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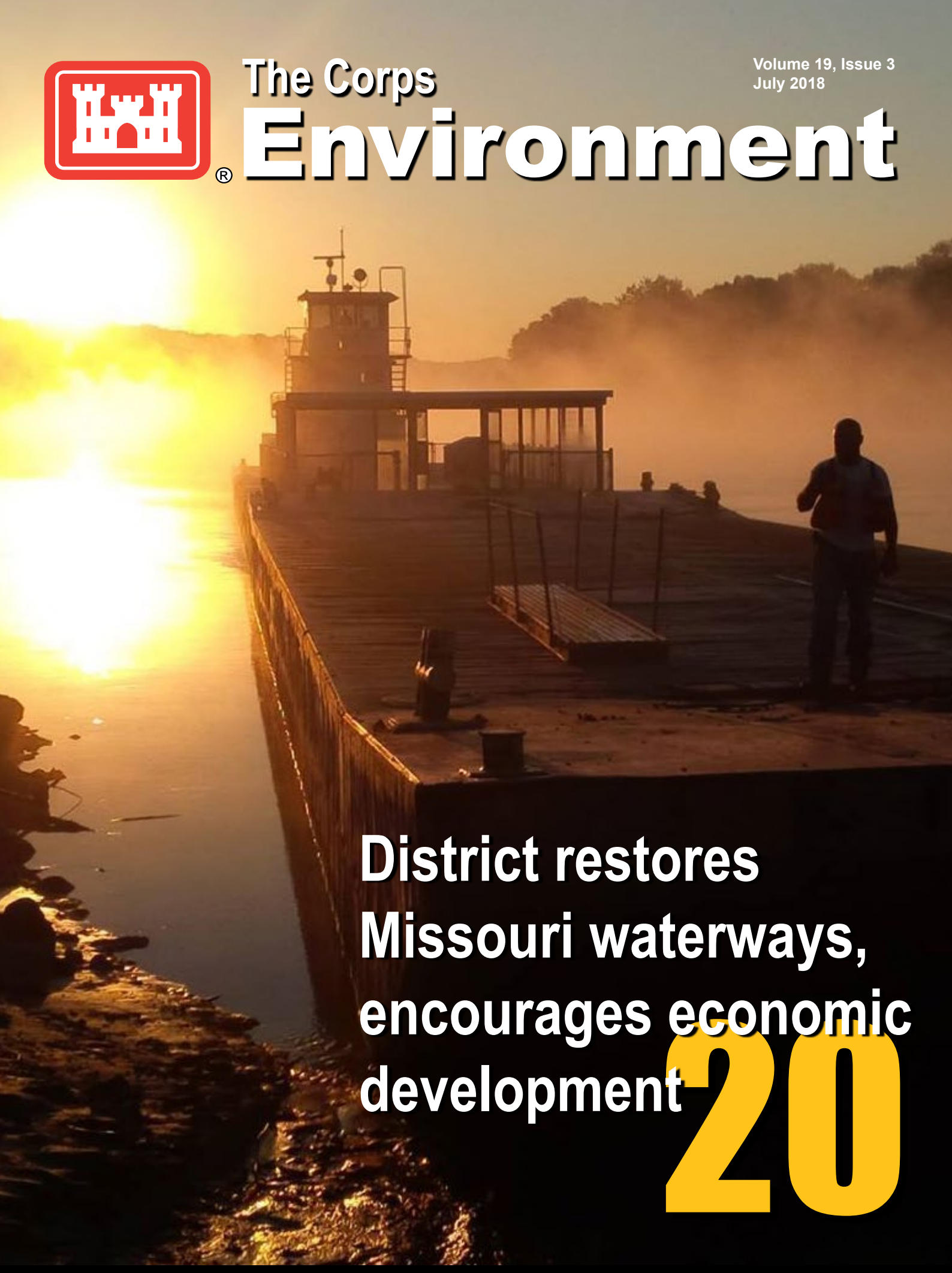

District restores Missouri waterways, encourages economic development

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contents

In each issue, The Corps Environment references and reinforces one of the Corps of Engineers' Environmental Operating Principles. This edition focuses on EOP #3: Create mutually supporting economic and environmentally sustainable solutions. In the EnviroPoints commentary on page 4, USACE Senior Policy Advisor, Maria Wegner, provides important insight into this EOP, with more throughout the publication. For a list of all seven EOPs, please visit the USACE website at https://www.usace.army.mil/Missions/Environmental/Environmental-Operating-Principles/.

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ENVIROPOINTS

Incorporating environmental, social benefits into decision-making

"Using guiding questions informs decisions, and provides opportunities to recommend solutions that deviate from the Corps' traditional economics focus."

By Maria Wegner
Senior Policy Advisor
U.S. Army Corps of Engineers, Headquarters

- Integrated water resources management
- Sustainability
- Resilience
- Ecosystem goods and services

Each of these topics lend themselves to consideration of monetary, non-monetary, quantified, and qualitative changes to society, environment, and economy and the opportunity to live the Environmental Operating Principles.

The Corps of Engineers solves complex problems for which there is no single best solution.

Planning for the coordinated development and management of water and related land resources requires the Corps to consider multiple, and sometimes competing, objectives of the nation and the communities in which we plan projects.

Applying our full technical and problem-solving capability to meet multiple objectives requires the identification, description, and consideration of a broad array of benefits and costs that expand the value provided by projects, ensure that projects are a smart long-term investment, and facilitate effective partnering and cost-sharing.

The Corps strives to provide sustainable solutions to the nation's water resources problems. Sustainable solutions seek to balance environmental, economic, and social benefits and costs associated with projects to meet present needs without sacrificing the ability to meet future needs.

We also consider three systems when formulating, evaluating and comparing potential water resources solutions – the human environment (people, economy), the natural environment (ecosystems), and the built environment (e.g., infrastructure, houses, roads).

Considering the human, natural and built environments allows the Corps to communicate changes to society, environment, and economy and promotes transparency in decision making.

Disclosing changes informs the decisions beyond the Corps, including those of our partners and stakeholders. What is gained and lost with each alternative solution? Who is the right implementing agency, organization, or partner?

Using guiding questions informs decisions, and provides opportunities to recommend solutions that deviate from the Corps' traditional economics focus. We can ask and answer questions, such as:

How does today's use of resources and interruption of natural processes impact the ability of future generations to use those resources?

Do the alternative solutions allow for future adaptation or will a new strategy be needed at some point in the future? If a new strategy, what is the trigger for when a new strategy may be necessary?

To what extent do the alternative solutions segment the community or cut off community networks, reduce community cohesion, impact social capital, or otherwise isolate segments of the population?

How sensitive are the alternatives to unforeseen conditions, including human and natural extreme events?

Moving decision-making beyond economic development is hard. It is easy to point to a single metric, such as net economic benefits or damage reduction, to choose a solution; it is a lot harder when the information includes a mix of monetary and non-monetary information. That is, however, how the Corps will move towards more sustainable solutions — through the explicit consideration of social and environmental objectives and the corresponding outputs associated with projects.

Maria Wegner
Senior Policy Advisor
U.S. Army Corps of Engineers, Headquarters

Over time, the policies, procedures, and tools will also advance, but that doesn't mean we are not able to make decisions with social and environmental information now.

I encourage you to keep pushing forward. Be explicit about the benefits and costs of each solution and the trade-offs inherent with each decision. View each decision as an opportunity to integrate and live the Environmental Operating Principles in your work. Essayons!

The Corps Environment

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Submissions

The Corps Environment's editorial staff welcomes submissions with an environmental, sustainability or energy focus from USACE and Army units worldwide. Send articles, photos, events, letters or questions to the editor at CEHNC-PA@usace.army.mil.

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www.usace.army.mil/Missions/Environmental.aspx

(Photo by Cpl. Matthew DeVirgilio)

A Soldier's effectiveness on the battlefield may rely on the unit's supply chain and how quickly broken parts and equipment can be repaired or replaced. Using 3-D printing technology, the Army hopes to enable Soldiers to print and replace spent parts from waste plastic through 3-D printing technology.

Army explores 3-D printing for battlefield use

By Joyce M. Conant
U.S. Army Research Laboratory Public Affairs

ABERDEEN PROVING GROUND, Maryland – A collaboration between the Army Research Laboratory and the Marine Corps has resulted in the discovery of using waste plastics — such as water bottles, milk jugs and yogurt containers — for 3-D printing parts that Soldiers may need on the battlefield.

Reclaimed materials may be the next materials used in additive manufacturing, or 3-D printing, to improve the self-reliance of service members on forward operating bases by cutting costs and decreasing the demand for the frequent resupplying of parts by the supply chain.

"The potential applications for additive manufacturing technologies are extensive — everything from pre-production models and temporary parts to end-use aircraft parts and medical implants," said ARL researcher Dr. Nicole Zander.

Additive manufacturing offers many advantages over traditional manufacturing, she said, including increased part complexity and reduced time and cost for one-off items, such as a bracket for a radio, one of the long-lead parts evaluated in the work.

The research by Zander and co-collaborator Marine Capt. Anthony Molnar, generated fused filament fabrication, or FFF filament, from 100-percent recycled polyethylene terephthalate, or PET, from bottles and plastics without any chemical modifications or additives. Work is also underway to generate filament from other recycled plastics and reinforced filaments.

Zander said that while PET is widely used in many applications, it is not widely used as a feedstock for FFF due to its high melting temperature, water absorption and issues with crystallinity, which can make printing difficult.

Steve Post, business development manager for Thermo Fisher, the maker of the equipment the Army used to produce its filament, said this is a strong statement on sustainability.

"The Army really thought out of the box on this application, turning a troublesome waste product into a valuable resource," he said.

See **3-D PRINTING**, page 7

3-D PRINTING

continued from page 6

Zander said recycled PET was shown to be a viable new feedstock, with mechanical properties of printed parts comparable to parts made from commercial filament. In addition to small parts for evaluation, several larger long lead item military parts were also printed with the filament.

"In terms of mechanical properties, most polymers used in FFF have bulk strengths between 30 and 100 MPa," Zander explained. Recycled PET has an average strength of 70 MPa, and thus may be a suitable 3-D printing feedstock."

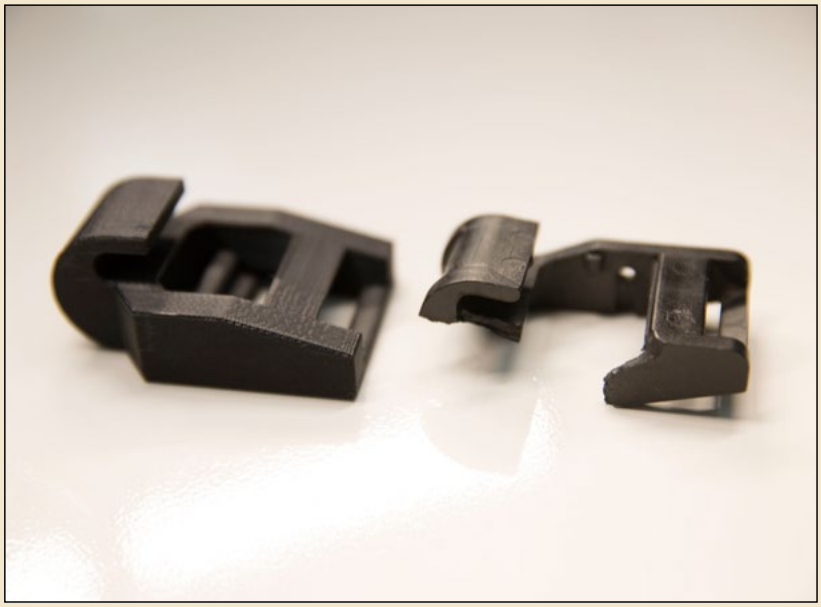
Mechanical testing, including uniaxial tensile and three point bending experiments, were conducted in the laboratory. In these tests, the tensile strength of 3-D printed recycled PET was compared against commercial filaments and found to have similar strength. In addition, a custom test fixture was made to test a 3-D printed radio bracket (a long-lead military item). Brackets made from recycled PET failed at a similar load to brackets printed with commercial ABS filament. The recycled PET filament may have the capability to replace commercial filament in printing a diverse range of plastic parts.

In addition to mechanical testing, the recycled plastics underwent chemical analysis, thermal stability and a host of other tests.

"Recycled polymers have a variety of different additives, fillers and dyes and may have experienced different processing conditions — even for the same polymer type," Zander said.

To get a better understanding of different recycled plastic feedstocks and the best properties to expect from such materials, chemical, thermal and mechanical analyses were performed.

Molnar, project officer with the mobility and counter mobility team in Quantico, Virginia, said PET plastics such as water bottles and packaging are one of the most prolific wastes found on the battlefield. Both U.S. and coalition forces produce large volumes of this waste, and being able to repurpose this on location by forward deployed forces will reduce the logistic burden of transporting parts to forward operating bases and the additional costs of disposing of the recyclable material.



Soldiers on the battlefield may soon be able to replicate items such as this canvas clip for the High Mobility Multipurpose Wheeled Vehicle through the use of 3-D printing technology. (Photo by Marine Sgt. Abbey Perria)

"Nikki's groundbreaking research will provide U.S. forces with the ability to 3-D print replacement parts on demand," Molnar said. "This will not only increase readiness of equipment but also provide troops with the ability to manufacture mission specific gadgets in the field.

"As our enemies have shown us, they can often out pace our ability to react to their new tactics and equipment," he continued. "This new technology will enable the warfighter to more rapidly develop tools necessary to defeat an ever changing enemy technology.

"With Nikki's continued research in incorporating additives, stronger filaments will continue to increase the capability to print stronger replacement parts. This will further enable Soldiers to push the boundaries of expeditionary manufacturing into not only larger parts, but also other areas such as printing building materials, unmanned platforms, and force protection devices."

Researchers said the driving force for this work is to enhance warfighter capability and readiness by enabling repairs while deployed and to reduce dependence of the logistical supply chain.

"While each unit carries large stockpiles of spare parts for emergencies, this is costly and increases the risk to warfighters during the convoy of those assets. It is also difficult to predict the failure and lifecycle of these parts," Zander said.

Zander and Molnar are in the process of building a mobile recycling facility to enable Soldiers to be able to repurpose plastics into feedstocks for 3-D printing.

"The MRF will be a plastic processing laboratory housed in a 20-foot ISO container, with all equipment and tools needed to fabricate 3-D printing filament from plastic waste," Zander said.

Researchers determined that recycled plastics have shown to be suitable material for 3-D printing, provided the material is properly cleaned and dried. The tensile strength of printed parts from recycled PET was equivalent to printed parts made from commercial off the shelf PET pellets and commercial filaments. But the research will not stop here.

Zander said blending with other plastics, or the addition of fillers such as reinforcing or toughening agents, may further improve the mechanical properties of the recycled plastics, or rPET, filament and expand the realm of applications in how it may be used.

"Ultimately, we'd like to produce the best possible feedstock we can from recycled plastics and waste materials," Zander said. "Future work will involve testing select 3-D printed long-lead parts against original parts to determine if they can be a suitable long-term or at least a temporary replacement."

Dredging project to widen, deepen ship channel

By Timothy Dugan
USACE, New England District

Improvement dredging of portions of the Boston Harbor Federal Navigation Project Main Ship Channel in Boston, Massachusetts, will be conducted under the terms of a $122,223,000 contract issued recently by the New England District.

Work will be accomplished by Cashman/Dutra, Joint Venture of Quincy, Massachusetts. Awarded in Feb. 15, 2017, the dredging is expected to take approximately three years to complete to deepen the project to its newly authorized depths. Dredging started this spring.

The dredging project is to accommodate large container ships that are calling on the U.S. east coast now that the Panama Canal improvements are completed.

Approximately 11.7 million cubic yards of silt, blue clay, till and weathered rock will be dredged to improve the following components of the Boston Harbor Federal Navigation Project: deepening and widening the Broad Sound North Channel to -51 feet Mean Lower Low Water; deepening and widening the Main Ship Channel to the Conley Terminal, including the turning basin to -47 feet MLLW; and deepening the President Roads Anchorage and deepening the lower Reserved Channel to -47 feet MLLW.

The material dredged will be placed at the Massachusetts Bay Disposal Site approximately 20 miles offshore of Boston Harbor, with the exception of a small fraction of the material being placed as a cap to the Main Ship Channel Confined Aquatic Disposal cell, just downstream of the inner confluence of the Chelsea and Mystic rivers.

Boston Harbor is the largest seaport in New England and the principal distributing point for regional commerce.

More than 87 percent of Boston Harbor commerce is the receipt and shipment of petroleum products. Principal commercial traffic consists of the import of distillate petroleum products, residual fuel oil, sugar, limestone and lumber; the receipt and shipment of other petroleum products; and the export of iron and steel scrap.

Initial work in Boston Harbor began shortly after the Civil War. The most recent improvement work was completed in May 1966. The current project includes the harbor proper and four access channels: the Chelsea River, the Fort Point Channel, the South Boston Reserved Channel and the Weir River at Nantasket Beach.

Previously completed by the Corps, the work on Harbor Proper consists of a 6-mile-long, 40-foot-deep main channel extending from Massachusetts Bay through Broad Sound to the entrance of the Mystic and Chelsea rivers. The channel is 900 to 1,100-feet-wide from the sea through Broad Sound to President Roads. The channel is 600-feet-wide from President Roads to the entrance of Mystic and Chelsea rivers.

A 35-foot deep channel that runs parallel to, and on the northerly side of, the aforementioned 40-foot-deep channel. The 35-foot-deep channel is 600-feet-wide and extends from the sea through Broad Sound to a point opposite the fish pier.

A 2-mile-long, 35-foot-deep channel that extends from an area abreast of Fort Point Channel to a point almost one mile past the Chelsea Street Bridge. The channel, which has widths varying from 100 to 1,000 feet, starts in the harbor in front of Fort Point Channel and adjacent to the 40-foot-deep channel. It extends down the harbor parallel to the 40-foot channel, past the Mystic River Bridge, except the portion in front of the former Charlestown Navy Yard which was deauthorized by Congress in 1992 and ends at the General Andrew P. McArdle Bridge at the entrance to the Chelsea River. The channel also splits at the Navy Yard and goes down the Charles River before ending at the Charlestown Bridge — a 2-mile-long channel, 30-feet-deep and 1,200-feet-wide from the sea through Broad Sound to President Roads. This channel is situated south of the 35 and 40-foot-deep Broad Sound channels — a 3-mile-long channel 27-feet-deep and 1,000-feet-wide extending from Nantasket Road through the Narrows to President Roads — a 550-foot- long stub channel, 15-feet-deep and 300-feet-wide, located at the northeast head of Long Island in the vicinity of Nix's Mate Shoal.

An approach channel (not originally built by the Corps) to the former U.S. Navy Dry Dock Number 3 in South Boston that was deepened to 40 feet — a 40-foot-deep anchorage along the northern limit of President Roads. The anchorage, 350 acres in area, measures 6,200 feet east to west and 2,500 feet north to south — a 35-foot-deep area lying west of the anchorage; stone seawalls that protect the harbor's exposed headlands and islands.

The percentage of traffic passing through the Chelsea River Channel has been increasing over the past several years. A recent study indicated that 46 percent of the traffic in Boston Harbor utilized the Chelsea River.

Corps' work on the Chelsea River includes a main ship channel 1.8 miles long extending from the General Andrew P. McArdle Bridge to the end of the river. From the McArdle Bridge to the Chelsea Street Bridge, the channel is 35-feet-deep and approximately 225 to 250 feet wide. From the Chelsea Street Bridge to a point near the river's end, the channel is 250 to 430 feet wide. At the end of the channel there is a turning and maneuvering basin 35-feet-deep and approximately 800-feet-wide and 1,000-feet-long.

The Fort Point Channel extends from Boston Harbor to the Northern Avenue Bridge in South Boston, a distance of about 1,000 feet. It is 23-feet-deep and 175-feet-wide.

The South Boston Reserved Channel extends from the 40-foot-deep channel in Boston Harbor to the L Street Bridge in South Boston, a distance of about 5,400 feet. It is 35-feet-deep and 430-feet-wide.

The 1.7-mile-long channel in the Weir River, 12-feet-deep and 150-feet-wide, provides access to the Nantasket Beach terminal in Hull. The channel extends from Sunset Point on Nantasket Beach, through the Weir River to Nantasket Pier.

The Water Resources Development Act of 1990 passed by Congress authorized a $26.2 million Navigation Improvement Project for Boston Harbor. The project proposes deepening the Mystic River and the Reserved Channel from the existing 35-foot depth Mean Low Water to 40 feet and the Chelsea River from 35 feet to 38 feet.

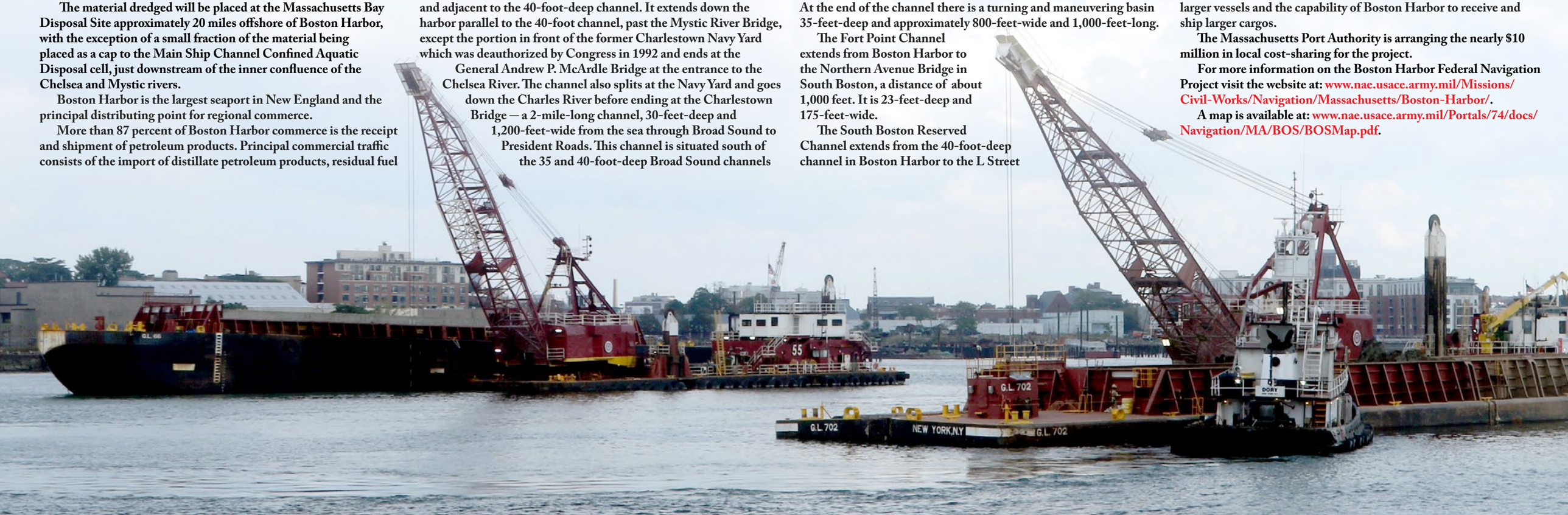
In addition, the Inner Confluence, which provides access to the Mystic and Chelsea rivers, and a widened maneuvering area at the entrance to the Reserved Channel, would be dredged to 40 feet. The size of the President Road Anchorage will be increased by almost 70 acres at no cost by establishing new channel limits that would extend into naturally deep areas.

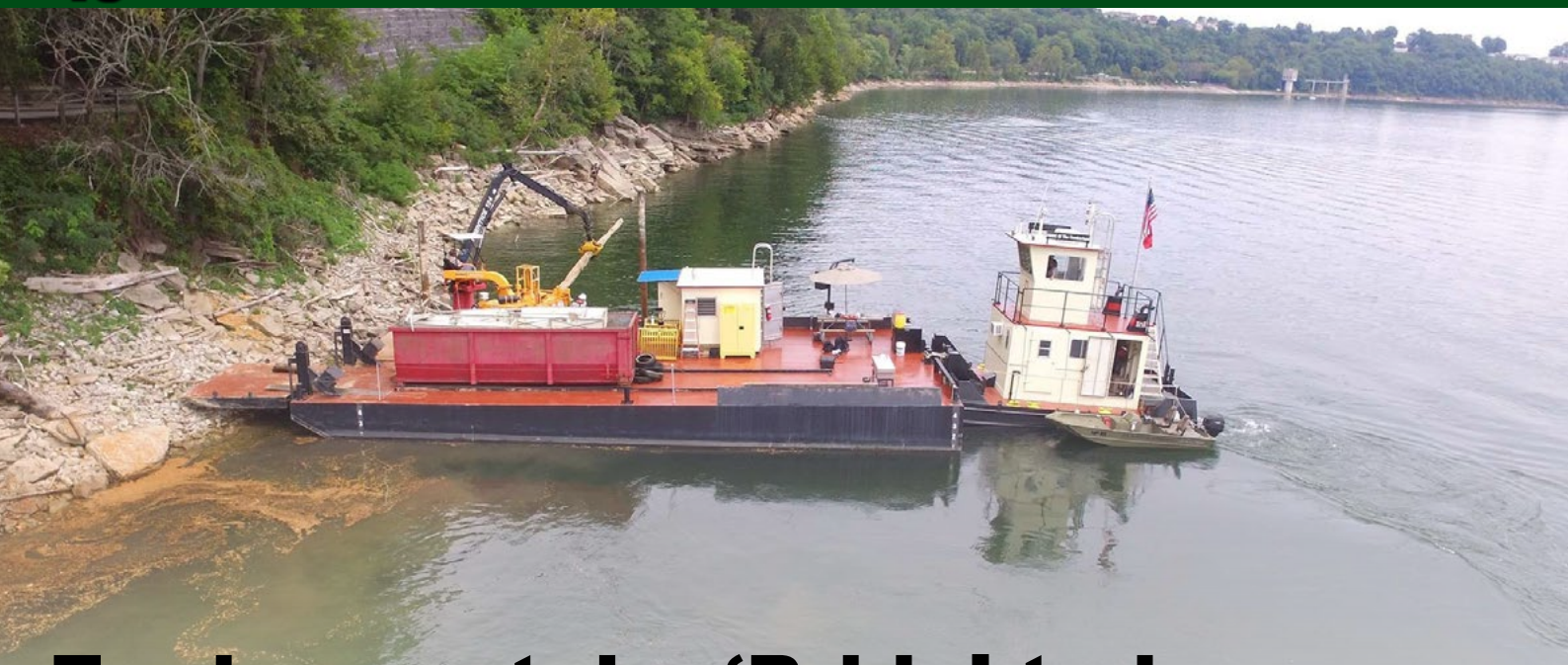
The deepening of the channels would primarily benefit local petroleum product importers and scrap exporters, who together account for about 93 percent of all shipping in the Port of Boston. Project benefits would be realized through reduced tidal delays for larger vessels and the capability of Boston Harbor to receive and ship larger cargos.

The Massachusetts Port Authority is arranging the nearly $10 million in local cost-sharing for the project.

For more information on the Boston Harbor Federal Navigation Project visit the website at: www.nae.usace.army.mil/Missions/Civil-Works/Navigation/Massachusetts/Boston-Harbor/.

A map is available at: www.nae.usace.army.mil/Portals/74/docs/Navigation/MA/BOS/BOSMap.pdf.





Engineers take 'Pride' to improve, maintain Cumberland waterways

By Mark Rankin
USACE, Nashville District

SOMERSET, Kentucky – Employees with the U.S. Army Corps of Engineers, Nashville District, have engineered a solution to help improve and maintain access at a sometimes debris-clogged Waitsboro recreation and boat launch area.

Chris Marlow, Nashville District Eastern Kentucky Area operations manager and Wolf Creek Power project manager, and his staff developed a low-cost, low-maintenance solution to support the debris mitigation efforts of the PRIDE at the Waitsboro ramp.

The "Pride of the Cumberland," a vessel operated by the Corps, travels to various areas keeping Lake Cumberland's waterways and shorelines clean and free of trash, logs and assorted debris.

Elegantly simple, the plan involved installing a floating debris containment boom to control the flanks of the ramp's courtesy float and intercept debris before it's able to impede access to the water, similar to an oil spill containment barrier.

Marlow engaged his staff to develop a plan of action, and then coordinated with Bill Ernest, a maintenance worker, and contractors to empower them to employ the plan and install the boom.

The containment boom is a series of floats moored together by a cable, anchor and winch system that can be adjusted to accommodate the lake's fluctuating elevation. The floats are highly visible, yellow in color and marked by solar powered strobe lights.

The Waitsboro ramp is popular among fisherman and recreational boaters alike because of its ease of access to Lake Cumberland and close proximity to the city of Somerset and major access roads, i.e. U.S. Highway 27 and Kentucky Highway 80.

Sometimes during heavy rains, a rapidly rising Lake Cumberland pushes massive amounts of downed logs and debris along the shoreline, making the popular boat ramp temporarily unusable. One of the lake's most popular launch ramps, Waitsboro experiences closures and numerous issues with usability.

According to Michael Lapina, USACE, Nashville District Eastern Kentucky Area operations manager, because of its location at the confluence of the north and south forks of the Cumberland River, coupled with a hairpin bend in the main body of the lake, Waitsboro is notorious for becoming inundated with driftwood and manmade debris, at times making it impossible to launch a boat.

"Keeping the lake clear and free of debris is priority," said Lapina. "One of the best ways to help manage and keep the lake clear is to use the 'PRIDE of the Cumberland' to execute the environmental and recreational missions at Lake Cumberland."

The Pride of the Cumberland consists of two 60-foot-long barges pushed by the 'PRIDE,' a 26-foot-long tow boat. The starboard port side barge has a mechanical knuckle boom material handler with attachments for lifting heavy logs and large debris from the water or shore and skimming debris from the water. The port side barge holds a roll-off dumpster for debris collection and a wood chipper to mulch wood of all sizes.

However, despite the tireless efforts of the Pride's master tender and crew of two, removing no less than 10,000 cubic yards of debris annually since 2003, the Waitsboro ramp is still plagued with a debris problem.

Lake Cumberland is one of the largest man-made lakes in the nation and each year millions of visitors travel from all over the United States to enjoy the beauty of its 63,000 surface acres of water and 1,255 miles of wooded shoreline.

Lapina advises boat operators to always wear their life jackets, use precaution when traveling in unfamiliar areas or when traveling on jet skis or at higher rates of speed, always scan the water for floating logs and also dispose of and pick up visible trash or debris.

"Lake Cumberland is large and it can present many hazards for just the Pride to collect, so it's an all-volunteer effort," said Lapina.

Post-installation, preliminary results have been promising. The debris boom has received high praise from lake-goers, who are impressed with its ability to improve access and enrich their recreational experience at Lake Cumberland.

The debris boom at Waitsboro is evidence of the Eastern Kentucky Area's dedication to execute the Corps mission and provide a quality recreational experience for visitors while maintaining and improving the integrity of lake resources.

New England District completes restoration project

EPA removes superfund site from National Priorities List

By Ann Marie R. Harvie
USACE, New England District

Following the restoration of a superfund site, the Environmental Protection Agency has removed the New England District's project from its National Priorities List, March 15.

The announcement follows years of cleanup and restoration work by Hatheway & Patterson at the superfund site located in Mansfield and Foxborough, Massachusetts.

"Deleting Hatheway & Patterson from the NPL is an exciting moment, marking the completion of many years of cleanup work and returning the site to the towns for future planning," said Alexandra Dunn, EPA regional administrator.

The site was a 40-acre wood treatment facility until the it went bankrupt in 1993, leaving soil contaminated with chemicals that included dioxin, pentachlorophenol, arsenic and organic solvents.

The EPA asked the New England District to execute remedial action to include excavation, offsite disposal and on-site cap construction to clean up the site. Work included the excavation of 43,500 tons of contaminated soil and shipping it off-site to a hazardous waste landfill.

According to the EPA, hazardous material within approximately two acres of the site located in Foxborough were consolidated and placed under an asphalt cap. Long-term monitoring of groundwater, surface water and fish tissue were performed regularly. In addition, operation and maintenance of remedial components including the cap were reviewed together with monitoring data during 5-year reviews to determine whether the cleanup was effective. Work began in August 2009 and was completed in September 2010. Sevenson Environmental of Niagara Falls, New York, served as contractor on the project.

New England District's Hatheway & Patterson Superfund Cleanup Team received the 2011 National Notable Achievement Award for Superfund Reuse/Revitalization for Region 1 (New England). The team also included members of EPA Region 1 and the Commonwealth of Massachusetts.

EPA proposed to delete the site from the NPL on December 2017. After a 30-day comment period, the agency determined the comments did not affect EPA's determination to remove the site.

Now that the site has been taken off the list, the property can be reused.

"The cleanup of the Hatheway & Patterson Site means the return of this property to productive use, the surrounding environment restored and the nearby neighborhood protected," said Massachusetts DEP Commissioner Martin Suuberg.

Portions of the site are already being reused by the towns.

According to the EPA, in Foxborough, a 119-space commuter parking lot is located on part of the site, which serves the town's commuter rail station. The town of Mansfield also uses part of the site for emergency vehicle storage and office space.

(New England District courtesy photo)

The New England District project culminated years of cleanup and restoration on what was once a 43-acre wood treatment facility, including the excavation and removal of 43,500 tons of soil contaminated with dioxin, pentachlorophenol, arsenic and organic solvents.

Research group studies restoration sites to determine shape of future projects

By Holly Kuzmitski
U.S. Army Engineer Research and Development Center

VICKSBURG, Mississippi — When Elizabeth Murray, U.S. Army Engineer Research and Development Center, heard the question, she knew it represented an opportunity to engage in an Engineering With Nature® research project. She also knew that the outcome of that research would determine the shape of future marsh restoration projects in the San Francisco Bay Area, possibly for many years to come.

"Restoring coastal marshes is important because they deliver so many benefits to people," Murray said. "Marshes provide economic benefits by acting as a shoreline buffer, protecting homes and infrastructure from flooding and wave energy."

"And, of course, marshes provide environmental benefits by providing habitat to endangered species, such as the ridgway's rail. However, restoration of these sites requires sediment because they've subsided — or sunk — so much, and bringing in that much sediment is expensive."

Murray, who is embedded in the San Francisco District as a research biologist with ERDC's Environmental Laboratory, said that it was her new colleagues, Eric Jolliffe and Tom Kendall, who asked whether the optimal barrier shape for decreasing wave energy at bayland restoration sites is long, linear berms or round mounds.

"The question was important, because it addressed a crucial step in marsh restoration, in which we use natural processes to optimize benefits and reduce costs," Murray said.

That crucial step is the natural build-up of the last foot or two of sediment in the marsh, a process known as sediment accretion.

"We bring in dredged material to address most of the subsidence, but it's best to let nature to do the work for the last foot or two," she said. "If the waves and water flow are slowed enough by barrier features, the sediment will fall out of the water and naturally build up marsh.

"Accreting the last foot of sediment naturally is desirable, because the grain size, chemistry and elevation develop exactly as the marsh requires, making conditions optimal for marsh vegetation to take root and propagate to form a fully functional marsh."

She said that the project was an ideal subject for EWN research, since using natural processes and identifying multiple project benefits are the goals of its initiative.

The research investigated two bay area marsh restoration projects that each used different designs for these barriers: Hamilton Wetlands and Sears Point. Located along the edge of San Pablo Bay, both sites had been diked and drained for over 100 years and had recently undergone restoration.

Hamilton Wetlands, a joint venture between San Francisco District and the California State Coastal Conservancy, primarily utilized long, linear berms to slow the flow of water; and Sears Point, restored by the Sonoma Land Trust, Ducks Unlimited and numerous other partners, used round marsh mounds.

Murray assembled a research team, first calling Dr. Jane Smith, ERDC Coastal and Hydraulic Laboratory. Smith specializes in wave modeling, allowing the research not only to ask how the restoration projects were implemented, but to investigate alternate designs utilizing the same volume of dredged material to form features, swapping mounds and berms. Smith and a team of CHL scientists, including Thad Pratt, Jarrell Smith and Catie Dillon developed and validated wave models at Hamilton Wetlands and Sears Point and then tested new designs at each site.

The ERDC research team concluded that the Hamilton Wetlands' interior berms reduce wave energy most efficiently, promoting more rapid accretion; therefore, the linear berms are optimal for marsh restoration, if the space is available to use them. However, at Sears Point, space constraints precluded berm siting in some areas; consequently, a combination of berms and mounds were optimal.

Murray said recent visits to Hamilton Wetlands show the site is thriving.

"Good, healthy marsh has developed on the site's fringe and on the berms, and sediment accretion is progressing nicely around the berms," she said.

Murray and the team are working to publish the results now.

"Documentation of the best way to design these projects is so important; there is so much restoration that has to happen in the bay, by the Corps and others," she said. "Wherever there are estuaries that have been diked off and subsided, there is the opportunity to apply these designs."

Process maps way to achieve environmental success

Can the civil works mission be accomplished with sustainable, nature-based solutions?

That is the guiding question of the U.S. Army Corps of Engineers Engineering with Nature initiative.

EWN is defined as the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes.

Since 2010, the EWN initiative has promoted an engineering and science-based portfolio that exemplifies novel ways to utilize natural processes in order to maximize benefits for infrastructure projects, navigation projects and ultimately the public.

Collaboration and partnerships are also critical components of EWN. As such, USACE districts, resource agencies, non-governmental organizations, the private sector and a cadre of international partners form the backbone of a critical network that identifies and implements solutions grounded in the practice of EWN.

As a leading practice, EWN is:

- Holistic – an ecosystems approach
- Innovative – science-based, solutions-oriented
- Collaborative – from design through implementation and monitoring
- Adaptive – supporting system sustainability and resilience
- Socially responsive – engaging stakeholders
- Cost-effective – efficient and value-adding

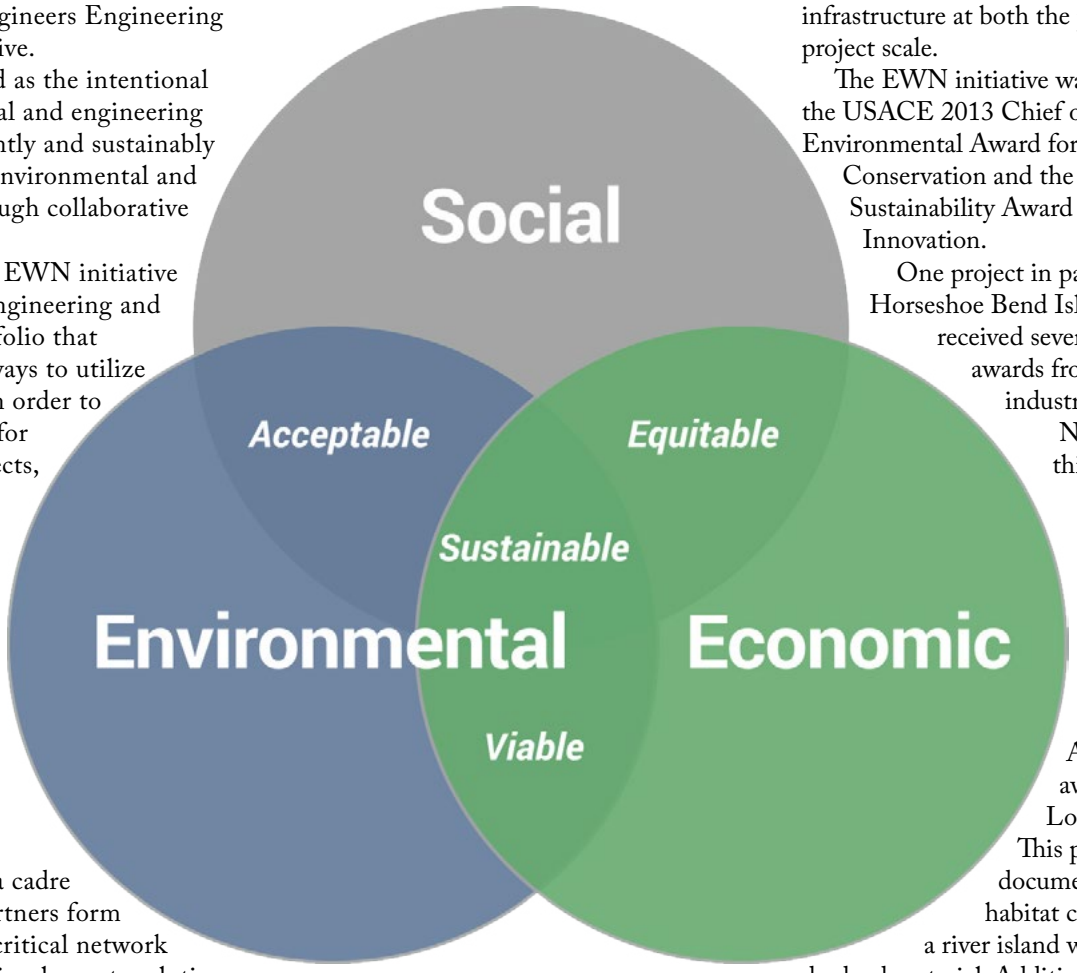
Example Research Projects

Several past and current EWN research projects focus on the sustainable placement of dredged material.

The removal and placement of dredged material is a major component of maintaining navigable waterways. This dredged material is increasingly viewed as a resource and significant research efforts are focused on using it beneficially.

Dredged material is often used to nourish degraded wetlands or created new wetlands in open water.

Dr. Brandon Boyd, team member with other scientists and engineers, is focused on determining the best practices for created wetland design.



"The configuration of a wetland determines the way waves and tides influence physical and biological processes," Boyd said. "We want to optimize their design to improve sustainability and plant diversity, which in turn will create a resilient habitat and ensure the placed dredged material does not wash away and return to navigation channels."

Studies focus on using plants as a means of keeping beach sand from washing away during storms.

Using large wave flumes and a scale model of sand dunes, Mary Bryant, a research hydraulic engineer working with other researchers, determined the optimal spacing of grasses to help prevent dune erosion.

Another major effort within the EWN Initiative is the incorporation of EWN elements into existing infrastructure.

Dr. Burton Suedel, a research biologist, led a team that designed modifications to two breakwater projects in the Cleveland and Ashtabula Harbors. The improved design provides features that create new habitat opportunities for Great Lakes birds, fish and invertebrates.

EWN continues to be recognized formally and informally for its significant contribution to sustainable water infrastructure at both the programmatic and project scale.

The EWN initiative was awarded the USACE 2013 Chief of Engineers Environmental Award for Natural Resource Conservation and the USACE 2014 Sustainability Award for Green Innovation.

One project in particular, the Horseshoe Bend Island project, has received several international awards from the dredging industry. For example, in November 2017, this project was presented with the Dredging and Port Construction Working, Building or Engineering With Nature Award at the DPC awards ceremony in London, England. This project documented the diverse habitat created when a river island was created using dredged material. Additionally, the study concluded that the island modified the river flow, reducing the annual dredging for the adjacent channel by one million cubic yards.

Building on the success of EWN to date, the EWN strategy 2018-2023 will expand implementation by: broadening and deepening engagement and collaboration with colleagues across mission areas and organizations; growing the capability to apply EWN principles and practices at project and system scales; and increasing the number and diversity of EWN applications while communicating effectively about accomplishments and future opportunities.

EWN initiatives, coupled with its noted success, serves to advance the USACE civil works' committment by bringing innovative and environmentally sustainable solutions to the water resource challenges while also contributing to the missions of its partners.

To learn more about the EWN initiative, its researchers and the projects, please visit www.engineeringwithnature.org.

Contributing writers include Brandon Boyd, Jeffrey King and Todd Bridges, ERDC Coastal Hydraulics Laboratory and Environmental Laboratory

Rat Race participants paddle down the Miller River. USACE, New England District, executed controlled water releases on Tully Lake and Birch Hill dams for the popular boat race. More than 200 paddlers participated while 500 spectators watched. *(Photo by Bill Mehr)*

Controlled dam releases thrill recreational white water enthusiasts

By Timothy J. Dugan
USACE, New England District

Controlled releases of water by the U.S. Army Corps of Engineers, New England District, from Birch Hill and Tully Lake dams, both in Royalston, Massachusetts, took place April 14-15 to provide adequate river flows for recreational canoeing, kayaking and rafting on the Millers River.

The Corps of Engineers provided water release flows up to 1,500 cubic feet per second from Birch Hill Dam and 400 cfs from Tully Lake Dam for the weekend events, according to Jeffrey Mangum, project manager.

Various events by local groups are scheduled for Athol-Orange, included the 55th annual River Rat Race on Saturday. Events by local groups scheduled in Erving included the Zoar Outdoor Rafting on Saturday and the Zoar Outdoor Rafting on Sunday.

"There were approximately 200 paddlers in the Rat Race on Saturday with approximately 500 spectators on the route," said Bill Mehr, natural resource specialist at Tully Lake. "There were approximately 30 recreational paddlers that took advantage of the release from Birch Hill."

According to Mehr, three commercial companies scheduled trips on the Millers River off property on Saturday.

"Approximately 20 boats, 100 customers and 20 staff for the three companies participated," he said.

The majority of the events scheduled for Sunday were canceled due inclement weather.

Construction of Birch Hill Dam was completed in 1942 at a cost of $4.8 million. The 1,400-foot-long, 56-foot-high dam can store 16.2 billion gallons of water.

To date, flood damages amounting to more than $80.3 million ($257.9 million, adjusted for inflation) have been prevented.

The state-leased Lake Dennison Recreation Area offers many recreational opportunities, including camping, hiking, hunting, swimming, picnicking, boating, fishing, mountain biking, horseback riding, snowmobiling and cross country skiing and attracts more than 250,000 visitors annually.

For details contact the park ranger staff at (978) 249-4467 or visit the website at: **http://www.nae.usace.army.mil/BirchHillDam**.

Tully Lake Dam, on the East Branch of the Tully River in Royalston, is 1,570 feet long and 62 feet high. Completed in 1949 at a cost of $1.7 million, the dam has a reservoir storage capacity of 7.1 billion gallons of water. Tully Lake Dam has prevented flood damages of $29.1 million ($81.1 million, adjusted for inflation) since it was constructed.

More than 100,000 visitors annually enjoy picnicking, hiking, boating, camping, mountain biking, disc golfing, fishing, hunting and cross country skiing.

For more information about Tully Lake Dam, contact the park ranger staff at (978) 249-9150 or visit the website at: **http://www.nae.usace.army.mil/TullyLake**.

Students rebuild wood duck habitats, study environmental science

For the second consecutive year, science students from Shepherd Hill Regional High School of Dudley, Massachusetts, joined park rangers to improve wood duck habitat at Hodges Village Dam, February 22.

Historically, a small wetland called Stumpy Pond had 8-10 pairs of wood duck boxes in the middle of the pond but over the years, weather, flooding or beavers chewing on them took their toll and the boxes needed to be replaced.

Identifying that need, park hosts from Hodges Village volunteered to make more.

New boxes made, Park Ranger Nicole Giles wanted to try something new by installing them on galvanized steel pipes instead of 4-by-4 pressure treated lumber. The thought being, beavers couldn't chew them and the pipes would deter other predators from climbing up into the boxes.

In February, four science students and their professor, Justin Sauvageau, volunteered for the project. They'd have to endure three hours of rain to carry four wood duck boxes about one mile down the trail to Stumpy Pond on the north end of Hodges Village.

Wood ducks generally nest in tree cavities along the shoreline of the pond. A group of them are usually spotted every summer in a quiet corner of the pond.

Giles wanted to get the boxes out so the ducks could have a chance to check them out this spring.

Despite the weather, the students had a great time. The group discussed behavioral tendencies for wood ducks and how to properly install the duck boxes.

Giles picked out trees that looked healthy enough to support a box and the students used teamwork to install them.

Each student played their own role in the installation process and a few learned how to properly use hand tools. They even got creative in placing their final box.

One small tree was growing out of a small island of roots and organic material creating a mini island. The students were determined to get their last box out on that tree overlooking the water so they used the small step ladder as a bridge to get to the island.

Giles is convinced this will be the favorite box among the ducks.

Professor Sauvageau's students are part of a national high school challenge called Envirothon.

Classes include extensive study of science topics such as water, soil, wildlife, insects and trees, and students present their findings to a panel of judges. Experience and volunteering for hands-on activities in the field are highly encouraged.

Because learning doesn't just come from the classroom, Professor Sauvageau actively gets his students to explore the outdoors and teaches them to apply their knowledge to real world situations. His students are also involved in other projects around Buffumville Lake and Hodges Village Dam.

Members of the water team are going to be testing lake water for pH and nutrient values, and looking at soil classifications in wetland areas.

Other students walked the trails at Buffumville doing a survey for invasive species. The information they provide will help staff determine which areas of the project need the most work in invasive species removal.

The team at Hodges Village looks forward to hosting Shepherd Hill Regional High School students again sometime in the future.

Students work in muddy conditions to install the wood duck boxes at Hodges Village Dam earlier this year. *(USACE, New England District courtesy photo)*

(Photo by Charles Coyle)
Paul Zang, Fort Drum Directorate of Public Works, stands next to the evacuated tube solar collectors at Area 3805, a former fuel storage area.

Solar heating, heat exchange speeds up groundwater remediation process

By Charles Coyle, Wayne Davis & Paul Zang

A team from Baltimore District, U.S. Army Corps of Engineers, and Fort Drum, New York, in partnership with Arcadis, successfully demonstrated an innovative method of using low-temperature heating to speed up remediation of groundwater at a location contaminated by residual fuel hydrocarbons, near a former fuel storage area on the installation.

Application of the solar heating/heat exchanger technology to groundwater is relatively new, and it may be possible to apply this technology to other contaminated groundwater sites to reduce the time it takes to reach clean-up goals.

There are a number of different ways to transfer heat to groundwater, as well as different types of heat sources that can be used. The solar collector/heat exchanger system that was used at Fort Drum is described later in this article.

Another heating method entails using wells equipped with submersible heat tracing and heat tracing powered either by photovoltaic solar panels, or by conventional electrical sources. Waste heat can also be recovered, via heat exchangers and reused. Regardless of the specific method of heat transfer, or source of heat, the general rule for thermal enhanced bioremediation processes is that by increasing the temperature by 10 degrees Celcius, biodegradation rates can be "bumped up" by a factor of approximately 2.

Conventional in-situ thermal treatment entails heating the subsurface to temperatures in the area of 89-100 degrees C, carrying with it relatively high capital and operational costs.

In contrast to conventional ISTT, only a modest increase in temperature is required for TE-bio. The ambient groundwater temperature, at mid-latitudes across the continental U.S. (i.e., northern California to New Jersey), is roughly around 15 degrees C. For TE-bio, a typical "delta T" goal would be to increase the groundwater temperature by approximately 10-15 degrees C. In most cases, TE-bio does not require vapor extraction. Elimination for vapor extraction and off-gas treatment makes TE-bio attractive from a cost standpoint.

During conventional ISTT, vapor extraction and off-gas treatment are almost always required, representing an important cost driver. Other attractive features of TE-bio are that it can be implemented using relatively inexpensive, off-the-shelf equipment that includes low operational costs.

The Arcadis design team for the Thermal In-Situ Sustainable Remediation system that was installed at Fort Drum was led by Cullen Flanders. The system relies on evacuated tube solar collectors to draw in solar heat. The heated glycol/water solution remains within a closed loop system that is circulated from the evacuated tube collectors to the heater wells that are submerged in groundwater. The heater wells (i.e., borehole heat exchangers) function as heat exchangers, transferring heat from the circulation system to groundwater.

The BHEs were constructed by wrapping flexible steel tubing around an inner casing that is inserted into an 8-inch diameter borehole. Except for the 1/10 to 1/25 HP circulation pump, the system does not require any gas or electrical power. For remote sites, or to meet a net-zero energy goal, it's possible to use power from a solar panel/battery system to run the circulation pump.

Located less than 40 miles from the Canadian border and on the leeward side of Lake Ontario, Fort Drum is not what one would consider an ideal location for capturing solar energy. However, the TISR system demonstrates that the technology can be successfully applied at locations with relatively low solar radiation intensity.

Prior to initiating heating, the ambient groundwater temperature at the Area 3805 site was approximately 12 degrees C. Temperatures of 21-26 degrees C were achieved within the area of the borehole heat exchangers. After initiating heating in August 2016, the temperature monitoring data indicates that it took about a month to move from approximately 12 degrees C to 20 degrees C (based on data from a thermocouple located 5 feet from the nearest BHE). Temperatures plateaued after about four to six weeks. The greatest temperature increases were observed at the shallowest depths.

See SOLAR HEAT, page 19

SOLAR HEAT

continued from page 18

For systems that rely on solar energy, heating capabilities may fluctuate depending on seasonal patterns. At locations that experience consistent cloud cover, there may be periods when groundwater temperatures fall below the target range.

Further north at higher latitudes, there will be a decrease in the amount of available solar energy, especially during the winter. At Fort Drum, lake-effect cloud cover reduces the heating capability of the TISRTM system. However, heating resumes as soon as the cloud cover dissipates.

The highest groundwater temperatures at Fort Drum are usually observed during the summer and fall seasons. The elevated temperatures appear to be hastening the rate of decline in total volatile organic compounds in the area of the TISRTM system. Baseline concentrations for total VOCs at a location approximately 5 feet from the nearest BHE, ranged from 17 to 3 parts per million (averaging 12 ppm) from 2008 through 2015.

During the last two sampling events from this same location, individual VOC constituent concentrations were less than their respective regulatory limits.

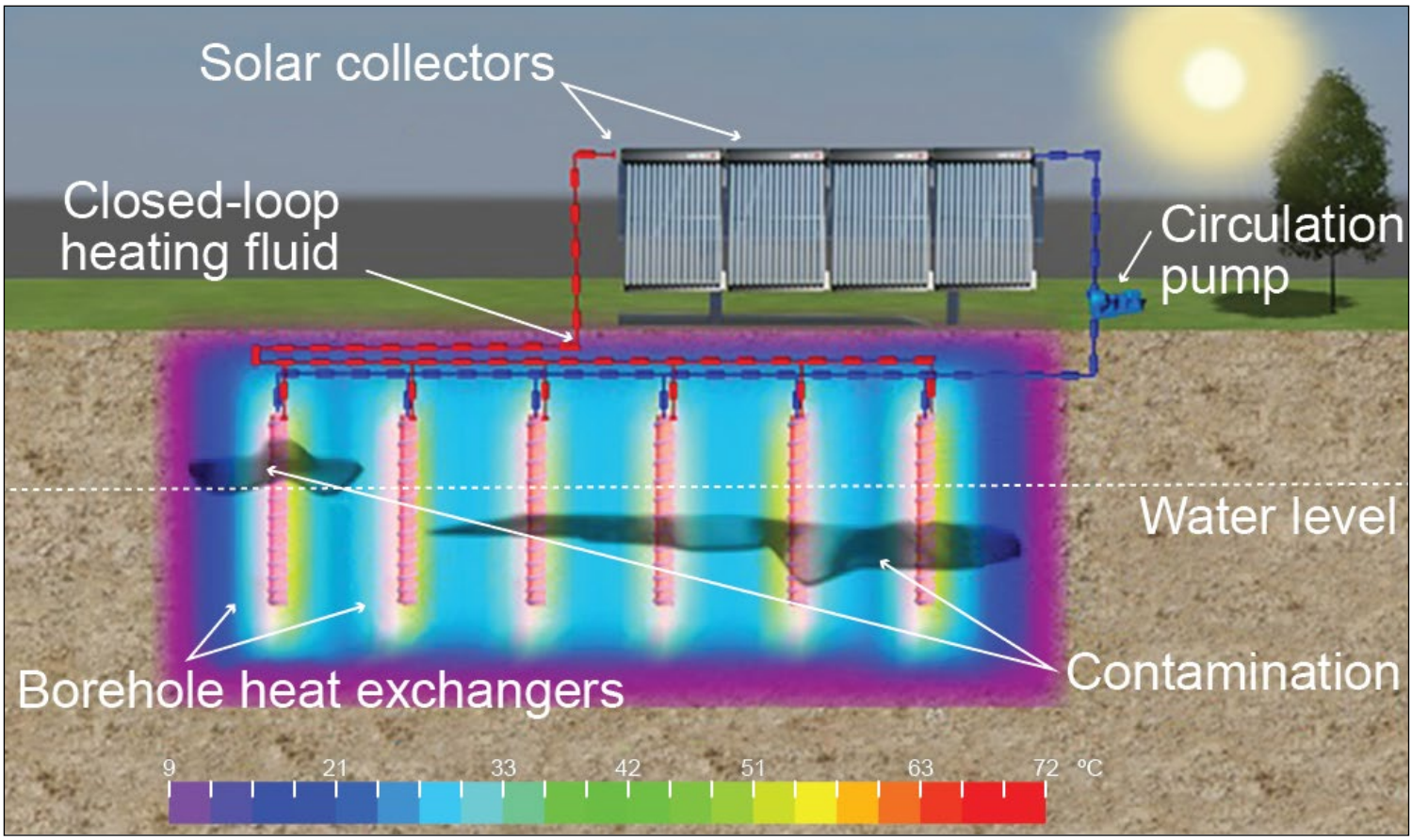
The primary contaminants of concern at Area 3805 include benzene, toluene, ethylbenzene, xylene and trimethylbenzene. TE-bio can also be applied to other types of common groundwater contaminants, including creosote constituents, pentachlorophenol and residual petroleum hydrocarbons. In the presence of supplementary organic substrate, TE-bio can also be applied to chlorinated solvents, munitions constituents (e.g., RDX and TNT); perchlorate and nitrate.

The ideal type of site for implementing TE-bio would have a slow-to-moderate groundwater velocity and shallow-to-intermediate depth to the contaminated zone. After the initial heating period, energy requirements for maintaining the temperature within the target range may be lower than expected. This is because of the insulating properties of the subsurface (i.e., it takes more energy to raise the temperature from ambient to the target range than it does to maintain the temperature within the target range).

Design of these types of systems is dependent on a number of variables, including groundwater velocity; solar radiation intensity; distance between heat/power source and contaminated groundwater zone; and depth to the bottom of the contaminated groundwater zone. The distance between the heat/power source, and the contaminated groundwater zone is important because there will be heat losses during transmission from the source to the contaminated groundwater zone.

For systems employing submersible heat tracing, there will also be losses in electrical power transmission as the length of the heat tracing lines increase. Drilling costs, for installation of heater wells, will increase as the depth to the contaminated zone increases. Spacing between heater wells is another critical design parameter. Usually, the best way to determine spacing is to perform a small-scale field demonstration.

Coyle is an environmental engineer, Environmental and Munitions Center of Expertise, U.S. Army Engineering and Support Center, Huntsville, assigned at Omaha, Nebraska. Wayne Davis is the project manager with the U.S. Army Corps of Engineers Baltimore District and Paul Zang works for the Directorate of Public Works, Fort Drum, New York.



General layout of the TISR system, showing connections between solar collectors and the heater wells.

District restores Missouri waterways, encourages economic development

Story & photo by Trisha Dorsey
USACE, Kansas City District

Navigation is one of the eight authorized purposes of the Missouri River that mandates the Corps of Engineers to manage the navigation channel between Sioux City, Iowa, and St. Louis, Missouri.

The Rivers and Harbors Act of 1945 calls for a 9-foot deep and minimum 300-foot wide channel.

Today, the focus of the Corps' navigation mission is to provide safe, reliable, efficient and environmentally sustainable waterborne transportation system for movement of commerce, national security needs and recreation.

In order to meet this mission, the Corps focuses on repairs to river structures from damage such as ice, debris, scouring and high water velocity.

While several sections of the Kansas City District play a role in the navigation mission, the Missouri River Area Office and River Engineering Section ensure the primary needs of the navigation stakeholders are met.

The Missouri River Area Office, located in Napoleon, Missouri, performs operation and maintenance functions or oversees contracts for small river construction projects. A survey crew inspects the channel depth during navigation flow support season and responds to requests or concerns regarding depth or passability. That office works hand-in-hand with the River Engineering Section located in Kansas City, Missouri, responsible for inspecting and identifying structures which may require repairs, modification or development of a new structure.

During winter months, the river engineering section conducts low water inspections to identify what maintenance actions need to be addressed along the river. Members of the crew note any structures that may be deficient and place them on a list to prioritize and schedule for repair.

To better help the Corps with this process, the district's Geographic Information Systems section and river engineering have teamed up to modernize the 1994 Missouri River Hydrographic Survey books to newer Missouri River Bank Stabilization and Navigation Project maps, complete with GIS layers. This new mapping standard should help improve with efficiency of inspections and reports.

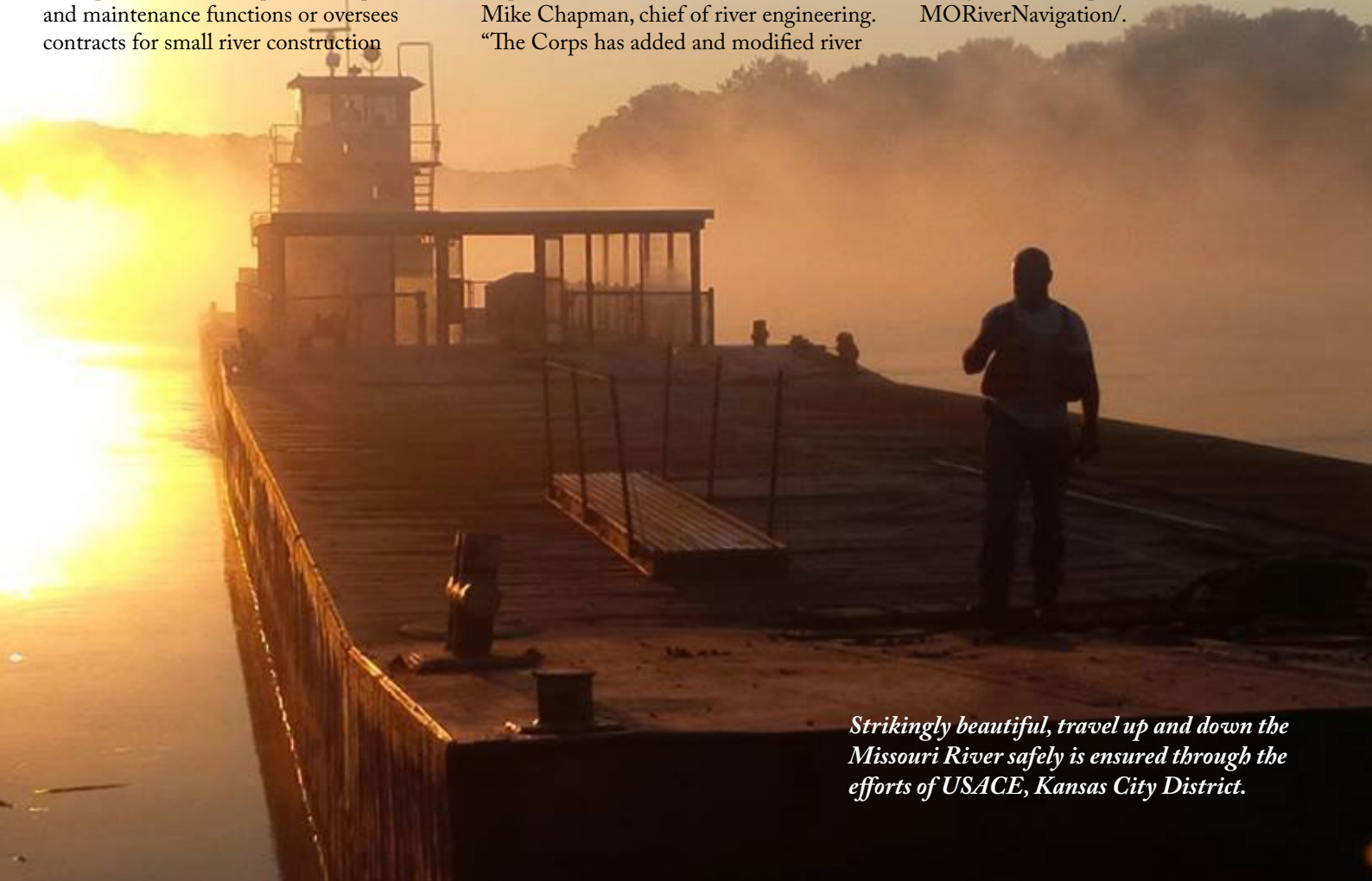
"This is a major tool we use to both inspect and schedule maintenance," said Mike Chapman, chief of river engineering. "The Corps has added and modified river structures since the 1994 data, so these updates now show the full inventory in GIS and can help us report project conditions better than before. These tell us the structure type, elevation, length and more."

To better communicate with navigation stakeholders, the Missouri River Area Office distributes daily boat reports via email when traffic is on the river. Information is also shared frequently on the Missouri River Navigation Facebook page.

Additionally, the Corps of Engineers, Northwestern Division hosts an annual navigation meeting to bring together stakeholders and federal agencies from all over the basin to discuss relevant topics and the outlook for the upcoming season.

"We are also working on a contract framework to shorten procurement time for maintenance to structures," said James Rudy, Missouri River Area Office operations project manager. "And looking ahead, if weather predictions are correct, we expect full flow support this year."

To more about the Corps of Engineers navigation mission, visit the Kansas City District website at http://www.nwk.usace.army.mil/Missions/Civil-Works/Navigation/ or https://www.facebook.com/MORiverNavigation/.



Strikingly beautiful, travel up and down the Missouri River safely is ensured through the efforts of USACE, Kansas City District.

Dredging project renourishes habitat for endangered bird species

Story & photo by Sara Corbett
USACE, Charleston District

In between Folly Beach and Kiawah Island lies an isolated island where thousands of birds flock and humans are not allowed.

While this might sound like the beginnings of a scary movie, it's actually Bird Key Stono Heritage Preserve, a 35-acre bird sanctuary that the U.S. Army Corps of Engineers, Charleston District, recently renourished.

"There were thousands of birds flying all around us," said Alan Shirey, environmental engineer. "It was like a scene from 'The Birds,' except they weren't attacking us, they were more interested in their lunch that was being pumped out."

Historically, the district has placed fill on Bird Key Stono when dredging the Folly River Federal Navigation Channel since it's the least cost disposal site for the operations and maintenance dredging of Folly River.

"This project is a win-win," said Shirey. "We are able to be good stewards of the taxpayers' money since pumping the dredged material onto Bird Key is the cheapest way to dispose of the material and protects the environment by increasing the footprint of Bird Key."

There are several government agencies that work together to protect the bird sanctuary.

Bird Key Stono is listed as a U.S. Fish and Wildlife Critical Habitat for Piping Plover and protected under the Endangered Species Act, but it is owned by the state of South Carolina and maintained by the South Carolina Department of Natural Resources. So the Corps coordinated closely with these organizations to ensure that sand was placed in the best locations for the upcoming bird nesting season.

Renourishment on Bird Key Stono was important after the island suffered significant erosion from Hurricane Irma, leaving little room for birds to live and nest. Forty-thousand yards of material was needed to replace the lost sand; approximately 4,000 dump trucks which cost $300,000 and was 100 percent federally funded by the Corps.

The cutterhead dredge, Cherokee, was used to suck up sand and water from the floor of the Folly River then pumped onto Bird Key Stono through pipes and, finally, bulldozers shaped the sand.

"It's a rare opportunity for us to renourish Bird Key Stono," said Shirey. "But I know that when we do have the chance, that the project will make a long-lasting impact to the birds and wildlife that reside on Bird Key Stono."

The Corps planned the dredging project around the spring nesting season so that the birds would have a new habitat before the season starts.

JOINING FORCES TO CLEAN UP TRIBAL LANDS

Story & photos
by Elizabeth Lockyear
USACE, Albuquerque District

Contractors with Britannia Environmental Consulting and Silent Hawk Environmental conduct a visual search for munitions on one of the Isleta Pueblo sites being remediated. Tribal lands such as these were used by the Department of Defense as training ranges for pilots during the onset of World War II.

ALBUQUERQUE, New Mexico – Beginning in 1993, Congress has annually set aside money to mitigate the environmental impacts of past actions by the Department of Defense on tribal lands.

The creation of the Native American Lands Environmental Mitigation Program recognized that the Defense Department has a legal obligation to address past military activity on tribal lands; that the government has Federal Trust Responsibilities (especially the government-to-government relationship with tribal nations); and the importance in engaging impacted tribes in the cleanup plans to support and build their capacity. Tribal engagement also respects the government-to-government partnership with a tribe.

While there are several DOD programs focused on cleaning up impacted land, NALEMP is unique in the support, consultation and collaboration with, and training to, the impacted tribe provided.

Beyond cleaning up and reducing the environmental damage to the impacted land, the program supports the tribe in developing its capacity for independent management of future environmental projects.

The program also provides training in project oversight and hazardous operations management.

Through engagement with the tribe, traditional ecological knowledge can be incorporated into the project design. The tribes' access to subsistence items, cultural activities can also be addressed.

"We sincerely enjoy working with the USACE NALEMP program because without their partnership, our lands would not be cleaned up," said Mark Dixon, director of Isleta Pueblo's Department of Natural Resources. "Although there is still much work to be done, the continued success of the program at the tribal level can only be attributed to the willingness of the USACE's trust responsibility. The capacity building and environmental remediation on tribal lands would not be possible without this program."

NALEMP consists of three main players: the tribe, the Office of the Secretary of Defense and the Corps of Engineers.

Once a site has been determined eligible for the program, and funding is available, the tribe and USACE enter into a cooperative agreement which addresses the problems attributable to past DOD activities.

Nationally the Defense Department has executed more than 260 CAs with more than 55 tribes totaling more than $114 million through NALEMP.

Since 2000, the USACE, Albuquerque District has executed CAs with seven Pueblos in New Mexico for a total amount of approximately $17 million.

James Glover, environmental scientist, Britannia Environmental Consulting, points out a feature on a practice bomb held by Mark Dixon, director of Isleta Pueblo's Department of Natural Resources. The bombs was one of many used to train pilots during the 1940s.

The result? More than 7,600 acres were visually surveyed and cleared through 2017.

The Albuquerque District has had CAs with the Acoma, Isleta, Laguna, San Felipe, Santa Ana, Santo Domingo pueblos and the Zuni tribe. The first NALEMP project in the Albuquerque District was with the Laguna Pueblo in 2000.

"We've had New Mexico tribes participating since," said Monika Sanchez, the District's NALEP program manager.

"We work more with munitions debris sites than any other [USACE] district in the NALEMP program," Sanchez said. This stems from the many DOD precision bombing ranges constructed for training during the 1940s.

According to Sanchez, only the Alaska District works with more tribes.

The major advantage of the NALEMP over other DOD restoration programs is that rural sites can be addressed expediently and that allows the pueblo or tribe to have more input through consultation in decision making and the cleanup process.

"This program is very unique because our tribal partners are able to take control of their site remediation and build the technical capacity for this unique type of work within the pueblo, which I think is wonderful," Sanchez said. "We couldn't accomplish so much without our great partners who are willing to mentor each other. They share lessons learned with other program participants, which is key to the success of our program."

Consider the case of Isleta Pueblo.

"Isleta has 15 sites that have been addressed and eight sites that still need to be addressed," Sanchez said. These sites were either formally used by the Defense Department or were impacted by undocumented defense-related activities (such as aircraft crash sites). The amount of impacted land is estimated to be over 29,000 acres, most of which is in remote and sparsely populated areas of the pueblo.

Beginning in 2001, the Pueblo of Isleta and USACE entered into cooperative agreements and the pueblo has been provided more than $3.7 million for investigations and clearance activities. The remaining sites include an estimated 10,000 acres and will be cleaned up as congressionally provided funding allows.

To date, the pueblo, through NALEMP, has successfully remediated one site of approximately 6,000 acres as well as 4,200 acres of another nearly 19,000-acre site.

In addition to its successes in remediating tribal lands, the NALEMP program has also brought benefits to the Albuquerque District.

"The presence of a robust NALEMP at the Albuquerque District, especially the program's emphasis on direct participation by a tribe in project execution, acted as a foundation for the district's successful tribal program and the establishment in the district of the USACE Tribal Nations Technical Center of Expertise," observed Ron Kneebone, director of the TNTCX.

Systematic approach leads to efficient, effective sediment management

The U.S. Army Corps of Engineers manages about 200 million cubic yards of dredged material annually for the navigation mission at a cost of about $1 billion.

The National Regional Sediment Management program was initiated in 1999 to take a regional or systems approach to address sediment related issues and support sustainable solutions across multiple projects in coordination with partnering organizations, governments and stakeholders.

RSM strategies, along with the data and knowledge it makes available, support the USACE Navigation, Flood Risk Management and Ecosystem Restoration missions, as well as provides valuable information for emergency management operations.

To date, USACE districts from all divisions, the Engineer Research and Development Center and the Institute for Water Resources have participated in the national RSM program in collaboration with other federal and non-federal agencies, stakeholders and partners, academia and non-governmental organizations.

Because sediment related challenges and their solutions vary, regional RSM teams have been established across the nation to address region specific challenges to managing sediments.

Recently, about 60 representatives from across USACE met at the Mobile District to present their efforts to the RSM community. The goal was to better understand how RSM principles and practices apply in different regions, identify each region's specific challenges and share solutions by determining if these challenges have been overcome by other regions.

District teams also discussed their methods for implementation, concluding that the success of RSM requires communication – within the district and region, both internally and with stakeholders.

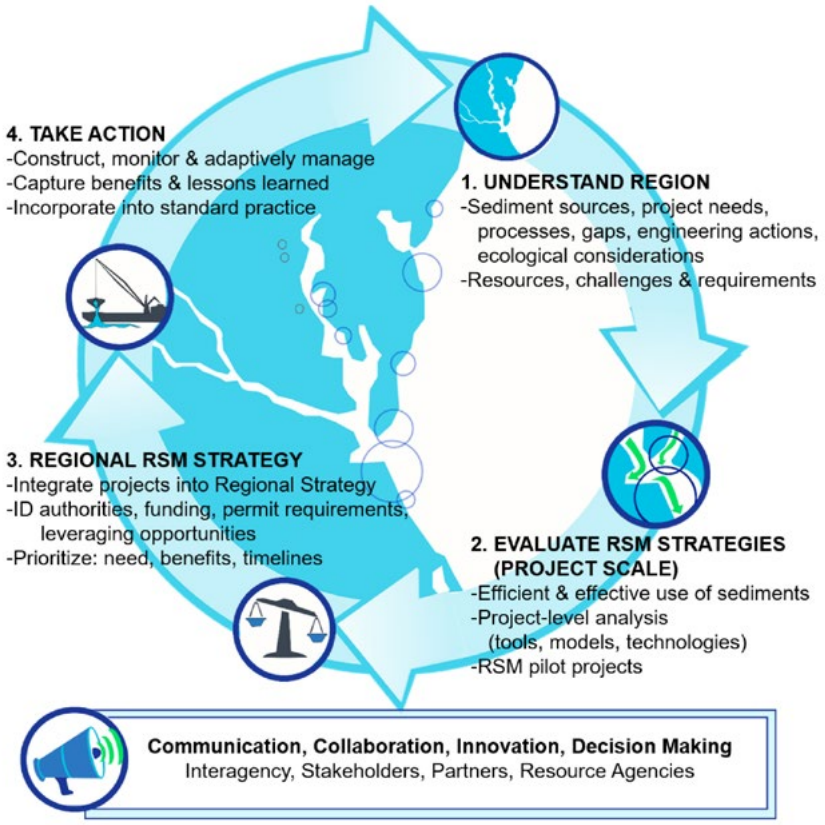


Figure 1. The Regional Sediment Management Process

At the meeting, individuals and their teams were recognized for their successes and accomplishments in implementing RSM.

At the meeting, Wynne Fuller and Larry Parson, Mobile District; Tom Smith, Honolulu District and Jeff Lillycrop, ERDC were recognized for Lifetime Achievement. Dr. Paul Boyd, Omaha District, was recognized as the RSMer of the Year. District of the Year honors went to the Portland District. The Mobile District was recognized for Exceptional Team Achievement. The Philadelphis District was recognized for Outstanding Collaboration and Outreach; and, Honolulu District was awarded for Innovative Technical Achievement.

The national RSM program works with USACE districts and divisions, research and development programs, stakeholders, partners, other federal and non-federal agencies, academia and non-governmental organizations to implement its principles and practices.

To learn more about the National RSM Program, visit **http://rsm.usace.army.mil/**.

Contributing writers include: Brandon M. Boyd, Katherine E. Brutsché and Linda S. Lillycrop from the U.S. Army Engineer Research Development Center.

The Regional Sediment Management panel of experts answer questions about implementation, challenges and the history and future of RSM practice. From left to right are: Jeff Lillycrop, Civil Works and Navigation technical director; Wynne Fuller, Operations division chief; Nate Lovelace, Dredge Material project manager; Larry Parsons, RSM co-lead and senior environmental specialist, all of Mobile District; and Linda Lillycrop, RSM program manager. *(Photo courtesty of Mobile District)*

Prescribed burns help maintain, enhance quality of wetlands, aquatic resources

Story & photo by Sara Corbett
USACE, Charleston District

Striving to balance responsible economic development with environmental protection, the U.S. Corps of Engineers, Charleston District, requires property owners or businesses to avoid and minimize potential impacts to wetlands or other waters to the maximum extent practicable.

Compensatory mitigation is used to offset the unavoidable loss of aquatic resource functions and ecological services on the project site.

"The overall goal of compensatory mitigation is to maintain and improve the quality of aquatic resources in a watershed," said Nat Ball, project manager. "For example, if a property owner needs to fill wetlands in order to develop a new residential or commercial facility, they must submit a mitigation plan that restores, enhances or preserves other aquatic resources within the same watershed as the project site."

There are two ways that an applicant can satisfy the requirement for compensatory mitigation: buying credits from an established mitigation bank or preparing and implementing a permittee-responsible mitigation plan.

When Boeing approached the Corps about expanding their existing facility, it was clear that the proposed project would have substantial impacts to U.S. waters. At the time, there were two mitigation banks located within the Cooper River watershed, but the loss of more than 150 acres of aquatic resources on the Boeing site would require the purchase of all of the available mitigation credits within the watershed. There weren't enough available to offset their impact, so they would also have to implement a permittee-responsible mitigation plan.

Boeing had to get creative and find their own permittee-responsible mitigation site. Working with several environmental and resource agencies, they were able to identify and purchase nearly 4,000 acres of land, including more than 2,200 acres of land in the privately-owned Fairlawn Plantation.

"Fairlawn Plantation is surrounded by the Francis Marion National Forest," said Ball. "Approximately 500 acres of wetlands at Fairlawn were restored about 10 years ago to create a mitigation bank. Boeing's proposed mitigation plan would add to this acreage of restored wetlands, and would turn the entire 2,241 acres of wetlands and uplands over to the U.S. Forest Service for public access and management as part of the national forest."

Restoring the property back to its natural state is no easy task so Boeing is working with The Nature Conservancy to successfully restore it.

"Fairlawn was historically a longleaf pine forest," said Eric Krueger, director of science and stewardship for TNC. "A healthy longleaf pine ecosystem consists of mature pine trees and low shrubs, like blueberries, and grass and wildflower floor covers. When a longleaf pine forest is neglected for long periods of time, mid-story hardwoods, such as sweet gums and water oaks, take over and choke out the floor covering because they don't get any sunlight. Our goal for this restoration is to get rid of the mid-story hardwoods, and reduce industrially planted pines back to natural densities."

Prescribed burnings, herbicide and logging are some of the methods that the Conservancy included in the restoration plan they created for this project.

"Restoration overall is progressing excellently and we are on track with the plan," said Krueger. "We've had some challenges, particularly with how wet it's been over the last few years, but the bulk of the logging and targeted herbicide work is completed. Next up is the second prescribed burning and continued planting of longleaf pine trees."

Boeing is three years into the restoration project with approximately two more years of work until it's complete. Boeing submits an annual monitoring report to the Corps outlining the work they have done on their mitigation sites and their plans for the next year.

The Nature Conservancy goes to Fairlawn Plantation twice a year to monitor the property for tree density, an increase in grass cover and low shrubs, and a decrease in mid-story hardwood trees.

Boeing's efforts and success have paved the way for other businesses to purchase additional land and to perform additional mitigation activities at Fairlawn plantation. Since then, the South Carolina Ports Authority, Palmetto Railways and Mercedes-Benz have each purchased tracts at Fairlawn Plantation.

District offers junior rangers unique opportunity to serve, protect environment

By Ann Marie R. Harvie
USACE, New England District

When the warm weather finally reaches New England, children in the region will have a unique opportunity to experience what a Corps of Engineers' park ranger is like.

This summer, several USACE, New England District recreation sites will host free junior ranger programs for children ages 6-12.

The objective is to develop youth awareness of the environment and the role the Corps plays in managing this environment at the lakes. It also solicits and encourages their assistance in helping Corps rangers serve the public and protect lands and natural resources.

The Corps of Engineers runs the junior ranger program nationally. Other agencies, such as the National Park Service, have similar programs.

Joan "JoJo" Cyr, Robert Hanacek and Tom Wisnaukas joined Rick Magee, a retired Corps' park ranger, to create the junior ranger program for the New England District at the Thames River Basin in 1985.

"The goal of the junior ranger program was to help school children from grades 4 to 6 understand the flood risk management mission of the Corps in New England," said Magee.

Although the junior ranger program has evolved over the years, the overall messages of environmental stewardship and the mission of the Corps' park ranger have stayed the same.

Up until 2018, the junior ranger program at Cape Cod ran for five days over the summer. There, first year participants would learn about park rangers, environmental stewardship, water safety, ocean exploration and the history of the Cape Cod Canal.

During their second year, the junior rangers would learn about soil, water, whales, pollinators, orienteering (until 2016) and engineering bridges.

This year, the youth will be offered a junior ranger booklet they can either download from the Canal website or pick up at the visitors' center.

Program participants can now earn junior ranger patches by completing a certain number of activities in the booklet, participate in a scavenger hunt and attend one or two ranger-led programs, depending on their age.

"By creating a booklet, we will be able to reach a much larger demographic, especially tourists who come in all the time looking for junior ranger opportunities for their littles," said Elisa Carey, program coordinator.

West Hill Dam's Viola Bramel has been running its program since 1991.

"We hold two sessions in late July for five days each Monday through Friday, and candidates must complete all five sessions to graduate," she said. "We have level 1, level 2 and advanced ranger programs."

At West Hill Dam, level 1 junior rangers study subjects that include: duties of a Corps ranger; natural resource management; flood reduction/water quality resources, forest resources and water safety.

"We have the kids do projects throughout the week," she said. For example, we'll have them rate the river quality base and learn whether other bodies of water are safe for swimming or wading by catching and releasing invertebrates such as crayfish. Keying out the quantity, they can tell the pollution status of a river or pond. They also practice a water safety rescue demonstration.

According to Bramel, level 2 junior rangers have two choices to earn their badge. The students can either assist with teaching the level 1 rangers for the entire session or they can attend five programs out of all the West Hill Dam Interpretive Programs offered during the summer. The children must attend programs that teach natural resources, forestry, fish and wildlife, park and recreation and cultural resources.

"New for 2018, we have given level 2 points for attendance at local fairs and Corps community exhibits," Bramel said.

Both levels at West Hill Dam take up to 35 children for each program, and the slots fill up quickly.

The advanced junior rangers receive a workbook filled with science experiments and other activities that they must complete to earn their final special patch and pin.

Many advanced junior rangers go right into the Corps' volunteer program, which starts at age 14.

"They keep busy volunteering with groups such as scouts for National Public Lands Day, community service, etc.," she said.

Buffumville Lake ran the junior ranger program created by Magee and his team until Dave Stiddem arrived with his Nashville District program.

The last junior ranger program took place at the project in 2009 due to dwindling participation.

"We began sign-ups for 2010, but we canceled because only two students enrolled," said Park Ranger Jamie Kordack.

Park Ranger Nicole Giles, who helped with past junior ranger programs throughout the district, hopes to revive the program this summer.

"We offer many different programs at Buffumville and Hodges and I thought the kids should get credit for attending," she said.

Cape Cod Canal Park Ranger Elisa Carey hosts a leaf presentation for the Junior Ranger Program. (Courtesy photo)

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Junior rangers conduct a science experiment during a program held by the Cape Cod Canal.

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Giles created the passport for junior rangers to keep track of the programs they attend with a few extra activities inside.

"We are offering many programs and subjects ranging from dam tours to pollinators to full moon and nature walks," she said. "It gives them incentive to explore and learn about the park and what we do. The program is very flexible."

The positive impacts of the New England District programs is illustrated by the number of former junior rangers who return as adults to participate in annual clean up events, such as Earth Day and National Public Lands Day.

Often, they come back to volunteer their time to help nurture the next generation.

"At West Hill Dam, we have 47 completed Eagle Scout projects that benefit our public lands," Bramel said. "All of those Eagle Scouts were junior rangers.

"We've had graduates who went on to become local firefighters and police officers," she said. "Now they are signing up their children. I can't tell you how gratifying it is to see the cycle continue."

West Hill Dam Park Rangers Ron Woodall and Viola Bramel speak to a student during a local fair. Junior rangers who visit Corps Educational Booths or attend interpretative programs at the dam receive credit towards graduation. (New England District file photos)

District contractor, Cashman Dredging, performs work on the Housatonic River.
(Photo by Erika Mark)

Project replenishes, revives eroded beach

District continues tradition to maintain, improve Housatonic River Federal Channel

By Ann Marie R. Harvie
USACE, New England District

The New England District team and its contractor, Cashman Dredging and Marine Contracting Company, LLC of Quincy, Massachusetts, completed dredging a portion of the Housatonic River Federal Channel in Connecticut two months ahead of schedule. Sponsored by the state of Conneticut, the project, originally estimated to cost $9.3 million, came in under budget.

"The project was finished in December," said Erika Mark, project manager. "Our dredge window was October 1 through March 31, so that is the time frame the contractor had to get the work done. They began dredging in mid-October and finished in December so there was plenty of time to spare."

A total of 273,881 cubic yards of clean, fine grain sand was dredged from the channel. Additionally, 228,064 cubic yards of that material was placed onto Hammonasset Beach State Park in Madison, Connecticut, to nourish the eroding beach, located 33 miles from the dredge site.

Besides Mark, other team members contributing to the project's success included retired project manager Jack Karalius, Valerie Cappola, Fred Pike, Ray Goff, Megan Cullen, Jeff Preston and Jeff Gaeta.

Well familiar with the history of the Housatonic River with the first project occurring in 1871, the New England District team continues the tradition of making improvements to facilitate navigation for commercial and recreational vessels.

BATS, BATS, BATS

Post secures abandoned mines, preserves bat habitat

Story & photos by Mark Schauer
Yuma Proving Ground, Arizona

Unlike most Army installations, U.S. Army Yuma Proving Ground's primary purpose is not to train troops, but to conduct natural environment testing on virtually every piece of equipment used by Soldiers.

Also atypical is the presence of abandoned mines in numerous locations across the proving ground's more than 1,200 square miles of range space.

Prior to Yuma Proving Ground's existence, Southwest Arizona was home to all manner of mining — gold, silver, copper, lead and mercury — and there are more than a dozen disused shafts and mining sites scattered about the installation. Some prospecting digs penetrate the earth only a few feet, while other more elaborate works snake hundreds of feet, with multiple horizontal turns that plunge into deep, sometimes flooded vertical shafts.

Abandoned for at least a century and frequently excavated out of soft and unstable rock, the mines are isolated and cool, perfect roosting for the 11 species of bats known to call the installation home.

They are also incredibly dangerous to anyone who trespasses within the proving ground's boundaries — stories abound throughout the American West of fatal or near-fatal mishaps involving abandoned mines. From treacherous drops to insufficient oxygen, old mines are no place for casual desert wanderers to tread.

"They're hazardous to people, but really good habitat for wildlife," said Daniel Steward, YPG wildlife biologist. "Our goal is to keep people safe and keep the habitat available for wildlife."

As such, personnel from YPG and the Arizona Game and Fish Department recently outfitted several of the more dangerous mine openings with barriers, preventing unauthorized access while allowing bats to come and go. They finished the work quickly to to minimize impact on the creatures before the spring mating season.

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"The worst thing you can do to a bat is walk into its home during the maternity period and disturb it," said Dr. Joel Diamond, a research ecologist for Arizona Game and Fish. "They'll vacate the roost, and that is what has happened in most of our major care systems in Arizona. YPG is a functional refuge since there is no recreational activity here."

All mines are different and the team had to use different methods to close off each.

In one mine shaft that had been drilled through solid rock, they installed a heavy steel gate, with resin covering the bolts that hold it securely in place.

In a more complex mine elsewhere on the range with an irregular opening in soft rock that had partially caved in, the team draped a massive single strand of wire-cable mesh that will serve to block human access as the mound shifts and erodes over time.

With this done, the team emplaced electronic data loggers that will record bat calls from sunset to sunrise over the next six months, allowing the officials to track what species of bats are using the mine and in what magnitude.

"We want to determine as soon as possible whether bats are still using it," explained Steward. "Any time you put an alteration on a mine, it will affect the way bats use it."

Fortunately, when Steward placed the data logger in one of the mines there was ample evidence that it was still hosting a large bat population: there were scattered areas of inches-deep guano, full of discarded pieces of insect wings.

Healthy bat populations are enormously beneficial to the community as a whole: a pregnant female bat can eat more than double her body weight in insects every day.

"Yuma is a big agricultural producer," Diamond said. "In the absence of these bat populations, you would need a lot more pesticides on the crops."

As average temperatures increase, so do insect populations, making bats even more necessary than ever.

Officials have observed a long-term trend of subtropical bat species migrating north.

"Over the past 50 or 60 years, we've seen animals that didn't winter in this latitude do so now," Diamond said. "They can now forage all year long. Years ago there were enough cold snaps to kill off the insect population every year, but no more."

Though home to anywhere from 60 to 120 unique military tests per week, YPG actively strives to minimize the footprint of its activities, particularly around desert washes.

"We take great pains to avoid washes whenever we're doing any kind of construction or testing," Steward said. "By doing that we protect the forage habitat of a plethora of species."

In addition to bats, YPG is home to a wide variety of wildlife. It is home to one of the healthiest populations of bighorn sheep in the state, and was specifically chosen as a place for the once-critically endangered Sonoran Pronghorn to recover from the brink of extinction.

"YPG provides a net benefit to a variety of wildlife species," Steward said. "While we're using our land intensively, we're also intensively managing our natural resources."