

University of Southern Maine Request for Proposal

Review of Circulation Studies and Modeling in Casco Bay

1.0 General Information

1.1 **Purpose:** The University of Maine System, acting through the University of Southern Maine, Casco Bay Estuary Partnership (CBEP), is seeking proposals for a report to be entitled *Review of Circulation Studies and Modeling in Casco Bay*. The report will review and assess the state of knowledge of circulation in Casco Bay, discuss relevant hydrodynamic and other modeling approaches, and identify available data sets relevant to circulation modeling in Casco Bay. A Powerpoint show that summarizes the report will be presented at a 2-day Casco Bay Circulation Modeling Workshop, to be scheduled later this year. In addition, services sought also include development of a post-workshop summary document. For more details on the scope of services, see Sections 1.4 and 2.0 below.

1.2 **General Background:** CBEP includes state, federal and local government, NGOs, and citizens. In 1990, Casco Bay was designated an “estuary of national significance” and included in the U.S. Environmental Protection Agency’s National Estuary Program, established in 1987 to protect nationally significant estuaries threatened by pollution, development, or overuse. As a result of this designation, the CBEP was formed with the mission of preserving the ecological integrity of Casco Bay while ensuring compatible human uses of the Bay’s resources through public stewardship and effective management.

This mission is being accomplished through a community-based, cooperative effort that involves concerned citizens, local governments, business and industry, state and federal agencies, and academic and research institutions. The goals of the CBEP as stated in the *Casco Bay Plan* (1996, revised 2006) include:

- Protecting and restoring fish and wildlife habitats
- Decreasing pollution from stormwater and combined sewer overflows
- Improving water quality to restore and sustain open clam flats and protect swimming beaches
- Reducing toxic pollution
- Promoting informed and responsible stewardship.

A program of environmental monitoring supports this work and tracks progress towards meeting these goals. To learn more about CBEP, visit the website at:

<http://www.cascobay.usm.maine.edu/>

1.3 **Circulation Modeling in Casco Bay:** In 1996, Bryan Pearce, Neal Pettigrew, and Bin Gong developed a hydrologic model of circulation in Casco Bay for CBEP. The results of that modeling effort were incorporated into the 1996 *Casco Bay Plan*. Subsequently, other models and modeling approaches have been applied in Casco

Bay and the larger Gulf of Maine by outside groups and researchers. These include the GNOME oil spill model developed by NOAA (see: http://response.restoration.noaa.gov/book_shelf/820_GNOME.pdf) and the ERMA GIS visualization tool developed at UNH (see <http://www.crrc.unh.edu/erma/index.html>). See also the attached partial list of relevant research reports in the Appendix (Section 4.0). CBEP has recently identified the need to improve our understanding of circulation in Casco Bay in order to address a variety of water quality and habitat-related management questions, including, for example:

- nutrient transport, e.g., the fate and transport of nutrients from wastewater treatment plant outfalls and other sources and how they influence offshore nutrient concentrations; how offshore waters are flushing; how riverine waters are circulated in Casco Bay
- oil spill transport, e.g., how a plume of spilled oil would travel and disperse; effects of current and winds; response of heavy versus light oil
- larval distribution, e.g., factors influencing clam set and distribution of lobster larvae; invasion pathways
- harmful algal blooms, e.g., factors influencing local distribution of HABs; role of upwelling in cyst movement

CBEP will host a Casco Bay circulation modeling workshop in spring/summer 2011, bringing together expert modelers and resource users to clarify the specific types of data and model/s needed to address key management issues. In preparation for this workshop and to follow-up on the results of the workshop, CBEP has defined three products to be developed in response to this Request for Proposals. They are described in Section 2.2, 2.3 and 2.4.

2.0 Performance Terms and Conditions

2.1 **Workplan:** Following contract award, the contractor will meet with CBEP staff and will develop a Workplan that includes: A list of deliverables, including a detailed outline of the Report and Product Due Dates

2.2 **Report:** In your proposal, describe the approach you will use to develop the report *Review of Circulation Studies and Modeling in Casco Bay*, including your literature review approach and graphic presentation formats that you will provide. It is expected that the report will include the following:

Table of Contents

List of figures/tables

Executive Summary (suitable for an educated lay audience)

Graphics, including maps of Casco Bay

Content as follows:

- a review of the current state of knowledge of circulation in Casco Bay
- a discussion of the various circulation models that have been applied to Casco Bay (or the Gulf of Maine if relevant) as well as additional state-of-the-art models that may be useful/relevant (e.g., hydrodynamic models for

3-D physical circulation and tide; particle transport models, ecosystem change models, and biochemistry models.

- a discussion of the strengths and weaknesses of the models and their relevance to the types of management questions described above in Section 1.3 (e.g., model vertical and horizontal resolution).
- a list of types of data that have been used in these models
- a table that identifies suitable Casco Bay data that are available for use in modeling efforts, organized by type of data set, with web links or other instructions for access.
- reference list

2.3 **Powerpoint Show:** Thirty-minute show will summarize the report outlined above at a level appropriate to an audience of modelers and marine scientists as well as educated laymen. Show will be presented at the Casco Bay Circulation Workshop (date to be set, likely spring/summer 2011).

2.4 **Workshop Summary** should include a succinct (1 – 2 pp.) consensus statement that lays out a framework for future model development, including:

- key management needs
- model outputs needed
- model vertical and horizontal resolution
- key local focus areas (such as Maquoit Bay)
- recommended technology

Note that attendance at both days of the workshop will be required.

2.5 **Product Due Dates:**

Workplan due February 18, 2011

Draft Report and draft Powerpoint show due March 31, 2011

Comments provided by April 8, 2011

Revised Draft Report and Powerpoint show due April 15, 2011

Final comments provided by April 22, 2011

Final Report and Powerpoint show (one copy electronic, one copy - camera ready) due May 1, 2010

Draft Workshop Summary will be due 3 weeks after the Workshop is held.

Comments provided one week later.

Final Workshop Summary one week later.

Final Workshop Summary due one week later.

Note: All deliverables including any graphics and tables should be available to us in electronic format for use on the web and in public presentations

2.4 **Budget:** Total bid for all tasks not to exceed **\$15,000**. In addition, separate invoices for travel expenses at the University of Southern Maine's reimbursement rate and not to exceed **\$500.00** may be submitted to the CBEP.

2.5 **Payments:** Payment will be upon submission of an approved itemized invoice to the CBEP by the Contractor on a net 30 basis unless discount terms are offered. Invoices *must* include a purchase order number.

3.0 Submission

Proposal Submission: Please submit 6 hard copies **or** one electronic copy of your proposal to:

Beverly Bayley-Smith
Casco Bay Estuary Partnership
University of Southern Maine
P.O. Box 9300
34 Bedford St.
228B Wishcamper Center.
Portland, ME 04104-9300

by February 11, 2011.

Submission by e-mail to **bbsmith@usm.maine.edu** is acceptable.
Beverly can be reached at (207) 780-4306

4.0 Appendix: Useful References

(Note: Where available, digital copies will be made available by CBEP via a Quickplace shared information site)

Geyer, W.R., Signell R.P., Fong, D.A., Wand, J., D Anderson.M., Keafer, B.A., 2004. The freshwater transport and dynamics of the western Maine coastal current. *Continental Shelf Research* 24: 1339-1357.

Gong, Bin. 1995. *General circulation and density distribution in Casco Bay Maine*. Master's Thesis. U. Maine.

Holte, James. 2003. Hydrography, Flushing Rates and Circulation of Quahog Bay, Mid-Coast, Maine. *Geological Society of America Annual Meeting*. Student presentation based on CDT and ADCP study across the mouth of Quahog Bay (supervised by Ed Laine).

Hulburt, E. M. and N. Corwin, 1970. Relation of the Phytoplankton to Turbulence and Nutrient Renewal in Casco Bay, Maine. *Journal Fisheries Research Board of Canada*, vol. 27 (11), pp. 2081-2090.

Janzen, C., J. H. Churchill, N. Pettigrew. 2005. Observations of exchange between eastern Casco Bay and the western Gulf of Maine. *Deep Sea Research II*, 52: 2411-2429 (1998 ECOHAB-GOM data)

Janzen, C. and Neal Pettigrew. 2004 – 2006 MOSAC –funded study. Observations of Tidal, Subtidal and Seasonal Variability in Casco Bay Circulation. Presentation at 2006 *Ocean Sciences Meeting* in Honolulu, progress reports on 2004 buoy data deployed in exchange channels between Casco Bay and the Gulf of Maine.

Kistner, D.A., Pettigrew, N., 1999. Reverse estuarine circulation in the New Meadows Estuary, Maine. American Spring Meeting, Boston, MA, 1999. In *EOS, Transactions. American Geophysical Union* 79(1), OS61

Parker, C.E. 1982. *The currents of Casco Bay and the prediction of oil spill trajectories*. Technical Report No. 28, Bigelow Lab.

Pearce, B., Pettigrew, N, and Bin Gong. 1996. *Casco Bay Circulation Modeling*. Casco Bay Estuary Program.

Ridderinkhof, H., 1995. Lagrangian Flows in Complex Eulerian Current Fields. In: *Quantitative Skill Assessment for Coastal Ocean Models [Coastal and Estuarine Studies, Vol. 47]*. D. R. Lynch and A. M. Davies (eds). Washington, D.C.: American Geophysical Union. pp. 31-48.

True, Ernest D., and James P. Manning. *Modeling Wind and Tidal Circulation in Casco Bay, Maine: a preliminary study*. 2008. Data modeled includes 1980 – 1981 Bigelow survey data (Parker, 1982), NODC hydrographic data, National Data Buoy Center data (Station 44007), GOMOSS buoy data, Portland tide gauge data, ECOHAB-GOM 1998 - 2000 data (Geyer *et al.*, 2004; Janzen *et al.*. 2005)

Vermersch, J. A., R. C. Beardsley, and W. S. Brown, 1979. Winter Circulation in the Western Gulf of Maine: Part 2: Current and Pressure Observations. *Journal of Physical Oceanography*, vol. 9, pp. 768-784.

Xue, Huije, Fei Chai and Neal Pettigrew. A model study of the seasonal circulation in the Gulf of Maine. 2000. *Journal of Physical Oceanography*. 1111-1135.

Xue, Huije. 2008. Connectivity of lobster populations in the coastal Gulf of Maine. Part I. Circulation and larval transport potential. *Ecological Modelling*. 210(193-211)

Xue, Huije. 2009. Implementation of a wetting-and-drying model in simulating the Kennebec-Androscoggin plume and the circulation in Casco Bay. *Ocean Dynamics* 60:342-357

The University of Maine System is an Equal Opportunity/Affirmative Action Employer and strongly encourages applications from and nominations of women and minority candidates. The University provides reasonable accommodations to qualified individuals with disabilities upon request.