

## **Project Letter**

### **Delaware Bay Wave Buoy Data Analysis**

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 (Effective March 15, 2003)

#### **UNIVERSITY Principal Contact (Technical):**

Hunter C. Brown  
Lead Engineer, Delaware Environmental Observing System  
212A Pearson Hall  
302-831-8272  
[hcbrown@udel.edu](mailto:hcbrown@udel.edu)

#### **UNIVERSITY Principal Contact (Administrative):**

Jessica L. Coté  
Office of Sponsored Programs  
Research Office  
University of Delaware  
210 Hullahen Hall  
Newark, DE 19716  
302-831-3634

#### **DEPARTMENT Principal Contact (Technical):**

Robert W. Scarborough, Ph.D.  
DNREC/DNERR  
89 Kings Highway  
Dover DE 19901  
302-739-9283  
[Bob.scarborough@state.de.us](mailto:Bob.scarborough@state.de.us)

#### **DEPARTMENT Principal Contact (Administrative):**

Brian Leahy  
DNREC/ DSWC  
89 Kings Highway  
Dover DE 19901  
302-739-9921  
[Brian.leahy@state.de.us](mailto:Brian.leahy@state.de.us)

**Type of Project (check one):**

Research       X  
Service         □  
Education      □

**Scope of Work:**

This project will attempt to determine any statistical relationship between the data from two Directional Wave Buoys deployed in the middle and lower reaches of the Delaware Bay, and nearby environmental observing instruments such as offshore NOAA buoys, regional Automated Surface Observation Stations, and any existing high-quality environmental monitoring equipment in the area.

**1.0 Data**

1.1 DNREC Buoy Data

Wave statistical data are available from DNREC during portions of the time period spanning from June 2007 through February 2012. This data includes wave height, mean wave direction, mean wave directional spread, and spectral wave periods, and water temperature. This data will serve as the foundation for statistical comparisons and model output comparisons.

1.2 NDBC Buoy #44009

The National Data Buoy Center maintains a 3m discus buoy (#44009, ARES payload) 26 NM south of Cape May which monitors oceanographic and meteorological data and calculates wave statistics. Wave data is available at one hour intervals including significant wave height, dominant period, average period, and mean wave direction. Spectral wave density is also available at the same one hour interval. Meteorological data available from this buoy includes wind direction, wind speed, wind gust speed, air temperature, water temperature, and barometric pressure. For this study, metadata on the NDBC buoy will be collected and analyzed to ascertain the station and period of record are suitable for the investigation of wave statistics. These data will be used in the proposed study in the analysis of ocean wind/wave impact on wave statistics within the confines of the Bay.

1.3 DEOS Meteorological Stations

The Delaware Environmental Observing System maintains a network of 50 meteorological stations throughout the Delaware, Maryland, and Pennsylvania region. Relevant Stations near the Delaware Bay will be identified and analyzed to determine the applicability in this study. Meteorological data from these stations will serve as input for model generation over time periods available for comparison within the DNREC data set.

1.4 ASOS and AWOS Stations

There are several Automated Surface Observing Stations (ASOS) and Automated Weather Observing Stations (AWOS) stations in the Delaware Bay region which observe and record meteorological data such as wind speed and direction, air temperature, barometric pressure, and

precipitation. The following stations will be considered for inclusion in the analysis performed in this study:

KGED – Georgetown, DE, Sussex County Airport  
KILG – Wilmington, DE, New Castle County Airport  
KWWD – Wildwood, NJ, Cape May County Airport  
KMIV – Millville, Cumberland, NJ, Millville Municipal Airport  
KACY – Atlantic City, NJ, Atlantic City International Airport  
KOXB – Ocean City, MD, Ocean City Municipal Airport  
KSBY – Salisbury, MD, Salisbury-Wicomico County Regional Airport

#### 1.5 USGS Data

The United States Geological Survey and the National Ocean Service (NOS) maintain water level sensors in several locations around the Delaware Bay (such as Bower's Beach, Reedy Point, and Lewes). Data from these stations can be used to estimate water depth throughout the Bay and determine potential existence of tidal, hydraulic (currents from the Chesapeake and Delaware Canal), and seiching influences on wave data.

## 2.0 Methodology

Wave statistics are typically calculated from the measured accelerations of the roll, pitch, and heave of a buoy. The time-series is often transformed into the frequency domain and a statistical analysis performed after filtering the data to minimize low frequency noise. Waves are influenced by a tremendous number of local effects such as wind stress and shear (including sea-breeze effects), fetch, surface and subsurface water currents, seiches, nearby marine traffic, water quality and pollutants, storm surge, and bathymetry, and distant influences such as gravitational disturbances such as lunar-induced tides and long-distance storm effects. While the aim of this project is not to design and construct a new physical model of waves in the Delaware Bay, we will attempt to determine the correlation between existing observational data and wave statistics calculated from in-situ observation platforms in the Bay.

Parametric regression analysis will be performed on existing wave data between the Delaware Bay wave buoys and the NDBC #44009 buoy to determine any direct correlations between wave heights inside the bay and at the offshore site. Existing data will qualify the validity of any a priori physical assumptions, such as narrow-banded wave spectra. Also, local wind and water level contribution to wave heights, periods, and directions will be investigated through a similar process to determine if any meaningful relationships can be determined between the wave statistics and collected meteorological data.

## 3.0 Expected Results

The desired result of this research will include the development of a statistical model which explains much of the variability of the wave conditions at the middle and lower Delaware Bay sites using the other environmental data sources described above.

**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, 2013.

**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 Coastal Management Program** grant from the NOAA under award number NA09NOS4190172 and **Delaware National Estuarine Research Reserve Operations, Education, and Research** grant from the NOAA under award number NA10NOS4200185, 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 Coastal Management Program and 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 NA11NOS4200108.*
- 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 \$48,000. 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 \$25,047.00.

A payment, in the amount of \$25,047, shall be made based on a schedule of \$10,000 made at execution of contract, upon submission of an invoice by CONTRACTOR, \$10,000 upon completion of the statistical analysis and the information reviewed by a representative of the DEPARTMENT, upon submission of an invoice by CONTRACTOR, and \$5,047 upon satisfactory completion of the project, including final report and statistical analysis, 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 \$25,047.00 as listed on the attached Budget Sheet.

Approved:

University of Delaware

Department of Natural Resources and  
Environmental Control

By: \_\_\_\_\_

By: \_\_\_\_\_

Name: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_



### Budget

|  |                          |
|--|--------------------------|
| CoPI Brown (3 months)                          | \$13,750.00              |
| Fringe Benefits                                | <u>\$4,400.00</u>        |
| <b>Total Salary, Wages, Benefits</b>           | <b>\$18,150.00</b>       |
| <b>Total Direct Costs</b>                      | <b>\$18,150.00</b>       |
| <b>Total Indirect Costs (\$18,150 X .38)</b>   | <b><u>\$6,897.00</u></b> |
| <b>Total Cost</b>                              | <b>\$25,047.00</b>       |
| <b>Total University of Delaware Cost Share</b> | <b>\$25,047.00</b>       |

#### **Budget Justification:**

Monies in the amount of \$13,750.00 will be used for three-month of salary for co-PI Brown over the one-year grant period. Co-PI Brown's responsibilities will include data collection, formatting, conditioning, statistical comparisons between DNERR and NDBC buoy platforms, and statistical comparisons between DNERR data, meteorological data and other environmental data sources. Brown will also be responsible for assistance in results interpretation, and final report and publication preparation.

Total indirect costs of \$6,897.00 (38%) and \$4,400.00 (32%) for fringe benefits are requested as per University of Delaware policy.

Cost share will be met using PI salary (.54 mo), fringe (32%), and IDC (38%) plus the Co-PI's tuition.

**Project Letter**

**A Climate Change Analysis for Delaware and the  
Delaware Bay Estuary**

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 (Effective March 15, 2003)

**UNIVERSITY Principal Contact (Technical):**

Daniel J. Leathers, Ph.D.  
Delaware State Climatologist  
213 Pearson Hall  
302-831-8764  
[leathers@udel.edu](mailto:leathers@udel.edu)

**UNIVERSITY Principal Contact (Administrative):**

Jessica L. Coté  
Office of Sponsored Programs  
Research Office  
University of Delaware  
210 Hullihen Hall  
Newark, DE 19716  
302-831-3634

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**Type of Project (check one):**

- Research       X  
Service         □  
Education      □

**Scope of Work:**

As part of a cooperative effort between the Office of the Delaware State Climatologist, the Delaware Geological Survey and several State Agencies to better monitor the State's changing environment, we propose the completion of an analysis of historical climate and related environmental data for Delaware and the Delaware Bay Estuary for the period 1895 through 2011. The major goal of the proposed research is to identify any statistically significant trends in diverse climate variables for the Delaware Region. These variables will include precipitation and precipitation extremes (both rainfall and snowfall), temperature, temperature extremes, drought indices (PDSI, PDHI and Palmer-Z), flood frequency, flood magnitude, and the frequency and magnitude of coastal storms (mid-latitude and tropical systems) and severe weather events (severe convective winds, hail, tornadoes). In addition, several "non-traditional" data sets will be investigated for their efficacy in informing the question of climate change in the Delaware Region including historic photography, personal journals and diaries, previous refereed literature, etc. Included in the analysis will be a thorough study of changing land surface conditions across the State (amount of impervious surfaces, development, deforestation, etc.) and their potential effect on the climate variables. All of the proposed work will leverage the personnel competencies and the data holdings of the Office of the Delaware State Climatologist, the Delaware Environmental Observing System, the Delaware Geological Survey and the Delaware Environmental Monitoring and Analysis Center. The majority of funds requested in this proposal will be used to support a M.S. or Ph.D. level graduate student in the Department of Geography at the University of Delaware. The student will work with the principal investigator and personnel from the organizations mentioned above in the completion of this project.

**1.0 Data**

**1.1 Statewide and Climate Division Data**

Statewide temperature and precipitation data are available for the period 1895 through 2011 from the National Climatic Data Center (NCDC; <http://www.ncdc.noaa.gov/oa/ncdc.html>). These data are made available by NCDC for the study of climate variability and change. When necessary, observations have been adjusted to account for the effects introduced into the climate record by factors such as instrument changes, station relocations, changes in observer or observing practice, urbanization, etc. Similar data is also available for the State's two climate divisions including Division 1 (New Castle County) and Division 2 (Kent and Sussex Counties). These data are available through both the Office of the Delaware State Climatologist (ODSC) and NCDC. These data will be used in the proposed study in the analysis of temperature and precipitation variability and large-scale drought (PDSI, PDHI and Palmer-Z) across the state over the last century.

**1.2 Daily Cooperative Weather Station Data for Delaware**

The DSI-3200 data set, available through NCDC, includes 23 National Weather Service Cooperative stations that have been located in Delaware at some point since the late 19<sup>th</sup> century. The DSI-3200 data includes daily observations of maximum temperature, minimum temperature, total liquid

precipitation and in some instances snowfall and snow cover on the ground. Although the data have been quality controlled, care must still be taken in their use to account for time of observation biases, poor sensor placement, etc. For this study, metadata on all stations will be collected and analyzed to ascertain those stations and period of record that are suitable for the investigation of climate change. The Cooperative data identified as suitable for further analysis will be used in the analysis of temperature and temperature extremes, precipitation and precipitation extremes and potential asymmetric changes in temperature (changes in maximum compared to minimum temperatures).

### 1.3 Stream Discharge and Tidal Water Levels

Stream flow data are maintained by the United States Geological Survey (USGS) through their National Water Information System (NWIS). There are 16 USGS stations (13 in DE, 3 in PA) on streams that drain into the Delaware Bay or Atlantic coastal bays in Delaware. USGS approved discharge and gage height data are available for all stations. Stream flow data will be analyzed for the magnitude and frequency of flood events over selected threshold levels (10yr flood, 50yr flood, etc...) as defined by the USGS. Trends in annual peak flows will be reviewed and compared against trends in regional hydroclimatological variables and local land use data.

Although an analysis will not be performed on tidal or storm surge data, a tidal station inventory will be developed with an examination of the data history for each station. There are approximately 15 – 20 tidal stations in the region maintained by the USGS and National Ocean Service (NOS). Metadata that will be investigated includes period of record, vertical datums used, instrumentation changes, data gaps, and physical location changes.

### 1.4 Coastal Storm and Severe Weather Data

Data on the frequency and intensity of coastal storms has been compiled in a previous study by the principal investigators (*Delaware Coastal Storm Climatology and Damage Report: 1923-2009*; <http://npws02.deos.udel.edu/coastalstorm/>). This report and accompanying data contains information on all facets of coastal storms along the Delaware Coastline and will be utilized in this research to better understand potential changes in both mid-latitude and tropical coastal storms that have affected Delaware.

Severe weather data (severe convective winds, hail, tornadoes) is available from the NOAA, National Weather Service, Storm Prediction Center, Severe GIS page (<http://www.spc.noaa.gov/gis/svrgis/>) in GIS format. Changes in the frequency of severe weather events, and changes in the spatial distribution of events will be investigated.

### 1.5 Land Surface Data

The available period of record for land use data is short compared to that of most climatic variables. Digitized land use data exist for the following years for Delaware - 1984, 1992, 1997, 2002, 2007 - and are accessible from the Office of State Planning and Coordination (OSPC; <http://www.stateplanning.delaware.gov/>). Land cover and land use data will be used to study possible relationships between land surface changes in Delaware and extremes in several climate variables (stream flow, temperature, etc). In addition, the longer period of record of US census data could potentially serve as a proxy for influence on runoff and stream flow and will be obtained for this research.

## **2.0 Methodology**

The literature pertaining to the analysis of climate variables and the extent of methodologies available for analysis is voluminous and their review is beyond the scope of this proposal. To adequately analyze the climatic variables described in Section 1.0, we propose the use of diverse statistical methodologies to ascertain the presence and significance of trends in the data. The analysis will begin with a thorough examination of the metadata for each climate variable, to ascertain those variables that are appropriate for further study. Methodologies will include linear-trend analysis, confidence interval tests and other methodologies commonly used in the literature. The distribution of some forms of climate data may often be highly skewed and have other irregularities that make them inappropriate for simple hypothesis testing. In this case we will utilize standard methodologies from the meteorological and climatological literature to identify the presence of trends and to affix statistical significance (Von Storch and Zwiers, 1999; Wilks, 1995). In addition, hydrologic data often requires specific statistical tests to identify significant trends, for this data type the recent work of Ries and Dillow (2006) will be followed.

## **3.0 Expected Results**

This study will identify any climatic or hydrologic variables that have shown a statistically significant trend across the Delaware and Delaware Bay Estuary Region for their specific periods of record. In addition, secondary impacts of these trends on diverse facets of Delaware's agriculture, energy usage and hydrology will be thoroughly analyzed. Finally, the influence of Delaware's changing land use on the climatic and hydrologic variables will be examined and the relationship between human-induced land surface change and the region's climate and hydrology will be more fully understood, especially in the context of modeled climate change scenarios.

### **Project Timeline:**

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  - 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 \$48,000. 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 \$24,967.00.

A payment, in the amount of \$24,967, shall be made based on a schedule of \$10,000 made at execution of contract, upon submission of an invoice by CONTRACTOR, \$10,000 upon completion of the statistical analysis and the information reviewed by a representative of the DEPARTMENT, upon submission of an invoice by CONTRACTOR , and \$4,967 upon satisfactory completion of the project, including final report and statistical analysis of secondary impacts, 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 \$24,967.00 as listed on the attached Budget Sheet.

Approved:

University of Delaware

Department of Natural Resources and  
Environmental Control

By: \_\_\_\_\_

By: \_\_\_\_\_

Name: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

## Budget

|  |                          |
|--|--------------------------|
| Graduate Student (7.5 months)                  | \$15,417.00              |
| CoPI Brinson                                   | \$614.00                 |
| Fringe Benefits                                | <u>\$1461.00</u>         |
| <b>Total Salary, Wages, Benefits</b>           | <b>\$17,492.00</b>       |
| Supplies                                       | \$600.00                 |
| <b>Total Direct Costs</b>                      | <b>\$18,092.00</b>       |
| <b>Total Indirect Costs (\$18,092 X .38)</b>   | <b><u>\$6,875.00</u></b> |
| <b>Total Cost</b>                              | <b>\$24,967.00</b>       |
| <b>Total University of Delaware Cost Share</b> | <b>\$24,967.00</b>       |

### **Budget Justification:**

Monies in the amount of \$15,417.00 will be used for graduate student salary over the one-year grant period. Graduate student responsibilities will include collection of climate and hydrologic data, metadata evaluation of data sources, statistical testing of data for identification and significance of trends, evaluation of secondary impacts of trends on Delaware and analysis of land-use/land cover influences on Delaware climate and hydrology. All graduate student work will be conducted under the supervision of the Co-PIs. Salary of \$614.00 (1% annual) is requested for Co-PI Brinson for additional data analysis work. Fringe benefit costs of \$1,461.00 are requested for the graduate student (8.2%) and Co-PI Brinson (32%).

Monies in the amount of \$600.00 will be used for supplies and expenses for both the graduate student and the co-PIs. These funds will be used for supplies for completion of the proposed work.

Total indirect costs of \$6,875.00 are requested as per University of Delaware policy.

Cost share will be met using PI/Co-PI salary (.15 mo for Leathers & .12 mo for Callahan), fringe (32%) and IDC (38%) plus the student's tuition.



