

Project Letter

A Numerical Model to Evaluate Potential Impacts of Sea-level Rise on Groundwater Resources in the Delaware Coastal Plain

to be held under the terms and conditions of the
Collaborative Agreement between the University of Delaware and the
Department of Natural Resources and Environmental Control

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Type of Project (check one):

- Research
Service
Education

Scope of Work:

Sea-level rise is expected to result in the inland migration of the mixing zone between fresh and saline water. The purpose of this project is to answer these questions: how far inland sea water migration may be expected to occur as sea level rises and how hydrogeologic parameters control that migration. The scope of work includes:

- (1) Use existing data and GIS to determine
 - a. Lengths of rivers/streams (USGS National Hydrography Dataset),
 - b. Position of tidal/nontidal boundary in rivers/streams (DNREC State Wetland Mapping Project),
 - c. Locations of production wells (irrigation/industrial/public-supply) in the surficial aquifer and distance from tidal water,
 - d. Locations of monitoring wells that will be installed in the St. Jones Reserve and
 - e. Hydrologic parameters: water-table elevation/depth, aquifer properties, recharge.
- (2) Install 200 Linear feet of monitoring wells in the St. Jones Reserve in Dover, Delaware, and perform slug tests after the installation.
- (3) Construct a set of three representative conceptual models representing major features of interest (Figure 3a, 3b and 3c in attachment).
- (4) Model three scenarios of sea-level rise (0.5, 1.0, and 1.5 meters in Delaware by the year 2100).
- (5) Perform sensitivity analysis to get bounds on water-table depth and position of the salt-water interface by changing these properties: hydraulic conductivity, recharge due to projected precipitation and ET, boundary conditions, simple pumping scenarios. Based on the sensitivity analysis results, the least impact case and most impact case will be determined.

1.0 Methodology

Based on the information in IPCC (2007) and CCSP (2009) and the recommendations and guidelines of federal agencies, the Delaware Sea-Level Rise Workgroup proposes to use sea-level rise estimates of 0.5, 1.0, and 1.5 meters in Delaware by the year 2100 (Figure 1 in attachment). These values represent the minimum, intermediate, and maximum rates expected based on the compilation of currently available information.

We propose to simulate the groundwater flow in the coastal surficial aquifer including movement of the fresh-water/salt-water interface and water table changes due to sea-level rise (Figure 2). We will use a 3-D variable-density groundwater flow model. Rather than developing a site-specific model, a series of representative models, from simplified boundary conditions to complicated boundary conditions with a meandering river/stream (Figure 3a, 3b and 3c), will be developed. Models will be designed to capture the generalized flow patterns and saltwater intrusion rates that occur in typical area along the coastline of the Delaware Estuary in Delaware. Although the model will be a generalized representation, practical data will be used to develop the conceptual model and set boundary conditions. For this purpose,

approximately 200 linear feet of monitoring wells will be drilled and installed within the St. Jones Reserve in Dover, Delaware to characterize geological information and hydraulic properties. By providing long term accurate groundwater level data, these wells will definitely enhance our understanding of surficial groundwater flow patterns in the St. Jones Reserve, which will also benefit DNERR's long term mission: to preserve and manage natural resources through coastal stewardship within the Reserve as a place for research, and for providing education and outreach programs that promote better understanding of Delaware's estuarine and coastal areas, and to promote informed coastal decision-making. The model will not include simulation of impacts from storm events nor daily tides. The study area is the Delaware River and Bay watersheds within the coastal plain of Delaware.

2.0 Expected Results

The outputs of this project include:

- (1) Maps of water table changes for six scenarios for each represented conceptual model (Table 1),
- (2) Maps of position of the fresh-salt water interface in the surficial water-table aquifer as defined by the 100mg/L line of chloride concentration in groundwater for each represented conceptual model (Table 1),
- (3) GIS data layers utilized in generating the maps and FGDC compliant metadata, and
- (4) Identification of data gaps and suggestions for future work.

Project Timeline:

The services of are to commence as soon as practicable after the execution of this Contract and shall be undertaken in such sequence as to assure their expeditious completion in light of the purposes of this Contract, but in any event all of the services required by this Contract shall be completed by March 15, 2014.

Federal Funding (check one):

- EPA funding will be used
- NOAA funding will be used
- No federal funding will be used

FOR USE WITH NOAA FUNDED PROJECTS ONLY

A. General:

- 1) CONTRACTOR shall comply with all applicable State and Federal laws and regulations. If applicable State and Federal laws and regulations conflict with the provisions of paragraph 15, then applicable laws and regulations supersede the provisions of paragraph 15. The provisions of paragraph 15 shall apply to the work to be performed under this Contract and such provisions shall supersede any conflicting provisions of this Contract.
- 2) This Contract is funded by the **Delaware National Estuarine Research Reserve Operations, Education, and Research** grant from the NOAA under award number NA12NOS4200151, and Catalog of Federal Domestic Assistance (CFDA) number 11.420. Neither the United States nor any of its departments, agencies, or employees is a party to this Contract.
- 3) The cover of the title page of all reports, studies, or other documents supported in whole or in part by this sub-award shall acknowledge the financial assistance provided by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration by including the following statement: *"This project was funded, in part, through a grants from the Delaware National Estuarine Research Reserve with funding from the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration under award numbers NA12NOS4200151.*
- 4) The rights and remedies of DEPARTMENT provided for in these clauses are in addition to any other rights and remedies provided by law or under this Contract.
- 5) Financial Report: CONTRACTOR must provide a semi-annual financial report that includes the following:
 - An accounting of procurement expenditures of goods and services by vendor for all covered transactions. Covered transactions include those procurement contracts for goods and services that are expected to equal or exceed \$25,000 and all non-procurement transactions (i.e., sub-awards to sub-recipients) irrespective of award amount.
 - A certification that each vendor for all covered transactions is not on the Federal Debarred and Suspended Listing by checking the Excluded Parties List System (<http://www.epls.gov/>).
 - A certification of whether or not the CONTRACTOR has expended \$500,000 or more in Federal awards during the CONTRACTOR's fiscal year and if so, that they have met the audit requirements of OMB Circular A-133. If the audit includes any findings related to the sub-award from the Division, a copy of the audit must be sent to the Division within 9 months of the end of the CONTRACTOR's audit period and the CONTRACTOR's decision on audit findings must be sent to the Division within 6 months after receipt of the audit report.

B. Remedies: Except as may be otherwise provided in this Contract all claims, counterclaims, disputes and other matters in question between DEPARTMENT and CONTRACTOR arising out of or relating to this Contract or the breach thereof will be decided by arbitration if the parties hereto mutually agree, or in a court of competent jurisdiction within the State of Delaware.

C. Audit; Access to Records: CONTRACTOR shall maintain books, records, documents and other evidence directly pertinent to performance on NOAA grant work under this Contract in accordance with generally accepted accounting principles and practices. CONTRACTOR shall also maintain

the financial information and data used by CONTRACTOR in the preparation or support of the cost submission, and a copy of the cost summary submitted to DEPARTMENT. The United State's Department of Labor, DEPARTMENT (and the State of Delaware) or any of their duly authorized representatives shall have access to such books, records, documents and other evidence for the purpose of inspection, audit and copying. CONTRACTOR will provide proper facilities for such access and inspection.

- D. Subcontracts: Any subcontractors and outside associates or consultants required by CONTRACTOR in connection with the services covered by this Contract will be limited to such individuals or firms as were specifically identified and agreed to in writing during negotiations, or as are specifically authorized in writing by DEPARTMENT during the performance of this Contract. Any substitutions in or additions to such subcontractors, associates, or consultants will be subject to the prior written approval of DEPARTMENT.
- E. Equal Employment Opportunity: CONTRACTOR agrees that it will not discriminate against any employee or applicant for employment because of race, religion, color, sex, age or national origin.
- F. Utilization of Small and Minority Business: CONTRACTOR agrees that qualified small business and minority business enterprises shall have the maximum practicable opportunity to participate in the performance of NOAA grant-assisted contracts and subcontracts.
- G. Covenant Against Contingent Fees: CONTRACTOR warrants that no person or selling agency has been employed or retained to solicit or secure this Contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees. For breach or violation of this warranty, DEPARTMENT shall have the right to annul this Contract without liability or in its discretion to deduct from the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.
- H. Gratuities:
 - 1) If it is found, after notice and hearing, by DEPARTMENT that gratuities (in the form of entertainment, gifts, or otherwise) were offered or given by CONTRACTOR, or any agent of DEPARTMENT or of NOAA with a view toward securing a Contract or securing favorable treatment with respect to the awarding or amending, or the making of any determinations with respect to the performance of this Contract, DEPARTMENT may, by written notice to CONTRACTOR, terminate the right of CONTRACTOR to proceed under this Contract and/or may pursue such other rights and remedies provided by law or under this agreement; provided that the existence of the facts upon which DEPARTMENT makes such findings shall be in issue and may be reviewed in proceedings pursuant to the Remedies clause of this Contract.
 - 2) In the event this Contract is terminated as provided in paragraph 13.H.1) hereof, DEPARTMENT shall be entitled (i) to pursue the same remedies against CONTRACTOR, and (ii) as a penalty in addition to any other damages to which it may be entitled by law, to exemplary damages in an amount (as determined by DEPARTMENT), which shall be not less than three nor more than ten times the costs incurred by CONTRACTOR in providing any such gratuities to any such officer or employee.
- I. Patents: If this Contract involves research, developmental, experimental, or demonstration work and any discovery or invention arises or is developed in the course of or under this Contract, such invention or discovery shall be subject to the reporting and rights provisions of 37 C.F.R. Part 401, in effect on the date of execution of this Contract. In such case, CONTRACTOR shall report the discovery or invention to NOAA directly or through DEPARTMENT and shall otherwise comply with DEPARTMENT'S responsibilities in accordance with 37 C.F.R. Part 401. CONTRACTOR hereby agrees that the disposition of rights to inventions made under this Contract shall be in

accordance with the terms and conditions of 37 C.F.R. Part 401. CONTRACTOR shall include provisions appropriate to effectuate the purposes of this condition in all subcontracts involving research, developmental, experimental, or demonstration work.

- J. Debarment and Suspension: NOAA grant-assisted contracts and subcontracts are subject to Subpart C of 15 CFR Part 26, "Governmentwide Debarment and Suspension (Nonprocurement)."
- K. Lobbying: NOAA grant-assisted contracts and subcontracts exceeding \$100,000 in Federal funds are subject to Section 319 of Public Law 101-121, which added Section 1352, regarding lobbying restrictions, to Chapter 13 of Title 31 of the United States Code as implemented at 15 CFR Part 28, "New Restrictions on Lobbying," in which case the CONTRACTOR must submit a completed "Disclosure of Lobbying Activities" (Form SF-LLL) regarding the use of non-Federal funds for lobbying. The Form SF-LLL shall be submitted within 15 days following the end of the calendar quarter in which there occurs any event that requires disclosure or that materially affects the accuracy of the information contained in any disclosure form previously filed. The Form SF-LLL shall be submitted to the DEPARTMENT.
- L. Data Furnished to CONTRACTOR: DEPARTMENT shall furnish all information, data, reports, records, and maps as existing, available, easily retrievable and necessary for the execution of the work to CONTRACTOR, without charge by DEPARTMENT, and DEPARTMENT shall reasonably cooperate with CONTRACTOR in carrying out the work.
- M. Cost and Compensation: It is agreed that the total cost for the services provided under this Contract shall not exceed \$49,957. Notwithstanding other terms and conditions of this Contract, it is understood and agreed that the total cost and compensation under this Contract shall not exceed the funds made available to the State of Delaware and DEPARTMENT by the National Oceanic and Atmospheric Administration for this project.
- N. Obligations: The obligations of the DEPARTMENT under this Contract shall be subject to the receipt of sufficient funds appropriated by the National Oceanic and Atmospheric Administration and the obligations of the DEPARTMENT are limited to the amount of such appropriation.

End of NOAA Funding Section

Payment Total and Schedule :

It is agreed that the total cost for the services provided under this Contract shall not exceed \$49,957.

A payment, in the amount of \$49,957, shall be made based on a schedule of \$15,000 made at execution of contract, upon submission of an invoice by CONTRACTOR, \$15,000 upon completion of the conceptual model and well installation and the information reviewed by a representative of the DEPARTMENT, upon submission of an invoice by CONTRACTOR , and \$19,957 upon satisfactory completion of the project, including final report and deliverables, in DEPARTMENT's sole discretion, and upon submission of an invoice by CONTRACTOR. Invoices shall be paid within 30 days after receipt by DEPARTMENT, if services are performed satisfactorily, in DEPARTMENT'S sole discretion. Determination of satisfactory performance shall not be unreasonably withheld.

The CONTRACTOR will provide non-federal match in the amount of \$50,077.00 as listed on the attached Budget Sheet.

Approved:

University of Delaware

Department of Natural Resources and
Environmental Control

Digitally signed by Jessica L. Cote
DN: cn=Jessica L. Cote,
o=University of Delaware,
ou=Research Office,
email=cote@udel.edu, c=US
Date: 2013.02.20 08:58:32 -05'00'

By: _____

By: _____

Name: Jessica L. Cote, CRA

Name: _____

Title: Contract & Grant Specialist

Title: _____

Date: _____

Date: _____