CONTRACT BETWEEN

NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

TABLE OF SECTIONS IN GENERAL TERMS AND CONDITIONS

I. Contract Award Data and Signatures
II. Compliance with Existing Laws and Policies
III. Insurance
IV. Indemnification
V. Assignments and Subcontracts
VI. Availability of Funds
VII. Procurement Standards
VIII. Property Management Standards
IX. Method of Payment
X. Matching and Cost Sharing Requirements
XI. Project Income
XII. Financial Management System
XIII. Financial and Performance Reporting
XIV. Monitoring Performance
XV. Audit Requirements
XVI. Contract Amendment
XVII. Closeout Procedures
XVIII. Termination, Expiration, and Suspension
XIX. Access to Records
XX. Record Retention
XXI. Approvals and Authorizations
XXII. Interest on Advance Payments and Disallowed Costs
XXIII. Miscellaneous Provisions

TABLE OF ATTACHMENTS ATTACHED*

A.	Additional Provisions and Special Modifications	☒ yes	☐ no
A-1.	Additional Federal Funded Agreement Provisions	☒ yes	☐ no
A-2.	Federal Funding Accountability and Transparency Act (FFATA) - $25,000 or greater	☒ yes	☐ no
A-3.	U.S. Environmental Protection Agency Funded Agreements	☐ yes	☒ no
A-4.	American Recovery and Reinvestment Act (ARRA) Funded Agreements	☐ yes	☒ no
B.	Approved Project Budget	☒ yes	☐ no
B-1.	Itemization and Justification of Budget	☐ yes	☒ no
B-2.	Approved Advance Payment	☐ yes	☒ no
C.	Expenditure Report	☒ yes	☐ no
D.	Scope of Services	☒ yes	☐ no
D-1.	Project Requirements	☒ yes	☐ no
D-2.	Contractor's Proposal	☒ yes	☐ no
E.	☐ Governing Body Resolution.. ☐ Corporate Resolution ☒ Other Authorization	☒ yes	☐ no
F.	Subcontractor Certification	☒ yes	☐ no
G.	Statement of Adequacy of Accounting System	☒ yes	☐ no
RB.	Reference Bibliography	☒ yes	☐ no

*Wherever this contract form, including any attachments, presents alternatives, choices must be indicated as follows: An "X" within brackets or on a blank line shall indicate selection of the particular alternative.

GENERAL TERMS AND CONDITIONS

I. Contract Award Data and Signatures

Contractor's - Name: **NEW JERSEY INSTITUTE OF TECHNOLOGY** (the "Contractor")

Address: University Heights
Newark, NJ 07102-1982

Vendor ID #: 226000910

Financial Officer's - name: Nancy Eng

- Title: Director, Grant and Contract Accounting (the "Chief Financial Officer")

The State of New Jersey (The "State")

Department of Environmental Protection (the "Department" or the "DEP")

Contracting agency's – name: **OFFICE OF ENGINEERING AND CONSTRUCTION** (the Contracting Agency")

- address: Mail Code 501-01A, P.O. Box 420
Trenton, NJ 08625

Source of Funds	AMOUNT	STATE ACCOUNT NUMBER	CFDA NUMBER/ CFDA TITLE/ Federal Agency	ACCOUNT TITLE FEDERAL GRANT AWARD NAME/NUMBER
State General Fund	$289,872	14-100-042-4895-130		HR-6
Federal	0.00			
Contractor	0.00			
Other (i.e. bond fund, tax fund etc.)	0.00			
	$289,872	TOTAL APPROVED PROJECT AMOUNT		

Work Period: The "effective date" of this contract is the date the Contractor executes it or the date the State executes it, whichever date is later. The "work period" for this contract commences on 8/1/2013 or the effective date, whichever is ☐ earlier ☒ later, and runs for a period of six months thereafter.* Contract funds may be used only to satisfy obligations which arise during the work period.

Purpose and Authority: Contract to be Funded: Flood Mitigation Engineering Resource Center

Statutory Authority for this Contract: NJDEP General Contract Authority, N.J.S.A. 13:1D-9(q); FY 2013 Appropriations Act; N.J.S.A. 58:16A-6

In consideration of the payment of the State, the Federal, and if through the State treasury, the "other" amounts shown above (the "contract"), the Contractor agrees to provide its share of the Total Project amount and to perform the work described in Attachment D, within the work period and in the manner and upon the terms specified in this contract. The provisions of this contract set forth in this Section I through Section XXIII constitute the General Terms and Conditions portion of this contract.

*Wherever this agreement form, including any attachments, presents alternatives, choices must be indicated as follows: An "X" within brackets or on a blank line shall indicate selection of the particular alternative. "NA" or "---" (a dashed line) shall indicate that no information is to be entered on a particular blank line. No blanks may remain just prior to execution, except in the signature blocks on attachments C and F.

DEP-070
12/12

STATE AND CONTRACTOR APPROVAL SIGNATURES

APPROVED AS TO LEGAL FORM

For the State: *

(signature)

Jill Denyes, Deputy Attorney General
(print name)

Date: 8/2/2013

For the Contractor **

(signature)

_____, Attorney for Contractor
(print name)

Date: _____

* A confidential and privileged memorandum pre-approving this agreement as to legal form ☐ has ☐ has not been provided to the Contracting Agency by the Deputy Attorney General.

** Approval of this contract by an attorney for Contractor is ☐ mandatory ☐ optional.

APPROVAL OF CONTRACTING AGENCY

OFFICE OF ENGINEERING AND CONSTRUCTION
(print name of Contracting Agency; all capitals)

By: _____
(signature)

Dave Rosenblatt
(print name)

Administrator
(print title)

Date: 7-10-13

EXECUTION SIGNATURES

By the signatures below, the Contractor and the State (the "parties") execute this contract and confirm that they are mutually bound by all provisions contained in its General Terms and Conditions and full authorized and empowered to enter into and bind their organization to all obligations under this agreement and in each attachment selected as "ATTACHED" in the Table of Attachments.

SIGNED

NEW JERSEY INSTITUTE OF TECHNOLOGY
(print Contractor's name; all capitals)

By: _____
(signature)

DONALD H SEBASTIAN
(Print name)

SR VP FOR R&D
(print title)

Date: 8/5/13

COUNTERSIGNED:

THE STATE OF NEW JERSEY
By: The DEP

By: _____
(signature)

Rich Boornazian
(print name)

Assistant Commissioner
(print title; Commissioner or authorized delegate)

Date: 8/13/13

II. Compliance with Existing Laws and Policies

The Contractor, in order to induce the State to award this contract, agrees in the performance of this contract to comply with all applicable federal, State, and municipal laws, rules, regulations, and written policies. Failure to comply with such laws, rules, regulations or policies shall be grounds for termination of this contract. Such laws, rules, regulations, and policies include, but are not limited to, the following:

A. The New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq., if applicable, is by this reference incorporated as part of this contract and the Contractor agrees to comply with it. The Contractor warrants that neither it nor any subcontractor it might employ to perform work in furtherance of this contract is suspended, debarred or otherwise listed or is on record in the Office of the Commissioner or Department of Labor for failure to pay prevailing wages in accordance with the New Jersey Prevailing Wage Act. The Contractor further warrants that it and any subcontractors it might employ to perform work in furtherance of this contract shall comply with the New Jersey Prevailing Wage Act.

B. The parties agree that, if applicable, the New Jersey Law Against Discrimination, N.J.S.A. 10:5-1 et seq., N.J.S.A. 10:5-31 et seq., N.J.S.A. 10:2-1 et seq., N.J.A.C. 13:6-1 et seq. and N.J.A.C. 17:27-1.1 et seq. are by this reference incorporated as part of this contract and are binding upon them. The Contractor agrees and guarantees to afford equal opportunity in performance of this contract in accordance with an affirmative action program approved by the State Treasurer. Further, if the cited laws and regulations apply to this contract, the Contractor agrees as follows:

   1. The Contractor shall not discriminate against any employee or applicant for employment because of age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation or sex. The Contractor shall take affirmative action to ensure that such applicants are recruited and employed, that employees are treated during employment without regard to their age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation or sex. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees, and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause;

   2. The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to age, race, creed, color, national origin, ancestry, marital status, affectional or sexual orientation or sex;

   3. The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining contract or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the Contractor's commitments under this act and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

   4. The Contractor shall include these same provisions in any subcontract for work in furtherance of this contract.

C. The act codified at N.J.S.A. 52:13D-12 et seq., the "New Jersey Conflicts of Interest Law", and the act codified at N.J.S.A. 40A:9-22.1 et seq., the Local Government Ethics Law, are by this reference incorporated as part of this contract. The Contractor represents and affirms that it will make its best efforts and responsible diligence in assuring that none of its employees, its subcontractors, its subcontractors' employees, is engaged in any conduct which constitutes a conflict of interest under, or a violation of, either the New Jersey Conflicts of Interest Law or the Local Government Ethics Law. The Contractor represents and affirms that itself is not engaged in any conduct which constitutes the aforementioned conflict of interest.

D. The Contractor represents and warrants:

   1. That no person or selling agency has been employed or retained to solicit or secure this contract in violation of N.J.S.A. 52:34-15,

   2. that it has made, and knows of no payments or gratuities made in violation of N.J.S.A. 52:34-19,

   3. that it is, and will remain, in full compliance with N.J.S.A. 40A:11-1 et seq., the Local Public Contracts Law, if applicable,

   4. and that it is, and will remain, in full compliance with N.J.S.A. 14A:13-1 et seq., and N.J.S.A. 15A:13-1 et seq. (both regarding out-of-state corporations), if applicable, and

   5. that it is, and will remain, in full compliance with N.J.S.A. 2A:44-143 (regarding bonds on construction and public works contracts), if applicable.

E. The Contractor shall report in writing to the Attorney General and the Executive Commission on Ethical Standards, the solicitation of any fee, commission, compensation, gift, gratuity or other thing of value by any State officer or employee or special State officer or employee from any other State vendor.

F. The Contractor shall not influence, or attempt to influence or cause to be influenced, any State officer or employee or special State officer or employee in his official capacity in any manner which might tend to impair the objectivity or independence of judgment of said officer or employee.

G. The Contractor warrants that it will obtain and maintain, during the term of this contract, all licenses, certifications, authorizations, or any documents required by the federal, state, county, or municipal governments and international authorities, wherever necessary, to perform this contract. The Contractor shall promptly notify the State of any disciplinary action or any change in the status of any license, permit, or other authorization required by law or this contract.

H. New Jersey State Circular Letter 04-04-OMB , Single Audit Policy for Recipients of Federal Grants, State Grants and State Aid is by this reference incorporated as part of this contract.

I. The following documents issued by the United States are by this reference incorporated as standards and procedures used by the Department and made part of this contract:

1. United States Office of Management and Budget ("OMB") Circulars A-21, A-87, and A-122 (Cost Principles: Educational Institutions; State, Local, and Indian Tribal Governments ; Non-Profit Organizations, respectively),
2. OMB Circulars A-102 and A-110 (Uniform Administrative Requirements for Grants in Aid and Other Agreements: State and Local Governments; Institutions of Higher Education, Hospitals and Other Non-Profit Organizations, respectively),
3. OMB Circular A-133 Revised (Audits of States, Local Governments, and Non-profit Organizations),
4. Common Rule regulations for federal agencies, as applicable. (e.g. 40 CFR 31 for USEPA), and
5. Compliance Supplement for Single Audits of State and Local Governments (Compliance Supplement Revised).

J. The following documents issues by the United States are by this reference incorporated as standards and procedures used by the Department and made part of this agreement:

1. United States Office of Management and Budget ("OMB") Circulars and the associated regulations A-21 (2 CFR Part 220), A-87 (2 CFR Part 225), and A-122 (2 CFR Part 230), the Cost Principles for Educational Institutions; State, Local and Indian Tribal Governments; and Non-Profit Organizations, respectively,
2. OMB Circulars and the associated regulations A-102 and A-110 (2 CFR Part 215), the Grants and Cooperative Agreements with State and Local Governments; and Uniform Administrative Requirements for Grants and Other Agreements with Institutions of Higher Education, Hospitals and Other Non-Profit Organizations, respectively,
3. OMB Circular A-133, Revised, Audits of States, Local Governments, and Non-Profit Organizations,
4. Common Rule regulations for federal agencies, as applicable (e.g. 40 CFR for U.S.E.P.A.) http://www.whitehouse.gov/omb/grants/chart.aspx , and
5. Compliance Supplement for Single Audits of State and Local Governments (Compliance Supplement Revised).

III. Insurance

The Contractor shall maintain in force for the term of this contract liability insurance as provided herein. These coverages shall be maintained either through insurance policies from insurance companies authorized to do business in the State of New Jersey or through formal, fully funded self-insurance programs authorized by law and acceptable to the Department. The minimum required coverages are:

A. Commercial General Liability: The minimum limit of liability shall be $1,000,000 per occurrence as a combined single limit for bodily injury and property damage. The policy shall include coverage for contractual liability and shall name the State of New Jersey as an additional insured. The policy shall also include coverage for products liability. The coverage to be provided under these policies shall be at least as broad as that provided by the standard basic, unamended, and unendorsed occurrence coverage forms currently in use in the State of New Jersey which shall not be circumscribed by any endorsements limiting the breadth of the coverage.

B. Business Automobile Liability Insurance which shall be written to cover any vehicle used by the insured. Limits of liability for bodily injury and property damage shall not be less than $1,000,000 per occurrence as a combined single limit.

C. Workers' Compensation Self Insurance in accordance with the laws of the State of New Jersey and commercially purchased Employer's Liability Insurance with a limit of not less than:

$1,000,000 Bodily Injury, Each Occurrence
$1,000,000 Disease Each Employee
$1,000,000 Disease Aggregate Limit

IV. Indemnification

The Contractor shall defend, indemnify, protect, and save harmless the State, its agents, servants, and employees from and against any and all claims, losses, demands, or damages of whatever kind or nature arising out or claimed to arise out of any tortious act or omission of the Contractor, its agents, servants, employees or subcontractors in the performance of this contract. The Contractor shall, at its own expense, appear, defend and pay all reasonable charges for attorneys and all costs and other expenses arising from such suit or claim incurred in connection therewith. If judgment shall be rendered against the State for which indemnification is provided under this paragraph, the Contractor shall, at his own expense, satisfy and discharge the same. However, the Contractor shall not have to indemnify the State for the State's negligent use of research results, or for the State's use of research results unless the research was negligently conducted by the Contractor. The Contractor does not hereby agree to indemnify the State against damage to the extent it results from the State's tortious action or inaction for which it would be liable under the New Jersey Tort Claims Act.

The State shall, as soon as practicable after the claim has been made against it, give written notice thereof to the Contractor, along with full and complete particulars of the claim. If the suit is brought against the State or any of its agents, servants, and employees, the State shall expeditiously forward or have forwarded to the Contractor every demand, complaint, notice, summons, pleading or other process received by the State or its representatives.

V. Assignments and Subcontracts

The Contractor shall not subcontract any of the work or services covered by this contract nor shall any interest be assigned or transferred, except as may be provided for in this contract or with the express written approval of the Department.

A. As a precondition of the Department's approval of a subcontractor and prior to any payments by the Department for subcontracted work, the Contractor shall secure from the subcontractor and shall submit to the Department a completed and executed copy of Attachment F, Subcontractor Certification.

B. The Contractor shall be responsible for compliance by any subcontractor with the terms, conditions and requirements of this contract.

C. The Contractor shall be responsible for any claims arising out of any subcontract hereunder and, as a condition of any subcontract hereunder, the subcontractor shall hold the State harmless from any claims by the subcontractor or third parties which may arise under or as a result of the subcontract.

VI. Availability of Funds

A. The State of New Jersey appropriates funds on a fiscal year basis, which is a period running from July 1 through June 30. The parties hereto recognize and agree that continuation of funding under this contract is expressly dependent upon availability to the Department of funds appropriated by the State Legislature from State or federal revenue or such other funding sources as may be available. The Department shall not be liable for any breach of this contract which results from the State Legislature's failure to appropriate the necessary funds.

B. The Department may encumber and commit to any contract only those funds which have been appropriated and are available during the State fiscal year in which the contract is executed. For any contract which will be completed during that fiscal year, the State's contract amount will be fully encumbered and committed. However, for any contract, the performance of which will span more than one State fiscal year, the Department may or may not be able to encumber and commit the full contract amount and the full funding of the contract may depend upon subsequent fiscal year appropriations by the State Legislature.

C. The parties understand that this contract is fully or partly funded as designated in Section II of Attachment A, Additional Provisions and Special Modifications.

VII. Procurement Standards

Procurement of supplies, equipment, and other services with funds provided by this contract shall be accomplished in accord with federal OMB Circulars A-102 or A-110 and the appropriate federal common rule, whichever would be applicable under federal law, which shall be provided to the Contractor, upon request, by the Department. Procurement shall also be consistent with the New Jersey Local Public Contracts Law, N.J.S.A. 40A:11-1 et seq., and other statutory requirements, as applicable. Both the federal and applicable State requirements shall be incorporated into any subcontracts under this contract.

Adherence to the standards contained in those applicable federal and state laws and regulations does not relieve the Contractor of the contractual responsibilities arising under its procurements. The Contractor is the responsible authority, without recourse to the Department, regarding the settlement and satisfaction of all contractual and administrative issues arising out of procurements entered into in support of this contract.

VIII. Property Management Standards

Property furnished by the Department or acquired in whole or in part with federal or Department funds or whose cost was charged to a project supported by federal or Department funds shall be utilized and disposed of in a manner generally consistent with state and federal requirements (OMB Circulars A-102 or A-110 and the appropriate federal common rule, whichever would be applicable under federal law).

IX. Method of Payment

A. Payment under this contract will be made upon submission by the Contractor of a properly executed State invoice form (available from the Department), and all invoices, bills, and other documents necessary to justify the payment. This form must also be accompanied by a certification from the Contractor that all procurements for which payment is requested have been made in accord with federal OMB Circulars A-102 or A-110 and the appropriate federal common rule, whichever would be applicable under federal law, and in accord with all applicable State laws and have been made during the work period.

1. If Attachment B-2, Approved Advance Payment, provides for a justification of an advance payment and if Section III of Attachment A, Additional Provisions and Special Modifications, so provides, an initial advance payment will be made to the Contractor upon receipt by the Department of a properly executed copy of this contract, signed by an appropriate officer of the Contractor organization, together with a properly executed invoice form.

2. Progress payments shall be made by the Department on a periodic basis as prescribed in Section III.B of Attachment A, Additional Provisions and Special Modifications. Such payments shall be issued only upon receipt of the required financial and narrative reports described in Section XIII of the General Terms and Conditions of this contract, Financial and Performance Reporting. Payment shall be made either in fixed amounts as determined by the Department to be reasonable to maintain an appropriate level of services or in the form of reimbursement of actually reported expenditures as indicated in Section III of Attachment A, Additional Provisions and Special Modifications.

3. If Section III of Attachment A, Additional Provisions and Special Modifications, so provides, a portion of the contract will be withheld pending receipt of the required final reports described in Section XVII of the General Terms and Conditions of this contract, Contract Closeout Procedures.

4. The Department shall withhold payment of any costs disallowed by the Department as improperly incurred under any provision of this contract.

5. Contractor may not use any contract funds to satisfy any obligation which arose outside the work period.

B. If this contract includes federal funds, all invoices must be submitted by the Contractor and all payments must be made by the State no later than ninety (90) days after the end of the work period.

X. Matching and Cost Sharing Requirements

If there are any matching and/or cost sharing requirements indicated in Section IV of Attachment A, Additional Provisions and Special Modifications, then, regardless of whether federal funds are involved, the Contractor shall account to the satisfaction of the Department for these requirements in accordance with federal OMB Circulars A-102 or A-110 and the appropriate federal common rule, whichever would be applicable under federal law.

XI. Project Income

Project income must be accounted for as indicated in Section V of Attachment A, Additional Provisions and Special Modifications. "Project income" means gross income earned by the Contractor from contract-supported activities. Such earnings include, but are not limited to, income from service fees, sale of commodities, usage or rental fees, and royalties on patents and copyrights. In all cases, interest earned on advances of contract funds shall be remitted to the Department, except for interest earned on advances to instrumentalities of a state as provided by the federal Intergovernmental Cooperation Act of 1968, P. L. 90-577.

XII. Financial Management System

The Contractor's Chief Financial Officer, as designated in Section I of the General Terms and Conditions of this contract, Contract Award Data and Signatures, shall be responsible for maintaining an adequate financial management system. The Chief Financial Officer shall notify the Department when the Contractor cannot comply with the requirements established in this Section XII, Financial Management System.

A. Contractor financial management system shall provide for:

1. accurate, current, and complete disclosure of the financial results of each project, agreement, or contract,
2. records that adequately identify the source and application of funds for Department- supported activities, and that contain information pertaining to awards and authorizations, obligations, unobligated balances, assets, liabilities, outlays, and income,
3. effective internal and accounting controls over all funds, property, and other assets, which controls adequately safeguard all such assets and assure that they are used solely for authorized purposes,
4. comparison of actual outlays with budgeted amounts for all major cost categories on Attachments B, Approved Project Budget; B-1, Itemization and Justification of Budget; D, Scope of Services; and D-2, Contractor's Proposal, and correlation of financial information with performance or productivity data, including the production of unit cost information required by the Department,
5. accounting records that are supported by source documentation,
6. procedures to minimize the time elapsing between the advance of funds from the Department and the disbursement by the Contractor, whenever funds are advanced by the Department, and
7. procedures for determining reasonableness, allowability, and allocability of costs generally consistent with the provisions of federal OMB Circulars A-102 or A-110 and the appropriate federal common rule, whichever would be applicable under federal law.

B. If required by Section VI of Attachment A, Additional Provisions and Special Modifications, the Department may require the submission of Attachment G, Statement of Adequacy of Accounting System.

C. The Department may review the adequacy of the financial management system of any applicant for financial assistance as part of a pre-award review or at any time subsequent to the award. If the Department determines that the Contractor's accounting system does not meet the standards described in paragraph B of this Section XII, Financial Management System, additional information to monitor the contract may be required by the Department upon written notice to the Contractor.

XIII. Financial and Performance Reporting

A. Attachment B, Approved Project Budget, is the approved financial plan to carry out the purpose of this contract. The budget shall be itemized to disclose specifically the contract tasks and project activities to be funded.

B. The Contractor shall submit interim expenditure reports, including a completed copy of Attachment C, Expenditure Report, comparing actual expenditures with the Approved Project Budget. These reports shall be submitted on a periodic basis as prescribed in Section VII of Attachment A, Additional Provisions and Special Modifications, and must be certified by the Contractor's Chief Financial Officer.

C. The Contractor shall submit performance reports on an interim basis as prescribed by the Department in Section VII of Attachment A, Additional Provisions and Special Modifications. Performance reports shall present the following information for each contract task and shall include all available and relevant, quantitative data pertaining to production of project work units, completion of contract tasks, and actual costs for each unit or task:

1. a comparison of actual accomplishments to the objectives established in Attachments D, Scope of Services; D-1, Project Requirements; and D-2, Contractor's Proposal, for the reporting period,
2. reasons why established goals were not met or tasks were not completed as scheduled, and
3. other pertinent information, including a description of work performed during the reporting period, relevant literature citations, raw data generated, any modifications to the planned scope of work, and an anticipated work schedule for the next reporting period.

D. The Contractor shall submit a final report on its overall performance of this contract, as prescribed in Section VII of Attachment A, Additional Provisions and Special Modifications, including a completed copy of Attachment C, Expenditure Report, comparing actual expenditures for the entire project with the Approved Project Budget, certified by the Chief Financial Officer, and a final performance report.

E. Extensions of reporting due dates may be granted upon written request to the Department.

F. If reports are not submitted as required the Department shall, at its discretion, suspend payments on this contract or any other contract entered into between the Department and the Contractor and shall take action to suspend payments to the Contractor by other State agencies.

G. If the Contractor has a history of unsatisfactory performance or the Contractor does not submit satisfactory reports, the Department may require additional and more detailed reports from the Contractor.

XIV. Monitoring Performance

A. The Contractor shall continually monitor its performance under this contract to assure that time schedules are being met, projected work units by time periods are being accomplished, and other performance goals are being achieved as applicable and as defined in Attachments D, Scope of Services; D-1, Project Requirements; and D-2, Contractor's Proposal.

B. The Contractor shall inform the Department as soon as possible if any of the following types of conditions affect project objectives and performance and shall describe the action taken, or contemplated, and the Department assistance needed, if any, to respond to any such condition:

1. problems, delays, or adverse conditions which will materially affect the ability to attain project objectives, prevent the meeting of time schedules and goals, or preclude the completion of project work units or contract tasks within established time periods; and

2. favorable developments or events which enable meeting time schedules and goals sooner than anticipated or producing more project work units or completing more contract tasks than originally projected.

C. The Department may, at its discretion, make site visits to:

1. review project accomplishments and management control systems,

2. audit the financial records pertaining to this contract, and

3. provide such technical assistance as may be required.

D. If the Contractor is not performing satisfactorily in the sole judgment of the Department, the Department may require remedial measures deemed necessary to fulfill the project requirements, including requiring the Contractor to obtain additional Department approvals before proceeding or requiring the Contractor to obtain outside technical or managerial assistance.

XV. Audit Requirements

A. All contracts are subject to audit by the State. This contract may be audited at the discretion of the State up to five (5) years after the date of last payment under this contract or as otherwise required, by the Office of the State Comptroller. Any such audit must be made in accordance with generally accepted auditing standards, including the standards described in the federal General Accounting Office Government Auditing Standards.

B. Where an audit conducted hereunder indicates any noncompliance by the Contractor with the material terms and conditions of this contract, the Contractor shall forthwith take corrective action as permitted or required by Section XVI of the General Terms and Conditions of this contract, Contract Amendment; Section XVIII of the General Terms and Conditions of this contract, Termination, Expiration, and Suspension; or as otherwise required by the Department. As a result of any audit hereunder, recommendations shall be made whether any costs incurred by the Contractor should be disallowed as beyond the scope or the purpose of this contract, excessive, or otherwise impermissible. The Department retains the right to recover any disallowed expenditures, and the Contractor shall return to the Department any disallowed expenditures no later than thirty (30) days after the request.

C. In any case, this contract is, at the discretion of the State, subject to audits by the State at any time prior to closeout and subject to a follow-up compliance audit which may build upon previous audits of the contract.

XVI. Contract Amendment

If it desires to amend this contract, the Contractor must submit a written request to the Contract Officer designated in Section IX of Attachment A, Additional Provisions and Special Modifications. Any amendment, whether requested by the Contractor or the Department, must be documented by completion of the Department's amendment form (DEP-076). The completed amendment form must be formally executed by authorized representatives of both parties in the same manner as this contract, unless the amendment being documented is of the type described in paragraph A, B, or C of this Section XVI, Agreement Amendment. If the amendment is of the type described in paragraph A, B, or C below, the Contract Officer may execute the amendment form for the State by signing it in the designated place, and no formal execution by authorized representatives of the parties will be required. As a nonrestrictive example only, if the Department requests, and the Contractor consents to, any amendment to the scope of the services to be performed by the Contractor, including any increase in the amount of the approved budget, such amendment must be memorialized by a completed amendment form, formally executed by authorized representatives of both parties.

A. The Contractor may obtain approval directly from the Contract Officer to transfer amounts of up to $20,000 or 10% of the total contract amount, whichever is less, from one direct cost category to another or from the indirect cost category to a direct cost category, as long as this transfer does not result in any change in the project's scope, work period, objective, or deliverables. If the total contract amount is less than $25,000, the Contract Officer may disregard the 10% limitation and approve transfers of up to $2,500.

1. "Indirect costs" are those incurred for a common or joint purpose benefiting more than one cost objective and not readily assignable to the cost objectives specifically benefited, without effort disproportionate to the results achieved. "Direct costs" are those which can be identified specifically with a particular cost objective.

2. The amendment form documenting any budget revision shall clearly show and justify each change in each cost category, either on the form or on an attachment to it.

B. The Department may reduce the contract budget and the scope of services so that they fairly reflect anticipated project expenditures and progress if:

1. the Department notifies the Contractor, that the Contractor is making project expenditures or progress at a rate which, in the judgment of the Department, will result in substantial failure to expend the contract or to fulfill the purposes of this contract,

2. the Department notifies the Contractor at least thirty (30) days in advance of any reduction,

3. after consultation, the Contractor is unable to develop to the satisfaction of the Department a plan to rectify its low level of project expenditures or progress, and

4. the Department considers the contractor's fixed costs when making any reduction.

C. The Contract Officer may approve no-cost time extensions to the work period or the due date of the final report in increments of six months or less but not beyond the expiration date as described in Section XVIII.A.2 of the General Terms and Conditions of this contract, Termination, Expiration, and Suspension. Written justification and documentation evidencing the need to extend the work period or the due date of the final report must be submitted to the Contract Officer at least thirty (30) days in advance of the scheduled end of the work period. The Contract Officer shall decide whether to grant the extension. The amendment form documenting any no-cost time extension shall clearly show and justify the change, either on the form or on an attachment to it.

D. The Contract Officer may approve proposed Contractor substitutions to the personnel and/or subcontractors identified and approved for this contract. The Contractor must submit a written request to the Department which includes:

1. An explanation of the reasons why the original personnel/subcontractors cannot be provided;

2. Vitae/credentials which demonstrates that the qualifications of the substitutions are equal to or better than the originally proposed personnel/subcontractors; and

3. A declaration that the substitution will be provided at no additional cost to the State.

XVII. Closeout Procedures

The closeout of this contract shall mean the process by which the Department determines that all applicable administrative actions and all required work have been completed by the Contractor. This process shall include the steps enumerated below.

A. The Contractor shall submit a final report as provided in Section VII of Attachment A, Additional Provisions and Special Modifications. The Department may permit extensions when requested in writing by the Contractor.

B. The Contractor shall, together with the submission of the final report, refund to the Department any cash advanced but not committed to payment of eligible project costs in accordance with the Attachment B, Approved Project Budget.

C. The Contractor shall refund to the Department any funds spent on costs which are disallowed by the Department. Such refund shall be made within thirty (30) days after the request.

D. In the event a final audit has not been performed prior to the closeout of this contract, the Department retains the right to recover any appropriate amount after fully considering any recommendation on disallowed costs resulting from the final audit.

E. The Contractor shall account for any property acquired with contract funds or received from the Department in accordance with Section VIII of the General Terms and Conditions of this contract, Property Management Standards.

F. The Contractor shall comply with any Federal audit or closeout procedures applicable to this contract and/or identified by the Department as necessary to qualify for Federal reimbursement for any funds expended under this contract.

G. The Department retains the right to request any additional information necessary to close out this contract and may retain any final contract payment until the closeout procedure is completed.

XVIII. Termination, Expiration, and Suspension

A. The following definitions shall apply for the purposes of this Section XVIII, Termination, Expiration, and Suspension.

1. Termination - The "termination" of this contract means the cancellation of unsatisfied contractual obligations prior to the completion of the contract tasks by the Contractor. Work should stop unless the Contractor wants to continue at its own expense and is not otherwise required for good cause to stop by the Department.

2. Expiration Date - The "expiration date" of this contract is the agreed upon date at which time the term of this contract automatically ends absent a formal written amendment executed by the parties. The expiration date of this contract shall be the third anniversary of the date the work period would end as initially agreed upon in Section I of the General Terms and Conditions of this contract, Contract Award Data and Signatures.

3. Suspension - The "suspension" of this contract means a temporary cessation of State support or assistance pending corrective action by the Contractor or pending a decision to terminate the contract by the Department. Work should stop unless the Contractor wants to continue at its own expense and is not otherwise required for good cause to stop by the Department.

B. If the Contractor fails to comply with any term, condition, requirement, or provision of this contract or fails to make sufficient progress so as to reasonably ensure completion of performance of this contract within the time frame set forth herein, the Department may upon notice to the Contractor suspend this contract and withhold further payments, prohibit the Contractor from incurring additional obligations of contract funds pending corrective action by the Contractor, or decide to terminate this contract in accordance with paragraph C of this Section XVIII, Termination, Expiration, and Suspension. The Department may, at its sole discretion, allow Contractor to incur additional costs that could not be reasonably avoided during the period of suspension provided that said costs meet the provisions of federal OMB Circulars A-102 or A-110, appropriate federal common rule or any other applicable state or federal requirements.

C. The Department may terminate this contract, in whole or in part, upon thirty (30) days notice, whenever it determines that the Contractor has failed to comply with any term, condition, requirement, or provision of this contract or fails to make sufficient progress so as to reasonably ensure completion of performance of this contract within the time frames set forth therein. The Department shall promptly notify the Contractor, in writing, of its determination and the reasons for the termination together with the date on which the termination shall take effect. Upon termination, the Department retains the right to recover any improper expenditures from the Contractor and the Contractor shall return to the Department any improper expenditures no later than thirty (30) days after the date of termination. The Department may, at its sole discretion, allow Contractor to retain or be reimbursed for costs reasonably incurred prior to the termination that were not made in anticipation of termination and cannot be canceled provided that said costs meet the provisions of federal OMB Circulars A-102 or A-110, appropriate federal common rule or any other applicable state or federal requirements.

D. The Department and the Contractor may terminate this contract in whole, or in part, when both parties agree that the continuation of the project would not produce beneficial results commensurate with the further expenditure of funds. The two parties shall agree upon the termination conditions including the date on which the termination shall take effect, and, in case of partial terminations, the portion to be terminated. The Contractor shall not incur new obligations for the terminated portion after the date on which the termination shall take effect, and shall cancel as many outstanding obligations as possible.

E. The closeout procedures described in Section XVII of the General Terms and Conditions of this contract, Closeout Procedures, shall apply in all cases of termination of this contract.

XIX. Access to Records

A. The Contractor agrees to make available to the Department, any Federal agency whose funds are expended in the course of this contract, the Office of the State Comptroller or any other State auditor, and any of their duly authorized representatives, such pertinent accounting records, books, documents, and papers as may be necessary to monitor and audit contractor's operations.

B. Whenever reasonable and practical, the State shall give reasonable notice to the Contractor prior to any visitation, inspection, or audit, including any visitation or request for documentation in discharge of the State's responsibilities. However, the State retains the right to make unannounced visitations, inspections, and audits as deemed necessary during normal business hours.

C. The State reserves the right to have access to records of any subcontractor and requires the Contractor to provide the State access to such records in any contract with the subcontractor.

D. The State reserves the right to have access to all workpapers produced in connection with audits made by the Contractor or by independent certified public accountants or licensed public accountants hired by the Contractor to perform such audits.

XX. Record Retention

A. The Contractor shall retain financial records, supporting documents, statistical records, and all other records in the contractor's financial management system or otherwise pertinent to this contract (a) for a period of five (5) years from the date of last payment under this contract or the State's record retention schedule, whichever is later, or (b) for such longer period as any applicable State or federal statute may require, with the qualifications stated below.

1. If any litigation, claim, or audit is started before the end of the five-year period, the records shall be retained until all litigations, claims, or audit findings involving the records have been resolved.

2. Records for nonexpendable property acquired with State funds shall be retained for five (5) years after its final disposition.

B. The State may request transfer of certain records to its custody from the Contractor when it determines that the records possess long term retention value and will make arrangements with the Contractor to retain any records that are continuously needed for joint use.

XXI. Approvals and Authorizations

A. Unless specifically stated otherwise, wherever this contract requires the approval or authorization of the Department, that approval or authorization must be given in writing by the Commissioner of the Department, by the authorized delegate who signed this contract, or by said delegate's successor or superior, if any.

B. If the Contractor is a municipal or county government agency, the Contractor must submit with this contract a copy of an ordinance or resolution, duly enacted by the governing body of that municipal or county government agency or of the municipality or county and authorizing execution of this contract. If the Contractor is a corporation, the Contractor must submit with this contract a corporate resolution, duly adopted by its board of directors, board of trustees, or equivalent governing body, and authorizing execution of this contract. The Department will not make any payments until such ordinance or resolution is received.

C. If the Contractor is a corporation or partnership, the Contractor must submit with this contract a disclosure of the names and addresses of any persons who own 10% or more of the firm's stock or interest, in accordance with N.J.S.A. 52:25-24.

D. If the Contractor is a corporation incorporated outside of New Jersey, the Contractor must, as a condition of payment hereunder, obtain a certificate of authority to do business in New Jersey from the Department of the Treasury and file a copy of that certificate with the Contract Officer designated in Section IX of Attachment A, Additional Provisions and Special Modifications.

E. If the Contractor is neither a government agency nor a corporation and if the Contractor has neither a residence nor a place of business in New Jersey, the Contractor hereby irrevocably appoints the Commissioner of the Department to receive process in any civil action which may arise out of or as a result of this contract. Within ten (10) days of receipt of any such process, the Commissioner shall transmit it by certified mail to the Contractor at the address shown in Section I of the General Terms and Conditions of this contract, Contract Award Data and Signatures.

XXI. Interest on Advance Payments and Disallowed Costs

A. Advance Payments: The Contractor is required to deposit any advance payments received hereunder in an interest bearing account. Any interest up to $100 per year may be retained by the Contractor for documented administrative expenses. If this contract is federally funded, any interest above $100 per year must be remitted on a quarterly basis to the Department for return to the federal government. If this contract is funded by the State, interest above $100 per year may be retained by the Contractor for purposes of this contract or shall be remitted to the Department as indicated in Section XI of Attachment A, Additional Provisions and Special Modifications.

B. Disallowed Costs: Where the Contractor has been reimbursed by the Department for costs which are subsequently disallowed by the Department, the Contractor shall return the funds to the Department no later than thirty (30) days after the request. Where the Contractor fails timely to return the funds or appeals the disallowed costs, an interest charge as indicated in Section XI of Attachment A, Additional Provisions and Special Modifications, shall be charged on the funds beginning thirty (30) days from the date the Contractor was notified of the debt. If the Contractor is successful on appeal, the accrued interest will be canceled.

XXIII. Miscellaneous Provisions

A. Governing Law: It is agreed and understood that this contract shall be governed and construed, and the rights and obligations of the parties hereto shall be determined, in accordance with the laws of the State of New Jersey including but not limited to the Contractual Liability Act, N.J.S.A 59:13-1 et seq.

B. Conflict of Terms: In the event of any conflict, the order of precedence shall be (1) the terms and conditions of this Contract; (2) any State Agency application form or specific correspondence describing the Project and/or soliciting a Contractor proposal; and (3) the contractor's proposal (D-2).

NOTE: The only exception to the above is that consistency with rules and regulations promulgated pursuant to the State Program's enabling legislation shall always have precedence in any conflict with the terms and conditions of this Contract.

C. Dispute Resolution: Consistent with the Contractual Liability Act, N.J.S.A 59:13-1 et seq., unless otherwise provided in this contract, all claims, counterclaims, disputes, and other matters in question between the State and the Contractor arising out of, or relating to, this contract or the breach of it will proceed as follows:

1. The dispute shall initially be submitted by either party for resolution via administrative proceedings conducted by the Department.

2. If there is no mutually agreeable resolution after administrative recourse is exhausted, the matter may then proceed to arbitration or litigation. Any litigation must be submitted to, and heard by, a court of competent jurisdiction within the State of New Jersey.

D. Performance: The Contractor warrants that it is aware of the work required to be performed under this contract, that it has the capabilities and credentials required by the contract, and that it will faithfully perform the work and abide by the terms, conditions, and other requirements of this contract.

E. Disclaimer of Agency Relationship: The contractor's status shall be that of an independent principal and not as an agent or employee of the State. Nothing contained in the contract shall be construed to create, either expressly or by implication, the relationship of agency between the State and the Contractor or its subcontractors.

F. Computation of Time: When the contract refers to a period of time in terms of days, the day of the act or event from which the designated period begins to run is not to be included. The last day of the period so computed is to be included, unless it is a Saturday, Sunday, or legal holiday, in which event the period runs until the end of the next day which is neither a Saturday, Sunday, nor legal holiday. In computing a period of time of less than seven days, Saturday, Sunday, and legal holidays shall be excluded.

G. Intellectual Property Rights: If the Contractor, in the course of its duties under this contract, develops any invention apparatus, computer program, discovery, or other intellectual property, the State will own the entire right, title and interest throughout the world to each such property right and to patents and copyrights protecting the same. The State's ownership shall be unaffected by any assignment, suspension, termination, or expiration of this contract.

H. Captions and Headings: Captions and headings used in this contract are for convenience of reference only and shall in no way be deemed to define, limit, explain, or amplify any term or provision.

I. Severability: In case any term or provision of this contract shall be held invalid, illegal, or unenforceable, in whole or in part, neither the validity of any remaining part nor the validity of any other term or provision shall in any way be affected by such holding.

J. Entire Agreement: The parties understand and agree that all prior understandings and agreements between them regarding performance of the obligations described herein are merged into this written contract which supersedes all such prior understandings and agreements. Neither party enters into this contract in reliance on any statement nor representation of the other which is not reiterated herein, or incorporated herein by reference.

K. Successor and Assigns: This contract shall be binding upon any successors or assigns of the Contractor. The State may, in its sole discretion, reject any proposed successor or assign of the Contractor.

L. Counterparts: This contract may be executed in multiple counterparts, each of which shall constitute an original instrument and all of which taken together shall constitute one and the same instrument.

M. Notices: All notices, certificates, and other documents (a "notice") to be given by one party to the other shall be in writing and shall be delivered to the other party. Any such notice shall be delivered to the address of the Contractor or

the Contracting Agency shown in Section I, Contract Award Data and Signatures, by overnight courier service or by regular first class, certified, or registered mail, postage prepaid. If mailed, said notice shall be deemed to have been received five (5) days after its deposit in the United States Mail; and if given otherwise, said notice shall be deemed to have been received when delivered to the party to whom it is addressed.

N. Waiver of Breach: The waiver by either party of any breach of this contract shall not be deemed a waiver of any subsequent breach of the same or any other term or provision.

O. Gender and Number: Use of the singular or plural includes the other and use of any gender includes all genders, as the context requires or permits.

P. Waiver of Jury Trial: In the event of litigation, Contractor waives any right it may have to a trial by jury.

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005
ADDITIONAL PROVISIONS AND SPECIAL MODIFICATIONS

This Attachment A adds the terms, conditions, requirements, and provisions specified in Sections I through XI below, and makes the modifications specified in Section XII below, to the preceding General Terms and Conditions of the contract between New Jersey Institute of Technology and the State of New Jersey, by and for the DEP.
(print Contractor's name)

I. Insurance (See Section III of the General Terms and Conditions of this contract, Insurance.)

A. The Contractor maintains and must continue to maintain the required insurance coverages as follows:

1. commercial general liability
   - ☒ insurance
   - ☐ self insurance
   - ☐ not required
2. automobile liability
   - ☒ insurance
   - ☐ self-insurance
   - ☐ not required
3. worker's compensation
   - ☒ insurance
   - ☐ self-insurance
   - ☐ not required
4. employer's liability
   - ☒ insurance
   - ☐ self-insurance
   - ☐ not required

B. Certificates of insurance or documentation of self-insurance

- ☐ is on file with the Department.
- ☒ will be forthcoming within 30 days after the effective date of this contract.
- ☐ other (explain) _____.

NOTE: No payment can be made until the Department has received acceptable documentation of these required coverages.

II. Availability of Funds (See Section VI of the General Terms and Conditions of this contract, Availability of Funds.)

Based upon funds available to the Department in the State's fiscal year, the contract (the sum of the State, the federal, and if through the State treasury, the other amounts, shown as components of the Total Project Amount in Section I of the General Terms and Conditions of this contract, Contract Award Data and Signatures) is

- ☒ fully funded.
- ☐ partially funded in the amount of $_____.
- ☐ not applicable.

III. Method of Payment (See Section IX of the General Terms and Conditions of this contract, Method of Payment.)

A. Advance payment, if justified and itemized in Attachment B-2, Approved Advance Payment, is
- ☐ authorized for $_____.
- ☒ not applicable.

B. Progress payments
- ☐ shall be made on a _____ (e.g. mo./qtr./deliverable) basis for $ _____ per payment.
- ☒ shall be based on actual expenditures submitted on a qtr (e.g. mo./qtr.) basis accompanied by ☐ receipts ☒ computer printouts.
- ☐ shall be made on submission of deliverables in accordance with the project specifications and requirements.
- ☐ are not applicable.

C. Final payment of _____
(amount or description)
- ☐ shall be withheld pending receipt of all final reports.
- ☒ is not applicable.
- ☐ (other, specify) _____.

NOTE: No payment can be made unless a proper state invoice is submitted with appropriate justification, receipts, etc. and unless any required expenditure and performance reports are submitted.

IV. Matching and Cost Sharing Requirements (See Section X of the General Terms and Conditions of this contract, Matching and Cost Sharing Requirements.)

- ☐ The Contractor shall provide the matching or cost sharing amounts indicated in Section I of the General Terms and Conditions of this contract, Contract Award Data and Signatures, and described further in Attachment B, Approved Project Budget.
- ☒ Matching and cost sharing requirements do not apply.

V. Project Income (See Section XI of the General Terms and Conditions of this contract, Project Income.)

A. Royalties, if any, received as a result of copyrights or patents produced under this contract shall be
- ☐ paid to the Department.
- ☐ retained by the Contractor.
- ☒ not applicable.

B. Other project income, if any, as defined in Section XI of the General Terms and Conditions of this contract, Project Income, shall be
- ☐ added to funds committed to the project by the Department and used to further eligible project objectives.
- ☐ deducted from the total project costs for the purpose of determining the net costs on which the Department shall base contract payments.
- ☐ paid to the Department.
- ☐ retained by the Contractor.
- ☒ not applicable.

VI. Certification of Adequacy of Accounting System (See Section XII of the General Terms and Conditions of this contract, Financial Management System.)

A. A statement attesting to the adequacy of the Contractor's accounting system in accordance with the standards set forth in Section XII of the General Terms and Conditions of this contract, Financial Management System,
- ☒ must be completed, on Attachment G, Statement of Adequacy of Accounting System, by the Chief Financial Officer identified in Section I of the General Terms and Conditions of this contract, Contract Award Data and Signatures.
- ☐ is not required.

B. Financial reports shall be prepared in a manner consistent with the Contractor's normal accounting records, which are kept on
- ☐ a cash basis.
- ☒ an accrual basis.
- ☐ modified accrual basis.
- ☐ (other, specify) _____.

VII. Financial and Performance Reporting (See Section XIII of the General Terms and Conditions of this contract, Financial and Performance Reporting.)

A. All financial reports must be certified by the Chief Financial Officer.

B. Interim expenditure reports, including a completed copy of Attachment C, Expenditure Report, shall be submitted

☐ on a quarterly (e.g. mo./qtr.) basis, no later than 30 days immediately following the end of the period.
☒ (other, specify) with progress payments, but no later than the due date of the final expenditure report.

C. Performance reports shall be submitted on a quarterly (e.g. qtr./annual) basis. These reports should be submitted no later than 30 days after the end of each reporting period.

D. A final expenditure report, including a completed copy of Attachment C, Expenditure Report, and a final performance report shall be submitted by the Contractor no later than 90 days after the Contractor's completion of all contract tasks, the expiration date of this contract, or the termination of this contract, whichever first occurs.

VIII. Audit Requirements (See Section XV of the General Terms and Conditions of this contract, Audit Requirements.)

A. Under the federal Single Audit Act or the State Circular Letter 04-04-OMB,

☒ this contract is subject to a single audit and will be audited as such on Contractor's fiscal year.
☐ this contract is not subject to a single audit and shall be audited as indicated in paragraphs B and C below.

B. If this contract is not subject to a single audit under paragraph A above,

☐ the contract shall otherwise be audited at the end of the work period.
☒ the contract may otherwise be audited at the Department's discretion up to five years after the Contractor's last payment.

C. If this contract is audited under paragraph B above, the audit shall be conducted by

☒ State auditors.
☐ Department internal auditors.
☐ a CPA firm appointed by Department.
☐ a CPA firm chosen by the Contractor.
☒ (other, specify) At the discretion of the Department.

D. The Department's records show the Contractor's fiscal year ends on 6/30. The Contractor shall notify the Department immediately if this date is incorrect or is changed.

E. Copies of all audit reports must be submitted to DEP, Office of Audit, PO Box 402, Trenton, NJ, 08625-0402 and to the Contracting Agency identified in Section I of the General Terms and Conditions of this contract, Contract Award Data and Signatures, not later than nine months after the close of the Contractor's fiscal year.

IX. Contract Amendment (See Section XVI of the General Terms and Conditions of this contract, Contract Amendment.)

All budget revisions and modifications must be submitted, in writing, to (name) John H. Moyle, (title of position) Manager or the successor to that position (the "Contract Officer").

X. Authorizations and Disclosures (See Section XXI of the General Terms and Conditions of this contract, Approvals and Authorizations.)

A. The Contractor is

☐ a local government agency.
☐ a New Jersey corporation.
☐ an out-of-state corporation.
☒ (other, specify) New Jersey Institute of Technology

B. Appended hereto as Attachment E, Governing Body Resolution or Corporate Resolution, is

☒ a governing body resolution.
☐ a corporate resolution.
☐ no resolution.

C. A Contractor's Stockholder Disclosure Statement is

☐ submitted herewith.
☒ not applicable.

D. A certificate of authority for Contractor to do business in New Jersey

☐ will be submitted.
☒ is not applicable.

NOTE: No payment can be made until the Department has received any documents required under this Section X, Authorizations and Disclosures.

XI. **Interest** (See Section XXII of the General Terms and Conditions of this contract, Interest on Advance Payments and Disallowed Costs.)

A. Interest above $100 per year on advance payment of State funds

☐ may be retained by the Contractor for documented purposes under this contract.
☐ shall be remitted to the Department on a quarterly basis.
☒ will not exist because no advance payment is authorized.
☐ (other, explain) _____.

NOTE: On federally funded grants, any interest above $100 per year must be remitted on a quarterly basis to the Department for return to the federal government.

B. Interest on payments of disallowed costs not returned within 30 days of request shall accrue in favor of the State at the rate specified in the "Notice of Intent to Collect" document (ADM-182).

XII. **Modifications to General Terms and Conditions**

The General Terms and Conditions of this contract are changed, supplemented, or deleted ("modified") as specified in this Section XII, which supersedes inconsistent terms, conditions, requirements, or provisions contained elsewhere in this contract. If all modifications do not fit on this page, the numeral "5" in the phrase "of 5" in the header of each page of this Attachment A must be changed to equal the total number of pages in this Attachment A, and each new page must be identified and successively numbered in the same manner as the first five pages.

☐ This Section XII does not contain modifications to the General Terms and Conditions of this contract.

☒ This Section XII does contain modifications to the General Terms and Conditions of this contract, and this Attachment A now comprises 5 pages.

ADDITIONAL TERMS AND CONDITIONS

Patent and Copyright Liability

The Contractor shall hold and save the State of New Jersey, its officers, agents, servants and employees, harmless from liability of any nature or kind, for or on account of the use of any copyrighted or uncopyrighted composition, patented or unpatented invention, article, or appliance furnished or used in the performance of this contract. This is in addition to and in no way limits any other indemnification provision in the contract.

Delay of Contract

The Contractor is responsible for completing the contract as required by the Scope of Services and according to any approved project work schedules. However, a project schedule may be extended for delays caused by events which could not reasonably be anticipated and which are beyond the control of the Contractor. Such causes include, but are not limited to, actions by employees or other contractors employed by the State, unanticipated work changes ordered by the State, strikes, lockouts, fire, delays caused by common carriers, unavoidable casualties, work stoppage orders and work suspension riders. The Contractor shall submit written documentation to the Project Manager in accordance with Section XVI in order to request an extension of an approved project work schedule.

Dissemination of Information

During the course of this contract and for two years following submission of an approved final report, the Contractor shall not print, publish, disclose or otherwise make known to third parties the content of any data, information, studies, computation, memoranda, graphs, reports or other material arising from this Contract without at least thirty (30) days prior written notification to the State, and without informing the State of the nature of such disclosures. The Contractor shall coordinate all such disclosures with the State and shall permit the State to preview any such disclosure prior to its release. Contractor agrees to seriously consider the comments and suggestions of the State in the final drafting of all publications.

During the above thirty day period, the State may request a delay of any disclosure for up to one (1) year, if necessary, in order to protect the public interest. If the Contractor is publishing materials that the Department has reviewed and found unsatisfactory, inadequate or unacceptable, at the request of the Department, the Contractor shall include in any publication of materials resulting from this contract a statement, conspicuously placed, that the Department finds the material inadequate or unsatisfactory, that the Department disagrees with the analyses, interpretations, or conclusions contained therein, or both.

Acknowledge/Co-Authorship

Publication by the Contractor of any work or portion of work arising from this Contract must include a written acknowledgment of the Department's assistance (e.g., financial, equipment, manpower). Also, where State employees have contributed substantive work on the project, the appropriate State employees (project manager or other significant Department participant(s)) shall be named as co-author(s) on publications arising from this Contract.

Access to Material

Unless otherwise specified in this contract, the State shall have access to all data, samples, material, evidence and documentation gathered, originated or prepared for the State by the Contractor during the performance of his contractual responsibilities for a period of three (3) years from the submission of the approved Final Report. During that time period any such data, samples, material, evidence and documentation shall be provided to the State in a reasonably timely manner upon request by the State.

Substitutions of Personnel and Subcontractors

If, during the course of the contract, the Contractor finds that he cannot provide the personnel or subcontractors identified in this contract, and desires to substitute personnel or subcontractors, the Contractor must request in writing from the Department permission to substitute personnel or subcontractors. Such request must:

1. Explain the reasons why the original persons cannot be provided;
2. Demonstrate that the qualifications of the substitution are equal to or better than the originally proposed persons; and
3. Warrant that the substitution will be provided at no additional cost to the State.

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

ACCOUNT DESCRIPTION	TOTAL BUDGET	FEDERAL	STATE	CONTRACTOR	OTHER
A. Personnel Costs Salaries	$213,242	0.00	$213,242	0.00	0.00
Fringe Benefits	$15,733	0.00	$15,733	0.00	0.00
B. Consultants and Subcontractors	$30,000	0.00	$30,000	0.00	0.00
C. Other Costs Specify below:					
▪ Travel	$5,000	0.00	$5,000	0.00	0.00
▪	0.00	0.00	0.00	0.00	0.00
▪	0.00	0.00	0.00	0.00	0.00
▪	0.00	0.00	0.00	0.00	0.00
▪	0.00	0.00	0.00	0.00	0.00
D. Audit	0.00	0.00	0.00	0.00	0.00
Subtotal Direct Costs	$263,975	0.00	$263,975	0.00	0.00
Less Program Income	0.00	0.00	0.00	0.00	0.00
Total Direct Costs	$263,975	0.00	$263,975	0.00	0.00
Indirect Costs	$25,897	0.00	$25,897	0.00	0.00
TOTAL PROJECT AMOUNT	$289,872	0.00	$289,872	0.00	0.00

TOTAL CONTRACT AMOUNT is ☒ the sum of "Federal" and "State" column totals $289,872
☐ the sum of "Federal" "State" and "Other" column totals $0.00

The sums identified in the "Total Budget" column are itemized and justified in (check one or more as appropriate)

☐ Attachment D, Scope of Services, on page(s) _____.
☒ Attachment D-2, Contractor's Proposal, on page(s) _____.
☐ Attachment B-1, Itemization and Justification of Budget, comprising _____

GRANT AGREEMENT
BETWEEN

(Name of Grantee)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

GRANT IDENTIFIER:

ADDITIONAL FEDERAL FUNDED AGREEMENT PROVISIONS

I. Debarment and Suspension

The Grantee (Loan Recipient or Contractor) shall fully comply with Executive Order 12549 as implemented in federal regulation entitled *GOVERNMENTWIDE DEBARMENT AND SUSPENSION (NONPROCUREMENT*, 2 CFR Part 180, Subpart C - *Responsibilities of Participants Regarding Transactions (Doing Business with Other Persons)* and the applicable Federal agency Common Rule regulations found in http://www.whitehouse.gov/omb/grants/chart.aspx. The Grantee (Loan Recipient or Contractor) is responsible for ensuring that any lower tier covered transaction as described in Subpart B of 2 CFR Part 180 and the applicable Federal agency Common Rule regulations, entitled "Covered Transactions," includes a term or condition requiring compliance with Subpart C. The Grantee (Loan Recipient or Contractor) is responsible for further requiring the inclusion of a similar term or condition in any subsequent lower tier covered transactions. The Grantee (Loan Recipient or Contractor) acknowledges that failing to disclose the information as required at 2 CFR 180.355 may result in the delay or negation of this assistance agreement, or pursuance of legal remedies, including suspension and debarment.

The Grantee (Loan Recipient or Contractor) may access the Excluded Parties List System at http://www.sam.gov.

II. Restrictions on Lobbying

A. The Grantee (Loan Recipient or Contractor) agrees to fully comply with Common Rule regulations for federal agencies, *NEW RESTRICTIONS ON LOBBYING* found in http://www.whitehouse.gov/omb/grants/chart.aspx. The Grantee (Loan Recipient or Contractor) shall include the language of this provision in award documents for all subawards exceeding $100,000, and require that subrecipients submit certification and disclosure forms accordingly.

(1) No federal appropriated funds may be expended by the Grantee (Loan Recipient or Contractor) to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) The Grantee (Loan Recipient or Contractor) shall file with the Department a certification, set forth in Appendix A-1-A, that the Grantee (Loan Recipient or Contractor) has not made, and will not make, any payment prohibited by paragraph (1) of this section.

(3) The Grantee (Loan Recipient or Contractor) shall file with the Department a disclosure form, set forth in Appendix A-1-B, following instructions contained in the Common Rule regulations for federal agencies, *NEW RESTRICTIONS ON LOBBYING* found in http://www.whitehouse.gov/omb/grants/chart.aspx, if the Grantee (Loan Recipient or Contractor) has made or has agreed to make any payment using non-federal funds which would be prohibited under paragraph (1) of this section if paid for with federal funds.

B. In accordance with the Byrd Anti-Lobbying Amendment, any recipient who makes a prohibited expenditure under the *NEW RESTRICTIONS ON LOBBYING* Common Rule regulations or fails to file the required certification or lobbying forms shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such expenditure.

III. Compliance with the Civil Rights Act of 1964

A. The Grantee (Loan Recipient or Contractor) must comply with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, the Age Discrimination Act of 1975, and a variety of program-specific statutes with non-discrimination requirements.

B. Other civil rights laws may impose additional requirements on the Grantee (Loan Recipient or Contractor) to which the Grantee (Loan Recipient or Contractor) must comply. These laws include, but are not limited to, Title VII of the Civil Rights Act of 1964 (prohibiting race, color, national origin, religion, and sex discrimination in employment), the Americans with Disabilities Act (prohibiting disability discrimination in employment and in services provided by State and local governments, businesses, and nonprofit agencies), and the Fair Housing Act (prohibiting race, color, national origin, age, family status, and disability discrimination in housing), as well as any other applicable civil rights laws.

IV. Trafficking Victim Protection Prohibition Statement

A. To implement requirements of Section 106 of the Trafficking Victims Protection Act of 2000, as amended, and the requirements contained in federal regulation 40 CFR Part 175, *TRAFFICKING IN PERSONS*, the Department may unilaterally terminate this award, without penalty, if a subrecipient that is a private entity fails to comply with these requirements. The Grantee (Loan Recipient or Contractor) must inform the Department immediately of any information received from any source alleging a violation of a prohibition in the Prohibition Statement below.

B. The Grantee (Loan Recipient or Contractor) must include the requirements of the Prohibition Statement below in any subaward you make to a private entity.

Prohibition Statement - You as the recipient, your employees, subrecipients under this award, and subrecipients' employees may not engage in severe forms of trafficking in persons during the period of time that the award is in effect; procure a commercial sex act during the period of time that the award is in effect; or use forced labor in the performance of the award or subawards under the award.

V. National Environmental Policy Act (NEPA)

The Grantee (Loan Recipient or Contractor) shall not begin any implementation work under this Agreement until the required environmental review process, if applicable, is completed in compliance with the National Environmental Policy Act (NEPA), 42 United States Code 4321, et seq., its implementing regulations 40 CFR Part 1500-1508, and other applicable federal agency NEPA requirements.

VI. Eligible Workers

A. The grantee shall ensure that all employees of the Grantee and the Grantee's contractors funded under this agreement complete the I-9 form to certify that they are eligible for lawful employment under the Immigration and Nationality Act (8 USC 1324a). The Grantee and the Grantee's contractors shall comply with the regulations regarding certification and retention of he completed forms. These requirements also apply to any contract or supplemental agreement under this agreement.

B. The Grantee agrees to make these forms available in accordance with the access to records and record retention provisions of this agreement.

VII. Requirement for Data Universal Numbering System (DUNS) number

As a condition of this agreement, the Grantee (Loan Recipient or Contractor) must provide to the Department its Data Universal Numbering System (DUNS) number. A DUNS number means the nine-digit number established and assigned by Dun and Bradstreet, Inc. (D&B) to uniquely identify business entities. A DUNS number may be obtained from D&B by telephone (currently 866-705-5711) or the internet (http://fedgov.dnb.com/webform). No Grantee (Loan Recipient or Contractor may receive a subaward unless this number is provided below:

Grantee (Loan Recipient or Contractor) DUNS Number _____

GRANT AGREEMENT
BETWEEN

(Name of Grantee)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

GRANT IDENTIFIER:

CERTIFICATION REGARDING LOBBYING

CERTIFICATION FOR CONTRACTS, GRANTS, LOANS, AND COOPERATIVE AGREEMENTS

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying" in accordance with its instructions. (Appendix A-1-B)

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352 , title 31 U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

_____
Typed Name & Title of Authorized Representative

_____ _____
Signature of Authorized Representative Date

DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbing activities pursuant to 31 U.S.C. 1352
(See reverse for public burden disclosure.)

Approved by OMB
0348-0046

1. Type of Federal Action:	2. Status of Federal Action:	3. Report Type:
_____ a. contract b. grant c. cooperative agreement d. loan e. loan guarantee f. loan insurance	_____ a. bid/offer/application b. initial award c. cooperative agreement	_____ a. Initial filing b. material change **For Material Change Only:** year _____ quarter _____ date of last report _____

4. Name and Address of Reporting Entity:	5. If Reporting Entity in No. 4 is a Subawardee, Enter Name and Address of Prime
☐ Prime ☐ Subawardee Tier _____, *if known*: **Congressional District,** *if known*: 4c	 **Congressional District,** *if known*:
6. Federal Department/Agency	**7. Federal Program Name/Description:** **CFDA Number,** *if applicable:* _____
8. Federal Action Number, *if known*:	**9. Award Amount,** *if known*: $
10. a. Name and Address of Lobbying Registrant (*if individual, last name, first name, MI*):	**b. Individuals Performing Services** (*including address if different from no. 10a)* (*last name, first name, MI*):
11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbing activities is a material representation of fact upon which reliance was placed by the tier above when this transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each failure.	Signature: _____ Print Name: _____ Title: _____ Telephone No.: _____ Date: _____
Federal Use Only:	Authorized for Local Reproduction Standard Form LLL (rev. 7-97)

INSTRUCTIONS FOR COMPLETION OF SF-LLL, DISCLOSURE OF LOBBYING ACTIVITIES

This disclosure form shall be completed by the reporting entity, whether subawardee or prime Federal recipient, at the initiation or receipt of a covered Federal action, or a material change to a previous filing, pursuant to title 31 U.S.C. section 1352. The filing of a form is required for each payment or agreement to make payment to any lobbying entity for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a covered Federal action. Complete all items that apply for both the initial filing and material change report. Refer to the implementing guidance published by the Office of Management and Budget for additional information.

1. Identify the type of covered Federal action for which lobbying activity is and/or has been secured to influence the outcome of a covered Federal action.

2. Identify the status of the covered Federal action.

3. Identify the appropriate classification of this report. If this is a followup report caused by a material change to the information previously reported, enter the year and quarter in which the change occurred. Enter the date of the last previously submitted report by this reporting entity for this covered Federal action.

4. Enter the full name, address, city, State and zip code of the reporting entity. Include Congressional District, if known. Check the appropriate classification of the reporting entity that designates if it is, or expects to be, a prime or subaward recipient. Identify the tier of the subawardee, e.g., the first subawardee of the prime is the 1st tier. Subawards include but are not limited to subcontracts, subgrants and contract awards under grants.

5. If the organization filing the report in item 4 checks "Subawardee," then enter the full name, address, city, State and zip code of the prime Federal recipient. Include Congressional District, if known.

6. Enter the name of the federal agency making the award or loan commitment. Include at least one organizational level below agency name, if known. For example, Department of Transportation, United States Coast Guard.

7. Enter the Federal program name or description for the covered Federal action (item 1). If known, enter the full Catalog of Federal Domestic Assistance (CFDA) number for grants, cooperative agreements, loans, and loan commitments.

8. Enter the most appropriate Federal identifying number available for the Federal action identified in item 1 (e.g., Request for Proposal (RFP) number; Invitations for Bid (IFB) number; grant announcement number; the contract, grant, or loan award number; the application/proposal control number assigned by the Federal agency). Included prefixes, e.g., "RFP-DE-90-001."

9. For a covered Federal action where there has been an award or loan commitment by the Federal agency, enter the Federal amount of the award/loan commitment for the prime entity identified in item 4 or 5.

10. (a) Enter the full name, address, city, State and zip code of the lobbying registrant under the Lobbying Disclosure Act of 1995 engaged by the reporting entity identified in item 4 to influence the covered Federal action.

    (b) Enter the full names of the individual(s) performing services, and include full address if different from 10(a). Enter Last Name, First Name, and Middle Initial (MI).

11. The certifying official shall sign and date the form, print his/her name, title, and telephone number.

According to the Paperwork Reduction Act, as amended, no persons are required to respond to a collection of information unless it displays a valid OMB control Number. The valid OMB control number for this information collection is OMB No. 0348-0046. Public reporting burden for this collection of information is estimated to average 10 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0046), Washington, DC 20503

GRANT AGREEMENT

BETWEEN

(Name of Grantee)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

GRANT IDENTIFIER:

ADDITIONAL FEDERAL FUNDED AGREEMENT PROVISIONS

FEDERAL FUNDING ACCOUNTABILITY AND TRANSPARENCY ACT (FFATA)

FEDERAL FUNDED AGREEMENTS OF $25,000 OR GREATER

I. Federal Funding Accountability and Transparency Act (FFATA)

A. The Grantee (Loan Recipient or Contractor) agrees to obtain a Data Universal Numbering System (DUNS) number that will represent a universal identifier for all federal funding assistance. DUNS numbers can be obtained from Dun and Bradstreet http://fedgov.dnb.com/webform/.

B. The Grantee (Loan Recipient or Contractor) agrees to register with the Central Contractor Registration (CCR)/System for Award Management (SAM) and to maintain current registration at all times during which this agreement is active or under consideration by the Department. Register at http://www.sam.gov/.

C. The Grantee (Loan Recipient or Contractor) agrees to submit a signed FFATA Request Form set forth in Appendix A-2 as a condition of this Agreement including Total Compensation of Subrecipient Executives if applicable as set forth below:

Reporting of Total Compensation of Subrecipient Executives.

1. Applicability and what to report. You shall report the names and total compensation of each of your five most highly compensated executives for your preceding completed fiscal year, if --

i. in the preceding fiscal year, you received—

(A) 80 percent or more of your annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR 170.320 (and subawards) (Check One ☐ Yes ☐ No); and,

(B) $25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts), and Federal financial assistance subject to the Transparency Act (and subawards) (Check One ☐ Yes ☐ No); and

ii. The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at http://www.sec.gov/answers/execomp.htm.) (Check One ☐ Yes, if the public does not have access ☐ No)

2. If the answer to all three questions in paragraph 1. of this section is "Yes", then enter the full name and total compensation for the five highest paid individuals below:

Executive Name	Executive Compensation
1.	$
2.	$
3.	$
4.	$
5.	$

   i. If Reporting of Executive Compensation is required above, check "Yes" on the form in Appendix A-2, otherwise check "No".

3. Definitions. For purposes of this award term:

   i. Executive means officers, managing partners, or any other employees in management positions.

   ii. Total compensation means the cash and noncash dollar value earned by the executive during the recipient's or subrecipient's preceding fiscal year and includes the following (for more information see 17 CFR 229.402(c)(2)):

   a) *Salary and bonus.*
   b) *Awards of stock, stock options, and stock appreciation rights.* Use the dollar amount recognized for financial statement reporting purposes with respect to the fiscal year in accordance with the Statement of Financial Accounting Standards No. 123 (Revised 2004) (FAS 123R), Shared Based Payments.
   c) *Earnings for services under non-equity incentive plans.* This does not include group life, health, hospitalization or medical reimbursement plans that do not discriminate in favor of executives, and are available generally to all salaried employees.
   d) *Change in pension value.* This is the change in present value of defined benefit and actuarial pension plans.
   e) *Above-market earnings on deferred compensation which is not tax-qualified.*
   f) Other compensation, if the aggregate value of all such other compensation (e.g. severance, termination payments, value of life insurance paid on behalf of the employee, perquisites or property) for the executive exceeds $10,000.

Federal Funding Accountability and Transparency Act (FFATA) Request Form

New Jersey Department of Environmental Protection (NJDEP)

The NJDEP is required under the Federal Funding Accountability and Transparency Act (FFATA) to collect subrecipient information for transactions of $25,000 or greater.

Legal Name of Entity Receiving Subaward				
DUNS Number			**Parent Entity DUNS Number (if applicable)**	
Federal Agency **(see pg. 2)**	CFDA No. **(see pg. 2)**		Program Source **(to be completed by NJDEP)**	
Subaward Amount	Transaction Type (Grant/ Loan/Contract)		**REQUIRED** - Current and valid registration in Central Contractor Registration/System for Award Management (SAM) (www.sam.gov)? ☐ Yes	
Project Title (if applicable)			**REQUIRED** - Agree to maintain current and valid CCR registration at all times during which a federal subaward is active or under consideration by the NJ Dept. of Environmental Protection? ☐ Yes	
Location of Entity Receiving Award				
City	State	Zip+4	County	Congressional District
Principal Place of Performance				
City	State	Zip+4	County	Congressional District
Reporting of Total Compensation of Subrecipient Executives Required ☐ Yes ☐ No				
NAME OF AUTHORIZED REPRESENTATIVE			TITLE	
SIGNATURE OF AUTHORIZED REPRESENTATIVE			DATE	

By signing this document, the Authorized Representative attests to the information.
The NJDEP will not endorse the subaward until this form is completed and included in the agreement

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

ITEMIZATION AND JUSTIFICATION OF BUDGET

If neither Attachment D, Scope of Services, nor Attachment D-2, Contractor's Proposal, provides an itemization, explanation, and justification for the Approved Project Budget, they must be provided on this Attachment B-1, comprising _____ pages, including this page.

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

APPROVED ADVANCE PAYMENT

If Attachment A provides for an advance payment, an itemization, explanation, and justification must be provided on this Attachment B-2, comprising _____ pages, including this page.

Budget for Advance Payment

Item Description	Item Cost
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
TOTAL ADVANCE PAYMENT	0.00

% of Approved Project Budget _____

% of Total Contract Amount - ☐ Contract is Sum of Federal and State _____
☐ Contract is Sum of Federal, State, and Other _____

Justification for Advance Payment

Explain the necessity for the advance payment, how it will be spent, and why this payment must be made before Contractor's performance of its obligations under this agreement can commence.

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

EXPENDITURE REPORT: For the period beginning _____ and ending _____

ACCOUNT DESCRIPTION	APPROVED PROJECT BUDGET	PREVIOUSLY REPORTED CUMULATIVE EXPENDITURES	ACTUAL EXPENDITURES AS OF _____ (date)	CUMULATIVE EXPENDITURES	UNEXPENDED BALANCE
A. Personnel Costs Salaries	$213,242				
Fringe Benefits	$15,733				
B. Consultants and Subcontractors	$30,000				
C. Other Costs Specify below:					
▪ Travel	$5,000				
▪					
▪					
▪	0.00				
▪	0.00				
D. Audit	0.00				
Subtotal Direct Costs	$263,975				
Less Program Income	0.00				
Total Direct Costs	$263,975				
Indirect Costs	$25,897				
TOTAL PROJECT AMOUNT	$289,872				

CERTIFICATION BY CHIEF FINANCIAL OFFICER

I certify that the above expenditures for the period are accurate as stated, that all procurements for which payment is required have been made in accordance with the standards contained in this contract, and that each obligation for which an expenditure is listed arose during the work period.

Signature: _____
(Signature)

Date: _____

Name: Nancy Eng
(print name)

Title: Director, Grant and Contract Accounting

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

SCOPE OF SERVICES

The Scope of Services for this contract comprises Attachment D-2, Contractor's Proposal; any project requirements delineated in Attachment D-1, Project Requirements; and any modifications, amendments, and additions to the Contractor's proposal discussed in this Attachment D. In case of conflict among the provisions of Attachments D, D-1, and D-2, the order of priority shall be: (1) Attachment D-1, (2) Attachment D, (3) Attachment D-2. This Attachment D comprises _____ pages, including this page.

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

PROJECT REQUIREMENTS

The Contractor shall comply with the requirements set forth below, as well as any rules and regulations promulgated pursuant to the program's enabling legislation, if any, N.J.S.A._____. See N.J.A.C._____. Listed below are specific requirements, including special conditions, of the program and the project covered by this contract. This Attachment D-1 comprises 1 pages, including this page.

The Contractor shall submit a written report detailing the results of the work conducted under this contract to the Department a written report detailing the results of the investigation within six months from the effective date of this contract. If, within the duration of the project, any short-term flood reduction alternatives are identified that can be considered for immediate implementation are identified, the contractor should provide the Department with an interim report on these findings.

The Contractor shall complete all tasks identified in the Contractor's Proposal, attached hereto as Attachment D-2, to the satisfaction and subject to the approval of the Department.

The Contractor shall ensure that its selection of subcontractor complies with all applicable federal, state and local statutes, rules and/or ordinances, including but not limited to those related to public advertisement and/or bidding.

The Project Implementation Schedule set forth in the Contractor's Proposal shall be adjusted to begin on the effective date of this contract.

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

CONTRACTOR'S PROPOSAL

Contractor's project proposal, comprising 94 pages, including this page, is incorporated into this contract as this Attachment D-2. Except as modified, amended, or supplemented by Attachment D, this Attachment D-2, Contractor's Proposal, describes the assignment tasks and project work units which the Contractor shall perform and deliver pursuant to this contract.

NJIT

New Jersey's Science & Technology University

Scope of Services Proposal

Flood Mitigation Engineering Resource Center

Submitted to:

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
Office of Engineering and Construction
Trenton, NJ
Attn: Dave Rosenblatt, Administrator
John Moyle, Manager of Dam Safety and Flood Control

Submitted by:

NEW JERSEY INSTITUTE OF TECHNOLOGY
Department of Civil & Environmental Engineering
Colton Hall RM 200
University Heights
Newark, NJ 07102-1983
(973) 596-2444
Marhaba@njit.edu
Attn: Taha F. Marhaba, Ph.D, P.E., Chairman

May 23, 2013
Rev. June 18, 2013

Table of Contents

EXECUTIVE SUMMARY 1

1.0 INTRODUCTION 3

2.0 OBJECTIVES 6

3.0 SCOPE OF WORK 6

3.1 TASK 1: FLOOD EFFECT DATA GATHERING, OUTREACH AND VERIFICATION 6

3.1.1 Data Gathering 6

3.1.2 Field Verification 8

3.1.3 Geospatial Data Analysis 9

3.2 TASK 2: FEASIBILITY OF ALTERNATIVE SOLUTIONS 12

3.2.1 Range of Alternative Solutions 12

3.2.2 Structural Measures 13

3.2.3 Non-Structural Measures 20

3.2.4 Environmental Impact 22

3.2.5 Vulnerability and Risk Analysis (VRA), Risk reduction and Mitigation Strategies 24

3.3 TASK 3: HYDRAULIC MODELING 27

3.3.1 Hydraulic Analysis and Flood Storm and Modeling Capabilities 31

3.3.2 Summary of CCH2D and DSS-Wise System Capabilities 32

3.3.3 Scope of the Deployment of CCH2D-COAST/inland, and DSS-WISE 33

4.0 IMPLEMENTATION 38

5.0 DELIVERABLES 39

6.0 QUALIFICATIONS OF THE RESEARCH TEAM 40

7.0 TIME REQUIREMENTS 47

8.0 BUDGET 47

9.0 REFERENCES 49

APPENDIX A: ACCOMPLISHMENTS OF THE RESEARCH TEAM – 53

APPENDIX B: EQUIPMENT AND FACILITIES 84

EXECUTIVE SUMMARY

As the deadliest and most destructive tropical cyclone of the 2012 Atlantic hurricane season, Hurricane Sandy caused extensive damage to many communities and towns along the coast and inland. Many homes, businesses and other infrastructures along the shoreline and beach fronts were severely damaged. Some are now uninhabited and must be demolished, while others still need major repairs. In response to the request from the New Jersey Department of Environmental Protection (NJDEP) for a short-term research and studies to provide both short-term remediation and long-term solutions to protect many communities from similar future storms, the Flood Mitigation Engineering Resource (FMER) Center is proposed.

The FMER Center will be a *premier research, engineering and technology resource* for the State of New Jersey in the domain of strategic planning and response to flood analysis and mitigation needs. The main goals are to provide technical assistance to the State of New Jersey's Department of Environmental Protection to reduce the risk to which vulnerable coastal and inland populations are subject to, and also to ensure a sustainable and robust landscape in the state that supports public safety and economic development. The center will be the *nexus* between NJDEP, the public, the US Army Corps. of Engineers, the regional academic research community, and the private sector engaged in the development and implementation of innovative planning, engineering, technologies and services that support the state and its citizens in flood mitigation related issues. The FMER Center will conduct related research that complements efforts in place and supports the State of New Jersey's strategic plan. The outputs of the Center can be used to respond to regional, state and local requests to evaluate protection alternatives and develop contingency plans in quiet times, and adjust forecasts and propose mitigation measures during storm events to help support the emergency management community with information and solutions to real-time problems.

The short-term focus of the center will be to perform an investigation of alternative measures for flood mitigation in the Hackensack/Moonachie/Little Ferry area. Care will be taken to enhance rather than duplicate any on-going efforts by the US Army Corps. of Engineers and other organizations. The focus can easily include other areas (e.g., Hudson River/Hoboken and Barnegat Bay), however, the approach is portable to the other two regions and possibly others regions. The 6-month project will involve assessment of the flood impacts, and evaluation of a range of capital improvement, maintenance and operations and regulatory measures, including structural and non-structural engineering alternatives, zoning, code and system design and redundancy measures. The evaluation will include hydraulic modeling, environmental, risk and socio-economic impacts, including estimated costs.

The NJIT team brings together a unique team to help solve the listed problems through best practices, new creative solutions and not reinventing the wheel. NJIT, the state's premier technological institution, is committed to the state's needs, and in protecting public and environmental health while fostering economic development. Responsible for generating a quarter of professional engineers in the State of New Jersey, NJIT's Newark College of Engineering (NCE) has been one of the early innovators in engineering education and research,

and has gained a national reputation for graduating pioneers and leaders in various engineering fields. The majority of the faculty members in the Department of Civil and Environmental Engineering, the largest department of its kind in the state, are licensed professional engineers by the State of New Jersey and collectively have had a leadership role in numerous projects funded by the National Science Foundation (NSF), US Department of Transportation, US Environmental Protection Agency, NJ Department of Transportation, and NJDEP among others. Their expertise in design and engineering is well known, and it encompasses structural, geotechnical, environmental, hydrologic, hydraulic, transportation, and geographical information systems (GIS)/remote sensing. Many have worked with the local communities to service and advance their well-being. The NJIT team is committed to working with the NJDEP in providing the optimal solutions in support of the state's Strategic Plan.

1.0 INTRODUCTION

The NJ Flood Hazard Area (FHA) Control Act Rules N.J.A.C. 7:13, adopted on November 5, 2007, implement the New Jersey Flood Hazard Area Control Act. Unless properly controlled, development within flood hazard areas can exacerbate the intensity and frequency of flooding by reducing flood storage, increasing stormwater runoff and obstructing the movement of floodwaters. In addition, structures that are improperly built in flood hazard areas are subject to flood damage and threaten the health, safety and welfare of those who use them. Healthy vegetation adjacent to surface waters is essential for maintaining bank stability and water quality. The indiscriminate disturbance of such vegetation can destabilize channels, leading to increased erosion and sedimentation that exacerbates the intensity and frequency of flooding. The loss of vegetation adjacent to surface waters also reduces filtration of stormwater runoff and thus degrades the quality of these waters.

Devastation in the wake of Hurricane Sandy has brought to attention the vulnerability of the entire east coast and some inland areas putting a large population in coastal regions at great risk. Increase in frequency of high magnitude storm events such as Irene and Sandy has brought to attention the need for long term and effective plans to mitigate flooding in the north Atlantic coast (Figure 1).

Hurricane Sandy did a lot of damage throughout its path. It was the second most costly storm in the history of United States. Preliminary U.S. damage estimates are near $50 billion, making Sandy the second-costliest cyclone to hit the United States since 1900 (Blake et al., 2013). For example, as shown in Figure 2, half the city of Hoboken flooded and in excess of 50,000 people evacuated. A 50-foot piece of the Atlantic City Boardwalk washed away, and the National Guard was mobilized to assist throughout the state. Up to 5 feet of water was observed in the streets of Moonachie and Little Ferry as the towns were devastated by the flood of water. More than 2.6 million customers were without power for several days, and at least 37 people were killed. All this resulted in estimated damages close to $30 billion.

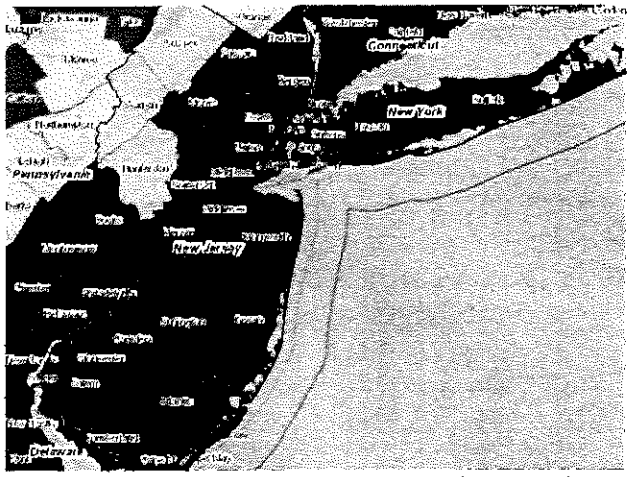


Figure 1. Sandy Impact Analysis (Purple indicates most impacted areas) (Source: FEMA)

Figure 2. National Guard in Hoboken during Hurricane Sandy Flooding

FEMA Coastal Analysis and Mapping Division has made available Hurricane Sandy Advisory Base Flood Elevations (ABFEs) Interactive Maps in New Jersey and New York. This is a very useful tool in tracking the extent at which the storm has different areas in the two states. The website also offers a lot of information on how to prepare for storms and steps to follow in case of emergency or voluntary evacuation. Some of the interactive map outputs for Newark, Jersey City, Hackensack, Little Ferry and Moonachie are shown in Figures 3-5.

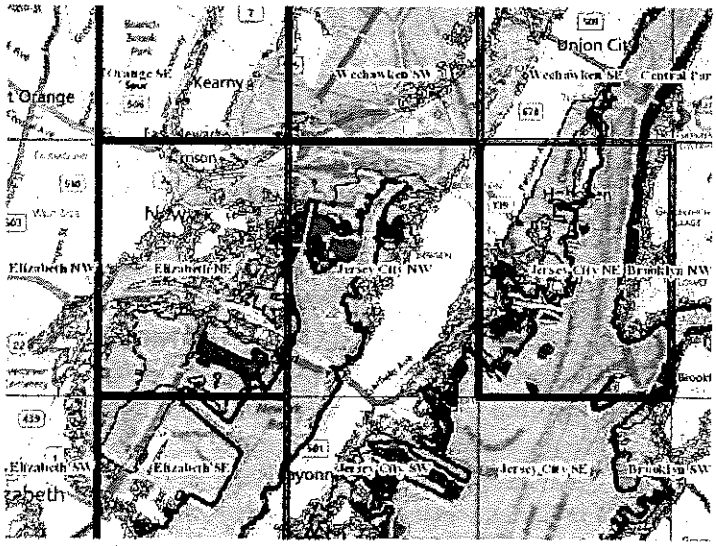


Figure 3. Advisory Base Flood Elevation Map (Interactive) – FEMA: Newark and Jersey City

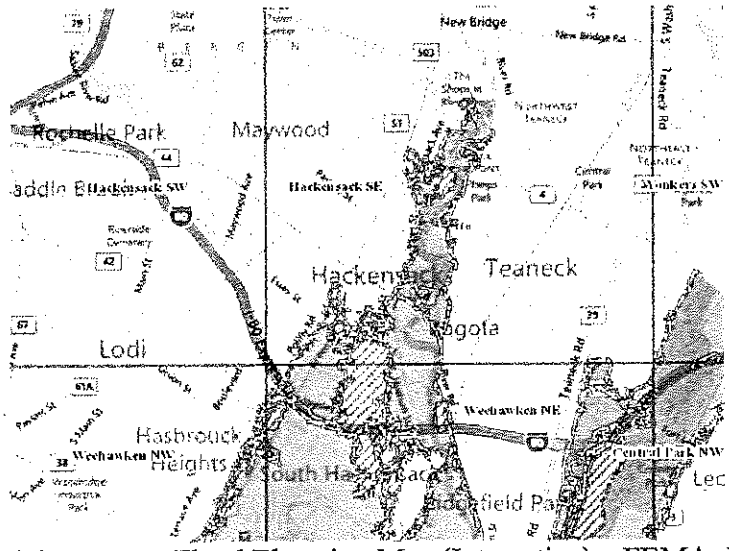


Figure 4. Advisory Base Flood Elevation Map (Interactive) – FEMA: Hackensack

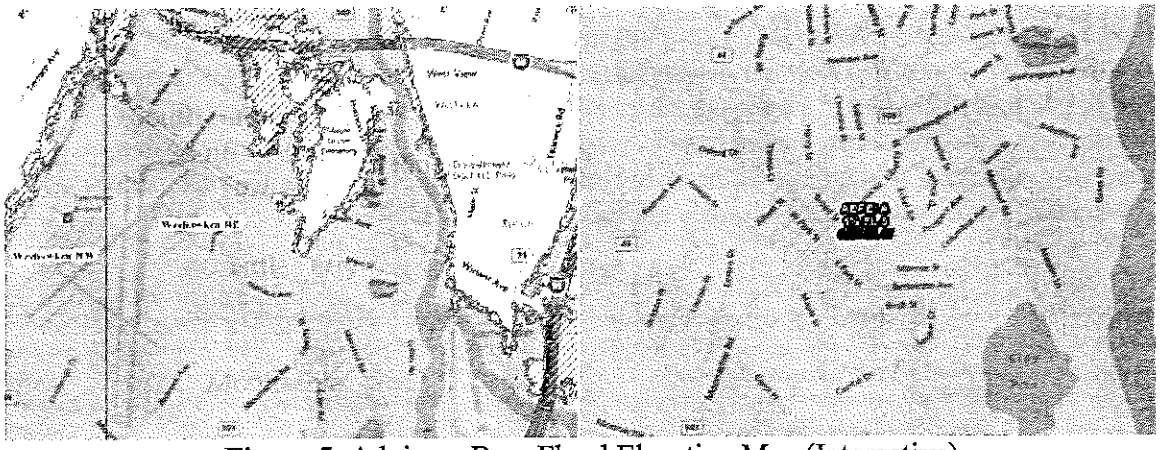


Figure 5. Advisory Base Flood Elevation Map (Interactive) –
FEMA: Little Ferry and Moonachie

The impact of Sandy on the municipalities of Moonachie, Little Ferry and Hackensack was devastating as was the situation for much of New Jersey. The Director of the Meadowlands Environmental Research Institute (MERI) called Sandy a 750 year storm event. For Moonachie and Little Ferry in particular, the streets were filled with (up to) five feet of water within a thirty-minute period. The residents needed the help of the emergency personnel to rescue them from their homes. Newspaper accounts indicated that as the result of Sandy, a thirteen-foot surge from the ocean, at Newark Bay, generated flooding conditions in the Hackensack River. This caused overtopping of the levees, which were designed to protect the community.

The damage caused by Hurricane Sandy on houses and businesses along the impacted regions was a result from damaging wind and tidal waves. Many boardwalks were damaged from these

two forces, and all floor panels were pulled off the supporting beams and piles as these structures do not have any protecting structures against these forces. This project will look into both structural and non-structural measures to protect the developed areas from future related incidences. The team will model the various alternatives and will recommend the optimal solutions taking into consideration, risk and socioeconomic impacts, among others. In addition, flooding or flooding surge after extreme hurricane often brings heavy land contamination near coastal regions. Typical contaminants include spilled oil, persistent organic pollutants (POPs), pesticides that contain endocrine disrupting compounds (EDCs), heavy metals, microbial pathogens or other invasive and infectious disease-causing species. For instance, hurricane Sandy forced the release of over 10 billion gallons of raw and partially treated sewage (90%+ of which went into waters in and around New Jersey and New York) causing significant contamination problems never before seen in the past. The team will apply our hydraulic models to environmental contamination to determine its extent in the studied region. Furthermore, we will evaluate the potential of *in situ* nanoremediation as a way to rapid eliminate these contaminations from soil or ground water (even sediment). Through this project, the team will also establish a unique connection between academic groups with public, industrial partners, and government agencies in this joint effort.

The following sections outline the objectives and scope of work in the 6-month project duration.

2.0 OBJECTIVES

The main objective is to provide the needed flood mitigation engineering solutions for the Hackensack area (including Moonachie and Little Ferry) by evaluating site-specific alternatives and recommended measures.

3.0 SCOPE OF WORK

In order to achieve the objectives, the following tasks outline the approach that will be taken during the study.

3.1 TASK 1: FLOOD EFFECT DATA GATHERING, OUTREACH AND VERIFICATION

3.1.1 Data Gathering

The purpose of this study is to gather facts from the municipalities with regard to impacts on the area and the people who reside there. The study will interview the following agencies:

- The municipal and county engineering offices.
- The Hackensack Meadowlands Development Commission that maintains the district's flood mitigation infrastructure.

- The Meadowlands Environmental Research Institute.
- The electric and natural gas utilities that service the area.
- FEMA and the U.S. Army Corps of Engineers.
- State agencies.
- Hospitals in the areas.
- Police and fire departments
- The Mayors and Freeholders in the area.
- The residents and the business people in the area.

The interviews of the above-cited agencies will give a picture of the extent of the devastation. They will also identify what solutions have been considered and the associated costs for those solutions. The plans and funding sources under consideration for all of the agencies to work together for future storms will also be investigated.

Prior to initiating the study on site, the investigators of this component of the NJIT overall study will confer with all of the members of the team. The purpose of this review is to solicit information required by the team to perform their study. This data will be compiled and forwarded to the NJIT team to formulate plans for protecting the region.

USGS Resources: http://nj.usgs.gov/hazards/flood/

USGS offers recent and historic data on water level at various locations of stream gages. It also identifies whether the level is currently at or above flood stage (identified as a black triangle) or at high flow (identified as blue circles) (see Figure 6). Tools such as comparison of current instantaneous flow to historical daily mean flow values are also available for all days of the year.

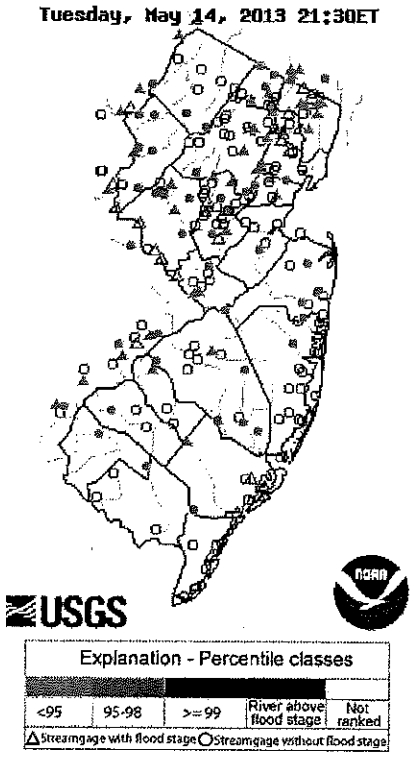


Figure 6. USGS Flood Maps

3.1.2 Field Verification

The FEMA's HAZUS-MH Hurricane Model represents an advance in the state of the art over most hurricane loss prediction models, in that it estimates wind induced loads, building response, damage, and then loss, rather than simply using historical loss data to model loss as a function of wind speed Vickery et al., (2006).

Although hydrodynamic models, e.g., FEMA's HAZUS-MH, are used extensively to quantify the physical hazard of hurricane storm surge, the connection between the physical hazard and its effects on the built environment has not been well addressed. Assessment of hurricane damage has traditionally been conducted through field reconnaissance deployments where damage information is captured and cataloged. The increasing availability of high resolution satellite and aerial imagery in the last few years has led to damage assessments that rely on remotely sensed information. Friedland (2009) evaluated suitability of using remote sensing in assessing residential building damage from hurricane storm surge at the neighborhood and per-building levels is investigated using visual analysis of damage indicators.

Identification, assessment, and documentation of flood related damage, and a review of flood mitigation and repair work is needed by the NJIT team to better understand the full extent of current conditions. This will be accomplished by contacting FEMA, insurance carriers, utilities, and town officials to review their available data. In addition faculty and student "boots on the

ground" reconnaissance teams will visit flood affected areas of Hackensack, Moonochie, and Little Ferry to identify, assess, and digitally document storm related damage to both the infrastructure and buildings. Flood related mitigation and repair work will also be documented. This information will help to more completely familiarize members of the NJIT Flood Mitigation Resource Center with the types, extent, and locations of flood damage and will serve to create a historic digital file of damage. The field documentation data will also be used to inform and educate the public and town officials about the current state of affairs in the study area and will help in identifying, prioritizing, and funding flood repair/mitigation work that still needs to be done.

3.1.3 Geospatial Data Analysis

The proposed geospatial data analysis of the Hackensack River will develop a 3-dimensional geometric model of the river channel, surface models of the "bare earth" areas that flank the riverbanks, and a predictive tide surge model. The geospatial attribute model of the river channel and the predictive storm surge model will provide important input parameters to the Hydrologic simulations for behavioral characteristics of the Hackensack River during extreme storm events. The proposed geospatial data modeling results as input for innovative Hydrologic simulation of coast-born forced surge propagation up the river will provide key technical information for engineering, environmental, cultural and social components (e.g., Forbes et al., 2010) for sustainable storm surge risk mitigation strategies.

Hydrologic modeling of the Hackensack River's response to coastal storm surge event simulation will require input of the water height at the river mouth (e.g., Tebaldi et al., 2012). The river will act as a channel that guides the tidal wave upstream and, given a certain water level, will flood the river banks with negative consequences to the social, cultural, economic and infrastructure fabric of the areas affected. Regional scale flood modeling involves integration of diverse Digital Elevation Model (DEM) for the "bare earth" surface and river bed morphology from bathymetric surveys, to constrain the modeling for discharge and flow rates (e.g., Knebi et al., 2005). The proposed hydrologic modeling will ingest high resolution gridded data for simulation runs of extreme events. Hence, data preparation for this task will include a) data mining, collection, and homogenization (to resolve geodetic datum and data resolution incompatibilities), b) develop a 3-D geometric attribute model of the river channel in the NJ State Plane Coordinate System (SPCS) and elevations relative to the North American vertical Datum of 1988 (NAVD88), and c) review historical water level time series data to parameterize a predictive storm surge water levels (e.g., Tebaldi et al., 2012) for river inundation.

This effort will concentrate on the Hackensack river basin located in Bergen County, NJ. Sound protecting and storm surge risk mitigation strategies for coastal river basin communities and assets require good geospatial data analysis and information about vulnerability to flooding. First, all the relevant geospatial data will be collected of the river and flanking areas from archived data at USGS, USACE, NOAA, and NGS to develop a DEM. Applicable dataset to acquire include

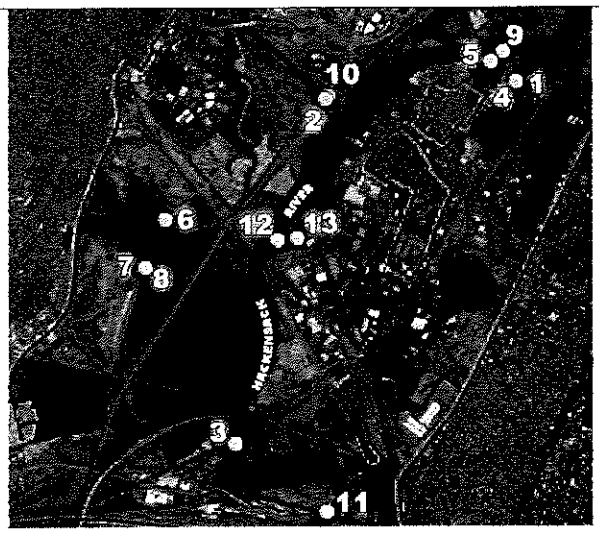
a) Digital Orthophoto quadrangle maps for visual photo interpretation
b) USGS, NOAA for Topographic DEMs – e.g., NED 30m resolution
c) Hackensack County/municipality High resolution DEM – LiDAR (1.16m resolution, vertical accuracy 3cm for "bare earth" model
d) USACE – Bathymetric profiles from single beam echo Sounder (SBES) , Multibeam (MBES), or Side Scan Sonar
e) Tide and water level gauge time series data and satellite altimetry results for the Atlantic coast
f) NJDEP land use maps

The following approach will be taken for data mining and homogenization, determining the geometric attributes, and storm surge amplitude:

Data Mining and Homogenization

For the quick-look feasibility study, the geospatial data analysis for the storm surge risk mitigation strategies will include a reconnaissance–type investigation using coarse resolution geospatial data to produce a 3-dimensional geometric model of the river channel, a surface model (DEM) of the flanking areas to predict the flooding extent during an extreme storm event, and a predictive model for ocean-borne surge propagation up the river. Preliminary results will provide useful indicators on the potential for success of rigorous and detail analysis using high resolution and accurate geospatial data.

Figure 7 is aerial image that shows the part of the Hackensack River area including the civil infrastructure along the river backs. The numbered dots indicate the tide station gauge - time series were processes by woodhol6 group over two 19-year tidal epochs up to the year 2001 (WHG, 2007). Existing continuous data recording of stream flow and water elevation is maintained by the USGS National Water System and the data is publically available via website (USGS:NWIS)



Tide Gauge Stations along Hackensack River

1. Mill Creek (old)	8. Harrier Meadow Zone 2 (Tidal)
2. Berry's Creek Canal (old)	9. Mill Creek (New & Current)
3. Hackensack River (Riverbend)	10. Berry's Creek Canal (New & Current)
4. Mill Creek Point	11. Hackensack River (Kearny, New & Current)
5. Secaucus High School Creek	12. Anderson 1 (River)
6. Harrier Meadow (Outer Bay)	13. Anderson 3 (Creek)
7. Harrier Meadow Zone 1 (Impoundment)	

Figure 7. Hackensack River tide gauge locations and civil infrastructure

Geometric Attributes of the Hackensack River

The team will integrate the NED DEM with Orthophoto in a GIS overlay to extract the coordinates of the river banks. The minimum data will be extracted and generalized to fit the planimetric position of the river's banks. The data will be reduced to the NAVD88 as needed.

Bathymetric prolife will be used to generate riverbed morphology. Bathymetric data relative to the Tidal datum of MLLW will be converted to NAVD88 (the national vertical datum). The morphologic model will provide estimates of the channel roughness (Manning n) for the storm surge simulation. The NAVD88 is an Orthometric datum (an implied gravity-based elevation datum) and hence, appropriate for hydrologic modeling for overland storm surge events. The river bed morphology combined with the "bare earth" DEM of the river banks and the surrounding regions will provide the necessary 3-D model of the river channel for the Hydrologic simulation. The river channel model will be used in the river response to storm surge events using the HEC simulation modeling approach. Moreover, the surface roughness parameters of the river channel can be deduced from the 3-D geospatial data model.

The 3-D geometric attribute model of the river channel, given in the New Jersey SPCS and height to relative to NAVD88, will be convenient for considerations in the design of flood mitigation strategies as well as design constrained on civil and non-civil infrastructure components.

Storm Surge Amplitude

The team will use time series (hourly, daily, and monthly records from tide gauge stations distributed along the coasts, in the Newark Bay, and up the river to evaluate location-specific storm surge amplitude propagation during Irene and Sandy. For all available stations, we analyze the time series of observed water levels and predicted ones (i.e. produced by the National Oceanic and Atmospheric Administration (NOAA)) based only on tides and seasonal cycle. The proposed plan is to use detailed records from all available data periods up to the present time from the water level gauges and satellite altimetry to elicit historic patterns of extreme high water events, combine these statistics with anticipated relative sea level change along the Atlantic coast, and then to project (changing) local extremes into the future. Comparison of the tide gauge and altimetry-derived sea level change of the North Atlantic and the NY and Newark bay will provide will stabilize long term sea level trends in this area. The results will serve as key parameters for the hydrologic simulation for new insights on the River's response to future extreme surge events.

3.2 TASK 2: FEASIBILITY OF ALTERNATIVE SOLUTIONS

3.2.1 Range of Alternative Solutions

Protective and adaptive alternative solutions that will be considered by this study include three categories: maintenance & operations, capital investments and regulatory. Maintenance and operation type strategies include such measures as sandbagging, portable pumps, temporary flood gates and the cleaning of drainage systems. Capital investments are permanent or mobile adjustable improvements and include installation of new fixed or adjustable flood barriers (e.g. proposed structural measures below); designing and building new green infrastructure and storage facilities (see non-structural measures below), elevating elements of critical infrastructure to levels above projected flood elevations; relocation of critical facilities to higher ground, and designing new assets for quick restoration after an extreme event. Regulatory strategies include modification of city building codes and system level and component-level design standards. For example, system-level engineering redundancy such as the interconnection of electric sub-stations can prove to be invaluable during or in the aftermath of a major Storm, when one sub-station fails. Our multi-disciplinary team is uniquely qualified to address and evaluate the range of alternative solutions including those presented below from an integrated effectiveness, cost-benefit and risk/vulnerability standpoint.

3.2.2 Structural Measures

3.2.2.1 Temporary Structures

Inland areas in New Jersey such as those in Little Ferry are subjected to the effects of floods and tides (FloodWatch, 2013). Recent storms such as Sandy have caused devastating effects in such localities. Since these areas are heavily built-up, the extent of damage is significant. In this proposal, a structural solution to mitigate such effect is proposed.

Most mitigating effects in similar inland areas such as the Tennessee Valley Authority (TVA) in USA and the Damodar Valley Corporation (DVC) in India consist of erecting dams and harnessing the energy by hydroelectric projects (Transcript of Tennessee Valley Authority Act,1933; DVC Act, 1948). Such practices do not lend themselves for application to our area of concern since there is no place for water to be impounded and/or discharged due to the highly developed nature of the region under consideration. Also the mitigating measures should take into account environmental and aesthetic considerations. The solution proposed here is based on floating dams to temporarily impound the flood waters (Floating dams, 2012) and tidal turbines to dissipate the energy from tides. Please see following figures (8, 9 and 10) of floating dam and tidal turbines (Tide Turbines, 2012).

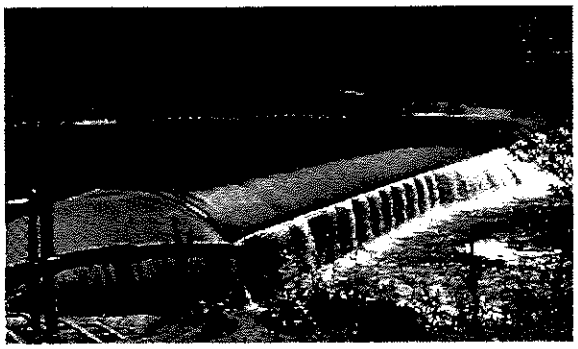


Figure 8. Floating Dam

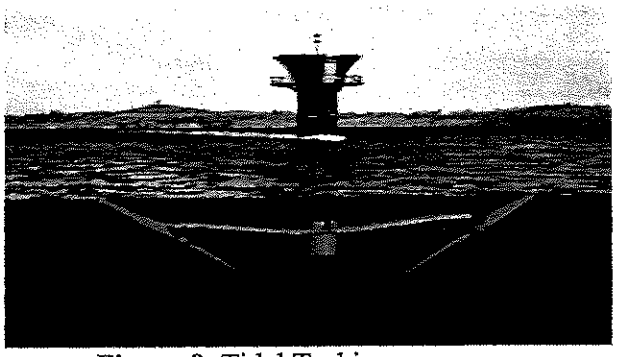


Figure 9. Tidal Turbine

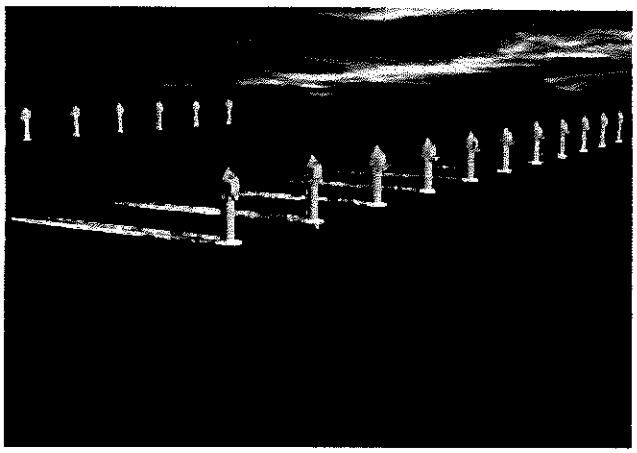


Figure 10. Arrangement of Tidal Turbines

3.2.2.2 Technical Application – A proposed alternative - Example 1

This conceptual mitigation scheme is proposed to address the quantity of water flowing and the tidal energy created during the storm. The above scheme will be incorporated in judiciously selected locations along the banks of the river based on the results of hydrological analysis of flood. Details are shown in Figure 11. Sheet piles will be driven to support about 5 to 7 feet of steel plating. (Tides are about 7 to 10 ft high; I will have to check this out). Depth of sheet piles will be about 15 to 20 ft below the riverbed. Theses heights can be adjusted based on the results of flood studies to be conducted as part of this research effort. Before the expected storm, steel plates about 7 to 10 ft high will be bolted to the sheet piles. They will be removed after the floods recede. The length of each section of steel plate will be based on the size and type of hoisting equipment. Prior to the storm, inflatable balloons (pontoons) will be stretched across the sheeting as shown in the figure. They will be removed after the storm event. Tide turbines will be located near the inflatable balloons to dissipate the energy from tides. The gaps between the sheeting will be filled with lean concrete to prevent water escaping through them as shown in the following Figure. All features except steel sheeting are temporary. Sheeting may project only a foot or so above the riverbed. No views will be obstructed. A temporary tidal basin may be created by this scheme. Tide turbines will harness energy from the water in the basin. Power gets knocked out during storms. Energy generated from tides, though not significant, can be used for emergency and essential services.

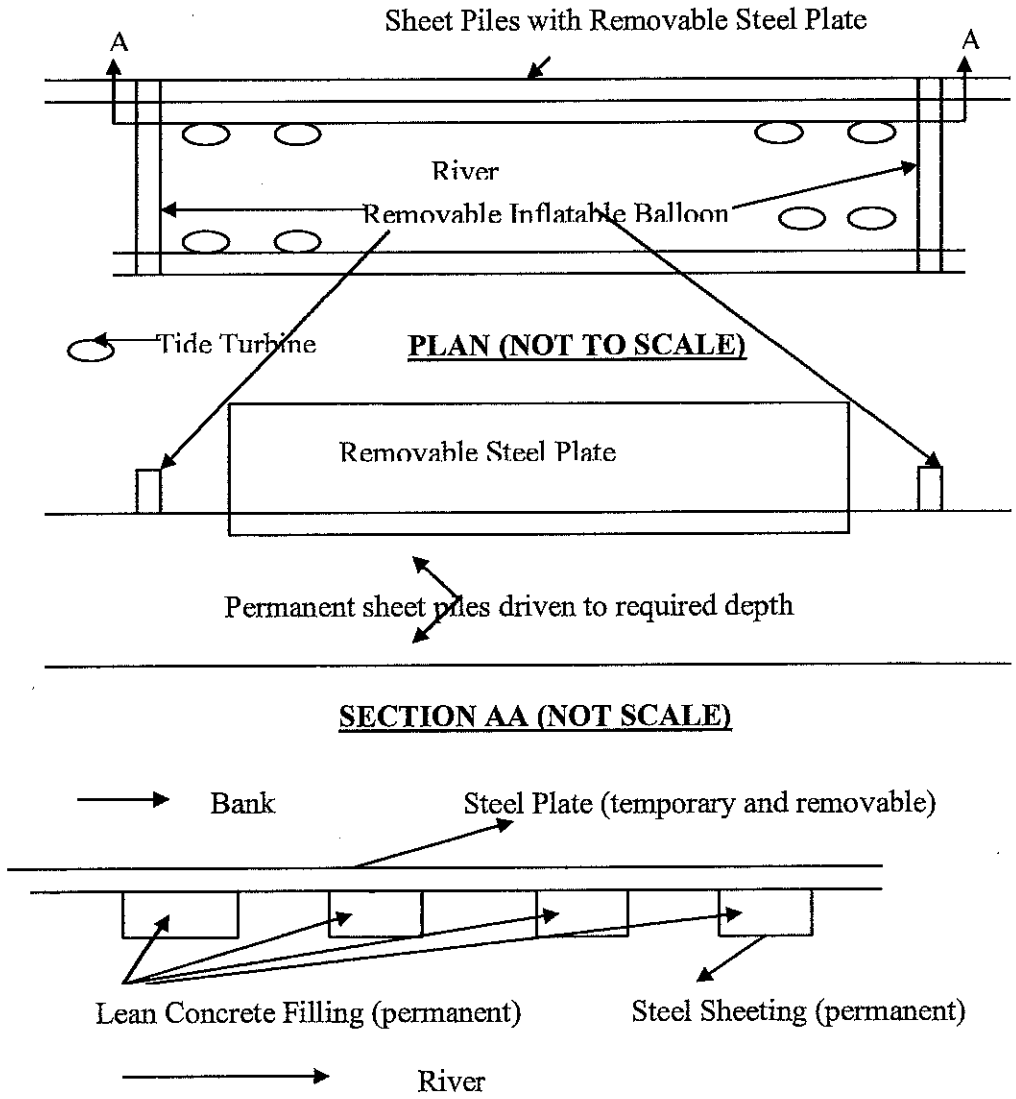


Figure 11. Detail showing steel sheeting and steel plate

3.2.2.3 Technical Application – Other Alternatives; Next Generation Flood Barriers

The overall objective of this component of the project is to develop and field test the next generation flood barriers that will protect coastline infrastructure from storm surges without compromising view, which is the primary concern of such solutions from public and environmental groups.

To successfully achieve the highly challenging goal of an aesthetic barrier on the shoreline and/or river banks the researchers at NJIT's Department of Civil and Environmental Engineering will be built upon the following principles and/or knowledge:

- Costs and benefits analysis at the end will determine the success.
- An aesthetic design requires a deployable and/or collapsible/retractable structure that is deployed/erected only during potential storm surges.
- There is an overwhelming knowledge on deployable and retractable structures used for space purposes and retractable roofs (Hernandez et al, 21987; Puig et al., 2010; Yan et al., 2012; Gantes et al., 2004; Wikipedia, 2013).
- Forces on flood barriers are dominantly hydrostatic and hydrodynamic, thus, they are lateral forces as oppose to typical structural design where gravity (vertical) forces are also important. Therefore, bulkier element of a system that is resisting mainly lateral forces such as flood barriers – such as foundation – are already hidden and camouflaged.
- To ensure viability and economic of the final design, a structural solution might be combined with other measures. For example, controlled openings (i.e. not water tight) might be provided along with run offs and storm basins to ensure economy of design and/or timely deployment/installation.
- Smart designs can take advantage of the presence of massive wave energy in stiffening and/or deploying the barrier system.

1. Deployable/Invisible Walls

Columns/vertical supports – like water hydrants – will be provided every so many feet along the coast or riverbank. During forecast of a major storm or hurricane these columns are fitted with high-strength prestressed fabrics to act as temporary dams.

Columns/vertical supports can be provided in various forms: i) permanent, ii) permanent but invisible using a retractable system, and iii) pre-cast and stored at an offsite, and delivered and inserted in pre-made holes. It should be noted the sleeved retractable system is common in aerospace applications (Puig et al., 2010)

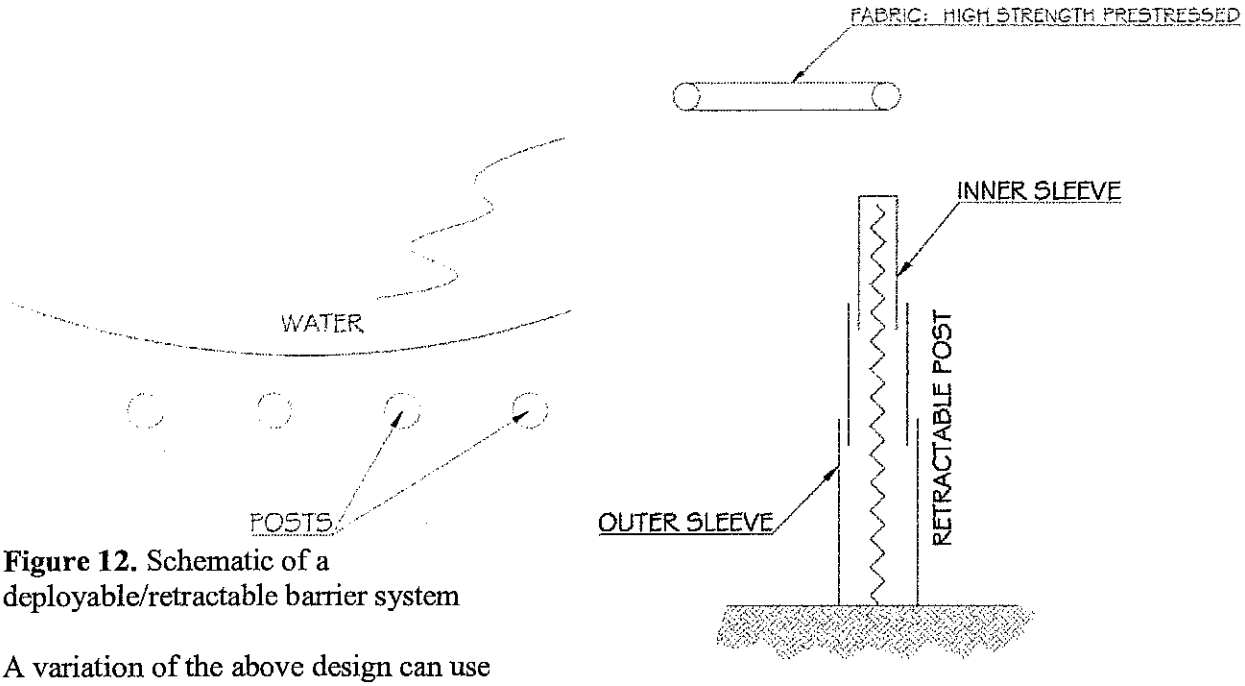


Figure 12. Schematic of a deployable/retractable barrier system

A variation of the above design can use dovetail connection to ensure water tightness. An artistic rendering is shown in the following figures (13 and 14).

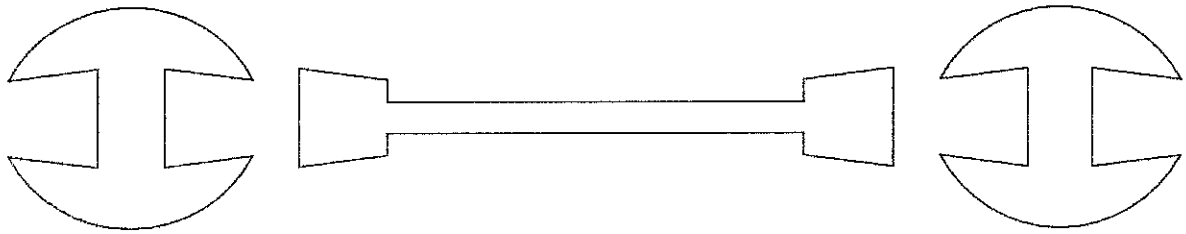


Figure 13. Plan of a deployable dovetail barrier system

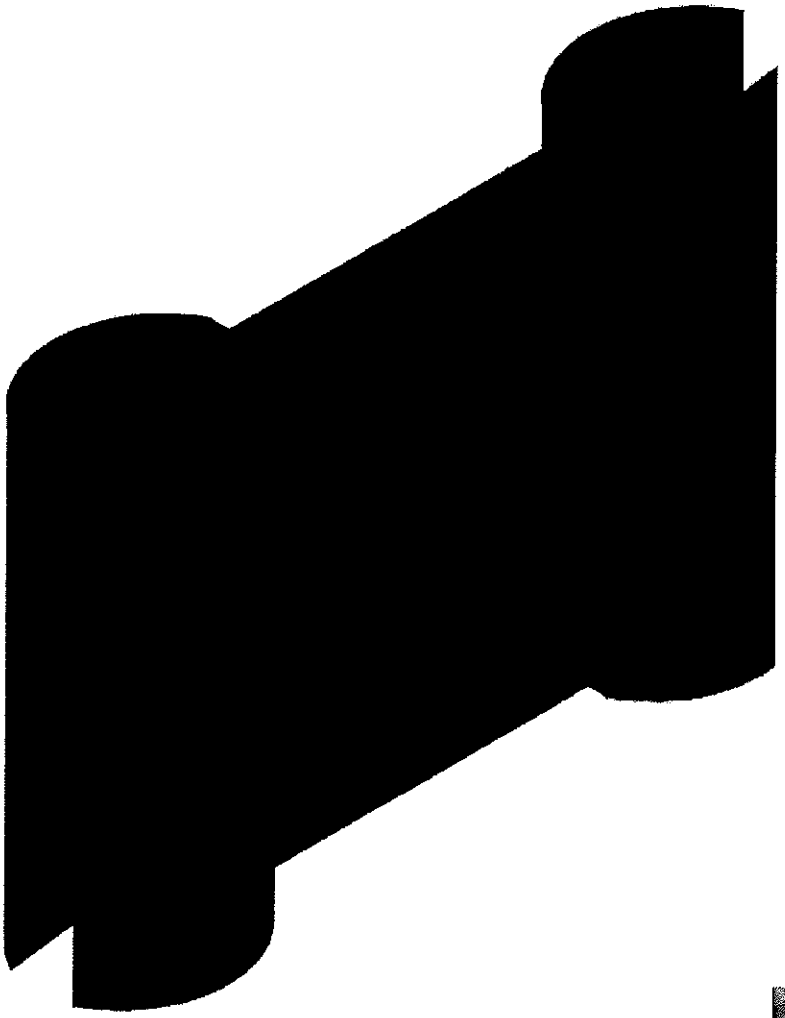


Figure 14. 3-D artistic view of the deployable dove-tail barrier system

2. Collapsible Sidewalks/Boardwalks

This design is based on the scissor-hinged strut structure concept, which is widely used in common systems such as the field deployable tower shown in Figure 15. It is proposed to develop a barrier system that consists of collapsible trusses to be built under sidewalks or board walks where needed. The entire system is raised during a major storm or hurricane. Hydraulic systems similar to those used in seismic design or other means including lifting with a crane can be used to raise the support.

Figure 15. Deployable tower using scissor-hinged system

The basic element of this system is a set of struts forming the collapsible truss as shown in Figure 15. In a barrier system the dominant controlling design forces are due to hydrostatic and hydrodynamic load of the storm wave. Therefore, the lateral strength of the system is of primary concern; unlike more common applications of scissor-hinged systems where vertical strength and stability is dominant and/or also critical. Thus, the vertical elements of the proposed system, which can be a challenge in making the system easily collapsible/foldable, are not as critical as and they otherwise are. On the other hand flood barriers require special attention to the foundation design and detailing. However, the foundation is hidden and can be designed to the required high storm level forces without any negative aesthetic implications.

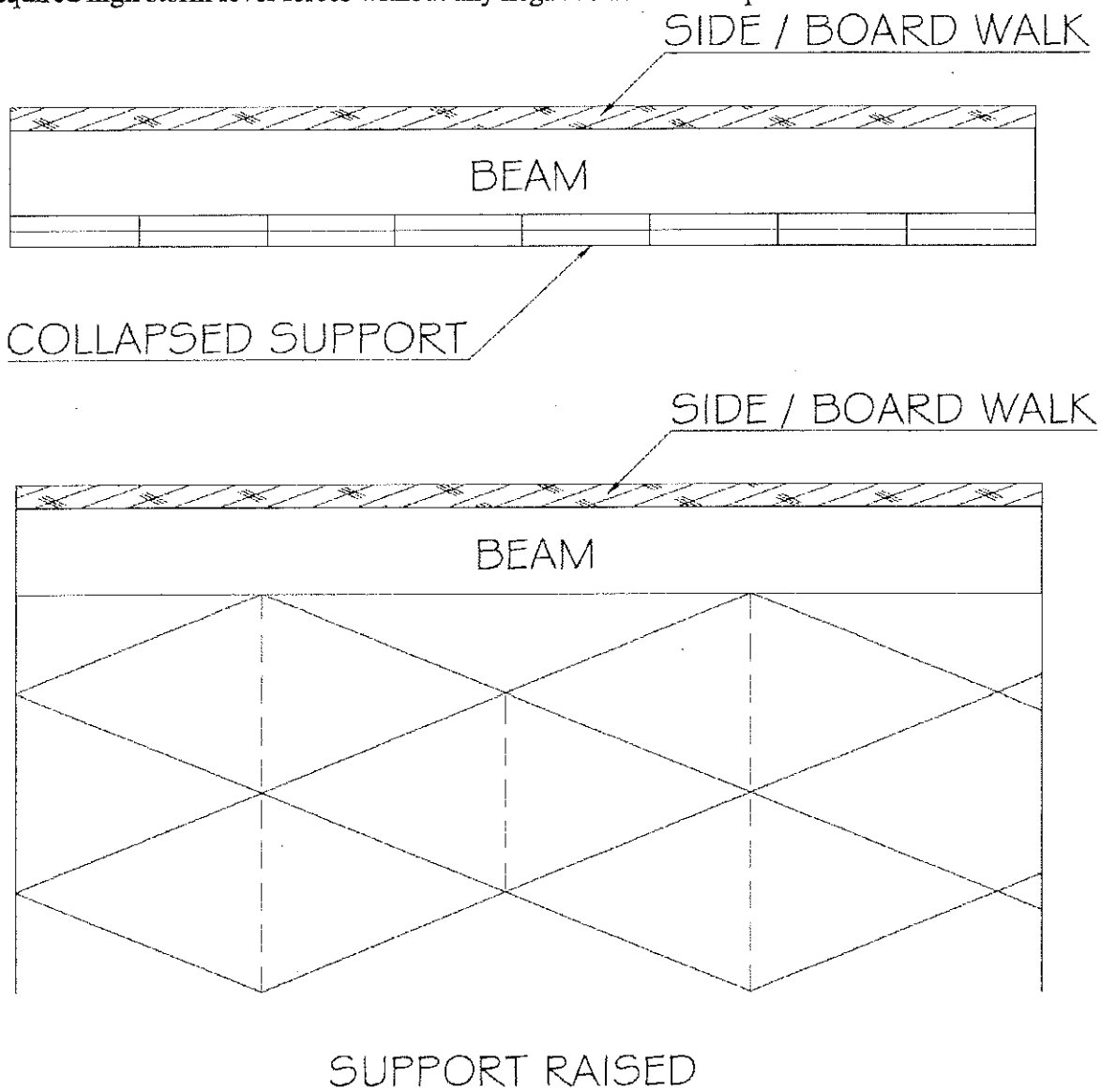


Figure 16. Collapsible/retractable side/board walk system to serve as flood barrier

3. Retractable Walls

Walls are made such that they can be retracted. Spring and pre/post stressing system will be used for storage and stiffness/stability during deployment. This will be similar to the retractable post shown in Figure 16 but continuous, thus, forming a wall.

These concepts will be evaluated using advanced finite element models, with special consideration to fluid-structure interaction. Parameter study will be performed to refine the designs.

4. Other Boardwalk Concepts

The damage caused by Hurricane Sandy on houses and businesses along the beach fronts and short line was a result from damaging wind and tidal waves. Many boardwalks were damaged from these two forces and all floor panels were pulled off the supporting beams and piles as these structures do not have any protecting structures against these forces. This proposal suggests building boardwalks or roadways with thick concrete panels that can be raised a 45-60 degree angle when approaching Hurricane is imminent. The heavy concrete panels under normal service conditions serve as roadways or walkways. However, while under severe wind force and tidal waves from Hurricane, these heavy walkways and floor panels, when raised, will serve as wind and water breakers, cutting down the amount of energy that will reach the homes and businesses along the shoreline. The proposed floor panels will be rigidly secured on one end and free to be raised on the other. Underneath the heavy floor slabs, a secured shoreline protecting structure can be built and hidden under the walkway. These structures should be able to protect expensive shore line and beach front houses and businesses. The protecting structures can also be built with Polymer Portland Cement Concrete with the addition of Fly Ash, a strong construction material specially developed for the New Jersey Sea Grant Program as new durable construction materials for off-shore structures.

3.2.3 Non-Structural Measures

There is an increasing trend in flood risk management to consider not just traditional structural measures, but to also develop a portfolio of non-structural mitigation measures. Non-structural approaches may be generally categorized as "preventative" or "soft engineering." Such mitigation measures are very cost effective since they have the ability to both: (1) reduce the adverse impact of the design flood; and (2) provide protection for even bigger floods that might overtop over the structural flood defense system.

Municipalities along the Hackensack River have already implemented a number of non-structural measures within their respective communities. However, there is still clearly a need to bring all jurisdictions to more uniformity and coordination of non-structural systems, as well as to introduce recently developed best practices.

For this part of the feasibility study, the NJIT Research team will first conduct a thorough review and cataloging of non-structural measures already in use throughout the affected region. This database will next be evaluated to identify new systems or improvements to existing systems that will enhance the protection of the watershed. The end goal is to enable decision-makers to make informed judgments and seek necessary funding to manage flood risk within the Hackensack basin.

Proposed Conceptual Solutions. Examples of potential non-structural mitigation measures are outlined below. These are divided into the categories of "preventive" and "soft engineering."

Preventive N-S Measures

- Planning and Zoning: Control future floodplain development through wise planning and zoning to limit vulnerability/exposure.
- Structure Resistance: Conduct property level flood proofing for new structures and retrofitting of existing structures through building codes, e.g. elevation and flow-through ground level.
- Design Resilience: Implement design standards that improve property resilience, e.g. raising the level of electrical systems.
- Relocation: Increase setback of existing structures to locations behind structural flood defenses.
- Warning: Install improved flood sensing, detection, forecasting, and notification systems. State of the art warning systems give residents a chance to evacuate or move possessions, as well as allow for the timely operation of flood defense structures.
- Emergency Planning: Establish up to date community flood emergency plans.
- Financial Incentives: Impose surcharges on property owners remaining in vulnerable zones.
- Property Acquisition: Acquire flood prone propertied through voluntary buyback, abandonment, or condemnation.

Soft N-S Engineering Measures

- Conveyance: Improvement and expansion of lateral drainage systems.
- Catchment Wide Storage: Conveyance of flood waters to nearby ponds, wetlands, or detention basins.
- Temporary Storage: Conveyance of flood waters to adjacent non-occupied areas, e.g. parks, parking lots.

3.2.4 Environmental Impact

Flooding or flooding surge after extreme hurricane brings heavy land contamination near coastal regions as Figure 17 shows. Typical contaminants include spilled oil, persistent organic pollutants (POPs), pesticides that contain endocrine disrupting compounds (EDCs), heavy metals, microbial pathogens or other invasive and infectious disease-causing species. As recently as 2012, hurricane Sandy devastated the New Jersey shore, resulting in around 7,700 gallons (29146 liters) of fuel spilled from Phillips 66's Bayway Refinery in Linden, New Jersey and 300,000 gallons (1,150,000 liters) of diesel fuel spill from a northern New Jersey oil facility. The predicted increase in frequency and severity of coastal flooding makes the potential for severe contamination events very high unless proper preventive and restoration measures are implemented.

To rapidly eliminate these contaminations from soil or ground water (even sediment), we need to develop and utilize *in situ* remediation technologies. One of the existing and also popular technologies is nanoremediation (or nano-enhanced remediation), which relies on the use of state-of-art nanotechnology. Specifically, highly reactive metallic nanomaterials are applied to the contaminated areas (topsoils, subsurface soils, groundwater, or sediments) to provide strong reducing or oxidizing power, high available surface area for adsorption, or antimicrobial activity that increase the removal efficiency of organic compounds, immobilize heavy metals, and deactivate pathogenic microorganisms. For this 6-month feasibility studies, we will evaluate the potential of active metallic nanomaterials toward the removal of spilled oil, POPs, heavy metals, and pathogenic microorganisms. Based on the research, we will suggest environmentally benign (not harming ecosystems themselves), low cost, and high efficient nanomaterials for the remediation purposes. Ultimately, we will present a comprehensive feasibility report on in situ nanoremediation to address the multiple contamination issues for the coastal regions that impacted by the aftermath of hurricane. Moreover, this project will also establish a unique connection between academic groups with public, industrial partners, and government agencies.

Why choosing Nanoremediation? Nanotechnology promises a potential revolution in approaches to soil and groundwater remediation. The nanotechnology market for soil and groundwater remediation is expected to grow to around $23.6 billion worldwide. Nanomaterials are significantly more reactive than larger particles because of their much greater surface area per unit of mass, and this effect is made use of in environmental remediation. One of the widely used nanomaterials in nanoremediation is zero valent iron (ZVI), which has been used in reactive barriers at numerous sites all over the world for the removal of organic and inorganic contaminants (Bernd et al., 2008 and Karn et al., 2009). The reaction rates of nanoscale zero-valent iron (nZVI) are 25–30 times faster than the reaction rates of granular iron in the Micrometer to millimeter range, and the sorption capacity is also much higher (Li et al., 2006).

Project Goals. In this feasibility study, we aim at answering the questions on whether applying nanomaterials on the contaminated topsoils after the impact of hurricane would potentially elevate the degradation of POPs and oil-spill-related organic pollutants, immobilization and

detoxification of heavy metals, and reduce the spread of microbial pathogen. In line with this aim, we propose the following the research tasks:

(1) Investigate the topsoil contamination and characteristics (e.g., concentration, types, and distribution) in the Hackensack areas through field tests and hydraulic modeling.
(2) Conduct comprehensive feasibility research on the removal efficacy of typical organic compounds (e.g., TCE or trichloroethylene), free soluble metals, and indicator microorganisms (e.g., fecal *E. coli*) by a number of commercialized nanomaterials (nZVI, CaO_2, CaO, and Fe_2O_3).

Proposed Approaches. (1) Investigation of the topsoil contamination and characteristics. Our research team will spend 1-2 month on comprehensive literature survey and collecting all relevant studies or technical reports related to topsoil contamination after hurricane flooding. This process may also involve the field tests, survey, and laboratory measurements with our environmental engineering laboratory facilities at NJIT. In addition to the monitoring studies, as indicated below, we will employ hydrologic models as an efficient and cost-effective alternative to simulate and predict possible contamination migration from potential sources after the flooding events. Moreover, these models will consider and evaluate the factors such as flood movement, flow direction, velocity, and discharge rates in the assessment of contamination migration and deposition. Ultimately, we will be able to establish criteria to prioritize the contaminated sites for nanoremediation, which will increase the cost efficiency of contamination remediation and ecosystem restoration. Thus, the first deliverable from this subtask will be the comprehensive report of the background investigation on the topsoil pollution in Hackensack areas through both field tests and mathematical simulation.

(2) Feasibility studies. Currently, most of the commercial nanoremediation business focuses on the removal of organic pollutants or heavy metals. Thus, for organic pollutants and heavy metals, the nanoremediation feasibility studies will primarily be conducted through the consultation and discussion with the local nanotechnology companies in the US such as Lehigh Nanotech LLC and obtain the relevant technical information regarding the removal efficacy by different nanomaterial products, protocols, and possible cost. For antimicrobial analysis, we will perform laboratory tests using standard methods such as enumeration of fecal and total coliforms in topsoil samples before and after the

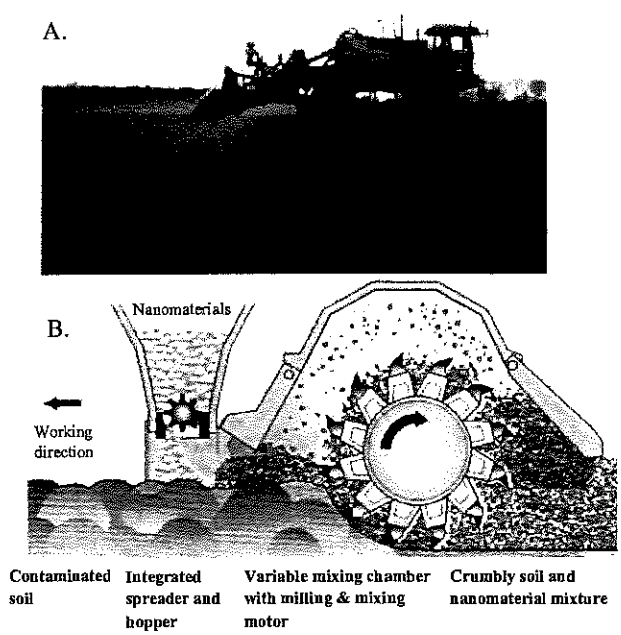


Figure 18. Modes of application of nanomaterials on contaminated topsoils. A. liquid spray; B. Mixing nanomaterials with contaminated topsoils.

application of nanomaterials. The lab results together with the technical information obtained from companies will be compiled to be a systematic feasibility report as our second deliverable from this subtask, which will probably last 2-4 months. This report will detail the technical options for nanoremediation depending on the removal targets and related protocols such as the mode of nanomaterial application on the contaminated topsoils as shown in Figure 18.

3.2.5 Vulnerability and Risk Analysis (VRA), Risk reduction and Mitigation Strategies

In addition to the various areas of expertise in civil and environmental engineering provided by the FM Center, NJIT would utilize its expertise in critical infrastructure systems protection and mitigation analysis to provide vulnerability and risk analysis in support of the goals of the NJDEP and the USACE North Atlantic Coast Comprehensive Study, namely the evaluation of structural and environmental flood protection and mitigation strategies and the development of comprehensive risk reduction strategies to help protect vulnerable coastal communities in New Jersey and to promote and enhance their resilience through a range of measures, including green infrastructure, and the protection of key resources such as flood control assets.

Scope of the Deployment of VRA Study Module. The framework of the VRA program area to be developed in support of the NJDEP/USACE North Atlantic Coast Comprehensive Study would apply to all 3 geographic areas of focus. However, the immediate area of application where this capability will be deployed is the second designated location of interest, namely the Hackensack, Moonachie/Little Ferry geographic area of interest.
The Intergovernmental Panel on Climate Change (IPCC) (1) has released projections for climate change variables which have elevated public awareness and led to the development of multi-sector Federal, state and local government initiatives to evaluate the vulnerability of key population areas and critical infrastructure and assess the impact of climate changes, represented by past and future Storm Events. The NJDEP/USACE North Atlantic Coast Comprehensive Study is one such major effort applying to three geographic locations of interest.
These population areas and related critical facilities are located in close proximity to coastal waters, which further magnifies the potential impacts of climate change variables, such as sustained sea level rise with associated storm surge, increased precipitation and increased temperature. An overview of the proposed evaluation process is presented below, with an emphasis on the coastal flooding potential and flood mitigation and adaptation strategies. Also, the possibility of combined or complex event scenarios will be investigated in order to anticipate storm related damage from such extreme events.

Vulnerability and Risk Assessment Process. The vulnerability and Risk assessment process can be categorized into the following five major tasks: Development of critical asset inventories within and surrounding the coastal communities of interest, analysis of past major storm damage, Flood Threat analysis based on a definition of climate change variables and projections and the development of flood modeling scenarios investigated by the Hydraulic Modeling and Environmental sub-teams, vulnerability assessment, and risk analysis, prioritization of assets and development of resilience and adaptation strategies and programs.

1. Development of Critical Asset Inventories

The thrust of this task is to develop inventories of assets critical to the populations at risk in the identified vulnerable areas. The definition of these critical assets will require a cooperative effort with the local and State Institutions, such as Administrative, technological and State emergency management institutions.

Critical Asset categories include:

1. Population Sheltering and Medical Services: Schools, sports facilities, as well as hospitals and clinics, medical supplies facilities and essential infrastructure services.
2. Transportation Assets to ensure evacuation routes.
3. Green Infrastructure Assets to reduce the potential impact of flood scenarios.

2. Analysis of Past Major Storm Damage and Resilience Performance

Based on a questionnaire and survey of key coastal communities of interest first in Region 2, but possibly across all 3 Regions, and in coordination with the Outreach to Communities sub-task, the level of inundation and other damage affected by the previous major Storms such as Sandy and Irene, will be evaluated. Also, the resilience of such communities due to green infrastructure assets, and other flood protection assets will be derived, based on recovery times and the degree of long-term disruption to major services beyond the aftermath of the storms.

Also, some of the data would be derived from contacts with the Meadowlands Environmental Research institute and its municipal representation within region2, which is used as a test-bed for the NJIT approach.

3. Threats Analysis: Scenarios Development based on Climate Change Variables and Combined Events

The definition of threat levels and event scenarios that could expose the communities of interest to potential future damage will be established using some assumptions on water levels, based on the current baseline, but taking into account climate projections, using some of the valid assumptions made by resilience studies performed in the New York/New Jersey coastal geographical areas.

For example, the New York City Panel on Climate Change (NPCC) (Zhang et al., 2012) provided guidance, analysis and information on climate change variables and associated risks, in the form of projections and probabilities associated with climate change impact on variables including temperature, precipitation, sea level rise and coastal storms. Table 2 shows a summary of the projections provided for these climate variables for the 2020s, 2050s and 2080s. This data does not include the potential additional impact of sea level rise projections accounting for possible accelerated rates of ice melt in the Greenland and West Antarctic Ice sheets, described as the "Rapid Ice-Melt Scenario. These assumptions will be integrated with the Hydraulic and

environmental Modeling sub-teams in order to plan for various Storm Scenarios, based on a given baseline, and associated precipitation and sea level rises.

The threat analysis will yield some key driving Storm events along with an updated baseline for seal level rises.

Table 2. Water Level Climate Projections (NPCC), (Zhang et al., 2012)

NPCC Climate Projections *(Rosenzweig, C. & Solecki, W. 2010)*					
		Baseline (1971-2000)	**2020s**	**2050s**	**2080s**
Air Temperature		12.8 °C (annual mean)	+ 0.8 – 1.7 °C	+ 1.7 – 2.8 °C	+ 2.7 – 4.2 °C
Precipitation		118.1 cm (annual mean)	+ 0 – 5%	+ 0 – 10%	+ 5 – 10%
Sea Level Rise		NA	+ 5.1 – 12.7 cm	+ 17.8 – 30.5 cm	+ 30.5 – 58.4 cm
Coastal Storms	**1-in-100 yr Flood to recur**	≈ once every 100 years	≈ once every 65 to 80 years	≈ once every 35 to 55 years	≈ once every 15 to 35 years
	1-in-500 yr Flood to recur	≈ once every 500 years	≈ once every 380 to 450 years	≈ once every 250 to 330 years	≈ once every 120 to 250 years

4. Vulnerability Analysis: Scenarios Development based on Climate Change Variables and Combined Events

Based on the above threat analysis, based on the impact of climate projections, and the assumption of Storm Surge Scenarios with associated probabilities of occurrence, the Hydraulic Modeling of such events (in the absence of new protective structural and environmental measures) and their impacts on key critical Assets identified in I. above will be evaluated. This will help establish an intrinsic vulnerability and resilience analysis of such communities, based on the impacted assets and their expected recovery times. Such analysis would be compared and corroborated with the results of Section II above related to past major Storm performance.
In addition to the modeling of flow velocity and elevations in the impacted communities, the vulnerability of some key assets such as flood control assets will be investigated in order to account for the possibility of combined events, based on probability of failure of such assets under future storm impact scenarios.

The range of events with flow inundation potential and their probabilities will be used **in a fault-tree model** established on a single or multi-community basis, as the analysis needs of the population protection and resilience would be established. The fault-tree model would be used to

establish a composite level of vulnerability (overall probability of failure of population protection) in the absence of any new structural or environmental protection measures or adaptation strategies.

5. Comprehensive Risk Analysis: Scenarios Development based on various protection and adaptation Strategies

A detailed Model-Based Vulnerability Analysis (MBVA) (Lewis, 2013) will be performed based on the Vulnerability Analysis fault-tree model(s) above. Using the current situation as a baseline and the results of the Vulnerability Analysis in Section IV corroborated by past performance as in Section II above, a risk analysis taking into account damage costs and other socio-economic costs associated with the various threat scenarios will be undertaken.
In the next step of the Risk Analysis, the range of protective Structural and environmental protection and adaptation strategies will be reviewed from a risk reduction standpoint, by running the hydraulic models to simulate storm flooding performance under various combined protection strategies and portfolios. This reduction of such socio-economic damage and other costs (benefit) of future events would be weighed against the life-cycle cost of such protective measures in a comprehensive cost-benefit analysis of various options/portfolios of measures at hand.

A number of options with associated life-cycle costs and expected global and specific coastal community/asset risk reduction will be presented and summarized for the feedback and approval of decision-makers and public representatives within the coastal communities, as well as the USACE and NJDEP Officials focusing on this comprehensive Program, in coordination with the NJIT Community Outreach sub-team. This review and feedback will help yield a prioritized list of protection measures and new assets, their expected protection capabilities and associated population protection plans (evacuation, survival and resilience) that would be achieved through this analysis, cooperation and collaboration with the Coastal Communities and agencies involved in the process.

3.3 TASK 3: HYDRAULIC MODELING

In support of the NJDEP Work Study goals and as an integral component of the objectives and overall approach laid out by the NJIT Team for this six-month work effort, a comprehensive modeling support sub-task will take place concurrently with several of the sub-tasks herein described. The models will be developed, calibrated and run by Drs. M. Altinakar and Y. Ding, who, along with Dr. F. Karaa from NJIT will constitute the Integrated Flood Modeling and Simulation (IFMS) team. Dr. Karaa will act as liaison of the IFMS team to other sub-teams to enable the evaluation and integration of proposed structural and environmental protective measures and other adaptive strategies as model scenarios to be included in the scope of this flood simulation and modeling project task. Dr. Karaa and various team members and sub-task managers will also interface with the IFMS sub-team and one another through the Project Office

infrastructure managed by the Team Leader to facilitate orderly information collection and dissemination throughout the study period.

Mustafa Altinakar, Ph.D. is Director & Research Professor, National Center for Computational Hydroscience and Engineering (NCCHE) at the University of Mississippi where Yan Ding, Ph.D. Dr.Eng., is Research Associate Professor and Yaffei Jia is Research Professor and Associate Director of Basic Research. Together, they have a unique level of expertise to address the flood simulation and modeling needs of the study, as described in the proposed NJIT approach. They are the developers of one- and two-dimensional flood modeling and mapping software packages that can be used for fluvial and coastal flood studies. Notably, the CCHE2D software, which will be used in the proposed modeling and simulation work, is a highly versatile, state-of-the-art integrated numerical model to study river and coastal flooding problems separately or in a coupled manner. The hydrodynamic module of CCHE2D can simulate inland river flows/floods. Coupled with the CCHE2D-Coast module, it can also simulate coastal hydrodynamics (tides, currents, and waves) and storm surges. The CCHE2D fluvial and coastal hydrodynamics module is enhanced with modules for simulating fluvial and coastal sediment transport and morphodynamics, contaminant transport and fate, and water quality.

The DSS-WISE software is an integrated two-dimensional dam/levee break/breaching flood software package developed with funding from the DHS S&T through SERRI (South East Region Research Initiative) Program. A special version of this software, called DSS-WISE Lite, has been converted into a web-based, automated dam break flood simulation and mapping tool in collaboration with the DHS Dams Sector Branch, USACE Headquarters, and connected to the DSAT (Dams Sector Analysis Tool) portal maintained by Argonne National Laboratory (ANL). It is used by DHS S&T and USACE units and their stakeholders to provide on-demand flood modeling capabilities to perform dam-break flood simulation and mapping for risk analysis and emergency action plan development. It is also used as an operational model for response planning during emergency situations. The DSS-WISE Lite tool was adopted by FEMA Region IV for operational modeling and flood emergency management during 2013 hurricane season. Also, DSS-WISE Lite is currently under testing by USACE Modeling Mapping and Consequence Division for adoption as their screening and risk assessment tool and emergency management tool to support both Storm real-time/emergency and Preparedness analysis needs encompassing Storm impacts and dam/levee breaks to the Department of Homeland Security Science and technology Directorate and the US Army Corps of Engineers.

All above models have been fully verified using analytical solutions and validated using both laboratory and filed data. The IFMS team has extensive experience of modeling complex real-life flood events involving both inland and coastal flooding and hurricane tracking. They have a combined experience of Storm and dam/levee induced flood modeling analysis that covers the range of scenarios that have or can be encountered within the proposed study, and was applied to case studies from the Mississippi River and the 2008 mid-west floods to analysis of impacts of protective measures on various regions under storm scenarios, and major flood events around the world.

The DSS-WISE was used during the 2011 Mississippi River Spring floods to provide flood maps of hypothetical levee breaches along the Mississippi River to Mississippi Emergency Management Agency (MEMA) for emergency management planning. In 2010 USACE used DSS-WISE to simulate catastrophic floods in Pakistan and provided situation awareness to US and Pakistan Governments (Figure 19). In 2012, NCCHE used DSS-WISE Lite capability to provide flood maps and consequence analysis (hypothetic loss-of-life and rural/urban damage) for two dams in imminent danger of failure (Figure 20). CCHE2D model was used as a forensic analysis tool to study levee failures along the upper Mississippi River reach during 2008 Midwest floods (Figure 21).

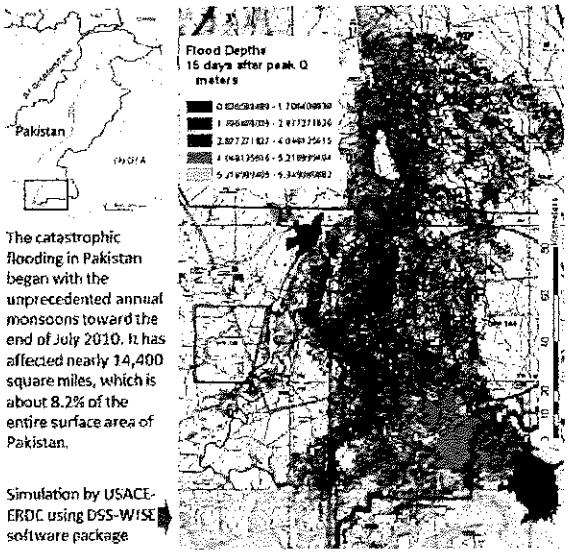


Figure 19. A Simulation of 2010 catastrophic floods in Pakistan using DSS-WISE model.

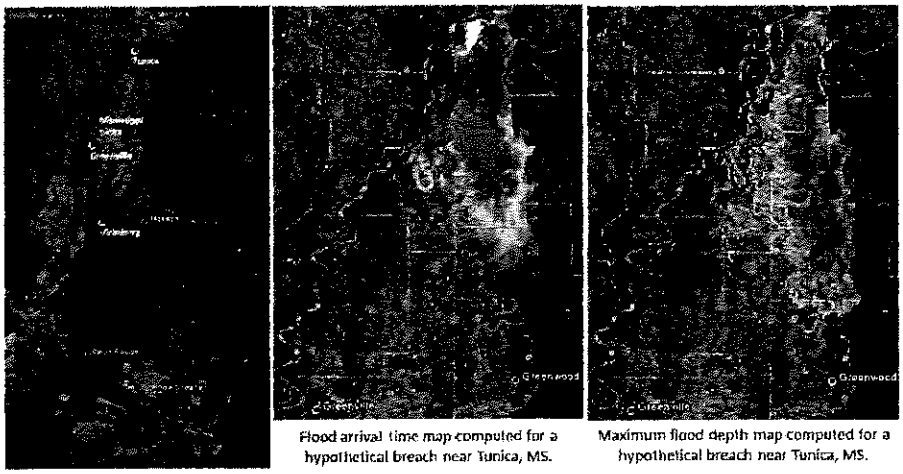


Figure 20. Simulation of a 10-day flood due to a hypothetical breach near Tunica, Mississippi, by NCCHE using DSS-WISE.

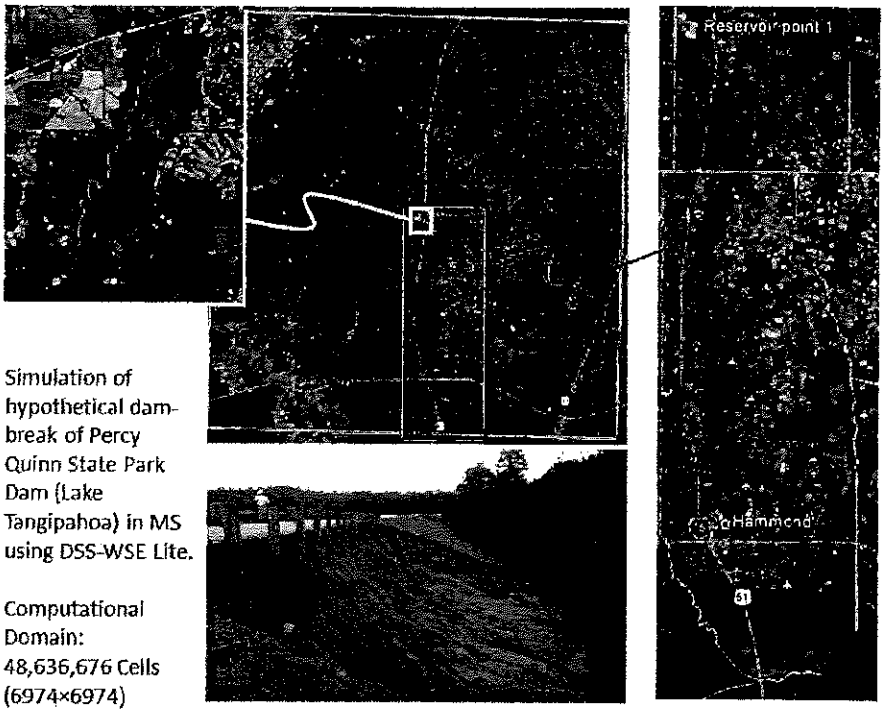


Figure 21. Simulation of hypothetical breaching of Quinn State Park Dam in MS, which was in imminent danger of failure during Hurricane Isaac (2012).

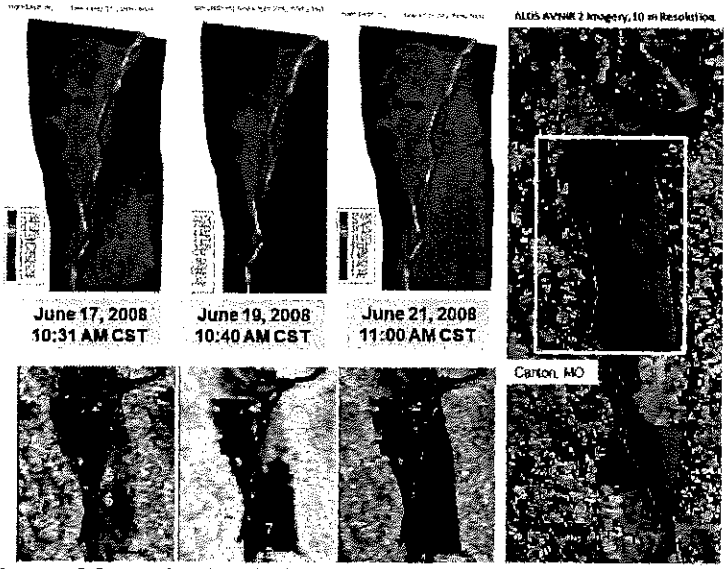


Figure 22. Comparison of forensic simulations of flooding near Canton, MO, due to multiple levee failures during 2008 Midwest floods with the satellite imagery.

3.3.1 Hydraulic Analysis and Flood Storm and Modeling Capabilities

Hurricane Sandy was the deadliest and most destructive tropical cyclone of the 2012 Atlantic hurricane season, as well as the second-costliest hurricane in United States history. The IFMS team has performed a preliminary simulation model test of Hurricane Sandy using CCHE2D-Coast, a key module of the CCH2D modeling environment, based on a request from the DHS S&T Program Coordinator in order to demonstrate the capabilities of the underlying numerical model to higher levels in the DHS administration.

Figure 23 shows the results of these simulations in Sandy Hook, NJ. Similar patterns and matches were derived for a number of coastal locations along the NJ Coast and other areas affected by Sandy. All the data utilized in this model was obtained from public sources. As can be seen in this figure, despite a lack of detailed information and data, the model results show an exceptionally good level of match with real recorded data at all locations studied along the East Coast.

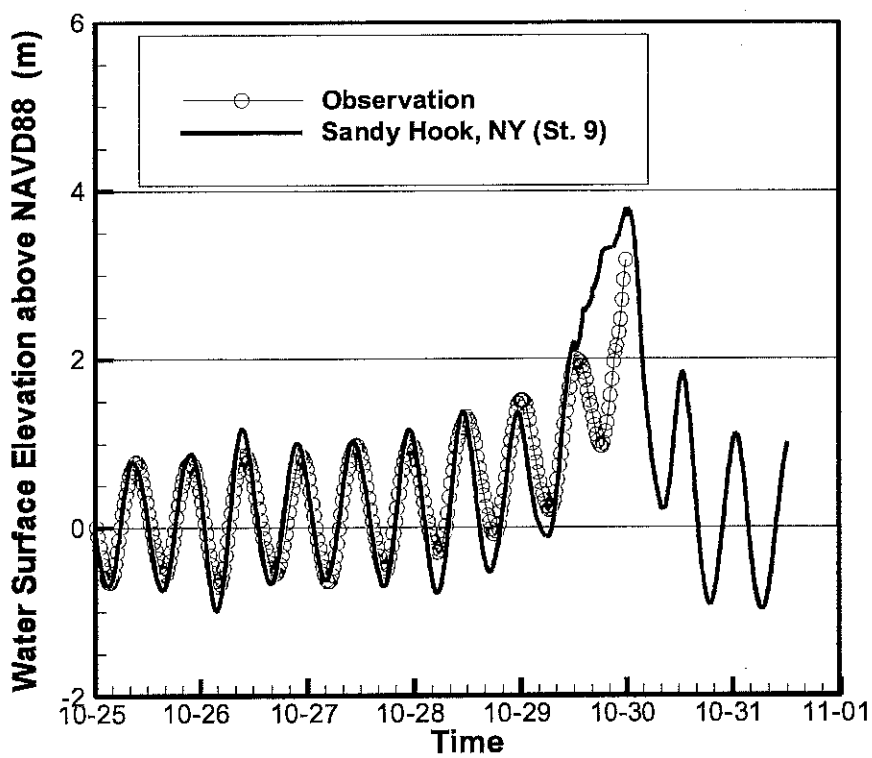


Figure 23. Comparisons of Water Elevations at Sandy Hook, NJ

The simulations were performed using the CCHE2D software, which comes with its own user-friendly and efficient mesh generator. As mentioned above, it is a two dimensional finite element

model that can simulate not only hydrodynamics for inland fluvial flows and storm surges during hurricanes by taking into account wave effect, but also sediment transport, fluvial and/or coastal morphodynamics, contaminant transport and fate and water quality.

In (Ding et al, 2013), the NCCHE team assess the impact of sea-level rise and hazardous storms on coasts and estuaries using integrated processes model . Unlike most other studies of sea-level rise which do not consider sediment transport and coastal morphodynamics, an integrated approach was adopted which takes into account these important processes as well. The paper describes the coastal sediment transport and morphodynamics capabilities offered by the CCHE2D-COAST model. Coastal morphodynamics can be an important issue during hurricanes, as the events during Hurricane Sandy, and many others, have shown. Many other models use a fixed bed concept, which assumes that the coastal morphology does not change. As now known and studied in (Ding et al, 2013), island barriers, tidal inlets, beaches may undergo severe changes, which in turn may affect storm surge and flooding depths.

3.3.2 Summary of CCH2D and DSS-Wise System Capabilities

The CCH2D software has several modules, one of which is **CCHE2D-COAST** developed by Dr. Ding. This tool was successfully used in 2012 for a project funded by the Governor of Mississippi regarding the impact of the new coastal protection systems of New Orleans on the flood levels along Mississippi coastline and the areas around Pearl River (Ding, 2012). During Hurricane Isaac, CCHE2D was used to predict storm surge levels based on advisories produced by NOAA. Comparison with observed data after the event had shown the exceptional quality of the predictions. As mentioned above, CCHE2D is an integrated model, which includes both the wave simulation (half and full plane versions) and sediment transport (thus ability to calculate changes in the coastal morphology). These integrated capabilities will be deployed as part of the scope of this study. It is also important to underline that CCHE2D and CCHE2D-Coast can be run on a desktop computer efficiently, whereas most of the standard used models (such as ADCIRC) require costly use of supercomputers to achieve a similar performance.
A parametric model developed by Ding et al for predicting hurricane wind field traveling inland after making a landfall is presented in (Ding, 2013), which provides a summary of the capabilities offered by the CCHE2D-COAST model. The use of parametric models greatly facilitates the efficiency of CCH2D numerical model without sacrificing accuracy. Also, it is possible to run the model with wind fields computed by an external software package such as the Weather Research and Forecasting (WRF) Model.

In summary, CCH2D is the appropriate environment for our proposed study:

1- The CCHE2D integrated model can also model inland flooding in rivers, including sediment transport and dam/levee break/breaching processes.
2- It also has a contaminant transport and fate (including adsorption/desorption) and water quality modules (nitrogen cycle, phosphorus cycle, phytoplankton cycle, BOD, DO, temperature, etc.).

3- It has been used to simulate the flooding due to levee breaches during 2008 Midwest floods and the impact of protective and adaptive strategies (9, 10).
4- It is currently being used to simulate the effects of a hypothetical radioactive contamination in some lakes.

As mentioned in (Altinakar, 2013), the system was validated by a blind test accomplished in collaboration with the USACE. It is also important to mention that the tool was successfully used as an emergency management tool during Hurricane Isaac. During that time, flood maps for two dams in imminent danger of failure were provided in 30 minute in one case and in a couple of hours in the other case; which prompted FEMA and the Governor's Office in Louisiana to send unsolicited "thank you" notes for the services rendered.
Also available in the tool set that we propose to deploy in this comprehensive study is the **DSS-WISE** system (Altinakar, 2012). The Decision Support System for Water Infrastructural Security (DSS-WISE) is an integrated software package for two-dimensional dam/levee break flood simulation, inundation mapping and consequence analysis. It allows the computation of the impacts on any set of populations at risk and their defined critical and non-critical assets as necessitated in the performance of the VRA sub-task.
The papers in (Altinakar, 2012) and (Altinakar, 2013) provide detailed information on the system and its performance. The capability was opened to public use in February 2012 with only one pilot state. Later gradually more states were added to the user list. It may be interesting to point out that as of now more than 250 dams have been studied by accredited users from 23 states. Some of the dams have been simulated more than 20 times using different scenarios. Currently the system provides 30m and 10m resolution simulations. The computational domain is 48 million cells for 30m resolution and 437 million cells for 10m resolution. The results for 30m simulations take on the average 5 to 15 minutes whereas 10m simulations take on the average 20 to 60 minutes.

3.3.3 Scope of the Deployment of CCH2D-COAST/inland, and DSS-WISE

The framework of the Flood modeling and simulation analysis tasks area to be performed in support of the NJDEP/USACE North Atlantic Coast Comprehensive Study would be applicable to all 3 geographic areas of focus. However, the immediate area of application where this capability will be deployed is the second designated location of interest, namely the Hackensack, Moonachie/Little Ferry geographic area of interest, covered by the NJIT team and Project Office. The following tasks are envisioned in conjunction with and in support of the work of the various NJIT sub-teams.

I- Expansion of the Hurricane Sandy simulation study to the Region of Interest (Region 2: Hackensack, Little Ferry)

The thrust of this task is to expand work performed recently which determined the validity of CCH2D-Coast in simulating hurricanes of the scope of Sandy. Preliminary Results of Hindcasting Wind, Storm Surge, Wave in Hurricane Sandy (shown in Figure 24) using CCHE2D-Coast were developed. Also shown respectively in Figures 25 and 26 are Storm Surge simulations and resulting maximum water levels.
It is important to note that the CCH2D-Coast Model integrates the following principal features:

1- Deformation/transformation of irregular waves

2- Tidal currents and river inflows
3- Coriolis force
4- Surface winds and bottom frictions
5- Wave-induced currents and wave set-up
6- Sediment transport due to waves and currents
7- Coastal/estuarine morphodynamic processes
8- Morphological changes around coastal structures, e.g., groins, offshore breakwaters, artificial headlands, jetties, artificial reefs, etc.

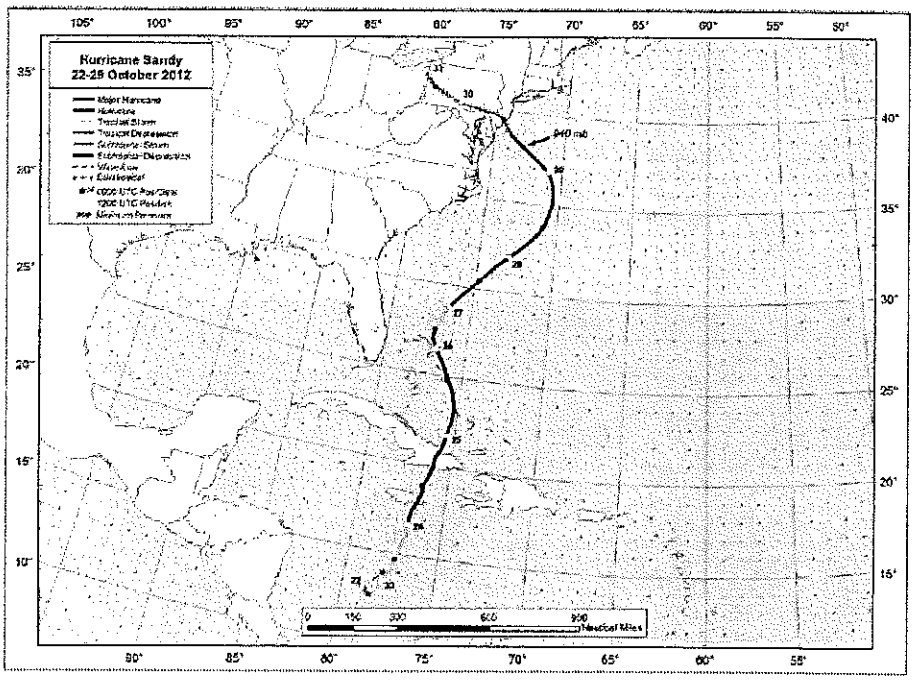


Figure 24. Best track positions for Hurricane Sandy, 22 - 29 October 2012 (From Eric S. Blake, Todd B. Kimberlain, Robert J. Berg, John P. Cangialosi and John L. Beven II, Tropical Cyclone Report - Hurricane Sandy, National Hurricane Center, Feb 12, 2013).

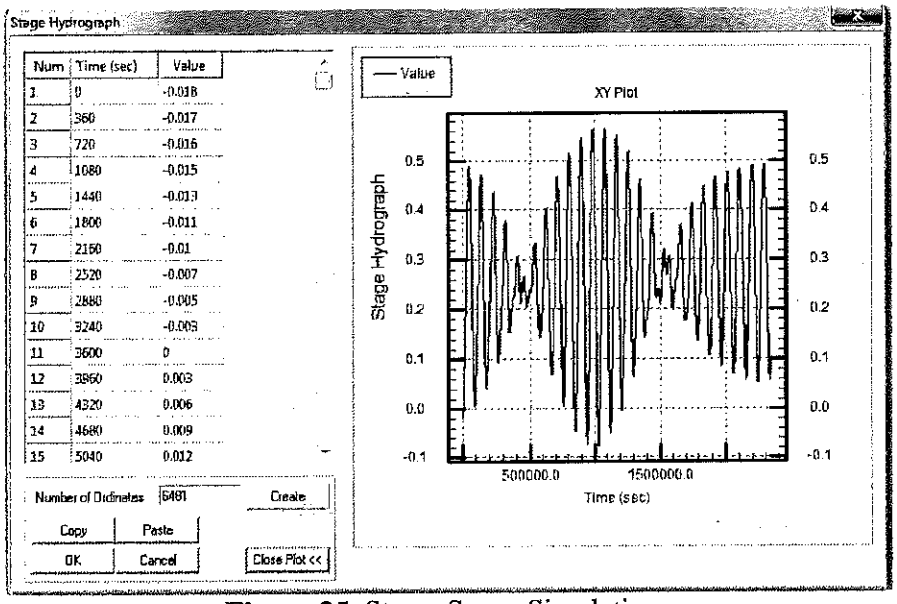


Figure 25. Storm Surge Simulations

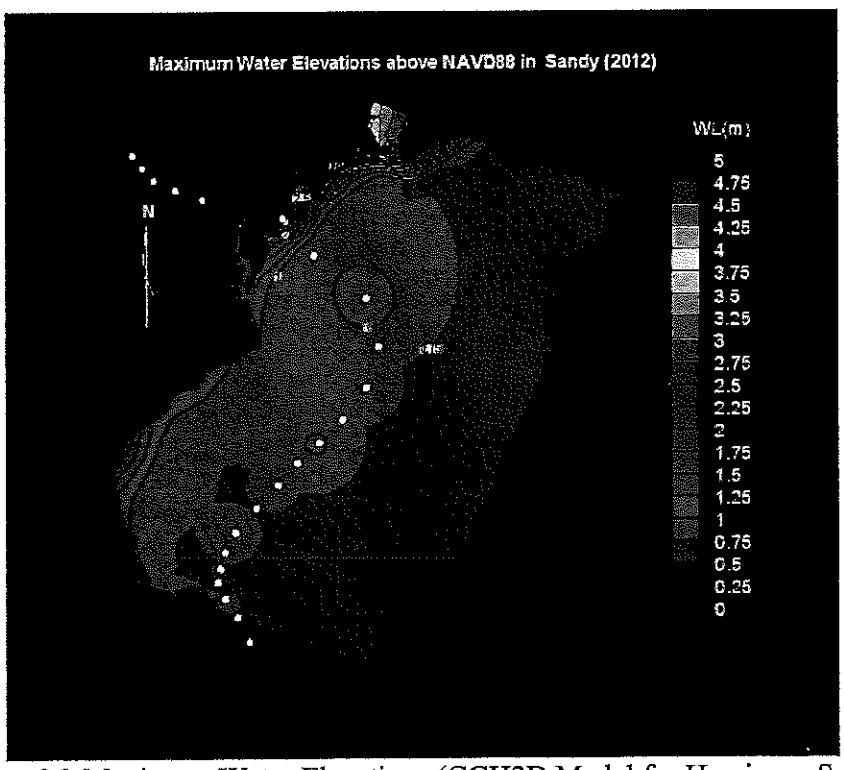


Figure 26. Maximum Water Elevations (CCH2D Model for Hurricane Sandy)

It is worth noting that this model set-up will be easily expanded to include region2 of interest in this study and as proposed by the NJIT team as the test-bed of the approach taken in this comprehensive study, using the same mesh size/resolution, given the fact that the model included a Mesh size of 500,000 nodes with High resolution near coasts and lower resolution at deep water and hindcasting storm surge and wave in Hurricane Sandy from October 25-Nov.1, 2012. This duration can be increased as needed. Also, all values used in the preliminary study can be changed as needed during this 6-month extensive study.

Storm wind and air pressure were created by a cyclonic wind model with land fall effect, with frequency of wave-current interaction of 2 hours and a Time step size for simulation of storm surge of 120 s. Tide elevations observed at Bermuda were used as the deepwater tide boundary conditions. Model validation was achieved by comparing the computed tidal elevations at 18 NOAA tide gauges in the U.S. Atlantic Coast. Simulation CPU Time: One-week sandy storm surge simulation took 3 hours on a single CPU of Intel(R) Core (TM) i7 CPU at 2.22GHz and Wave-current fully-coupled simulation took 8 hours on a single Laptop computer CPU. It is worth noting that these are values used for the preliminary study but with better data, which will be used for this study, one may need to update some of these choices in order to further improve modeling capability.

An expanded version of the model will be run to account for impacts starting with the simulated conditions at the mouth of the river(s) contiguous to the start of the zone of interest. The detailed topography of the region of interest will be derived from USGS data which is up to 3 meters in resolution along with GIS data from the State of New Jersey and the Meadowlands Commission. A flow chart of the CCH2D Modeling environment is show in Figure 27 below.

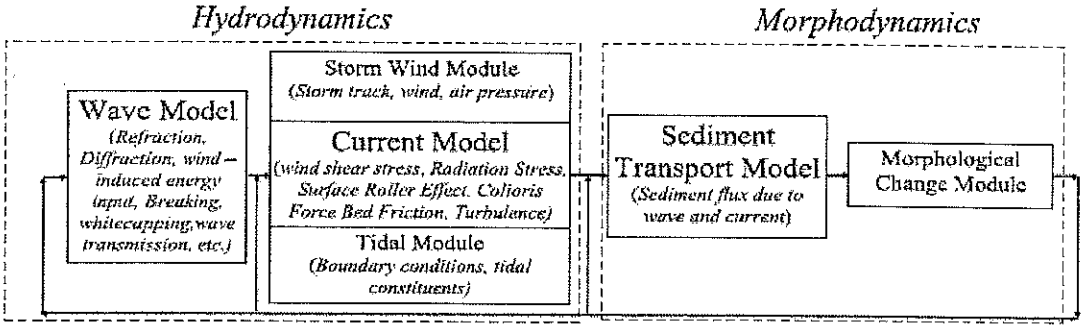


Figure 27. Modules of CCH2D Hydrodymanics/Morphodynamics Integrated Processes (Ding et al, 2013).

As mentioned in (Ding et al, 2013), "It is important to note that all the modules share one grid system for simulating coastal/ocean processes in sequence. Thus, unlike the model steering operation used in some storm-surge models, CCHE2D-Coast does not need to switch executable codes of the modules. As a result, this model avoids possible errors and loss of information due to interpolation and extrapolation of the results between different grid systems for different process models. The mesh of CCHE2D-Coast is non-orthogonal, which allows general structural

quadrilateral grids. This structural mesh can model irregular coastlines in a more flexible way, in comparison with a rectangular mesh. In addition to the unified mesh, implicit numerical schemes for solving all the governing equations of wave, current, and morphological change models make this integrated model efficient and capable of running simulations in a standard laptop computer with a relatively short computational time".

II- Modeling and Simulation Analysis of Past Major Storm Damage and including Climate Change impacts Across the Time Horizon of Interest

Also, some of the data related to this and past storms would be derived from contacts with the Meadowlands Environmental Research institute and its municipal representation within Region2, which is used as a test-bed for the NJIT approach. This will allow the simulation of past Storms of interest and the further calibration of the CCH2D model for the Region 2 study.

III- CCH2D-Model Higher Resolution study focused on the Region of Interest

The mesh size can be increase to run the parametric-based models included in CCH2D at a higher level of resolution with a dedicated model run within the confines of the region of interest. A similar study was performed for the Pearl River as part of (Ding, 2012).
To run the higher-resolution model which analyzes flooding from key river sections and tributaries, flows and water levels in these water bodies will be simulated using cross-section data available from previous HEC-RAS (HEC- River Analysis System) and available databases on rainfall and water gage data from NOAA available from various sites, some of which web-enabled.

IV- Comprehensive Flood Modeling and Simulation Analysis: Scenarios Development based on various protection and adaptation Strategies

In support of the Model-Based Vulnerability Analysis (MBVA) and risk analysis performed by the VRA sub-team, a range of scenarios will be modeled, simulated and analyzed for the region of interest ranging from structural and environmental protective measures to green infrastructure adaptive strategies. Using the currently verified Sandy model described above as a baseline and the results of the Flood Simulation and Modeling Analysis in Section III corroborated by past performance as in Section II above, a risk analysis taking into account damage costs and other socio-economic costs associated with the various threat scenarios will be undertaken.
In the next step of the Risk Analysis, the range of protective Structural and environmental protection and adaptation strategies will be reviewed from a risk reduction standpoint, by running the hydraulic models to simulate storm flooding performance under various combined protection strategies and portfolios. Also included is the possibility of running simulations of combined complex events for region 2 using possible dam and levee breaches and breaks and using DSS-WISE. Additionally, the contaminant migration prediction capabilities of the proposed solution will be used to model potential areas of contamination due to flood events impacting a range of possible contaminant sources around industrial sites and areas containing debris and various types of contaminants. Such predictions will be integrated with the work of the Environmental sub-team, which is investigation treatment options, including the use of nanomaterials for the treatment of top soils.

The results of these model scenarios will interfaced to the fault-tree models which includes the probabilistic evaluation of these scenarios and the comprehensive cost-benefit analysis of various options/portfolios of measures at hand proposed by the VRA sub-team for further refinement and

prioritization in cooperation and collaboration with the Coastal Communities and agencies involved in the process.

4.0 IMPLEMENTATION

The tasks discussed in the previous section will all run simultaneously. The hydraulic model(s) will be calibrated using verified data (Task 1). The model(s) will then be applied using the alternatives developed in Task 2 taking into account environmental impact, vulnerability and risk as well as socio-economic factors to come up with the most optimal recommendations (see Figure 28).

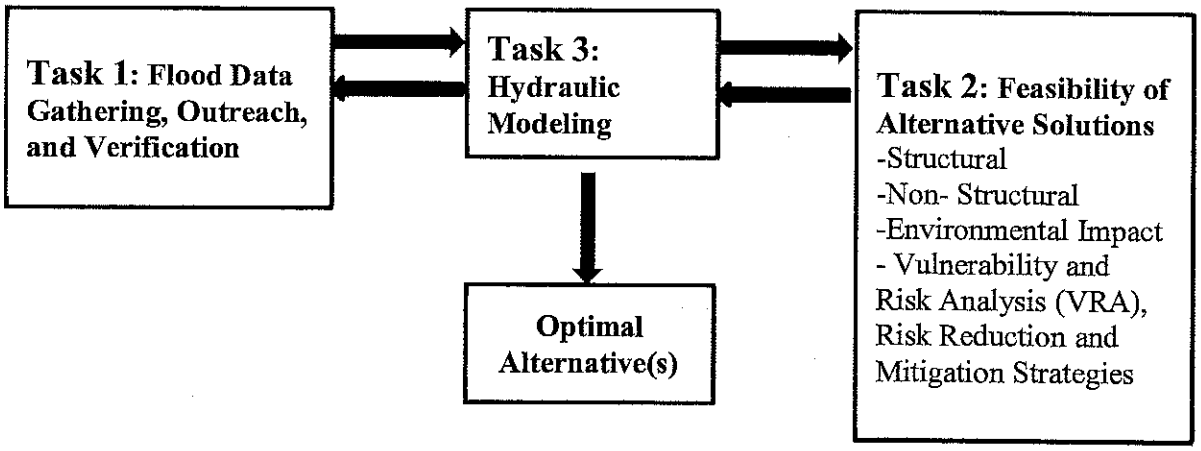


Figure 28. Project Tasks

The project team consisting of thirteen (15) faculty members with expertise in all areas of civil and environmental engineering, will be responsible for executing the various tasks. The Team Leader, Dr. Taha Marhaba, Chairman of the Department of Civil and Environmental Engineering at NJIT, will have the overall responsibility of the project. The multi-disciplinary team consists of faculty in all civil, hydraulic and environmental areas. Drs. Mustafa Altinakar and Yan ding from the University of Mississippi's National Center for Computational Hydroscience will collaborate with the rest of the NJIT team on the hydraulic modeling task (Task 3).

Figure 29 shows an organizational diagram of the team.

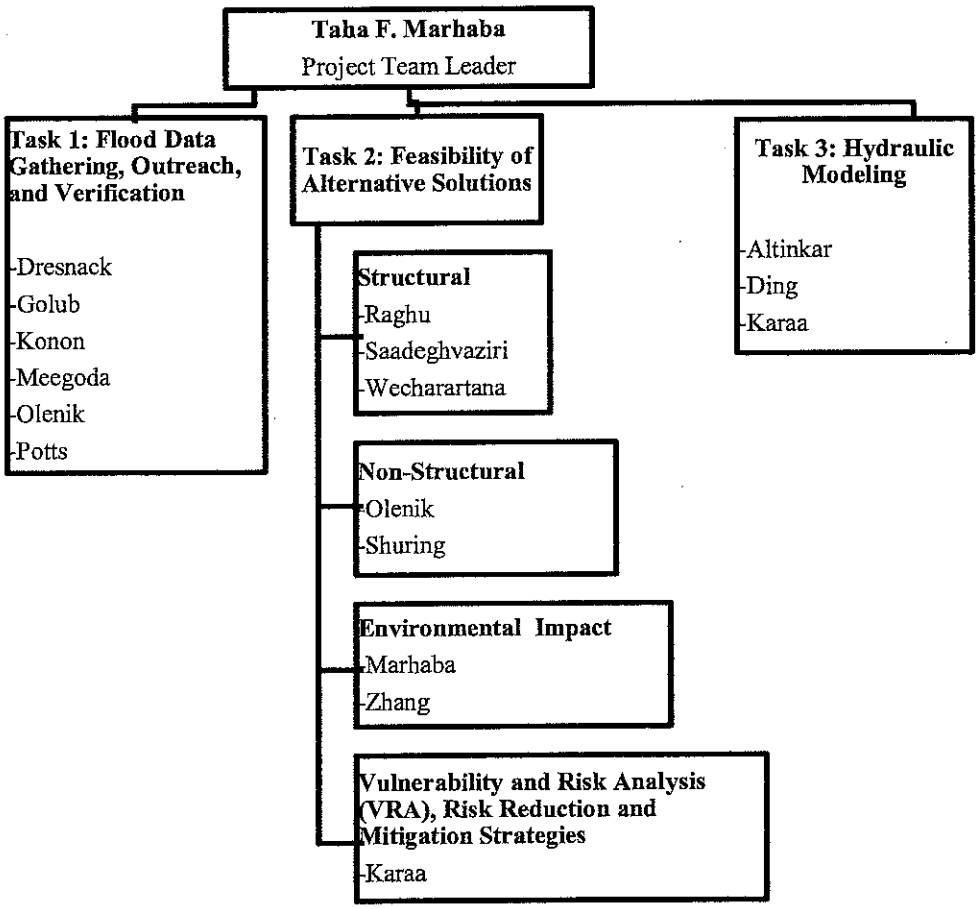


Figure 29. Organizational Diagram of the Team

5.0 DELIVERABLES

Monthly Reports	Monthly progress reports will be sent to the NJDEP that will be broken down into the respective tasks. The reports will be sent to NJDEP at the beginning of every month. In addition, monthly meetings may be scheduled.
Final Report	A final report will be delivered to NJDEP that includes all pertinent data and analysis no later than 7 months beyond the project starting date.

6.0 QUALIFICATIONS OF THE RESEARCH TEAM

Dr. Taha F. Marhaba, P.E. is currently a professor of environmental engineering and chairman of the Department of Civil and Environmental Engineering (CEE) at NJIT. The CEE Department is one of the largest civil engineering departments in the region, and is home to 26 tenured/tenure-track faculty, 2 university lecturers, 5 administrative staff, 10 full-time research staff, 530 undergraduate students, and 270 masters and doctoral students. He manages an annual budget of over $10 million. Dr. Marhaba will take the lead in the overall management of the project team and tasks. He will be the main contact person for the project. Dr. Marhaba, a licensed engineer in the state, earned a Bachelors, Masters and Doctorate in Civil and Environmental Engineering from Rutgers University, whose alumni engineering society recently awarded me the "Distinguished Engineer Award" for achievements that have contributed significantly to the national economy, security, public welfare, the quality of life, to the solution, and advancement of a specific technical need in engineering. Before joining NJIT in 1995, he worked for several years with Stone & Webster Engineering Corp.. He has extensive engineering experience and research totaling over $13 million. Dr. Marhaba has conducted fundamental and applied research in various areas of civil and environmental engineering, specifically water quality, drinking water treatment, and environmental systems and management. His scholarly work is published in books/book chapters, refereed journals and technical reports. Dr. Marhaba serves on the NJDEP State Water Supply Advisory Council.

Dr. Mustafa S. Altinakar is currently the Director and Research Professor at the National Center for Computational Hydroscience and Engineering (NCCHE) of the University of Mississippi in Oxford Mississippi, USA. He will be working with Drs. Yan Ding and Fadi Karaa on the modeling task of the project, bringing the optimal expertise to the project. He obtained his Ph.D. (1988) in Hydraulics at the Hydraulic Research Laboratory (LRH), Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, M.S (1980) and B.S. (1978) degrees in Civil Engineering at the Middle East Technical University, Ankara, Turkey. He also holds a Masters in Applied Mathematics from the Department of Mathematics at EPFL (1987). Before joining the NCCHE in December 2002, Dr. Altinakar served as the Acting Director of LRH-EPFL from 2001 to 2002 and the Head of the Fluvial Hydraulics Section of LRH-EPFL from 1997-2001. From 1989 to 1997, he was a Senior Design Engineer and Project Manager at Bonnard and Gardel Consulting Engineers Ltd. in Lausanne and took part in large-scale projects, including design of dams, hydroelectric power plants, flood protection schemes, drinking water supply and waste-water collection networks, etc. in Switzerland, France, Turkey, and North African countries. During the same period, he also held a part-time Research Associate position at LRH-EPFL and taught undergraduate and graduate courses. Dr. Altinakar's research interests include fluvial hydraulics and its environmental aspects, sediment transport and local scour, flood simulation and mapping, natural hazards and emergency management, diffusion and dispersion in waterways, transport and fate of contaminants, stratified flows, computational fluid dynamics, integrated watershed management, optimization and decision support systems, and the design of hydraulic structures. He co-authored two text books in French; one on hydrodynamics and another on fluvial hydraulics. The latter was translated into English and Chinese. He published

more than 120 journal articles, conference papers, and articles in online encyclopedias. He is a member of the ASCE, IAHR, AGU, ASFPM and ASDSO. He is the Chair of the IAHR Fluvial Hydraulics Committee, member of the ASCE-EWRI Task Committee on Dam/Levee Break Fluvial Processes, and serves as the IAHR liaison at the International Flood Initiative (IFI) of UNESCO.

Dr. Yan Ding is research associate professor at the at the National Center for Computational Hydroscience and Engineering (NCCHE) of the University of Mississippi in Oxford Mississippi, USA. Dr. Yan Ding earned a bachelor of science, a master of science, and a doctorate in hydraulic engineering from Tsinghua University at Beijing, China, in respectively 1987, 1990, and 1994. Between 1995 and 1998, he worked in the civil engineering department at CHUO University, Tokyo, Japan, as a research associate and teaching assistant. As he completed a dissertation on the finite elemental modeling of fluid flows and hydrodynamic stability analysis of turbulence transition, Dr. Ding received his doctoral degree of engineering in computational mechanics at CHUO University in 1999. From 1998, he started to work in the New Civil Engineering Research Institute (or INA) in Tokyo, Japan. He became a senior coastal engineer to develop and apply numerical models to facilitate coastal structure designs and waterfront environmental assessment on sediment transport management, coastal erosion protection, and water quality control in rivers, coasts, and estuaries. In 2001, Dr. Ding joined the NCCHE at the University of Mississippi. Since then he has dedicated the majority of his career to development and application of numerical models for simulating coastal/estuarine morphological and fluvial processes through modeling hydrodynamics, sediment transport, and water quality. He has conducted a long-term collaborative contracted research project on coastal process modeling and development of the CMS-M2/3D in SMS (Surfacewater Modeling System) for coastal inlet assessment, which is sponsored by the Coastal Inlets Research Program, U.S. Army Corps of Engineers. Dr. Ding has a wide spectrum of research interests including river/coastal hydraulics, pollutant/sediment transport, water quality, numerical analysis, and large-scale optimization as well as its applications to water resource management and flood control in open channel flows. He has published 47 peer-reviewed papers in highly-reputable journals, book chapters, conference proceedings, and more than 10 technical reports. Dr.Ding has 16 invited lectures in international conferences, universities, and research institutes. His memberships in professor societies include : the ASCE - EWRI (the Environmental & Water Resources Institute) and the ASCE - COPRI (the Coasts, Oceans, Ports, and Rivers Institute). Dr. Ding is a member of the Computational Hydraulics Committee in ASCE-EWRI and a member of the Technical Committee on the Verification and Validation of 3D Free Surface Flow Models.

Drs. Robert Dresnack, P.E. and Eugene Golub, P.E. have collabarated on numerous funded research projects on behalf of the NJDEP,NJDCA and NJDOT for almost forty years related to hydrologic and hydraulic studies and public outreach and public participation related thereto. They are co-authors of the Flood Manual prepared for NJDEP in the 1980s. Some of the studies related to this proposal include (a) Environmental Assessment of constructing a 96 inch pipeline connecting Round Valley Reservoir and the Confluence of the North and South Branches of the Raritan River-1976(outreach and public participation), (b) Safe yield studies for the Raritan

River,Passaic River, and Hackensack River-1980's, (c) Value of Wanaque Reservoir as a flood reducing facility on downstream locations-1980's, (d) Environmental and Economic Assessment of constructing a one billion gallon reservoir at the confluence of the North and South Branches of the Raritan River -1980-81(outreach and public participation), (e) Evaluation of the Environmental and Socio-Economic Impacts of the Completion of the Route #21 Corridor in Passaic and Clifton, New Jersey-2002-06(outreach and public participation), (f) Developed a Flood Plain Manual for New Jersey for the NJDEP-1980's(outreach and public participation), (g) Design and Evaluation of Bridges for Scour-Hydraulic and Hydrologic Investigations-2010-currently, and (h) Assessment of the Department of Community Affairs Storm Water Detention Regulations-1996-7(outreach and public participation). In addition to the above, Professor Dresnack teaches an undergraduate course in Water Resources Engineering which examines, in part, analysis of extreme storm events and related Return Periods. He also teaches a graduate course in Environmental Impact Analysis. Dr Golub teaches a graduate course in Open Channel Flow. Lastly, they both have served as consultants in related studies for numerous consulting firms and municipalities and both have extensive experience in providing expert testimony related to the above areas of study.

Dr. Tom Hsu is professor of structural engineering at NJIT and has conducted research in the areas of structural engineering, structural mechanics and design, particularly in the area of structural concrete analysis and design. His recent research efforts involve biaxially loaded slender concrete columns, high strength concrete with and without fibers, composite columns, and constitutive equations for concrete using strain space plasticity, fatigue crack growth rate in concrete, and computer applications using spline functions. Dr. Hsu has several patents in structural innovation.

Dr. Fadi A. Karaa is a specialist in critical infrastructure, an Associate Professor in the Department of Civil and Environmental Engineering and Director of the Critical Infrastructure Systems graduate program. His research focus is in infrastructure management systems, risk management, construction management and large-scale project and enterprise asset management systems. He is an expert in the areas of failure and risk analysis of water and wastewater infrastructure systems, and the optimization of infrastructure capital improvement plans. He has also developed a Bayesian and statistical modeling framework for multi-modal analysis of dam safety. His research areas of interest include the monitoring and sensing of the performance of key assets such as dams and levees, as well as comprehensive decision and risk modeling for protection analysis and the development of information tools for the support of mitigation and resilience measures, such as flood warning systems and optimal evacuation and population protection strategies. Karaa has led a range of research and development projects in construction and infrastructure management and developed several decision support and management systems. Notable projects include 1) a NSF-sponsored project on the development of an expert system for water distribution system maintenance, rehabilitation and reconstruction decisions, 2) the development of a decision support system for the management and mitigation of infiltration and inflow for Army facilities, which was applied in several large-scale Army installations, 3) a worldwide inventory and SDWA treatment selection, compliance management and costing system for Army facilities across its source water, stored, treated and distributed water and 4)

multi-criteria life-cycle analysis and technical evaluation studies for two of the largest pipeline rehabilitation projects in the Greater Boston Area. His past experiences in industrial management and systems consulting include serving as vice president for Oracle Corporation, where he led the Northeast Consulting Group and a national data warehousing practice for the industrial sector, and Vice President of Business Intelligence at Information Resources designing and implementing enterprise solutions for Fortune 100 companies. Karaa received his PhD In civil engineering (water resource systems and project management), MS in management (finance and MIS) and MS in Civil Engineering all from MIT; he was awarded an Engineer Diploma from Ecole Polytechnique, Paris. He was the recipient of the Arthur T. Ippen Award, from MIT and the Boston Society of Civil Engineers President's Award.

Prof. Walter Konon, P.E., H.H.S., has been a Professor of Civil and Environmental Engineering at the New Jersey Institute of Technology since 1974. He has extensive professional and academic experience in the areas of heavy construction and infrastructure renovation. He currently teaches undergraduate and graduate courses in construction engineering, materials testing, infrastructure repair, and work zone safety. Prof. Konon currently heads the Construction Division at NJIT. He also serves as Associate Department Chair and Chief Advisor, and was a former Department Chair. Prof. Konon's current research involves design and construction modifications to reduce infrastructure costs. His work has been funded by many public agencies including NJDOT, NJDEP, NSF, and New Jersey Department of Community Affairs. Prof. Konon is a licensed professional engineer and high-rise building inspector. Prior to joining NJIT, he worked on large construction projects with contractor Peter Kiewit and the consulting firm of Couddry Carpenter, and also as a structural test engineer at Grumman Aircraft. Prof. Konon was a Senior Fulbright Visiting Professor at the Kiev Institute of Civil Engineering and the Moscow Institute of Civil Engineering, both in the former U.S.S.R.

Dr. Jay Meegoda is the director of Geotechnical Laboratory and a Professor of Civil and Environmental Engineering at New Jersey Institute of Technology. He received his BS (Honors) from University of Sri Lanka and his M.S. and his Ph.D. from the University of California at Davis. He has been working as educator, consultant and researcher in engineering for over 32 years. He utilizes scientific concepts and engineering technologies in his research to provide solutions to real world problems. Dr. Meegoda has worked with state and local governments, and foreign governments to provide technical input for broad range of problems. He has many research collaborations with many nations spanning all five continents of the world. Dr Meegoda has worked on three major research areas. His primary research is in Mechanics of Geo-Environmental Engineering, which includes Engineering Properties of Contaminated Soils, Centrifugal Modeling of Contaminant Movement in Soils and Remediation of Contaminated Soils, Micro-mechanics of Soils, Reuse of Contaminated Soils, and Ultrasound. His second major research area is sustainable use of waste, which is still under the broad area of Geo-environmental Engineering. Dr. Meegoda as PI has successfully concluded several multidisciplinary research projects worth over $6M from agencies such as NSF, USEPA, US Army, FHWA, NJDOT and NJDEP that provided broader impact to the society. Some of those technologies are now extensively used while others are to be commercialized. He has published over 150 papers. He has one patent and applied for one provisional patent. He received the

research implementation award from the New Jersey Department of Transportation in 2011 for his Culvert Information Management Research, the best theoretical paper award from the Environmental and Water Resources Institute of ASCE in May 2012 for his research collaboration with China and the best practice paper award from the Environmental and Water Resources Institute of ASCE in May 2001 for the paper describing the results of one USEPA SITE demonstration project. Dr. Meegoda currently serves Associate Editor of the ASCE Journal of Hazardous, Toxic, and Radioactive Waste Management, Editorial Board Member ASTM Geotechnical Testing Journal, Springer Journal on Waste and Biomass Valorization and The Scientific World Journal, Guest editor, Journal of Hazardous Materials, special issue on Contaminated Dredged Sediments and Associate Editor of the 4th International Symposium on Environmental Geotechnology and Global Sustainable Development. He is a guest/research/visiting professor/scholar of six different universities.

Dr. Thomas Olenik, P.E. associate professor of civil and environmental engineering. He is co-author of the Flood Manual originally prepared for NJDEP. He has 35 years of design and construction experience regarding water distribution, sanitary and stormwater systems. In addition to teaching two design courses concerning the abovementioned utilities, he has designed many residential and commercial projects requiring the design of such systems. Dr. Olenik is a member of the Site Infrastructure Advisory Board (SIAB) for the New Jersey Department of Community Affairs. This group produced a publication known as the "Residential Site Improvement Standards." Dr. Olenik was the co-author of three chapters concerning the design and construction of water, sanitary and stormwater systems. He serves as the chairman of the committee that wrote these technical documents. In addition, he has served as a qualified expert witness for many planning boards and related legal testimony.

Dr. Laramie Potts is an associate professor of Engineering Technology at NJIT and serves as the program coordinator of the Surveying Engineering Technology (SET) program at NJIT. He has been working as an educator, consultant, and researcher in geoinformatics for over 10 years. He utilizes scientific concepts and engineering technologies in his research to provide solutions to real world problems. Dr. Potts has worked with state and local governments in providing technical input for geospatial mapping problems. Dr Potts' research focuses on surveying, geodesy, integration of multi-sensor remote sensing technologies, and hydro-acoustic signal processing for hydrographic mapping. His research on mapping includes modeling (regional and local) crustal mass variations from gravity and topography data. His research activities on space weather utilize dual frequency geodetic measurements and solar indices to update predictive models on ionospheric electron density variations and delays for surveying measurements. His GIS related research is focused on real-time Geospatial Infrastructure Information Management Systems (GIIMS). He has authored and co-authored more than 25 refereed journal articles and more than 30 conference presentations on geophysical modeling, geospatial data analysis, and GIS applications. He is a member of the New Jersey Society for Professional Surveyors (NJSPLS) and a member The Hydrographic Society of America (THSOA). Laramie is also a member of the North American Geoid Project which aims to support geoid (and gravity field) theories and specifications in the US and other countries.

Dr. Dorairaja Raghu, P.E., has been a Faculty in the Civil Environmental Engineering Department at NJIT since 1977 September. He has prior experience of teaching in USA and India for over 8 years. In India, he worked as an Engineer for 3 years and in USA, he has had extensive professional and consulting experience. His area of specialization is Geotechnical Engineering. His areas of research have been in geotechnical and geotechnical engineering, having obtained several research grants and having several publications to his credit. He was declared "Engineer of the year" in 1990 by the North Jersey Branch of the American Society of Civil Engineers. Recently he won the Robert Van Houten Award for Teaching Excellence at NJIT. He has been a licensed Professional Engineer in the State of New Jersey since 1979.

Dr. M. Ala Saadeghvaziri, P.E. is a professor of Civil and Environmental Engineering at New Jersey Institute of Technology. He joined NJIT in 1988 as an assistant professor after receiving his BS (with high honors, 1981), MS (1983), and PhD (1988) degrees from University of Illinois @ Urbana-Champaign. His research interest is in the area of structural engineering with emphasis on non-linear response of structural and mechanical systems under extreme events such as earthquake ground motion and effect of blast loads, serviceability of concrete structures, and application of finite element methods. He has completed many successful projects for NJDOT, which have included advanced finite element applications. He has supervised a project supported by DoD/NSF on blast load simulations and its effect on structures using explicit finite element analysis. This experience will further enhance the success of the simulations task(s) of the proposed work. Dr. Saadeghvaziri is a registered professional engineer in the state of New Jersey and a fellow of ASCE. He is extensively involved with professional service by serving as reviewer for various agencies such as NSF and many Journal publications. He was a member of ASCE Seismic Effects Committee, and is currently serving on Bridge Security Committee, and Blast Shock and Vibratory Effect Committee. He is also an ABET program evaluator and have conducted evaluation of several civil engineering programs nationally.

Dr. John Schuring, P.E. is a Professor of Civil and Environmental Engineering at the New Jersey Institute of Technology. Dr. Schuring has over 30 years' experience in the areas of civil, hydraulics, and geotechnical engineering in both the academic field and professional practice. He currently teaches undergraduate and graduate courses in hydraulics, hydrogeology, engineering geology, and construction materials. Dr. Schuring served as an academic administrator for eight years, first as Department Chair and later as Interim Dean of the Newark College of Engineering. Dr. Schuring is the Founding Director of the NJIT Hydraulics and Hydrogeology Laboratory. Dr. Schuring's current research and consulting interests include bridge scour, bridge load testing, groundwater modeling, and engineering geomorphology. His funded research, which has totaled more than $2.5 million, has been supported by USEPA, USDOE, US Air Force and NJDOT, in addition to corporate clients including Union Carbide, AT&T, BP America and Exxon. In addition, Dr. Schuring has provided consultation on dozens of bridge and infrastructure projects for regional agencies, including the NJDOT, NYS Thruway Authority, Triboro Bridge & Tunnel Authority, ConnDOT, NYCDOT and Delaware Joint Bridge & Toll Commission. Among these projects was the Schoharie Creek Bridge reconstruction. Dr. Schuring holds five U.S. patents for a soil treatment process known as pneumatic fracturing, which is now in wide commercial use throughout the U.S. and Canada. He has also published 50

articles in symposia proceedings, technical journals, and special technical publications. Prior to joining NJIT, Dr. Schuring worked as a consulting geotechnical engineer for area engineering firms, and among his projects was the Jacob Javits Convention Center in Manhattan, where he was Resident Engineer. He also served in the United States Air Force as a Civil Engineering Officer.

Dr. Methi Wecharatana, P.E. is professor of civil engineering and Associate Chairman for Graduate Studies. He received his PhD in Materials Engineering from the University of Illinois in 1982. He has over 31 years experience in fracture mechanics of cemetitious materials. He will be responsible for examining the feasibility of structural measures in the project. Dr. Wecharatana's work is widely published and received numerous awards worldwide for his research and teaching excellence. He is a member of the Board of Directors of the Greening of the Industry Network. He is actively involved in international collaborations of higher education, research, and code development. He is presently working for NSF and USAID in helping Indonesia and the Philippines create a University Industry Cooperative Research Center on Hazardous substance management.

Dr. Wen Zhang is currently an assistant professor of NJIT's Newark College of Engineering in the Department of Civil and Environmental Engineering. His research mainly focuses on environmental applications and implications of nanotechnology, which covers both the positive and negative aspects of novel engineered nanomaterials. Wen has demonstrated expertise in nanomaterial characterization, photocatalysis for contaminant removal and antimicrobial applications, and environmental biotechnology. Wen has published more than 29 peer-reviewed journal articles and made oral presentations at more than 15 national/international conferences. Wen was a research Fellow funded by the Semiconductor Research Corporation (SRC) from 2009 to 2012. In 2011, he received the Simon Karecki Award from the Global Research Collaboration and SEMATECH Engineering Research Center for his outstanding contribution to Environmentally Benign Semiconductor Research and Manufacturing. Most recently, he received the 2012 CH2M Hill/AEESP Outstanding Doctoral Dissertation Award from the Association of Environmental Engineering and Science Professors (AEESP).

7.0 TIME REQUIREMENTS

Time requirements for deliverables are depicted in the chart below. It is assumed that the project will start on July 1, 2013 and end on December 31, 2013. The Final Report will be submitted by January 30, 2014 (or 7 months following the official start date).

	Jul	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**
TASK 1: Flood Effect Data Gathering, Outreach and Verification							
TASK 2: Feasibility of Alternative Solutions							
Task 3: Hydraulic Modeling							
Monthly Reports							
Final Report							

8.0 BUDGET

The proposed total budget requested from NJDEP is $289,872 with a match from NJIT of $149,809, bringing the total project cost to $439,681. The detailed budget is shown on the next page, which includes faculty time, staff time and student time as well as local state travel and a subcontract to the National Center for Computational Hydroscience and Engineering (NCCHE) of the University of Mississippi (Oxford, Mississippi).

New Jersey Institute of Technology - FY13 BUDGET

FY13 Categories	Account	Hours	Hourly Rate	Yr - 1 Sponsor	Yr - 1 NJIT	Total Sponsor	Total NJIT	Grand
Faculty AY								
10 Month Non-Tenure Track/Research Prof	611002	175	114.29		20,000	0	20,000	20,000
12 Month Non-Tenure Track/Research Prof	611002		0.00	0		0	0	0
	611007		0.00	0		0	0	0
	612008		0.00		0	0	0	0
Sub-Total				0	20,000	0	20,000	20,000
Faculty Summer								
various NJIT faculty	614024	1575	126.98	200,000		200,000	0	200,000
	614024		0.00	0		0	0	0
	614024		0.00	0		0	0	0
Sub-Total				200,000	0	200,000	0	200,000
Professional Staff								
Admin Staff	616101		0.00	0		0	0	0
Support Staff	617201	120	43.98	5,275		5,275	0	5,275
Sub-Total				5,275	0	5,275	0	5,275
Students								
PhD Stipend	619104		29.41	0		0	0	0
Masters Stipend	619104		14.70	0		0	0	0
Undergraduates, hourly	619113		0.00	0		0	0	0
Other Students		400	19.92	7,967		7,967	0	7,967
Sub-Total				7,967	0	7,967	0	7,967
Total Personnel				213,242	20,000	213,242	20,000	233,242
Fringe Benefits								
Full Time, 35.0%	657050			1,846	7,000	1,846	7,000	8,846
Summer, 8.8%	657060			13,600	0	13,600	0	13,600
Part Time & Students, 3.6%	657070			287	0	287	0	287
Total Fringe Benefits				15,733	7,000	15,733	7,000	22,733
Total Personnel & Fringe				228,974	27,000	228,974	27,000	255,974
Equipment								
Equipment < 2500	711000					0	0	0
Equipment > 2499	710002					0	0	0
Total Equipment				0	0	0	0	0
Supplies:								
Supplies	734002					0	0	0
						0	0	0
Total Supply Costs				0	0	0	0	0
Travel & Conferences								
Domestic	740008			5,000		5,000	0	5,000
International	741008					0	0	0
						0	0	0
Total Travel & Conferences				5,000	0	5,000	0	5,000
Other Operating Expense								
Consultants	756101		0.00	0		0	0	0
Labs Services	756239					0	0	0
Other Costs				0	0	0	0	0
Subcontracts/Agreements								
< $25,001	758110			25,000		25,000	0	25,000
> $25,000	758111			5,000		5,000	0	5,000
Subcontracts/Agreements				30,000	0	30,000	0	30,000
Participant Support								
Participant (With F&A charged)	756918					0	0	0
Participant (No F&A charged)	756918					0	0	0
Participant Support				0	0	0	0	0
Total Other Operating Expense				30,000	0	30,000	0	30,000
Student Aid		# of Credits	# of Semsters					
Tuition GS Out of State	788003	0	0	0		0	0	0
Tuition GS in State	788003	0	0	0		0	0	0
E-Tuition	788049	0	0	0		0	0	0
		# of Students	# of Semsters					
Tuition GS Full Time Out of State	788003		0	0		0	0	0
Tuition GS Full Time In State	788003		0	0		0	0	0
Total Student Aid				0	0	0	0	0
Total Direct Costs				258,974	27,000	258,974	27,000	285,974
Total MTDC				258,974	27,000	258,974	27,000	285,974
F&A: 10% of MTDC, 42% Match	700001			25,897	122,809	25,897	122,809	148,707
TOTAL PROJECT COSTS				289,872	149,809	289,872	149,809	439,681

PI
Taha F. Marhaba

DEPARTMENT
Civil and Environmental Engineering

PROPOSAL TITLE
Flood Mitigation Engineering Resource Center

SPONSOR AGENCY
NJDEP

FLOW THROUGH AGENCY SUBCONTRACT TO NJIT

DATE/TIME PROPOSAL TO BE SUBMITTED TO AGENCY
(EX: 00/00/00 00:00 AM or PM)

DATE TO SUBMIT TO SRA
(At least 2 days prior to date above)

FIELD OF SCIENCE
4. Civil

TYPE OF RESEARCH
Applied Research

EQUIPMENT LIST

CONSULTANTS NAME

SUBCONTRACTORS NAME
University of Mississippi

9.0 REFERENCES

Altinakar, M.S., McGrath, M.Z., Ramalingam, V.P., Matheu, E.E., Matthews, M., Seda-Sanabria, and Thomas, B. Jr. (2013): "Web-Based, Automated 2D Dam-Break Simulation and Mapping", Proceedings of MODSIM World 2013, 4/30-5/2, 2013, Hampton Roads Convention Center in Hampton, VA.

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Ding, Y., Ding, T., Jia, Y., Altinakar, M. S. (2013). Developing a Tropical Cyclone Parametric Wind Model with Landfall Effect for Real-Time Prediction of Wind and Storm Surge, In: Proceedings of 2013 IAHR Congress, Tsinghua University Press, Beijing, Chengdu, China, Sept. 8-13, 2013, 14 p.

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FEMA Resources: https://sites.google.com/site/region2coastal/sandy/abfe

Floating dams- www.nyc.gov/html/dep/html/press_releases/12-02pr.shtml

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Peter J. Vickery, Peter F. Skerlj, Jason Lin, Lawrence A. Twisdale Jr.4, Michael A. Young5, and Francis M. Lavelle (2006), "HAZUS-MH Hurricane Model Methodology. II: Damage and Loss Estimation," Natural Hazards Review, Vol. 7, No. 2, pp. 94-103.

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APPENDIX A: ACCOMPLISHMENTS OF THE RESEARCH TEAM – SHORT 2-PAGE RESUMES

TAHA F. MARHABA, Ph.D, P.E. (TEAM LEADER)

Professor and Chairman, Department of Civil & Environmental Engineering
New Jersey Institute of Technology
Newark, NJ 07102
(973) 642-4599, (973) 596-5790 fax, Marhaba@njit.edu

Dr. Marhaba has been a member of the Environmental Division in the Department since 1995. He was involved in teaching undergraduate and graduate courses in civil and environmental engineering that included design capstone, environmental engineering, solid waste, hazardous waste, fundamentals of engineering preparatory course, physical and chemical treatment. Since joining NJIT in 1995, he immediately self-started in research and scholarly activities, obtaining his first grant as Principal Investigator (PI) only several months into the position. He has extended his connections with industry and volunteered his time to serve his profession. He has held numerous positions in the American Water Works Association (AWWA) section in New He has externally funded and graduated numerous Ph.D. and M.S. students as primary advisor. He supervised several post-doctoral research associates funded through his externally funded research. He has significantly contributed to the Department's mission. During his tenure at NJIT, Dr. Marhaba was awarded numerous awards from the profession and NJIT in teaching and research. Dr. Marhaba has been a key spokesperson for the Department to the media in the area of environmental engineering. Dr. Marhaba has been involved in numerous overseas collaborations and partnerships to provide opportunities for the students to learn about state-of-the-art technologies, the policy and management system already in place as well as the future global trend. He has collaborated with numerous researchers at NJDEP in the past 25 years.

I. Academic Professional Experience

Chairman	CEE Department	New Jersey Institute of Technology	2009 – Present
Associate Chairman	CEE Department	New Jersey Institute of Technology	2006 – 2008
Professor	CEE Department	New Jersey Institute of Technology	2008 – Present
Associate Professor	CEE Department	New Jersey Institute of Technology	2000 – 2008
Assistant Professor	CEE Department	New Jersey Institute of Technology	1995 – 2000
Founding Director	NJ Applied Water Res. Ctr.	New Jersey Institute of Technology	2003 – 2006
Adjunct Professor	CEE Department	Rutgers, The State University of NJ	1994 – 1995
Visiting Professor	International Postgraduate Programs in Environmental and Hazardous Waste Management, Chulalongkorn Univ., Thailand		2000 – 2005

II. Other Professional Experience

Environmental Engineer	Stone & Webster Engineering Corp.	Cherry Hill, NJ	1993 – 1995 1991 – 1992
Assistant Process Engineer	Envirogenics Systems Co.	El-Monte, CA	1988 – 1989

III. Education

Ph.D.	Environmental Engineering	Rutgers, the State University of New Jersey	1993
M.S.	Environmental Engineering	Rutgers, the State University of New Jersey	1990
B.S.	Civil Engineering	Rutgers, the State University of New Jersey	1989

IV. Professional Licenses

Professional Engineer (P.E.)	State Board of Professional Engineers and Land Surveyors, State of New Jersey, No. 24GE03939200	1995 – Present

V. SIGNIFICANT PUBLIC APPOINTMENTS

Council Member	Water Supply Advisory Council, State of New Jersey	2012 – Present

VI. SCHOLARLY ACTIVITIES (Selected)

Selected Published Books and Book Chapters:

Marhaba, T.F. and Borgaonkar, A., Chapter 15- Evaluating Sustainability Strategies in Monitoring Water Quality: Pollution Assessment, Analysis, and Remediation, Edited by Satinder Ahuja, 2013, Elsevier B.V., ISBN: 9780444593955

Marhaba, T.F., Chapter 12- Monitoring Disinfectants in Handbook of Water Quality and Purity, Edited by Satinder Ahuja, 2009, IWA Publishers. ISBN: 9781843393184

Selected Published Refereed Journal Papers:

Chien S., Gao S, Meegoda J., Marhaba T., Estimation of Maintenance Fleet Size for Spreading Operation Considering Road Geometry, Weather and Traffic, *ASCE Journal of Transportation Engineering*, in press 2013.

Marhaba T.F. Bonkaonkar A., and , Punburananon K., Principal component regression model applied to dimensionally reduced spectral fluorescentsignature for the determination of organic character and THM formation potential of source water, *Journal of Hazardous Materials*, 169(1-3), pp. 998-1004, 2009.

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Pavasant P., Apiratikul R., Sungkhum V., Suthiparinyanont P., Wattanachira S. and Marhaba T.F., Biosorption of Cu^{2+}, Cd^{2+}, Pb^{2+}, and Zn^{2+} using dried marine green macroalga Caulerpa lentillifera, *Bioresource Technology*, 97(18), pp. 2321-2329, 2006.

Musikavong C., Wattanachira S., Marhaba T.F. and Pavasant P., Reduction of organic matter and trihalomethane formation potential in reclaimed water from treated industrial estate wastewater by coagulation, *Journal of Hazardous Materials*, 127(1-3), pp. 48-57, 2005.

Meegoda, Jay N., Marhaba, Taha F., and Ratnaweera, Prasanna, Strategies to Mitigate Salt Runoff from Salt Storage and Salt Truck Maintenance Facilities, *ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management*, 8 (4), 247-252, 2004.

Marhaba T.F., Pu Y., Bengraine K., New Jersey's Water Supply Demand and Needs, *Clean Technologies & Environmental Policy*, 6 (1), 51-60, 2003.

Marhaba T.F. and Lackey D.M., Flow Control Regulations to Gain Waste Disposal Self Sufficiency, *Environmental Engineering and Policy*, 1(2):125-136, 1998.

Professional Societies: American Board for Engineering and Technology (ABET) Program Evaluator (2012- present) for engineering programs; American Society of Civil Engineers (ASCE); American Water Works Association (AWWA)

VII. RESEARCH GRANTS (External)

Awarded and supervised 15 research projects as the Principal Investigator (PI) or Co-Principal Investigator (Co-PI) with total external funding of $2.6 million funded by NJDEP and NJDOT among others. Also participating in three multi-year grants as a Participating Investigator (I), totaling over $12 million.

VIII. HONORS, AWARDS, AND LISTINGS (partial)

Received the "Distinguished Engineer Award" from the Engineering Society of Rutgers University (2010); "Educator of the Year" award from the North Jersey Section of the American Society of Civil Engineers (2009); NJIT Institute Excellence in Teaching Award (2008); Listed in Water-Purification-Filters as "Expert" in water quality, since 2003.; Received numerous poster and paper awards.

MUSTAFA S. ALTINAKAR

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altinakar@ncche.olemiss.edu

Dr. Mustafa S. Altinakar is the Director and Research Professor at the National Center for Computational Hydroscience and Engineering (NCCHE) of the University of Mississippi in Oxford Mississippi, USA. His fields of specialization and research interests include fluvial hydraulics and its environmental aspects, sediment transport and local scour, flood simulation and management, diffusion and dispersion in waterways, transport and fate of contaminants, stratified flows, computational fluid dynamics, integrated watershed management, optimization and decision support systems, and design of hydraulic structures. He is also specialized in flood protection, risk analysis, flood emergency management, optimization.

His publications include 2 books, more than 100 journal and conference papers, several articles for online encyclopedias. He has been invited to deliver keynote lectures, short courses at various universities and leading research institutes around the world.

He is a member of the ASCE (American Society of Civil Engineers), IAHR (International Association of Hydro-Environment Engineering and Research), AGU (American Geophysical Union), ASFPM (Association of State Flood Plain Managers) and ASDSO (Association of State Dam Safety Officials). He serves as the Chair of the Standing Committee on Global Water Issues of the International Flood Initiative (IFI) of UNESCO/IAHR, Chair of the IAHR Task Committee on Fluvial Hydraulics, and member of the Fluids Committee of the ASCE.

A. Professional Preparation

1988 Federal Institute of Technology, Lausanne, Switzerland ; Ph.D. in Hydraulics
1987 Federal Institute of Technology, Lausanne, Switzerland ; M.Sc. in Numerical Analysis
1980 Middle East Technical University, Ankara, Turkey ; M.Sc. in Civil Engineering
1978 Middle East Technical University, Ankara, Turkey ; B.Sc. in Civil Engineering

B. Appointments

2010 – Director and Research Professor, National Center for Computational Hydroscience and Engineering, The University of Mississippi.
2005 – 2010 Associate Director of Applied Research and Research Professor, National Center for Computational Hydroscience and Engineering, The University of Mississippi.
2003 – 2005 Research Professor, National Center for Computational Hydroscience and Engineering, The University of Mississippi.
2001 – 2002 Acting Director of Laboratory of Hydraulic Research, Department of Civil Engineering, Federal Institute of Technology, Lausanne, Switzerland
1998 – 2001 Research Associate (Tenure) and Head of the Fluvial Hydraulics Section, Lab. of Hyd. Res., Dep. of Civil Eng., Federal Inst. of Technology, Lausanne, Switzerland
1998 – 2002 Expert for Consulting Engineering Companies in Switzerland and France,
1989 – 1997 Senior Design Engineer and Project Manager, Bonnard and Gardel Consulting Engineers, Ltd., Lausanne, Switzerland
Part-time Research Associate, Lab. of Hyd. Res., Dep. of Civil Eng., Federal Inst. of Technology, Lausanne, Switzerland
1980 – 1988 Teaching Assistant, Laboratory of Hydraulic Research, Department of Civil Engineering, Federal Institute of Technology, Lausanne, Switzerland
1978 – 1980 Graduate Research Assistant, Hydromechanics Laboratory, Department of Civil Engineering, Middle East Technical University, Ankara, Turkey

C. Publications

Books

1. Graf, W.H. and M.S. Altinakar, "FLUVIAL HYDRAULICS: Flow and transport processes in channels of simple geometry"; John Wiley and Sons, 1st ed. 1998, 2nd ed., 2000. Chinese translation by Profs Z. Wan and W. Zhao was published by Chengdu University Press, Chengdu, Rep. of China, 1st ed. 1998
2. Graf, W.H. and M.S. Altinakar: "HYDRODYNAMIQUE"; Presse Polytechnique et Universitaire Romand, Lausanne, Switzerland, 1st ed by Editions Eyrolles, Paris, France in 1991, 2nd revised edition by Presse Polytechnique et Universitaire Romand, Lausanne, Switzerland, in 1995.

Selected Journal Publications

1. Ding, Y., Kuiry, S.N., Elgohry M., Jia, Y., Altinakar, M.S., and Yeh, K.-C. (2013). Impact assessment of sea-level rise and hazardous storms on coasts and estuaries using integrated processes model, Ocean Engineering, Accepted, In Press. http://dx.doi.org/10.1016/j.oceaneng.2013.01.015
2. Brodtkorb, A. R. , Sætra, M. L. and Altinakar, M.S. (2011). Efficient Shallow Water Simulations on GPUs: Implementation, Visualization, Verification, and Validation, Computers & Fuids, 55, (2011), pp 1--12. DOI: 10.1016/j.compfluid.2011.10.012.
3. Qi, Honghai and Altinakar, M.S. (2011), "Simulation-based decision support system for flood damage assessment under uncertainty using remote sensing and census block information", Natural Hazards, Vol: 59, Issue: 2, pp. 1125-1143
4. Ozeren, Y., Wren, D. G., Altinakar, M.S. and Work, P. A. (2011): "Experimental Investigation of Cylindrical Floating Breakwater Performance with Various Mooring Configurations"; Journal of Waterway, Port, Coastal, and Ocean Engineering doi:10.1061/(ASCE)WW.1943-5460.0000090.
5. Qi, Honghai and Altinakar, M.S. (2011), "A GIS-based decision support system for integrated flood management under uncertainty with two dimensional numerical simulations", Environmental Modelling and Software, Vol: 26, Issue: 6, pp. 817-823.
6. Leupi, C., Miglio E., Altinakar, M., Quarteroni, A., Deville, M.O. (2009): "A 3D finite element model for free-surface flows". Computers & Fluids, Vol. 38, Issue 10, pp. 1903-1916. DOI: 10.1016/j.compfluid.2009.05.003.
7. Qi, H., M.S. Altinakar, D.A.N. Vieira, and Alidaee, Bahram (2008): "Application of Tabu Search Algorithm with a Coupled AnnAGNPS-CCHE1D Model to Optimize Agricultural Land Use"; JAWRA Journal of the American Water Resources Association, Volume 44, Number 4, August 2008 , pp. 866-878(13).
8. Wu, W., M.S. Altinakar, and S.S.Y. Wang (2006): "Depth-Average Analysis of Hysteresis between Flow and Sediment Transport under Unsteady Conditions"; International Journal of Sediment Research (IJSR), Vol.21, No.2, pp. 101-112.

Selected Conference Papers

1. Altinakar, M.S., McGrath, M.Z., Ramalingam, V.P., Matheu, E.E., Matthews, M., Seda-Sanabria, and Thomas, B. Jr. (2013): "Web-Based, Automated 2D Dam-Break Simulation and Mapping", Proceedings of MODSIM World 2013, 4/30-5/2, 2013, Hampton Roads Convention Center in Hampton, VA.
2. Altinakar, M.S., Singh, J., Ding, Y., and Inman, M. (2013): "A Computer-Game for Operational Dam Break Flood Simulation and Mapping". Accepted for publication in: Proceedings of the 6th International Perspective on Water Resources and Environment (IPWE 2013), Jan 7-9, 2013, Izmir Turkey.
3. Altinakar, M.S., McGrath, M.Z., Matheu, E.E., Ramalingam, V.P., Seda-Sanabria, Y., Breitkreutz, W., Oktay, S., Zou, J.Z., and Yezierski, M. (2012): "Validation of Automated Dam-Break Flood Simulation Capabilities and Assessment of Computational Performance", Proceedings of the Annual National Dam Security Forum in conjunction with the ASDSO Dam Safety 2012 Conference, September 16-20, 2012 at the Colorado Convention Center, Denver, CO.
4. McGrath, M.Z., Altinakar, M.S., and E. Miglio (2010): "Representation of Dam-Breach Geometry on a Regular 2-D Mesh Using Quadtree Local Mesh Refinement "; Proceedings of the International Conference on Fluvial Hydraulics (River Flow 2010), September 8-10, Braunschweig, Germany
5. Singh, J., M.S. Altinakar, Yan Ding (2010): "Well-Balanced, Positivity Preserving Central Scheme for Simulating Shallow Water Flows over Complex Topography"; Proceedings of the International Conference on Hydroscience and Engineering (ICHE-2010), August 2-5, Chennai, India

Yan Ding, Ph.D, Dr. Eng
Research Associate Professor, National Center for Computational Hydroscience and Engineering The University of Mississippi, 335 Brevard Hall, University, MS 28677-1848 Email: ding@ncche.olemiss.edu; Phone: (662) 915-8969, Fax: (662) 915-7796

Professional Preparation

Tsinghua University, Beijing, China	Hydraulic Machinery	B.S.	1987
Tsinghua University, Beijing, China	Hydraulics and River Dynamics '	M.S.	1990
Tsinghua University, Beijing, China	Hydraulics and River Dynamics	Ph.D.	1994
CHUO University, Tokyo, Japan	Computational Mechanics	Dr. Eng.	1999

Appointments
University of Mississippi, National Center for Computational Hydroscience and Engineering, Research Associate Professor, 2012-pressent, Research Assistant Professor, 2005-2012, Research Scientist 2001-2005.
INA Corporation, Coastal Engineering Department, Tokyo, Japan, Senior Engineer, 1998-2001
CHUO University, Tokyo, Japan, Research Associate and Teaching Assistant, 1995-1998
Tsinghua Univrsity, Beijing, P.R. China, Lecturer, 1994.

Five Publications Related to this Proposal
Ding, Y., Kuiry, S.N., Elgohry M., Jia, Y., Altinakar, M.S., and Yeh, K.-C. (2013). Impact assessment of sea-level rise and hazardous storms on coasts and estuaries using integrated processes model, Ocean Engineering, Accepted, In Press. http://dx.doi.org/10.1016/j. oceanering.2013.01.015
Ding, Y., Yeh K.-C., Chen, H.-K., and Wang, S. S.Y. (2012). Coastal and estuarine planning for flood and erosion
Protection using integrated coastal model, in: Coastal Hazards – Trends in Engineering Mechanics, Huang Et al. eds., ASCE, pp163-176 (ISBN978-07844-1266-4).
Ding, Y. (2011), Sea-Level Rise and Hazardous Storms: Impacts on Coasts and Estuaries, in Handbook for Mitigating Climate Change, Wei-Yin Chen, John Seiner, Toshio Suzuki and Maximilian Lackner eds., Springer, pp1523-1555 (ISBN 978-1-4419-7991-9).
Singh, J., Alitnaker, M., and Ding, Y. (2011). 2D numerical modeling of dam break flows over natural Terrain using a central explicit scheme, Advances in Water Resources, 34, 1366-1375.
Kuiry, S.N., Ding, Y., and Wang, S.S. Y. (2010), Modeling coastal barrier breaching flows with well-balanced shock-capturing technique, Computers & Fluids, 39 (10), 2051-2068.

Five Other Significant Publications
Ding, Y., Ding, T., Jia, Y., Altinakar, M.S. (2013) Developing a Tropical Cyclone Parametric Wind Model with Landfall Effect for Real-Time Prediction of Wind and Storm Surge, In: Proceedings of 2013 IAHR Congress, Tsinghua University Press Beijing, Chengdu, China, Sept. 8-13, 2013, 14 p.
Ding, Y., and Wang, S.S. Y. (2012). Optimal control of flood diverson in watershed using nonlinear Optimization , Advances in Water Resources-Elsevier, Vol. 44, August 2012, Pages 30-48.
Ding, Y., and Wang, S.S.Y. (2011), Modeling of Wave-Current Interaction Using a Multidirectional Wave-Action Balance Equation,In: Proc. 10th Int. Conf. On Coastal Engineering (ICCE), No. 32, Shanghai, China, Available at http://journals.tdl.org/ICCE/article/view/1315/pdf 99
Ding, Y., and Wang, S.S.Y. (2008). Develoment and application of coastal and estuarine morphological Process modeling system, Journal of Coastal Research, Special Issue No. 52, 127-140.
Ding, Y., Wang, Sam S. Y., and Jia, Yafei (2006)), Development and validation of a quasi three-Dimensional coastal area morphological model, J. Waterway, Port, Coastal, and Ocean Engineering, ASCE, Vol. 132, No. 6, pp. 462-476.
Synergistic Activities

- Invited NSF review panelist: the NSF Cyber-Enabled Discovery and Innovation (CDI) Program (April 2011), the NSF Environmental Engineering Program, Chemical, Bioengineering, Environmental and Transport Systems Division (CBET) program (April, 2012, June, 2010, and May, 2009), the NSF Collaboration in Mathemical Geoscience (CMG) program (May, 2010, May 2009).
- Invited grant proposal reviewer: Invited by U.S. Army Corps of Engineers (USACE) – Engineering Research and Development Center (ERDC) to review ERDC's Basic Research Strategic Research Areas for Geospatial Research and Engineering Environmental Quality and Installations Military Engineering, Civil Works, FY 2009 (Apr. 2008), FY 2010 (May 2009), and FY 2011 (May 2010).
- Technical Committee Member in ASCE-COPRI Task Committee on Coastal and Estuarine Hydroscience (2010-); ASCE-EWRI Computational Hydraulics Committee (2005)
- Collaboration with USACE-ERDC Coastal Inlet Research Program (CIRP) for Coastal Modeling System (CMS) model development (Dr. Nicholas C. Kraus, D. Zeki Demirbilek, Dr. Lihwa Lin) Sept. 2005-Dec. 2007).
- Conferences Session Chair: "Turbulent Flows I", May 24, 2012, ASCE-EWRI Congress 2012, Albuquerque, NM; "Application of GIS in Hydraulic Modeling II", ASCE-EWRI Congress 2011, May 23, 2011, Palm Sopring, California; Computational Hydraulics Session, ASCE-EWRI Congress 2009, Kansas City Missouri, May 18-21, 2009; Co-Chair and Program Committee member, The Sixth International Conference on Hydroscience and Engineering, Brisbane, Australia, 5/30-6/3, 2004.
- UM-NCCHE Annual Award Committee Chair, Nov.-Dec. 2010.
  UM-NCCHE Director Search Committee Member, June-July 2010.
- Coordinator of the NCCHE-NSL (National Sedimentation Laboratory) Joint Seminar, 2008-present.
- The Outstanding Performance Award (Research Assistant Professor), National Center for Computatonal Hydroscience and Engineering. The University of Mississippi, Dec. 2009, The Outstanding Performance Award (Research Scientist) Dec. 19, 2003.

Collaborators and Other Affilitations
Sam S. Y. Wang (NCCHE, The Univ. of Mississippi); Mustafa, S. Altinakar (NCCHE, The University of Mississippi), Yafei Jia (NCCHE, The Univ. of Mississippi); Weiming Wu (NCCHE, The Univ. of Mississippi); Soumandra Kuiry (NCCHE, The univ. of Mississippi; Jaswant Singh (NCCHE, The Univ.
Of Mississippi; Yaoxin Zhang (NCCHE, The Univ. of Mississippi); Philip J. Rhodes (The University of Mississippi), Nicholas C. Kraus (USACE-ERDC-CHL-MS), Zeki Demirbilek (USACEERDC-CHL, MS).
Lihwa Lin USACE-ERDC-CHL, MS); Scott Hagen University of Central Florida), Keh-Chia Yeh (National Chiago Tung University, Taiwan, ROC) Mutsuto Kawahara (CHUO University, Japan), Toshimitsu Takagi (INA Co., Japan).

Advisors
Mutsuto Kawahara, CHUO University, Japan C.-J. Yu, Tsinghua University, China

Thesis advisor and postgraduate-scholar sponsor
Moustafa Elgohry-Ph.D. 2007-present

1. **ROBERT DRESNACK** Professor of Civil and Environmental Engineering

2. **Education**
   BS Civil Engineering – City College of New York – 1961
   MS Civil (Sanitary Engineering) – NYU – 1963
   Ph.D. Civil (Sanitary Engineering) – NYU – 1966

3. **Academic experience** - All at NJIT (1966 to present)
   Assistant Professor - 1966
   Associate Professor - 1968
   Professor - 1975

4. **Non-Academic experience**

1972 – Present	Consultation services and expert testimony in environmental impact analysis related to water, air, and noise pollution control for consulting firms and municipalities in the tri-state region.
1966-1972	Part-time Consultant – U.S. Army Corps of Engineers Water and Wastewater projects in the northeastern United States
1963-1966	Civil Engineer, Board of Water Supply (New York City) Hydraulic and Hydrologic studies.
1961	Civil Engineer, Borough President of the Bronx (New York City) surveys, subdivisions, municipal engineering work.

5. **Professional registration**
   P.E. license – New Jersey (#17371)
   New York (#43849)

6. **Current membership in professional organizations**
   American Water Works Association (AWWA)

7. **Honors and awards**
   Faculty Recognition Award, Student Senate (4/1/10)

8. **Service activities (within and outside of the Institution)**
   Institutional Service
   Department P&T Committee
   Environmental Division – Division Head
   Governing Board – NJIT Chapter AAUP
   Collective Bargaining Unit Negotiator
   Co-Advisor – AWWA Student Chapter
   Team Member – Middle States Accreditation Preparation at NJIT
   External
   Environmental Consultant – Indian Forest Homeowners Association

9. Most important presentations & publications last five years

Publications

Schuring, Dresnack & Golub (2010). Review of Bridge Scour Practice in the U.S. (vol. SP-210, pps. 1110-1119). ASCE Geotechnical Special Publication, No. 210, Scour and Erosion Proceedings of the Fifth International Conference on Scour and Erosion.

Schuring, Dresnack & Golub (2011). Final Report – "Design and Evaluation of Bridge for Scour using HEC18" (158 pages), NJIT, submitted to NJDOT as part of a research contract.

Dresnack & Golub (2009). Final Report – "Economic & Quality of Life Impacts of Route 21 Freeway Construction," NJIT, submitted to NJDOT as part of a research contract.

Dresnack, Golub, Konon, Marhaba & Meegoda (2009) – Final Report – "Salt Runoff from NJDOT Yard Maintenance Facilities," NJIT, submitted to NJDOT as part of a research contract.

Presentations

Schuring, Dresnack & Glub – Annual NJDOT Research Showcases – 2009, 2011 – related to bridge scour research.

Schuring, Dresnack & Golub – "Review of Bridge Scour Practice in the U.S." – ASCE, Fifth International Conference on Scour and Erosion, ICSE – 5, San Francisco, CA., November 7-10, 2010.

1. EUGENE GOLUB Professor of Civil and Environmental Engineering

2. Degrees

Ph.D.	Applied Mechanics	Polytechnic Institute of Brooklyn – 1969
MS	Civil Engineering	Columbia University – 1964
BCE	Civil Engineering	The Cooper Union – 1962

3. Service on this faculty

45 Years of Service:	1968 to present
Original Appointment:	Assistant Professor – 1968
Advancement:	Associate Professor – 1972
	Dept. Chair – 1976-1988
	Professor – 1978 - -

4. Other related experience

1966-68 Research Assistant/Associate in Applied Mechanics, Polytechnic Institute of Brooklyn

1962-66 Instructor of Civil Engineering, The Cooper Union

5. Consulting Consulting in stormwater management and environmental assessment.

6. State(s) in which registered New Jersey

7. Principal publications

Golub, E., Dauenheimer, E., Dresnack, R., Ehrenkrantz, E., "Analysis of Flow Reduction Factors for Stormwater Regulations," *Proceedings of Envirosoft '98*

Golub, E, "The Presidents Corner", The Advocate, The Newspaper of NJ Conference of AAUP, 2001

Golub, E., Chair Water Supply Advisory Council, "Report & Recommendations Managing Future Droughts in New Jersey", October 2000

Milano, G. & Golub, E., A Remedy for the Statics Condition, Proceedings of the 2001 ASEE Annual Conference & Exposition, June 2001

Golub, E., Shaw, H., Lederman, P., Konon, W., Dauenheimer, E., Ghoi, J., "Monroe Township Alternate Space Conditioning Project, Report", November 2000

Milano, G., Golub, E., "High/Low Tech Approach for Success in Statics", Proceedings International Conference on Engineering Education, Manchester, UK, August 2002

Dauenheimer, E., Golub, E., Konon, W., "Aesthetics and Constructability in the Design of Noise Wall Barriers", Research at NCTIP, November 2001, pp 32-38

Milano, G., Golub, E., "A Remedy for the Statics Condition", 5th Regional Conference on Innovations in Teaching and Learning, NJIT, April 2002

Milano, G., Golub, E., "High/Low Approach for Success in Statics", Proceedings 3rd Global Congress on Engineering Education, Glasgow, Scotland, June 2002

Golub, Eugene, Environmental Science and Engineering, edited by James Pfafflin and Edward Ziegler, "Environmental Education", 2006

Golub, Eugene & Dresnack, Robert, "The Route 21 Freeway Completion Experience", Urban Transport 2005, Algarve Portugal, April 2005

8. Scientific and professional societies of which a member

American Society of Civil Engineers – Fellow
American Association of University Professors – Member

9. Honors and awards

1962 Chi Epsilon
1966 Sigma Xi
1985 Foundation Overseers Public and Institute Service Award at NJIT
1987 Engineer of the Year – North Jersey Branch of ASCE
1987 Elected, Eminent Engineer of Tau Beta Pi – Gamma Chapter
1987 Resolution by Newark City Council – Newark Housing Inventory Project
1989 Elected Fellow of ASCE

10. Institutional and professional service in the last five years

Professional Service

Water Supply Advisory Council – Chair (gubernatorial appointment)
New Jersey Water Supply Master Plan Public Advisory Committee – Chair
Water Quality Institute – Member (ex-officio)
Newark Watershed Conservation and Development Corporation – Member of Board of Trustees, (appointed by Newark Mayor)
Freehold Township Planning Board – Member
American Association of University Professors

11. Institutional Service

Department P&T Committee
President NJIT Chapter AAUP
Negotiations Committee
Executive Committee
Faculty Load Committee

11. Professional development activities in the last five years

Development of Web-based Mechanics Course Materials

1. **Name: CHENG-TZU THOMAS HSU**

2. **Education**: Ph.D. Civil-Structural Engineering, McGill University, 1974
   MS Applied Mechanics, Yale University, 1972
   M.Eng Civil-Structural Engineering, McGill University, 1969
   MS Engineering Mechanics, College of Chinese Culture, 1967
   BSE Civil Engineering, Cheng-Kung University, 1964
3. **Academic Experience**: 34 Years of Service at NJIT – 1978-Present
   Assistant Professor (1978-1983, full-time)
   Associate Professor (1983-1986, full-time)
   Full Professor (1986-Present, full-time)
   Associate Chair for Graduate Studies (1988-1993, part-time)
4. **Non-Academic Experience**:

1974-1978 - Civil Engineering Specialist, Bechtel and Company, Montreal/Toronto, Ca
1974 - Bridge Design Engineer, Beauchemin-Beaton-Lapointe, Inc., Montreal, Ca

5. **Certifications or Professional Registrations**: Hold Professional Engineer license in Taiwan Province, ROC and Provinces of Quebec and Ontario, Canada
6. **Current Membership in Professional Organizations**:

American Society of Civil Engineers (ASCE) – Fellow and Life Member
American Concrete Institute (ACI) – Fellow
American Association of University Professor – Member
Chinese American Professional and Academic Society – Member
Tau Beta Pi, Chi Epsilon, Sigma Xi – Member

7. **Honors and Awards**:

1994 Elected, Fellow of ACI
1993 Elected, Fellow of ASCE
1992 Elected, Honorable Professor by Wuhan University of Technology
1988 Elected, Eminent Engineer of Tau Beta Pi – NJ Gamma Chapter
1987 Received ASCE Raymond C. Reese Research Prize
1984 Chi Epsilon
1979 Sigma Xi

8. **Service Activities**:

Professional Service:
Proposal reviewer for NSF, Canadian and several east European Science agencies
Technical paper reviewer for ASCE and ACI Journals, and several International Journals
ASCE-ACI Technical Committee 441 – Reinforced Concrete Columns – Member
ACI Technical Committee 444 – Experimental Analysis – Member
ACI Technical Committee 435 – Deflection of Building Structures – Consulting Member
Institutional Service:
Department P & T Committee (1986 – Present)
Director of High Performance Concrete Laboratory (1998 – Present)
Director of Structures Laboratory (1998 – 2005)
Strength of Materials Laboratory (1998 – 2003)

9. **Presentations from the Past Five Years**:

Lu, X. B., and Hsu, C. T. T. (2007), "Tangent Poisson's Ratio of High Strength Concrete in Triaxial Compression", Magazine of Concrete Research, Vol. 59, No. 1, pp. 69-77.
Lu, X. B., and Hsu, C. T. T. (2007), "Stress-Strain Relations of High Strength Concrete under Triaxial Compression", Journal of Materials in Civil Engineering, ASCE, V. 19, No. 3, pp. 261-268.
Punurai, S., Punurai, W., and Hsu, C. T. T. (2007), "A Very Early Strength Concrete for Highway Construction", Journal of Testing and Evaluation, ASTM, Vol. 45, No. 6, pp. 609-617.
Punurai, W., Punurai, S., Chen, J., and Hsu, C. T. T. (2009), "Stress-Strain Behaviour of Concrete Cylinders Confined with CFRP Composite Fabrics", Proceedings, 9th FRPRCS International Symposium, July 13-15, Sydney, Australia, 4 pages.
Punurai, W., Chen, J., and Hsu, C. T. T. (2009), "RC Slender Columns Strengthened by CFRP Composite Fabrics Subjected to Biaxial Bending and Axial Compression", Proceedings, 9th FRPRCS International Symposium, July 13-15, Sydney, Australia, 4 pages.
Hsu, C. T. T., and Punurai, W. (2010), "Combined Tension and Compression Strengthening of RC Beams by CFRP Composite Fabrics", Proceedings, 13th Structural Fault + Repairs, June 15-17, Edinburgh, Scotland, UK, 10 pages.
Hsu, C. T. T., Punurai, W., and Punurai, S. (2010), "Biaxially Loaded RC Slender Columns Strengthened by CFRP", A Computer Program, US Copyright Certificates of Registration, No. TXu 1-637-863, April 2 (Effective Date: 6/18/2008).
Punurai, W., Hsu, C. T. T., and Punurai, S. (2010), "Structural Engineering – Laboratory and Experiments", US Copyright Certificates of Registration, No. TX 7-080-629, March 19 (Effective Date: 7/30/2009).
Hsu, C. T. T., Punurai, S., and Munoz, P. R. (2010), "Composite Floor System Having Shear Force Transfer", US Patent, USPTO No. 7,779,590 (B2), August 24 (15 Claims).
Hsu, C. T. T., and Punurai, W. (2011), "Tension and Compression Strengthening of RC Members by CFRP Composite Fabrics", ACI SP- 275 and FRPRCS 10, International Symposium, American Concrete Institute, April 2-6, Tampa, Florida, 20 pages.
Hsu, C. T. T., and Luke, A. (2012), "Strength of Materials – Laboratory Manual", 2nd Edition, LAD Custom Publishing, Inc., Buford, GA, January, 54 pages.
Punurai, W., and Hsu, C. T. T. (2012), "Mechanics of Materials – Laboratory and Experiments", 4th Edition, Lambert Academic Publishing GnbH & Co. KG, Saarbrucken, Germany, ISBN 978-3-8484-2287-6, March 2, 88 pages.
Hsu, C. T. T., Munoz, P. R., Punurai, S., Majdi, Y., and Punurai, W. (2012), "Behavior of Composite Beams with Cold-Formed Steel Joists and Concrete Slab", Proceedings, 21th International Specialty Conference on Cold-Formed Steel Structures, St. Louis, Mo, Oct. 24-25, 15 pages.

10. **Most Recent Professional Development Activities**:

Attended the 13th Structural Fault + Repairs Conference in Edinburgh, Scotland, UK, June 15-17, 2010.
Attended the ACI Committee Meetings and ACI Annual Convention in Tampa, Florida, April 2-6, 2011.

Fadi Antoine Karaa, Ph.D. **NJIT, Newark, NJ 07102**
Associate Professor of Critical Infrastructure karaa@njit.edu; Tel. (973) 642-4198
Graduate Program Director, Critical Infrastructure Systems

Appointments

New Jersey Institute of Technology, Associate Professor, 2006 - current.
PDA, Principal, 2002 - 2006
Oracle Corporation, Vice President, Data Warehousing and Exchange Solutions, 1998 – 2002
Oracle Corporation, Senior Practice Director, Enterprise Solutions, 1995 – 1998
Information Resources, Director and Vice President, 1991 - 1995
Northeastern University, Assistant Professor and Director, Construction Management Program, 1984 – 1991.

Professional Preparation

Ecole Polytechnique, Paris, France	Engineering, Sciences	Ingénieur, 1980
Massachusetts Institute of Technology	Civil Engineering Systems	MS, CE, 1982
Massachusetts Institute of Technology	MIS, Finance	MS, Management, 1984
Massachusetts Institute of Technology	Water Resource Systems/ Construction Management	Ph.D., PM/Systems, 1984

Selected Relevant Publications and Presentations

Karaa, F., A. Katz and E. Niver, "A Decision Model for the Determination of Preferred Methods for Locating Underground Conduits", Submitted to the Journal of Pipeline Systems, ASCE, March 2013.

Karaa, F., "A Graduate Research and Education Model for Managing the Critical Infrastructure of the 21st Century", The Infrastructure Security Partnership, Critical Infrastructure Symposium, April 2013, West Point, NY.

Karaa, F. and S. Banerji, "Development of Connectivity-Based Underground Fiber-Optic Network Inventory Systems", Proceedings of Transportation Research Board 2013, pp. 1-17.

Karaa, F.A, "Role of Modeling and Simulation in Critical Infrastructure Information Management", FAA Modeling, Simulation & Analysis Summit, Professional Development and Continuing Education Carnegie Library Center, Stockton College, May 2009.

Zaghloul, H. and F. Karaa "Infiltration/inflow Mitigation and Control for Army Wastewater Collection Systems", Champaign, Ill., US Army Corps of Engineers Technical Report, Construction Engineering Research Laboratories, National Technical Information Service, distributor, 1995.

Karaa, F.A., H. Zaghloul and R. Scholze ," Expert System for Wastewater Collection system Infiltration and Inflow Mitigation", Eighth Conference on Computing in Civil Engineering and Geographic Information Systems Symposium, pp. 121-128, June 1992.

Zaghloul, H., F.A. Karaa, J. Clark and M. Korfist, " Army Water Supply Management System for Installations Drinking Water Facilities", , Eighth Conference on Computing in Civil Engineering and Geographic Information Systems Symposium, pp. 145-152, June 1992.

Karaa, F.A. and D.H. Marks, "Performance of Water Distribution Networks: An integrated Approach", Karaa, *Journal of Performance of Constructed Facilities*, ASCE, Vol. 4, No. 1, February 1990.

Karaa, F.A. and S. Alam ,"Knowledge-Based Expert System for Planning Water Distribution Reconstruction and Rehabilitation", proceedings of the Computing in Civil Engineering Conference and Symposium on Data Bases, New York: ASCE, 0-87262-803-5, 1991, 948 pp., pp.448-459

Selected Synergistic Activities/Reports

-Development of Maintenance Management Software Systems for Massachusetts Water resources Authority and Army Water Supply Integrated Database Management System to manage infrastructure maintenance priorities, track Contamination levels across all whole water supply chain, and recommend most cost-effective treatment plans, 1986-1992
-Development of a Comprehensive Inventory Management System for Underground Fiber Optic Conduits, comprehensive inventory of fiber optic external and internal facilities, UTRC, Final Report, March 2013.
-Innovative and Effective Techniques for Locating Underground Conduits, Final Report, Submitted to NJDOT/UTRC: Decision Model for the selection of the most effective locating techniques for underground infrastructure, 2010.
-Analysis techniques and Advanced Remote Sensing of Deteriorating Water and Sewer Distribution Systems: Supervised student and report development, which led to the comparative analysis of a range of technologies, including GPR, GT, acoustic methods and Infrared Thermography in sub-surface utility applications, 1991.
-Development of US Army Water Supply Integrated Database Management System: Worldwide facilities inventory, assessment and contamination tracking, including sources, storage, pumping, treatment and distribution systems. Developed integrated data model, with SDWA-based cost-effective treatment modeling and costing, 1992.

Professional Organizations

Founding Member, SARMA, Security Analysis and Risk Management Association, 2007
TISP, The Infrastructure Security Partnership, Institute Membership, 2011, 2012, 2013
TRB, 2011, 2012, 2013
Past Memberships: ASCE (1984); APWA (1985), Chairman, Administrative Management Committee; New England Chapter, 1989; ASEM (1986) ; Construction Research Council, Project Management Institute, the Planning Forum; American Water Works Association, New England Water Pollution Control Association Member, NJ Homeland Security Technology Committee Member, CEE Department Research Committee; BSCES Engineering Management Technical Group, Chairman Executive Committee 1988-1989; Infrastructure Executive Committee, Construction Division

Honors/Awards

Nominated for Excellence in Graduate Teaching Award, NJIT, 2013.
Keynote Speaker, Construction Roundtable of NJ, 2007.
Keynote Speaker, 2nd Annual Electronic Commerce Conference, September 2000.
Arthur T. Ippen Award, MIT, 1981
Boston Society of Civil Engineers President's Award, "Making the Change from Engineer to Manager" Lecture Series, 1990

WALTER KONON, P.E., B.I.

NJIT – NEWARK, NJ 07102-1982
(973) 596-2476
KONON@NJIT.EDU

PROFESSIONAL LICENSES

PROFESSIONAL ENGINEER, NEW YORK 1972; NEW JERSEY 1975 LICENSED BUILDING INSPECTOR H.H.S., NEW JERSEY 1979

EDUCATION

B.S.C.E.	CITY COLLEGE OF NEW YORK	1966
M.S.C.E.	CITY UNIVERSITY OF NEW YORK	1970

EXPERIENCE

1974 - PROFESSOR, HEAD OF THE CONSTRUCTION DIVISION, DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING, NEW JERSEY INSTITUTE OF TECHNOLOGY, NEWARK COLLEGE OF ENGINEERING, NEWARK, NJ.

FALL 91 SENIOR FULBRIGHT VISITING PROFESSOR AT THE KIEV INSTITUTE OF CIVIL ENGINEERING, KIEV, UKRAINE.

SPRING 79 SENIOR FULBRIGHT VISITING PROFESSOR AT THE MOSCOW INSTITUTE OF CIVIL ENGINEERING, MOSCOW, U.S.S.R.

SUMMER 76 CONSTRUCTION MANAGER, LANDMARK DESIGN BUILDERS, DOVER, N.J. CONSTRUCTION OF OFFICE AND WAREHOUSE BUILDINGS.

SUMMER 75 CONSTRUCTION ENGINEER, SCHIAVONE CONSTRUCTION COMPANY, SECAUCUS, N.J., JERSEY CITY WATER TREATMENT PLANT.

9/73-8/74 ASSISTANT RESIDENT ENGINEER, COUDDRY, CARPENTER, DIETZ AND ZACK (CONSULTING ENGINEERS). SECTION 5, JAMAICA, NEW YORK CITY SUBWAY CONSTRUCTION.

9/72-9/73 ENGINEER, SUPERINTENDENT, KIEWIT-MORRISON-SLATTERY (CONTRACTORS), 63RD ST., TUBE TUNNEL. TUBE AND ROCK TUNNEL PROJECT ACROSS THE EAST RIVER, N.Y.C.

9/67-9/72 LECTURER, CIVIL ENGINEERING DEPARTMENT, CITY UNIVERSITY OF NEW YORK.

2/66-8/67 STRUCTURAL TEST ENGINEER, GRUMMAN AIRCRAFT ENGINEERING CORP. BETHPAGE, N.Y.

PROFESSIONAL SOCIETIES

FELLOW - AMERICAN SOCIETY OF CIVIL ENGINEERS
MEMBER - AMERICAN SOCIETY FOR ENGINEERING EDUCATION
MEMBER - INTERNATIONAL SOCIETY OF EXPLOSIVES ENGINEERS

Jay N. Meegoda, Ph.D., P.E.
New Jersey Institute of Technology
Email: Meegoda@adm.njit.edu
Tel.:973-596-2464

Education

University of Sri Lanka, Moratuwa	Civil Engineering	B. Sc. (Hon.)	1980
University of California, Davis, CA	Civil Engineering	M.S.	1983
University of California, Davis, CA	Civil Engineering	Ph. D.	1985

APPINTMENTS

Professor	New Jersey Inst. of Technology	9/1999-Present
Visiting Professor,	China University of Mining & Tech	9/2006-Present
Associate Professor	New Jersey Inst. of Technology	9/1990-8/1999
Research Professor	National Chiao Tung University	1/1995-8/1995
Assistant Professor	New Jersey Inst. of Technology	9/1985-8/1990

Professional Engineer: Delaware

Selected JOURNAL Publications Relevant to Statement of Work

Dredging and Management of Dredged Materials" Geotechnical Special Publication # 65, **Jay N. Meegoda**, T. H. Wakeman, A. K. Arulmoli and W. J. Librizzi, Editors, American Society of Civil Engineers, 208 pages, 1997

Aboobaker, N., **Meegoda, J. N.**, and Blackmore, D., "Fractionation and Segregation of Suspended Particles using Acoustic and Flow Fields" Journal of Environmental Engineering, Vol. 129#5, pp 427-434, 2003.

Meegoda, J. N., Veerawat, K., "Ultrasound to Decontaminate Organic Compounds in Dredged Sediments" Soil & Sediment Contamination: An International Journal, Vol. 11 #1, pp. 91-116, 2002.

Meegoda, J. N. and Perera, R., "Ultrasound to Decontaminate Metals in Dredged Sediments" Journal of Hazardous Materials, Vol. 85#1-2, pp. 73-89, 2001.

Meegoda, J. N., Kamolpornwijit, W., Vaccari, D. A., Ezeldin, A. S., Noval, B. A. Mueller, R. T. and Santora S., "Remediation of Chromium Contaminated Soils -A Bench Scale Investigation" Journal of Hazardous, Toxic, and Radioactive Waste Management, Vol. 3#3, pp. 124-131, 1999.

Meegoda, J. N., Partymiller, K., Richards, M. K., Kamolpornwijit, W., Librizzi, W., Tate, T., Noval, B. A. Mueller, R. T. and Santora S., "Remediation of Chromium Contaminated Soils -A Pilot Scale Investigation" Journal of Hazardous, Toxic, and Radioactive Waste Management, Vol. 4#1, pp. 7-15, 2000.

Meegoda, J. N., Charleston, G., and Kamolpornwijit, W., "Construction use of Vitrified Chromium Contaminated Soils" Journal of Hazardous, Toxic, and Radioactive Waste Management, Vol. 4#3, pp. 89-98, 2000.

Meegoda, J. N., and Kamolpornwijit, W. (2011), "Chromium Steel from Chromite Ore Processing Residue - A Valuable Construction Material from a Waste," Frontiers of Environmental Science and Engineering, Volume 5#2, pp. 159-166.

GRANTS AND CONTRACTS Relavent to the Project

Role	PI	Agency	Title	Amount	Date of Award
PI		NJDOT/USDOT	Drainage Identification, Analysis and Mapping Project	$579,726	1/2010
PI		NSF	Ultrasound to Decontaminate Dredged Sediments	$118,365	5/1997
Co-PI	Bill Librizzi	NJDEP	Remediation and Reuse of Chromium Contaminated Soils Through Cold Top In-situ Vitrification	$374,232	6/1994
Co-PI	Dorairaja Raghu	NSF	Development of State-of-the-art Geo-environmental Engineering Research Facilities	$958,735	1/1993
PI		NJDEP	Full Scale Testing of Construction Materials Containing Petroleum Contaminated Soils	$52,981	6/1992
PI		NJDEP	Construction Uses of Petroleum Contaminated Soils	$92,000	7/1990

HONORS, AWARDS, AND LISTINGS

Associate Editor of the **ASCE** Journal of Hazardous, Toxic, and Radioactive Waste Management
Editorial Review Board Member, Springer Journal on Waste and Biomass Valorization
Editorial Review Board Member, Online Journal of Waste Management
Editorial Review Board Member, Online Journal of Hydrogeology & Hydrologic Engineering
Editorial Review Board Member, Online Scientific World Journal
Best Theoretical Paper Award, 2012, Environmental Multimedia Council of the Environmental and Water Resources Institute (EWRI) of American Society of Civil Engineers (ASCE) for the paper is entitled "Microscopic Modeling of Air Migration during Air Sparging," appeared in the April 2011 issue of the ASCE Journal of Hazardous, Toxic, and Radioactive Waste Management
Best Practice Paper Award, 2001, Environmental Multimedia Council of the Environmental and Water Resources Institute (EWRI) of American Society of Civil Engineers (ASCE). The paper is entitled "Remediation of Chromium Contaminated Soils -A Pilot Scale Investigation" ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, Vol. 4, #1, January 2000, pp. 7-15.
ASCE New Jersey Section Educator of the Year Award, 2005, in recognition of outstanding contributions to research and the education of Civil Engineers through guidance and efforts
ASCE North Jersey Branch Educator of the Year Award, 2001, in recognition of outstanding contributions to the education of Civil Engineers through guidance and efforts.
Advisory Board Member Passaic River Coalition
Advisory Board Member, EU Asia-link Project on Geo-environmental Engineering Training Program in China, Tsinghua University, Beijing, China
Keynote speaker of numerous international environmental conferences in Egypt, China, Sri Lanka, India, and Tunisia

Thomas J. Olenik, Ph.D., P.E.
Associate Professor of Civil & Environmental Engineering
New Jersey Institute of Technology
Newark, NJ 07102
Phone: (973) 596-5895 e-mail: Olenik@njit.edu

EDUCATION

Newark College of Engineering	B.S.C.E.	1968 Civil Engineering
Newark College of Engineering	M.S.C.E.	1970 Civil Engineering
Rutgers University	Ph.D.	1974 Environmental Engineering

Professional Engineer: NJ

Qualifications

Dr. Olenik has 35 years of design and construction experience regarding water distribution, sanitary and stormwater systems. In addition to teaching two design courses concerning the abovementioned utilities, he has designed many residential and commercial projects requiring the design of such systems.

Dr. Olenik is a member of the Site Infrastructure Advisory Board (SIAB) for the New Jersey Department of Community Affairs. This group produced a publication known as the "Residential Site Improvement Standards." Dr. Olenik was the co-author of three chapters concerning the design and construction of water, sanitary and stormwater systems. He serves as the chairman of the committee that wrote these technical documents.

In addition, he has served as a qualified expert witness for many planning boards and related legal testimony.

Project Experience Relevant to Statement of Work

Water Distribution Systems. In addition to the design of many miles of water mains, Dr. Olenik served as a consultant to the Jersey City Water Department regarding the operation of their treatment and distribution systems. He has also designed and evaluated the construction of seven miles of 96-inch transfer pipe for the State of New Jersey. In addition, he has performed computer analysis of water distribution systems for private and public developments. These projects include the design of several water tanks and pump stations along with the pressure mains for the 5,000-unit Hills Development in Bedminster, NJ. Similar services were provided to at least 50 other projects that consisted of at least 50 units of residential development.

Sanitary Sewer Systems. As a design consultant, Dr. Olenik has designed and constructed hundreds of miles of sanitary sewer pipe for various developments. These design tasks included pipe specifications, etc., and the design of related pump stations. These services were also supplied to the projects listed above under Water Distribution Systems.

Stormwater Management Systems. Dr. Olenik's efforts in this area consists of the design and construction of 15-inch to 96-inch storm sewers, detention ponds for flow and volume control and the design of best management facilities for water quality control. He was a co-author of a Master Drainage Study for the City of Newark, NJ. Dr. Olenik also serves as a technical reviewer for new stormwater management regulations for the New Jersey Department of Community Affairs.

Professional Recognition and Affiliations

Member: American Society of Civil Engineers; American Society of Engineering Education; Chi Epsilon, Tau Beta Pi

Selected Publications Relevant to Statement of Work

"Residential Site Improvement Standards", N.J. Dept. of Community Affairs, January 6, 1997.
"Land Development Regulations: Roadblock to Affordable Housing", June 1992.
"Design of Land Development Projects in a Over-regulated Environment", presented at Specialty Conference, American Society of Civil Engineers, September 1991.
Raritan Confluence Reservoir – Environmental Inventory, November 1978, NJDEP (design of 96-inch water main) (externally funded project).
Pipeline Assessment for Adverse Social Environment, 1978 Proceeding of Institute of Environmental Science – Environmental Assessment of the Raritan Confluence Force Main, May 1977, NJDEP (externally funded project).
Co-authored Master Drainage Study for the City of Newark (externally funded project).

Dr. Laramie V. Potts
Associate Professor (Surveying Engineering Technology)
Department of Engineering Technology
New Jersey Institute of Technology (NJIT)
Newark, 07102-1982

Tel: 973-596-8191
Fax: 973-642-4184
email: lpotts@njit.edu

PROFESSIONAL PREPARATION

University of Cape Town, SA	Land Surveying	B.Sc. *1984*
The Ohio State University	Geodetic Science and Surveying	M.Sc. *1993*
The Ohio State University	Civil Environ. Eng. & Geod. Sci	Ph.D. *2000*
The Ohio State University & Remote Sensing	Laboratory for Space Geodesy PostDoc. *2001-2005*	

APPOINTMENTS

2006-present:	Assistant Professor, Dept. Engineering Technology,	NJIT
2006:	Lecturer: Introduction to Geology and Planetary Science.	OSU
1999-1995:	Dept. Civil and Environ. Eng. and Geodetic Science	OSU
1993-1995:	Graduate Research Asst., Center for Mapping,	OSU
1990-1992:	Graduate Teaching Asst., Geodetic Science and Surveying	OSU

PUBLICATIONS

Potts, L.V., J. Mraz, POB case study Kill Van Kull Strait/NJIT: GPS and Imaging Combined to Map the Kill Van Kull Strait, *Point of Beginning*, 2011, p5-7, December 2011.

Von Frese, R.R. B., L V. Potts, S. B. Wells, T. E Leftwich, L.R Gaya-Pique, H. Kim, A. V. Golynsky, O. Hernandez, J-W. Kim, J.S. Hwang, GRACE gravity observations target possible mega-impact in Wilkes land, Antarctica, *Geochem. Geophys. Geosyst.*,10(3) Q02014, doi:10.1029/2008GC002149, 2009.

C.K. Shum, H. Araki, K. Matsumoto, S. Sasaki, H. B. Iz, Y. Chen, L. V. Potts, Research in Selenodesy Using the KAGUYA/SELENE Laser Altimeter and Other Data, The *2nd KAGUYA(SELENE) Science Working Team Meeting*, Campus Innovation Center in Tokyo, 15-17 January, 2008.

Potts, L. V., O. Akyilmaz, A. Braun, C. K. Shum, Multi-resolution dune morphology using Shuttle Radar Topography Mission (SRTM) and dune mobility from fuzzy inference systems using SRTM and altimetric data, *International Journal of Remote Sensing*, V29 (10), 2879, 2008

Potts, L. V., L. Gaya-Pique, H.-R. Kim, R. von Frese, and C. K. Shum, Comparison of altimetry-derived ionosphere electron counts and CHAMP-measured External Field over Polar Regions, *EGU General Assembly*, EGU06-A-05010, Vienna, April 2-7. 2006.

Potts, L. V. and R. von Frese. Impact induced mass flow effects on lunar shape and the elevation dependence of nearside maria with longitude. *Physics of the Earth and Planetary Interiors Special issue: Studies of the Earth's Deep Interior* Eds: B.L.N. Kennett, E.J. Garnero and D.E. Loper, 2005

Mautz, R., J. Ping, K. Heki, B. Schaffrin, C. Shum, L. V. Potts. Efficient spatial and temporal representations of global ionosphere maps over Japan using B-spline wavelets, *Journal of Geodesy*, DOI: 10.1007/s00190-004-0432-z, V78 (11-12), 662 - 667, 2005.

Potts, L. V. , A. Braun, C. K. Shum, Morphology and migration of large sand dunes using SRTM

and altimetric data, In *The Shuttle Radar Topography Mission - Data Validation and Applications Workshop*, Reston Virginia, 2005.

Potts, L. V., C..K. Shum, R.R.B. von Frese, S-C. Han, R. Mautz. Recovery of Isostatic Topography over North America from CHAMP gravity and topography correlations, In: *Earth Observation with CHAMP: Results from Three Years in Orbit,* Ch. Reigber, H. Luehr, and P. Schwintzer, J. Wickert (Eds.), Geosciences Series (ISBN: 3-540-22804-7), 193-198, Springer-Verlag, Berlin, Heidelberg, 2005

Ping, J., K. Matsumoto, K. Heki, A. Saito, P. Callahan, L. V. Potts, and C. Shum, Validation of Jason-1 nadir ionosphere TEC using Geonet. *Marine Geodesy*, 27, doi:10.1080/01490410490889049, 741-752, 2004.

Potts, L. V., R. von Frese, T. Leftwich, P. Taylor, C. Shum, and R. Li, Gravity-inferred crustal attributes of visible and buried impact basins on Mars, *Journal of Geophysical Research*, 109, doi:10.1029/2003JE002225, 2004.

SYNERGISTIC ACTIVITIES

Innovation in Teaching: Developed several learning modules for PodCasts and media player using Camtasia Relay. Develop web-based learning tools (e.g., quizzes) using open source such as Moodle.
Outreach: Volunteer as faculty mentor for inner city high school students enrolled in a Summer Enrichment for Economically Disadvantages Students (SEEDS) program. Tasks involve student research in any STEM topic of their choice. Past projects include 1) GIS analysis and correlation between groundwater elevation and population health in the state of New Jersey, and 2) Designing a home-made optical turbidity meter.
Recruitment: Visits high schools to inform students on surveying engineering education and careers. Serve as chair for the Marketing and Recruiting Committee of the Surveying and Mapping Educators of North America. Committee goals include advising strategies for survey education marketing, student recruitment, market mobility, and curriculum advisement.
Journal Reviewer:
Science (2003)
Meteoritics and Planetary Science (2004)
IEEE Geosciences and Remote Sensing Letter (GRSL) (2005)
Surveying and Land Information Science (2008-2010)
J. Geophysical Research: Space Weather (2012 – present)

COLLABORATORS and OTHER AFFILIATIONS

O. Akyilmaz, M. AKAR, and M. Cepni (Istanbul Technical University, Turkey)
A. Braun (U. Calgary, Cañada)
N. Meegoda, NJIT
C.K. Shum (OSU)
R.R.B. von Frese (OSU)

DORAIRAJA RAGHU

EDUCATION	Ph.D.	Civil Engineering	Texas Tech University - 1975
	MS	Civil Engineering	University of Kentucky - 1972
	MS	Civil Engineering	Madras University, India - 1962
	BE (Hons)	Civil Engineering	Annamalai University, India – 1961

ACADEMIC EXPERIENCE

Assistant, Associate and currently Full Professor, Civil and Environmental Engineering, New Jersey Institute of Technology, Newark, NJ, 1977- Present, Fulltime
Assistant Professor, Civil Engineering, Tri-State University, Indiana, 1975-77, Fulltime
Lecturer, Civil Engineering, San Diego State University, San Diego, California 1974-75, Fulltime
Lecturer/Research Assistant, Civil Engineering, Texas Tech University, Lubbock, Texas, 1972-74, Part-time
Research Assistant, Civil Engineering, University of Kentucky, Lexington, Kentucky, 1970-72, Part-time
Lecturer in Civil Engineering, Birla Institute of Technology and Sciences, India, 1965-70, Fulltime

NON-ACADEMIC EXPERIENCE

Assistant Engineer, Foundry Forge Project, Ranchi, India, 1962-65, Foundation Design and Construction

CERTIFICATIONS OR PROFESSIONAL ORGANIZATIONS

Licensed Professional Engineer, State of New Jersey, Active, since 1978

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

Member, American Society of Civil Engineers
Member, National Society of Professional Engineers
Member, International Society of Soil Mechanics and Foundation Engineering

HONORS AND AWARDS

Robert Van Houten Award for Excellence in Teaching, NJIT Alumni Association, May 2013.
Excellence in Upper Division Undergraduate Instruction, New Jersey Institute of Technology (Institute Award), 2010
Engineer of the Year, American Society of Civil Engineers. North Jersey Branch, New Jersey Section 1990
Professor of the Year, American Society of Civil Engineers, Student Chapter, New Jersey Institute of Technology

SERVICE ACTIVITIES

Member, Promotion and Tenure Committee, Department
Member, Faculty Search Committee, Department
Chairperson, Awards Committee, Department

Chairperson, Speakers Bureau Subcommittee of Continuing Education Committee, New Jersey Society of Professional Engineers

IMPORTANT PUBLICATIONS AND PRESENTATIONS (LAST 5 YEARS)

"Biodegradation Settlement of Slightly Organic Fills", Proceedings of the 22nd International Conference on Solid Waste Technology and Management, March 2007 at Philadelphia, Pa
"Characterization of Water Treatment Residues and their Beneficial Uses", proceedings of ASCE GeoCongress 2008 Conference - Sustainable Use of Waste and Related Issues, New Orleans, March 2008, pp. 367 - 374. C: Swamy C Basim
A study of biodegradation settlement of Landfills using (C+H)/L parameters", Proceedings of the 23rd annual conference on Solid Waste Technology and Management, March 2008. Coauthor: J.J. Lifrieri
"A Simple Method to Determine Volume of Gas Produced and Biodegradation Settlement", Proceedings of the 24th annual conference on Solid Waste Technology and Management, March 2009. Coauthor: J.J. Lifrieri
"Determination of Landfill Settlement of a Municipal Solid Waste of Known Composition Based on (C+H)/L Values, Proceedings of the 25th annual conference on Solid Waste Technology and Management, March 2010. Coauthor: J.J. Lifrieri
"Considerations Regarding Geotechnical Testing of Solid Wastes", Proceedings of the 26th Annual conference on Solid Waste Technology and Management, March 2011. Coauthor: Swamy C Basim
"Use of Asphalt Millings as Structural Embankment ", Proceedings of the 27th annual conference on Solid Waste Technology and Management, March 2012. Coauthors: Swamy C Basim and SV Dinesh

MOST RECENT PROFESSIONAL DEVELOPMENT ACTVITIES

23rd International Conference on Solid Waste Technology and Management, Philadelphia, PA, March 2008
24th International Conference on Solid Waste Technology and Management, Philadelphia, PA, March 2009
25th International Conference on Solid Waste Technology and Management, Philadelphia, PA, March 2010
26th International Conference on Solid Waste Technology and Management, Philadelphia, PA, March 2011
27th International Conference on Solid Waste Technology and Management, Philadelphia, PA, March 2012
Member, Continuing Education Subcommittee, New Jersey Society of Professional Engineers, 2010-12.

M. Ala Saadeghvaziri, Ph.D., P.E.

Office Address
Department of Civil Engineering, New Jersey Institute of Technology, Newark, NJ 07102-1982
Tel: 973-596-5813; Fax: 973-596-5790; E-mail: ala@njit.edu; http://www-ec.njit.edu/~ala

Education

Ph. D. in Civil Engineering University of Illinois @ Urbana-Champaign, 1988.
M. S. in Civil Engineering University of Illinois @ Urbana-Champaign, 1983.
B. S. in Civil Engineering University of Illinois @ Urbana-Champaign, 1982.
(Graduated with High Honors)

Academic Experience

1988 – Present Full/Associate/Assistant Professor, Dept. of CEE, NJIT.
1982 – 1988 Research and Teaching Assistant, University of Illinois @ Urbana-Champaign
Courses taught: Finite element methods, Earthquake engineering, Structural dynamics, Plastic analysis and design, Reinforced concrete design, Structural analysis, Strength of Materials, Dynamics, Statics.

Practical Experience

Consultant in finite element analysis, seismic design and structural vibrations, nonlinear response of structures including a cable stayed bridge built on the Mississippi river.

Area of Specialization

Structural engineering with emphasis on: nonlinear response of structures, finite element and computational methods, extreme event engineering, and structural applications of composite and renewable materials.

Ongoing/Most Recent Research Projects

Multi-Hazard Analysis and Progressive Collapse Evaluation of Structures: Toward a New Design Framework
Sustainable Infrastructure and Green Design: Educational and Research Needs
Re-Use of Structures: Monograph Series in Structural Sustainability
High-value Structural Application of Recycled Materials
Assessment and Development of a Multi-Hazard Protective System for Structures Against Blast Loads and other Hazards
Next Generation Serviceability Requirements for Highway Bridges and Applications of High Performance Materials

Principal Publications of Last 5 Years

Feizi B., Saadeghvaziri M.A. and Spillers W.R. (2013)." The Effect of Engineered Mass/Stiffness Eccentricity on Displacement Mitigation: Steady State Case" Journal of Engineering Mechanics (Under Review)
Saadeghvaziri, M. Ala, et. al "Design for Deflection Control vs. Use of Specified Span to Depth Ratio Limitations," Final Report, FHWA-NJ-2012-009, October, 2012
Feizi B., Saadeghvaziri M.A. and Spillers W.R. (2012)."Seismic Effectiveness of Mass/Stiffness Eccentricity in Mitigation of Structural Vibrations: A Statistical Study", Journal of Engineering Mechanics (Under Review)
Feizi B., Saadeghvaziri M. A. (2012), "Optimum Distribution of Mass/Stiffness Eccentricity for Seismic Applications," Engineering Structures Journal (under review).
Darjani, S., and M. A. Saadeghvaziri, "Bridge Dynamic Response Due to Truck Load Sequence," *The 6th International Conference on Bridge Maintenance, Safety and Management* (IABMAS 2012), Lake Como, Italy, on July 8-12, 2012.
Darjani, S., Saadeghvaziri, M.A., "Dynamic Response and Serviceability Considerations of Bridges under Moving Load", the second International Conference on Architecture and Structure in the University of Tehran, Iran, May 15-16, 2011.
Mahgoub, M., A. Jamali, and M. Ala Saadeghvaziri, "Seismic Properties of Confined Recycled Aggregate Concrete," 1st Middle East Conf. on Smart Monitoring, Assessment and Rehabilitation of Civil Structures, American University in Dubai, Feb 8-10, 2011.
Darjani, S., and M. Ala Saadeghvaziri, "Dynamic Response of Highway Bridges Subjected to Moving Loads," Transportation Research Board, 2011 Annual Meeting, Jan. 23-27, 2011.

Saadeghvaziri, M. Ala, and N. Carlson, "On Multi-hazard Considerations in Design of Structures," 9th US National and 10th Canadian Conf. on Earthquake Engineering, Toronto, July 25-29, 2010.
Jamali, A., and Saadeghvaziri, "Shear Transfer Mechanism in Slab-on-Girder Bridges," Proceedings, IABMAS10, 5th International Conf. on Bridge Maintenance, Safety and Management, Philadelphia, July 11-15, 2010.
Saadeghvaziri, M. Ala, and S. Darjani, "Serviceability Considerations of High Performance Steel Bridges," **Proc.** IABMAS10, 5th International Conf. on Bridge Maintenance, Safety and Management, Philadelphia, July 11-15, 2010.
Saadeghvaziri, M. Ala, and S. Darjani, "Serviceability Considerations of High Performance Steel Bridges," Proc. Structures Congress 2010, ASCE, Fort Lauderdale, May 12-14, 2010.
Saadeghvaziri, M. Ala, A. Jamali, "Controlled Composite Action (C^2A) to Eliminate Deck Cracking," Proc. Structures Congress 2010, ASCE, Fort Lauderdale, May 12-14, 2010.
Saadeghvaziri, M. Ala, and N. Carlson, "A Multi-hazard Protective Jacket for Structural Members," Proc. Structures Congress 2010, ASCE, Fort Lauderdale, May 12-14, 2010.
Carlson, N., and M. Ala Saadeghvaziri, "On Effectiveness of Water in Attenuating Impact and Blast Loads," the International Conf. on Computational and Experimental Engineering Sciences (ICCES'10), March 28-April 1, 2010, Las Vegas.
Saadeghvaziri, M. Ala, and N. Carlson, "ProJack B4 – Protective Jacket to Blunt Blasts on Bridges and Buildings," Final Report, DoD Disruptive Technology Accelerator Program (Picatinny/NJIT), April 2010.
Saadeghvaziri, M. Ala, and S. Darjani, "On Finite Element Modeling and Determination of Bridge Acceleration Subjected to Moving Load," Proceedings, Transportation Research Record, 2010 Annual Meeting, January 2010.
Saadeghvaziri, M. Ala, B. Feizi, L. Kempner, and D. Alston, "On Seismic Response of Substation Equipment and Application of Base-Isolation to Transformers," IEEE Transactions on Power Delivery, Vol. 25, No. 1, January 2010.
Saadeghvaziri, M. Ala, and A. Jamali, "An Innovative Concept to Eliminate Deck Cracking," CD-Proceedings, Transportation Research Record, Annual Meeting, January 2009.
Schwer, L., M. A. Saadeghvaziri, J. O'Daniel and T. Madsen, "Free-Air Blast Simulation: Engineering Models and MM-ALE Calculations," 20th Inter. Symp. on Military Aspects of Blast and Shock, Oslo, Norway, Sept., 2008.
Saadeghvaziri, M. Ala, B. Feizi, F., "Beneficial Aspects of Multi-Hazard Approach to Design for Highway Bridges," Proceedings, 6th National Conference on Bridges and Highways, Charleston, SC, July 2008.
Jamali, A., and Saadeghvaziri, M. Ala, "Application of CFRP in Development of High Performance Continuity Connections," Proc., 4th International Conference on FRP Composites in Civil Engineering (CICE2008), July 2008, Zurich, Switzerland.
Saadeghvaziri, M. Ala, and B. Feizi, "On Seismic Specifications for Highway Bridges in US," Proc. 3rd Inter. Bridge Conference, Tehran, Iran, May 2008.
Saadeghvaziri, M. Ala, and A. Yazdani-Molagh, "Seismic Behavior and Capacity / Demand Analyses of Three Multi-Span Simply Supported Bridges" Journal of Engineering Structures, Vol. 30, No. 1, January 2008

Scientific and Professional Societies: American Society of Civil Engineers (ASCE) – Member; Earthquake Engineering Research Institute (EERI) – Member; American Concrete Institute (ACI) – Member
Others/Honors: Fellow, ACSE, 2008; ABET Program Evaluator, 2007-present; Associate Dean, Newark College of Engineering, NJIT, Sept. 2009-2011; Chair of Faculty Council, NJIT, 2006-07 (1-yr only allowed); Department of Civil Engineering Representative, Faculty Council, NJIT, 2004-07; 1997 Educator of the Year Award, New Jersey Section, ASCE; Marquis Who's Who in Science & Engineering ; Chi Epsilon;Phi Kappa Phi

1. JOHN R. SCHURING Professor of Civil and Environmental Engineering

2. Education

Ph.D.	Geotechnical Engineering	Stevens Institute of Technology 1987	
M.C.E.	Geotechnical Engineering	University of Alaska, Anchorage	1977
B.E.	Civil Engineering	Stevens Institute of Technology 1974	

3. Academic Experience

New Jersey Institute of Technology	Assistant Professor	1982-1987	Full Time
New Jersey Institute of Technology	Associate Professor	1987-1994	Full Time
New Jersey Institute of Technology	Professor	1994-present	Full Time
New Jersey Institute of Technology	Department Chair	1999-2005	Full Time
New Jersey Institute of Technology	Associate Chair UG	2005-2006 & 2011	Full Time
New Jersey Institute of Technology	Interim Dean NCE	2006-2007	Full Time

4. Non-Academic Experience

Woodward-Clyde Consultants	Asst. Project Engineer	1979-82	Full Time
N.H. Bettigole Company	Design Engineer	1978-79	Full Time
Alaska Testlab	Soils/Materials Engineer	1977	Full Time
United States Air Force	Civil Eng. Officer, 1st Lt.	1974-77	Full Time

5. Certifications or Professional Registrations

Professional Engineer	New York	1981	Licensed and registered
Professional Engineer	New Jersey	1979	Licensed
Professional Engineer	Maine	1981	Licensed

6. Current Membership in Professional Organizations

American Society of Civil Engineers, Member
Chi Epsilon, Member
Tau Beta Pi, Member

7. Honors and Awards

ASCE National Certificate of Commendation for Exceptional Service – 2009 & 2011
ASCE Educator of the Year Award, New Jersey Section - 2009
Vincent A. Stabile Chair Professor for Innovation and Technology - 2008-present
NJIT Master Teacher Designation – 2007-present
Van Houten Excellence in Teaching Award by NJIT Alumni Association - 2006
New Jersey Public Sector ACE Mentor of the Year Award - 2005
Thomas Alva Edison Patent Award by the R&D Council of New Jersey - 2001
ASCE/EWRI Award for Best Theoretical Published Article - 1999
Harlan J. Perlis Institute Award for Research - 1994

8. Service Activities

National Science Board, National Academy of Engineers, Moving Forward to Improve Engineering Education Committee – Member – 2006-2007
Board of Directors, Architectural Engineering and Construction (ACE) Mentor Program of New Jersey – Member – 2009-present

Citizen Advisory Committee, CSO and Storm Water Protection Program, Newark Water and Sewer Utilities Authority – 2006-present
New Jersey Science Olympiad, R&D Council of NJ – Faculty Mentor – 2009-present
NJIT Master Teacher Committee – Member – 2008-present
CEE Hydraulics and Hydrogeology Laboratory – Director – 1999-present
CEE Department Curriculum Committee - Member – 2000-present
ASCE Student Chapter - Faculty Advisor – 1998-present

9. Principal Publications and Presentations of last five years

Schuring, J.R., R. Dresnack, E. Golub, M. Ali Khan, M. R. Young, R. Dunne, and N. Aboobaker, "Review of Bridge Scour Practice in the U.S.," ASCE Geotechnical Special Publication No. 210, Scour and Erosion, Proceedings of the Fifth International Conference on Scour and Erosion, Nov. 7-10, 2010, San Francisco, CA, pp. 1110-1119.
Talerico, J., Schuring, J.R., and Khera, R.P., "A Landslide in Glacial Soils of New Jersey," Paper 3.19, Proceedings: Fifth International Conference on Case Histories in Geotechnical Engineering, New York, NY, April 13-17, 2004.
Schuring, J.R., Fracturing Technologies to Enhance Site Remediation, Technology Evaluation Report TE-02-02, Ground-Water Remediation Technologies Analysis Center (GWRTAC), April 2002, 58 pages (monograph).
Schuring, J.R., Boland, T. and King, T., U.S. Patent No. 6,012,185 (divisional) "Treating Non-Naturally Occurring Subsurface Soil Contaminants with Pneumatic Injection of Dry Media," 41 claims, 2000
Keffer, E.B., Schuring, J. and Abrams, S., "Remediation of a Low Permeability TCE Contaminated Bedrock, Part 1: Pneumatic Fracturing Technology for Permeability Enhancement," Remediation in Rock Masses, Inyang, H.I. and Bruell, C.J. (Ed.), ASCE Press, pp. 137-151, 2000.
Ding, Y., Schuring, J.R., and Chan, P.C., "Engineering Reliability Assessment of Contaminant Removal by Pneumatic Fracturing, Practice Periodical of Hazardous, Toxic, and Radioactive Waste, ASCE, Vol. 4, No. 1, pp. 24-29, 2000.
Dauenheimer, E. and Schuring, J., "Diagnostic Load Testing to Help Aging Bridges Cope," Proc. Conference on Nondestructive Evaluation of Civil Structures and Materials, Oct.1990.

10. Recent Consulting Projects

Bridge Scour, New Jersey – Evaluated more than 30 scour critical bridges to determine risk level. Developed recommendations for monitoring, countermeasures, and status upgrade.
Landslides, New Jersey and New York - Investigated major landslides triggered by extreme weather events, some involving affected structures. Determined causative factors.
Vehicular Tunnel, New York City - Investigated causes for settlement and distress of roadways and structures. Developed recommendations for stabilization and repair.
Highway Extension, New Jersey - Analyzed soft, problem soils for roadway relocation and new bridge structure. Developed design criteria for site preloading, cofferdams, and piles

1. Name: Wen Zhang

PhD, Assistant Professor
Department of Civil and Environmental Engineering
New Jersey Institute of Technology
323 Martin Luther King Blvd. Newark, NJ 07102
Office Phone: (973) 596-5520; Fax: (973) 596-5790; E-mail: wzhang81@njit.edu

2. Education/Training

Georgia Institute of Technology	PhD	2 009-2011	Environmental Engineering
Tongji University	MS	2004-2007	Environmental Engineering
Tsinghua University	BS	2000-2004	Environmental Engineering

3. Academic Experience

09/2012–present *Assistant Professor,* **New Jersey Institute of Technology**
05/2012–09/2012 *Research Engineer I,* **Georgia Institute of Technology.**
08/2011–05/2012 *Postdoctoral Research Scientist,* **Georgia Institute of Technology**
08/2009–07/2011 *Graduate Research Assistant,* **Georgia Institute of Technology**
08/2007–08/2009 *Graduate Research Assistant,* **Arizona State University**

4. Certifications

2009-present Engineer-In-Training (EIT)
2012-present Green Associate of Leadership in Energy and Environmental Design (LEED)

5. Current Membership

2008-present Member of American Chemistry Society (ACS) in Colloid and Surface Science Division and Environmental Chemistry division
2012–present Associate Member of the Royal Society of Chemistry (AMRSC)
2011–present Member of Association of Environmental Engineering and Science Professors (AEESP)
2012–present Member of American Society of Microbiology (ASM)

6. Honors and Awards

2013 Travel Grants for AEESP NSF Ethics Education Workshop
The 2012 CH2M Hill/AEESP Outstanding Doctoral Dissertation Award.
The 2011 Simon Karecki Award, SRC/SEMATECH Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, 2011.
Certificate of Merit for Presentation at ACS 241st National Meeting, 2011.
Certificate of Appreciation for the Peer Review Contribution, ACS, 2011.
Travel Grant recipient, Division of Graduate Studies (DGS), Arizona State University, 2008.

7. Service Activities

Professional Service

Faculty Judge for 2012 Georgia Tech Research and Innovation Conference (GTRIC).

Judge for 2012 U.S. Stockholm Junior Water Prize (Arizona State).
Institutional Service:
Director of Environmental Engineering Laboratory (2013-present)

8. Selected Publications

Wen Zhang, Yongsheng Chen. Experimental Determination of Conduction and Valence Bands of Semiconductor Nanoparticles using Kelvin Probe Force Microscopy. ***Journal of Nanoparticle Research***. 2013. DOI: 10.1007/s11051-012-1334-2.

Wen Zhang, Yang Li, Junfeng Niu, and Yongsheng Chen. Mechanism of Photogenerated Reactive Oxygen Species of Engineered Metallic Nanoparticles and their Antibacterial Properties under UV irradiation. ***Langmuir.*** 2013. DOI: 10.1021/la400500t

Yang Li, **Wen Zhang**, Junfeng Niu, and Yongsheng Chen. Mechanism of Photogenerated Reactive Oxygen Species and Correlation with Antibacterial Properties of Engineered Metal Oxide Nanoparticles. ***ACS Nano*, 2012.** DOI: 10.1021/nn300934k.

Madhavi Kalive, **Wen Zhang**, Yongsheng Chen, and David Capco. Human intestinal epithelial cells exhibit a cellular response indicating a potential toxicity upon exposure to hematite nanoparticles. ***Cell Biology and Toxicology***, DOI 10.1007/s10565-012-9229-7.

Wen Zhang, Joseph B Hughes, and Yongsheng Chen. Impacts of hematite nanoparticle exposure on biomechanical and surface electrical properties of *E. coli* cells. ***Applied Environmental Microbiology*, 2012**. DOI: 10.1128/AEM.00193-12.

Wen Zhang, John Crittenden, Kungang Li, and Yongsheng Chen. Attachment efficiency of nanoparticle aggregation in aqueous dispersions: modeling and experimental validation. ***Environmental Science and Technology*, 2012**, DOI: 10.1021/es203623z.

Yang Li*, **Wen Zhang***, Kungang Li, Ying Yao, Junfeng Niu, and Yongsheng Chen. Oxidative Dissolution of Polymer-Coated CdSe/ZnS Quantum Dots under UV Irradiation: Mechanisms and Kinetics. ***Environmental Pollution*, 2012**, 164: 259–266. (*The first and second authors contributed equally to this work)

Wen Zhang, Bruce Rittmann, and Yongsheng Chen. Size effects on adsorption kinetics of hematite NPs on *E. coli* cells. ***Environmental Science and Technology*, 2011**, 45 (6): 2172-2178.

Wen Zhang, Ying Yao, and Yongsheng Chen. Quantifying and Imaging the Morphology and Nanoelectric Properties of Soluble Quantum Dot Nanoparticles Interacting with DNA. ***Journal of Physical Chemistry C*, 2011**, 115(3):599-606.

Wen Zhang, Ying Yao, Kungang Li, Ying Huang, Yongsheng Chen. Influence of dissolved oxygen on aggregation kinetics of citrate-coated silver nanoparticles. ***Environmental pollution*. 2011**, 159 (12): Pages 3757–3762.

Wen Zhang, Andrew Stack, and Yongsheng Chen. Interaction force measurement between *E. coli* cells and nanoparticles immobilized surfaces by using AFM. ***Colloids and Surfaces B: Biointerfaces,* 2011**, 82(2): 316-324.

Wen Zhang, Madhavi Kalive, David G Capco, and Yongsheng Chen. Adsorption of hematite nanoparticles onto Caco-2 cells and the cellular impairments: effect of particle size. ***Nanotechnology* 2010**, 21: 2–9.

APPENDIX B: EQUIPMENT AND FACILITIES

The New Jersey Institute of Technology (NJIT) is a public research university enrolling nearly 10,000 students in 76 degree programs. The strong applications orientation of the university's research program has allowed NJIT to respond to state, federal, and industrial initiatives, to help address pressing public policy issues, and stimulate economic growth. The faculty members from NJIT collectively have had a leadership role in numerous projects funded by the National Science Foundation (NSF), US Department of Transportation, US Environmental Protection Agency, NJ Department of Transportation, and NJ Department of Environmental Protection among others.

NJIT was one of four national universities designated under the federal Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, which Congress reauthorized, in 1998, as the Transportation Equity Act for the 21st Century (TEA-21). Evolving from the strategic planning process of the U.S. Department of Transportation's University Transportation Centers Program, NJIT's National Center for Transportation and Industrial Productivity (NCTIP) was established to scientifically determine means to increase efficiency and productivity of private or public sector entities and industries through transportation improvements. This is accomplished by undertaking high quality, multi-disciplinary, innovative education and research activities that can withstand rigorous peer review in the areas of freight and passenger movement efficiency, and facility, institutional, and regulatory transportation efficiency.

NJIT also house the Material Characterization Laboratories (MCLs). The MCLs have a unique combination of highly skilled technical personnel and state of the art instrumentation. The instruments that can be used in environmental analysis include gas chromatograph (GC), high performance liquid chromatograph (HPLC), ion chromatograph (IC), total organic carbon (TOC) analyzer and environmental scanning electron microscope (ESEM), gas chromatograph/mass spectrometers (GC/MSs), liquid chromatograph/mass spectrometer (LC/MS, thermogravimetric analyzer (TGA), atomic emission detector (AED), inductively coupled plasma-mass spectrometer (ICP/MS), and atomic absorption spectrometers (AAs). The MCLs are capable of providing a wide variety of high-quality analyses, characterization procedures, and related technical support to solve research problems.

NJIT: New Jersey's Science and Technology University

- Top 200 American research universities –The Center for Measuring University Performance at Arizona State
- Top 50 among colleges without a medical school for research expenditures and top ten among universities whose main re-search is in engineering – *NSF*
- Top 10 among technological universities in faculty scholarly productivity – *Academic Analytics*
- A *Princeton Review* Best College
- 6th among public universities nationwide in alumni earning potential – Payscale.com
- Top 100 producers of minority degrees, including 5th in the nation for bachelor's degrees in engineering technologies to all minority students – *Diverse Issues in Higher Education*
- NJIT has been named to the President's Higher Education Community Service Honor Roll, one of the highest federal recogn-tions a college or university can receive for its commitment to volunteering, service-learning and civic engagement

RESEARCH AND DEVELOPMENT

NJIT's research expenditures totaled more than $102 million in FY2012.
As of August 20, 2012, NJIT had 114 non-provisional patent applications pending of which 56 are funded by third parties and 25 provisional patent applications pending. In addition, NJIT has 154 unexpired US patents of which 53 are unlicensed. The remaining 101 are either licensed (84, optioned 6) or jointly owned (11 with third parties).
NJIT is home to the Enterprise Development Centers (EDC), New Jersey's largest high-technology business incubator, and one of the largest in the nation. Ninety companies presently housed at the EDC employ 800 people. It has attracted more than $67 million in third-party funding and has revenues of $82 million.

Department of Civil and Environmental Engineering (CEE)

The Department of Civil and Environmental Engineering is made up of 27 faculty conducting research in transportation, environ-mental, water resources, structural, geotechnical, and construction engineering. The department is home to about 800 students majoring in undergraduate and graduate programs. The department offers degree programs in civil engineering, environmental engineering, critical infrastructures and transportation. The versatile Faculty and Staff conduct over $10 million in research grants addressing many contemporary problems of technology and society. The three main strategic focus areas are:

Resilient Infrastructure Systems: Sustainable design and materials selection, energy efficient design and construction, green building design and operation, simulation technologies that model societal interaction with infrastructure systems, linkage of material/structural state data with life-cycle models and inclusion of social science and economic models in infrastructure design and construction processes.

Sustainable Environment Systems: Hazard analysis and mitigation, reliability assessment, developing and incorporating sensors and information technologies, geographical information systems and remote sensing, infrastructure health monitoring and damage detection with instrumentation and sensors including non-destructive testing techniques, minimization of operational disruption of infrastructure systems due to human activities and natural disasters, post-disaster recovery planning and decision making for sustainable infrastructure management.

Intelligent Transportation Systems: Sensors and digital communications to collect, process, and disseminate information to im-prove the safety, reduce environmental impact, improve security, efficiency and effectiveness of highways and railroads. The facul-ty also carry out a strong research 'niche' in the areas of traffic analysis, safety issues, transportation security, information trans-portation systems, disaster routing and regional transportation planning, with a special strength in computer simulation and modeling.

Department of Civil & Environmental Engineering (CEE) LABORATORIES

Computer Laboratory: The Department of Civil Engineering has extensive state-of-the art computer laboratories running a number of software products such as GIS-based planning tools, program management tools, vulnerability and risk analysis tools (fault-tree and MBVA analysis) and Institute and regional databases. In addition, the Project Office for the proposed project will include interfaces to key modules used in the project such as the DSS-Wise environment mentioned above. A working web-enabled computing environment for this project will be set up for the hydraulic analysis and the decision model summarizing the evaluation of alternative measures using the DSS-Wise environment and analytical risk and socio-economic models in a virtual environment, to enable capture, transformation and processing of field data in an efficient and integrated manner using common reference databases:

The DSS-WISE version is a GIS-enabled, integrated 2D (two-dimensional) flood model and decision support system fully coupled with ArcGIS. It consists of two major components:
A two dimensional numerical model called **CCHE2D-FLOOD**. This model has several characteristics that distinguish it from other models. CCHE2D-FLOOD solves a conservative form of full dynamic shallow water equations over complex natural terrain using a so called an explicit, shock-capturing numerical scheme. This allows CCHE2D-FLOOD to be able handle mixed flow regimes and sharp positive waves, which are not captured by other programs, is a cause of instability for many commercial software packages. CCHE2D-FLOOD handles wetting and drying of the terrain, disconnected flood domains. Since it is an explicit scheme, the time steps need to be small. In order to be faster-than-real time, CCHE2D-FLOOD was programmed as a multi-core and multi-threaded parallel code. It, thus, takes advantage of multi-core architecture of modern desktop computers to run very fast. Additional algorithms are implemented to increase the speed of simulations. These algorithms allow tracking and calculating only cells with water, which increases the speed many folds for a large number of real-life applications. The numerical model also contains a lot of other features that allow the user to define realistic flood scenarios. These include observation points, lines and profiles to extract time dependent information at selected locations in greater detail, sources and sinks to model various hydraulic structures and their operating behavior, local refinement for increasing the resolution of the mesh at selected locations, etc. It is important that the model has been verified using analytical solutions and fully validated using both laboratory and field data.

A graphical user interface (GUI) that allows the user to define the real-life problem to be solved in a GIS environment, launch the simulation from the same GIS environment and retrieve and analyze/map the results always in the same GIS environment. DSS-WISE GUI has been developed as an extension of ArcGIS software. It has a pre-processor unit that allows the user to define the scenario to be simulated in a very efficient and user friendly manner. Since the GUI is embedded in ArcGIS, the user has access to all ArcGIS functions at all times in addition to the specially designed capabilities for modeling and analysis with DSS-WIE. Once the problem definition is completed all the input files for the numerical analysis are automatically prepared. The numerical model can be launched without leaving the ArcGIS environment. The output files provided by the numerical model CCHE2D-FLOOD are all compatible with the ArcGIS system. They can be directly imported into ArcGIS for mapping and analysis for informed decision making.

The results include maps of flood depths, water surface elevations, horizontal velocity components, discharge components, etc. as a function of time at user specified intervals, maps of maximum flood depth, maximum flood velocity, maximum flood discharge, arrival time, flood receding time, etc.. Also, velocity depth and discharge information are provided as a function of time at user specified locations. These results can be interfaced with geospatial information layers to perform consequence analysis (loss of life, flood hazard risk mapping, etc). Since the output files are HAZUS-MH compatible, they can be directly used for additional consequence analysis using this standard FEMA tool. These results under various scenarios will be used as key inputs to the VRA sub-team risk analysis and risk reduction alternative strategy evaluation. In summary, the features that set DSS-WISE apart from other similar software are:

User friendly integrated environment that allows the user to work from scenario setup to simulation, mapping and consequence analysis in the same GIS environment.
State-of-the-art numerical scheme that guarantees a robust and accurate solution, which is shock capturing and, thus, able to handle mixed-flow regimes and wetting and drying efficiently.
Ability to simulate very large domains (up to hundreds of millions of cells) at unprecedented speed even on desktop computers thanks to multi-core and multi-threaded parallel programming and special algorithms to track and compute only water containing cells. This capability makes DSS-WISE an ideal tool for emergency management applications.
A rich collection of results files which are compatible with GIS software and HAZUS-MH software packages.

DSS-WISE Lite includes a series of application programs, system programs and database applications in order to provide a web based simulation environment with automated input data preparation based on a minimum set of information provided by the user and additional data obtained from national databases. This program is accessed from DSAT (Dam Sectors Analysis Tool) platform, which is a web portal developed jointly by the DHS and USACE and hosted by a server at Argonne National Laboratory.

Structural Testing Laboratory: The Structural Testing Laboratory features a 1000 kip adjustable load fram in a 20-foot ceiling to allow testing of large-scale structural systems. The lab also features a combination strong floor/strong wall that is used with a 100-kip servo-hydraulic structural actuator, which provides great versatility in the application of lateral and dynamic loadings. All testing is PC-controlled with automated data acquisition, and the equipment can be configured to operate in strain-, stress-, or piston-control modes. The laboratory also houses a 55 kip MTS machine.

Geotechnical Laboratory: The Geotechnical Laboratory is suitably equipped to perform a variety of soil identification and index property tests. Students measure soil permeability using both constant head and triaxial permeameters. Strength and compressibility characteristics of soil specimens are also analyzed using unconfined compression devises, consolidometers, and direct shear devices. These laboratory tests are planned to be linked to computer data acquition systems in future lab upgrades. The undergraduate laboratory experience culminates in a PC-controlled triaxial compression test of a clay specimen.

Hydraulics Laboratory: The CEE Hydraulics Laboratory is the department's showcase teaching laboratory. It allows students to demonstrate and analyze key hydraulic phenomena using hands-on physical devices and computer models. Some experiments investigate the basic properties of fluids, e.g., viscosity, capillarity, Reynold's number. The laboratory also contains equipment that demonstrates the various design principles associated with weirs, pips networks, submerged gates, pumps, and stream gauges. The laboratory features a 5-meter tilting flume that allows students to explore more complex phenomena such as backwater effects, culvert tailwaters, and sediment transport. A water hammer experiment was added in 2012.

Strength of Materials Laboratory: This laboratory allows students to analyze a variety of mechanical and material properties including hardness, tensile strength, compressive strength, torsion, and beam deflections. PC-monitored strain gages, load cells, and LVDT's have been incorporated into most of the experimental investigations. The lab also utilizes an MTS universal testing machine that performs material tests using pro-grammed control and feedback loops which is located in the Weston Hall basement Structure Laboratory. Multi-channel strain gage monitoring equipment is used in experiments involving the full-size beam test and plane strain measurements.

Surveying Laboratory: Field exercises for the Surveying Laboratory are conducted throughout campus, and students use the CEE Computer La-boratory to reduce and analyze their data using software packages such as AutoCAD Land Development Desktop. Equipment is issued from the Surveying Equipment Room located in Colton 305. The students use state-of-the-art equipment including automatic levels, total stations and GPS receivers. The Surveying Lab is equipped with up to date equipment thanks to a unique relationship between NJIT and Leica Geosystems. NJIT also has a Leica GPS base station receiver on the roof of Colton Hall and Maintains a computer in Colton 326 which receives data from a network of base stations throughout New Jersey. All these data are transmitted to the National Geodetic Survey (NGS). These base stations are part of a national network of base stations referred to as the Continuously Operating Reference System (CORS), used by the federal government as control points for surveying, mapping, and seismic monitoring.

Environmental Laboratory: The Environmental Laboratory is used in conjunction with the Geoenvironmental Engineering Laboratory for envi-ronmental analyses and experimentation. The laboratory contains equipment for environmental analyses and experimentation, including, gas chromatographs, organic carbon analyzer, atomic adsorption spectrophotometer. UV-vis spectrophotometer, mercury analyzer, ozone genera-tor, jar test apparatus, centrifuge, balances, wet chemistry supplies and chemicals.

Concrete Laboratory: The Concrete Laboratory is equipped to perform a variety of concrete field and strength tests; batch, mix and test concrete for air, slump, compressive strength, splitting tensil strength, and modulus of elasticity. The laboratory was renovated in 2009. A new dedicated concrete compression testing machine was purchased in 2012.

Geoenvironmental Engineering Laboratory: This state-of-the-art laboratory was established with a $1 million equipment grant from the National Science Foundation (NSF) and a $1.4 million institutional match by NJIT. The facility contains state-of-the art instrumentation for investigating soil contaminant interactions, speciation of inorganic and organic contaminants, transport and transformation phenomena, and environmental behavior of geosynthetics and waste residues on macroscopic and microscopic levels. Available equipment includes an environmental scanning electron microscope (ESEM), x-ray florescence (XRF), calorimeter, FT-IR spectroscopy, organic carbon anslysis, capillary electrophoresis, gas chro-matography/mass spectrometry, controlled environment chambers, reactors, respirometry, and toxicity testing.

High Performance Concrete Laboratory/Structural Testing Laboratory: The High Performance Concrete Laboratory is one of the few academic facilities in the country capable of testing very high strength concrete under uniaxial as well as triaxial states of stress. The laboratory contains a servo-hydraulic testing system with a "very stiff" frame that can apply up to 1000 kips to specimens under a computer controlled closed-loop environment. Specimens can be tested at confining pressures ranging up to 12 ksi and at temperatures ranging from – 200 to 400 deg. C. The lab also has two fully controllable curing rooms and a variety of equipment for durability testing and aggregate characterization, and a freeze-thaw chamber for testing concrete durability.

Transportation Laboratory: The transportation research facility is equipped with over 30 computers and contains the latest most sophisticated transportation planning, traffic analysis, computer programming and GIS database management software. Well equipped to perform the most complex research in transportation and logistics, as well as data management.
Remote-Sensing/GIS Laboratory: The Remote Sensing/Geographic Information System Laboratory provides interdisciplinary support of research and courses involving civil engineering, transportation engineering, environmental engineering, geoscience and surveying. The laboratory con-tains modern, state-of-the-art image interpretation facility with softcopy photogrammetry and GIS modules. In addition, it houses a continuously operating satellite base station for the National Geodetic Survey, which is one of only ten of this kind in the U.S.

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER:

GOVERNING BODY RESOLUTION

INSERT CURRENT BOARD RESOLUTION

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

GOVERNING BODY RESOLUTION

INSERT CURRENT BOARD RESOLUTION

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

CONTRACT NUMBER: EC14-005

SUBCONTRACTOR CERTIFICATION

As a condition of the State's consent to the subcontract entered into between _____ (the "subcontractor") and **NEW JERSEY INSTITUTE OF TECHNOLOGY** (the "Contractor") (such subcontract, the "subcontract") for work in furtherance of the contract with the State of New Jersey (the "State") captioned above (the "contract") and in consideration of any payment or benefit the subcontractor may receive for its performance of the subcontract, the subcontractor agrees that the following terms, provisions, and conditions ("terms") shall be additional terms of the subcontract, shall inure to the benefit of the State, and shall not be modified in any way without the written agreement of the State:

1. With respect to all services and goods the subcontractor provides pursuant to the subcontract or in furtherance of the contract, the subcontractor shall comply with, and shall be bound by, all terms of the contract (excepting only (a) those terms, if any, requiring the provision of goods or services not required by the subcontract, (b) the following Sections of the General Terms and Conditions of the contract: IV, IX, X, XI, XIII, XV, XVI, XVII, and XXII, and (c) Attachments B, B-1, B-2, C, and G) as though it were the Contractor and as though all such terms were explicit terms of the subcontract for the benefit of the State as third party beneficiary. The subcontractor acknowledges that the Contractor has given it a complete copy of the contract and that it is familiar with all of the contract's terms

2. The subcontractor acknowledges and accepts that it is an independent principal working for the Contractor and has no relationship with the State in connection with the contract as its agent, servant, employee, contractor, or otherwise.

3. The subcontractor shall make no claim or demand against the State, its officers, its agents, its servants, or its employees (the "State or its agents") (a) which arises out of or in connection with, or which is based on, (i) the subcontract or the contract, (ii) any services or goods the subcontractor provides pursuant to the subcontract or in furtherance of the contract, or (iii) the relationship between the subcontractor and the Contractor in connection with the subcontract or (b) which would not exist if the subcontract did not exist.

4. The subcontractor shall defend, indemnify, protect, and save harmless the State, its officers, its agents, its servants, and its employees from and against any damage, claim, demand, liability, judgment, loss, expense, or cost (collectively, "damage") arising, or claimed to arise, from, in connection with, or as a result of, the subcontractor's performance, attempted performance, or failure to perform in connection with the subcontract (collectively, "performance"), regardless of whether such performance was undertaken by the subcontractor, its officers, its directors, its agents, its servants, its employees, its subcontractors, or any other person at its request, subject to its direction, or on its behalf. As nonrestrictive examples only, this indemnification shall apply, but shall not be limited, to (a) any settlement by the State of any claim or judgment against the State or its agents, provided the subcontractor had the opportunity to participate in the settlement negotiation, and (b) all attorneys' fees, litigation costs, and other expenses of any nature, incurred by the State in connection with any damage. The subcontractor (a) shall immediately notify the State of any damage for which it or the State might be liable and (b) shall, at its sole expense, (i) appear, defend, and pay all charges for attorneys, all costs, and all other expenses incurred in connection with any damage and (ii) promptly satisfy and discharge any judgment rendered against the State or its agents, or any settlement entered into by the State, for any damage. The subcontractor shall not assert any defense which would be available to the State but not to the subcontractor, whether arising pursuant to the New Jersey Tort Claims Act or otherwise, without having first obtained the written approval of the New Jersey Division of Law. This agreement to indemnify shall continue in full force and effect after the termination or expiration of the subcontract and the contract. The subcontractor does not hereby agree to indemnify the State against damage to the extent it results from the state's tortious action or inaction for which it would be liable under the New Jersey Tort Claims Act. As soon as practicable after it receives a claim for damage made against it, the State shall notify the subcontractor in writing and shall have a copy of such claim forwarded to the subcontractor.

CONTRACT
BETWEEN
NEW JERSEY INSTITUTE OF TECHNOLOGY
(Name of Contractor)
AND
THE STATE OF NEW JERSEY
BY AND FOR
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CONTRACT NUMBER:

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1. With respect to all services and goods the subcontractor provides pursuant to the subcontract or in furtherance of the contract, the subcontractor shall comply with, and shall be bound by, all terms of the contract (excepting only (a) those terms, if any, requiring the provision of goods or services not required by the subcontract, (b) the following Sections of the General Terms and Conditions of the contract: IV, IX, X, XI, XIII, XV, XVI, XVII, and XXII, and (c) Attachments B, B-1, B-2, C, and G) as though it were the Contractor and as though all such terms were explicit terms of the subcontract for the benefit of the State as third party beneficiary. The subcontractor acknowledges that the Contractor has given it a complete copy of the contract and that it is familiar with all of the contract's terms

2. The subcontractor acknowledges and accepts that it is an independent principal working for the Contractor and has no relationship with the State in connection with the contract as its agent, servant, employee, contractor, or otherwise.

3. The subcontractor shall make no claim or demand against the State, its officers, its agents, its servants, or its employees (the "State or its agents") (a) which arises out of or in connection with, or which is based on, (i) the subcontract or the contract, (ii) any services or goods the subcontractor provides pursuant to the subcontract or in furtherance of the contract, or (iii) the relationship between the subcontractor and the Contractor in connection with the subcontract or (b) which would not exist if the subcontract did not exist.

4. The subcontractor shall defend, indemnify, protect, and save harmless the State, its officers, its agents, its servants, and its employees from and against any damage, claim, demand, liability, judgment, loss, expense, or cost (collectively, "damage") arising, or claimed to arise, from, in connection with, or as a result of, the subcontractor's performance, attempted performance, or failure to perform in connection with the subcontract (collectively, "performance"), regardless of whether such performance was undertaken by the subcontractor, its officers, its directors, its agents, its servants, its employees, its subcontractors, or any other person at its request, subject to its direction, or on its behalf. As nonrestrictive examples only, this indemnification shall apply, but shall not be limited, to (a) any settlement by the State of any claim or judgment against the State or its agents, provided the subcontractor had the opportunity to participate in the settlement negotiation, and (b) all attorneys' fees, litigation costs, and other expenses of any nature, incurred by the State in connection with any damage. The subcontractor (a) shall immediately notify the State of any damage for which it or the State might be liable and (b) shall, at its sole expense, (i) appear, defend, and pay all charges for attorneys, all costs, and all other expenses incurred in connection with any damage and (ii) promptly satisfy and discharge any judgment rendered against the State or its agents, or any settlement entered into by the State, for any damage. The subcontractor shall not assert any defense which would be available to the State but not to the subcontractor, whether arising pursuant to the New Jersey Tort Claims Act or otherwise, without having first obtained the written approval of the New Jersey Division of Law. This agreement to indemnify shall continue in full force and effect after the termination or expiration of the subcontract and the contract. The subcontractor does not hereby agree to indemnify the State against damage to the extent it results from the state's tortious action or inaction for which it would be liable under the New Jersey Tort Claims Act. As soon as practicable after it receives a claim for damage made against it, the State shall notify the subcontractor in writing and shall have a copy of such claim forwarded to the subcontractor.

Date: _____, _____

_____
(print name of subcontractor)

by: _____
(signature)

_____
(print name)

_____
(print title)

_____
(number and street)

_____
(municipality, state, and zip code)

_____
(telephone number)

ATTEST:

_____
(signature of another officer of subcontractor, if corp. or org.; otherwise, person as witness)

_____
(print name and title)

CERTIFICATION*

I, _____, _____, of
(print name) (print title)

_____ certify that the individual who executed this
(print subcontractor's name)
Subcontractor Certification on behalf of the subcontractor was duly authorized to do so.

ATTEST:

_____
(signature of subcontractor's secretary or equivalent)

_____
(signature of another officer of subcontractor, if corp. or org.; otherwise, person as witness)

_____
(print name)

_____
(print name)

_____
(print title)

_____
(print title)

Date: _____

SEAL

***This certification must be completed if the subcontractor is an organization, rather than a sole proprietorship.**

REFERENCE BIBLIOGRAPHY

This bibliography is provided for reference purposes only. It lists documents incorporated by reference into this contract and other documents which might be helpful to the Contractor.

A. New Jersey Department of the Treasury

- State Circular Letter 04-04-OMB: Single Audit Policy for Recipients of Federal Grants, State Grants and State Aid
- State Grant Compliance Supplement

B. United States General Accounting Office

- Government Auditing Standards (Yellow Book)

C. United States Office of Management and Budget

- Circular A-21: Cost Principles for Educational Institutions
- Circular A-87: Cost Principles for State, Local, and Indian Tribal Governments
- Circular A-102: Grants and Cooperative Agreements with State and Local Governments
- Uniform Administrative Requirements for Grants and Cooperative Agreements with State and Local Governments (Common Rule), (March 11, 1988) http://www.whitehouse.gov/omb/grants/chart.aspx
- Circular A-110: Uniform Administrative Requirements for Grants and Other Agreements with Institutions of Higher Education, Hospitals and Other Nonprofit Organizations
- Circular A-122: Cost Principles for Nonprofit Organizations
- Circular A-133 Revised: Audits of States, Local Governments, and Non-profit Organizations
- Compliance Supplement for Single Audits of State and Local Governments-Uniform Requirements for Grants to State and Local Governments (Compliance Supplement, Revised)
- A-21 (2 CFR Part 220), A-87 (2 CFR Part 225), A-110 (2 CFR Part 215), and A-122 (2 CFR Part 230)

D. American Institute of Certified Public Accountants ("AICPA")

- State and Local Governments – Audit and Accounting Guide
- Not-for-Profit Organizations — AICPA Audit and Accounting Guide
- Auditing Recipients of Federal Awards: Practical Guidance for Applying OMB Circular A-133
- Government Auditing Standards and Circular A-133 Audits – AICPA Audit and Accounting Guide