

**ATTACHMENT TO RESOLUTION 10-206
PROFESSIONAL SERVICES AGREEMENT BETWEEN LEWIS COUNTY,
ACTING AS FISCAL AGENCY FOR THE CHEHALIS RIVER BASIN FLOOD
CONTROL AUTHORITY AND ANCHOR QEA**

PERSONAL SERVICES AGREEMENT

Between

LEWIS COUNTY

and

ANCHOR QEA

THIS AGREEMENT is made and entered into by and between LEWIS COUNTY, WASHINGTON, herein referred to as "County", acting as the lead agency for the Chehalis River Basin Flood Authority ("Flood Authority") and Anchor QEA, 1423 3rd Avenue, Suite 300, Seattle, WA 98101, herein referred to as "Anchor" or "Contractor".

IT IS THE PURPOSE OF THIS AGREEMENT to enter into an Agreement between Lewis County and Anchor to provide consulting services to assist the Flood Authority in fish studies related to upstream water detention for flood control in the Chehalis River Basin, consistent with the Proposal submitted by Anchor in response to a Request for Proposals offered by the County and opened on July 12, 2010, and the scope of work and budget submitted by Anchor for the same, as attached hereon.

THEREFORE, IT IS MUTUALLY AGREED THAT:

Statement of Work

Anchor shall furnish the necessary personnel, equipment, material and/or services and otherwise do all things necessary for, or incidental to, the performance of the work set forth in the scope of work attached hereon as Attachment "A."

Period of Performance

Subject to its other provisions, the period of performance of this Agreement shall commence on the date of signing by both parties and be completed as agreed and shown in the attached scope of work, Attachment "A", but may be modified or extended by mutual agreement.

Payment

Compensation for the work provided in accordance with this agreement shall be as set forth in the proposal, and included therein as Attachment "B". In no case shall total payment for services under this Agreement exceed \$900,000.

Future Non-Allocation of Funds:

If sufficient funds are not appropriated or allocated for payment under this contract for any future fiscal period, the County, acting as the lead agency for the Flood Authority, will not be obligated to make payments for services or amounts incurred after the end of the current calendar year. No penalty or expense shall accrue to the County in the event this provision applies.

GENERAL CONDITIONS

1. **Scope of Contractor's Services:** Anchor QEA hereafter referred to as the "Contractor" or "Anchor", agrees to provide to the County the services as described in Attachment "A" and attached hereon to this Agreement solely on behalf of Lewis County, acting as the lead agency for the Flood Authority and as directed by the Director of Community Development.
2. **Accounting and Payment for Contractor Services:** The County Contractor shall be paid for performance under this contract, in accordance with the Proposed Project Budget as included within the attached thereto Attachment "B" of this Agreement.
3. **Assignment and Subcontracting:** No portion of this contract may be assigned or subcontracted to any other individual, firm or entity without the express and prior written approval of the Lewis County Contract Manager.
4. **Labor Standards and Contract Assistance:** The Contractor shall comply with the provisions of the Lewis County Contract and Procurement Assistance Program, attached hereto as Special Conditions.
5. **Independent Contractor:** The Contractor's services shall be furnished by the Contractor as an independent contractor and nothing contained herein or in this contract shall be construed to create a relationship of employer-employee or master-servant, but all payments made thereunder and all services performed shall be made and performed, pursuant to this Memorandum or any contract, by the Contractor as an independent contractor.

The Contractor acknowledges that the entire compensation for any work request or order shall be specified within said work request or order, and the Contractor, its agents, officers, employees or subcontractors, are not entitled to any County benefits including, but not limited to: vacation pay, holiday pay, sick leave pay, medical, dental, or other insurance benefits, or any other rights or privileges afforded to Lewis County employees.

Contractor will defend, indemnify and hold harmless the County, its officers, agents or employees from any loss or expense, including but not limited to settlements, judgments, setoffs, attorneys' fees or costs incurred by reason of claims or demands because of breach of the provisions of this paragraph by the Contractor.

6. **No Guarantee of Employment:** The performance of all or part of this contract by the Contractor shall not operate to vest any employment rights whatsoever and shall not be deemed to guarantee any employment of the Contractor or any employee of the Contractor or any subcontractor or any employee of any subcontractor in the present or in the future.

7. **Taxes:** The Contractor understands and acknowledges that the County will not withhold Federal or State income taxes. Where required by State or Federal law, the Contractor authorizes the County to make withholding for any taxes other than income taxes (i.e., Medicare). All compensation received by the Contractor will be reported to the Internal Revenue service at the end of the calendar year in accordance with applicable IRS regulations. It is the responsibility of the Contractor to make the necessary estimated tax payments throughout the year, if any, and the Contractor is solely liable for any tax obligation arising from the Contractor's performance of this contract. The Contractor hereby agrees to indemnify the County against any demand to pay taxes on compensation earned pursuant to this contract.

The County will pay sales and use taxes imposed on goods or services acquired hereunder as required by law. The Contractor must pay all other taxes including, but not limited to: Business and Occupation Tax, taxes based on the Contractor's gross or net income, or personal property to which the County does not hold title. The County is exempt from Federal Excise Tax.

8. **Regulations and Requirement:** This contract shall be subject to all laws, rules, and regulations of the United States of America, the State of Washington, and political subdivisions of the State of Washington.

9. **Right To Review:** This contract is subject to review by any Federal or State auditor. The County or its designee shall have the right to review and monitor the financial and service components of this program by whatever means are deemed expedient by the County. Such review may occur with or without notice, and may include, but is not limited to, on site inspection by County agents or employees, inspection of all records or other materials which the County deems pertinent to any contract and its performance, and any and all communications with or evaluations by service recipients under such contract(s). When necessary, Contractor shall have an affirmative duty to notify such service recipients of this right to review. The Contractor shall preserve and maintain all financial records and records relating to the performance of work under any contract for 3 years after contract termination, and shall make them available for such review, within Lewis County, State of Washington, upon request.

10. **Modifications:** Either party may request changes in this contract. Any and all agreed modifications shall be in writing, signed by each of the parties, and effective on the latter date of execution by the respective parties.

11. **Termination for Default:** If the Contractor defaults by failing to perform any of the obligations of this contract or becomes insolvent or is declared bankrupt or commits an act of bankruptcy or insolvency or makes an assignment for the benefit of creditors, the County may, by depositing written notice to the Contractor in the U. S. mail, postage prepaid, terminate the contract, and at the

County's option, obtain performance of the work elsewhere. If the contract is terminated for default, the Contractor shall not be entitled to receive any further payments under the contract until all work called for has been fully performed. Any extra cost or damage to the County resulting from such default(s) shall be deducted from any money due or coming due to the Contractor. The Contractor shall bear any reasonable extra expenses incurred by the County in completing the work, including all increased costs for completing the work, and all damage sustained, or which may be sustained by the County by reason of such default.

If a notice of termination for default has been issued and it is later determined for any reason that the Contractor was not in default, the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to the Termination for Public Convenience paragraph hereof.

12. **Termination or Suspension for Public Convenience:** The County may terminate this contract in whole or in part whenever the County determines, in its sole discretion, that such termination or suspension is in the interests of the County. Whenever the contract is terminated or suspended in accordance with this paragraph, the Contractor shall be entitled to payment for actual work performed at unit contract prices for completed items of work. An equitable adjustment in the contract price for partially completed items of work will be made, but such adjustment shall not include provision for loss of anticipated profit on deleted or uncompleted work. Termination or suspension of such contract by the County at any time during the term, whether for default or convenience, shall not constitute a breach of contract by the County. Lewis County may reactivate the contract in whole or in part following suspension upon depositing written notice of reactivation to Contractor in the U.S. mail, said reactivation becoming effective ten (10) days following mailing.
13. **Defense & Indemnity Agreement:** The Contractor agrees to defend, indemnify and save harmless the County, its appointed and elective officers and employees, from and against all loss or expense, including but not limited to judgments, settlements, attorney's fees and costs by reason of any and all claims and demands upon the County, its elected or appointed officials or employees for damages because of personal or bodily injury, including death at any time resulting therefrom, sustained by any person or persons and on account of damage to property including loss of use thereof, when such injury to persons or damage to property is due to the negligence of the Contractor, his/her subcontractors, its successor or assigns, or its or their agent, servants, or employees. It is further provided that no liability shall attach to the County by reason of entering into any contract, except as expressly provided herein or as otherwise required by operation of law upon political subdivisions of the State of Washington.
14. **Insurance:** The Consultant shall procure and maintain for the duration of the Agreement, insurance against claims for injuries to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the Consultant, its agents, representatives, or employees. Insurance is to be placed with insurers with a current A. M. Best rating of no less than A: VII.

a. Minimum Amounts of Insurance:

Consultant shall maintain the following insurance limits:

1. Automobile Liability insurance with a minimum combined single limit for bodily injury and property damage of \$1,000,000 per accident.
2. Commercial General Liability insurance shall be written with limits no less than \$1,000,000 each occurrence, \$2,000,000 general aggregate.
3. Professional Liability insurance shall be written with limits no less than \$1,000,000 per claim and \$1,000,000 policy aggregate limit.

b. Other insurance provisions:

The insurance policies are to contain, or be endorsed to contain, the following provisions:

1. The Consultant will furnish an original certificate of insurance, indicating Lewis County is additionally insured. This certificate will be included as part of the proposal package.
2. The Consultant's insurance shall be endorsed to state that coverage shall not be cancelled by either party, except after thirty (30) days prior written notice by certified mail, return receipt requested, has been given to the County.

15. **Industrial Insurance Waiver:** With respect to the performance of this contract and as to claims against the County, its appointed and elected officers, agents and employees, the Contractor expressly waives its immunity under Title 51 of the Revised Code of Washington, the Industrial Insurance Act, for injuries to its employees, and agrees that the obligations to indemnify, defend and hold harmless provided in this contract extend to any claim brought by or on behalf of any employee of the Contractor. This waiver is mutually negotiated by the parties to this Memorandum as part of the valuable consideration of present and future contracts.
16. **Venue and Choice of Law:** In the event that any litigation should arise concerning the construction or interpretation of any of the terms of this contract, the venue of such action of litigation shall be in the courts of the State of Washington in and for the County of Lewis. This contract shall be governed by the laws of the State of Washington. Except as otherwise stated herein, each party shall be responsible for its own attorneys fees.
17. **Withholding Payment:** In the event the Contractor has failed to perform any substantial obligation to be performed by the Contractor under this contract, and said failure has not been cured within the times set forth in any contract, then the County may, upon written notice, withhold all moneys due and payable to Contractor, without penalty, until such failure to perform is cured or otherwise adjudicated.
18. **Future Non-Allocation of Funds:** If sufficient funds are not appropriated or allocated for payment under this contract for any future fiscal period, the County will not be obligated to make payments for services or amounts incurred after the end of the current fiscal period. No penalty or expense shall accrue to the County in the event this provision applies.

19. **Contractor Commitments, Warranties and Representations:** Any written Commitment received from the Contractor concerning this contract shall be binding upon the Contractor, unless otherwise specifically provided herein with reference to this paragraph. Failure of the Contractor to fulfill such a commitment in accordance with industry standards shall render the Contractor liable for damages to the County. A commitment includes, but is not limited to, any representation made prior to execution of this contract, whether or not incorporated elsewhere by reference, as to performance of services or equipment, prices, or options for future acquisition to remain in effect for a fixed period, or warranties.

20. **Patent/Copyright Infringement:** Contractor will defend and indemnify the County from any claimed action, cause or demand brought against the County, to the extent such action is based on the claim that information supplied by the Contractor infringes upon any patent or copyright. The Contractor will pay the costs and damages attributable to any such claims that are finally awarded against the County in any action. Such defense and payments are conditioned upon the following:

That Contractor shall be notified promptly in writing by County of any notice of such claim.

Contractor shall have the right, hereunder, at its option and expense, to obtain for the County the right to continue using the information, in the event such claim of infringement, is made, provided no reduction in performance or loss results to the County.

21. **Disputes:**

General

Differences between the Contractor and the County, arising under and by virtue of this contract shall be brought to the attention of the County at the earliest possible time in order that such matters may be settled or other appropriate action promptly taken. Except for such objections as are made of record in the manner hereinafter specified and within the time limits stated, the records, orders, ruling, instructions, and decisions of the County, shall be final and conclusive.

Notice of Potential Claims

The Contractor shall not be entitled to additional compensation which otherwise may be payable, or to extension of time for (1) any act or failure to act by the County, or (2) the happening of any event or occurrence, unless the Contractor has given the County a written Notice of Potential Claim within 10 days of the commencement of the act, failure, or event giving rise to the claim, and before final payment by the County. The written Notice of Potential Claim shall set forth the reasons for which the Contractor believes additional compensation or extension of time is due, the nature of the cost involved, and insofar as possible, the amount of the potential claim. Contractor shall keep full and completed daily records of the work performed, labor and material used, and all costs and additional time claimed to be additional.

Detailed Claim

The Contractor shall not be entitled to claim any such additional compensation, or extension of time, unless within 30 days of the accomplishment of the portion of the work from which the claim arose, and before final payment by the County, the Contractor has given the County a detailed written statement of each element of cost or other compensation requested and of all elements of additional time required, and copies of any supporting documents evidencing the amount or the extension of time claimed to be due.

22. **Ownership of Items Produced:** All writings, programs, data, public records or other materials prepared by the Contractor and/or its consultants or subcontractors, in connection with the performance of any contract shall be the sole and absolute property of the County. The Contractor is not liable for any reuse of these materials except as it relates to this project.
23. **Confidentiality:** The Contractor, its employees, subcontractors, and their employees shall maintain the confidentiality of all information provided by the County or acquired by the Contractor in performance of any contract, except upon the prior written consent of the Contract Manager or an order entered by a court after having acquired jurisdiction over the County. Contractor shall immediately give to the County notice of any judicial proceeding seeking disclosure of such information. Contractor shall indemnify and hold harmless the County, its officials, agents or employees from all loss or expense, including but not limited to settlements, judgments, setoffs, attorney's fees and costs resulting from Contractor's breach of this provision.
24. **Notice:** Except as set forth elsewhere in this contract, for all purposes under said contract, except service of process, notice shall be given by the Contractor to the Contract Manager. Notice to the Contractor for all purposes under any contract shall be given to the address of record supplied by the contractor. Notice may be given by delivery or by depositing in the U.S. mail, first class, postage prepaid.
25. **Severability:** If any term or condition of this contract or the application thereof to any person(s) or circumstances is held invalid, such invalidity shall not affect other terms, conditions or applications which can be given effect without the invalid term, condition or application. To this end, the terms and conditions of said contract are declared severable.
26. **Waiver:** Waiver of any breach or condition of this contract shall not be deemed a waiver of any prior or subsequent breach. No term or condition of thereof shall be held to be waived, modified or deleted except by an instrument, in writing, signed by the parties hereto.
27. **Survival:** The provisions of paragraphs 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25 and 26 of this Agreement, shall survive, notwithstanding the termination or invalidity of this Agreement for any reason.

28. **Entire Agreement and Interpretation:** This contract represents the entire agreement for professional services as between the parties, and supersedes any prior oral statements, discussions or understanding between the parties.
29. **Contract Management**
The Contract Manager for Lewis County and the program manager for the Contractor shall be responsible for and shall be the contact person for all communications and billings regarding the performance of this Agreement.

SPECIAL CONDITIONS

A. **Definitions**

The COUNTY is the recipient of CONTRACTOR's services, and at all times acts through its Board of County Commissioners. The Contact Manager of the COUNTY will be Robert A. Johnson, Director of Community Development, or his designee.

B. **Non-Discrimination (Lewis County Funds)**

The CONTRACTOR should be aware that public funds are being used to assist in projects associated with any contract between the parties. During the performance of any contract, the CONTRACTOR agrees as follows:

1. The CONTRACTOR will not discriminate against any employee or applicant for employment because of race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The CONTRACTOR agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this non-discrimination clause.
2. The CONTRACTOR will, in all solicitations or advertisements for employees placed by or on behalf of the CONTRACTOR, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.
3. The CONTRACTOR will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, notice to be provided by the agency contracting officer, advising the labor union or worker's representative of the contractor's commitments under Section 202 or Executive Order No. 11246 of September, 1965, and shall post copies of the notice in a

conspicuous place available to employees and applicants for employment.

4. The CONTRACTOR will comply with all provisions of Executive Order No. 11246 of September 24, 1965, and of the rules, regulations and relevant orders of the Secretary of Labor.
5. The CONTRACTOR will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books and records for purposes of investigation to ascertain compliance with such rules, regulations and orders.
6. In the event of the CONTRACTOR'S non-compliance with the non-discrimination clauses of this contract or with any such rules, regulations, or orders, any contract may be canceled, terminated or suspended in whole or in part and the contract(s) may be declared ineligible for further government contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.
7. The CONTRACTOR will include the provisions of Paragraphs (1) through (7) in every sub-contract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each sub-contract or vendor. The CONTRACTOR will take such action with respect to any sub-contract or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for non-compliance: Provided, however, that in the event the CONTRACTOR becomes involved in, or is threatened with, litigation with a sub-contractor or vendor as a result of such direction by the contracting agency, the CONTRACTOR may request the United States to enter into such litigation to protect the interest of the United States.

C. Original Specifications

It is hereby expressly agreed by and between the parties involved that in any matter, dispute, suit, or proceedings arising or in any way growing out of any contract in which it may be necessary to introduce into evidence the original of such specifications, that a printed copy thereof may be used in lieu thereof with like force and effect as though the original was produced.

The CONTRACTOR, shall further verify that:

1. He had not employed or retained any company or person (other than a full-time bona fide employee working solely for the offerer) to solicit or receive said contract(s); and
2. He has not paid or agreed to pay any company or person (other than a full-time bona fide employee working solely for the offerer) any fee, commission, percentage, or brokerage fee contingent upon or resulting from the award of said contract(s); and
3. He has not been asked or otherwise coerced, whether expressed or implied, into contributing funds, for any purpose as a condition to doing business with the COUNTY.

IN WITNESS WHEREOF, the parties have executed this Agreement

This Agreement represents the entire Agreement between the parties and supersedes any prior oral statements, discussions or understandings.

Lewis County Contract Manager

Robert A. Johnson, Director of
Community Development
2025 NE Kresky Ave.
Chehalis, WA 98532
(360) 740-2606

Contractor Program Manager

Anchor QEA
Robert Montgomery
1423 3rd Avenue, Suite 300
Seattle, WA 98101
(206) 287-9130

LEWIS COUNTY

By: _____

Robert A. Johnson

ANCHOR QEA

By: _____

Robert Montgomery

Ed Berschinski

Date: _____

8/19/10

Date: _____

8-19-10

Attachment A

Chehalis River Basin Fish Studies Scope of Services -- Anchor QEA

Proposed Scope of Work

Working with the assumptions described in the Introduction, the following tasks are proposed to evaluate potential fish impacts. These tasks are described below in more detail.

- **Task 1: Review Existing Fish and Habitat Data**
- **Task 2: Meetings and Project Management**
- **Task 3: Hydraulics and Hydrology** – to predict changes in streamflow and sediment transport and large woody debris (LWD) recruitment; to inform other analyses
- **Task 4: Water Quality** – to predict the changes in water temperature and dissolved oxygen under different alternatives and inform the habitat simulation modeling
- **Task 5: Fish Habitat Availability Modeling Using PHABSIM** – to predict the changes in available habitat provided under different alternatives, including various flow release scenarios and ramping rates
- **Task 6: Fish Population Modeling using SHIRAZ** – to characterize the magnitude and significance of species-specific changes to fish population productivity, abundance, and spatial distributions due to the watershed changes resulting from the proposed facilities
- **Task 7: Report Preparation**
- **Task 8: Data and Model Transfer Workshop**

1 Task 1: Review Existing Fish and Habitat Data

The Anchor QEA Team will conduct a thorough review of all available resources providing information on fisheries resources and habitat conditions in the Chehalis River basin. Fish information on species/run distributions, life history characteristics (e.g., age of outmigration for juvenile salmon and age of return for adult salmon), timing, and population size will be gathered. Available habitat data to characterize substrate, habitat types, cover, and side channels will be compiled and reviewed. Anchor QEA will review available reports and publications. In addition, we will contact organizations and local fish biologists working in the watershed that may have useful data for the study.

The information compiled and reviewed in this effort will be used to inform all subsequent tasks, including the identification of analysis reaches in the PHABSIM fish habitat modeling and SHIRAZ fish population modeling.

2 Task 2: Meetings and Project Management

A key element to the successful and efficient completion of the proposed studies will be to stay on track with the vision of the Flood Authority through regular communication in meetings, calls, and correspondence. At the outset, the Anchor QEA Team proposes to meet with the Flood Authority to clarify assumptions, identify data sources and reports, address initial questions and decision points, and establish a schedule for subsequent meetings and calls. Additional meetings and calls will occur with the full group or sub-groups, as appropriate, depending on the topics to be discussed. The Anchor QEA Team will also provide monthly updates explaining the activities underway in each study element. These updates will include brief descriptions of important preliminary findings.

3 Task 3: Hydrology and Hydraulics Studies

Hydrologic and hydraulics studies are proposed to determine the post-reservoir stream flow regime in the Chehalis River and South Fork Chehalis River, estimate the flood reduction benefits along the two rivers, evaluate the sediment transport regime pre- and post-reservoir, and evaluate the potential change in LWD recruitment and transport. The proposed tasks are as follows.

3.1 Reservoir Operations Studies

A reservoir routing model will be prepared to confirm the performance of the two reservoirs in reducing flooding, to test different operational scenarios and sizes of reservoirs, and to determine the outflow throughout the year. We will analyze two sets of reservoir configurations: the reservoir configurations described in the February 2009 EES report and a set of reservoir configurations to be selected by the Flood Authority with input from Anchor QEA. The reservoir configurations described in the EES report would be operated for flood control and hydropower with instream flow augmentation in the downstream river systems resulting primarily from hydropower releases. The second set of reservoir configurations could include flood storage only or flood storage with late summer instream flow augmentation.

We propose to use a reservoir operations model such as RiverWare or HEC-ResSim. RiverWare is primarily used by the U.S. Bureau of Reclamation in multi-objective reservoir planning and operations and HEC-ResSim is commonly used by the U.S. Army Corps of Engineers (Corps) for the same type of applications. HEC-ResSim software is free while a license agreement is required for RiverWare. We will discuss the choice of model with the Flood Authority and select the most appropriate one to use.

We will use the reservoir operations model for reservoir routing and hydrologic routing of flows down the Chehalis River and South Fork Chehalis River systems. We propose to assemble a model for the entire Chehalis River Basin down to the point of interest at the U.S. Geological Survey (USGS) gaging station near Porter at River Mile (RM) 33. The model will include the Newaukum and Skookumchuck Rivers and local inflow. Operational rules and information for Skookumchuck Dam will be requested from the Corps.

The input to the reservoir operations model will be a time series of streamflow developed for each reservoir site along with inflow from other streams and rivers downstream of the proposed reservoirs. Regression equations have been developed by the Corps that relate flow in different reaches of the Chehalis River and tributaries during floods. The equations were developed using the network of USGS gaging stations that exist in the basin. We will utilize those regression equations to develop time series of flow in the upper Chehalis and South Fork Chehalis rivers, and downstream tributaries that are multi-year to test the performance of the reservoirs during both flood and non-flood time frames.

The reservoir operations models also use hydrologic routing routines to simulate attenuation in floodplain areas and calculate timing of peak runoff through the Chehalis River system. We will calibrate the routing parameters in the models for the Chehalis River from the site of the proposed reservoirs to the Chehalis River at Porter gage by comparing attenuation observed from gaging records and by using the HEC-RAS unsteady flow model that has been developed for the Chehalis River basin first by P.I.E., then by the Corps, and now by NHC. The use of that model is described in the Hydraulic Analyses section.

The model will test the operational scenarios agreed to by the Flood Authority. The reservoir operations model will also be used to optimize the operations of the reservoirs for a given reservoir size, hydropower operations and desired instream flow regime. The output from the model will be daily time series of flow at selected sites within the Chehalis River basin. Flow statistics will be prepared that will provide information needed for the fisheries, sediment, and woody debris recruitment analyses. The statistics will include flow duration curves by month and recurrence intervals of high flows (annual to 100-year floods).

We also propose to establish simple stream gaging stations that will provide a record of streamflow geographically closer to the proposed reservoir sites. Gaging stations that consist only of pressure transducers and data loggers housed in plastic pipes will be installed at two locations that are also being analyzed in the instream flow analysis. Gage height data will be collected throughout the time period for this study. The gaging stations can remain and collect data after this study is complete. We plan to

collect two sets of streamflow measurements at the gaging sites to assist in determining the relationship of flows at the sites to downstream gages. A complete calibration of the gage will not be possible because of time and budget constraints.

3.2 Hydraulic Analyses

A HEC-RAS model of the Chehalis River exists that is being used by a Federal Emergency Management Agency (FEMA) contractor (NHC) to route flow through the river basin and estimate flood levels. The model is being run in an unsteady flow mode to account for the large volume of floodplain storage that exists along the Chehalis River. Anchor QEA proposes to use the model to confirm the estimates of flood reduction from proposed flood retention facilities and to provide estimates of water levels in the Chehalis River and off-channel areas. The existing model will be modified to represent post-project conditions for alternatives considered. The reservoir operations model will only perform hydrologic routing and not hydraulic calculations. Hydrologic output from the reservoir model will be input to the HEC-RAS model. The HEC-RAS model will estimate the resulting flow and stage in the Chehalis River. Rating curves at selected sites will be calculated using output from the hydraulic model. Frequency analyses of flow and stage at selected sites will be calculated for pre- and post-reservoir conditions. That data will be used in the instream flow analysis.

The accuracy of the current calibration of the HEC-RAS model will be assessed through a review of existing flow and high water data. Moreover, data collected for the PHABSIM model will also be used to calibrate the model at the range of flows important to the analyses. That data will include water depth, flow, and velocity at selected cross-sections for three flows.

3.3 Geomorphic, Sediment and Large Woody Debris Evaluation

The reservoirs have the potential to change the sediment transport regime in the Chehalis River and South Fork Chehalis River. Capturing high flows will reduce flooding but will also reduce the rate and volume of sediment transport and alter the magnitude and location of erosion along the rivers. The net effect may be beneficial or detrimental with respect to future management issues or instream habitat for salmonids and other species.

A geomorphic and sediment transport study is proposed for the Chehalis River and South Fork Chehalis River for the reach extending above the reservoirs to the USGS gage at Porter. Using existing data, a preliminary geomorphic evaluation will be performed to provide reach-scale site assessments of the river, which will include evaluation of current and historic channel locations and patterns, potential sediment input areas, likely floodplain connectivity, geomorphic or geologic constraints, and potential significant sediment and large woody debris input areas. The river will be delineated into preliminary reaches with similar geomorphic and hydrologic conditions, such as slope, channel type or classification, floodplain connectivity, channel migration character, and wood and sediment regime (production, transport, or aggrading). The reach delineation will compile all existing and collected data and will be documented in a GIS database.

These evaluations will allow us to develop an informed site reconnaissance plan that will confirm findings of the evaluations and collect new data in specific areas where those data will best aid in answering the questions posed by this study. Preliminary reaches may be modified as additional analyses are conducted following site reconnaissance. The geomorphic reconnaissance will be completed for critical sections identified during the preliminary assessment and will include field review of river conditions, review of floodplain connectivity, and review of LWD recruitment and collection areas. During the geomorphic reconnaissance, visual identification of characteristic sediment size within critical reaches will be noted and mapped. This information will be used to inform the sediment transport evaluation.

The HEC-RAS model will also be used to evaluate changes to instream and floodplain hydrodynamics from proposed flood retention facilities. Water velocity, water depth, and bottom shear stress predicted in the model will be used to evaluate sediment transport potential within critical reaches. Sediment transport potential will be calculated and plotted as a function of flow rate at

each cross-section in the model within critical reaches using analytical calculations. A comparison of pre- and post-reservoir hydraulic and sediment transport conditions will be performed to estimate the effect of proposed alternatives on sediment transport in the system. A review of sediment budget information will be conducted to evaluate the body of information available within the project area. This review will include gravel mining studies, forest practices evaluations or environmental reviews, and other instream flow or sediment related studies. Flow routing from the HEC-RAS model will also be used to inform the habitat simulation module in the PHABSIM model discussed in Task 5.

Potential source areas and distribution of LWD within the project length for existing conditions will be identified from available data and geomorphic field reconnaissance. An evaluation of impacts from proposed retention facilities to recruitment and accumulation of LWD will be completed using results from the geomorphic assessment and hydraulic and hydrodynamic evaluations.

4 Task 4: Water Quality Studies

The objective of the water quality studies is to determine the impacts of the proposed structure on the primary water quality parameters of concern in the Upper Chehalis River, which are dissolved oxygen (DO), temperature, and fecal coliform. The approach proposed here integrates the use of existing data with additional data collection to develop and calibrate water quality and temperature models for the proposed structures as well as for downstream reaches of the Chehalis River. The water quality and temperature modeling efforts will inform the fish habitat assessment and help quantify the habitat changes from proposed management actions.

4.1 Water Quality and Temperature Modeling

The hydraulic and sediment transport analyses proposed in the previous section will be supplemented with water quality modeling. For this purpose, we are proposing the use of water quality simulation modules in HEC-RAS and the Dynamic Reservoir Simulation Model (DYRESM) for simulating heat budgets in the proposed structure. DYRESM is a one-dimensional hydrodynamic model that is widely used for predicting the vertical distribution of temperature, salinity, and density in lakes and reservoirs (e.g., Gal et al. 2003¹; Hipsey 2007²). The numerical model simulates surface exchanges of heat, mass, and momentum; surface mixing; and deep mixing. If water quality concerns in the proposed reservoir are to be considered, additional water modeling can be accomplished through the CAEDYM model, which is the water quality counterpart of DYRESM. The overall approach is summarized as:

- Spatial changes in water quality under background (existing) conditions assessed through water quality and sediment transport capabilities in HEC-RAS. Loads of suspended solids and DO will be specified using existing data and also through focused data collection efforts proposed in this document.
- Reservoir temperature variations (including stratification) will be captured by the DYRESM model. The reservoir water levels, inflows, and outflow release information used in the DYRESM model will be based on the scenarios selected for evaluation in the reservoir operation model (HEC-ResSim or Riverware) proposed under Task 3. Temperature-DO relationships will be used to specify DO concentration to HEC-RAS if the CAEDYM model is not used.
- Water quality data will be used to establish background and stormflow loads to the system, in order to calibrate the water quality and temperature models.

The temperature and DO information from these water quality analyses will inform the habitat simulation module in the PHABSIM model.

¹ Gal, G., Imberger, J., Zohary, T., Antenucci, J.P., Anis, A. & Rosenberg, T. 2003 Simulating the thermal dynamics of Lake Kinneret. *Ecol. Model.* 162, pp. 69-86.

² Hipsey, M.R. 2007. Water Quality Modeling of West Seti Hydropower Reservoir Using DYRESM-CAEDYM. Center for Water Research, University of Western Australia, Nedlands, Australia.

To the extent that slow-flowing reaches with localized water quality issues are identified, modeling efforts can be focused to answer specific questions. For instance, if thermal stratification in the deeper reaches of the Chehalis River is an issue, then a DYRESM model can be developed for the deeper portions to address temperature and DO changes.

4.2 Current Water Quality Data Available

Monthly water quality data is available at five WDOE stations in the Upper Chehalis, two of which are long-term stations at Dryad (RM 98) and Porter (RM 33) respectively. Continuous temperature data are available for summer periods from 2001 to the present at the Dryad and Porter stations. In the South Fork Chehalis River, continuous temperature is available at Beaver Creek Road.

Recently, a basin-wide water quality study was funded by WDOE (Green et al 2009³). Water samples collected between November 2006 through June 2009 were analyzed for DO, pH, temperature, fecal coliform, and turbidity. The study concluded that pH variations in the basin were generally small and within the state standards, thereby suggesting that algal photosynthesis and respiration cycles were not contributing to water quality deterioration. This dataset, if available, can be used to provide an estimate of background conditions.

In addition, other volunteer programs and historical Total Maximum Daily Load (TMDL) studies contain additional data that would be useful for characterizing the background conditions.

4.3 Water Quality Data Gaps

For the purposes of this study, additional data collection will be required. Suspended solids concentration entering the reaches upstream of the proposed structures will be critical to quantify the solids to the system. Moreover, temperature and DO vary diurnally. Under critical flow conditions, it will be necessary to understand these variations to assess violations from current water quality standards and also to assess the water quality changes from flows augmented through the structures proposed.

Biological activity can also affect DO levels in the stream. Control of flow releases will likely affect the habitat for attached algae in the stream (less scouring than what would occur at normal high flow in the absence of the structures). Because many of the peaks occur in winter months when algal activity is usually depressed due to the lower temperatures, this is unlikely to be an issue. Moreover, recent data collected from the basin did not show water quality deterioration from algal activity (see discussion under Current Water Quality Data Available section). Nutrient data collection is not proposed here. However, if spring flow peaks are mitigated by the proposed structure, there is a potential for algal blooms that can adversely affect water quality (i.e., DO and pH). In order to evaluate these effects, additional water quality parameters including nutrients (ammonia, particulate and dissolved inorganic phosphorus), and chlorophyll-a data will be required, but this work is not included in this proposal.

4.4 Proposed Water Quality Data Collection

The following surveys are proposed for temperature, DO, and other water quality parameters:

- Deployment of continuous data loggers for temperature at the headwaters, and at the confluence of each major tributary. These locations may be augmented with additional locations that are deemed to be critical in terms of flow and fish habitat, based on field reconnaissance surveys.
- Deployment of DO probes at select critical locations identified previously.

³ Green, J., Loft, D. and Lehr, R. 2009. State-of-the-river Report for the Chehalis River Basin, 2006-2009, A Water Quality Study, Grays Harbor College, Aberdeen, WA. Internet Reference: <http://www.chehalisbasinpartnership.org/technical/State-of-the-River%20JAG%2010-11-09.pdf>

In addition to the above mentioned data collection efforts, four focused surveys are proposed under critical conditions: two each under high flow and low flow, respectively. The critical conditions survey will involve measurement of several water quality parameters including DO, pH, temperature, turbidity, coliform, and Total Suspended Solids (TSS) at the same locations as the monthly surveys. If deemed necessary, nutrients and organic carbon will also be analyzed.

The data collected will be used for the following:

- Establish solids loading to the system under high flow conditions—this will be important in identifying redistribution of solids in the presence of proposed structure; it will also be critical in the assessment of sedimentation potential within the proposed structure
- Provide assessment of coliform counts encountered under different flows
- Provide an assessment of natural variations in temperature and DO under different flow conditions
- Establish turbidity versus TSS correlations for possible future monitoring and extrapolations
- Provide calibration targets to water quality and temperature models
- Provide a basis for comparing water quality and habitat changes with and without the proposed project

5 Task 5: Fish Habitat Availability Modeling Using PHABSIM

The fish habitat availability studies described in this section have not changed from the version provided at the time of the interview. However, as described above in the assumptions, the list of species/runs to be modeled will be those with habitat suitability curves established by WDFW and WDOE. This includes: coho, fall Chinook, chum, steelhead, and resident rainbow trout.

Fish habitat studies identified to evaluate the impact of proposed flood control impoundments on the Upper and South Fork Chehalis rivers include the IFIM, or more specifically, use of the PHABSIM instream flow study sub-component of the IFIM. One prior PHABSIM instream flow study was conducted on the Upper Chehalis River by WDOE and WDFW (Caldwell et al. 2004⁴), with a study site at RM 110.9. Because the proposed dam site on the Upper Chehalis River is at RM 108.3, there is the potential to use this study for habitat evaluation of the river between the dam site and RM 100.2 where Elk Creek enters the river at Doty. Other segments of the Upper Chehalis and the South Fork Chehalis have no instream flow study sites and would require additional data collection.

Application of PHABSIM under the IFIM consists of stream reach stratification, mesohabitat mapping, study site selection, transect placement (1-dimensional hydraulic modeling) or study site boundary delineation (2-dimensional hydraulic modeling), hydraulic and topographic data collection, hydraulic model calibration, selection of fish species and habitat suitability criteria (HSC), and linkage between the channel hydraulics and HSC to compute an index between habitat area (weighted usable area—WUA, or more accurately physical habitat index [PHI]) and discharge. Depending on the issues identified in the habitat evaluation, changes in the habitat index due to project effects can be interpreted as is, adjusted by downstream flow accretion prior to interpretation, or combined with altered flow patterns over time in a habitat time series for interpretation.

⁴ Caldwell, B., J. Pacheco, H. Beecher, T. Hegy, and R. Vadas. 2004. Chehalis River Basin WRIA 22 and 23 Fish Habitat Analysis Using the Instream Flow Incremental Methodology. Prepared by the Washington Department of Ecology and the Washington Department of Fish and Wildlife. March 2004. Open File Technical Report 04-11-006.