# emrrp logo

# Ecosystem Management and Restoration Research Program

# Project Record

# Project Title: Multi-dimensional Modeling of Interactions between Nutrients and Riparian Vegetation for Improved Riverine Ecosystem Management

# Reference SON: 2015-ER-1

# Lead PI’s: Todd Steissberg

# Latest Update: October 12, 2021

# Deliverables – Initial Plan

| Work Unit Major Deliverables/Tasks – RAS-2D | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Task/Product** | **Milestones** | | **Status** | | **Remarks** |
| **Original Specified Delivery Date** | **Project Year** | **Percent Completion** | **Anticipated Delivery Date** |
| **(Qtr/FY)** | **(1,2,..n)** | **(%)** | **(Qtr/FY)** |
| Task 1 - Develop 2D water quality transport scheme and riparian vegetation mapping techniques in HEC-RAS. | Q1/FY16 – Q4/FY17 | 1,2 | 70% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 1/Model - 2D transport scheme and riparian vegetation mapping capabilities in HEC-RAS. | Q4/FY17 | 1,2 | 70% | TBD |  |
| Task 2 - Research nutrient dynamics and interaction with vegetation life cycle, develop quantitative methods to characterize their relationships, develop 2D NSM and RVSM theory. | Q1/FY16 – Q2/FY17 | 1,2 | 100% | Q4/FY18 |  |
| Task 2/TR - ERDC technical report (TR) documenting research and new features included in updated NSM and RVSM. | Q2/FY17 | 1,2 | 40% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 3 - Modify/improve current NSM and RVSM to include new features and processes identified in Task 2. | Q1/FY17 – Q2/FY18 | 2,3 | 70% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 3/Model - Updated NSM and RVSM – DLL Software | Q2/FY18 | 2,3 | 70% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 4 - Integrate NSM and RVSM into HEC-RAS-2D and develop the graphic user interface. | Q3/FY17 – Q4/FY18 | 2,3 | 10% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 4/Model - Integrated HEC-RAS-2D/NSM/RVSM - Software | Q4/FY18 | 2,3 | 10% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 5 - Gather and prepare data for model inputs, test the model integration, validate HEC-RAS-2D with NSM and RVSM using actual project data sets, and develop a technical report documenting the model testing and validation studies. | Q2/FY18 – Q2/FY19 | 3,4 | 15% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 5/TN - ERDC and HEC technical notes (TNs) documenting HEC-RAS-2D/NSM/RVSM testing and validation. Updated HEC-RAS User’s manual and Applications Guide. | Q2/FY19 | 3,4 | 15% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 6 - RVSM model certification and technical transfer. | Q1/FY19 – Q4/FY19 | 4 | 0% | TBD | Suspended Mar 2018 to complete RAS-1D release |
| Task 6/TR - Final ERDC and HEC technical report (TR) and HEC-RAS - RVSM model testing and validation study material and documentation in support of model certification. One-day workshop covering the new integrated HEC-RAS-2D/NSM/RVSM software. | Q4/FY19 | 4 | 0% | TBD | Suspended Mar 2018 to complete RAS-1D release |

# Deliverables – Revised Plan for 1D WQ and Vegetation (FY19 – FY20)

| Work Unit Major Deliverables/Tasks – RAS-1D WQ | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Task/Product** | **Milestones** | | **Status** | | **Remarks** |
| **Original Specified Delivery Date** | **Project Year** | **Percent Completion** | **Anticipated Delivery Date** |
| **(Qtr/FY)** | **(1,2,..n)** | **(%)** | **(Qtr/FY)** |
| Task 1 - Restructure the WQ transport engine to more efficiently integrate with the WQ library | Q3/FY19 | 1 | 100% | Q3/FY19 |  |
| Task 2 - Modify the WQ library for the new .NET GUI | Q1/FY19 | 1 | 100% | Q1/FY19 |  |
| Task 3 - Testing and Validation | Q3/FY19 | 1 | 100% | Q1/FY20 |  |
| Task 4a - Final Documentation  Task 4b - Beta Version  Task 4b - Final 1D WQ Product\*  \*Will be included in HEC-RAS v5.1. Release date is currently unknown. | Q4/FY19  Q3/FY19  Q4/FY19 | 1  1  1 | 100%  100%  100% | Q1/FY20  Q1/FY20  Q1/FY20 |  |

| Work Unit Major Deliverables/Tasks – RAS-1D RVSM | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Task/Product** | **Milestones** | | **Status** | | **Remarks** |
| **Original Specified Delivery Date** | **Project Year** | **Percent Completion** | **Anticipated Delivery Date** |
| **(Qtr/FY)** | **(1,2,..n)** | **(%)** | **(Qtr/FY)** |
| Task 1 - Update Groundwater Component | Q1/FY19 | 1 | 100% | Q1/FY19 |  |
| Task 2 - Refine Hydraulic Roughness Component | Q2/FY19 | 1 | 100% | Q2/FY19 |  |
| Task 3 - Vegetation Pre-processor (Mapping) | Q3/FY19 | 1 | 100% | Q3/FY19 |  |
| ~~Task 4 -Vegetation Parameter GUI~~ | ~~Q3/FY19~~ | ~~1~~ | ~~0%~~ | ~~Q3/FY19~~ |  |
| Task 5 - Testing and Validation | Q4/FY19 | 1 | 100% | Q4/FY19 |  |
| Task 6a - Final Documentation  Task 6b - Beta Version  Task 6b - Final Product\*  \*Will be included in HEC-RAS v5.1. Release date is currently unknown. | Q4/FY19  Q3/FY19  Q4/FY19 | 1  1  1 | 100%  100%  100% | Q4/FY19  Q4/FY19  Q1/FY20 |  |

# Deliverables – Revised Plan for 2D WQ (FY20 – FY22)

| Work Unit Major Deliverables/Tasks – RAS-2D Water Quality | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Task/Product** | **Milestones** | | **Status** | | **Remarks** |
| **Original Specified Delivery Date** | **Project Year** | **Percent Completion** | **Anticipated Delivery Date** |
| **(Qtr/FY)** | **(1,2,..n)** | **(%)** | **(Qtr/FY)** |
| Task 1. Upgrade WQ modules & documentation (temperature, general constituents, nutrients) | Q2/FY21 | 1 | 100% | Q2/FY21 |  |
| Task 2. Build vegetation and WQ user interface (UI) tools | Q1/FY21 | 1 | 100% | Q1/FY21 |  |
| Task 3. Finalize 2D transport solver (advection-diffusion) | Q3/FY21 | 1 | 100% | Q4/FY21 |  |
| Task 4. Link 2D transport solver, WQ modules, and UI | Q4/FY21 | 1 | 100% | Q4/FY21 |  |
| Task 5. Testing and validation | Q2/FY22 | 2 | 25% | Q3/FY22 |  |
| Task 6. Technical Transfer: Documentation (TR and TN) and project demo | Q4/FY22 | 2 | 15% | Q4/FY22 |  |
| Task 7. Technical Transfer: Workshop | Q4/FY22 | 2 | 0% | Q4/FY22 |  |

# Deviations

| Significant Changes of Plan, Delays, Problems | | |
| --- | --- | --- |
| **Task/Product/Goals** | **Description of Change** | **Remarks/Justification/Impacts** |
|
|  |
| Task 4 - Integrate NSM and RVSM into HEC-RAS-2D and develop the graphic user interface. | Interactions between NSM and RVSM | We have performed the literature review for linking NSM and RVSM to provide plant uptake of nutrients and provide biomass back to NSM. Due to having to spend more time on the Vegetation Mapping and the 2D Groundwater capabilities we will need to simplify how these two modules interact over what we initially intended. We will develop a TN that describes the more detailed interactions as well as the simplified interactions. We can revisit whether the more detailed interactions are needed at the end of the work unit. If these are needed then we can scope out what it would take to add them as an out year task or possibly a new work unit.  If we pursue the more detailed NSM/RVSM linkages then we may want to consider a new work unit that will also extend RVSM to operate in wetlands and coastal environments as well as include the development of a national vegetation database. |
| Suspension of RAS-2D WQ and RVSM tasks in March 2018. | Suspended 2D Tasks | In March 2018, the RAS project team and the EMRRP management meet and discussed the need to finalize the release of HEC-RAS-1D WQ and RVSM.  Beta versions of the 1D models are being used on USACE district projects but GUI development was not completed due to personnel trying to work on 1D and 2D tasks at the same time. In order for HEC to release a product the computation engine, GUI, testing and validation, and supporting documentation all have to be completed.  It was decided that the final release of RAS-1D was becoming critical and hence work on RAS-2D was suspended until RAS-1D is released.  The following four slides will discuss the milestones needed to be completed before RAS-1D WQ and RVSM can be released. |

# Other Achievements

| Big Wins/Other Significant Activities | | |
| --- | --- | --- |
| **Description** | **Qtr/FY** | **Remarks/Impacts** |
| Presentations – Discussed current EMRRP model developments and future needs of the districts. | Q3/FY17 | San Francisco, Sacramento, and Los Angeles Districts |
| ERDC-U | Q4/FY17 | ERDC-U funded Jennifer McAdoo (Los Angeles District) to collaborate with EL on a project to build an HEC-RAS/RVSM model for the Santa Ana River. This pilot project demonstrated the new capabilities and positions us to participate in future LA District ecosystem restoration projects using EMRRP developed tools. |
| ERDC-U | Q2/FY19 | ERDC-U funded Chris Solek (Los Angeles District) to collaborate with EL on a project to continue building and improving the HEC-RAS/RVSM model for the Santa Ana River. This model will be used to improve ecological management and restoration of the Santa Ana watershed. |
| RVSM workshop | Q2/FY19 | A development workshop was held at HEC in Davis, CA in February 2019. Participants included staff from ERDC, HEC, LA District, PSU, RMA, and LimnoTech. A number of ideas were generated for improving and extending HEC-RAS/RVSM for vegetation modeling of various aquatic systems as well as improving the Santa Ana river model. |
| Recruited and hired two team members at EL-EPW with excellent software development skills | Q3/FY20 | The new team members add significant new capabilities in software design, implementation, and management. |
| Recruited a computer scientist and a water resources engineer | Q2/FY21 | The new team members add significant new capabilities in software design, implementation, and management. |
| Abstracts on HEC-RAS-1D-WQ, HEC-RAS-RVSM, and NSM presented at National Conference for Ecosystem Restoration (NCER), July 2021 | Q4/FY21 | Organized two sessions at the National Conference on Ecosystem Restoration (NCER). 1. Water Quality Model Development. 2. Water Quality Model Applications. |
| Linking USGS WEBMOD with ClearWater-Riverine-RAS2D water quality modelCollaborating with USGS Colorado Water | Q1 – Q4/  FY21 | Collaborating with USGS Colorado Water Science Center. WEBMOD (Water, Energy, and Biogeochemical Model) will provide runoff inputs to the riverine water quality model |

# Obligations and Expenditures

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Obligation and Expenditure Projections** | | | | | |  |  |  |  |  |  |  |  |  |  | |
| **FY** | **Project Year** | **Categories** | **OCT** | **NOV** | **DEC** | **JAN** | **FEB** | **MAR** | **APR** | **MAY** | **JUN** | **JUL** | **AUG** | **SEP** | **FY Total** | |
| **(1, 2, … n)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | **($K)** | |
| 20 | 1 | Contract and Purchase Obligations |  |  | 0 |  |  | 0 |  |  | 0 |  |  | 125 | 125 | |
| Labor Expenditures |  |  | 55 |  |  | 40 |  |  | 30 |  |  | 0 | 125 | |
| **Total** | **0** | **0** | **55** | **0** | **0** | **40** | **0** | **0** | **30** | **0** | **0** | **125** | **250** | |
| 21 | 2 | Contract and Purchase Obligations |  |  | 0 |  |  | 0 |  |  | 0 |  |  | 250 | 250 | |
| Labor Expenditures |  |  | 60 |  |  | 50 |  |  | 0 |  |  | 0 | 110 | |
| **Total** | **0** | **0** | **60** | **0** | **0** | **50** | **0** | **0** | **0** | **0** | **0** | **250** | **360** | |
| 22 | 3 | Contract and Purchase Obligations |  |  | 100 |  |  | 0 |  |  | 0 |  |  | 0 | 100 | |
| Labor Expenditures |  |  | 70 |  |  | 65 |  |  | 65 |  |  | 65 | 265 | |
| **Total** | **0** | **0** | **170** | **0** | **0** | **65** | **0** | **0** | **65** | **0** | **0** | **65** | **365** | |
| **Total FY Project Funding** | | | | | | | | | | | | | | | | **975** | |