**exhibit a**

**SCOPE OF WORK**

**Geomorphic assessment and conceptual design**

**OF the peshastin creek River mile 8.8 project, chelan county, WA**

**Prepared by**;

Natural Systems Design, Inc.

**Prepared for:**

Chelan County Natural Resource Department

December 29, 2014

The Chelan Country Natural Resource Department (CCNRD), has requested that Natural Systems Design (NSD) prepare a scope of work to conduct a geomorphic and hydraulic assessment, and alternative analysis, and to develop conceptual design plans for restoration opportunities at River Mile 8.8 of Peshastin Creek, WA. The project area is located in Township 23 North, Range 17 East, Sections 24 and 13, between river miles 8.4 and 9.2 immediately below the Ingalls Creek and Peshastin Creek confluence, and extends downstream to the Ingalls Road bridge. The construction of SR 97 in 1956 changed the creek channel alignment through the project study area. The creek was relocated to remain on the west side of the road which created the existing 3,880 feet straight channel while disconnecting approximately 35 acres of floodplain and 4,320 feet of the historic Peshastin Creek channel.

The Lower Peshastin Creek Tributary and Reach Assessment (TRA) (Interfluve 2010) identified the reconnection of the historic main channel at RM 8.8 as a priority habitat restoration project within Peshastin Creek. In August 2010 the Yakama Nation completed a prioritization of all of the project sites identified in the TRA. In this prioritization, projects that provided process-based restoration and addressed limiting biological factors for target salmonid species and life-history stages ranked highest. Within Peshastin Creek, the reconnection of floodplain and lengthening of the mainstem is a Biological Strategy Tier 1 action and top priority for addressing limiting habitat factors and the recovery and long-term viability of salmonids in Peshastin Creek (UCRTT 2013, UCSRB 2007). The top-tier projects were all projects that provided side channel reconnection, which included the RM 8.8 project site. The CCNRD, following guidance from the RTT and using the prioritization work, is evaluating the reconnection project at the RM 8.8 site in the context of reach-based restoration. Based this guidance, the primary goal at the RM 8.8 site is to reconnect stream channel process to the disconnected stream channel and floodplain.

For the 2012 SRFB grant application process the CCNRD and their consultant drafted four floodplain reconnection alternatives that were developed solely on an examination of existing topographic data and a field reconnaissance. The Upper Columbia Regional Technical Team requested that two of the reconnection alternatives (backwater reconnection and full channel reconnection) be removed from consideration due to expected low biological benefit vs. construction cost. Following receipt of the SRFB grant in 2013 no additional work was completed on the alternatives analysis. At this time the CCNRD believes that baseline geomorphic and hydraulic analyisis should be completed to evaluate the feasibility of a full channel reconnection, along with the partial reconnection alternatives.

Based on the current status of the project as described above, the primary purpose of this scope of work is to assess the existing geomorphic and hydraulic processes to guide the selection and conceptual design of restoration efforts within the RM 8.8 project area. NSD will first complete a rapid geomorphic assessment and hydraulic analysis to better understand and document the current stream conditions occurring at the confluence of Peshastin and Ingalls Creek and within the reach of Peshastin Creek extending from RM 9.2 to RM 8.4 (Tasks 1 and 2). This work will provide clearer context for the assessment and selection of the preferred alternative (Task 3), and the drafting of the conceptual plans for the preferred alternative (Task 4).

For this project, NSD’s core team consists of Tim Abbe, PhD, PEG, PHG, Principal In-Charge leading geomorphic assessment, and Quality Assurance/Quality Control (QA/QC), concept design and alternative analysis; John Soden, M.S. will be responsible for providing fisheries and wetland input, managing staff time, completing draft documents and project timeline; Leif Embertson PE, CFM, will lead hydraulic modeling and Shawn Higgins, MS will be supporting geomorphic assessment, hydraulic modeling and technical documents.

Work to be completed by NSD has been divided into the following list of tasks and linked to specific project deliverables:

Task 1: Rapid Geomorphic Assessment

Task 2: Hydraulic Assessment

Task 3: Alternatives Analysis

Task 4: Conceptual Design and Cost Estimate

Task 5: Management and Meetings

Task 1. rapid Geomorphic Assessment

To initiate this study, NSD will arrange a conference call to discuss project goals, scope of work and schedule, and to collect all available information on the Peshastin Creek study area (RM 9.2 – 8.4).

Following the kickoff meeting, NSD will conduct a rapid geomorphic assessment to document the existing river channel and floodplain processes within the study area. This effort will include the collection of existing data, and a 1-day field reconnaissance. The existing data that NSD expects to collect includes the following:

* *Existing topographic and bathymetric data, including LiDAR DEM.*
* *1-D HECRAS Model prepared by ICF in 2012.*
* *Peshastin Creek and Ingalls Creek hydrology*
* *All existing studies, including but not limited to*
	+ *Lower Peshastin Creek Tributary and Reach Assessment (Interfluve 2010)*
	+ *WSDOT assessments/highway plans*
	+ *Fish use data.*
* *Property parcel maps.*

NSD will coordinate with the CCNRD to conduct geomorphic reconnaissance. The CCNRD will secure any permission needed to access private land. Following data collection, NSD will create a basemap of existing geomorphic conditions based on the field surveys, and existing studies and data.

As part of this task NSD will evaluate the feasibility of a full channel reconnection near the Peshastin Creek and Ingalls Creek confluence, and a partial channel reconnection downstream of this location.

The results from this task will be presented in a Technical Memorandum that incorporates the data presented from the hydraulics analysis in Task 2.

Assumptions

* *CCNRD will arrange for land access for topographic survey.*
* *No jurisdiction wetland mapping will be done.*
* *Accuracy of the composite digital elevation model will be dependent on existing LiDAR DEM. No changes will be done to LiDAR DEM other than to burn in existing survey data provided by the CCNRD.*

Deliverables

* *Kick-off conference call with the CCNRD.*
* *1 day site reconnaissance.*
* *Map of geomorphic observations including:*
	+ *Bed and bank characteristics*
	+ *General floodplain vegetation*
	+ *General wetland areas*
* *Data files from field reconnaissance.*
* *Notes from field reconnaissance*

Task 2. Hydraulic Assessment

NSD will create a new digital elevation model (DEM) using existing LiDAR DEM and survey data provide by the CCNRD as collected in Task 1. The new DEM will be used to build computational mesh for 2-D hydraulic model. Hydraulics of the project reach will be analyzed using a two dimensional (2-D) RiverFlo-2D computer model. For the 2D hydraulic modeling we recommend utilizing Hydronia’s RiverFLOW2D Plus and Aquaveo SMS v11.2 computer software. RiverFLOW2D Plus is a two-dimensional finite volume computer model that provides depth averaged hydraulic parameters at nodes within a triangular model mesh domain. RiverFLO-2D determines depth averaged hydraulic parameters by solving the shallow water equations resulting from the integration of the Navier-Stokes equation. SMS is a GIS based program that creates the triangular model mesh, model input files, and displays model results.

Based upon observations made during the site visit and review of available information a hydraulic model representative of existing conditions and will be developed. The 2-D model will extend from RM 9.2 to to 8.4, be representative of existing or current conditions, and also be calibrated to match results from field survey (provided by the CCNRD) to the extent possible.

The 2D hydraulic model will be used to evaluate existing and proposed condition hydraulic and floodplain processes. To evaluate conditions a steady state simulation of the following flow events will be run:

* 100 year flood discharge.
* 2 year flood discharge
* 1.01 year flood discharge
* Low summer flow discharge

NSD assumes that these flows will be run for existing conditions and for the selected restoration alternative (described in Task 3).

The data from Task 2 will be presented in the technical memorandum as prepared in Task 1.

Assumptions:

* *The existing condition 2D model mesh will begin approximately near RM 8.4 and extend upstream to RM 9.2 and will include the Peshastin Creek confluence with Ingalls Creek;*
* *The 2D model will be run for up to three reconnection alternatives (Task 3) as determined by the CCNRD and NSD.*

Deliverables:

* *Composite DEM combining existing LiDAR DEM with new topographic survey;*
* *Maps and GIS data from the existing and proposed condition hydraulic model. Maps will include at minimum results for flow depth, velocity, and shear;*

Task 3. Alternatives analysis

The results from Tasks 1 and 2 will be used to assess up to three floodplain/channel reconnection alternatives. NSD assumes that the three alternatives will be the following:

* Full Channel Reconnection: Full channel reconnection into the historical channel through the installation of two large bridges in SR 97.
* Partial Flow Reconnection – Upper Connection at RM 9.08: Installation of two culverts in SR 97 at upstream and downstream points to allow high flows into the historical channel.
* Partial Flow Reconnection – Lower Connection at RM 8.66: Installation of two culverts in SR 97, one at a mid-way point (RM 8.66) and one at the downstream end to allow high flows into the historical channel.

NSD will prepare plan view concepts for each of the proposed alternatives. For each of the alternatives NSD will qualitatively evaluate existing hydraulic and floodplain processes, the potential to reconnect flows to the historical channel, potential flood risks to SR 97 and private property, and the biological benefit to listed fish species. Based on this analysis, NSD will prepare a matrix that compares the proposed alternatives and through consultation with the CCNRD a preferred alternative will be selected.

Deliverables

* *Alternatives analysis matrix.*

Task 4. Conceptual Design and Cost Estimate

NSD will prepare conceptual plans for the preferred alternative as selected in Task 3 as required in the SRFB Manual 18 guidelines. The conceptual plans will include the following:

* Plan view, profile, and cross section views of the proposed activity.
* Proposed dimensions for bridges or culverts within SR 97 and at the existing access roads that cross the historical channel.
* Proposed locations and typicals for in-channel elements (LWM).
* Proposed floodplain planting areas.

NSD will also develop a construction cost estimate based on the type and number of structures proposed within the SR 97 road prism and at the access road crossings, and the extent of earthwork necessary within the historical channel. This scope of work assumes that significant structural engineering or geotechnical work associated with the design of the preferred alternative will be completed during a future phase of design.

Deliverables

* *Conceptual plans and cost estimate.*

Task 5. Meetings and Management

This task includes the labor and expenses associated with scheduling, coordination, meetings, and quality control services for this work. For activities covered by this scope of work, NSD shall work closely with the CCNRD throughout the process to meet the goals and objectives of the work assignment. NSD will coordinate its activities with Mike Kane, CCNRD’s project manager to ensure that NSD’s activities do not duplicate or conflict with other CCNRD activities, approaches, policies, or procedures.

This task also assumes that NSD will prepare materials and attend one meeting in Wenatchee, WA to present the findings of the study. The meeting will be scheduled by the CCNRD and will include attendance by Dr. Abbe, Mr. Embertson, and Mr. Soden.

Deliverables:

* *Monthly invoicing*
* *Progress updates (email and/or teleconference) as appropriate*
* *One meeting in Wenatchee, WA.*

PROJECT BUDGET AND SCHEDULE

This project budget represents our knowledge of the work already completed, best understanding of the requested project elements, and accompanying assumptions. For the scope of services described above, we estimate that our total fee will be completed on a time and materials basis not to exceed value of $62,389. This budget estimate is made based on the scope of services outlined above and is broken out per task below in Table 1.

Table 1 – Project budget and schedule

| dESCRIPTION | beginning date  | ending date | sUB total |
| --- | --- | --- | --- |
| Task 1. Rapid Geomorphic Assessment | March 2015 | June 2015 | $19,390 |
| Task 2. Hydraulic Assessment | May 2014 | August 2015 | $18,635 |
| Task 3. Alternatives Analysis | August 2015 | August 2015 | $10,805 |
| Task 4. Conceptual Plans and Cost Estimate | August 2015 | September 2015 | $7,455 |
| Task 5. Meetings and Management | March 2015 | October 2015 | $6,104 |
| **PROJECT TOTAL** | **$62,389** |