
# INCREASING INFRASTRUCTURE'S RESILIENCY TO GLOBAL CLIMATE CHANGE EFFECTS

*Seeking Non-Traditional Federal Partnerships in Rhode Island's Coastal Beach Zones*

**James McMahon**

Roger Williams University
SCHOOL OF LAW

Sea Grant
Rhode Island

NOAA

THE UNIVERSITY OF RHODE ISLAND

*Marine Affairs Institute*

While many Federal agencies traditionally incorporate environmental restoration and rehabilitation principles into their primary mission, this memorandum focuses on inclusion of federal entities that could be considered "non-traditional" environmental partners in environmental restoration and rehabilitation efforts.

Section one of this memorandum provides general background information on commonly accepted projections of the effects of climate change and sea level rise within the Southern New England Whole System, a geographic and political region with similar climate and interests.[1][2] The first section will also focus on climate change issues faced specifically by Rhode Island.

The second section of this memorandum describes four case studies where private stakeholders, state governments, and non-traditional federal partners have successfully executed programs designed to improve human infrastructure's functionality while improving the natural environment; specifically, the case studies examine mitigating the potential numerous damages of climate change and sea level rise.

The third section outlines the interests that non-traditional Federal partners currently have in the Rhode Island coastal beach zone, defined in this memorandum as the 19 municipalities in Rhode Island that have publicly owned coastal beach facilities.[3] After currently existing federal interests and holdings are identified, the section provides a survey description the programs offered by these potential partners.

The fourth section identifies potential concurrent interests beneficial to The Nature Conservancy; specifically, where the opportunity to improve infrastructure's resiliency to the impacts of climate change intersects with the partnership opportunities available from potential non-traditional Federal partners.

Lastly, this memorandum concludes with strategies The Nature Conservancy can employ to efficiently coordinate interests between stakeholders, State agencies, and potential non-traditional federal partners. These strategies include environmental initiatives and specific federal programs designed to increase infrastructure's resiliency in the face of global climate change.

## Section One: Background Information on Climate Change Impacts in Southern New England

The Southern New England Whole System, defined as Long Island, Connecticut, Rhode Island, and Massachusetts, will potentially suffer the most pronounced effects of global climate change. The residents in one of the nation's most heavily industrialized and inhabited coastal and estuarine areas will be among the first to feel a rise in average sea levels and temperatures, a highly visible consequence of the global warming trend.

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[1] Tony Dutzik, *Global Warming and New England*, New England Climate Coalition (September 2003, Last visited Sept. 6, 2012), available at http://www.cleanair-coolplanet.org/solutions/trans_solutions/climate%20change%20final.pdf.

[2] *Assessing Coastal Vulnerability to Sea Level Rise in Southern New England*, NOAA Coastal Services Center (Last visited Sept. 6, 2012) available at http://www.csc.noaa.gov/digitalcoast/inundation/slr-newengland.

[3] *Explore Rhode Island Beaches,* Rhode Island Tourism Division (Last visited Sept. 6, 2012), available at http://www.visitrhodeisland.com/what-to-do/beaches/.

In the past twenty years, sea levels in New England rose on average by 2-3.7mm per annum, while the global average rose between 0.6-1mm per annum in the same period.[4] This rise could be augmented by a slowdown in the Atlantic Meridional Overturning Circulation (Gulf Stream), which would most significantly affect the North Atlantic and the Northeast's coast specifically.[5] Some scientists have claimed that these changes' projected effects will have a greater impact on New England than previously estimated; in the coming century, projected global sea levels could rise on average between two to six feet.[6] Although the current approximate 400% ratio of New England sea level rise to global levels has been seen as unsustainable and attributed to land subsiding due to geologic factors,[7] even the projected global average would have disastrous consequences on human and natural systems, if left unmitigated. These impacts include habitat destruction or fragmentation, encroachment by non-native species, natural and recreational assets becoming spoiled, and damage to life or property in a human system.[8]

New England is in a unique position to manage and adapt to the challenges presented by global climate change's effects by using the region's features such as high population densities, heavy industrialization, and many private coastal landholdings as assets rather than impediments. Within the Southern New England Whole System, Rhode Island faces some of the greatest vulnerabilities to global climate change's effects, with the second-highest population density of any state[9] and 400 miles of coastline.[10] Fourteen percent of its coastal land and ten percent of its total land area covered by impermeable surfaces,[11] which can reach temperatures in excess of 130°[f] and discharge up to 16 times the amount of water a similarly-sized forested area would during two inches or rain.[12] A large coastal lowlands area risks inundation from gradual sea level rise and sudden storm surges.

With current climactic conditions, in the next century Rhode Island would naturally sustain damages totaling $2.5-4.5 billion from storm and flooding events, but with continued high emissions levels the State is projected to sustain $2-6 billion in additional damages from

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[4] David Abel, *Rising Sea Levels a Threat to East*, Boston Globe (June 25, 2012), available at http://www.boston.com/news/local/massachusetts/articles/2012/06/25/sea_level_rising_3_4_times_faster_along_east_coast_than_globally_government_report_finds/?page=full.

[5] *10.3.4 Changes in the Atlantic Meridional Overturning Circulation*, Intergovernmental Panel on Climate Change (Last Visited Sept. 6, 2012) available at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch10s10-3-4.html.

[6] David Abel, *Rising Sea Levels a Threat in the East, Study Says*, Boston Globe (June 25, 2012), available at http://www.boston.com/news/local/massachusetts/articles/2012/06/25/sea_level_rising_3_4_times_faster_along_east_coast_than_globally_government_report_finds/?page=full.

[7] Arthur C. Redfield, *Postglacial Change in Sea Level in the Western North Atlantic Ocean*, 157 Science 687, available at http://www.sciencemag.org/content/157/3789/687.abstract.

[8] *Assessing Coastal Vulnerability to Sea Level Rise in Southern New England*, NOAA Coastal Services Center (Last visited Sept. 6, 2012) available at http://www.csc.noaa.gov/digitalcoast/inundation/slr-newengland.

[9] 20*10 Census: Rhode Island Profile*, United States Census Bureau (last visited Sept. 6, 2012) available at http://www.census.gov/geo/www/guidestloc/pdf/44_RhodeIsland.pdf.

[10] *Historical Information*, Rhode Island Government (last visited Sept. 6, 2012) available at http://www.ri.gov/facts/history.php.

[11] *Impervious Surfaces*, Narragansett Bay Estuary Program (last visited Sept. 6, 2012), available at http://www.nbep.org/currents_change/impervious_surface.html.

[12] Lance Frazer, *Paving Paradise: The Peril of Impermeable Surfaces* (July 2005), available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1257665/.

increased storm severity and frequency.[13] Alarmingly, the damages calculation assumes that Rhode Island will not further develop or populate their coastal regions, a highly unlikely scenario. With 17% of the total state area already under water,[14] Rhode Island's unique size and coastal orientation also poses distinct challenges to human development and infrastructure's construction and maintenance.

The bridge and highway system maintained by the Rhode Island Department of Transportation (RIDOT) is among the State's largest infrastructure systems in a physical scope, budgetary percentage, economic benefit, and environmental impact. This department, in a state measuring approximately 37 miles by 48 miles (1,033.8 square miles total area[15]), is responsible for over 1,100 road miles and 800 individual bridges within their jurisdiction.[16] Despite the RIDOT's efforts, Rhode Island's transportation network's roadways and bridges are in notoriously poor conditions due to heavy use, seaside corrosion, high maintenance costs, and a small population to spread costs over, among other reasons. RIDOT concedes that in during the current economic recession its investment in infrastructure has not been able to keep pace with demand.[17]

In fact, Rhode Island is ranked as second-to-last in per-capita spending on highways, with $314 per citizen compared to the $500 per citizen national average.[18] Despite a claim that Rhode Island spends approximately two to three times higher than the national average per mile on its road system,[19] The American Association of State Highway and Transportation Officials (AASHTO) ranked Rhode Island 47th in the nation, with overall "poor" roads,[20] while private groups such as Transportation 4 America rated 68% of Rhode Island's roads in poor or mediocre condition.[21] In 2010, the Reason Foundation ranked Rhode Island as having the worst roads in the nation based on 2008 Federal Highway Administration (FHWA) data.[22] However, the FHWA

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[13] Timmons Roberts et. al., *Summary: Preliminary Assessment of Rhode Island's Vulnerabilities to Climate Change and Its Options for Adaptation Action* (March 2010), available at http://envstudies.brown.edu/Summary-RIClimateChangeAdaptation.pdf.

[14] *How Much of Your State is Wet?,* USGS Water Science School (last modified Aug. 1, 2012), available at http://ga.water.usgs.gov/edu/wetstates.html.

[15] 20*10 Census: Rhode Island Profile*, United States Census Bureau (last visited Sept. 6, 2012) available at http://www.census.gov/geo/www/guidestloc/pdf/44_RhodeIsland.pdf.

[16] *About RIDOT*, Rhode Island Department of Transportation (last visited Sept. 6, 2012), available at http://www.dot.state.ri.us/divisions/index.asp.

[17] *Tolling: Change Needed for R.I.'s Future,* Rhode Island Department of Transportation (last visited Sept. 6, 2012), available at http://www.dot.state.ri.us.

[18] *Highway Expenditures Per Capita*, RIEPC (last visited Sept. 6, 2012), available at http://www.dot.state.ri.us/documents/Highway_Expenditures_per_capita.pdf.

**[19]** *State Rep. Michael Chippendale says Rhode Island has the worst maintained bridges in U.S. and second worst maintained roads* PolitiFact Rhode Island (Last updated June 22, 2012), available at http://www.politifact.com/rhode-island/statements/2012/jun/22/michael-chippendale/state-rep-michael-chippendale-says-rhode-island-ha/.

[20] *Rough Roads Ahead,* American Association of State Highway and Transit Officials (2009) available at http://roughroads.transportation.org/RoughRoads_FullReport.pdf.

**[21]** *State Rep. Michael Chippendale says Rhode Island has the worst maintained bridges in U.S. and second worst maintained roads* PolitiFact Rhode Island (Last updated June 22, 2012), available at http://www.politifact.com/rhode-island/statements/2012/jun/22/michael-chippendale/state-rep-michael-chippendale-says-rhode-island-ha/.

[22] See id.

rejected a February 2012 proposal from the State to implement tolling to close this deficit and advised reliance on highway appropriations.[23]

Rhode Island has implemented a program that mandates low-impact development (LID), requiring environmental mitigation and protection efforts to be included in any new projects.[24] RIDOT Director, Michael Lewis, has announced that he considers RIDOT to be "ahead of the curve" in implementing this planning, which takes into account rainfall, topographic and tidal data into new construction projects.[25] However, Director Lewis has also stated that the state will rely on federal programs to fund the majority of these projects, and that if municipalities cannot secure funds to upgrade the resiliency of their infrastructure then they should consider removal or abandonment of structures.[26]

Degrading infrastructure and coastal development threatened by increasing flooding, inundation, and erosion will substantially threaten Rhode Island's close economic relationships to its natural systems and resources. The commercial fishing industry, among Rhode Island's greatest cultural and economic assets, is also the economic sector most directly impacted by the effects of sea level rise. In 2010, commercial fishing and processing activities in the state directly contributed $200.9 million to the state economy, and provided 4,968 jobs.[27] To protect this asset, Rhode Island has designated all waters within their control (3nm from the mean low water baseline) as zero-discharge zones, and a recent ruling from the EPA has declared the portions of Mount Hope Bay under Massachusetts's protection, as well as Nantucket and Vineyard Sounds as zero-discharge as well.[28] Unfortunately, even with optimistic scenarios for levels of emissions reduction, the amount of damage that has already been done to the climactic system could cause this important industry to collapse commercially by 2050.[29]

Studies show that encroaching on buffer zones in riparian areas can increase the temperature in a watercourse by up to 4 degrees (with a reduction from a 100-foot buffer to a 50-foot buffer), and an 11% increase in sediment clouding in the water as well.[30] Water sheeting off of impervious surfaces is contaminated not only by chemical and particle pollutants, but also is usually introduced into the system at a much higher temperature than naturally occurs. A rise in ambient temperature is a precursor to emergence of invasive, non-native species that displace native species from their traditional habitats.

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[23] *Tolling Proposals in Rhode Island*, RIDOT (last visited Sept. 6, 2012) available at http://www.dot.state.ri.us/TollingInfo/tolling_index.asp.

[24] Horsley Witten Group et. al., *Rhode Island Low Impact Development Site Planning and Design Guidance Manual* (Feb. 2011), available at http://www.dem.ri.gov/programs/bpoladm/suswshed/pdfs/lidplan.pdf.

[25] Tim Faulkner, *R.I. Cities and Towns Adapting to Climate Change,* ecoRI News (Oct. 24, 2011) available at http://www.ecori.org/climate-change/2011/10/24/ri-cities-and-towns-adapting-to-climate-change.html.

[26] Tim Faulkner, *R.I. Cities and Towns Adapting to Climate Change,* ecoRI News (Oct. 24, 2011) available at http://www.ecori.org/climate-change/2011/10/24/ri-cities-and-towns-adapting-to-climate-change.html.

[27] Emerson Hasbrouck et. al., *Rhode Island Commercial Fishing and Seafood Industries-the Development of an Industry Profile*, Cornell Cooperative Extension Marine Program (Oct. 12, 2011), available at http://ccesuffolk.org/assets/Marine-photos/Marine-Pdfs/Final-Reports/RI-Profile-Final-2nd-Print.pdf.

[28] *Patrick-Murray Administration Secures No Discharge Area Designation for Mount Hope Bay*, Massachusetts Executive Office for Energy and Environmental Affairs (Last updated June 29, 2012), available at http://www.mass.gov/eea/pr-2012/120629-pr-mount-hope-bay.html.

[29] Fred Pearce, *No More Seafood by 2050?*, NewScientist Environment (Last updated Nov. 2, 2006) available at http://www.newscientist.com/article/dn10433-no-more-seafood-by-2050.html.

[30] Horsley Witten Group et. al., *3.0 Riparian Buffer Standards* (Last visited Sept. 6, 2012), available at http://www.horsleywitten.com/DEM-LID-Guide/docs/3_bufferstandards.pdf.

Projects to increase the resiliency of infrastructure in the face of the challenges presented by the many threats of global climate change will be of a scope that will require coordination between stakeholders such as The Nature Conservancy, and local, state and federal partners. In the next section, several projects designed to improve or rehabilitate the efficient functioning of both human and natural systems in a sustainable and responsible fashion will be discussed.

## Section Two: Four Case Studies in Infrastructure Rehabilitation and Redesign Incorporating Climate Change Adaptation and Resiliency

### Case Study One: 2011 Bristol Town Beach Rehabilitation: Bristol, Rhode Island

#### I. Background

This case study is a standard public works project that includes climate change resiliency in its project design. It was executed using traditional federal partners and should serve as a point of reference for the subsequent studies.

This case study focuses on a local issue; Bristol Town Beach's repeated closures to swimming and fishing primarily due to unacceptable levels of *Enterococcus* bacterial colonies in the water.[31] *Enterococcus* is a bacterial organism that is naturally resistant to antibiotics, is extremely resistant to both high and low heat, and can thrive in saline environments.[32] In humans, exposure to the bacterium in significant amounts may result in urinary tract infections, diverticulitis, bacteremia, and meningitis.[33] In Bristol, pollutants infiltrated the water supply through chemical fertilizer's repeated application in nearby fields, insufficient removal of fecal matter from large flocks of migratory geese, two nearby septic leach fields with poor drainage, and four storm drains with outflow into nearby areas. Moreover, the plot's topography sloped towards the beach area and concentrated damaging effects,[34] such as hydrocarbons introduced into the waterfront by runoff from access roads, due to the poorly designed parking area.[35] In addition to the health concerns, the beach closures had a negative impact on tourism, removed a recreational facility from public use, and generally impacted the quality of life for users.

#### II. Methods

In order to efficiently remedy the issue, a working team in the town of Bristol, consisting of parks and recreation, community development, and planning staffs, coordinated their efforts with state health and environmental agencies, the Coastal Resources Management Council, the National Resource Conservation Service, the EPA, and private stakeholders to rehabilitate the site and improve its functionality against increasing precipitation events.[36] In the coming century Rhode Island's predicted precipitation levels are expected to increase 20-30% in the winter,

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[31] Amie Parris and Lauren Toracinta, *2011 Season Report*, Rhode Island Department of Health Beach Program (March 2012), available at http://www.health.ri.gov/publications/annualreports/2011BeachProgram.pdf.
[32] *Vancomycin-Resistant Enterococci*, Medicine.net (last visited Sept. 6, 2012) available at http://www.medicinenet.com/vancomycin-resistant_enterococci_vre/article.htm.
[33] See id.
[34] Meg Kerr, *Restoring Bristol's Waterfront*, Narragansett Bay Journal (last updated June 6, 2012) available at http://www.nbep.org/journals/23-2012/BristolWaterfront.pdf.
[35] See id.
[36] See id.

although only one week per month in the winter will maintain snow cover.[37] Even under conservative estimates, this forecast will result in increased erosion and polluted runoff entering the wastewater treatment system and ultimately entering the environment.

The property's redesign and repurposing included Low-Impact Development (LID) techniques with a focus on mitigating runoff. To address biological contamination, the changes included the removing septic leach fields with connections to the sewer mains, and a program to re-level the nearby fields to encourage proper drainage. Over 100 new trees planted act as a natural and beneficial way to discourage Canada geese from landing and fouling the site. Reducing hydrocarbon introduction required a complete overhaul of the parking lot, incorporating new techniques to capture, retain, and safely dispose of wastewater using a new layout. Introducing a bio-swale to impound runoff, and creation of six bio-retention water treatment systems within the parking area, will reduce pollutants entering the water stream.[38] Rain gardens placed in the lot break up the impermeable surface, reduce heat retention and water "sheeting" off the lot during rain, and act as an area to introduce native plantings. Marsh grasses planted in a line act as a final buffer to filter pollutants between the infrastructure area and the beach.[39]

III. Resolution

Introducing passive and natural treatment systems into the Bristol Town Beach site represents modern management designed to include and improve natural environments and reduce human inputs into the system. In the period 1998-2010, before the beach improvements began, forced beach closures due to the presence of *Enterococcus* bacterium totaled 25 separate incidents involving 89 days of restricted access.[40] In 2012, since the improvements have been made, the beach has recorded an 80% increase in general water quality; with 12 samples taken per month, the beach has only been closed twice, totaling 6 days, even with the heavy precipitation that Rhode Island received during the summer of 2012.[41]

Future plans to continue the restoration include introducing natural gravel and biomass treatment systems for large-diameter storm drain outflows, re-channelizing the existing wastewater disposal network, erosion mitigation techniques, and creating a scenic and educational walking path through the property.[42] Intended to entirely mitigate events requiring beach closure, these actions will necessitate continuing partnerships with federal agencies assisting the project for funding, expertise and advice.

Case Study Two: 2012 Sellwood Bridge Process Improvements: Portland, Oregon

I. Background

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[37] *Rhode Island: Confronting Climate Change in the U.S. Northeast*, Union of Concerned Scientists (last visited Sept. 6, 2012) available at http://www.climatechoices.org/assets/documents/climatechoices/rhode-island_necia.pdf.

[38] Amie Parris and Lauren Toracinta, *2011 Season Report*, Rhode Island Department of Health Beach Program (March 2012), available at http://www.health.ri.gov/publications/annualreports/2011BeachProgram.pdf.

[39] See id.

[40] *Bristol Town Beach*, Rhode Island Department of Health (last visited Sept. 6, 2012) available at http://ribeaches.org/beach.cfm?beachID=RI627966.

[41] Meg Kerr, *Restoring Bristol's Waterfront*, Narragansett Bay Journal (last updated June 6, 2012) available at http://www.nbep.org/journals/23-2012/BristolWaterfront.pdf.

[42] See id.

The United States Department of Transportation (DOT) uses its Exemplary Human Environment Initiatives annual awards program to publicize projects under DOT's purview that not only add value and efficiency to human systems, but also display principles of environmental sustainability and stewardship; one such project is the Sellwood Bridge Process Improvements' model design features.[43] The Sellwood Bridge's un-rehabilitated state was very similar to multiple Rhode Island bridges and the challenges they face, specifically the Mount Hope Bridge (built in 1928 and rated as "Structurally Deficient").[44] The Sellwood Bridge provides a major link between Multnomah and Clackamas Counties, and serves as a major transit artery for commuters entering Portland.[45] Constructed in 1925, by 2010 the bridge had become the busiest two-lane bridge in Oregon.[46] However, the two narrow traffic lanes (a pre-standardization width of 31 feet, while now the AASHTO recommends 37.5 feet),[47] caused bottlenecks and slowdowns, and the bridge had a 10-ton limit for crossings. Furthermore, the road deck did not have emergency lanes or a shoulder, it only had a single narrow sidewalk, and a landslide left unsafe conditions. Aside from the infrastructure concerns, the bridge also impacted an anadromous fish habitat in the Willamette River, and the Willamette's undeveloped west bank in the project area was a dynamic and unspoiled natural ecosystem.[48]

## II. Methods

The rehabilitation design needed to increase the bridge's safety and efficiency, while minimizing the environmental impact any new construction would have, and mitigating the unavoidable or pre-existing effects. This called for a multi-use, multi-mode system which would allow unlimited weight and freight transit, have multiple access points for public transit, including dedicated bus stops and tram lines, and sufficiently wide lanes and sidewalks to prevent clustering and generally improve traffic flow and safety in the area.[49]

Preventing pollutants from entering the Willamette watershed became the project's high priority. In addition to requiring Best Management Practices (BMP) from its contractors to prevent pollution (including positioning equipment, using silt and erosion fences, and other standard practices), the bid also required the contractors to rehabilitate contaminated soils under adjacent roadways to the bridge to prevent hydrocarbon leaching. Contractors were also required to re-grade and re-landscape the river's banks with minimal landscape cuts to better prevent

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[43] *EHEI Awards Process Improvements: Sellwood Bridge*, FHWA Office of Planning, Environment and Realty (last visited Sept. 6, 2012) available at http://www.fhwa.dot.gov/environment/ehei/awards/2011/oregon.cfm.

[44] *Mount Hope Bridge*, Bridgehunter.com (last updated June 11, 2012) available at http://bridgehunter.com/ri/bristol/mount-hope/.

[45] *EHEI Awards Process Improvements: Sellwood Bridge*, FHWA Office of Planning, Environment and Realty (last visited Sept. 6, 2012) available at http://www.fhwa.dot.gov/environment/ehei/awards/2011/oregon.cfm.

[46] See id.

[47] *AASHTO Controlling Design Criteria and Design Expectations*, Arizona DOT (last visited Sept. 6, 2012) available at http://www.azdot.gov/highways/projects/I-40_Lupton_TI/pdf/IDCR-2012/Chapter-5-AASHTO-Controlling-Design-Criteria-Design-Exceptions.pdf.

[48] *Final Environmental Impact Statement and Final Section 4(f) Evaluation*, Oregon Department of Transportation (August 2010), available at http://www.sellwoodbridge.org/files/phase2/FEIS/FEISand4f.pdf.

[49] *Table S-4: Final Environmental Impact Statement and Final Section 4(f) Evaluation*, Oregon Department of Transportation (August 2010), available at http://www.sellwoodbridge.org/files/phase2/FEIS/FEISand4f.pdf.

erosion and restore topographic contours to a more natural state.[50] This low-impact method will rehabilitate the surrounding area and redistribute precarious soil to a more sustainable configuration to prevent future landslides from damaging the bridge. Wherever soil is removed, the land must later be replanted with native trees and grasses to encourage quick reformation of habitats, and to lessen spreading by invasive species.[51] Channeling runoff into two underground "filter vaults," impoundment basins collect water and allow it to slowly percolate back into the system (after passive filtering mitigates water "sheeting" and the pollutants brought with it). Nearby culverts and streams will be rehabilitated to increase habitats for those organisms displaced by the construction. Finally, wetlands will be restored and created at other sites selected by the Portland Bureau of Environmental Services, replacing habitats that will be unavoidably damaged by the construction.[52] In the long-term, plantings selected and design choices made will reduce the bridge's visual and noise impacts, and riverside parkland and green space surrounding the bridge will be developed to engage the community, offer recreation, and provide a site for environmental and historical education.[53]

## III. Resolution

Although redevelopment process's main focus brought the Sellwood Bridge in conformance with standard road designs and geometries to improve human systems, mitigating environmental impacts that resulted from this project were a major concern. To most efficiently use their resources with minimal negative consequences, the Oregon Department of Transportation (ODOT) created a stakeholder group (the Community Task Force, "CTF"), populated by community members, private organizations and conservation groups, elected representatives from city and county governments, and the responsible transportation authorities, such as ODOT, TriMet and Metro (Portland-area transportation concerns).[54] The Stakeholder group evaluated five distinct options for bridge design and construction, including a no-build alternative, under a NEPA Alternatives Analysis.[55] This multi-part design process and ability to compare and contrast plans led the CTF to unanimously agree on one alternative that best protects the environment while meeting the most community goals and human concerns.[56] After ODOT approval, the DOT apportioned $33 million in funding to not only reconstruct the bridge's functionality, but to improve its resiliency to future environmental challenges.[57]

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50 *3.12.3 Build Alternatives Environmental Consequences: Final Environmental Impact Statement and Final Section 4(f) Evaluation*, Oregon Department of Transportation (August 2010), available at http://www.sellwoodbridge.org/files/phase2/FEIS/FEISand4f.pdf.

51 *Cumulative Impacts- Vegetation: Final Environmental Impact Statement and Final Section 4(f) Evaluation, Oregon Department of Transportation (August 2010*), available at http://www.sellwoodbridge.org/files/phase2/FEIS/FEISand4f.pdf.

52 See Id.

53 *Mitigation Measures for Specific Alternatives: Final Environmental Impact Statement and Final Section 4(f) Evaluation*, Oregon Department of Transportation (August 2010), available at http://www.sellwoodbridge.org/files/phase2/FEIS/FEISand4f.pdf.

54 *EHEI Awards Process Improvements: Sellwood Bridge*, FHWA Office of Planning, Environment and Realty (last visited Sept. 6, 2012) available at http://www.fhwa.dot.gov/environment/ehei/awards/2011/oregon.cfm.

55 *Final Environmental Impact Statement and Final Section 4(f) Evaluation*, Oregon Department of Transportation (August 2010), available at http://www.sellwoodbridge.org/files/phase2/FEIS/FEISand4f.pdf.

56 *EHEI Awards Process Improvements: Sellwood Bridge*, FHWA Office of Planning, Environment and Realty (last visited Sept. 6, 2012) available at http://www.fhwa.dot.gov/environment/ehei/awards/2011/oregon.cfm.

57 See id.

Construction on the final approved plan began in July 2012 and should be completed in 2015-2016.[58] At last report, the construction was proceeding as planned.

Case Study Three: 2005 Route 112 Bypass Wildlife Passages: Gorham, Maine

I. Background

This project represents a small-scale rehabilitation, more within a municipal government's purview, but still has a scope requiring federal partnerships for full execution. Encroachment into habitat areas by high waters, temperature changes, and climactic shift represents a major effect of climate change and sea level rise. By 2100 in New England under a moderate emissions reduction scheme, the summer Heat Index (a measure of perceived temperature) will most closely resemble current conditions found in Maryland, and under a low-level emissions reduction plan projection will reflect current conditions found in Georgia.[59] This will displace native species into more favorable conditions while invasive non-native species spread to fill the vacuum left behind. A factor multiplying the damages of habitat loss is fragmenting pre-existing habitat areas through the spreading human infrastructure, most notably roads. This infrastructure transverses migration routes, diverts watercourses, spreads noise, light and particle pollution, and in extreme cases fully separates species populations.[60]

In an effort to mitigate habitat loss and protect against further effects climate change, the Maine Department of Transportation (MaineDOT) incorporated features facilitating wildlife passage and natural systems while constructing a new bypass highway easing traffic flow and improving transit efficiency. Given the area's rural character and dispersed population, increasing access to public transit was not feasible, but a sustainably designed roadway could fulfill human needs while maintaining environmental stewardship.[61]

II. Methods

In order to obtain full funding and best conserve scarce resources, MaineDOT created a partnership consortium to share expertise and contribute funding, including the Federal Highway Administration and the U.S. Fish and Wildlife Service.[62] While recognizing the transit link's many benefits, mitigating environmental impacts remained an overriding principle in routing and design, especially minimizing losses of natural habitats or productive farmland. Sixteen alternative designs for the bypass had been proposed with the majority rejected for unacceptable impact to the human and natural environment.[63] After a discussion process with stakeholders, the

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[58] *Frequently Asked Questions*, Sellwood Bridge Project (last visited Sept. 6, 2012), available at http://www.sellwoodbridge.org/?p=frequently-asked-questions.

[59] *Confronting Climate Change in the U.S. Northeast*, Union of Concerned Scientists (last visited Sept. 6, 2012) available at http://www.climatechoices.org/assets/documents/climatechoices/confronting-climate-change-in-the-u-s-northeast.pdf.

[60] Laura Tepper, *Road Ecology: Wildlife Habitat and Highway Design,* The Design Observer Group (last updated Sept. 22, 2012), available at http://places.designobserver.com/feature/road-ecology-wildlife-crossings-and-highway-design/29498/.

[61] *Maine: Gorham (Bernard P. Rines) Bypass Route 112 Wildlife Passage*, FHWA Environmental Review Toolkit (last visited Sept. 6, 2012), available at http://environment.fhwa.dot.gov/ecosystems/eei/11me.asp.

[62] See id.

[63] *Bypass Alternatives: Gorham Bypass Study Environmental Assessment,* MaineDOT (last visited Sept. 6, 2012), available at http://www.maine.gov/mdot/planningstudies/gorhambypass/pdf/ea/fig_2_2.pdf.

final design chosen has the greatest benefit to human travelers and businesses, while maintaining existing habitats and the area's undeveloped nature. In 2005, the EPA determined the proposed bypass project would have No Significant Impact (FONSI) on the environment due to the environmental mitigation techniques.[64]

The new bypass' design diverts the majority of through traffic safely around the village. Narrow local roads leading in and out of the village have been replaced with the modern standard of two 12-foot lanes in either direction with 8-foot shoulders on either side to allow emergency access and maintain traffic flow. Adding a climbing lane for trucks and slow vehicles prevents backups.[65] This remains one of the few feasible ways to increase the region's connectivity to the Portland metropolitan area, as transit options in Gorham remain primarily private vehicle-based.

To improve environmental functionality, the bypass' design mitigates habitat fragmentation's effects caused by the new construction. MaineDOT and their federal partners conducted aerial surveys and GIS evaluation of the area to site the culverts in natural floodplains and terrain cuts, thus preserving migration patterns and allowing ample water flow through the openings during flooding events.[66] Bridge design incorporated wide openness ratios, preserving as best as possible free flowing streams and allowing large amounts of water to discharge during spring melts. To reduce maintenance needs during this deluge, the bridges maintain habitat areas with dense vegetation on the embankments, which prevents erosion and reduces runoff. In areas where raising the roadway was not feasible culverts maintain habitat connectivity. The culverts' large bore sizes prevent water pooling and allow dry passages for smaller species even during flooding.[67]

## III. Resolution

The bypass diverts through traffic from the historic Gorham Village area, creating a more livable and pedestrian-friendly retail and commercial core while allowing the region's economic growth through more efficient transit routing linking the Town of Gorham to the Portland metropolitan area. The bypass infrastructure not only addresses the Village's requirements today, but also fits into a larger improvement plan for the Maine Highway System projected for completion by 2030.[68] Not only will this save funds for the Maine taxpayer, but it will also minimize disruptive events for the local ecosystem. Prior to the bypass' construction, only one in four vehicles travelling through Gorham Village had a destination in the Village, creating dangerous conditions for not only residents but also travelers.[69] Under 2025 projected conditions, the bypass should remove between 13% and 33% of the current truck-traffic volume from the

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[64] *Signed FONSI,* MaineDOT (last visited Sept. 6, 2012), available at http://www.maine.gov/mdot/planningstudies/gorhambypass/pdf/fonsi/signedfonsi.pdf.

[65] *Gorham Bypass Study: Transportation and Engineering Technical Repor*t, MaineDOT (June 2003), available at http://www.maine.gov/mdot/planningstudies/gorhambypass/pdf/ea/tetr.pdf.

[66] *Maine: Gorham (Bernard P. Rines) Bypass Route 112 Wildlife Passage*, FHWA Environmental Review Toolkit (last visited Sept. 6, 2012), available at http://environment.fhwa.dot.gov/ecosystems/eei/11me.asp.

[67] *Maine: Gorham (Bernard P. Rines) Bypass Route 112 Wildlife Passage*, FHWA Environmental Review Toolkit (last visited Sept. 6, 2012), available at http://environment.fhwa.dot.gov/ecosystems/eei/11me.asp.

[68] Connecting Maine: Statewide Long Range Transportation Plan 2008-2030, MaineDOT (July 2010), available at http://www.maine.gov/mdot/connectingmaine/plan.htm.

[69] *Gorham Bypass Study: Transportation and Engineering Technical Report*, Maine Department of Transportation (June 2003), available at http://www.maine.gov/mdot/planningstudies/gorhambypass/pdf/ea/tetr.pdf.

Village,[70] resulting in 440-1190 vehicles per hour fewer than 2025 peak traffic flow conditions.[71] Otherwise, an 11% increase in truck traffic has been projected as the region develops.[72]

The plan's environmental benefits are less easily quantified, but it is well to note that the potential drastic consequences of habitat destruction typically associated with large-scale public works projects are avoided as much as possible under the design chosen. As the Maine's habitats warm with global climate change's effects, species populations will become more concentrated and the demand and stress on remaining favorable areas will become greatly magnified. The culverts and overpasses incorporated into the bypass will prevent these areas from becoming isolated, and allow the environmental systems natural and dynamic flow. Game cameras placed in the culverts have documented many native species using the passages and avoiding the road, and only one human-animal vehicle collision has been documented in the project area after construction.[73] While this project will not directly combat the climate change's spread, it will go far in deferring the consequences felt by humans and the environment. MaineDOT has been promoting this project in numerous conferences and awards schemes, and has offered their expertise to other states with similar situations.[74]

Case Study Four: 2011 Former Mare Island Naval Shipyard Restoration: Vallejo, California

I. Background

Mare Island Naval Shipyard, a 5,000 acre industrial campus, served the nation as the first and primary West Coast Naval repair and refitting facility from 1854-1996, with an operational history spanning 142 years.[75] During that time period, the Naval Shipyard helped ensure national security by constructing over 500 vessels and submarines.[76] However, along with that storied legacy, the Naval Shipyard also suffered from less-enlightened environmental management practices, and from over a century heavy industrial use and pollution. Located on the Mare Island Straits portion of the Napa River's fragile watershed ecosystems, the pollutants present at the former Naval Shipyard represented a large liability in the area. With projected sea level rise, pollutants currently contained on land stand a high chance of being introduced into the ocean.

One of the most highly concentrated and polluted areas at the Shipyard, the 230-acre landfill site "Investigation Area HI (IA-H1)," contained a general disposal area for the former Shipyard with refuse and industrial debris, and was standing as a landfill.[77] This site is extremely close to the Mare Island Straits, and had displaced important estuarine habitats in its expansion.

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[70] See id.
[71] See id.
[72] See id.
[73] *Maine: Gorham (Bernard P. Rines) Bypass Route 112 Wildlife Passage*, FHWA Environmental Review Toolkit (last visited Sept. 6, 2012), available at http://environment.fhwa.dot.gov/ecosystems/eei/11me.asp.
[74] *Maine: Gorham (Bernard P. Rines) Bypass Route 112 Wildlife Passage*, FHWA Environmental Review Toolkit (last visited Sept. 6, 2012), available at http://environment.fhwa.dot.gov/ecosystems/eei/11me.asp.
[75] T*he 2012 Secretary of Defense Environmental Awards: Environmental Restoration- Individual/Team: Former Mare Island Naval Shipyard, California*, Department of Defense (last visited Sept. 6, 2012), available at http://www.acq.osd.mil/ie/download/2012_Environ_Awards_Brochure_online.pdf.
[76] *Mare Island History,* City of Vallejo Convention and Visitors Bureau and Solano County Film Office (last visited Sept. 6, 2012), available at http://www.visitvallejo.com/about-vallejo/mare-island-history.php.
[77] T*he 2012 Secretary of Defense Environmental Awards: Environmental Restoration- Individual/Team: Former Mare Island Naval Shipyard, California*, Department of Defense (last visited Sept. 6, 2012), available at http://www.acq.osd.mil/ie/download/2012_Environ_Awards_Brochure_online.pdf.

Losing those buffer zones would magnify the effects of sea level rise in the area, and the landfill's contents could easily spread into the waterway.[78]

II. Methods

Typically landfills are capped with clay covers and hydro-seeded, a method that is aesthetically appealing but risks high runoff due to the impermeability necessary to function as a cap.[79] Poor cap design can result in erosion and water sheeting, which wears away at the seal, introducing the pollutants into the environment.[80] The Department of Defense Legacy program funds environmental and cultural restoration on former military sites, and the program provided funds to cap the landfill in a sustainable way. A dedicated restoration team under the Legacy program ensured that the landfill cap did not become marginalized or reduced in scope even with five simultaneous restoration projects going on at the former Shipyard.[81] The teamwork on the project led to innovative thinking and methods being used to best achieve the desired results with minimal resources.

Using local vendors to source project materials saved costs and improved stewardship, reducing the project's carbon footprint while providing a short-term boost to the local economy.[82] Further reductions to the carbon footprint, including carpooling and fuel-storage schemes to efficiently use resources while keeping labor overhead low, added to environmental stewardship[83] Grading the cap into a low slope prevented water sheeting while maintaining flow and reducing the pooling by channeling runoff into the wetlands areas to serve as a natural source of water replenishment and keeps lifetime maintenance costs low.[84] After grading, stocking the site with native plants and grasses helped restore the ecosystems displaced by the landfill's construction. At completion, the rehabilitation had improved or restored 120 acres of existing wetlands, and created 8.7 acres of new wetlands.[85] In this new ecosystem, new public access trails and recreation facilities create value where the prior facilities served as a liability. As a final benefit, the new wetlands areas are designated protected areas inhabited by the Salt Marsh Harvest Mouse, a State and Federally protected species.[86]

III. Resolution

The restoration removed an environmental liability within the San Francisco Bay in a natural and sustainable manner without further construction or high-impact methods. Through a federal partnership with local stakeholders, a site that could potentially introduce toxins has been replaced by a vibrant and robust ecosystem. The new Mare Island adds value not only in coastal

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[78] See id.
[79] *4.26 Landfill Cap,* Federal Remediation Technologies Roundtable (last visited Sept. 6, 2012), available at http://www.frtr.gov/matrix2/section4/4-27.html.
[80] See id.
[81] T*he 2012 Secretary of Defense Environmental Awards: Environmental Restoration- Individual/Team: Former Mare Island Naval Shipyard, California*, Department of Defense (last visited Sept. 6, 2012), available at http://www.acq.osd.mil/ie/download/2012_Environ_Awards_Brochure_online.pdf.
[82] See id.
[83] See id.
[84] See id.
[85] See id.
[86] See id.

climate change resiliency, but also in real estate, social and cultural capital, and abilities for natural rehabilitation. The estuary environment relies on a precise and delicate balance of salinity, temperature and water quality, and serves as highly effective protections for mitigating sea level rise's effects by absorbing storm surges made more frequent and powerful by climate change. The cap's design not only restores and creates these wetlands areas, but also is specifically designated to have low maintenance costs and high environmental functionality.

The value added to human systems can be more easily quantified, as the rehabilitation process injected $20 million into the local economy, which had suffered greatly from the base's closure.[87] This project also created value in job training, as the skills crews developed in green construction methods are highly transferrable. All told, the cap process including the environmental management techniques saved $42 million over standard cap-and-disposal costs by reducing lifetime maintenance costs and integrating the natural environment into the project.[88] By using a natural and passive design throughout all the project's aspects, the Department of Defense prevented releasing over 9,000 tons of carbon dioxide into the environment.[89]

## Section Three: Identification of Non-Traditional Federal Partnerships and Interests In Rhode Island's Coastal Beach Zones

Part One: Selection of Non-Traditional Federal Stakeholders.

Increasing the resiliency of infrastructure to the challenges presented by global climate change's effects will require a greater scope of involvement and increased level of commitment by federal agencies considered "non-traditional partners" in environmental rehabilitation and restoration. Three elements guided this memorandum's selection of the federal agencies considered to be non-traditional partners:

A) Does the federal partner's traditional mission infrequently incorporate environmental stewardship principles?
B) Does the federal partner have an interest in contributing to the goal of increasing infrastructure resiliency?
C) Does the federal partner have the ability to meaningfully contribute to the goal of increasing infrastructure resiliency?

Under this framework agencies such as those under the Department of the Interior and Department of Agriculture (i.e., EPA, USFWS) are not given examination, as the programs offered by these organizations can be considered as traditionally fulfilling these agencies environmental focus. Furthermore, entities such as the Department of State are not considered as their climate change efforts focus on coordinating international efforts and programs and do not have a strong domestic interest.[90]

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[87] T*he 2012 Secretary of Defense Environmental Awards: Environmental Restoration- Individual/Team: Former Mare Island Naval Shipyard, California*, Department of Defense (last visited Sept. 6, 2012), available at http://www.acq.osd.mil/ie/download/2012_Environ_Awards_Brochure_online.pdf.
[88] See id.
[89] See id.
[90] *Policy and Public Outreach,* U.S. Department of State Bureau of Oceans and International Environmental and Scientific Affairs, (last visited Sept. 6, 2012), available at http://www.state.gov/e/oes/policy/index.htm.

Some "traditional" federal partners synchronize their efforts and develop common priorities in reducing New England's climate change liabilities through membership in an organization appropriately named the Northeast Federal Partners, administered by the Environmental Protection Agency.[91] In the February 2010 meeting the Northeast Federal Partners identified several agencies that in its opinion could and should increase their commitment to sharing the burden in facing the challenges presented by climate change.[92] This section of the memorandum focuses on three of those identified agencies that should be considered non-traditional partners in this arena: the Department of Defense (DOD), the Department of Transportation (DOT), and the Department of Housing and Urban Development (HUD).

Part Two: Non-Traditional Federal Stakeholders in Rhode Island's Coastal Beach Zones.

I. Department of Defense (DOD)

Among all 50 states, Rhode Island has the smallest area under federal control, with only 5,248 out of the 677,120 (0.8%) acres total land under federal jurisdiction in the state.[93] The Department of Defense controls 2,874 of the 5,248 acres, making it the primary federal landholder in Rhode Island with two major installations: the former Davisville Naval Construction Battalion Center and the Newport Naval Education Training Center.[94] The USFWS and the National Parks Service, not considered under the focus of this article, controls the remaining federal acreage.[95]

In addition to the two Naval installations, 83 Formerly Used Defense Sites (FUDS) fall within Rhode Island's borders,[96] the third highest numerically and the highest density in New England.[97] These sites represent large environmental liabilities for the DOD as many had been constructed and operated before the modern design and stewardship principles had been introduced.[98] With very few exceptions, these FUDS are found within the Coastal Beach zone.[99] These obsolete installations represent unwanted human infrastructure in sensitive areas and the overwhelming majority contain some form of Hazardous, Toxic, or Radioactive Wastes

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[91] *Meeting Packet, February 17 2010,* Northeast Federal Partners (last visited Sept. 6, 2012), available at http://collaborate.csc.noaa.gov%2Fnroc%2FShared%2520Documents%2FNortheast%2520Federal%2520Partners%2FFebruary%252017%2C%25202010%2FFederal%2520Partners%2520Packet%25202-17-10%2520(final).pdf.

[92] See id.

[93] *Federal Lands and Indian Reservations: Rhode Island,* Department of the Interior National Atlas of the United States (last updated Feb. 3, 2011), available at http://nationalatlas.gov/printable/images/pdf/fedlands/RI.pdf.

[94] See id.

[95] Ross W. Gorte et. al., *Federal Land Ownership: Overview and Data* (February 8, 2012), available at http://www.fas.org/sgp/crs/misc/R42346.pdf.

[96] *Formerly Used Defense Sites (FUDS) Per State: Rhode Island*, United States Army Corps of Engineers (last updated Sept. 30, 2010), available at https://environment.usace.army.mil/downloaddbfile.cfm?file_id=CDEC1BC0-188B-313F-1B118F916D3D721E.

[97] *Formerly Used Defense Sites (FUDS) Per State: Rhode Island*, United States Army Corps of Engineers (last updated Sept. 30, 2010), available at https://environment.usace.army.mil/downloaddbfile.cfm?file_id=CDEC1BC0-188B-313F-1B118F916D3D721E.

[98] *Conclusions and Recommendations: Portsmouth Anti-Aircraft Gun Emplacement*, United States Army Corps of Engineers (August 1995), available at http://naelibrary.nae.usace.army.mil/dp198/ned95144.pdf.

[99] *Formerly Used Defense Sites (FUDS) Per State: Rhode Island*, United States Army Corps of Engineers (last updated Sept. 30, 2010), available at https://environment.usace.army.mil/downloaddbfile.cfm?file_id=CDEC1BC0-188B-313F-1B118F916D3D721E.

(HTRW), either in the open or stored in containers.[100] These sites also have impermeable surfaces, potential munitions, or debris requiring recycling and removal. After service life has passed, responsibility for each service station rehabilitation and end-of-life maintenance falls to the Army Corps of Engineers for administration.

The two major Defense Reservations in Davisville and Newport are finalized on the EPA's CERCLA "Superfund" site list with rehabilitative efforts underway, and may be considered separately from the FUDS for environmental rehabilitation.[101] The first reservation, the former Naval Construction Battalion Center Davisville, was selected for closure in 1991 budget cuts, and formally decommissioned in 1994.[102] After selection for participation in the Department of Defense's Installation Restoration Program (IRP), designed to mitigate and neutralize the hazards present on former military installations, the base's desirable portions have been transferred to or placed under state jurisdiction, through the RIDEM and the Rhode Island Economic Development Council (RIEDC).[103]

On the non-desirable portions, the Department of the Navy, the EPA and RIDEM formed a coalition to organize, supervise and execute cleanup activities,[104] including a cap-and-cover and wetlands restoration project on the Allen Harbor Landfill, very similar to the Mare Island landfill in the Case Studies section of this memorandum. Adjacent to the base and comingling pollutants, FUDS NIKE missile defense site (PR-58) is an installation type with a high occurrence rate on the FUDS list and is typically contaminated with pollutants such as fuels and solvents.[105] The Five-Year Review analysis, critique and priority-setting investigation conducted as part of the IRP is due in 2013, offers an opportunity for stakeholder input on new and innovative methods to improve efficiency, reduce lifetime maintenance costs, and improve environmental functionality and resiliency.[106]

Small and dispersed, many FUDS sites do not receive the same comprehensive planning and project management used on the Newport or Davisville installations, and obsolescence and condition prevents easy conversion into economic uses. The FUDS program design does not rebuild the sites but manages their responsible disposal.[107] Therefore, an opportunity exists for stakeholders to propose methods to not only reduce this inventory, but to do so in a manner that converts the properties into ecologic assets. Part five of this memorandum will discuss programs that can be coordinated to achieve these goals.

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[100] *Waste Site Cleanup and Reuse in New England*, U.S. Environmental Protection Agency (last updated Sept. 8, 2012), available at http://yosemite.epa.gov/r1/npl_pad.nsf/SelectedByState?OpenForm&View=Rhode%20Island.

[101] *Davisville Naval Construction Battalion Center,* U.S. Environmental Protection Agency (last updated March 16, 2012), available at http://yosemite.epa.gov/r1/npl_pad.nsf/8b160ae5c647980585256bba0066f907/fce0198f5c41e173852568ff005adb07!OpenDocument.

[102] See id.

[103] See id.

[104] See id.

[105] *Investigation of Former NIKE Missile Sites for Potential Toxic and Hazardous Waste Contamination*, United States Army Corps of Engineers (March 1986), available at http://www5.hanford.gov/pdw/fsd/AR/FSD0001/FSD0037/D199050026/D199050026_19154_198.pdf.

[106] *Davisville Naval Construction Battalion Center,* U.S. Environmental Protection Agency (last updated March 16, 2012), available at http://yosemite.epa.gov/r1/npl_pad.nsf/8b160ae5c647980585256bba0066f907/fce0198f5c41e173852568ff005adb07!OpenDocument.

[107] *Formerly Used Defense Sites*, Defense Environmental Restoration Program (last updated Jan. 28, 2011), available at http://www.denix.osd.mil/fuds/Overview.cfm.

II. Department of Transportation (DOT)

The second department identified on the Northeast Federal Partners list of governmental entities called to increase their climate change resiliency commitment may well be the largest indirect contributor to climate change's effects, the Department of Transportation (DOT). Distinct from GHG release during construction, materials manufacture, and other infrastructure-centered activities overseen by the DOT emissions exhaust from vehicles on those roadways represents 35% of New England's total emissions linked to global warming.[108] Spreading particle pollution has led to respiratory issues, and New England suffers some of the highest Asthma occurrences nationwide.[109] Clearly, some level of commitment to mitigating the effects of climate change should be demanded of any organization that is so closely connected to its root causes, if not responsible for them.

In Rhode Island, the DOT works closely with the RIDOT to coordinate infrastructure development, mostly through distributing congressional highway funding appropriations. Rhode Island's infrastructure serves as a major transit artery for travel within the Northeast and must also cope with a large amount of tourist travel and substantial shipping and other marine commerce. Rhode Island's small land area and low population reduces the potential taxpayer pool that other states can rely upon to amortize dense infrastructure investments' high costs. The DOT Federal Highway Administration (FHWA) denied Rhode Island's pilot program tolling highways and the recent economic downturn further reduced the available tax base, causing the state to become more dependent on federal funding for their future projects and for current maintenance and rehabilitation activities.[110]

These maintenance and rehabilitation activities take place with great regularity along Rhode Island's extensive coastline, and concentrated residences and commerce along these coastlines leads to frequent conflicts between human engineering works and the inexorable march of nature. Salt water and salt air are two of the most corrosive elements that infrastructure can be exposed to and make up a serious issue in a coastal state.[111] Coastal Rhode Island's sandy, low-lying soil attracts engineering projects for easy development, but can be prone to flooding and erosion.[112] Roadways, highways, bridges, and municipal parking lots make up a substantial proportion of coastal impermeable surfaces, and substantial amounts of runoff enters Narragansett and Mount Hope Bays over property under the DOT's eventual oversight. While the department does not undertake its own construction or maintenance activities, they can provide the necessary funding and expertise to the RIDEM to execute these goals.[113]

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[108] Tony Dutzik, *Global Warming and New England,* New England Climate Coalition (September 2003, Last visited Sept. 6, 2012), available at http://www.cleanair-coolplanet.org/solutions/trans_solutions/climate%20change%20final.pdf.

[109] *The Burden of Asthma in New England,* Asthma Regional Council of New England (last visited Sept. 6, 2012) available at http://asthmaregionalcouncil.org/uploads/Surveillance/TheBurdenofAsthmainNewEnglandMarch2006.pdf.

[110] [110] *Tolling: Change Needed for R.I.'s Future,* Rhode Island Department of Transportation (last visited Sept. 6, 2012), available at http://www.dot.state.ri.us.

[111] *Roads and Salinity*, Australian Department of Infrastructure, Planning and Natural Resources (last visited Sept. 6, 2012), available at http://www.environment.nsw.gov.au/resources/salinity/booklet4.pdf

[112] *Hurricanes and Coastal Storms*, Rhode Island Coastal Resources Management Council, (last visited Sept. 6, 2012), available at http://www.crmc.ri.gov/coastalstorms.html.

[113] *Federal-Aid Financing Procedures,* U.S. Department of Transportation Federal Highway Administration (last visited Sept. 6, 2012), available at http://www.fhwa.dot.gov/reports/financingfederalaid/procs.htm.

The Providence Viaduct, an expressway designed to facilitate traffic flow within the city as it expands over the coming century, has been coordinated between DOT and RIDOT to improve human efficiency while keeping an eye to environmental stewardship.[114] An environmental aspect of the Providence transit infrastructure rehabilitation converted former impermeable surfaces and unproductive areas into a "greenbelt" within the city. This is an ongoing project designed to give Providence parks and open space in formerly underutilized areas,[115] adding aesthetic beauty to the city and providing a facility for community interaction and recreation.

Urban parks and green space play a large role in climactic moderation; they have an unparalleled ability for plant life to capture and store carbon cleans the air and provides an overall higher air quality. In addition to quality-of-life benefits enjoyed by the public, the rise in air quality also includes projections for reduced state spending on public transit and long-term healthcare costs.[116] These green spaces also break up the impermeable surfaces that create the urban "heat island" effect, where an urban core has a higher ambient temperature than surrounding areas due to heat-absorbent materials; wind struggling to move in between highly built areas; and concentrated intensive energy use.[117] In a city, even small-area greening processes (such as green roofs), could represent a substantial drop in average temperatures.[118] Twenty-three percent of the Providence city limits has been planted with trees, but up to 57% of the city has the potential to support tree cover.[119] For every dollar invested in urban planting efforts, the state of Rhode Island realizes $3.33 in annual benefits.[120] Green space provided by swales and buffer zones could be created and maintained not only to increase traffic flow and provide easier use of transit, but also to create a barrier for pollutants and disperse runoff before it erodes the shoulder or adjacent features.[121] In section five of this memorandum, statutory programs administered by the DOT will be examined for their relevancy to this goal.

## III. Department of Housing and Urban Development (HUD)

In Rhode Island, sea level rise will be first be felt by the housing stock closely hugging, and in some cases passing beyond, the coastal baseline. As the state's population grows and economic capacity increases, the many coastal cities in the state will seek to develop their full resource potential. It follows that within this process there will be ample opportunity for HUD to advise, design, and administer the growth of sustainable and functional communities.

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[114] I-95 Providence Viaduct Project Description, Rhode Island Department of Transportation (last visited Sept. 6, 2012), available at http://www.providenceviaduct.com/default.asp.

[115] *Welcome to the I-Way*, Rhode Island Department of Transportation, (last visited Sept. 6, 2012), available at http://www.dot.ri.gov/documents/iway/IwayCommem.pdf.

[116] *Cost and Health Consequences of Air Pollution in California*, RAND Corporation (last visited Sept. 6, 2012), available at http://www.rand.org/pubs/research_briefs/RB9501/index1.html.

[117] *Heat Island Effect*, U.S. Environmental Protection Agency (last visited Sept. 6, 2012), available at http://www.epa.gov/hiri/.

[118] *Green Roofs*, U.S. Environmental Protection Agency (last visited Sept. 6, 2012), available at http://www.epa.gov/hiri/mitigation/greenroofs.htm.

[119] *State of Providence's Urban Forest 2008*, City of Providence Parks Department (last visited Sept. 6, 2012) available at http://providenceri.com/sites/default/files/file/Parks_and_Recreation/Providence_Urban_Forest_as_of_2008.pdf.

[120] See id.

[121] *Green Streets,* Low Impact Development Center, Inc. (last visited Sept. 6, 2012), available at http://www.lowimpactdevelopment.org/greenstreets/background.htm.

In Rhode Island, HUD directly invests in economically and environmentally sustainable housing stock's development and construction, and encourages the rehabilitating existing infrastructure through grant distribution to concerned state agencies.[122]

HUD represents an organ for synthesis of human, economic, and natural concerns, and is keen to promote its status as the "re-invented HUD," that is, a shift in focus from large-scale construction and housing projects in urban cores, and instead encouraging expanding multi-class, multi-ethnicity, and multi-cultural housing options dispersed into community settings.[123] With this re-invention process, HUD has focused on environmental stewardship, such as encouraging compliance with the Coastal Barriers Resource Act 1982 (16 U.S.C. 3501 et seq.), which denies federal assistance in almost all forms to building projects taking place in environmentally fragile and sensitive coastal barrier areas.[124]

This priority shift was also evidenced in the hiring of HUD Environmental Staff, experts employed by the department to advise homeowners, contractors, and other interested parties on the environmental consequences and benefits involved with HUD initiatives.[125] The Environmental Staff Officer corps in Region I (New England) coordinates projects, and Rhode Island is served by both the Boston and Hartford HUD field office's Environmental Officers, making it one of the few states with multiple HUD Environmental Staff available for assistance.[126] These officers are most commonly tasked with advising a stakeholder evaluating project's environmental issues by using HUD's Assessment Tools for Environmental Compliance (ATEC), a collection of documents, formulae and other planning tools keyed into specific types of topography, geographic location, and function of proposed infrastructure.[127] Specific programs that could assist HUD's goal in creating "safe and suitable living environments" and The Nature Conservancy's goal in increasing the resiliency of infrastructure to the effects of climate change will be discussed in the next section of this memorandum.

## Section Four: Potential Coordination of Concurrent Interests between The Nature Conservancy, State Agencies and Potential Federal Partners

Part One: Non- Traditional Federal Partner's Programs to Increase Climate Change Resiliency.

I. Department of Defense (DOD)

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[122] Rhonda Siciliano, *HUD AWARDS RHODE ISLAND HOUSING AUTHORITIES $12 MILLION TO IMPROVE, PRESERVE NATION'S PUBLIC HOUSING STOCK* (last updated Feb. 10, 2012), available at http://portal.hud.gov/hudportal/HUD?src=/states/rhode_island/news/HUDNo.2012-02-10.

[123] Sec. Henry G. Cisneros, *Legacy for a Reinvented HUD: Charting a New Course in Changing and Demanding Times,* (last visited Sept. 6, 2012), available at http://www.huduser.org/Periodicals/CITYSCPE/VOL1NUM3/cisneros.pdf.

[124] *Guidelines for Compliance,* U.S. Department of Housing and Urban Development (last visited Sept. 6, 2012), available at http://portal.hud.gov/hudportal/documents/huddoc?id=DOC_12983.pdf.

[125] *Local Environmental Contacts,* U.S. Department of Housing and Urban Development (last visited Sept. 6, 2012), available at http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/environment/contact/localcontacts.

[126] See id.

[127] *Assessment Tools for Environmental Compliance,* U.S. Department of Housing and Urban Development (last visited Sept. 6, 2012), available at http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/environment/atec.

Although the DOD's official statements laud environmental restoration and conservation efforts at active installations as a realistic training resource, there also is an overriding principle that benefits to national security will not be foregone for any but the most dire environmental concerns.[128] While this may lead to prioritization conflicts on active-duty installations, in Rhode Island Formerly Used Defense Sites (FUDS) make up the overwhelming majority of DOD reservations,[129] no longer used and able to be rehabilitated without regard for maintaining operational effectiveness. Naval Station Newport is the only active duty site, and already is finalized on the EPA CERCLA Superfund cleanup list.[130]

The DOD offers several cleanup programs and services within the Defense Environmental Restoration Program (DERP), which manages environmental rehabilitation on active duty sites, sites subject to Base Re-Alignment and Closure (BRAC) listings, such as Davisville, and the FUDS inventory, which is restricted by DERP to installations transferred from direct DOD control prior to 1986 (all installations on the Rhode Island list make this cutoff).[131] Within the overall DERP environmental rehabilitation program, several targeted programs address the site-specific issues and options for each property.

The DERP Installation Restoration Program (IRP) attempts to redress the damages caused by contaminants or other pollution discharged while the sites in question had been under active military use.[132] Typically, this pollution would have taken place before modern environmental regulations and disposal techniques became common practice. These contaminants represent a large environmental liability, which under certain circumstances can form a plume that contaminates groundwater sources. Davisville has been found to have the ideal geologic conditions for plume formation and spread.[133]

Approving a site for inclusion in the IRP cleanup program requires the DOD to first conduct an initial observation, evaluation, and knowledge-building process known as Relative-Risk Site Evaluation (RRSE). This process quantifies the site into a low, medium, or high-risk contamination level with corresponding priority for cleanup action.[134] The ranking is based off objective and subjective factors including the contamination's size and scope, the likelihood that the contamination will migrate, and the effects that the migration will have on human and natural systems. After conducting document and source reviews, as well as a physical inspection, a Feasibility Study (FS) proposes and ranks alternatives for mitigating and rehabilitating

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[128] *Quadrennial Defense Review Report,* U.S. Department of Defense (Feb. 2010) available at http://www.defense.gov/qdr/images/QDR_as_of_12Feb10_1000.pdf.

[129] *Formerly Used Defense Sites (FUDS) Per State: Rhode Island*, United States Army Corps of Engineers (last updated Sept. 30, 2010), available at https://environment.usace.army.mil/downloaddbfile.cfm?file_id=CDEC1BC0-188B-313F-1B118F916D3D721E.

[130] *Newport Naval Education and Training Center,* Environmental Protection Agency (last updated Sept. 7, 2012) available at http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101431.

[131] *Formerly Used Defense Sites,* U.S. Army Corps of Engineers (last visited Sept. 6, 2012) available at http://www.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/219/Article/1401/formerly-used-defense-sites.aspx.

[132] *Installation Restoration Program,* Defense Environmental Restoration Program (last updated Oct. 8, 2010), available at http://www.denix.osd.mil/irp/Overview.cfm.

[133] *Davisville Naval Construction Battalion Center,* U.S. Environmental Protection Agency (last updated March 16, 2012), available at http://yosemite.epa.gov/r1/npl_pad.nsf/8b160ae5c647980585256bba0066f907/fce0198f5c41e173852568ff005adb07!OpenDocument.

[134] *Cleanup Process,* Defense Environmental Restoration Program (last updated Oct. 8, 2010), available at http://www.denix.osd.mil/DERP/process.cfm.

environmentally sensitive areas.[135] In the final evaluative step the DOD issues a Record of Decision (ROD) that summarizes the evaluation process, describes the findings, and contains the goals and proposed cleanup by the DOD approved by the FS.[136]

After RRSE and priority coding, there is a two-step process for rehabilitation to the DOD's satisfaction. The initial step is Remedial Design (RD), preparing the site for restoration activities using demolition, landscaping, removing equipment, or creating access points.[137] After the site is prepared for rehabilitation the next step is Remedial Action Construction (RA-C), which itself has two forms: Remedy in Place (RIP), stabilizing the affected area to prevent further contamination; and the more intensive Response Complete (RC), where in the DOD's opinion all goals and programs outlined in the initial ROD have either been completed or become self-perpetuating.[138]

The final step in the cleanup process, Long-Term Management (LTM) (formerly known as Long-Term Maintenance), is executed through Remedial Action Operations (RA-O).[139] The name change reflects the DOD's changing attitude towards its commitment to climate change resiliency, and incorporates ongoing improvements to managed environment's functionality. In this phase projects proposed by the ROD are continued and the remedial actions undertaken are reviewed in 5-year increments. The next review for the Davisville site will take place in 2013.[140] The base commander oversees IRP cleanups on active installations, but for FUDS sites the authoritative agency is the Army Corps of Engineers and the responsible individual for project co-ordination is the regional Corps commander.[141]

Related to the IRP, the Department of Defense Legacy Program (Legacy) seeks to preserve an area's natural and environmental characteristics by funding DOD restoration efforts.[142]

To qualify for Legacy funding, a proposed project must primarily provide a "useful product" for the DOD with a direct benefit to DOD missions.[143] This cannot merely fulfill statutory obligations, nor be the implementation of an existing program's routine operations. The project also cannot be evaluation for evaluation's sake, and must contain some context, comparison or recommendations.[144] Under this program, the DOD is primarily seeking to outsource new research and development into restoration methods, which then can be "packaged" by the department and transferred with minimal losses to other similarly situated

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[135] See id.
[136] See id.
[137] See id.
[138] See id.
[139] See id.
[140] Letter from James T. Owens, Director, EPA New England-Region 1 Office of Site Remediation and Restoration, to Curtis Frye, BRAC PMO Northeast, Department of the Navy (Mar. 28, 2008), available at http://www.epa.gov/superfund/sites/fiveyear/f2008010002378.pdf.
[141] *Formerly Used Defense Sites*, U.S. Army Corps of Engineers (last visited Sept. 6, 2012) available at http://www.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/219/Article/1401/formerly-used-defense-sites.aspx.
[142] *Welcome to the Department of Defense Legacy Tracker,* Department of Defense Legacy Resources Management Program (last visited Sept. 6, 2012), available at https://www.dodlegacy.org/legacy/index.aspx.
[143] *What's Fundable,* Department of Defense Legacy Resources Management Program (last visited Sept. 6, 2012), available at https://www.dodlegacy.org/legacy/index.aspx (follow "Does my project idea qualify?" hyperlink to attached "what's fundable" PowerPoint download).
[144] See id.

sites.[145] In the past, this has covered programs such as regional environmental initiatives, habitat restoration, invasive species management, and wildlife monitoring.[146] All activities that have been approved in the past have a direct connection to mitigating the climate change's detrimental effects, and can be used as a template to guide future proposals.

Both the IRP and Legacy programs hold a strong opportunity for The Nature Conservancy to involve itself with directing rehabilitation activities. The Nature Conservancy could serve as a coordinator to bring together state interest in improving the natural environment and improving human efficiency in the face of global climate change's effects and DOD's interest in environmental restoration and decreasing the managed FUDS projects inventory by the project goal of FY2020.[147] Most projects will be proposed and planned through a Defense and State Memorandum of Understanding (DSMOA), which outlines the responsibilities and contributions that the State and the Department will undertake in specific rehabilitation efforts in an attempt to spread costs and improve project efficiency.[148] This process also ensures that the state is given ample opportunity to propose strategies that will fulfill its individual goals and needs.

To put "boots in the mud," The Nature Conservancy has two main options for participation in these programs. The first could be to propose an innovative and transportable strategy under the Legacy Program. This route requires the most original input from The Nature Conservancy to determine what the site needs and how the restoration could be achieved using a new and innovative method that is not site-specific. However, this also affords The Nature Conservancy the greatest involvement and participation in the decision making process, and the greatest freedom in determining the rehabilitation's overall direction. Second, a less direct method for The Nature Conservancy to participate is as a community stakeholder in a Restoration Advisory Board (RAB), which is responsible for collecting and synthesizing community input and reactions to the IRP program. Typically, an RAB will meet every six months to evaluate decisions made and offer input.[149] This system does not necessarily propose solutions, but instead focuses stakeholder energies to comment on and evaluate the various proposed alternatives for a site before the ROD is entered into. While this does not allow The Nature Conservancy the same direct control over a project as the Legacy program it represents a still allows a voice in the restoration process for a substantially lower investment of time, capacity and finances. However, there no statutory duty exists for DOD to conform its actions to the RAB's recommendations.[150]

II. Department of Transportation (DOT).

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[145] See id.
[146] See id.
[147] *Formerly Used Defense Sites,* Defense Environmental Restoration Program (last updated Jan. 28, 2011), available at http://www.denix.osd.mil/fuds/Overview.cfm.
[148] *DSMOA Community Portal,* U.S. Department of Defense (last visited Sept. 6, 2012), available at https://dsmoa.usace.army.mil/dsmoa_production/Security/tabid/63/Default.aspx?returnurl=%2fDSMOA_Production%2fDefault.aspx.
[149] *Restoration Advisory Board Rule Handbook*, Office of the Secretary of Defense (March 2007), available at http://www.denix.osd.mil/rab/upload/RAB-Rule-Handbook_Final.pdf.
[150] See id.

In Rhode Island, every area protected or administered by The Nature Conservancy has state-maintained routes nearby, if not immediately adjacent to the protected site's boundaries.[151] These state roads, including state highways and the Interstate Highway System, fall under the RIDOT's purview for their construction, routine maintenance, and lifetime management, with assistance from DOT in sharing expertise or defraying costs through appropriations[152] from its component agencies, the Federal Transit Authority (FTA) and the Federal Highway Administration (FHWA).[153] This section will describe relevant funding opportunities that meet both DOT and The Nature Conservancy's goals of safe, responsible and practical development of human networks without unnecessary disruption to natural dynamic systems.

Most DOT future development sustainability initiatives stem from funding provided by the Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users 2005 (SAFTEA-LU 2005), designed to prioritize sustainable land-use considerations in transit planning.[154] A breakdown of the three most germane programs under this sweeping Act can be most effectively accomplished in an outline format:

*a) FHWA SAFTEA-LU §5027 Surface Transportation Environment and Planning (STEP) Collaborative Research Program*[155]

The FY2012 STEP budget totaled $13.9 million. STEP is organized into 5 program areas and 21 "emphasis areas." Environmental "emphasis areas" hold priority, with grants issued for research in: Air Quality and Climate Change ($1.64M); Water, Wetlands, Vegetation, Wildlife and Habitat ($1.014M); and Environmental Streamlining and Stewardship ($1.604M) (amongst other smaller awards). Each STEP emphasis area has a contact person who reviews stakeholder feedback submitted through the STEP website and other sources to develop and implement research projects within the expected STEP funding levels.

This program is designed to help community and transit planners in understanding the complex and interdependent relationship between the planning and construction of surface transportation networks and their effects on the environment. STEP-approved programs may include research to develop more accurate models for evaluating transportation control measures or evaluation of system designs for use by state and local governments to meet environmental requirements. STEP programs also assist in identification of indicators of economic, social, and environmental performance of transportation systems to facilitate alternatives analysis. This may include developing and refining FHWA's strategy to describe key areas related to climate change adaptation, which would provide a foundation for future activities, such as continued technical assistance to states that pilot FHWA's Conceptual Model for Assessing Vulnerability and Risk of Climate Change Effects on Transportation Infrastructure, or disseminating technical assistance

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[151] *Places We Protect: Rhode Island,* The Nature Conservancy (last visited Sept. 6, 2012), available at http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/rhodeisland/placesweprotect/index.htm.

[152] *Highway and Bridge Maintenance,* Rhode Island Department of Transportation (last visited Sept. 6, 2012) available at http://www.dot.state.ri.us/divisions/highwbridgmaint.asp.

[153] *DOT Agencies,* U.S. Department of Transportation (last updated May 20, 2009), available at http://www.dot.gov/DOTagencies.htm

[154] *A Summary of Highway Provisions in SAFTEA-LU,* Federal Highway Administration Office of Legislation and Intergovernmental Affairs (Aug. 25, 2005), available at http://www.fhwa.dot.gov/safetealu/summary.htm.

[155] *FY2013 Implementation Strategy,* Federal Highway Administration Office of Planning, Environment and Realty (last updated Aug. 23, 2012), available at http://www.fhwa.dot.gov/hep/step/about_step/strategy/.

on climate change effects. In FY2012, STEP made $500,000 in state grants available to research climate change and transportation

In FY2012, STEP made available $250,000 to state DOTs to better understand, apply, and evaluate sustainable methodologies in transportation project development. According to the DOT, state efforts might include: developing a strategic sustainability plan, developing training and technical guidance on sustainability, research on how sustainable solutions may be integrated into transportation, research on how to measure the benefits of applying sustainable techniques and methodologies, supporting the continued development of FHWA's Sustainable Highways Self-Evaluation Tool, creating of an inventory of brownfields for transportation infrastructure and research to understand how brownfields may be used to support sustainability goals and objectives, and developing and sharing an understanding of the relationship between sustainability and livability.

*b) FHWA SAFTEA-LU §6002 "Eco-Logical" Grant Program*[156]

Developed by FHWA and seven other federal agencies, this program promotes strategic integrated planning, mitigation, and performance measurement as the key factors in the "Ecosystem Approach." The grant program currently provides funds to 15 projects nationwide that typify these attributes, but none in Rhode Island as of FY2012.[157]

As the first 15 Eco-Logical grant projects reach completion, FHWA may consider funding additional applications using the Eco-Logical approach. These applications will likely be continuations of selected grant projects that have demonstrated the approach's effective implementation and have ready opportunities to advance or replicate project components. Specifically, FHWA will consider developing performance measures to help evaluate if projects lead to quantifiable environmental improvements and efficient project resolution.

The 2011 Eco-Logical Grant Program Annual Report highly lauded the program and expressed desires for increased expansion and partnership. Looking to the future, the Strategic Highways Research Program 2 (SHRP2) implementation funding appropriations and increased commitment from the partner federal agencies should expand the Eco-Logical approach's scope and bring new tools and resources into the program. According to the DOT, "greater adoption of the Eco-Logical approach throughout the nation's diverse environmental and political contexts should ultimately lead to even more innovative strategies for its implementation as new types of organizations adapt the approach to fit their constraints and priorities."

*c) FHWA SAFTEA-LU §5202 Innovative Bridge Research and Deployment (IBRD) Program*[158]

FHWA has made available funds for new construction and replacement bridge projects that meet at least one of the statutory program goals: developing new, cost-effective, innovative highway bridge applications; developing construction techniques to increase safety and reduce

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[156] *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects*, Federal Highway Administration (last visited Sept. 6, 2012), available at http://www.environment.fhwa.dot.gov/ecological/eco_toc.asp.

[157] *Eco-Logical Grant Program Projects*, Federal Highway Administration (last visited Sept. 6, 2012), available at http://www.environment.fhwa.dot.gov/ecological/eco_gps.asp.

[158] *Innovative Bridge Research and Deployment Program-Selection Criteria and Other Information*, Federal Highway Administration (last updated Nov. 10, 2011) available at http://www.fhwa.dot.gov/discretionary/ibrd2012selc.htm.

construction time and traffic congestion; developing engineering design criteria for innovative products, materials, and structural systems for use in highway bridges and structures; reducing maintenance costs and life-cycle costs of bridges, including costs of new construction, replacement or rehabilitation of deficient bridges; developing highway bridges and structures that will withstand natural disasters; developing improved methods to detect bridge scour and economical bridge foundation designs that will withstand bridge scour; and effective transfer of resulting information and technology by documenting and wide dissemination of objective evaluations of the performance and benefits of these innovative designs, materials, and construction methods.

Unlike some FHWA funding schemes, in this case the proposed project may be on any public roadway including state and locally funded projects, and funds may be used for preliminary engineering, repair, rehabilitation, or construction of bridges or other highway structures. Funding is also available for project performance evaluation and the structure's monitoring. The actual amount available varies in yearly congressional appropriations and is subjected to obligation limitation and rescission, but for comparison and estimation, the IBRD program was funded at $13.1M for each of the fiscal years 2005 through 2009.

III. Housing and Urban Development (HUD).

The Department of Housing and Urban Development (HUD) was the final department listed on the Northeast Federal Partner's call for increased involvement by federal agencies in adapting to global climate change's effects. Unfortunately, in the interim HUD's commitment has not been fully actualized. HUD does, however, offer planning programs and toolkits for local planning and development authorities to better include green design principles into their strategic development plans.[159]

The Partnership for Sustainable Communities is an interagency task force comprised of members of HUD, the DOT and the EPA, [160] and sometimes offers grants to support activities that improve development quality and protect human health and the environment.[161] Utilizing research gained by each component Department as well as tapping into community resources such as stakeholder input and case studies, the Partnership developed a set of six basic "Livability Principles" that define a sustainable community.[162] In their opinion, such communities: provide more transportation choices; promote equitable, affordable housing; enhance economic competitiveness; support existing communities; value communities and neighborhoods; and coordinate and leverage Federal policies and investment.[163]

Unfortunately, no current grant opportunities exist under this program, but it does conform closely with The Nature Conservancy's goals to sustainably develop infrastructure with

[159] *Green Homes and Communities*, U.S. Department of Housing and Urban Development (last updated Nov. 9, 2011), available at http://www.hud.gov/offices/cpd/about/conplan/greenhomes.cfm.
[160] *About Us*, Partnership for Sustainable Communities (last visited Sept. 6, 2012), available at http://www.sustainablecommunities.gov/aboutUs.html.
[161] *Partnership Grants, Assistance & Programs*, Partnership for Sustainable Communities (last visited Sept. 6, 2012), available at http://www.sustainablecommunities.gov/grants.html.
[162] *About Us*, Partnership for Sustainable Communities (last visited Sept. 6, 2012), available at http://www.sustainablecommunities.gov/aboutUs.html.
[163] See id.

a close eye to improving human functionality and dynamic natural ecosystems.[164] While this may seem to be an impediment, the opportunity exists for The Nature Conservancy to propose options that would revitalize this program, or to use this program's principles in creating educational materials for State and local planning authorities.

Part Two: Other Federal Partners Increasing Infrastructure's Resiliency to the Effects of Climate Change

I. Department of Homeland Security (DHS)

Rising sea levels and changes in ocean currents and salinity gradients will cause navigation and ocean safety infrastructure will become damaged with increasing storm severity and frequency, causing navigational beacons to potentially lose their effectiveness.[165] As the parent agency of the Immigration and Customs Enforcement Agency, Customs and Border Patrol, the peacetime Coast Guard, and other related national security agencies such as FEMA, DHS relies heavily on coastal infrastructure to execute its mission.[166]

DHS coordinates efforts with several governmental agencies to require strategic examinations of sustainable options in all planning and mission stages, prioritizing the most fragile or threatened natural environments. Desire to sustainably protect coastal infrastructure has led to a call for reviewing the placement of Naval, USCG, and CBP coastal installations with an eye to relocation or improved mitigation measures.[167] Mitigation measures such as sustainable landscaping, habitat restoration, or environmentally passive designs have been strongly recommended for incorporation into any new structures' construction under the control of DHS regardless of the location.[168]

The goal of retrofitting necessary infrastructure to incorporate environmental sensitivity principles and mitigation is a long-term project, expected to continue through at least FY2018-2020.[169] In the interim, DHS seeks to better integrate its non-security risk installations or reservations into the surrounding communities, which will build relationships with stakeholders while mitigating issues associated with highly concentrated development and habitat fragmentation.[170] In both goals, DHS is in compliance with Executive Order 13514, which

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164 *Partnership Grants, Assistance & Programs,* Partnership for Sustainable Communities (last visited Sept. 6, 2012), available at http://www.sustainablecommunities.gov/grants.html.

165 *Climate Change and Navigation,* The World Association for Waterborne Transit Infrastructure (last visited Sept. 6, 2012), available at www.pianc.org/downloads/envicom/envicom-free-tg3.pdf.

166 *Department Components,* U.S. Department of Homeland Security (last visited Sept. 6, 2012), available at http://www.dhs.gov/department-components.

167 *National Security Implications for Climate Change for U.S. Naval Forces*, Naval Studies Board (last visited Sept. 6, 2012), available at http://serppas.org/Files/Climate/Implications%20of%20Climate%20Change%20for%20U.S.%20Naval%20Forces.pdf.

168 *Strategic Sustainability Performance Plan,* U.S. Department of Homeland Security (last visited Sept. 6, 2012), available at http://www.dhs.gov/xlibrary/assets/mgmt/dhs-strategic-sustainability-performance-plan.pdf.

169 See id

170 See id.

demands that federal agencies and departments strive to use 95% of their purchasing contracts to include environmentally sustainable or low-impact methods, materials, or procedures.[171]

Rhode Island has had a traditionally strong Coast Guard presence, with stations in many coastal towns, and navigation structures widely dispersed throughout the state.[172] DHS is concerned with potential damages to human systems through global climate change's effects and has committed to ameliorating and mitigating any potential damages through sustainable means. An opportunity exists for The Nature Conservancy to use its knowledge of environmentally sensitive areas and best management practices to propose options over the DHS retrofit initiative's life to best effectuate goals on either side. Although law enforcement and national security will always occupy the highest priority in the department's decision matrix, DHS wisely realizes that this mission will be ineffective unless adaptation and mitigation measures are undertaken.

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[171] Letter from Elaine C. Duke, Under Secretary for Management, U.S. Department of Homeland Security, to All Department of Homeland Security Employees (Oct. 16, 2008), available at http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=11012&destination=ShowItem.

[172] *Rhode Island Coast Guard Stations*, Rhode Island Tourism Council (last visited Sept. 6, 2012), available at http://www.visitrhodeisland.com/what-to-do/jewels-of-the-bay/ri-coast-guard-stations/.
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