EXHIBIT A

SCOPE OF WORK
(nhc)

The Stillaguamish Flow Assessment Team (SFAT)

The Stillaguamish Flow Assessment Team (**SFAT**) is composed of Northwest Hydraulic Consultants (**nhc**), the Stillaguamish Tribe Natural Resources Department, Keta Waters, and Snohomish County Surface Water Management. This scope referred to in item 4 of the attached contract covers work that will be done for this project by **nhc** and its subconsultants and excludes work on this project which will be conducted by Snohomish County Surface Water Management. Snohomish County's work for this project will be conducted under a separate agreement with the CLIENT. Nhc will coordinate the technical work under both agreements and provide the CLIENT with a single point of contact to communicate with the SFAT.

Introduction to Technical Approach

The **SFAT** will take a geographically focused approach to target discrete subbasins within the Stillaguamish Watershed where human actions are likely to be affecting flow regime both now and in the future. Two subbasins of the Stillaguamish Watershed will be studied as part of this project, Pilchuck Creek basin and Church Creek basin. Pilchuck Creek is a major tributary to the Stillaguamish River, draining over 50 square miles, and is used by all anadromous salmonids including chinook salmon. The primary human impact on Pilchuck Creek's hydrology has tentatively been identified as water withdrawals. Church Creek is a significant tributary, draining approximately 10 square miles that will experience extensive urbanization associated with the Stanwood Urban Growth Area.

Our overall approach can be summarized as incorporating two contrasting but very representative and transferable case studies. One is a larger chinook stream affected primarily by water withdrawals, the other is a smaller coho stream affected primarily by current and future urbanization and associated land cover change. For both of these stream systems we propose to perform tasks which closely parallel sample tasks described by the Subcommittee in the RFQ.

Base Agreement Tasks

The tasks under the heading "Base Agreement Tasks" represent the scope of work of to be completed under this agreement between the CLIENT and NHC. Additional optional tasks that would require an increase in the NTE amount of this agreement and the agreement with Snohomish County are described under the heading "Optional Tasks".

The scope, deliverables, and estimated budget breakdown between this agreement and a separate agreement to be developed between Snohomish County and the CLIENT are provided below.

Task 1: Assess Instream Flow Hydrology and Effects on Salmon Recovery

Task 1 is broken down into a series of sub-tasks. The emphasis of the overall task will be to address the ecological consequences of flow changes which are the result of past and anticipated land use and flow management actions.

Task 1a. Semi-Quantitative Analysis of Flow Management Actions and Hydrologic Effects.

In Task 1a an inventory will be made of the pertinent flow management actions in each pilot basin which have already occurred and those which are anticipated to occur. Flow management actions are considered here to broadly include all anthropogenic actions with direct and indirect effects on streamflows. In this context, flow management actions encompass:

1) land management issues and land use change in particular;

2) development regulations including forest harvest practices, sensitive areas ordinances, land use zoning, and stormwater management codes;

3) water right issues including currently permitted withdrawals, present and future exempt withdrawals, inchoate (permitted but not yet exercised) water rights, and instream flow regulations;

4) water management issues including water storage for consumptive supply and/or streamflow augmentation, interbasin transfers of potable water supplies, and interbasin transfers of wastewater discharges and reclaimed water; and

5) water conservation and efficient use practices.

Results from Task 1a will provide necessary input to the subsequent characterization of hydrologic conditions as well as a basis for identifying potential future management implications to undo or mitigate past management actions.

Deliverables: The deliverable from Task 1a will be an inventory of past and anticipated actions in each pilot basin. The inventory will include narrative discussion plus quantified data and maps. The narrative will describe current and future land use and impervious coverage, estimated current and future withdrawals from existing active and exempt water sources, and significant interbasin water transfers. Maps will be used to show the spatial distribution of current and future land use, surface water diversions, and major wells in relation to hydrography of the pilot basins.

Task 1b. Review/Prioritize Hypothetical Mechanisms for Salmon-Sensitive Flow Change in the Pilot Basins.

A targeted review of available literature will be conducted of ecological impacts related to shifts in magnitude, timing, duration, and flashiness of flow as well as flow-related effects such as shifts in stream hydraulics, sedimentation, and geomorphic conditions. The review will include but will not necessarily be limited to the latest available literature on Indicators of Hydrologic Alteration (IHA) and Range of Variability Approach (RVA) along with any recent refinements to these methods developed by the King County Normative Flow project. Flow parameters and impact mechanisms identified in this review will be screened and prioritized in light of the flow-affecting management actions identified in Task 1a, and available literature and data on coho and chinook habitat conditions, salmon populations, and life histories in the pilot basins. Based on the flow

parameter literature review and knowledge of relevant pilot basin conditions, a set of reach-specific hypotheses will be developed regarding potential, current and future, salmon-relevant, ecological impacts caused by flow changes associated with land use and water withdrawals.

Deliverables: Referenced literature review with summary interpretation of relevance to pilot basin conditions and list of hypotheses regarding spatial distribution of significant current and future ecological impacts related to flow regime-linked basin management actions.

Task 1c. Hydrologic Modeling, Flow Parameter Extraction and Analysis.

HSPF models will be developed for the two pilot basins will be used to simulate continuous, long term flow hydrographs from which selected parameters will be extracted for comparison of past, present, and future conditions. Four scenarios will be simulated: pristine (a.k.a. "Template"), current, and at least two future scenarios that reflect reasonable "low" and "high" mitigation measures related to flow regime in the two basins. For each of these scenarios, hydrologic parameters prioritized for "focal" salmon species in the pilot basins will be extracted compared, and analyzed. These parameters will be identified based on a targeted review of available literature conducted in Task 1b.

Deliverables: HSPF models and databases. Technical memorandum documenting HSPF model setup and calibration as well as hydrologic assessment of basins under current and alternative future conditions as benchmarked by natural flow parameters.

Task 1d. Incorporate Hydrologic Modeling Results into Reach Scale Salmon Effects Models

The SFAT will apply two different approaches, Ecosystem Diagnosis and Treatment (EDT) and a simpler, lumped index method. With the EDT approach, we will take up the challenge of deriving, documenting, and applying relationships between the model's inputs (data and parameters) and flow regime information derived in previous tasks. Three tiers of flow-affected EDT inputs that reflect descending levels of precision and confidence with regard to their relationship to flow regime data. Tier-1 will include at least four "Level 2 Environmental Attribute values" in EDT that can be directly identified with relatively high precision and confidence from hydrologic modeling data. Tier-2 and Tier-3 will require supplemental relationships or models and inferences that represent the mechanisms connecting flow regime to EDT parameters for bed scour, embeddedness, fine sediment, temperature, dissolved oxygen, and turbidity, as well as physical habitat structure and size. With regard to some of these parameters, hydraulic modeling or analysis techniques such as HEC-RAS may be employed to assess spatial variation of depth, velocity, wetted area, and perimeter in addition to sediment transport capacity, in order develop a linkage between flow regime and Tier-2 and Tier-3 parameters.

The second approach will modify and apply methods pioneered by Snohomish County of directly evaluating subbasin and habitat characteristics throughout using the Matrix of Pathways and Indicators (NMFS 1996) and/or Quality Indices (May et al. 1997). Modifications will be oriented toward increasing the flow regime sensitivity of these methods. Hydrologic outputs and *a priori* knowledge of current habitat (e.g., Snohomish County SWM 2003) and water quality conditions can be listed as indicators of salmon productivity and compared with Matrix Values. This approach will rely on Snohomish County SWM's databases of water quality and invertebrate data collected Stillaguamish Watershed since 1991 in order to directly tie environmental conditions to fish productivity, assemblage diversity, and relative abundance.

Deliverables: A technical memorandum that describes the methods and approaches to be used in Salmon Effects modeling. This memorandum will identify Tier-1, Tier-2, and Tier-3 EDT parameters as well as describe the procedures applied to translate flow regime data to EDT parameter values. Additionally, the rationale for selection and method of incorporation of flow parameters into the modified index method will be documented.

Task 1e. Application of Procedures to Estimate Human-Induced Flow Regime Change on Salmon

EDT and the modified index approach described in Task 1d will be applied to the four scenarios described in Task 1c, pristine, current, and two alternative future flow regimes, in Pilchuck Creek Basin and Church Creek Basin as indicated in the following modeling application table:

	EDT Modeling	Modified Index Approach
Pilchuck Creek/chinook	Yes	Possible
Pilchuck Creek/coho	Yes	Yes
Church Creek/coho	Possible	Yes

EDT modeling for both chinook and coho in Pilchuck Creek will be performed. The EDT results for coho in Pilchuck Creek will provide an opportunity to calibrate the modified index approach for subsequent application to coho populations in Church Creek

Model applications listed as "possible" will be considered for completion by the SFAT subject to two necessary conditions: first, actual costs and progress in completing other work described in this agreement as determined by NHC, and second, the CLIENT's desire to have these modeling applications completed as part of the project.

In applying the existing EDT model, Pilchuck Creek stream reaches will be checked and re- characterized as necessary to show proper sensitivity to the spatial distribution of flow related management practices. Model runs for template, current, and alternative future conditions will be used to derive standard reports. These reports will inform stakeholders about current management actions that are likely to cause unacceptable degradation as measured by life history diversity, productivity, capacity, and equilibrium abundance of the species of concern (i.e., chinook salmon, coho salmon). Similarly, reports will suggest flow-related restoration and protection actions to be considered by stakeholders. It should be noted that iterations or sensitivity runs with the ecosystem model may be necessary to finalize future alternative scenarios represented in the hydrologic modeling described in 1c.

Deliverables: A technical memorandum documenting the model applications and results in terms flow management impacts on metrics of coho and chinook salmon viability in the two pilot basins. The memorandum will discuss hierarchy of flow parameters and discuss any shifts in this hierarchy with species and basin characteristics. Salmon viability sensitivity to flow-affecting management actions in the pilot basins will be discussed, laying the foundation for work on management implications in the pilot basin described under Task 2.

Task 2 Management Implications of Flow-Related Salmonid Impacts Analysis

Conclusions that can be drawn from Task 1 results will be utilized to formulate pilot basin management options and to describe their likely implications for flow regime-related impacts on salmon. Management options that may be considered include, but are not limited to, enhanced stormwater BMP requirements, impervious area and clearing limit restrictions, instream flow recommendations, enhanced water conservation, water supply storage, or water source substitution. Descriptions of individual management actions will include an assessment of the strength of the relationship linking them to flow changes and salmon impacts as informed by the results of Task 1 work.

Deliverables: A written memorandum detailing the potential management options and implications that will also serve as a component section or chapter of the overall project report to be completed for Task 3. This section will discuss both the specific implications for Pilchuck Creek and Church Creek basins and also the general implications for other Puget Sound basins where water withdrawals and urbanization are drivers of flow regime change with potentially significant impacts on salmon.

Task 3 Communication of Findings

To enhance transferability of this pilot project, all reviews, applied methods, and assumptions will be documented in a series of sub-task and task-level memoranda. These memoranda will form the basis of a draft and final report documenting the pilot study to facilitate replication of project successes and avoidance of project pitfalls in other stream basins within the Puget Sound

Basin. The draft report in the form of an electronic WORD document will be provided to the CLIENT for review.

It will be the responsibility of the CLIENT to coordinate the review process and provide NHC with a consolidated set of comments from which NHC will prepare and submit final version of the report in both electronic and hard copy form together with all supporting electronic files and data associated with the project.

Additionally, the **SFAT** will document and communicate the preliminary and final results of the study in the form of oral presentations, develop a PowerPoint slide show on the project, submit an abstract for presentation at a suitable regional or national conference, and send a team representative to present the project at the conference contingent on acceptance of the abstract by the conference organizers.

Deliverables: Electronic files and hard copies of draft and final report (maximum of 20), Powerpoint slide show, oral presentation of results at two half-day meetings, abstract for regional or national conference, presentation of project at regional or national conference (subject to acceptance of presentation by conference organizers).

Task 4 Project Management and Quality Assurance/Quality Control (QA/QC)

NHC will provide the CLIENT with a single point of contact for the technical work of the entire SFAT and will coordinate the work all SFAT members. Dr. David M. Hartley will be the NHC Principal-in-Charge and project manager for this project and will be the designated point of contact for both technical and administrative service to the CLIENT under this agreement. Additionally, he will coordinate the technical work of the entire SFAT with regard to development of a integrated, quality-assured deliverables. In the event of Dr. Hartley's unforeseen absence or incapacity, Mr. Bill Rozeboom, NHC Senior Engineer, will provide these services to the client.

For its part, the CLIENT agrees to assign one or two individuals as coordinators for this project and if two individuals will be assigned, one will be assigned as a technical coordinator and the other as an administrative coordinator.

Deliverables: Monthly or as-necessary meetings or conference calls with representatives of the Water Quantity Subcommittee, monthly progress reports describing completed work items, expected work for the upcoming month, and the status of the project budget and schedule, monthly invoicing for submittal to Shared Strategy, internal quality assurance and quality control review of all work products by NHC principals.

Optional Tasks

Tasks 5 and Task 6 are described here for the consideration of the CLIENT. Performance of task 5 or task 6 in this project would require an increase in the NTE of the attached agreement as noted below.

Task 5 Coordination with NOAA Fisheries to Support SHIRAZZ Modeling

The Shared Strategy Subcommittee on Water Quantity has expressed an interest in having the SFAT coordinate its work with NOAA Fisheries to facilitate SHIRAZZ modeling in the project pilot basins. Two alternative levels of coordination are described below as 5a or 5b:

Alternative 5a, "high" coordination for SHIRAZZ. The SFAT will coordinate with the NOAA-Fisheries scientific team as they identify hydrologic parameters for input into the SHIRAZZ model of the Snohomish Watershed in the first quarter of 2005. Coordination will be accomplished through meetings, conference calls, and e-mail communications. Once these hydrologic inputs (statistics or data) have been identified, the SFAT will perform necessary database programming and calculate these inputs at key locations within the Stillaguamish pilot study basins. The inputs and key locations will be defined and documented in a brief technical memorandum.

Deliverables: Technical memorandum, electronic data files including locations GIS shape file of key locations, and SHIRAZZ input data tabulated by location.

Alternative 5b, "low" coordination for SHIRAZZ. The SFAT will coordinate with the NOAA-Fisheries scientific team as they identify hydrologic parameters for input into the SHIRAZZ model of the Snohomish Watershed in the first quarter of 2005. Coordination through conference calls, and e-mail communications. Once these hydrologic inputs (statistics or data) have been identified, the SFAT will develop a technical memorandum comparing the hydrologic inputs and the relative flow-regime sensitivity of SHIRAZZ (as implemented in the Snohomish Watershed) and EDT (as implemented in the pilot basins of the Stillaguamish Watershed).

Deliverables: Technical memorandum comparing the how each of the two models utilize flow regime parameters.

Task 6 Additional Future Scenario

The Shared Strategy Subcommittee on Water Quantity has expressed in possibly having an additional future scenario modeled in addition to the "high" and "low" future mitigation scenarios described in the base agreement scope. If this task is funded and implemented, the purpose and definition of this 3rd scenario will be determine through dialogue with the Shared Strategy Subcommittee on Water Quantity and/or Shared Strategy's project technical lead. One possible purpose of this scenario would be locate and demonstrate the "inflection point" in salmon population response as predicted by EDT or index methods associated with future land use or water withdrawal. Another purpose for a third modeling scenario would be to represent a more realistic urbanization "end point" based on methods than in the literature as compared with a more traditional future "build out" scenario adopted in regional basin plans.

Deliverables: All deliverables described in the Base Agreement Scope associated with Tasks 1c, 1d, 1e, 2, 3, and 4 would be augmented appropriately to reflect addition of a 3rd future scenario.

Estimated Project Schedule

The following schedule represents an estimate of project progress based on a project start date of January 10, 2005. Upon receiving a written notice to proceed, the SFAT project manager will meet with the CLIENT's designated technical lead to agree upon a more detailed schedule and milestones for the project.

Task	Description	Interim Deliverable	Due Date-Draft	Due Date-Final
1a	Analysis of pilot basin flow management actions	Narrative, data, and maps	2/9/05	2/23/05
1b	Literature review, basin review, and hypotheses	Literature review and summary of pilot basin conditions	2/21/05	3/2/05
1c	Hydrologic Modeling and Analysis	HSPF models and databases and technical memorandum	3/9/05	3/23/05
1d	Interpret Model Results at Reach Scale	Technical memorandum on hydrology-salmon modeling linkage.	3/23/05	4/6/05
1e	Estimation of Human-Induced Flow Regime Change on Salmon	Technical memorandum on results of salmon population modeling	4/27/05	5/11/05
2	Management Implications	Management options memo	5/18/05	6/1/05
3	Communications of Findings	Project Report and conference abstract	6/8/05	6/22/05