**Application:** This template is used when the Certified LPA owns the contract on a federal funded project.

**Version date: 9/17/2020**

**GENERAL INSTRUCTIONS:**

* Yellow highlighted areas include instructions that should be deleted prior to release.
* Blue highlighted areas indicate text or fields that need information provided or revised.
* “Agency” means the Certified LPA as defined in the CLPA Contract.
* **Delete instructions throughout the document before executing Contract or amendment. This can be automated as follows:**
	+ From the “Edit” menu select “Replace”;
	+ With cursor in the “Find what” field, click “More” button, then “Format” then “Font” , then in the font field select “Times New Roman” text ;
	+ Leave the “Replace with” field blank;
	+ Click “Replace All”. This will delete all yellow highlighted text.

**PROJECT-SPECFIC INSTRUCTIONS:**

**Add estimated plan sheet deliverables for each subtask in Task 15.**

**Many scope of work tasks provided in this template are not necessary for every project. The project Hydraulic Engineer should advise on the applicability and/or need for each task on a particular project. If an entire subtask is not needed, leave the task number, add “RESERVED” behind the subtask title and delete all subtask text.**

**Scope of work and budget by other disciplines to support this task, or for the Hydraulic Engineer involvement in other tasks can easily be over looked. Coordinate between disciplines to include the necessary scope and budget for the following coordinated efforts:**

* Topographic survey needs to support analysis and design of Hydraulic elements of project (e.g.-stormwater facilities, storm sewer, stream/river cross-sections, contributing impervious areas)
* Right-of-way needs to support hydraulic related project elements (e.g.-bridge scour countermeasures, temporary water management, stormwater facilities, storm outfalls and outfall protection) in right-of-way scope of work
* DAP, Advanced Plans, PS&E level design support to prepare plans and specifications for hydraulic related project elements (stormwater facilities, storm sewer, scour countermeasures, stream restoration, bank stabilization, channel lining, debris countermeasures, temporary water management, etc.).
* CA/CI to support RFIs, Submittal Reviews, Consultation, and Special inspections related to Hydraulic project elements.
* Support of Joint Permit Applications and Endangered Species Act Consultation with narrative and Quantity take-offs of impacts below OHW

**TASK 7 HYDRAULICS RELATED SERVICES**

Consultant shall provide stormwater management and hydraulic related design services under this SOW for delivery of tasks and deliverables according to the agreed upon delivery schedule.

[7.1, 7.2, 7.3 and 7.4 does not apply if the project only has stormwater management design, reserve these tasks and remove narrative]

### 7.1 Hydraulic Site Investigation

The purpose of this subtask is to identify existing information and field conditions.

Consultant shall:

* Obtain the Flood Insurance Study (“FIS”) report and if available the Flood Insurance Rate Map using the Federal Emergency Management Agency (“FEMA”) web site.
* Review local floodplain ordinances to determine if there are any applicable to this water body.
* Determine if applicable stream gauge records exist, and obtain them, if possible.
* Locate and obtain existing topographic maps of the tributary drainage basin.
* Visit the bridge/culvert Project site to observe site conditions, physical properties, and collect data needed to perform a thorough hydraulic study.
* Evaluate the site and determine survey data requirements for hydraulic analysis.
* Conduct a pebble count at two locations and collect 2 streambed sediment samples in the vicinity of the bridge for grain size analysis.
* Determine channel and floodplain hydraulic roughness values (document with photographs).
* Record observations with respect to the following:
* Lateral channel stability.
* Stream channel hydraulic roughness.
* Aggradation or degradation of bed material.
* Existing evidence of scour and/or erosion.
* Coordinate with Agency ODOT Geotechnical Engineer and review geotechnical report with regard to lateral stream stability and scour potential.

**7.1 Consultant Deliverables and Schedule:**

Consultant shall incorporate the information from this task into deliverables for Task 7.4

### 7.2 Hydrologic Analysis

The purpose of this subtask is to perform hydrologic analysis to determine appropriate flow rates for design of various Project elements.

Consultant shall:

* Review the ODOT Hydraulic Manual and available hydrologic data sources to determine the most appropriate 2-, 10-, 25-, 50-, 100-, and 500-year design flow for the proposed bridge/culvert.
* Analyze available stream gauge records to calculate flood frequency and flow duration values to support hydraulic analysis and design.

In the absence of stream specific data, Consultant shall delineate the tributary drainage basin utilizing available topographic maps and utilize the regional regression equations described in the U.S. Geological Survey (“USGS”) magnitude and frequency of floods in Western Oregon to predict design flows.

* Determine the temporary water management discharge estimates for the portion of the year when construction will take place to be used in temporary water management design recommendations and included in the technical specifications for the Project.
* Determine the fish passage high flow and fish passage low flow

**7.2 Consultant Deliverables and Schedule:**

Consultant shall incorporate information from this task into deliverables for Task 7.4

### 7.3 Hydraulic Analysis

The purpose of this subtask is to perform a variety of hydraulic analysis in support of design, and provide hydraulic design recommendations related to bridge, culvert, scour, and open channel.

Consultant shall:

* Simulate hydraulic conditions of the stream using Hydrologic Engineering Centers (“HEC”)-River Analysis System (“RAS”) (version X.Y) software.
* Create a model to simulate “Existing Conditions” at the proposed bridge site to determine current water surface profiles, velocities, depths, and flow area for the various design flows.
* Create a model to simulate “Natural Conditions” at the proposed bridge site to determine natural water surface profiles, velocities, depths, and flow area for the various design flows when there was not a bridge or culvert.

[Remove or add items under bridge hydraulics, as needed for the Project]

**Bridge Hydraulics**

Consultant shall:

* Create a model for up to X alternatives to simulate “Proposed Bridge” at water way crossing to determine water surface profiles, velocities, depths, and flow area for the various design flows. [cross check with the Bridge task to be consistent with the number of alternatives]
* Provide waterway opening design recommendations.
* Prepare Hydraulic data table.

[Remove or add items under culvert hydraulics, as needed for the Project]

**Culvert Hydraulics**

Consultant shall:

* Create a model for up to X alternatives to simulate “Proposed Culvert” at water way crossing to determine water surface profiles, velocities, depths, and flow area for the various design flows. [cross check with the Bridge task to be consistent with the number of alternatives]
* Provide culvert size and material recommendation.
* Prepare Hydraulic data table.

[Remove or add items under scour analysis, as needed for the Project]

**Scour Analysis**

Consultant shall:

* Evaluate up to X bridge scour alternatives following ODOT guidelines and the methods as described in the Federal Highway Administration (“FHWA”) publication HEC-18, Evaluating Scour at Bridges, and HEC-23, Bridge Scour and Stream Instability Countermeasures.
* Review past bridge inspection reports that might include evidence of past scour problems.
* Conduct a scour analysis using results from the hydraulic analysis including, evaluation of pier scour and contraction scour.
* Coordinate with the bridge and geotechnical engineers on the design of the bridge foundation
* Provide scour countermeasure design recommendations.
* Conduct supporting design calculations (e.g. riprap size calculations).
* Coordinate with bridge engineer on countermeasure design details.

[Remove or add items under open channel hydraulics, as needed for the Project]

**Open Channel Hydraulics**

Consultant shall:

* Design revetment and bank stabilization for up to X alternatives following Agency ODOT guidelines and the methods as described in FHWA publication HEC-11, Design of Riprap Revetment, and HEC-18, Evaluating Scour at Bridges.
* Evaluate hydraulic conditions under fish passage high flow and fish passage low flow, provide fish passage design recommendations, and demonstrate compliance with Oregon Fish Passage Laws (ORS 509.580 through 910).
* Develop a streambed material gradation recommendation and prepare a material specification.
* Provide waterway enhancement design recommendations for stream boulders, large woody debris, and/or bioengineered stream bank restoration.
* Perform calculations to predict the stability of waterway enhancements.

[Remove or add items under Sediment Transport Analysis and Channel Stability Analysis, as needed for the Project]

**Sediment Transport Analysis and Channel Stability Analysis**

Consultant shall:

* Evaluate the vertical and lateral stability of the Project reach of [name of stream/river here] under existing conditions and to evaluate problems (i.e. aggradation, degradation, erosion) under Project conditions.
* Evaluate the results of the hydraulic site investigation to determine the dominate sediment transport mechanisms that are occurring within the Project reach.
* Utilize the information from the hydraulic site investigation to define geomorphic sub-reaches to be used in the sediment transport calculations.
* Evaluate upstream sediment supply conditions.
* Utilize the results of the hydraulic modeling (HEC-RAS) to perform sediment transport calculations for the Project reach under existing and Project conditions.
* Complete one of the following, depending upon the dominate sediment transport mechanisms that are occurring within the reach, as determined through hydraulic site investigation (Task 7.1). Consultant shall either:

1) Calculate erosive flow energy under existing and Project conditions for comparison and describe the potential risk for channel stability problems caused by the design. This occurs if sediment transport is low and channel stability is observed to be governed by the stability of the channel boundary sediments (i.e. threshold channel).

**OR**

2) Perform a sediment continuity analysis to determine the aggradation/degradation potential by geomorphic sub-reach and how that potential would change between existing and Project conditions. This occurs if sediment transport is observed to be significant and channel stability is governed by a balance in bedload transport rates (i.e. alluvial channel).

**7.3 Consultant Deliverables and Schedule:**

Consultant shall incorporate information from this task into deliverables for Task 7.4.

Consultant shall provide:

* A\*.ZIP file containing HEC-RAS model files for Existing Conditions, Natural Conditions, and Proposed Conditions to the APM within 10 days following submittal of the Final Hydraulics Report.

### 7.4 Hydraulics Report

The purpose of this subtask is to summarize the findings of the hydraulic related services and document the design recommendations.

Consultant shall prepare a draft version of the Project Hydraulics Report per Agency ODOT Hydraulics Manual guidelines containing preliminary design recommendations for the hydraulic related services.

* Consultant shall prepare a final Hydraulics Report to reflect Agency’s and ODOT review comments and to include changes to hydraulic related design recommendations that need to be modified due to advancement of the overall Project design.

**7.4 Consultant Deliverables and Schedule:**

Consultant shall provide:

* Draft Hydraulics Report in PDF file format, along with an MS Word file containing the report narrative, and [define how many] hard copies, due with the Design Acceptance Package.
* Final Hydraulics Report, PDF file of complete report, and [define how many] hard copies, due with the Final Plans.

### 7.5 Stormwater Management Design

The purpose of this subtask is to design stormwater systems for the conveyance and treatment of drainage in the Project.

[Remove or add items under Storm Sewer Conveyance, as needed for the Project]

**Storm Sewer Conveyance**

The purpose of this subtask is to provide design of stormwater conveyance facilities that collect and carry highway runoff in conformance with: 1) ODOT’s Federal Aid Highway Program Programmatic Biological Opinion and 2) any Agency requirements that are stricter than the Federal standards.

Consultant shall:

* Determine the locations of flow entering and leaving the Project right-of-way (R/W).
* Review existing conditions downstream of locations where flow is leaving the Project R/W for deficiencies and document observations.
* Delineate on-site drainage basins, calculate peak flow rates for design, model the proposed pipe network, and calculate hydraulic grade line to check that proper freeboard design requirements are being met.
* Check inlet capacity and inlet spacing, calculate gutter flow to check spread, and provide design recommendations for inlet locations.
* Provide design recommendations for pipe network, associated pipe sizes, pipe material recommendations, and manhole access design recommendations (i.e. -spacing, location within a travel lane, etc.).
* Provide manhole diameter design recommendations based upon analysis of pipe connections at each manhole.
* Compare pipe network against known utilities in the Project area and provide design recommendations to minimize utility conflicts or to adjust existing utilities.
* Provide Stormwater Outfall design and energy dissipator design recommendations in compliance with applicable Project permits.

[Remove or add items under Roadside Channel Conveyance, as needed for the Project]

**Roadside Channel Conveyance**

Consultant shall model ditches to calculate water surface elevation, depth, and velocity and provide channel lining design recommendations per HEC-15, Design of Roadside Channels with Flexible Linings.

[Remove or add items under Stormwater Quality Design, as needed for the Project]

**Stormwater Quality Design**

The purpose of this subtask is to provide design of stormwater management facilities that provide water quality treatment of highway runoff per Agency standards and/or Federal Aid Highway Program Programmatic Biological Opinion, whichever standard is most strict.

Consultant shall:

* Define Contributing Impervious area.
* Delineate on-site drainage subbasins.
* Identify treatment Best Management Practice (“BMP”) types applicable for the site.
* Identify potential locations to site facilities within and outside the existing R/W.
* Estimate facility size, type and space needs at each of the potential locations.
* Evaluate constraints to siting a stormwater facility (i.e.-drainage area, adjacent grades, roadway safety, presence of existing utilities, protected resource areas, etc.)
* Prepare up to 3 stormwater management strategies that combine potential stormwater facilities into a comprehensive solution for meeting the needs of the Project.
* Compare alternative stormwater management strategies and recommend a preferred strategy.

[Remove or add items under Stormwater Quantity Design, as needed for the Project. Include hydraulics engineer effort in Task 3.5.2]

**Stormwater Quantity Design**

The purpose of this subtask is to provide design of stormwater management facilities that control quantity and flow rate of highway runoff per Agency standards and/or Federal Aid Highway Program Programmatic Biological Opinion, whichever standard is most strict.

Consultant shall:

* Define Contributing Impervious Area (“CIA”).
* Delineate on-site drainage subbasins.
* Identify potential locations to site facilities within and outside the existing R/W.
* Estimate facility size, type and space needs at each of the potential locations.
* Evaluate constraints to siting a stormwater facility (i.e. drainage area, adjacent grades, roadway safety, presence of existing utilities, protected resource areas, etc.).
* Prepare up to 3 stormwater management strategies that combine potential stormwater facilities into a comprehensive solution for meeting the needs of the Project.
* Compare alternative stormwater management strategies and recommend a preferred strategy.
* Provide written design recommendations in the Stormwater Design report (Task 7.6) for:
* Pipe network and associated pipe sizes
* Manhole diameter
* Pipe material recommendations
* Channel Lining
* Stormwater outfall
* Energy dissipator
* Provide documentation in the Stormwater Design report (Task 7.6) for up to 3 stormwater management strategies and include a recommended preferred strategy.

**7.5 Consultant Deliverables and Schedule:**

Information from this task shall be incorporated into deliverables for Tasks 7.6.

### 7.6 Stormwater Design Report

The purpose of this subtask is to provide preliminary stormwater design recommendations and document the final stormwater facility design recommendations.

* Consultant shall prepare a preliminary version of the Project Stormwater Design Report per Agency ODOT Hydraulics Manual or Federal-Aid Highway Program [select the strictest manual] guidelines containing preliminary stormwater facility design recommendations.
* Consultant shall prepare a final Stormwater Design Report to reflect Agency review comments on stormwater facility design recommendations, changes to stormwater facility design due to advancement of the overall Project design, and supporting documentation of the final stormwater facility design.

**7.6 Consultant Deliverables and Schedule:**

Consultant shall provide:

* Draft Stormwater Design Report in PDF file format, along with an MS Word file containing the report narrative, and [define how many] hard copies, due with the Design Acceptance Package.
* Final Stormwater Design Report, PDF file of complete report, and [define how many] hard copies, due with the Final Plans.

### 7.7 Stormwater Operation and Maintenance (O&M) Manual

The purpose of this subtask is to provide Operations and Maintenance Manual documentation of all proposed stormwater management facilities so that Agency has a record of the stormwater facilities that need to be operated and how to maintain them after the Project is constructed.

Consultant shall prepare up to X Draft Operation and Maintenance (“O&M”) Manuals, one for each stormwater facility anticipated for the Project, per Chapter 4, Section 4.6.6 of the Hydraulics Manual (latest edition).

Consultant shall prepare operational plans as outlined in Technical Bulletin GE 16-01 (B) titled “Stormwater Control Facility Operation and Maintenance Plan Development Drafting Guidance”.

**7.7 Consultant Deliverables and Schedule:**

Consultant shall provide:

* One copy of each Draft O&M manual in MS Word and Adobe “pdf” format to the APM with Advanced Plans.
* One copy of each draft operational plan in MicroStation format (CAD file) to the APM with Advanced Plans.

### 7.8 Temporary Water Management Design

The purpose of this task is to prepare temporary water management design recommendations, special provisions, and plan for inclusion in the construction documents.

Consultant shall:

* Identify the construction activities requiring temporary water management
* Determine the timeframe for which each temporary water management effort will need to be in place (often the in-water work period)
* Summarize the requirements for temporary water management due to the chosen environmental permitting method
* Prepare a plan and special provisions for flow and sediment control of surface water and groundwater seepage during construction activities based on site conditions.

**7.8 Consultant Deliverables and Schedule:**

Information from this task shall be incorporated into report deliverables for Task 7.6, and Technical Specifications and Plan Sheet deliverables for Advanced Plans Task 15.X.

[If this task is not needed, marked reserved and delete narrative]

### 7.9 Floodplain Impact Analysis

Projects requiring work in a mapped Special Flood Hazard Area (100-year floodplain) are usually required to demonstrate compliance with the local floodplain development requirements. When a project requires work in a mapped floodway and cannot achieve a No-Rise condition, then FEMA’s Letter of Map Revision process must be followed in order to remain in compliance with the National Flood Insurance Program. The purpose of this task is to evaluate and prepare documentation commensurate with the level of Project impacts on the 100-year water surface elevation.

[Choose the scope items that are appropriate for the project.]

**Floodplain Development Permit Application**

Grading work and/or a structure proposed as part of this Project will be located within a mapped Special Flood Hazard Area and is subject to Agency’s Floodplain Development requirements.

Consultant shall complete supporting information, prepare a No-Rise Analysis Memorandum, prepare a Floodplain Development Permit application, and submit to Agency.

[Choose the scope items that are appropriate for the project.]

**Conditional Letter of Map Revision (CLOMR)**

Prepare a Conditional Letter of Map Revision (“CLOMR”) prior to construction of the Project and permitting by Agency. The purpose of this task is to carry out the additional hydraulic modeling and to prepare the application forms and documentation for submitting a CLOMR application to FEMA.

Consultant shall:

* Coordinate with FEMA and the FEMA contractor responsible for review of the CLOMR application.
* Request detailed study data from FEMA, including a copy of the “Effective” model used in the most recent FIS.
* Update and run the Effective model using HEC-RAS to create a “Duplicate Effective Model” to be used in the CLOMR application. This may require adjustments to the model to run on the latest version of the HEC-RAS software.
* Tie the existing conditions HEC-RAS geometry file into the Effective model upstream and downstream of the Project reach.
* Run the updated existing conditions HEC-RAS model for the 10-year, 50-year, 100-year, and 500-year hydrographs from the Agency Effective FIS (FEMA xxxx). This model forms the “Corrected Effective Model” as well as the “Existing Conditions Model” for the CLOMR application.
* Tie the Project conditions HEC-RAS geometry file into the Effective FIS model upstream and downstream of the Project reach.
* Run the extended Project conditions HEC-RAS model for the 10-, 50, 100, and 500-year events. This model forms the “Post-Project Conditions Model” for the CLOMR application.
* Create a “certified topographic map” following the requirements set forth in the CLOMR application.
* Modify the Existing Conditions and Proposed Conditions models to perform a floodway analysis under both scenarios.
* Map the boundaries of the floodway for both existing conditions and Project conditions using the results of the hydraulic modeling.
* Fill out the CLOMR application forms including the “Overview and Concurrence Form”, the “Riverine Hydrology and Hydraulics Form”, and the “Riverine Structures Form”.
* Create backup data for the CLOMR application including electronic hydraulic model files and documentation and explanations of the hydraulic modeling.
* Submit CLOMR application to FEMA.
* Respond to requests for additional information from FEMA.

[Choose the scope items that are appropriate for the project.]

**Letter of Map Revision (LOMR)**

A Letter of Map Revision (“LOMR”) shall be required because the Project will raise the 100-year water surface elevation along both banks through the Project reach. The purpose of this task is to update hydraulic models, maps, and forms prepared for the CLOMR to include as-built conditions and submit the application to FEMA so the flood insurance rate maps can be updated.

Consultant shall

* Update models and analysis performed for the CLOMR using as-built survey data.
* Prepare LOMR Application and supporting information.
* Respond to requests for additional information from FEMA.

Agency will provide public notification required for the CLOMR.

Application and application Fees will be paid for and sent by Agency/Consultant.

**7.9 Consultant Deliverables and Schedule:**

Consultant shall provide:

* No-Rise Analysis Memorandum in PDF file format and [define how many] hard copies, due with Advanced Plans.
* Floodplain Development Permit Application for Agency in PDF file format, due with Advanced Plans.
* Conditional Letter of Map Revision Application in PDF file format and [define how many] hard copies, due with Advanced Plans.
* Letter of Map Revision Application in PDF file format and [define how many] hard copies, due within 3 months following receipt of as-built survey information.