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NEW YORK CITY ECONOMIC DEVELOPMENT CORPORATION
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INNOVATION AT THE EDGE

Changing the Course of Waterfront Construction

Submitted by Ocean and Coastal Consultants, Atelier Ten & dMASS Inc.
Change the Course
NYC Waterfront Construction Competition

Submitted to:
Maryann Catalano
Senior Vice President
Contracts NYCEDC
110 William Street
6th Floor
New York, NY 10038

Contact information:
Ocean and Coastal Consultants, Inc.
35 Corporate Drive
Suite 1200
Trumbull, CT 06611
W. Stuart Lewis, P.E.
twle@ocean-coastal.com
1 203 268 5007 or 203 400 6072

Executive Summary
We envision a thriving waterfront that is reliable and easier to maintain, one where it is financially sound to apply proactive maintenance practices to mitigate the potential for emergency repairs, and one that delivers more benefits to owners and users while costing less to manage. We see new construction that pushes the edge in terms of materials and designs and contributes to the health of the harbor. In short, we envision NYCEDC as a global leader in waterfront management.

The present approach to repair and maintain New York City’s shoreline infrastructure is economically and environmentally unsustainable. The far-ranging effects of Hurricane Sandy and new data on rising sea levels have added emphasis to this reality. Deteriorating waterfront infrastructure and escalating costs for construction and rehabilitation along the waterfront are not unique to New York. Cities around the world are facing this crisis and will need to “change the course.” The right solution for New York City will establish NYCEDC at the forefront of waterfront management globally.

Ocean and Coastal Consultants, dMASS Inc., and Atelier Ten are pleased to present an innovative approach to achieve your goals of sustainable, cost-effective maritime construction and management. Ocean and Coastal Consultants is a specialty engineering consultancy with a singular focus on projects in the marine environment and a proven history for delivering successful inspection and design projects for EDC. For the past decade, OCC has set a standard of innovation in marine rehabilitation design in New York Harbor, embracing the use of modern construction materials and pursuing solutions to provide proven performance and positive environmental impact. dMASS Inc. identifies emerging technologies, high-performing innovations, and new business models to help clients become more competitive while aligning environment and business. Atelier Ten is a collaborative, interdisciplinary and innovative firm of environmental design consultants and lighting designers focused on delivering sustainability to the planned and built environment.

Introduction
The scale, age, and condition of the City’s waterfront necessitate new solutions. Reactive repair and replacement of waterfront structures is expensive, inefficient, and potentially disruptive to facility operations and to the marine environment. Risks and costs are too high to escalate, not only in New York Harbor, but for every waterfront city around the world.

Options for creative solutions are expanding. Effective application of data management tools offers significant potential time and cost savings. The standardization of the repair and construction process, founded in sound engineering and construction methods and utilizing parties with knowledge of the New York City waterfront, can reduce costs and lead to improved efficiency. Considerate use of innovative materials holds promise to alter the effectiveness, longevity, and cost of repair and construction methods. Sustainable management offers opportunities to apply more cost-effective solutions and to identify potential revenue generators over the long-term.

We have analyzed current construction materials, construction practices, and regulatory processes. Our solution relies on principles of sustainable urban development that incorporate meaningful structural integrity monitoring and reporting and focuses on strategies that foster iterative improvements in waterfront management as science and technologies evolve. Our approach balances pragmatism with forward thinking. Specifically, we propose a solution that includes:

1. **Facilitating a Multi-Party Process**
2. **Adopting Standardization for Projects and Data Management**
3. **Applying Sustainability Principles to Project Planning & Management**
4. **Tracking and Capitalizing on Innovations in Materials & Structures**
5. **Identifying Value-Added Opportunities**

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**The right solution for New York City will establish NYCEDC at the forefront of waterfront management globally.**
1 FACILITATING A MULTI-PARTY PROCESS

After an internal NYCEDC team has had an opportunity to determine the overall direction and goals for waterfront management, we propose establishing an on-going, facilitated process to shape the continued application of that direction and to achieve the long-term goals for the program.

Our team excels at bringing disparate parties together to solve problems. By assembling NYCEDC representatives, regulatory agencies, selected marine consultants and contractors and other interested parties, we will help ensure that the best ideas and the best minds are brought to bear to help NYCEDC succeed. We will facilitate a kick-off session to establish goals, define clear communications, build relationships, and set the stage for information sharing. We will then facilitate workshops aligned with specific program objectives. Development of open, trusting relationships, knowledge transfer, and information sharing will be critical to the ongoing success of this effort.

Multi-Party Process

The absence of standardization for project conceptualization through contractor demobilization creates inefficiencies and increases project costs. Seemingly minor differences in repair details, materials, construction techniques, and contractor processes is a major contributing factor to the high costs of waterfront construction, management, and procurement. This translates into delays in obtaining regulatory approvals, results in inconsistent repair methods that increase initial costs, complicates follow-up repairs, and creates significant costs caused by a lack of a central information depository on the repairs and condition of waterfront infrastructure. Our team proposes to help NYCEDC develop effective standard operating procedures (SOP) for marine asset management, design, rehabilitation, construction, and procurement that will enable NYCEDC to more effectively manage the regulatory process, engineering design, contract document review, and material procurement. Our approach comprises five primary characteristics: Standardized Repairs, Permitted Repair Database, Enhanced Data Management, Multi-Year Contracts, and Preferred Vendor Management Program.

Standardized repairs

We will standardize the development of repair details and specifications across all agencies and engineering and contracting firms to increase productivity, improve quality, and improve rates of regulatory approval. The process and effects of the deterioration of existing construction materials in New York Harbor is well studied and documented. By utilizing the existing knowledge of consultants and contractors, it is easy to envision developing standard repair details and techniques applicable to the types of structures to be encountered in New York. The benefits of standardizing the repairs and others will go beyond the efficiency of generating contract drawings and permit approval. Standardized repair details will increase the productivity of marine contractors and divers critical to the rehabilitation and construction processes. No longer will they need to review and perform unique repairs. All repairs regardless of the engineering or contracting firm will be consistent. Freed from the need to constantly tailor means and methods to specific consultant designs, contractor methods can become more uniform and efficient, increasing competition and reducing costs.

Permitted repair database

In this phase of the solution we will expand upon the existing DEC General Maintenance Permit. We will bring together current marine engineers, regulatory reviewers, environmental experts, and EDC representatives to continue building a working relationship and to begin establishing a set of standard permitted repairs. The eventual goal is to establish a database for all possible repairs that will be permitted and approved for immediate implementation.

Effective standardization is critical for cost savings.

Enhanced tools for collecting, mapping & managing data

Countless tools exist today for collecting and compiling geographically based data. The challenge is to make the data most readily useful. Contractors working on waterfront projects today collect information on conditions and lessons on the difficulty of implementing repairs as designed, but the value of that information is not necessarily captured because it’s not shared. Contractors should be required to provide data on existing conditions from surveys and assessments with time and GIS information. Likewise, sensor systems in new and replacement construction will help make it possible to identify problems before they become crises, to know when to combine multiple replacement and maintenance projects, and to reduce unnecessary maintenance based on time factors alone. Sensor networks can be used to track structural integrity in real time. They could reduce the need for post-event inspections, like those that were required after hurricane Sandy, and reduce risk to divers. They could also alert waterfront engineers of potential structural problems, invisible to human inspectors, before those problems develop into crises.

Multi-year contracts

Multi-year contracts with fixed prices established per standardization repairs will allow NYCEDC to better manage emergency repairs. Multi-year contracting can reduce costs by permitting the contractor to amortize nonrecurring “start-up” costs over the life of the contract. In addition, multi-year contracts will enable contractors to maintain a stable workforce, which will result in enhanced quality and consistency in workmanship.

Preferred vendor management program

Although waterfront management projects are designed and specified by different firms for a multitude of city agencies, NYCEDC should be able to negotiate preferred rates on materials from vendors who will benefit from serving ongoing projects across more than 500 miles of waterfront. We envision a Preferred Vendor Management program being executed via a bidding process whereby NYCEDC can leverage its position as a multi-project and multi-year buyer. An additional benefit will be the continued development of waterfront-specific repair and construction materials to create further cost and time efficiencies.

2 ADOPTING STANDARDIZATION FOR PROJECTS & DATA MANAGEMENT

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Development of open, trusting relationships, knowledge transfer, and information sharing will be critical to ongoing success.
3 APPLYING SUSTAINABILITY PRINCIPLES TO PROJECT PLANNING & MANAGEMENT

Sustainable practices are integral to the success of NYCEDC development projects. Fundamentally, our team believes that the New York City waterfront infrastructure can be adapted to enhance sustainable characteristics for projects in sensitive environments without compromising their high level of functionality. As part of the facilitated process, we will help develop a sustainable, low-impact, and ultimately a restorative plan for waterfront construction.

We will lead NYCEDC through the analysis of sustainability and innovation elements from early planning stages to project design, engineering, and project execution. Guided by our team’s innovative research and analysis, we will facilitate an integrated design team process to establish sustainable design goals for the project. These goals should be specific and achievable, representing realistic and tangible benchmarks. They should comprehensively pinpoint achievement in carbon emissions reductions, environmental quality, water ecology, operations and maintenance, transportation, and potentially energy production and waste management. We have often found that early establishment of project environmental goals has added benefits including marketing opportunities and simplification of difficult regulatory processes.

Our macro-to-micro approach to incorporating sustainability focuses on making the most out of environmental opportunities and enhancing the approach in our projects. We will draw on our extensive knowledge of high-performance building and infrastructure principles, strategies, technologies, and analytical tools to advocate for creative, practical, and appealing design solutions. Our methodologies combine qualitative and quantitative thinking. We will deliver design solutions centered on the cornerstones of environmental integrity, economic viability, and social well-being. Specific opportunities include: Life-Cycle Thinking, Expanded and Continual Monitoring, Preventive Maintenance Program, and Environmental Monitoring and Smart Data Systems.

Adopt a life-cycle perspective

Life-cycle analyses would enable NYCEDC to better identify the environmental costs inherent for material extraction, manufacture, and in the overall transportation process impact areas that extend well beyond the actual project boundary. As construction materials can weigh heavily on natural resources, projects now often consider how a material’s full life cycle factors into its embodied energy and overall environmental impact. NYCEDC could use this information to evaluate materials and sourcing decisions, potentially reducing time, costs, and environmental impacts.

Expanded and continual monitoring

This could ensure that new and existing structures are operating as intended, problems are identified early, and corrective measures are taken before structures become unstable or even lost. Incorporating active monitoring, adapting continuing maintenance protocols, and using sturdier products or designs could reduce the on-going operational impact on the environment.

Improved preventive maintenance

Changing the existing model from re-active to pro-active will yield long-term cost savings. Preventive repairs are long-term cost savings solutions. Emergency repairs are costly and resource-intensive. This will help to ensure efficient operations over time by maintaining systems consistently rather than waiting until they malfunction. Expensive repairs and system failures are avoided.

Environmental monitoring and smart data systems

Through strategic partnerships with local universities, EDC should maintain a system of environmental sensors along the shoreline to better monitor conditions such as temperature, light, chemical constituents of the water, and hydrodynamic conditions. Over time, this information could be combined with assessments and sensors on structures to identify conditions that contribute to deterioration and failure behavior of different pile materials and designs, again leading to reduced maintenance costs and improved design over time. Similar programs on the Gowanus Canal in Brooklyn might prove to be a successful model for such monitoring and research.
Innovations in Materials and Structures

Innovation in waterfront construction and maintenance is a dynamic phenomenon. New materials, research, and methods are emerging everyday in myriad industries with applicability to NYCEDC projects. A truly successful construction and maintenance program for NYCEDC will be one that incorporates a systematic, ongoing review of emerging technologies and strategies, as well as a mechanism for testing their ability to perform and to deliver cost and time savings.

Our team members track innovations that deliver more functionality with fewer resources. We maintain a database with emerging research, strategies, and products to identify cross-industry opportunities to do better with less. Given resource constraints and other economic and resource related pressures, there is not only a growing need for these innovations, but growing research and investment in them. New York City has an opportunity to tap into this innovation stream and to become a hub of waterfront innovation. Our team can help identify material innovations globally and then connect NYCEDC with researchers, innovators, and investors who are interested in testing, developing, investing in, and deploying new applications.

Using our team’s proprietary innovations database, we have already identified a variety of innovative technologies that have the potential to improve waterfront construction and maintenance, reduce costs of construction and maintenance, and minimize environmental impact. These innovations are now entering the marketplace or are being tested in related industries. They include advances in new materials, structural designs, and smart building technology. Several examples include: Resilient Bio-Inspired Materials, High-Performing Materials, Self-Monitoring and Healing Materials, and Advanced Structures.

Examples

Resilient bio-inspired materials

Marine scientists are using a steel skeleton and electrically conductive wire mesh to build artificial reefs. A very small electrical charge causes a self-healing concrete material similar to clam shells to form and coat the designed structures. New research focused on how such underwater structures, developed by working with nature rather than resisting it, cope with a variety of marine stressors. This work is yielding advanced structural materials that are resistant to deterioration (in fact strengthen with age) and have the potential to result in reduced rehabilitation costs over time.

High-performance materials

Recent advances in concrete, steel, fabric, and other materials offer lighter weight yet stronger alternatives requiring fewer resources and potentially lower installation costs. For example:

1) Carbon and glass fiber fabrics are being used to provide strong, durable, corrosion-resistant skeletons for bridges.
2) New cellular concrete incorporates air cells that increase strength compared to traditional concrete, and requires less material.
3) Nano-structured steel is lighter and stronger than its predecessors.

Self-monitoring & healing materials

Researchers have developed polymers with embedded fiber optic networks that sense damage and excessive stresses in the materials themselves. Such technologies are already in use in smart bridges around the world to enhance safety, reduce unnecessary maintenance and replacement, and reduce costs. The next generation of such smart materials includes feedback that actually stimulates healing in the material itself. There are many self-healing materials in development, including self-healing concrete.

Advanced structures

Most existing underwater support structures use vertical compression members supporting horizontal decks at 90º and are subject to excessive stresses from constantly changing currents, tides, and waves, as well as shifting loads on the pier surfaces. Advanced structural research being employed on large aboveground structures such as stadiums, airports, skyscrapers, indicates that improved performance can be achieved with fewer tons of resources and lower cost by employing triangulated truss structures that distribute tension and compression loads and accommodate shifting external forces more effectively. In addition to underwater trusses, the use of tension structures to suspend cantilevered decks can enable reduction or even elimination of underwater pier supports. Both of these approaches would benefit from the use of new, lighter-weight materials for deck construction.

A truly successful program will be one that incorporates a systematic, on-going review of emerging technologies and strategies.

Identifying Value-Added Opportunities

Today, NYCEDC manages construction repairs as a cost center. We propose examining strategies for value-added activities on the waterfront that complement and enhance NYCEDC’s activities. These can either be revenue-generating activities or activities that provide other benefits to New York City residents.

For example, NYCEDC would benefit from fostering research on the waterfront. First, the city could provide an opportunity for researchers to use sites for testing new materials and construction techniques and for measuring the performance of existing ones. Research findings would be applicable to construction and maintenance projects. Second, by partnering with research entities, the city could potentially sell or license resulting intellectual property. In this way, NYCEDC could turn a cost into a revenue-generating and value-added activity.

Research and demonstration opportunities could also be explored in the area of on-site energy generation above and below water level with solar photovoltaics or tidal power.

In terms of education and outreach, the development of smartphone applications that link project sites to monitoring of water quality, salinity, temperature, and so on could provide additional benefits by connecting the public to their nearby waterfronts.

Each of these opportunities is easily envisioned on new and existing facilities with implementation achieved during the construction or rehabilitation process.
NYCEDC has an enormous opportunity today to become the global leader in innovative, sustainable, and cost-effective waterfront management. It’s the right time to “change the course.”

By leveraging the practical and theoretical knowledge contained within this team, we can deliver a tangible, real-world solution for immediate implementation while helping NYCEDC establish a foundation to transform construction and repair over the long-term.

Our whole-systems approach integrates creative solutions to address the critical factors that drive the cost and duration of projects, as well as solutions that will help the city derive more value from the waterfront.

This proactive approach to innovation and research is consistent with a long-term view that will help New York City become a model for waterfront construction globally and enhance the city’s reputation as the preferred place to do business and to live. It will accelerate innovation in waterfront management and generate new opportunities for NYCEDC.

### Expected Cost Savings and Value Added Through “Innovation at the Edge” Implementation

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- Facilitating a multi-party process
- Adopting standardization for projects and data management
- Applying sustainability principles to project planning & management
- Tracking and capitalizing on innovations in materials & structures
- Identifying value-added opportunities

5-Year Increments During Implementation

ANNUAL COSTS (Budgeted & Emergency)

EXPECTED COST SAVINGS AND VALUE ADDED THROUGH “INNOVATION AT THE EDGE” IMPLEMENTATION
Kathryn Lewis, MBA, Co-Founder/CEO, dMASS | Kathryn has expertise in business value creation, strategic marketing, and business systems. She uses cutting-edge thinking, fresh technology tools, and management innovation to help businesses build value. Prior to starting dMASS Inc., she spearheaded the launch of an international network for scientists and business leaders who work in energy harvesting technologies. Her experience also includes healthcare management consulting and marketing analysis for a global logistics company.

Stuart Lewis, PE, Associate Project Manager, Ocean and Coastal Consultants | Stuart is an associate project manager and diver with over seven years experience as a structural and construction engineer. He has a strong background in bridge condition inspection, structural analysis, ferry barge logistics and marine construction. He has gained extensive experience and familiarity with EDC through his work around the harbor. His ability to effectively coordinate with clients and his OCC project team are instrumental to the successful delivery of inspection and rehabilitation projects on schedule and budget.

Douglas Friend, PE, MSc, New York Regional Manager, Ocean and Coastal Consultants | With more than 15 years of experience in inspection, evaluation, and rehabilitation of marine and waterfront facilities and as manager of OCC’s newly founded New York office, Doug has specific experience and interest in sustaining and developing the waterfront of New York Harbor. Throughout his career Doug has led and managed the delivery of inspection and design projects to EDC and HRPT throughout the five boroughs with specific project experience that includes condition structural evaluation, construction supervision and inspection, and rehabilitation of waterfront structures.

Benjamin Shepherd, LEED AP BD+C, Associate Director, Atelier Ten | Ben is an accomplished lighting and environmental designer. Emphasizing integrated and resourceful design to enhance the visual experience of buildings, he has lectured widely and consulted on many significant green building projects both in the United States and abroad.

Kristin Aldred Cheek, MS, Principal, dMASS | Kristin is a sustainable business practitioner with expertise in social science research and communications. As a colleague of Howard Brown’s at RPM Systems, she participated in some of the nation’s first “corporate greening” projects. She has advised companies on energy efficiency and resource performance and managed communications on environmental cleanup projects. Her experience also includes research related to public participation in natural resource management and the economic impacts of natural resource use.

Ocean & Coastal Consultants (OCC) is an engineering consulting firm specialized in Coastal and Port Engineering. We provide underwater investigations with one of the largest contingencies of Professional Engineer and Engineer Divers in the United States.

We offer unique expertise for solving complex problems in the coastal and offshore environments including:

• Underwater Investigation
• Dredge Design / Disposal
• Regulatory Services
• Coastal Engineering
• Construction Administration
• IT/GIS Database Development
• Coastal Resource Evaluation
• Offshore Wind Energy
Atelier Ten is a collaborative, interdisciplinary and innovative firm of environmental design consultants and lighting designers focused on delivering sustainability to the planned and built environment.

Our team’s background in architecture, engineering, lighting design, environmental studies and urban design translates into a profound respect for architectural design and urbanism with an enthusiasm for working with emerging designers and established firms. Our core objective is to meet the needs of our clients by developing well-integrated buildings with simple systems that work with natural laws of physics to increase comfort, reduce energy consumption and contribute back to the greater environment.

We believe passionately in delivering a legacy of positive change. By recognizing and analyzing opportunities for improving energy efficiency, water conservation, material resources, and carbon emissions reductions, we provide integrated, full-service consulting on environmental design, building systems performance analysis, lighting and daylighting design, benchmarking, sustainable masterplanning, and inter-related services. Our broad and worldwide portfolio spans from the tallest LEED Gold Office building in the United States to the world’s largest thermal labyrinth at Federation Square in Australia, to hundreds of award-winning projects and LEED certified buildings.

Enlightened but pragmatic solutions are a hallmark of our work. Our clients value our macro-to-micro approach to planning and design, always concentrated on making the most of environmental opportunities and enhancing the human experience in our projects. We provide big picture guidance on goals, policies, and long-term planning, supported by technical analysis to test out design strategies for long-term use and cost. We draw from our extensive knowledge of green building design principles, strategies, technologies, and analytical tools to advocate for creative, practical, and appealing design solutions. Our methodologies combine qualitative and quantitative thinking; we deliver design solutions based on the cornerstones of sustainability, environmental integrity, economic viability and social wellbeing. An international firm, Atelier Ten provides a seamless, integrated service, marked by accessibility, reliability and efficiency at every level. Founded in 1990 in London by a team of progressive engineers, we have since expanded, with offices in New York, New Haven, San Francisco, Glasgow, Abu Dhabi, and Bangkok.

Recognized by
The Guardian
Stumble Upon
Jetson Green
GreenBiz.com
Treehugger
Core77

Publishers of
Naked Value

**Value Mining**
Reports and analyses drawn from dMASS Inc.’s growing database of products, services, research, and business models in every economic sector to identify risks, opportunities, and product redevelopment strategies.

**Consulting**
Opportunity mapping and other business services to help organizations pursue resource performance improvements to do better with less.

**Connecting & Informing**
Tracking, documenting, and sharing critical information on cutting-edge innovations that improve resource performance and mitigate environmental and business risks. Workshops to help participants align good business and good environmental performance and begin to pursue systematic, intentional innovation. Services that accelerate innovation by connecting innovators and investors.

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**dMASS Inc.**
identifies hidden risks and opportunities for businesses and investors

Resources are at the heart of nearly every major challenge facing businesses and even entire economies around the globe today. There’s no doubt that the future is about delivering more benefits to more people using fewer tons of resources. Resource performance is the key to profitability and competitiveness in the marketplace, as well as the key to managing environmental impacts and risks.

We draw on our unique system for detecting and classifying innovations and resource trends to help business leaders and investors gain a competitive advantage. We use our wealth of experience in business and in environmental management to help our clients profitably align the two. We offer a positive, practical perspective for anyone interested in understanding the relationship between innovation and resource use today.

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**SERVICES**

**Value Mining**

**Consulting**

**Connecting & Informing**

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**atelier ten**
Environmental Design Consultants + Lighting Designers
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