EXHIBIT A
IGA

USGS Contract #_____
City Contract #_____

INTERGOVERNMENTAL AGREEMENT

USGS
and
CITY OF PORTLAND

Willamette River 2-year Inundation Modeling

This Intergovernmental Agreement ("IGA") is entered into by and between the U.S. Geological Survey ("Grantee") and the City of Portland ("City"), acting by and through its Bureau of Environmental Services.

This IGA is authorized pursuant to ORS 190.110 and becomes effective upon the date indicated in the GENERAL PROVISIONS below.

PURPOSE

City and Grantee desire to work together to implement the development of an approach for quantifying high quality rearing habitat for spring chinook in the Willamette River.

By this IGA, Grantee agrees to build a long-reach model in a subarea of the river to use as a proof-of-concept; and City agrees to reimburse Grantee for costs associated with the provision of these services as described in this document.

WHEREAS, this work will be funded by a basin-wide improvement grant from the Meyer Memorial Trust; and

WHEREAS, this project supports the work of the Willamette Biological Opinion's Habitat Technical Team, of which the City is an active voting member; and

WHEREAS, this project will contribute to the development of a Willamette Basin habitat restoration monitoring framework to track progress toward salmon recovery goals.

GENERAL PROVISIONS

1. Effective Date and Duration. This IGA is effective upon execution by all parties. Unless earlier terminated or extended, this IGA shall expire when Grantee's completed performance has been accepted by City or on December 31, 2019, whichever date occurs first.

2. Statement of Work. The statement of work (the "Work"), including the delivery schedule and budget for the Work, is contained in STATEMENT OF WORK below. Grantee agrees to perform the Work in accordance with the terms and conditions of this IGA.

3. Consideration. City agrees to pay Grantee a sum not to exceed $60,000 as allocated in the STATEMENT OF WORK.

4. Project Representatives. Each party has designated a project manager to be the formal representative for this project. All reports, notices, and other communications required under or relating to this IGA shall be directed to the appropriate individual.

	CITY		**GRANTEE**
Project Mgr:	Melissa Brown	Project Mgrr:	Susan Wherry
Organization:	City of Portland	Organization:	USGS
Address:	1120 SW Fifth Ave., Suite 1000 Portland, OR 97204	Address:	2130 SW 5th Ave Portland, OR 97201
Phone:	(503) 823-5482	Phone:	503-251-3219
Email:	Melissa.brown@portlandoregon.gov	Email:	swherry@usgs.gov

5. Subcontracts. Grantee shall not enter into any subcontracts for any of the work scheduled under this IGA without obtaining prior written consent from City's project manager.

6. Amendments. The terms of this IGA shall not be waived, altered, modified, supplemented, or amended, in any manner whatsoever, except by written instrument signed by both parties.

7. Reimbursement.
   A. Grantee shall submit itemized invoices to City for reimbursement of services performed. Invoices shall include: Name and Address of Grantee, Contract Number, Date of Invoice, Project Name, List of items for payment (and corresponding receipts), List of tasks for which reimbursement request corresponds, and Total amount of payment request.

   B. Non-itemized or incomplete billings shall be detained for payment processing until Grantee has supplied correct information to City.

   C. All invoices must be submitted to City prior to the expiration date of this agreement. City shall not be responsible for payment of invoices received after that date.

   D. Invoices shall be submitted in duplicate, identifying the City IGA number, to:

      Melissa Brown
      BES – Watershed Services
      1120 SW Fifth Avenue, Room 1000
      Portland, OR 97204

      City shall pay all approved invoices within 30 days.

   E. All non-expendable property, including computer hardware and related software, acquired in the provision of these services are the sole property of City and shall be surrendered upon completion of services or termination of this IGA.

   F. The parties recognize and agree that some of the activities and obligations for reimbursement addressed in this IGA have or will commence or arise prior to the effective date of this IGA.

8. Termination.
   A. The parties may agree to an immediate termination of this IGA or at a time certain upon mutual written consent.

   B. Either party may terminate this IGA effective not less than 30 days from delivery of written notice.

   C. Either party may terminate this IGA effective not less than 10 days from written notice or at such other date as may be established by both parties under any of the following conditions:

1) If funding is not obtained and continued at levels sufficient to allow for purchase of the specified services. When possible, and when agreed upon, the IGA may be modified to accommodate a reduction in funds.

2) If federal or state regulations or guidelines are modified, changed or interpreted in such a way that the services are no longer allowable or appropriate for purchase under this IGA, or are no longer eligible for the funding proposed for payments authorized by this IGA.

D. Either party may terminate this IGA in the event of a breach by the other party. Prior to such termination, however, the party seeking termination shall give the other party written notice of the party's intent to terminate. If the party has not cured the breach within 10 days or a longer period as granted in the cure notice, the party seeking compliance may terminate this IGA.

9. Funds Available and Authorized. Both parties certify that, as of this IGA's date of execution, sufficient funds are available and authorized for expenditure to finance the costs of this IGA within either party's current appropriation and limitation. Both parties understand and agree that payment of amounts under this IGA attributable to work performed after the last date of the current budget period is contingent on either party receiving appropriations, limitations, or other expenditure authority.

10. Captions. The captions or headings in this IGA are for convenience only and in no way define, limit or describe the scope or intent of any provisions of this IGA.

11. Choice of Law and Venue. Oregon law shall govern this IGA and all rights, obligations and disputes arising out of the IGA. Venue for all disputes and litigation shall be in Multnomah County, Oregon.

12. Severability/Survival. If any of the provisions contained in this IGA are held unconstitutional or unenforceable, the enforceability of the remaining provisions shall not be impaired. All provisions concerning the limitation of liability, indemnity and conflicts of interest shall survive the termination of this IGA for any cause.

13. Ownership of Work Product. All work products, including reports and research data in hard copy or electronic form that result from this IGA are the joint property of City and Grantee.

14. Access to Records. Both parties and their duly authorized representatives shall have access to the books, documents, papers, and records which are directly pertinent to this IGA for the purpose of making audits, examinations, excerpts, and transcripts.

15. Compliance with Applicable Law. Both parties shall comply with all federal, state, and local laws, regulations, executive orders and ordinances applicable to the Work under this IGA.

16. No Third-Party Beneficiary. The City and Grantee are the only parties to this IGA and, as such, are the only parties entitled to enforce its terms. Nothing contained in this IGA gives or shall be construed to give or provide any benefit, direct, indirect, or otherwise, to third parties unless third persons are expressly described as intended to be beneficiaries of its terms.

17. Indemnification. To the extent allowed under the Oregon Constitution and within the limits of the Oregon Tort Claims Act, codified at ORS 30.260 through 30.300, each party agrees to indemnify and defend the other and its officers, employees, agents and representatives from and against all claims, demands, penalties and causes of action arising from this IGA or arising out of or resulting from the acts or omissions of the indemnitor, its employees, agents or representatives.

18. Merger Clause. This IGA constitutes the entire agreement between the parties. No waiver, consent, modification or change of terms of this IGA shall bind either party unless in writing and signed by both parties. Such waiver, consent, modification or change, if made, shall be effective only in the specific instance and for the specific purpose given. There are no understandings, agreements, or representations, oral or written, not specified herein regarding this IGA.

STATEMENT OF WORK

A. Project Representatives

Each party has designated an individual to be the formal representative for this project. All reports, notices, and other communications required under or relating to this IGA shall be directed to the appropriate individual.

CITY		GRANTEE	
Name:	Melissa Brown	Project Mgr:	Susan Wherry
Organization:	City of Portland	Organization:	USGS
Address:	1120 SW Fifth Ave., Suite 1000 Portland, OR 97204	Address:	2130 SW 5th Ave Portland, OR 97201
Phone:	(503) 823-5482	Phone:	503-251-3219
Email:	Melissa.brown@portlandoregon.gov	Email:	swherry@usgs.gov

B. Project Description

1. Project Goals
   - Develop an approach for quantifying high quality rearing habitat for Spring Chinook salmon through metrics that could be readily evaluated at 5-10 year intervals. The approach will incorporate high quality habitat criteria, as determined by regulatory agencies; duration of high quality habitat inundation; seasonal low flow variability (water temperature); spatial variability owing to channel morphology and water quality; and existing models and datasets previously produced by the USGS, University of Oregon, ODFW, NOAA, and others.
   - The habitat model will inform the development of a scientific framework that allows the scientific community to establish realistic objectives for increasing rearing habitat and meeting targets through restoration, flow management, and other means.
   - The model will inform the framework so that work along the Willamette River mainstem can be monitored for effectiveness and adaptive strategies that many need implementation so that progress toward basin recovery goals can be tracked.

2. Scope of Work and Duties Performed
   a. Develop an approach quantifying duration, spatial extent of high quality rearing habitat:
      - Define attributes of “high quality” rearing habitat and how these change with floodplain morphology, discharge and temperature.
      - Develop metric(s) that can be used to evaluate changes in the availability of high quality habitat.
      - Develop methods for implementing metrics that utilize existing datasets and criteria.
   b. Develop scientific framework to support project partners’ efforts to establish realistic targets for restoration and flow management in the Willamette mainstem.

- Determine process for assessing maximum potential increases in high quality habitat that could be gained through typical restoration activities (re-vegetation, side channel connection, flow management).
- Establish a GIS-based application that uses USGS geomorphic mapping to support this process.

c. Conduct proof-of-concept study to apply the approach developed in Task a. to sections of the upper and lower Willamette mainstem reaches.
   - Define short (10-30km) reaches of upper and lower Willamette to use in pilot study.
   - Quantify rearing habitat availability based on metrics and approach developed in Task a.
   - Analyze resulting maps and metrics to assess spatial patterns of habitat variability and how these patterns change under different flow years (high vs. low winter flow years).
   - Evaluate maximum potential increase in rearing habitat that could be realistically achieved through typical restoration and management practices using approach developed in Task a.

d. Publish datasets and develop a brief report that summarizes the approach and findings from the proof-of-concept study
   - Summarize assumptions and previous studies/criteria that support habitat mapping criteria and associated metrics.
   - Describe precise methods used for proof-of-concept study, the resulting datasets and analyses.
   - Publish USGS Open File Report summarizing the methods and results.
   - Develop metadata and publish all final datasets in ScienceBase.

e. Provide outreach and technical support to framework project partners (BES, Bonneville Environmental Foundation, and the University of Oregon).
   - Work with BES, BEF, and UO to build monitoring framework.
   - Describe study to stakeholders, solicit input through a series of outreach events organized by project partners.
   - Present findings at 2019 Within Our Reach and other regional river-related conferences, as appropriate.

C. Deliverables

- Peer-reviewed, publicly available USGS Open File Report summarizing the USGS contributions to the monitoring framework project.
- Peer-reviewed, publicly available datasets with associated metadata.

D. Timeline

Contract will commence upon BES' receipt of a grant award from Meyer Memorial Trust, November 1, 2017:

- February 2018: Finalize scope of work between BES and USGS; secure review and input from project partners (BEF, UO, MMT)
- May 2018: Complete Tasks 1 and 2 in collaboration with project partners and other regional experts
- May 2018: Begin proof-of-concept study (Task 3)
- August 2018: Finalize proof-of-concept study and draft manuscript
- September 2018: Submit draft manuscript to peer-review
- December 2018: Present findings at Within Our Reach conference in Corvallis; finalize comments to peer-reviewers
- January 2019: Submit report for USGS review and publication

- January –March 2019: engage with stakeholders and project partners on overall monitoring approach and discussion of next steps

E. Budget

The budget for the USGS habitat inundation modeling that defines this contract is $60,000. Cooperative Matching Funds from USGS in the amount of $32,000 shall be applied to the overall framework budget funded by the MMT grant.

This agreement may be signed in two (2) or more counterparts, each of which shall be deemed an original and which, when taken together, shall constitute one and the same agreement. The parties agree that City and Grantee may conduct this transaction, including any contract amendments, by electronic means, including the use of electronic signatures.

CITY OF PORTLAND

By: _____
Michael Jordan, Director

Date: _____

Approved as to form:

_____
City Attorney

GRANTEE

By: _____

Name: _____

Title: _____

Date: _____

USGS
science for a changing world

—PROPOSAL—

Developing an approach for quantifying high quality rearing habitat for spring Chinook salmon in the Willamette River, Oregon

Prepared by

Rose Wallick, Tamara Wood, Susan Wherry, Tessa Harden

U.S. Geological Survey
Oregon Water Science Center
2130 SW 5th Avenue
Portland, OR 97201
rosewall@usgs.gov
tmwood@usgs.gov

503-251-3219

Prepared for:
Melissa Brown
City of Portland, Bureau of Environmental Services
1120 SW 5th Avenue, Room 1000,
Portland, OR 97204
melissa.brown@portlandoregon.gov
503-823-5482

January 31, 2018

—Proposal—
Developing an approach for quantifying high quality rearing habitat for spring Chinook salmon in the Willamette River, Oregon

BACKGROUND AND PROBLEM

The Willamette River floodplain of northwestern Oregon provides seasonally important habitats for a wide range of aquatic, riparian, and terrestrial species (Colvin and others, 2011; Hulse and others 2001). The floodplain also supports valuable agricultural, aggregate, and recreation industries (Hulse and others, 2001). Following Euro-American settlement of the Willamette Valley in the mid-19th century, major losses in floodplain habitats have resulted from construction of upstream flood control dams, conversion of floodplain forests to other land uses, widespread bank stabilization efforts, and other alterations to the floodplain system. Declines in habitat quality and availability have contributed to declining populations of many culturally and ecologically significant species, such as Pacific lamprey (*Entosphenus tridentata)* and western pond turtle (*Actinemys marmorata*), ESA-listing of spring Chinook salmon (*Oncorhynchus tshawytschya)* and Winter Steelhead (*O. mykiss*; NMFS, 2008), and near-expiration of some species (such as Yellow-billed cuckoo, *Coccyzus americanus*).

In recent decades, a diverse network of partners, including public and private funders, non-governmental organizations, university researchers, municipal, county, state and federal agencies, have aligned around a common goal of improving the health of the river for human and aquatic life. Examples of major, river-scale efforts to improve Willamette River floodplain habitats include: Meyer Memorial Trust's Willamette River Initiative (WRI), The Habitat Technical Team for the Willamette River Biological Opinion (HTT), Willamette Anchor Habitats Working Group (WAHWG) funded through Oregon Watershed Enhancement Board (OWEB), and the Willamette Wildlife Mitigation Program (WWMP) managed by Oregon Department of Fish and Wildlife (ODFW). Overlain on these river-scale programs are a local restoration projects and programs orchestrated by watershed councils, municipalities, soil and water conservation districts, and land trusts and other organizations. Collectively, these groups are making major investments in restoration and conservation actions to improve floodplain health. For example, more than $27 million is anticipated for restoration projects, conservation acquisitions, and easements through the WAHWG program (WAHWG, 2015), and the City of Portland and U.S. Army Corps of Engineers are planning more than $30 million in future restoration projects along the lower Willamette River (BES, 2016).

A comprehensive monitoring program is needed to track the status and trends in floodplain habitats and evaluate the collective impact of restoration, conservation, and flow management efforts along the Willamette River floodplain. The lack of a comprehensive monitoring program to track the success of Willamette River restoration projects has been repeatedly noted by the Independent Science Review Panel (ISRP) for the Northwest Power and Conservation Council (ISRP, 2017, pgs 21-22) and also noted by the Willamette Habitat Technical Team (HTT) of the Willamette River Biological Opinion (HTT, 2015).

To address ISRP concerns, the HTT requested that a monitoring sub-team convene and create a roadmap for a robust, long-term monitoring and evaluation program for the Willamette River. In spring of 2017, Bonneville Environmental Foundation (BEF), University of Oregon (UO), and the City of Portland'sBureau of Environmental Services (BES) submitted a proposal to Meyer Memorial Trust (MMT) to develop a vision for a long-term, integrated river-scale monitoring program with the following objectives:

- Develop an approach for identifying quantifiable, decadal-scale objectives for improvements in floodplain health with explicit timelines, associated spatially-explicit metrics for measuring success, and a plan for adaptively managing habitat improvement efforts if targets are not achieved. Floodplain health would be evaluated through metrics of:
    - Channel complexity, floodplain forests, rearing habitat for juvenile spring Chinook salmon, and native fish populations
- Solicit feedback from stakeholders to refine and improve the process through series of workshops.
- Demonstrate this process in a proof-of-concept project in a designated reach of the Willamette River above the Willamette Falls, and use the results of the proof-of-concept to explore and discuss application of the process below Willamette Falls.
- Summarize findings, recommendations, and associated costs to develop a long-term river-scale monitoring program for the Willamette River.

As part of this vision for a comprehensive monitoring program, the project partners (MMT, BEF, BES, UO) requested that USGS develop an approach for quantifying habitat for juvenile spring Chinook salmon. The criteria for identifying high quality juvenile rearing habitat are already developed (Van Remoortere, 2014) and have been applied to evaluate habitat availability at low flows and high flows (summarized at http://ise.uoregon.edu/slices/docs/juvenile_chinook_TD.pdf). The project partners envisioned that USGS could utilize hydraulic models to evaluate how habitat availability incrementally varies with flow. This approach could then be repeated at decadal intervals to track changes in habitat availability that may arise from flow management, restoration projects, or other management actions. Ideally, this approach would allow stakeholders to estimate the number of days that high-quality habitat is available within a given section of the Willamette River, for a specified time period.

The underlying spatial framework for this effort would be the SLICES framework, which divides the Willamette River floodplain into a series of 100-m wide transects oriented orthogonal to the floodplain axis (called 100-m SLICES herein; Hulse and others, 2002; http://ise.uoregon.edu/slices/Main.html). The SLICES framework already includes metrics of channel complexity (channel length and channel area), floodplain forest, native fish populations, and high-quality habitat for summer and winter conditions. The project partners envision that the SLICES framework and associated datasets, together with the new USGS approach for identifying rearing habitat (described in this proposal), would provide a comprehensive basis for tracking the status and trends of key floodplain features and habitats. These datasets would form the foundation for a future long-term monitoring program and could be repeated at decadal intervals to assess the effect of restoration projects and inform future Willamette River Report Card efforts (https://ecoreportcard.org/report-cards/willamette-river/). These approaches and associated datasets could also be utilized to plan and prioritize future restoration efforts or evaluate potential effects of changes in flow management or climate change.

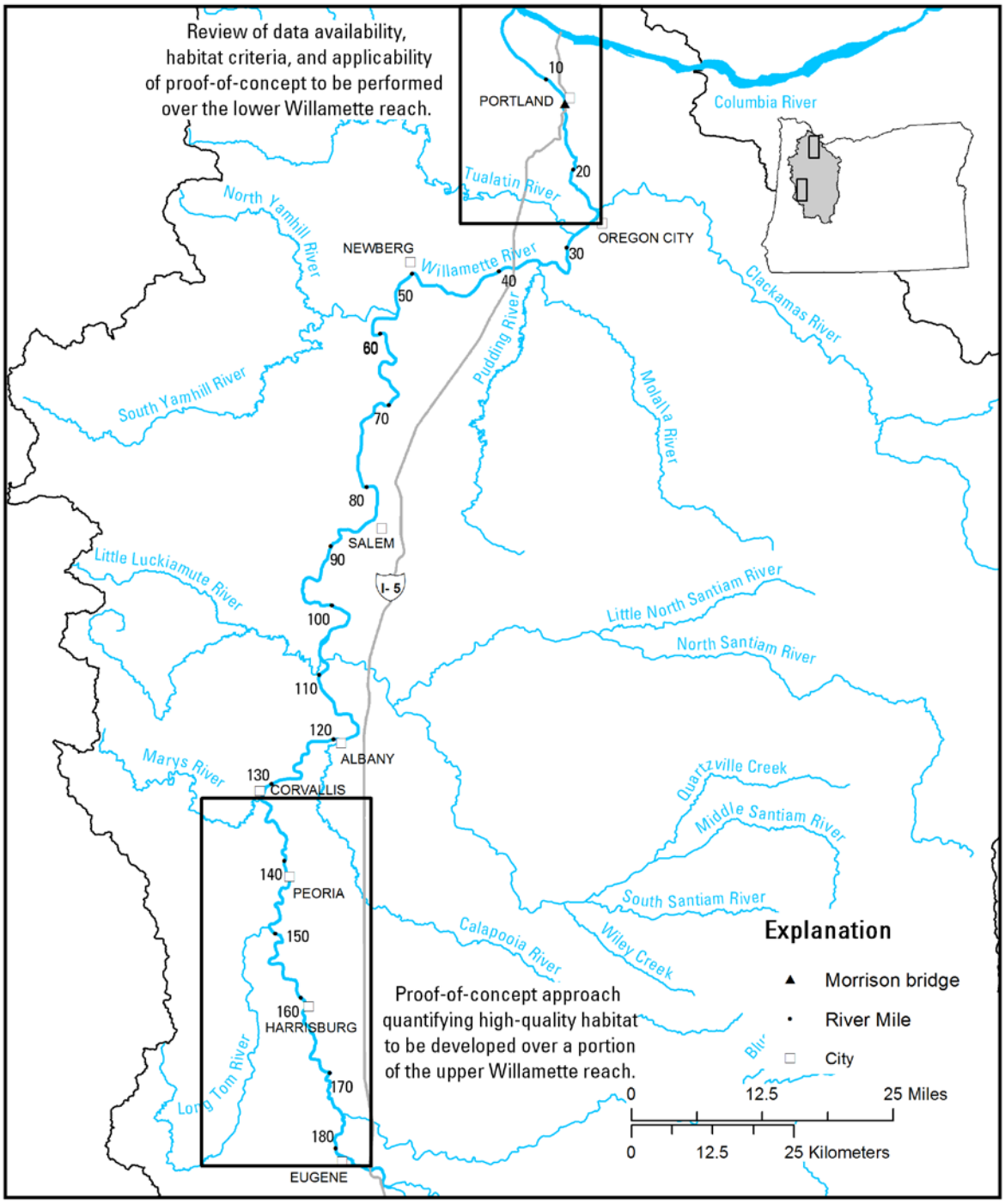

Figure 1. Map showing the Willamette River basin.

OBJECTIVES

The overarching goal of this study is to develop a technique for quantifying spatial and temporal patterns in high quality rearing habitat for juvenile spring Chinook salmon along the Willamette River's mainstem. The technique will be a cost-effective, repeatable method to evaluate patterns in aquatic habitat over a test reach of the Willamette River. The technique is expected to be applied in the future to evaluate the entire river system at 5-10 year intervals. Our primary objective for this proposal is to provide a proof-of-concept that is tested in select locations in the basin, not to implement the approach in its final form.

This approach will build upon the work of the SLICES framework (http://ise.uoregon.edu/slices/docs/juvenile_chinook_TD.pdf), which includes GIS coverages of high quality habitat, and the individual criteria that define high quality rearing habitat for spring Chinook salmon, for each 100-m SLICE. This study will expand their work by using hydraulic models to provide water surface elevations which can be used to evaluate rearing habitat availability as a continuous function of discharge, as well as investigating local effects of channel morphology and floodplain topography on the calculated area of juvenile rearing habitat.

The following tasks will be completed to achieve this proposal's objectives and are described in more detail in the Approach section:

1. Develop a model of a portion of the Willamette River to estimate water surface elevation and inundation extent for each 100-m SLICE, as a function of discharge. The model resolution will be developed at an appropriate scale to capture habitat features of interest.
2. Use the results of objective 1 to create inundation maps by overlaying simulated water surface elevation on LiDAR-derived topographic elevation of the Willamette River floodplain.
3. Intersect the inundation maps with coverages of characteristics of Chinook habitat to sum the land area that meets the criteria for high quality habitat at SLICES 100-m river transects within the long model reach.
4. Demonstrate how seasonality can be incorporated into the habitat calculation by using the results of objectives 1-3 to calculate habitat at discharges representative of different times of year.
5. Summarize approach and findings from pilot study in a USGS report and through presentations with the Willamette floodplain community.
6. Provide technical support to UO, BES, BEF, and other Willamette River floodplain stakeholders as they develop a monitoring framework and plan for adaptively assessing floodplain health.

RELEVANCE AND BENEFITS

As the Nation's leading earth science agency, USGS is proactive in ensuring that its activities are consistent with its mission and that its mission continues to remain relevant to the Nation's needs. USGS periodically updates a set of strategic planning documents to prioritize its core activities. The most recent Science Strategy (U.S. Geological Survey, 2007) contains six themes that represent significant and challenging societal issues, each of which requires a comprehensive strategy to provide

the scientific data and knowledge needed to help decision-makers make wise and informed choices. Under the Water mission area, the strategy states that USGS will:

> *...forecast likely outcomes for ... water quality and aquatic ecosystem health caused by changes in land use and land cover, natural and engineered infrastructure, water use, and climate.*

Results of this study will provide BES as well as other tribal, state, federal, and non-profit partners with a framework for evaluating the cumulative effects of hydrologic variability, flow management, restoration actions and other floodplain management activities on rearing habitat for Spring Chinook. This effort will support the USGS core mission of providing reliable data and scientific information to support the wise management of the Nation's water resources.

While this study has the potential to inform future water-science projects related to all nine priority actions listed within the USGS Water Science Strategy (Evenson and others, 2013), our objectives align with three specific priority actions:

- Advance ecological flow science.
- Integrate watershed assessment, research, and modeling.
- Clarify the linkage between human water use (engineered hydrology) and the water cycle (natural hydrology).

APPROACH

This study includes 6 tasks to address specified objectives.

Task 1. Build a stream hydraulic model, covering at least 20 km of the upper Willamette River (segment between Corvallis and Eugene), at the coarsest resolution possible to resolve river meanders and features like gravel bars and side channels. The appropriate reach for this is yet to be determined, but will be chosen in consultation with BES to provide the best chance of success for this proof-of-concept study.

Task 1.1. Build a mesh or grid for the model, and establish bed elevation with existing LiDAR and sonar bathymetry. Structures such as culverts and bridges will not be included in this pilot model effort.

Task 1.2. Perform a rudimentary calibration at low and moderate discharges. Calibration data will draw upon existing USGS data, including continuous water level data from 2015 and 2016 and surveyed water surface profiles collected at low to moderate discharges between 2015 and 2017.

Task 1.3. Use the model to simulate water surface profiles at a range of discharges spanning low to high discharges. For the Willamette River at Harrisburg, minimum summer streamflow is typically 5,000 cfs while peak flows can range from 50,000-60,000 cfs. Increments of discharge will be 5,000 to 10,000 cfs based on previous modeling and analyses.

Task 1.4. Develop relationship of water surface elevation and discharge in 1 km intervals along river and use relationship to estimate water surface elevation for discharge.

Task 2. Create inundation maps using water surface profiles generated in Task 1.

Task 2.1. Generate a sloping plane of the water surface using the relationships generated in Task 2.2 Several approaches will be evaluated to determine the best method for efficiently creating the inundation maps for a wide range of discharges. Methods to be considered include:

- Option 1: Calculate elevation and position of the right and left edge of wetted channel at 1-km intervals and linearly interpolate to generate coarse-resolution GIS layers of inundation and depth.
- Option 2: Utilize a 'bathtub' approach whereby the water surface profiles from Task 1 are used to develop broad planar surfaces for each simulated discharge, which are overlain on the lidar-derived digital elevation model (DEM). Areas where the topographic surface is lower than the water surface elevation are considered inundated. This 'bathtub' approach is similar to the existing inundation maps for Willamette River created for the 2-year recurrence interval flood event (River Design Group, 2014).
- Option 3: Apply the methodologies established by the USGS Flood Inundation Mapping (FIM) Program. Utilizing very similar methodology as Option 2, the FIM program outlines a well-documented process for developing hydraulic models to generate water surface profiles which are overlain on DEMs to estimate depths and inundation extents (https://water.usgs.gov/osw/flood_inundation/science/index.html).

Task 2.3. Overlay the water surfaces from task 2.1 onto LiDAR derived land surface elevation to generate high-resolution layers of inundation and depth of water. The resulting inundation maps will be visually inspected and compared against available aerial photographs and satellite imagery collected at different flows to check that the mapped inundation appears reasonable for a given discharge. Because the maps will not be generated by detailed two-dimensional, calibrated hydraulic models, they should not be used to estimate flood inundation or hazard potential, but will provide a useful platform for this proof-of-concept study to illustrate how habitat inundation may vary under different flows.

Task 3. Intersect the layers of inundation at selected discharges created in Task 2 with layers representing features of high-quality juvenile Spring Chinook habitat (land slope angle between 0 and 5%, a water depth less than 3 feet, floodplain forest, and location within 1 km of the active low flow river channel) to create a series of maps of areas meeting all criteria for high quality habitat for each modeled discharge. This set of maps can be queried to calculate the area meeting all the criteria for each 100-m SLICE for each modeled discharge (essentially creating relationships between discharge

and area of high quality habitat for each 100-m SLICE). When coupled with mean daily discharge for a designated period of time (January to March, for example), the number of days, and number of acres of high quality habitat for each 100-m SLICE can be computed.

Task 3.1. Use the results from this task to demonstrate the change in acres of habitat at individual locations along the river corridor through time (January to March, for example).

Task 3.2. Aggregate the results to demonstrate a metric, such as: number of acre-days of high quality habitat in an average January, along the entire long reach.

Task 3.3. Describe limitations to the analyses and potential technical issues requiring refinement or further considerations that could improve the approach before it is applied to the entire Willamette River above Willamette Falls.

Task 4. Drawing upon existing datasets (for example, LiDAR, bathymetry, hydraulic models created by USGS and USACE, and USGS gaging data), develop a set of considerations and recommendations for estimating availability of high quality rearing habitat in the Lower Willamette River between Willamette Falls and confluence with Columbia River. Habitat criteria for the lower Willamette River, which in this tidally-influenced reach will differ from the upper Willamette River, will be supplied by BES. The USGS will review this habitat criteria together with available datasets and models to describe potential approaches for efficiently computing rearing habitat availability in the Lower Willamette. This task will draw upon past geomorphic and fisheries studies in the Lower Willamette (for example, Friesen and others, 2007; Simenstad and others, 2011). Findings from this task, together with those from Tasks 1-3 can be used to evaluate plausible approaches and level of effort needed to evaluate rearing habitat availability along the entire Willamette River corridor.

Task 4.1. Summarize existing datasets and models that could be readily used to evaluate rearing habitat availability in the Lower Willamette River.

Task 4.2. Describe potential approaches for computing rearing habitat availability in the Lower Willamette River and the analyses needed to develop a similar metric as those outlined in Task 3.

Task 5: Publish models, and a peer-reviewed report summarizing approaches and findings.

Task 6: Outreach and technical support to project partners and broader community.

- Provide technical support to BES, UO and BEF as they develop a larger status and trends monitoring framework that draws upon this juvenile rearing habitat study and other USGS projects in Willamette Valley.

- Describe the study to stakeholders, solicit input through two to four outreach events organized by BEF, BES and UO.
- Present findings at 2018 Within Our Reach conference (http://www.withinourreach.net/).

QUALITY ASSURANCE / QUALITY CONTROL AND DATA MANAGEMENT

All models will be archived according to the USGS policy on archiving models (USGS, 2015a). Model results will be discussed in a publication.

PRODUCTS

Results of Objectives 1-4 will be summarized in a USGS report. Publication of the report is planned for spring of 2019. In addition, spatial datasets and maps will be peer-reviewed and formally published along with supporting metadata in ScienceBase, USGS' data archive. Results will be discussed through meetings/presentations and products will be shared with stakeholders.

REFERENCES

Colvin, R., Giannico, G.R., Li, J., Boyer, K.L., and Gerth, W.J., 2009, Fish use of intermittent watercourses draining agricultural lands in the upper Willamette River Valley, Oregon: Transactions of the American Fisheries Society, v. 138, p. 1302–1313.

BES, 2016, Projects for a Healthy Willamette River, Water Resources Development Act Projects Fact Sheet, accessed February 26, 2018 at: *https://www.portlandoregon.gov/bes/article/539517*

Evenson, E.J., Orndorff, R.C., Blome, C.D., Böhlke, J.K., Hershberger, P.K., Langenheim, V.E., McCabe, G.J., Morlock, S.E., Reeves, H.W., Verdin, J.P., Weyers, H.S., and Wood, T.M., 2013, U.S. Geological Survey water science strategy—Observing, understanding, predicting, and delivering water science to the Nation: U.S. Geological Survey Circular 1383–G, 49 p.

Friesen, T.A., Vile, J.S., and Pribyl, A.L., 2007, Outmigration of Juvenile Chinook Salmon in the Lower Willamette River, Oregon: Northwest Science, Vol. 81, No. 3, 173-190.

Gregory, S., Ashkenas, L., Oetter, D., Wildman, R., Minear, P., Jett, S., and Wildman, K., 2002, Revetments, *in* Hulse, D., Gregory, S., and Baker, J., eds., Willamette River Basin atlas: Corvallis, Oregon State University Press, p. 32–33, accessed October 16, 2017, at *http://oregonstate.edu/dept/pnw-erc/*.

INR, 2017, Mapping Riparian Forest Structure in the Willamette Valley: Project Summary for Stakeholders, 8 pgs plus datasets.

Simenstad, C.A., Burke, J.L., O'Connor, J.E., Cannon, C., Heatwole, D.W., Ramirez, M.F., Waite, I.R., Counihan, T.D., and Jones, K.L., 2011, Columbia River Estuary Ecosystem Classification—Concept and Application: U.S. Geological Survey Open-File Report 2011-1228, 54 p.

Van Remoortere, Pieter H. 2014. A Place To Grow: Prioritizing and designing habitat for juvenile Chinook Salmon within the floodplain of the Willamette River. Master's Thesis. Dept. of Landscape Architecture. University of Oregon. Eugene, Oregon 97403-5234

TIMELINES

Timelines for this project will depend upon contracting with BES, coordination of Task 1 with project partners and Willamette Basin fisheries experts and completion of hydraulic models for a separate USGS study on the Willamette River above Newberg. These and other factors were considered when developing the project timeline (Table 1). A final schedule for the study will be developed through discussions with BES and other project partners and will be developed to support other aspects of the broader project.

Table 1. Task timeline for ORWSC staff.

Date	Task
February, 2018	Finalize scope of work between BES and USGS; secure review and input from project partners (BEF, UO, MMT)
April/May 2018	Complete Tasks 1 and 2 in collaboration with project partners and other regional experts
May/June 2018	Begin proof-of-concept study (Task 3)
August 2018	Finalize proof-of-concept study and draft manuscript
September 2018	Submit draft manuscript to peer-review
December 2018	Present findings at Within Our Reach conference in Corvallis; finalize comments to peer-reviewers
January 2019	Submit report for USGS review and publication
January –March 2019	Engage with stakeholders and project partners on overall monitoring approach and discussion of next steps

PERSONNEL

Several staff members will be involved in the study tasks, including stakeholder outreach, project management, modeling and analyses efforts, and reporting. The anticipated hourly staffing matrix is as follows:

Table 2. Hours for ORWSC Staff.

Grade	FY 2018	FY 2019
GS-5 Hydrologist	60	20
GS-11 Hydrologist	360	120
GS-12 Hydrologists (2)	210	70
GS-13 Hydrologist	42	14

BUDGET SUMMARY

The following budget assumes USGS will provide project funds through its Cooperative Matching Funds (CMF) Program. Cooperative Matching Funds are expected to be available in future years, but are dependent on yearly Congressional appropriations and availability in the USGS Oregon Water Science Center.

Table 3. Funding summary for ORWSC study.

USGS FY	**USGS CMF**	**BES**	**Total**
2018	$24,000	$45,000	$69,000
2019	8,000	$15,000	$23,000
Total	$32,000	$60,000	$92,000

Table 4. Detailed budget for ORWSC.

Budget item	**FY 18**	**FY19**	**Total**
USGS salaries and indirect costs	$67,725	$22,575	$90,300
Travel to meetings	450	150	600
Other expenses	825	275	1,100
	$69,000	$23,000	$92,000

EXHIBIT B
Joint Funding Agreement

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Oregon Water Science Center
2130 SW 5th Avenue
Portland, OR 97201
http://or.water.usgs.gov/

April 4, 2018

Melissa Brown
City of Portland, Bureau of Environmental Services
1120 SW 5th Avenue, Room 1000
Portland, OR 97204

Dear Ms. Brown,

The U.S. Geological Survey (USGS) and the City of Portland, Bureau of Environmental Services (BES), collaboratively prepared a scope of work to jointly develop an approach for quantifying high quality rearing habitat for spring Chinook salmon in the Willamette River, Oregon. This letter and subsequent joint funding agreement (JFA) provide the mechanism to establish this relationship and collaboration in Federal fiscal year (FFY) 2018-2019 (October 1, 2017 through September 30, 2019).

The total cost for this project in FFY 2018-2019 will be $92,000. The USGS will provide $32,000 of Cooperative Matching Funds and BES will provide $60,000. Enclosed is a signed original of our standard JFA for the project covering the period April 1, 2018 through September 30, 2019.

Please sign and return one fully-executed original to Andrew Kerslake at kerslake@usgs.gov. The signed agreement is not a bill and no funds are required at this time; rather, the agreement is our legal authority that permits the work to be done and authorizes USGS to accept funds. The USGS Water Resources Cooperative Program operates under the authority of statute 43 USC 50, which allows us to perform this work. The Oregon Water Science Center DUNS number is 137883463.

Federal law requires that we have a signed agreement to continue this work; therefore, please return the signed agreement as soon as possible. If, for any reason, the agreement cannot be signed and returned in the near future, please contact Susan Wherry at (503) 251-3263 or email swherry@usgs.gov to make alternative arrangements.

This is a fixed cost agreement to be billed quarterly via Down Payment Request (automated Form DI-1040). We can bill you on a specific date if that is more convenient relative to your fiscal year planning and budgeting process. Please allow 30 days from the end of the billing period for issuance of the bill. If you experience any problems with your invoice(s), please contact Andrew Kerslake at (503) 251-3253.

The results of all work under this agreement will be available for publication by USGS in collaboration with BES. During the course of this jointly planned activity and partnership, USGS may provide unpublished USGS data or information to your office for scientific peer and (or) courtesy review. Guidance concerning USGS's non-disclosure policy will be provided with any review material and is further explained in USGS Fundamental Science Practices at http://www.usgs.gov/fsp/.

Sincerely,

James D. Crammond
Center Director

Cc: To file, available upon request

Form 9-1366
(April 2015)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Agreement#: 18WNOR000023800
Customer#: 6000000238
Project #:
TIN #: 93-6002236
USGS DUNS #: 137883463

Fixed Cost Agreement YES[X] NO[ ]

THIS AGREEMENT is entered into as of April 1, 2018, by the U.S. GEOLOGICAL SURVEY, Oregon Water Science Center, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the City of Portland, Bureau of Environmental Services, party of the second part.

1. The parties hereto agree that subject to the availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation the development of an approach for quantifying high quality rearing habitat for spring Chinook salmon in the Willamette River, Oregon, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50, and 43 USC 50b.

2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) include In-Kind-Services in the amount of $0.00

(a) $32,000 by the party of the first part during the period April 1, 2018 to September 30, 2019

(b) $60,000 by the party of the second part during the period April 1, 2018 to September 30, 2019

(c) Contributions are provided by the party of the first part through other USGS regional or national programs, in the amount of : $0

Description of the USGS regional/national program: N/A

(d) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties

(e) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.

4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.

5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.

6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.

7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

8. The maps, records or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request; be furnished by the party of the first part; at cost, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records or reports published by either party shall contain a statement of the cooperative relations between the parties.

9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered quarterly. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983.).

Form 9-1366
(April 2015)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Agreement#: 18WNOR000023800
Customer#: 6000000238
Project #:
TIN #: 93-6002236
USGS DUNS #: 137883463

USGS Technical Point of Contact

Name: Susan Wherry
Hydrologist
Address: 2130 SW 5th Avenue
Portland, OR 97201
Telephone: (503) 251-3263
Fax: (503) 251-3470
Email: swherry@usgs.gov

Customer Technical Point of Contact

Name: Melissa Brown
City of Portland, BES
Address: 1120 SW 5th Avenue, Room 100
Portland, Oregon 97204
Telephone: (503) 823-5482
Fax:
Email: melissa.brown@portlandoregon.gov

USGS Billing Point of Contact

Name: Andrew Kerslake
Financial Specialist
Address: 2130 SW 5th Avenue
Portland, OR 97201
Telephone: (503) 251-3253
Fax:
Email: kerslake@usgs.gov

Customer Billing Point of Contact

Name: Melissa Brown
City of Portland, BES
Address: 1120 SW 5th Avenue, Room 100
Portland, Oregon 97204
Telephone: (503) 823-5482
Fax:
Email: melissa.brown@portlandoregon.gov

U.S. Geological Survey
United States
Department of Interior

Signature

By_____ Date:
Name: James D. Crammond
Title: Center Director

City of Portland
Bureau of Environmental Services

Signatures

By_____ Date: _____
Name:
Title:

By_____ Date: _____
Name:
Title:

By_____ Date: _____
Name:
Title: