota - Question 11)

What criteria for designating a fish species as important in the Hanford Reach were used?

Response:

See revised Section 2.2.2.6. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.12 (Aquatic Biota - Question 12)

What is the yearly variability in Chinook salmon along the Hanford Reach of the Columbia?

Response:

Estimates of adult chinook salmon migrating through the Hanford Reach can be obtained from Army Corps of Engineers passage counts at McNary, Ice Harbor and Priest Rapids dams. Estimates of adult salmon spawning are contained in various reports by Watson (Refs 73, 116 of Section 2.2).

See Tables 2.2-21a and 2.2-21b regarding annual estimates of adult fall chinook utilization of the Reach. 6

Washington Department of Fisheries documents have annual estimates of juvenile outmigration. Studies at Priest Rapids Dam (PRD) involving downstream migrant passage can be summarized to provide estimates of abundance. Hatchery releases estimates from Ringold and PRD rearing facilities can also be obtained.

See also revised Section 2.2.2.6.1.1. 6

Table 3 has been deleted and included as Table 2.2-21a of ASC/ER Section 2.2. 6

Table 4 has been deleted and included as Table 2.2-21b of ASC/ER Section 2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.13 (Aquatic Biota - Question 13)

Where in the river are juvenile migration and feeding areas located?

Response:

See Section 2.2.2.6.1.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.14 (Aquatic Biota - Question 14)

What is the distribution of (rainbow/steelhead) spawning grounds relative to the proposed intake and discharge locations?

Response:

See revised Section 2.2.2.6.1.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.15 (Aquatic Biota - Question 15)

What will the thermal effects be upon rainbow/steelhead trout, especially in terms of sublethal effects?

Response:

See revised Section 5.1.3.2.4.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.16 (Aquatic Biota - Question 16)

What are the locations of (coho salmon) spawning areas and distributions of fry and 1+ juveniles in the river? Are they located near the proposed intake/outfall site?

Response:

See revised Section 2.2.2.6.1.3. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.17 (Aquatic Biota - Question 17)

What is the distribution of coho out-migrants in the river near the proposed intake outfall?

Response:

See revised Section 2.2.2.6.1.3. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.18 (Aquatic Biota - Question 18)

What is the distribution of sockeye out-migrants in the river?

Response:

See revised Section 2.2.2.6.1.4. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.19 (Aquatic Biota - Question 19)

What criteria were used to determine the important status of fish species?

Response:

See revised Section 2.2.2.6. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.20 (Aquatic Biota - Question 20)

What data exist to indicate whether or not the White Sturgeon is anadromous to the Hanford Reach of the Columbia River?

Response:

See revised Section 2.2.2.6.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.21 (Aquatic Biota - Question 21)

What are the spawning and rearing areas preferred by (northern squawfish)?

Response:

See revised Section 2.2.2.6.2.7. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.22 (Aquatic Biota - Question 22)

Will the consumptive water use of the proposed facility adversely impact juvenile and adult anadromous salmonids?

Response:

See revised Section 5.1.3.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.23 (Aquatic Biota - Question 23)

Why are several species of salmon listed as species of concern and identified as candidates for the threatened and endangered list, not listed in this section?

Response:

See response to Question E290.10.

RESPONSES TO EFSEC QUESTIONS

Question E290.24 (Aquatic Biota - Question 24)

What is the composition of the river bottom (substrate texture, etc.) within 0.5 miles of the intake discharge site? WAC 463-42-415.

Response:

See revised Section 2.4.1.1.3. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.25 (Aquatic Biota - Question 25)

What are the detailed design characteristics and specifications of the intake structures?

Response:

See new Section 4.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.26 (Aquatic Biota - Question 26)

What are approach velocities under varying flow conditions?

Response:

River velocities in the vicinity of the intakes are reported in Appendix B to the ASC/ER. Approach velocities resulting from water withdrawal are given by the following equation:

$$V = 0.5 \left(\frac{Q}{93.6} \right)^2$$

Where: V - average approach velocity in ft/sec.
Q - withdrawal rate in ft^3/sec.

RESPONSES TO EFSEC QUESTIONS

Question E290.27 (Aquatic Biota - Question 27)

What are the estimated dilution isopleths for the areas surrounding river discharge points? WAC 463-42-415.

Response:

See revised Section 5.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.28 (Aquatic Biota - Question 28)

What is the character of river substrate in the vicinity of intake and outfall pipes?

Response:

See revised Section 2.4.1.1.3. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.29 (Aquatic Biota - Question 29)

What backfill techniques will be employed?

Response:

See new Section 4.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.30 (Aquatic Biota - Question 30)

What specific environmental constraints will be imposed on the construction of intake and outfall pipes?

Response:

See new Section 4.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.31 (Aquatic Biota - Question 31)

How will the intake structures be anchored to the river substrate?

Response:

See new Section 4.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.32 (Aquatic Biota - Question 32)

What local habitat alteration may occur as the result of placement of relatively permanent underwater structures in the river?

Response:

Refer to the response Question E290.34.

See also new Section 4.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.33 (Aquatic Biota - Question 33)

What is the specific construction schedule to be employed to minimize turbidity and endangerment of aquatic life?

Response:

See new Section 4.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.34 (Aquatic Biota - Question 34)

What specific types of aquatic life and/or habitats could potentially be impacted by construction in the area?

Response:

See new Section 4.1.2.2. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.35 (Aquatic Biota - Question 35)

How will approach velocities be affected if a perfectly parallel placement of the three intake structures is not achieved?

Response:

See revised Section 5.1.2.1. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.36 (Aquatic Biota - Question 36)

Given the absence of adequate river substrate data, how can it be assured that large boulders, Ringold outcrops, or holes capable of producing significant cross currents or rising currents will not effect the hydraulics near the intake surface?

Response:

Bathymetric profiling (ASC/ER Appendix B) did not reveal structures capable of altering the river hydraulics in the vicinity of the S/HNP intake. Velocity distribution measurements verify this finding.

See also revised Section 2.4.1.1.3. 6

RESPONSES TO EFSEC QUESTIONS

Question E290.37 (Aquatic Biota - Question 37)

Are river flows at intake locations laminar?

Response:

Natural flows in rivers are turbulent. Laminar flow does not exist outside of the laboratory. The Columbia River at Hanford because of substrate, gradient, and flow volume is generally considered to have a turbulent flow.

RESPONSES TO EFSEC QUESTIONS

Question E290.38 (Aquatic Biota - Question 38)

What in-situ verification occurred to verify the lack of salmonid spawning in the discharge area?

Response:

Lack of spawning habitat was concluded by the following:

1) Forty continuous years of "fixed-wing" aerial redd counts during the spawning season,

2) D. Watson's 1981 aerial spawning survey,

3) Close scrutiny of aerial photographs,

4) Visual ground observations along both shorelines during low river flows, and

5) SCUBA observations to characterize the bottom substrate.

RESPONSES TO EFSEC QUESTIONS

Question E290.39 (Aquatic Biota - Question 39)

What site specific data/ecological parameters for the proposed intake/discharge site were employed to conclude that the effects of such structures on aquatic biota is "inconsequential"?

Response:

Previous studies (WPPSS Aquatic Ecological Studies 1-7) indicated that operation of S/HNP would not significantly affect phytoplankton and zooplankton communities. These studies also provided extensive information on abundance and composition of aquatic biota in the Hanford Reach. Because many habitat characteristics of previously studied areas were similar to those near the S/HNP site, extensive site specific data were not collected for this amendment. However, field studies in support of certain general assumptions were conducted. Only the fish and benthic communities were investigated, because they were the only communities for which a significant potential impact could be postulated. 6

Benthic studies involved substrate mapping, bathymetric surveys, and assessments of midstream species composition and abundance. Data indicates major benthic components differ little from previous studies in the Hanford Reach. 6 6

Methods for fish studies were chosen to be comparable with previous aquatic ecological studies; however, in this case, Hanford Slough fish populations were studied as well as main river fish populations in the vicinity of the proposed intake/discharge. Information has been gathered on seasonal and spatial abundance, movement, and life history aspects of fish populations. Trends in abundance and species composition are similar for other areas where direct comparisons can be made. 6

See Appendix K for a report on the site specific studies. 6