
Accomplishments of the

# NAVY ENVIRONMENTAL SUSTAINABILITY DEVELOPMENT TO INTEGRATION PROGRAM

# 2021 YEAR IN REVIEW REPORT

**AVAILABLE FOR DOWNLOAD AT:**
**HTTPS://EPL.NAVFAC.NAVY.MIL/NESDI**

## MISSION OF THE NESDI PROGRAM

The mission of the NESDI program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes and materials; and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Navy readiness and lethality. The program seeks to accomplish this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

The NESDI program is the Navy's environmental shoreside Research, Development, Test & Evaluation (RDT&E) program. The NESDI technology demonstration and validation program is sponsored by the OPNAV N4I Installations Division and managed by the Naval Facilities Engineering Systems Command (NAVFAC) out of the Engineering and Expeditionary Warfare Center (EXWC) in Port Hueneme, CA. The program is the Navy's complement to the Environmental Security Technology Certification Program which demonstrates and validates technologies important to the Department of Defense tri-services and the Department of Energy.

## CONTENTS


MISSION OF THE NESDI PROGRAM . . . . . 1

A WORD FROM OUR PROGRAM MANAGER . . 4

THE NUMBERS . . . . . 6

THE NESDI PROGRAM PROCESS . . . . . 7

PROJECT ACCOMPLISHMENTS . . . . . 10

- Non-Isocyanate Polyurethane-Free Formulation Coatings for Aircraft and Support Equipment (project no. 525) . . . . . 10
- In Situ Treatment of 1,4-Dioxane using Enhanced Biodegradation (project no. 545) . . . . . 11
- Demonstrating Effectiveness of Novel Treatment Technologies for the Removal of Poly- and Perfluoroalkyl Substances from Groundwater (project no. 555) . . . . . 11
- Development and Demonstration of a Portable, Temporary Barrier to Aid in Cargo and Equipment Inspections to Prevent Brown Treesnake Dispersal (project no. 561) . . . . . 12
- Evaluation of Various Real-Time Monitors to Accelerate On-Site Analysis for Vapor Intrusion (project no. 568) . . . . . 12
- In-Pipe Stormwater Treatment System (project no. 576) . . . . . 13
- Demonstrating the Use of a Novel, Hybrid Polyelectrolyte/Hydrophilic Polymer for In Situ PFAS Treatment Applications (project no. 577) . . . . . 13
- Mesocosm Field Testing of In Situ PFAS Treatment Trains (project no. 578) . . . . . 14
- Development and Implementation of Methods to Reduce Sealant Waste in Fleet/Depot Level Operations (project no. 580) . . . . . 14
- Assessment of Cadmium Alternatives for Connector Applications (project no. 581) . . . . . 15
- Sensor Interface and Infrastructure for Monitoring (SIIM) (project no. 582) . . . . . 16
- Low-profile Integrated Porous Pretreatment Swale (LIPPS) for Metals Treatment in Industrial Areas (project no. 583) . . . . . 16
- Real-Time Multi-Contaminant Detection System (RMDS) (project no. 584) . . . . . 17
- High Efficiency Media for Metals Removal in NPDES Discharges (project no. 585) . . . . . 17
- Demonstration and Application of Amendments Targeting Comingled Organics and Metals in Sediments (project no. 594) . . . . . 18
- Demonstration of a Signal Activated Bottom Lander Trap (SABL) (project no. 595) . . . . . 18

RESULTS OF OUR FY21 NEEDS SOLICITATION . . . . . 20

OUR EIGHT FY21 "NEW START" PROJECTS . . . . . 25

- Alternative Oil Skimming Technologies for Afloat Oil Spill Response: Down-selection and Demonstration at a Navy Port (project no. 597) . . . . . 28
- Minimizing Hazardous Waste from Expired Paints and Associated Solvents from Ships Supply (project no. 598) . . . . . 29
- Pathways for Addressing Opportunistic Premise Plumbing Pathogens at Navy Installations (project no. 599) . . . . . 30

Advanced Anodize Repair (project no. 600) . . . . . 30

Chronic Toxicity and Bioaccumulation Evaluation of Multiple PFAS for Benthic and Pelagic Species Relevant to Marine Ecological Risk Assessment (project no. 601) . . . . . 34

Closed Loop, In Situ Soil Flushing at PFAS-Impacted Source Zones (project no. 602) . . . . . 35

Characterization of Antifouling Paint and Environmental Loading with Navy Dome System (project no. 603) . . . . . 38

An Integrated Navy Approach to Estimate Risk and Cleanup Goals for Radionuclides Associated with Buildings at Current and Former Navy Installations (project no. 604) . . . . . 40

**NESDI BY THE NUMBERS** . . . . . 41

**PROJECT CLOSEOUTS** . . . . . 42

Demonstration of Non-Chromated Adhesive Bond Primer for Metal Repair Bonding (project no. 500) . . . . . 43

Dry Dock Sediment Management (project no. 503) . . . . . 44

Demonstration of New Strategies for Enhanced Monitored Natural Recovery (EMNR) at Navy Sediment Sites (project no. 522) . . . . . 44

Structure-function Relationship and Environmental Behavior of Per- and Polyfluorochemicals from Aqueous Film-forming Foams (project no. 527) . . . . . 45

Technology Evaluation and Sampling for Treatment of Perfluorochemicals (project no. 534) . . . . . 45

Stable Carbon Isotopes for Tracing In Situ RDX Remediation (project no. 537) . . . . . 46

Utility Vault Water Treatment (project no. 541) . . . . . 47

Sewer Gas Elimination Technology (project no. 548) . . . . . 47

Demonstration of Optimized non-NMP (n-Methyl-2-pyrrolidone) Solvents for Immersion Chemical Depainting (project no. 549) . . . . . 48

Initiation Decision Report of Laser Coating Removal on Naval Aircraft Components (project no. 557) . . . . . 48

Background Analysis and Tracer Study to Identify Metal Contaminant Source Contributions to Stormwater Runoff (project no. 559) . . . . . 49

Source Metal Particle Removal for Stormwater Compliance (project no. 566) . . . . . 50

Business Processes and Requirements Enabling Technology Integration (project no. 567) . . . . . 51

**OUR FY22 SCHEDULE** . . . . . 52

**PROMOTING OUR SUCCESSES** . . . . . 54

**FOR MORE INFORMATION** . . . . . 56

## A WORD FROM OUR PROGRAM MANAGER

Ken Kaempffe

**Welcome to the Navy Environmental Sustainability Development to Integration (NESDI) program's fiscal year (FY) 2021 Year in Review report. This year's report highlights our efforts to manage the NESDI program in spite of the challenges resulting from the COVID-19 pandemic.**

Our research projects continued to be delayed by the impacts of COVID-19. Major difficulties included the inability to travel to project sites, the inability to work as planned in laboratories, and difficulty obtaining materials due to supply chain disruptions. These difficulties were overcome with application of innovative workarounds, including using local civilian and contractor personnel for on-site work and adjusting project scopes so that more paper/table top studies were performed vice on-site work. Principal Investigators and partner organizations were able to travel to field sites during several time periods in FY21. However, there continues to be a significant backlog of field work that will persist into FY22.

We continue to conduct our research to the maximum extent possible given the continuing twists and turns of the COVID-19 pandemic.

In spite of the pandemic many projects had significant successes. I would like to draw your attention to the following projects of which more details can be found on pages 10-18 in this report.

One successful project that was completed in FY21 is NESDI project no. 555: Demonstrating the Effectiveness of Novel Treatment Technologies for the Removal of Poly- and Perfluoroalkyl Substances from Groundwater. This project evaluated a wide selection of sorbents and resins in batch and column adsorption tests for the treatment of groundwater impacted by PFAS. Based on these studies, there is presently no all-encompassing treatment approach for PFAS-impacted groundwater, as variability between site conditions could potentially make one treatment approach less favorable than another. Results of the study will be used by Remedial Project Managers (RPM) when deciding on treatment approaches at actual sites.

NESDI project no. 581 (Assessment of Cadmium Alternatives for Connector Applications) established two Limited Purpose Cooperative Research and Development Agreement (LP-CRADA). One is with Glenair to obtain no-cost Electrical Wiring and Interconnect System (EWIS) components plated with Glenair's proprietary tin-zinc finish. The second is with Amphenol, Eaton, Radiall and TE Connectivity—all of whom are members of the Connectors Manufacturer Group Consortium. The project is assessing the performance issues surrounding zinc-nickel and other cadmium-alternative plating technologies for EWIS components.

NESDI project no. 583 (Low-profile Integrated Porous Pretreatment Swale (LIPPS) for Metals Treatment in Industrial Areas) resulted in three EXWC engineers being granted a patent for a modular porous swale filtration system. The patent states: "Industrial and commercial sites may allow stormwater runoff to flow into a water retention area, body of water or a processing facility. Toxic metals, suspended solids and other pollutants, however, flow from the stormwater runoff and can lead to pollution of waterways. In that regard, it is desirable to have an efficient and cost-effective apparatus that can remove toxic metals and suspended solids from stormwater runoff." In FY21, the 95 percent design was completed and material was purchased to start assembling prototypes and conducting field demonstrations in FY22.

The NESDI program also launched eight new start projects in FY21, including two efforts that address PFAS—Chronic Toxicity and Bioaccumulation Evaluation of Multiple PFAS for Benthic and Pelagic Species Relevant to Marine Ecological Risk Assessment (project no. 601) and Closed Loop, In Situ Soil Flushing at PFAS-Impacted Source Zones (project no. 602). All eight "new start" projects are profiled later in this Year in Review report.

All of these efforts—especially in the middle of a global pandemic—would not have been achievable without the support and guidance that we receive from our resource sponsor, OPNAV N4I Installations Division, and members of our management team—the Technology Development Working Group (TDWG). I am grateful to you all. I hope you find this Year in Review report to be a useful resource for additional insights into our projects and the overall operation and continued success of our program in FY22 and beyond.

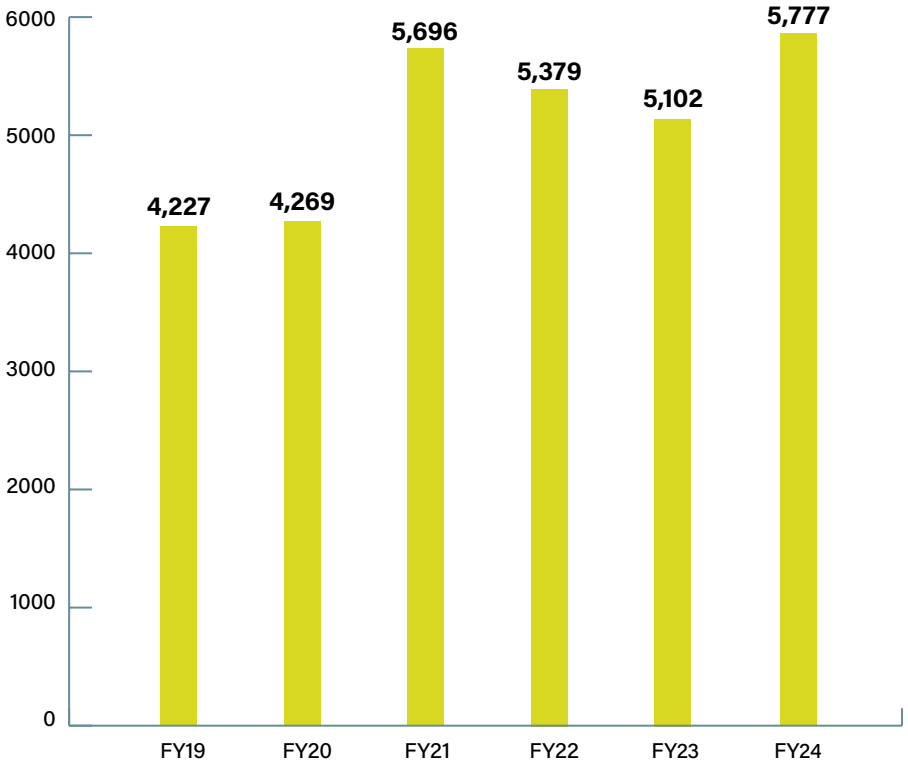
Ken Kaempffe, P.E.
NESDI Program Manager

## THE NUMBERS

Each year, the NESDI program establishes its investments based on the requirements identified by its end users from across the Navy and potential risk to the Navy mission.

The chart below shows the evolution of the program's actual funding levels from fiscal year (FY) 2019 through FY21, as well as the projected funding levels for FY22 through FY24.

### PROGRAM FUNDING (FY19 – FY24)



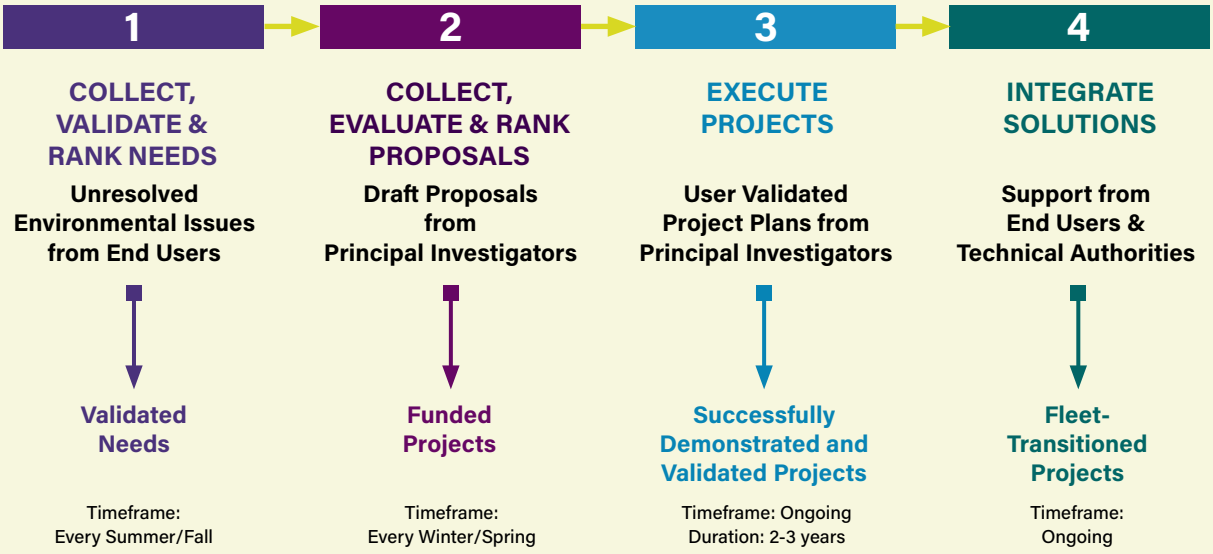

1. Funding in thousand dollars for PE 0603721N/Environmental Protection, 0817 Environmental Sustainability.
2. Future year funding is based on the 2023 Office of the Secretary of Defense budget dated 26 August 2021.

From 1994 to the present year, the NESDI program has been funded as high as $10,195k in one year (2003) to as low as $3,712k (in 2015). Future year funding is planned at approximately $5,500k per year.

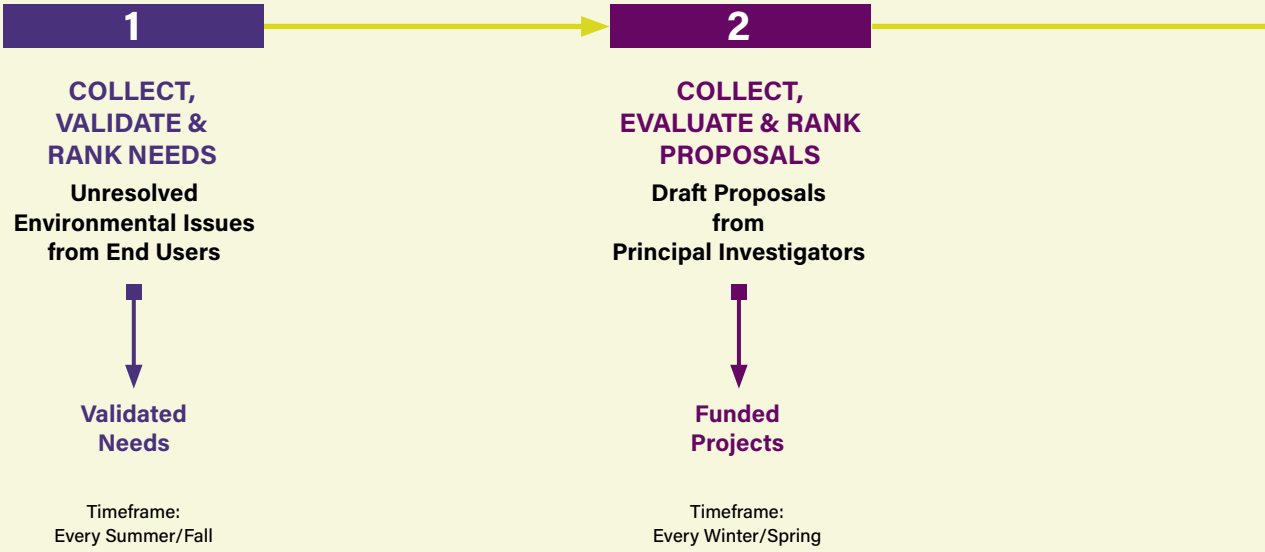
## THE NESDI PROGRAM PROCESS

Each year, the NESDI program typically executes a four-phase process to ensure the comprehensive collection of outstanding needs from across the Navy through the successful transition of workable solutions into the Navy's shoreside operating environment and its range testing and training activities. Throughout this process, the program's targeted customers—including need submitters, end users, technical authorities and other stakeholders—provide valuable input to develop meaningful needs, support the ongoing execution of individual projects, and help to ensure the successful integration of resultant technologies and other innovations.

The four phases of the program's management process are described in the pages that follow.



## THE NESDI PROGRAM PROCESS




### Collect, Validate & Rank Needs

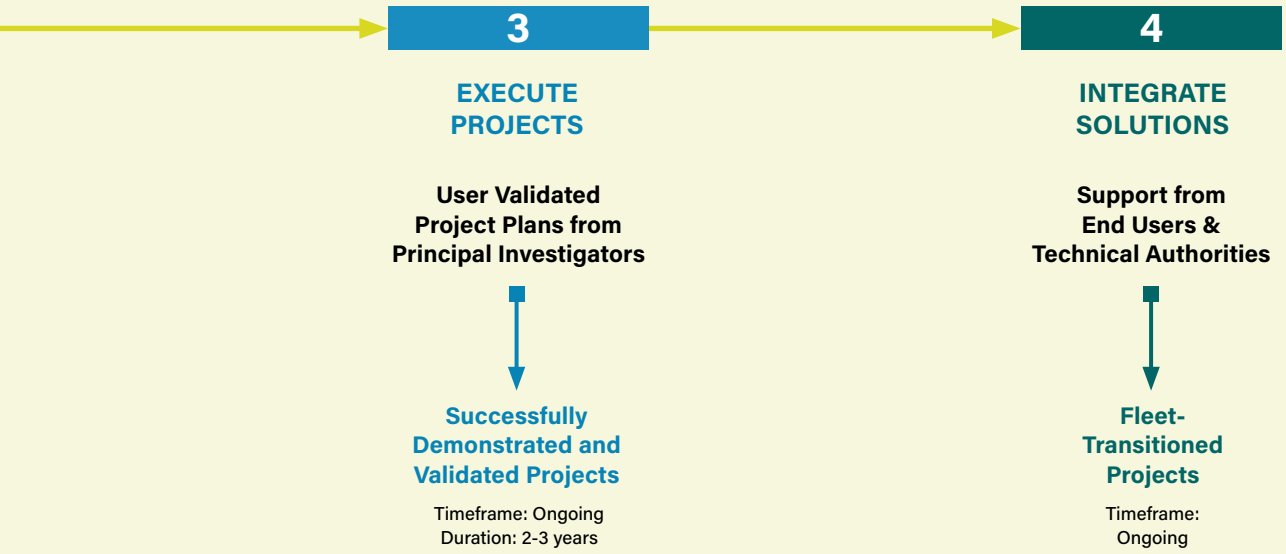
During this first phase of the annual management process executed by the NESDI program, our management team—the Technology Development Working Group (TDWG)—solicits environmental needs from across the Navy's shore community.

Once these needs are received, the TDWG validates and ranks them based on a variety of criteria including how pervasive the problem is in the Navy, the extent and severity of the associated compliance risk and the potential impacts on the mission of the Navy if the need is not addressed. Those preliminary rankings are then reviewed and validated by subject matter experts from the program's resource sponsor (OPNAV N4I Installations Division).

### Collect, Evaluate & Rank Proposals

During this second phase of the program's annual management process, the TDWG collects project proposals that address the needs collected in the first phase of the process.

In particular, the TDWG first requests, collects and reviews short "pre-proposals," and then requests more detailed, full-length proposals. The TDWG then recommends to the program's resource sponsor which proposals should receive program support.




## Execute Projects

Once proposals have been selected and funded, the NESDI program ensures during this third phase of its annual management process that the "new start" projects are effectively launched and remain properly focused on the needs they were intending to address through initial planning, ongoing reporting and management oversight. As part of this oversight, NESDI program managers require project investigators to submit quarterly status reports, justify monthly project expenditures, adjust execution schedules as required and make other timely modifications to the project's management plan that may be necessary as the project evolves over time.

The first step toward execution of any NESDI project is the completion of the program's Project Management Plan (PMP) template. PMPs contain four chapters, including a summary of problem statement, a detailed description of the project itself, an execution approach which includes a discussion of performance objectives, a cost assessment, risks and associated mitigation strategies, and a summary of the project schedule, milestones, funding and staffing. Investigators are also required to generate a preliminary return on investment (ROI) using the program's Technology Integration and Cost Analysis (TICA) software. This tool—available via the NESDI program's website—allows investigators to generate economic analyses by site or scenario, quantify intangible benefits and calculate ROIs and payback years per site/scenario among other factors.

## Integrate Solutions

Throughout the project lifecycle, the NESDI program concentrates on moving the demonstrated technologies and other solutions out of the laboratories and demonstration sites and into the appropriate operational environment. During this fourth and final phase of the NESDI program process, the TDWG, Principal Investigators and end users work together to ensure that various solutions are successfully integrated into Navy operations and weapons system acquisition programs and verify that the solutions provide the anticipated benefits.

## PROJECT ACCOMPLISHMENTS

**In this chapter of the FY21 Year in Review report, we highlight 16 projects that had notable accomplishments over the course of this fiscal year.**

### Non-Isocyanate Polyurethane-Free Formulation Coatings for Aircraft and Support Equipment (project no. 525)

**PRINCIPAL INVESTIGATOR:**
**Micaela Rionda (NAVAIR)**

A specification revision for MIL-PRF-85285 (polyurethane topcoat) has been edited to account for the new topcoat chemistries and is under review. Investigators anticipate that at least one product will be qualified to MIL-PRF-85285 Type IV (a two component high solids polyurethane topcoat) once the revision is complete. Personnel from Naval Air Warfare Center Aircraft Division (NAWCAD) Patuxent River will use the data collected under this project and the Office of Naval Research's Advanced Topcoat Systems Future Naval Capabilities program to generate an authorization letter for the new topcoat's use for flat/camouflage finishes.

Worker applying polyurethane coating to an F/A-18 aircraft.
(Photo Credit: Jennifer Nunez)

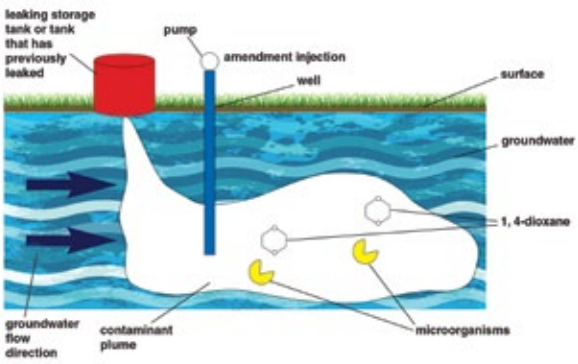
**Years project funded: FY16-FY20**

**Total NESDI funding: $333.5k ($134.7k in leveraged funding from ESTCP and others)**

## In Situ Treatment of 1,4-Dioxane using Enhanced Biodegradation (project no. 545)

**PRINCIPAL INVESTIGATOR:**
**Dr. Tony Danko (NAVFAC EXWC)**

Three treatment approaches were evaluated in the pilot-scale, in situ demonstration using a series of push-pull tests—monitored natural attenuation, biostimulation and bioaugmentation. The field demonstration provided insights into the in situ treatment of 1,4-dioxane and highlighted that bioaugmentation may be warranted at many sites but it also may require effective amendment delivery with significant engineering challenges. Technology transfer activities are ongoing.




An idealized representation of the treatment of a groundwater plume containing 1,4-dioxane via amendment (in this case microorganisms) injection to facilitate remediation.
(Diagram Credit: Amy Jungers)

**Years project funded: FY17-FY21**

**Total NESDI funding: $435.6k ($250.0k in leveraged funding from the installation and NAVFAC Headquarters)**

## Demonstrating Effectiveness of Novel Treatment Technologies for the Removal of Poly- and Perfluoroalkyl Substances from Groundwater (project no. 555)

**PRINCIPAL INVESTIGATOR:**
**Dr. Jovan Popovic (NAVFAC EXWC)**

Of the key findings, granular activated carbon (GAC) (F400), ion exchange (PFA694E) and organoclay F demonstrated the most consistent removal performance for all PFAS analyzed. Data agreement between rapid small-scale columns (RSSC) and columns scaled 400 times was consistent, indicating that RSSCs could potentially provide useful insight regarding treatment system design. Chemical sorbent regeneration using an alcohol (e.g., methanol and isopropanol) and low concentration base (0.1 N sodium hydroxide) offers a robust and straightforward method to desorb PFAS from spent GAC, but not spent strong base anion exchange resin.

PFAS column treatability study construction at NAVFAC EXWC's environmental laboratory (left) and commercially available sorbents for batch and flow-through column studies (right).
(Photo Credit: Jovan Popovic)

**Years project funded: FY18-FY20**

**Total NESDI funding: $126.7k ($40.0k in leveraged funding from ESTCP and the user community)**

## Development and Demonstration of a Portable, Temporary Barrier to Aid in Cargo and Equipment Inspections to Prevent Brown Treesnake Dispersal (project no. 561)

**PRINCIPAL INVESTIGATOR:**
**Dr. Itzel Godinez (NAVFAC EXWC)**

NAVFAC EXWC and U.S. Geological Survey personnel completed a small-scale prototype test of three brown tree snake barriers in a controlled environment with small (<800 mm), medium (800-950 mm), medium/large (951-1100 mm) and large (>1100 mm) snakes. The preliminary results indicate various levels of success based on the different barrier configurations and will be reported in a document currently under development. Results are expected in early FY22 and will finalize features such prototype height, corner design parameters and approach to properly integrate fencing material to the barrier prototype frame. The next iteration will include terrain configuration and perimeter entrance/exit testing of two redesigned barrier prototypes.

The brown treesnake. (Photo Credit: Shane R. Siers)

**Years project funded: FY18-FY22**

**Total NESDI funding: $405.7k ($215k in leveraged funding from the U.S. Air Force, U.S. Fish and Wildlife Service and NAVFAC Marianas)**

## Evaluation of Various Real-Time Monitors to Accelerate On-Site Analysis for Vapor Intrusion (project no. 568)

**PRINCIPAL INVESTIGATOR:**
**Chris Patterson (NAVFAC EXWC)**

Project investigators completed the desktop and field demonstration portions of this project. The team tested four newly-available field instruments for on-site analysis for vapor intrusion (VI). The preliminary results include sensitivity and accuracy as well as a list of advantages and disadvantages of each instrument. The lessons learned from this project will provide end users with increased confidence in the instruments they use for real-time VI analysis. The final report and completion of this project is planned for FY22.

A number of COTS instruments including this one will be demonstrated in this NESDI effort that seeks to identify the most reliable device for the mobile analysis of indoor air and soil gas samples.
(Photo Credit: Travis Lewis)

**Years project funded: FY19-FY21**

**Total NESDI funding: $241.9k (including $30.0k in vendor-supplied samplers)**

## In-Pipe Stormwater Treatment System (project no. 576)

**PRINCIPAL INVESTIGATOR:**
**Brandon Swope (NIWC Pacific)**

During FY21, the in-pipe stormwater treatment system was designed and components were manufactured. A series of up to 30 individual treatment units (ITU) that are connected and deployed in-line within a discharge pipe have been prepped and are ready for deployment during a storm event. The system provides regional bases and shipyards with a new technology to help meet stringent stormwater permit compliance. The system has gone through several design iterations from initial prototypes to a field-tested beta version, with the current status being a robust 3-D printed design in near final commercializable form. During this time period, initial invention disclosures were submitted with a patent application being filed. The system now has the designation of being "patent pending."

**ITUs will be fitted with different mesh types.** (Photo Credit: Brandon Swope)

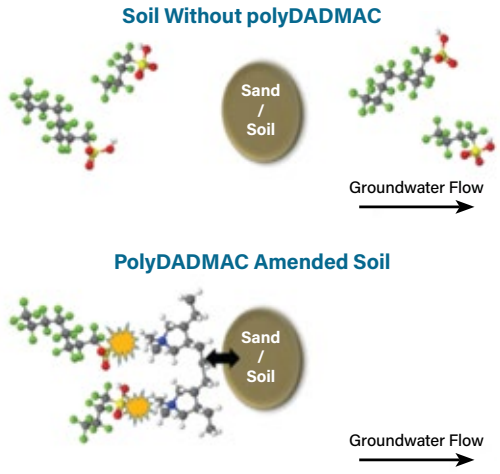
**Years project funded: FY19-FY22**

**Total NESDI funding: $335k**
**($61k in leveraged funding from stakeholders)**

## Demonstrating the Use of a Novel, Hybrid Polyelectrolyte/ Hydrophilic Polymer for In Situ PFAS Treatment Applications (project no. 577)

**PRINCIPAL INVESTIGATOR:**
**Dr. Jovan Popovic (NAVFAC EXWC)**

Laboratory studies indicate high levels of PFAS capture in site derived soils amended with polydiallyldimethylammonium chloride (polyDADMAC). In comparison to controls run in the absence of polyDADMAC, it was revealed that experimental groups may offer soil PFAS retention up to fifteen times that of unamended controls before detecting any PFAS leaching. While these observations are limited to the laboratory scale, this project was set to begin field injections in early November 2021 to demonstrate this phenomenon on a larger scale.




**The functionality of the polyDADMAC in situ amendment.** (Diagram Credit: Jovan Popovic)

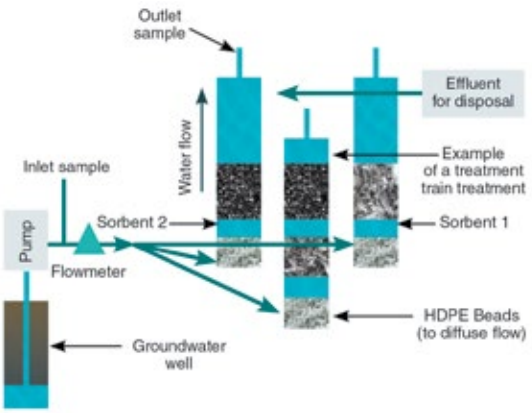
**Years project funded: FY20-FY23**

**Total NESDI funding: $650.5k**

## Mesocosm Field Testing of In Situ PFAS Treatment Trains (project no. 578)

**PRINCIPAL INVESTIGATOR:**
**Dr. Nicholas Hayman (NIWC Pacific)**

This project completed a suite of laboratory evaluations for five sorbents, finding five of the six initially removed more than 90 percent of a suite of PFAS compounds from artificial groundwater, although time to breakthrough was affected by water quality. In addition, investigators are in process of developing a field apparatus that will allow for onsite evaluations that will be tested in FY22. By understanding how water quality parameters (pH, temperature, conductivity and organic matter content) affect the sorption of PFAS to these materials, Remedial Project Managers (RPM) and other end users will be able to better select sorbents for their respective field sites.




**General schematic of field-testing apparatus to be deployed at the former Tustin Marine Corps Air Station.** (Photo Credit: Nick Hayman)

**Years project funded: FY19-FY22**

**Total NESDI funding: $815.4k**

## Development and Implementation of Methods to Reduce Sealant Waste in Fleet/Depot Level Operations (project no. 580)

**PRINCIPAL INVESTIGATOR:**
**Dr. Alan Grieve (NAVAIR)**

The project team has been testing sealants representing the most common in fleet use. A group of these sealants is being artificially aged in conditions mimicking a hazardous materials locker at the Fleet Readiness Center Southeast (FRCSE). The aging process has been ongoing for close to six months. Both groups are presently being re-tested which will allow for the comparison of the impact (if any) of the non-optimal storage conditions. In addition, a new simple pull test (designed as a simple alternative to laboratory-based peel tests) is being evaluated for possible field use and inclusion in the test protocol. Development of the test kit is ongoing.

**This NESDI project will demonstrate the effectiveness of a test protocol in reducing sealant waste generated by various aircraft programs including the MH-60S Sea Hawk helicopter.** (Photo Credit: Mass Communication Specialist Seaman Apprentice Darren Newell)

**Years project funded: FY20-FY23**

**Total NESDI funding: $485.0k**

## Assessment of Cadmium Alternatives for Connector Applications (project no. 581)

**PRINCIPAL INVESTIGATOR:**
**Joe Marchica (NAWCAD Lakehurst)**

The project is assessing the performance issues surrounding zinc-nickel and other cadmium-alternative plating technologies for Electrical Wiring and Interconnect System (EWIS) components. Conductivity, wear resistance and corrosion resistance will be assessed including the questions associated with the mating and demating these components with legacy cadmium-plated components.

As part of this effort, NAVAIR and project team personnel signed a Limited Purpose Cooperative Research and Development Agreement (LP-CRADA) with Glenair to obtain no-cost EWIS components plated with Glenair's proprietary tin-zinc finish. Investigators are performing laboratory corrosion testing to evaluate the fitness of these parts. This will help to determine if it is worthwhile to include these parts in the primary outdoor exposure testing on the Navy Electrical System Testbed (NEST) and durability testing on the Automatic Wire Test Set (AWTS) in a moderately-corrosive environment. Glenair provided enough parts to account for all of the aforementioned testing.

Investigators also sought to obtain no-cost EWIS components with other finishes that are also included in the project's test matrix. This included cadmium-plated components to compare the parts plated with alternative finishes to a cadmium baseline, and commercially available EWIS parts finished with zinc-nickel and nickel polytetrafluoroethylene (PTFE or Teflon) per MIL-DTL-38999 (miniature, high density, bayonet and screw threaded circular connectors) and MIL-DTL-85049 (backshells and other military standard circular connector accessories). All parts have been delivered.

NAVAIR and project team personnel signed another LP-CRADA with Amphenol, Eaton, Radiall and TE Connectivity—all of whom are members of the Connectors Manufacturer Group Consortium. All remaining parts needed for the test matrix were obtained from these suppliers. One set of parts will have a standard trivalent chromium pretreatment (TCP) passivation process and one will be passivated using a novel Cobalt-free process.

The project team also requested and obtained information and test data that would establish the Amphenol tin-zinc finish as being mature and robust enough to warrant testing in an outdoor exposure test. Investigators will compare this to the Glenair tin-zinc data and, using this information, will determine which finish will receive priority placement in a space-limited test matrix on the NEST exposure.

**Degraded wires (left) and degraded connectors (right) from the V-22 Osprey Full Authority Digital Engine Control (FADEC) and Flight Control Wiring.**
(Photos compliments of NAWC-AD Patuxent River Wiring Laboratory.)

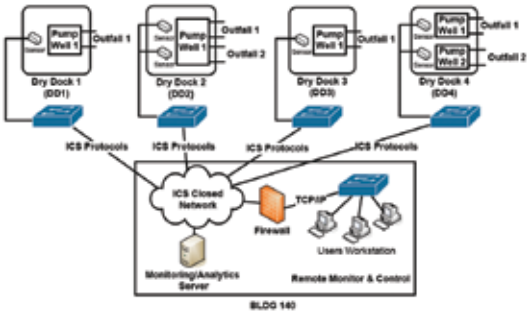
**Years project funded: FY20-FY22**

**Total NESDI funding: $680.0k**

## Sensor Interface and Infrastructure for Monitoring (SIIM) (project no. 582)

**PRINCIPAL INVESTIGATOR:**
**Lewis Hsu (NIWC Pacific)**

This project team has identified network components and interface devices from Defense Information Systems Agency approved devices to ensure security is considered from the start. The design, build and test of a long range encrypted wireless telemetry network and user interface has been performed and demonstrated for stakeholders at the Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility (PHNSY&IMF). Field deployment of the system is planned for FY22 to enable data-driven decision making relevant to shipyard operations.




Conceptual framework for closed network monitoring solution with data analytics and user interface. (Schematic Credit: Henry Au)

**Years project funded: FY20-FY22**

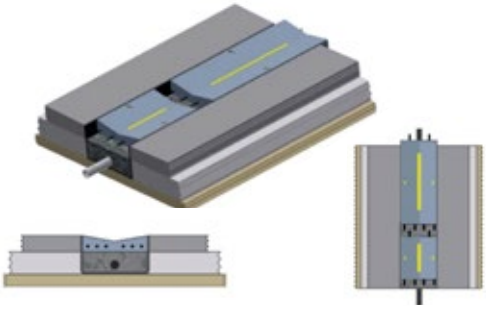
**Total NESDI funding: $456.3k ($350k in leveraged funding from stakeholders)**

## Low-profile Integrated Porous Pretreatment Swale (LIPPS) for Metals Treatment in Industrial Areas (project no. 583)

**PRINCIPAL INVESTIGATOR:**
**James Pilkington, P.E. (NAVFAC EXWC)**

Three NAVFAC EXWC engineers were granted a patent for a modular porous swale filtration system. As is stated in the patent, "Industrial and commercial sites may allow stormwater runoff to flow into a water retention area, body of water or a processing facility. Toxic metals, suspended solids and other pollutants, however, flow from the stormwater runoff and can lead to pollution of waterways. In that regard, it is desirable to have an efficient and cost-effective apparatus that can remove toxic metals and suspended solids from stormwater runoff."

The project team sampled and surveyed three demonstration locations at Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS&IMF) for future LIPPS installation. The 95 percent design was completed and material was purchased to start assembling prototypes over the course of FY22.



Components of an LIPPS model.
(Schematic Credit: Dennis How)

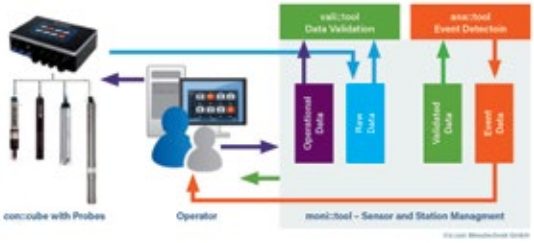
**Years project funded: FY21-FY23**

**Total NESDI funding: $486.0k ($90.0k in leveraged funding from ESTCP and stakeholders)**

## Real-Time Multi-Contaminant Detection System (RMDS) (project no. 584)

**PRINCIPAL INVESTIGATOR:**
**Autumn Resto (NAVFAC EXWC)**

This project team completed a sensor alternatives analysis and found that although no suitable market ready real time monitoring sensors were available, a novel metal detection sensor technology to instantaneously detect metal ions in aqueous environments was found in the RDT&E demonstration phase. A contract was awarded to the University of Chicago (working with Argonne National Laboratory) to modify their novel sensor design for copper detection for use with this project.




RMDS sensing system flow.
(Diagram Credit: Autumn Resto)

**Years project funded: FY21-FY23**

**Total NESDI funding: $699.8k ($250.0k in leveraged funding from NISE and stakeholders)**

## High Efficiency Media for Metals Removal in NPDES Discharges (project no. 585)

**PRINCIPAL INVESTIGATOR:**
**Brandon Swope (NIWC Pacific)**

This project team has identified a commercial product (MetalZorb) that has proved highly effective in laboratory studies and also in initial field deployments. Thus far, data have been obtained for one of the deployment locations, where the pre-Best Management Practice (BMP) sample was above the Numeric Action Level (NAL) permit value and the post-BMP sample was reduced below the NAL. Additional sites and field deployments are planned for FY22. This will provide Navy stakeholders with an option to help achieve stormwater permit compliance at historically challenging sites.

The MetalZorb filtration media.
(Photo Credit: Brandon Swope)

**Years project funded: FY19-FY22**

**Total NESDI funding: $415.0k ($60.0k in leveraged funding from stakeholders)**

## Demonstration and Application of Amendments Targeting Comingled Organics and Metals in Sediments (project no. 594)

**PRINCIPAL INVESTIGATOR:**
**Gunther Rosen (NIWC Pacific)**

In its first year, this project evaluated over a dozen candidate amendments that successfully removed more than 90 percent of contaminant concentrations in freshwater and saltwater laboratory experiments. These evaluations were followed by an evaluation of three contaminated Navy sediments subject to restoration that also showed significant effectiveness (reduced availability to organisms and sediment). This project will move to the field in FY22 for testing at scale which should help facilitate rapid technology transfer to Navy end users.

AquaGate+ amendments being deployed at a Navy site. (Photo Credit: Courtesy of ESTCP project no. ER-201131)

AquaGate+ reactive amendment media. (Photo Credit: Scott Collins)

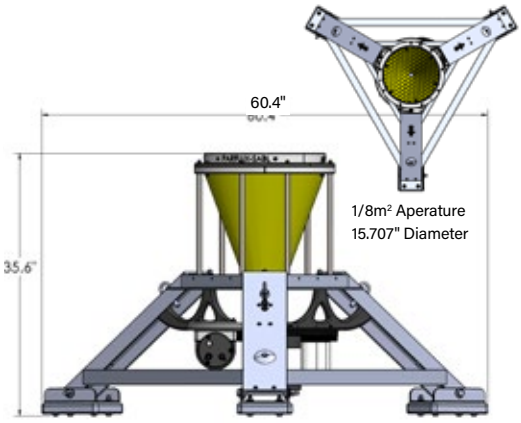
**Years project funded: FY20-FY23**

**Total NESDI funding: $530.8k ($184.0k in leveraged funding from user community)**

## Demonstration of a Signal Activated Bottom Lander Trap (SABL) (project no. 595)

**PRINCIPAL INVESTIGATOR:**
**Molly Colvin (NIWC Pacific)**

In the first year of this effort, two SABL units have been designed and built and are currently undergoing bench and field-based preliminary testing before full-scale deployment at Naval Base San Diego (NBSD) during the 2021-2022 winter months/ wet season. This new technology will complement and significantly enhance an NBSD Sediment Site Investigation planned for FY22. This leveraging opportunity will lead to improved assessment, decision making and reduced long-term management costs for contaminated sediment sites.




This NESDI project is developing and demonstrating an automated technology (a signal-activated bottom lander) that can aid sediment remediation efforts by targeting specific particle discharge or resuspension events. (Schematic Credit: Courtesy of McLane Research Laboratories)

**Years project funded: FY20-FY23**

**Total NESDI funding: $618.6k**

**AquaGate+ amendments being deployed at a Navy site. (project no. 594)**
(Photo Credit: Courtesy of ESTCP project no. ER-201131)

## RESULTS OF OUR FY21 NEEDS SOLICITATION

The program's formal needs collection process for FY21 ran from June through August of 2020. Overall, 58 needs were submitted by personnel from across the Navy and Marine Corps. Through the program's annual needs solicitation, screening and ranking process, the program's management committee (the TDWG), advanced 29 needs (approximately half of the total received) to the program's resource sponsor (OPNAV N4I Installations Division) so that their subject matter experts (SME) could review and then approve (or reject) the TDWG's recommendations and/or rankings. All of these needs were ultimately validated by OPNAV N4I Installations Division SMEs who also made suggestions and adjusted some of the original TDWG rankings. These needs are listed in the table below.

| No. | Need | Title | Submitter/Command |
|---|---|---|---|
| 1. | N-1338-21 | Environmentally Acceptable, Oxsol-Free, Low-VOC Topside Coatings for Surface Ships | Mark Ingle / NAVSEA |
| 2. | N-1339-21 | Rapid, Sensitive Screening Method for PFAS in Soil | Malcolm Gander / NAVFAC |
| 3. | N-1340-21 | Optimizing Oil-Change Intervals of DoD Emergency Reciprocating Internal Combustion Engines (RICE) | Kimberly Hammer / NAVSEA |
| 4. | N-1342-21 | Minimizing Hazardous Waste from Expired Paints/Associated Solvents from Ships Supply by Developing Approved Method for Shelf Life Extensions at Field Activities | Jessica Klinkert / NAVSEA |
| 5. | N-1344-21 | Evaluation of Regional Airfield Vegetation Regimes to Reduce Wildlife Strikes by Aircraft at Naval Airfields | Laura Muhs / NAVFAC |
| 6. | N-1345-21 | Determination of Infrastructure Needs for Shoreside Collection and Treatment of Clean Ballast and Compensated Fuel Ballast (CFB) from Navy Vessels | Rachel Jacobs / NAVSEA |
| 7. | N-1347-21 | Subsurface Fate and Transport of Petroleum-Based Contaminants in Naval Facilities | John Muraoka / NAVFAC |
| 8. | N-1353-21 | Predictive Modeling for PFAS Fate and Transport Modeling | Malcolm Gander / NAVFAC |
| 9. | N-1354-21 | Environmental Impacts from Navy Vessel Hull Paints | Tom McCue / NAVSEA |
| 10. | N-1360-21 | Better Techniques to Evaluate Potential Remedial Options at Sediment Sites | Len Sinfield / NAVFAC |
| 11. | N-1361-21 | Brush Electroplating Repair of Zinc-Nickel and Anodize | Jack Benfer /NAVAIR |
| 12. | N-1365-21 | Electromagnetic Interference Shielding Tape (EMIST) | Peter Sheridan for Jacob Deeb / NAVAIR |
| 13. | N-1366-21 | Conservation Efforts Adverse Impact on Drinking Water Quality | Patricia Greek / Other |
| 14. | N-1367-21 | Rapidly Curable Sealants | Peter Sheridan for Jacob Deeb / NAVAIR |
| 15. | N-1368-21 | Hexavalent Chromium-Free Conversion Coating for Anodize Coating Repairs and Touch-up Conversion Coating Application | Peter Sheridan for Jacob Deeb / NAVAIR |

| No. | Need | Title | Submitter/Command |
|---|---|---|---|
| 16. | N-1369-21 | Novel Low-Cost Groundwater Arsenic Removal Emerging Technology | Michael Bizon /NAVFAC |
| 17. | N-1370-21 | Fill PFAS Marine Ecotoxicity Data Gaps | Jason Speicher / NAVFAC |
| 18. | N-1371-21 | New Emerging Fats, Oil and Grease Removal Technology | Melvin Kutaka / Other |
| 19. | N-1372-21 | Port/Ship Deployed, Remotely Operated Skimmers for Oil Spill Response | Kyle Lawrence for Stuart Morgan / NAVFAC |
| 20. | N-1374-21 | Mathematical Modeling of Vapor Intrusion Mitigation Systems | Carlotta Cellucci / NAVFAC |
| 21. | N-1381-21 | Unifying the Approach to Estimate Risk and Calculate Cleanup Goals for Radionuclides n Media for Environmental iRestoration Program | Alex Scott / NAVFAC |
| 22. | N-1382-21 | Navy Installation Solid Waste Diversion Technology, Process Knowledge & Capability | Rachelle Knight / CNIC |
| 23. | N-1384-21 | Cost-Effective, Low-Waste Depainting of Weapons | Barry Olson / NAVAIR |
| 24. | N-1385-21 | Excluding Endangered Waterbirds from the Joint Base Pearl Harbor-Hickam West Loch Oxidation Pond | Ashley Noel Dunn / NAVFAC |
| 25. | N-1386-21 | Pierside Recycling System for Flight Deck Cleaning Operations | Kenny Ross / NAVSEA |
| 26. | N-1390-21 | Debris Control for Stormwater and Dry Dock Drainage Systems | William Arkfeld / NAVSEA |
| 27. | N-1392-21 | Addressing Aluminum and Iron Pollution in Stormwater from Loading Operations on Wharves at Naval Weapons Stations | Kyle Lawrence / NAVFAC |
| 28. | N-1393-21 | Artificial Intelligence Computing to Improve Navy Risk Posture and Regulatory Compliance | Lisa Rotty / NAVFAC |
| 29. | N-1397-21 | Treatment of PFAS in Various Waste Streams | Various submitters |

**The program received 23 full proposals that addressed the needs listed on the previous pages. Overall, the quality of the submitted proposals was excellent. However, due to funding limitations the following eight proposals were the only ones advanced to become "new start" projects:**

1. An Integrated Navy Approach to Estimate Risk and Cleanup Goals for Radionuclides Associated with Buildings at Current and Former Navy Installations (proposal no. 236)

2. Closed Loop, In Situ Soil Flushing at PFAS-Impacted Source Zones (proposal no. 240)

3. Remotely Operated Oil Spill Response Equipment: Down-Selection and Demonstration at a Navy Port (proposal no. 244)

4. Minimizing Hazardous Waste from Expired Paints and Associated Solvents from Ships Supply (proposal no. 245)

5. Pathways for Addressing Opportunistic Premise Plumbing Pathogens at Navy Installations (proposal no. 246)

6. Advanced Anodize Repair (proposal no. 251)

7. Characterization of Antifouling Paint and Environmental Loading with Navy Dome System (proposal no. 252)

8. Chronic Toxicity and Bioaccumulation Evaluation of Multiple PFAS for Benthic and Pelagic Species Relevant to Marine Ecological Risk Assessment (proposal no. 254)

One proposal was not approved—Electromagnetic Interference Shielding Tape (EMIST) (proposal no. 253).

**These eight "new start" projects are highlighted in the next chapter of this report.**

**Navy drinking water treatment facility with potable treated water storage tanks and reverse osmosis tanks. (project no. 599)**
(Photo Credit: Autumn Resto)

**The following 14 full proposals will be held over and reconsidered as potential "new start" projects in the program's next cycle:**

1. 3D-Printed Cone Spray Ionization Mass Spectrometry for the Rapid, Low-Cost and In-Situ Detection and Mapping of PFAS in Soil (proposal no. 235)

2. Knowledge Base and Pre-Processor Tool for Modeling Groundwater at PFAS Sites Using Numerical Groundwater Models (proposal no. 237)

3. External Concentrating Parabolic Collector (XCPC) Solar Thermal Evaporation for PFAS-Impacted Wastewater Minimization (proposal no. 238)

4. Subterranean Arsenic Removal (SAR) from Well Groundwater (proposal no. 239)

5. Artificial Intelligence for Environmental Compliance (proposal no. 241)

6. Application of Supercritical Water Oxidation (SCWO) to Destroy PFAS-Impacted Waste Streams (proposal no. 242)

7. Technologies, Process Knowledge & Capabilities that Increase Non-Organic Waste Diversion (proposal no. 243)

8. Oxsol-Free and Low-VOC Surface Ship Topside Coatings for Maintaining Environmental Regulations (proposal no. 247)

9. Evaluation of Regional Airfield Vegetation Regimes to Reduce Wildlife Strikes by Aircraft at Naval Airfields (proposal no. 248)

10. Pyrolysis Gas Chromotography for Rapid Soil PFAS Screening and Analysis (proposal no. 249)

11. Evaluation of Existing and Required Pierside Infrastructure to Accommodate Shoreside Collection and Treatment of Navy Vessel Ballast Discharges (proposal no. 250)

12. Ultraviolet Curable Sealant for Hazardous Waste Reduction and Rapid Cure (proposal no. 255)

13. Cadmium and Hexavalent Chromium Free Brush Electroplating Repair of Zinc-Nickel Corrosion Preventative Coatings (proposal no. 256)

14. Subsurface Fate and Transport of Petroleum Based Contaminants in Naval Facilities (proposal no. 257)

## OUR EIGHT FY21 "NEW START" PROJECTS

In the fourth quarter of FY21, the NESDI program launched eight "new start" projects including an effort to determine if remotely operated oil spill response (OSR) equipment can respond to oil spills more effectively than current equipment ("new start" project no. 597). Another project (no. 601) will produce acute and chronic toxicity and bioaccumulation data for 10 priority polyfluoroalkyl substances whereas a second related effort (project no. 602) will demonstrate that in situ soil flushing, used in conjunction with sorption and destructive treatments, is a viable method for the removal and subsequent destruction of PFAS from affected soil.

A complete list of these and all other FY21 "new start" projects is provided below.

1. Remotely Operated Oil Spill Response Equipment: Down-Selection and Demonstration at a Navy Port (project no. 597)

   *Marty McMorrow, P.E., PMP (NAVFAC EXWC)*

2. Minimizing Hazardous Waste from Expired Paints and Associated Solvents from Ships Supply (project no. 598)

   *Todd Heintzelman (NAVSUP WSS)*

3. Pathways for Addressing Opportunistic Premise Plumbing Pathogens at Navy Installations (project no. 599)

   *Autumn Resto (NAVFAC EXWC)*

4. Advanced Anodize Repair (project no. 600)

   *Alexander Westbrook (NAWCAD Patuxent River)*

5. Chronic Toxicity and Bioaccumulation Evaluation of Multiple PFAS for Benthic and Pelagic Species Relevant to Marine Ecological Risk Assessment (project no. 601)

   *Dr. Nicholas Hayman (NIWC Pacific)*

6. Closed Loop, In Situ Soil Flushing at PFAS-Impacted Source Zones (project no. 602)

   *Ben Rhiner, P.E. (NAVFAC EXWC)*

7. Characterization of Antifouling Paint and Environmental Loading with Navy Dome System (project no. 603)

   *Dr. Channing Bolt (NIWC Pacific)*

8. An Integrated Navy Approach to Estimate Risk and Cleanup Goals for Radionuclides Associated with Buildings at Current and Former Navy Installations (project no. 604)

   *Kenda Neil (NAVFAC EXWC)*

**Brief introductions to all of these efforts can be found on the following pages.**

**Sailors conduct facility response training which includes a simulated oil spill and oil spill recovery using two utility boats, a dedicated skimmer boat and oil booms to contain the spill. Alternative skimming technologies would greatly reduce the number of manhours required for spill cleanup. (project no. 596)**
(Photo Credit: Seaman Jasmine Ikuseibiala)


30-OP-19-02

## OUR EIGHT FY21 "NEW START" PROJECTS

### Alternative Oil Skimming Technologies for Afloat Oil Spill Response: Down-selection and Demonstration at a Navy Port (project no. 597)

**Marty McMorrow, P.E., PMP (NAVFAC EXWC)**

The goal of this effort is to determine if remotely operated oil spill response (OSR) skimming equipment and other alternative technologies can respond to on-water oil spills more effectively than existing equipment with respect to safety, cost, speed, oil recovery rate and maneuverability.

When an oil spill occurs, time is of the essence. Facility Response Teams (FRT) need remotely operated and/ or compact oil spill equipment to rapidly deploy from an oil spill response boat or port location to contain and clean up spills quickly and effectively. In particular, the equipment may need to be able to access tight spaces and maneuver within them while maintaining their heading against currents.

Many of the candidate technologies for demonstration have been tested and evaluated under controlled conditions at the Oil Spill Response Research and Renewable Energy Test Facility, also known as Ohmsett, which is the recognized independent performance evaluation organization for the oil spill response industry. It is anticipated that two or three technologies will be selected and demonstrated at two to three Navy sites. Criteria will include effectiveness, ease of use, responsiveness of controls, maintainability and reputation of the vendor. The selected technologies will then be rigorously evaluated by experienced FRT leaders.

For demonstrated technologies that meet the stated requirements, NAVFAC EXWC personnel will deliver a report and a combined guidance document /procurement package to NAVFAC's Oil Spill Response Program. Provided they approve, the equipment will be added to the list of OSRP-approved equipment. EXWC will then notify the Navy On-Scene Commander Media Field Team, which will communicate the availability of the equipment to FRTs in their regions.

**Sailors conduct facility response training which includes a simulated oil spill and oil spill recovery using two utility boats, a dedicated skimmer boat and oil booms to contain the spill. Alternative skimming technologies would greatly reduce the number of manhours required for spill cleanup.** (Photo Credit: Seaman Jasmine Ikuseibiala)

## Minimizing Hazardous Waste from Expired Paints and Associated Solvents from Ships Supply (project no. 598)

**Todd Heintzelman (NAVSUP WSS)**

The objective of this study is to minimize the amount of hazardous waste produced by expired paints and associated solvents originating from ship supplies.

Navy ships place excess paint in storage after use. The paint's shelf life often expires while in storage and therefore becomes hazardous waste. In some cases, the shelf life of expired paint can be extended, but there is conflicting guidance and understanding on how this can be achieved. The Defense Logistics Agency (DLA) often requires offsite laboratory testing of paints in order to extend the paint's shelf life. If not tested, the paint is treated as hazardous waste, which incurs disposal and handling costs, increases the risk to human health and the environment, and runs the risk of violating existing regulations.

This project is producing an Initiation Decision Report (IDR) that provides situational understanding of the problem, current process and procedures, recommendations regarding quantities of paint to purchase, as well as techniques for effectively managing and extending the shelf life of paints.

The location for this IDR is Puget Sound Naval Shipyard & Intermediate Maintenance Facility (PSNS & IMF). This facility alone spends $47,000 to dispose of expired paint each year. This project team will research historical data regarding the quantity of paint ordered per year at the base and the quantity disposed of due to expired shelf life. They will then develop a paint quantity purchase guideline based on

**PSNS & IMF spends $47,000 to dispose of expired paint each year.** (Photo Credit: Mass Communication Specialist 2nd Class Eric Coffer)

ship class that states how much material a ship is recommended to purchase in order to "right size" the amount of paint in the ship's supply. To prevent waste upfront, the team will research relationships between size of unit issued versus quantity used (i.e., ordering a gallon but only using a quart), and will inquire whether suppliers can package their material into smaller containers based on demand.

The team will also enable increased reuse of paint by researching shelf life regulations, process and procedures, and management practices to determine the root cause of why paint shelf life expires. Finally, the team will assess hazardous material offload options at larger Navy bases prior to ship availability at PSNS & IMF.

There is a potential return on investment estimate of $817,000 per year, along with a 70,000-pound decrease in expired paints. The IDR will identify feasible solutions that the Navy can implement to decrease the amount of hazardous waste produced by expired paints.

## Pathways for Addressing Opportunistic Premise Plumbing Pathogens at Navy Installations (project no. 599)

**Autumn Resto (NAVFAC EXWC)**

This project team is studying ways to reduce or eliminate Opportunistic Premise Plumbing Pathogens (OPPP) in drinking water at U.S. Navy facilities. OPPPs are pathogens that are known to cause serious human infections (such as legionella). The Navy medical community is seeing an increase in OPPP-related illnesses stemming from domestic water systems of Navy facilities. This may be due to the combined effects of conflicting policy requirements, water and energy conservation efforts, aging infrastructure, reduced system demands, low flows, limited disinfection residuals, and oversized combined potable and firefighting distribution systems.

The goal of this effort is to perform a deep dive into the conservation measures that may be adversely affecting the quality of drinking water. Current Navy water system operation and maintenance plans, conservation methods, distribution systems, novel and current treatment technologies and methodologies as well as conflicting Navy, federal, state and local policies are being analyzed to offer potential solutions. A review of a broad range of operational and conservation issues that impact water quality—such as toilet flush volumes, water heater temperatures and combined drinking water/firefighting infrastructure are being made to determine the best course of action to address each and how they negatively impact drinking water quality. Investigations will be made to determine key areas where water restrictions may need to be removed or reduced, which operations need optimizing, conflicting policies that should be restructured, and areas where infrastructure can be modified and retrofitted.

## Advanced Anodize Repair (project no. 600)

**Alexander Westbrook (NAWCAD Patuxent River)**

This project seeks to promote and demonstrate two technologies as suitable

**Navy drinking water treatment facility with potable treated water storage tanks and reverse osmosis tanks.** (Photo Credit: Autumn Resto)


**This NESDI project seeks to find suitable replacements for hexavalent chromium-based formulas for the repair of anodized aluminum coatings on the F/A-18 Hornet and other U.S. Navy aircraft.** (Photo Credit: Sgt. Booker T. Thomas III)

replacements for hexavalent chromium-based formulas for the repair of anodized aluminum coatings.

Trivalent chromium touch-up applicators have been on the approved products list for over 10 years. However, transitioning to these applicators has largely been avoided due to the difficulty of visually inspecting the applied coating, as it is colorless. A recent NESDI project (project no. 514: Enhanced Trivalent Chromium Pretreatment (eTCP) for Improved Coloration and Corrosion Performance of Aluminum Substrates) has shown the efficacy of a trivalent chromium coating system that incorporates a dye into the coating, producing an easily visually identified conversion coating.

The leading hexavalent chromium-free touch-up applicators will be tested for five qualities, time until failure in an accelerated salt fog environment (ASTM B117 Neutral Salt Fog), paint adhesion, conductivity, coating weight and ease of use. The applicators will be tested and compared to hexavalent chromium-based applicators, and the best performing applicator will be tested and demonstrated at a Fleet Readiness Center (FRC).

The second repair method that will be advanced is brush aluminum anodizing. Anodizing is an electrochemical oxidation treatment commonly formed on the surface of aluminum for providing wear and/or corrosion resistance. It is a mature technology that's been around for decades. This project will verify its effectiveness and will test for the optimum sealer. Providing that both technologies perform equal to or better than hexavalent chromium, a decision tree will be created to help FRC personnel choose the best process for their needs.

If successful, this project will remove 12.7 gallons of hexavalent chromium annually from the waste stream at FRC Southwest alone, with more anticipated from FRC Southeast. It will also eliminate thousands of associated contaminated plastic applicators. Just as important, the hazardous waste generated during


MA
VMFA-112


**This NESDI project seeks to find suitable replacements for hexavalent chromium-based formulas for the repair of anodized aluminum coatings on the F/A-18 Hornet and other U.S. Navy aircraft. (project no. 600)**
**(Photo Credit: Sgt. Booker T. Thomas III)**

the application is not carcinogenic or mutagenic, reducing the risk of serious health issues for service members.

Once the products have been successfully demonstrated in the operational environment, Local Process Specifications will be generated and distributed, ensuring that future users have a clear understanding of how to use these products and processes.

### Chronic Toxicity and Bioaccumulation Evaluation of Multiple PFAS for Benthic and Pelagic Species Relevant to Marine Ecological Risk Assessment (project no. 601)

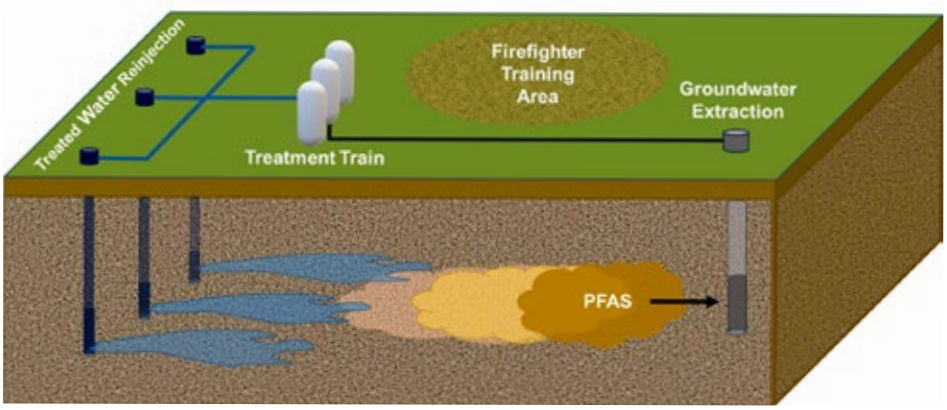
**Dr. Nicholas Hayman (NIWC Pacific)**

The objective of this study is to produce acute and chronic toxicity and bioaccumulation data for 10 priority polyfluoroalkyl substances (PFAS).

PFAS are a group of thousands of chemicals that are persistent in the environment and may be present at Department of Defense (DoD) sites primarily due to their use in aqueous film-forming foam (AFFF), although they can be found worldwide at sites not influenced by DoD facilities. Currently, there are robust data sets that suggest two of these compounds, perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), are detrimental to human health, resulting in significant regulatory and public concern. In addition, both PFOS and PFOA have been shown to be chronically toxic to aquatic organisms and bioaccumulate in aquatic systems, resulting in concerns over the environmental risk posed by these compounds. However, there is a lack of data regarding these chemicals' effects on marine species.

In the first task, the team will use PFAS-spiked marine water and

**A Sailor carries a tank of AFFF down a ladder during a fire drill. AFFF is highly effective yet contains polyfluoroalkyl substances.** (Photo Credit: MCS 2nd Class Nathan K. Serpico)




**The fundamental processes involved in in situ soil flushing for PFAS-impacted sites.**
(Graphic Credit: Jovan Popovic)

sediment to conduct water toxicity tests for two critical pelagic marine species, the opossum shrimp (*Americamysis bahia*) and topsmelt fish (*Atherinops affinis*) and will report toxicity values such as lowest observed effect concentration (LOEC) and median lethal (LC50) or median effect (EC50) concentrations. If during this testing, no adverse effects are observed at concentrations well above (i.e., 100 times higher) detected concentrations of individual PFAS at AFFF-impacted sites, then species will be retested using a reduced concentration series to verify the no observed effect concentration (NOEC), and all test concentrations will be verified by a DoD-certified analytical laboratory (Eurofins). This testing will also sample tissue of exposed animals to develop water-to-tissue uptake factors.

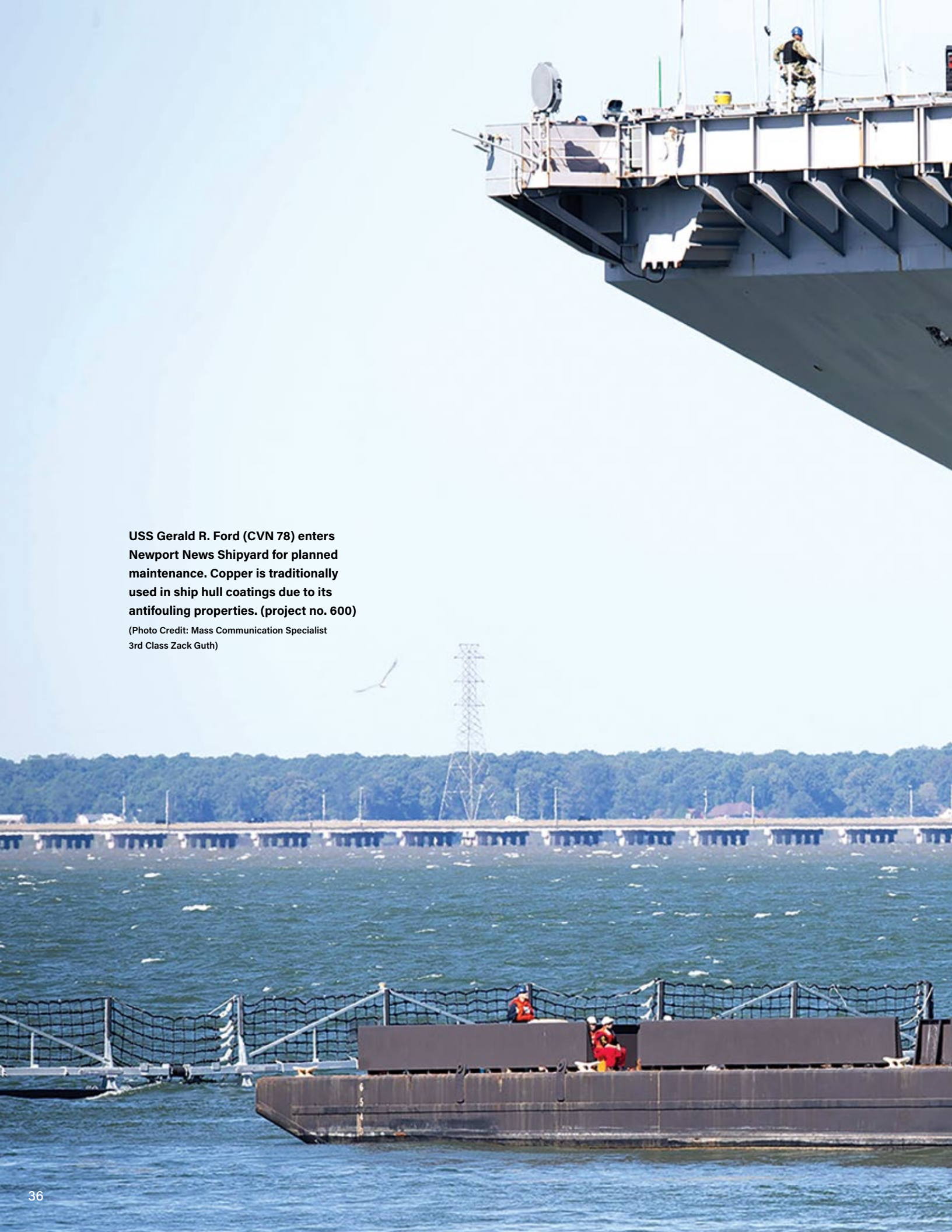
Next, sediment testing will be conducted for a marine polychaete (*Nephtys caecoides*). Based on the project team's initial data, chronic toxicity effect thresholds for many PFAS in sediment are expected to be higher than the levels observed at AFFF sites, indicating that direct toxicity to sediment species is unlikely to drive risks at these sites. However, AFFF concentrations at these sites may still pose risks to aquatic-dependent wildlife, due to uptake of PFAS into tissues of benthic invertebrates. The team will test concentrations that are at the high end of the observed range at affected sites for all 10 PFAS, and will also test two PFAS mixtures with concentrations within ranges that have been observed at Navy sites to provide sediment-to-tissue uptake values, which would indicate a risk to other aquatic life.

Throughout the project, the team will provide data to the end user community (regulators, risk assessors, site managers) via a variety of methods including publication of at least two peer-reviewed manuscripts, at relevant Navy working group meetings, and through an advisory panel created as part of the project that includes Navy RPMs as well as scientists from the EPA and the California State Water Board.

## Closed Loop, In Situ Soil Flushing at PFAS-Impacted Source Zones (project no. 602)

**Ben Rhiner, P.E. (NAVFAC EXWC)**

The goal of this effort is to demonstrate that in situ soil flushing, used in conjunction with sorption and destructive



**USS Gerald R. Ford (CVN 78) enters Newport News Shipyard for planned maintenance. Copper is traditionally used in ship hull coatings due to its antifouling properties. (project no. 600)**

(Photo Credit: Mass Communication Specialist 3rd Class Zack Guth)


42582

treatments, is a viable method for the removal and subsequent destruction of PFAS from affected soil.

PFAS chemicals can persist for years following groundwater treatment. Further, waste management entities are becoming increasingly reluctant to accept any PFAS-laden material, thereby increasing the complexity of PFAS disposal. Meeting discharge limits will ultimately be achieved through both significantly reducing the source and destroying any PFAS captured during treatment. In situ source treatment will also decrease high concentration PFAS mass stored in soils, which may decrease the chemicals' persistence in soils and groundwater down the road. This approach is more accurate and less costly than treating the resultant plume.

In situ soil flushing is a minimally invasive technology that has historically been employed for subsurface remediation, allowing for sites to reach specified cleanup goals without excavation. This technology is predicated on the use of water to mobilize chemicals bound to source zone soils, after which the resultant mixture is pumped from an extraction well for subsequent treatment and reinjection. Certain PFAS compounds adhere to clays or organic matter found in soil more readily than that of other PFAS, but it is becoming increasingly apparent that these compounds may flush out quite rapidly under augmented flow.

The first task will be laboratory testing of sample soils taken from an affected area. Upon successful completion of this task, a pilot scale trailer utilizing conventional PFAS removal strategies will be mobilized to treat source area groundwater.

Using data leveraged from another NESDI project (no. 555: Demonstrating the Effectiveness of Novel Treatment Technologies for the Removal of Poly- and Perfluoroalkyl Substances from Groundwater), the project team will further investigate the potential for onsite sorbent regeneration. Sorbent regeneration can be achieved through either direct destruction of PFAS sorbed to the filter media (e.g., thermal, electrochemical or acoustic/sonolytic treatment) or eluting the sorbed PFAS into a small liquid matrix. This study intends to demonstrate the latter concept, where small batches of PFAS-containing liquid regenerant will undergo subsequent destruction using a pilot scale sonolysis reactor developed under a NAVFAC Headquarters-funded project.

It is hoped that this process will replace or limit the expensive soil excavation method previously used for PFAS-impacted soils and will eliminate its need for disposal.

### Characterization of Antifouling Paint and Environmental Loading with Navy Dome System (project no. 603)

**Dr. Channing Bolt (NIWC Pacific)**

The goal of this project is to test copper release rates of various types and ages of antifouling hull coatings at Navy harbors to better support regulatory standard setting.

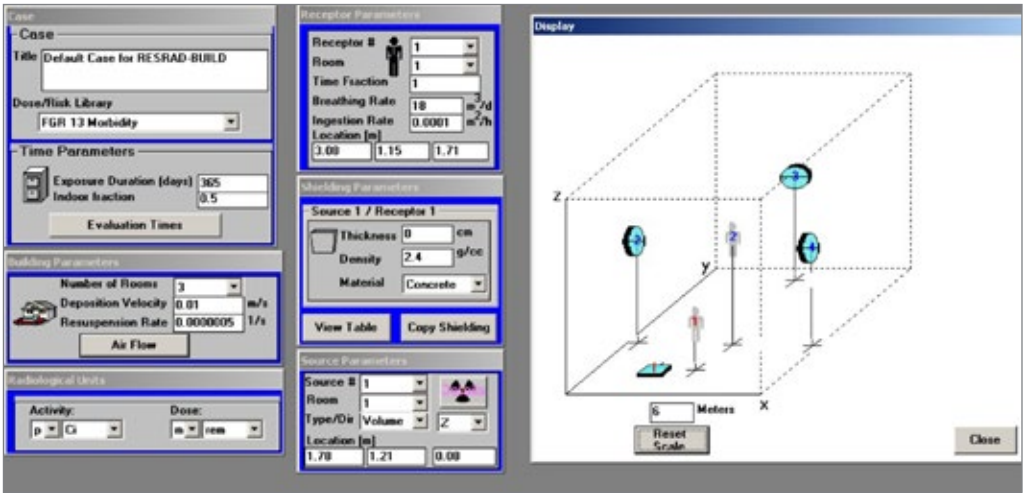
Meeting regulatory levels for copper concentrations in Navy harbors has long been an issue. One of the sources of copper is the antifouling coatings used on ship hulls. The current approach to determining the amount of copper released by these coatings is an American Society for Testing and Materials (ASTM) laboratory-based

method that utilizes artificial seawater. This method is required for all paints to be registered and approved for use as antifouling coatings; but the method significantly overestimates the release rate of copper. Moreover, the method itself specifies that the rates "are not to be used for environmental loading calculations." However, in the absence of better information and data, the ASTM data are used by regulatory authorities to calculate environmental loadings and regulate antifouling coatings. A more scientifically defensible method for calculating copper loading is needed.

Personnel from the Naval Information Warfare Center (NIWC) Pacific have developed novel methodologies to address knowledge gaps by conducting in situ assessments of leaching rates on vessel hulls. The most reliable one of these methods is known as the dome method. In this technique, an acrylic dome is positioned on a hull by a diver and connected via tubing to a peristaltic pump above the water line. The dome is adhered onto the hull with vacuum pressure, allowing the system to isolate and recirculate a fixed volume of water, over a known hull surface area, for a fixed duration. Samples are collected in 15-minute intervals, analyzed and a simple time versus concentration plot is generated to establish copper release rates.

A similar technology, the in-water hull cleaning sampling device (or hull scrubber) will be applied for measurement of particulate load from cleaning. This technique also uses a diver-applied device, with systematic pressure provided through a spring release. The device includes a shaft with a handle, that is configured for the attachment of different types of cleaning materials (i.e., brushes or abrasive pads) used for cleaning of ship hulls. Once the hull scrubber is positioned, the handle is rotated to simulate the hull cleaning process

**USS Gerald R. Ford (CVN 78) enters Newport News Shipyard for planned maintenance. Copper is traditionally used in ship hull coatings due to its antifouling properties.** (Photo Credit: Mass Communication Specialist 3rd Class Zack Guth)




**The RESRAD-BUILD software calculates radiological dose and risk incorporating site-specific parameters that would result in realistically conservative cleanup goals for U.S. Navy sites.** (Graphic Credit: Kenda Neil)

and a fixed amount of water around the hull is captured and transferred to the surface for analysis. Total copper is measured in the hull scrubber, and used for estimation of particulate mass and concentration release from the ship hull. This information is used to estimate loadings. This approach is used to describe and quantify the expected loading from cleaning and the release of copper and zinc content in the particles associated with cleaning efforts.

These methods have been tested and proven to be effective for use in determining regulatory limits, and have recently been used by the State of California Department of Pesticide Regulation. The early part of this project will improve these existing technologies.

NIWC Pacific has teamed with personnel from the Naval Sea Systems Command (NAVSEA) to identify ships with different paint ages and sample their hulls with contractor support from SEAWARD Marine.

Environmental loading quantifications estimated from measurements generated via this effort should support realistic assessment of environmental conditions, such as in Total Maximum Daily Load (TMDL) regulations, and assigning realistic and appropriate regulatory control (Uniform National Discharge Standards) of Navy discharges such as underwater ship husbandry and hull coating leachate.

This information can be included to support TMDL assessments in Navy harbors and at shoreside facilities via direct addition of the information into TMDL development, loading calculations or model improvement. A more realistic assessment of copper loadings associated with antifouling paints may lead to more lenient regulations and cost savings associated with required mitigation. The realistic loading scenarios produced by this effort should also be used for optimization of antifouling coatings lifecycle use.

## An Integrated Navy Approach to Estimate Risk and Cleanup Goals for Radionuclides Associated with Buildings at Current and Former Navy Installations (project no. 604)

**Kenda Neil (NAVFAC EXWC)**

The purpose of this effort is to develop a Navy-wide approach for estimating

risk and calculating cleanup goals for radiologically-impacted buildings.

Past radiological activities have potentially impacted infrastructure (i.e., buildings) at installations Navy-wide. At Superfund sites, the Navy's approach differs from the EPA's approach for assessing risks associated with radiologically impacted buildings and environmental media and establishing cleanup goals, which leads to delays in the schedule and increases in lifecycle costs when negotiating cleanup levels with the EPA.

Currently, there are two prevailing sets of models for estimating risk and dose from radiologically impacted infrastructure (e.g., buildings), which can lead to disparate cleanup goals. EPA's Building Preliminary Remediation Goals (BPRG) Calculator for radiological risk and Building Dose Compliance Concentration (BDCC) Calculator for radiological dose produce nonspecific and highly conservative risk estimates—often due to default assumptions not appropriate for Navy site conditions. This leads to unrealistically conservative remedial action levels. However, the Department of Energy's RESidual RADioactivity code for Buildings (RESRAD-BUILD) calculates radiological dose and risk incorporating site-specific parameters that would result in realistically conservative cleanup goals for Navy sites.

The approval and adoption of the RESRAD family of codes for deriving cleanup goals for Navy sites could speed cleanup negotiations and reduce programmatic lifecycle costs appreciably.

The project team will disseminate the results of this project to both federal and targeted non-federal sectors and stakeholders. The team will also provide radiological cleanup personnel with a set of case studies that provide an approach for conducting risk assessments and deriving appropriate cleanup levels.

## NESDI BY THE NUMBERS

### PROGRAM

665: Program participants
16: Commands supporting the program
36: Activities supporting the program

### NEEDS

949: Needs submitted
295: Needs approved
31: Percentage of needs approved
10: Commands submitting needs

### PROPOSALS

415: Pre-proposals submitted
255: Pre-proposals approved
61: Percentage of pre-proposals advanced to full proposal stage
7: Commands submitting pre-proposals
255: Full proposals submitted
182: Full proposals approved
71: Percentage of full proposals approved
6: Commands submitting full proposals

### PROJECTS

181: Projects launched
91: Participating Principal Investigators
6: Commands participating in projects
12: Activities participating in projects
13: Completed projects (in FY21)

### OTHER

3: Program Managers (Scott Mauro, Leslie Karr, Ken Kaempffe)
265: Current active website users
423: Website users since 2007

(Note: These numbers were compiled in November 2021 from data available on the NESDI website since 2007.)

## PROJECT CLOSEOUTS

Each year, the NESDI program works to transition the results of its completed projects into the ongoing operations of the Navy. Thirteen such projects have moved into this transition phase where the program looks for additional support from regional, installation and ship personnel to leverage these validated technologies where appropriate. Over the course of FY21, the NESDI program closed out the following 13 projects:

1. Demonstration of Non-Chromated Adhesive Bond Primer for Metal Repair Bonding (project no. 500)
2. Dry Dock Sediment Management (project no. 503)
3. Demonstration of New Strategies for Enhanced Monitored Natural Recovery at Navy Sediment Sites (project no. 522)
4. Structure-function Relationship and Environmental Behavior of Per- and Polyfluorochemicals from Aqueous Film-forming Foams (project no. 527)
5. Technology Evaluation and Sampling for Treatment of Perfluorochemicals (project no. 534)
6. Stable Carbon Isotopes for Tracing in situ RDX Remediation (project no. 537)
7. Utility Vault Water Treatment (project no. 541)
8. Sewer Gas Elimination Technology (project no. 548)
9. Demonstration of Optimized non-NMP (n-Methyl-2-pyrrolidone) Solvents for Immersion Chemical Depainting (project no. 549)
10. Initiation Decision Report of Laser Coating Removal on Naval Aircraft Components (project no. 557)
11. Background Analysis and Tracer Study to Identify Metal Contaminant Source Contributions to Stormwater Runoff (project no. 559)
12. Source Metal Particle Removal for Stormwater Compliance (project no. 566)
13. Business Processes and Requirements Enabling Technology Integration (project no. 567)

**Summaries of these specific project accomplishments follow.**


**P-3 Orion components were used in this NESDI project to assess the performance of a hexavalent chromium-free adhesive bond primer.** (Photo Credit: MCS Seaman Zachary Dalton)

## Demonstration of Non-Chromated Adhesive Bond Primer for Metal Repair Bonding (project no. 500)

**PRINCIPAL INVESTIGATOR:**
**Justin Massey (NAVAIR)**

The project tested and validated a non-chromated bond primer that maintains bond durability in harsh environments. The performance of the primer was validated via a demonstration at various FRCs on the F/A-18 Hornet and P-3 Orion aircraft. Based on performance, it is recommended that the tested primer (BR6747-1NC) be implemented as a drop-in replacement for use within the grit blast prior to sol-gel bond preparation applications.

The greatest benefit derived from implementing the new primer is the reduction in hazardous waste disposal costs and reduction in personnel exposure to hazardous materials. The project data and recommendations from the final report have been transferred to multiple Fleet Support Teams (FST), (including and not limited to the F/A-18 Hornet, E-2 Hawkeye, P-3 Orion, and P-8 Poseidon programs) for concurrence to use this non-chrome bond primer technology on said airframes. The project data has also been shared with Foreign Military Sales (FMS) allied countries who also plan to implement this technology through their respective aircraft organizations. This report is of significant importance to European allies who have pre-emptively requested this information due to their requirement to eliminate hexavalent chromium in accordance with the European Union Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) mandates.

**The Municipal Cleaning Vehicle.** (Photo Credit: Pat Morrow)

## Dry Dock Sediment Management (project no. 503)

**PRINCIPAL INVESTIGATOR:**
**Patrick Morrow (NSWCCD)**

This project refined a commercial-off-the-shelf (COTS) Municipal Cleaning Vehicle (MCV) manufactured by Triverus, LLC to provide a platform of tools and methods suitable for operation within the dry dock environment to reduce NPDES permit violations. The demonstration site was PSNS & IMF. The project team also developed additional tools and equipment that work in conjunction with the MCV to help loosen and collect the sediment and water stream from low-lying areas such as sand traps and troughs.

This cleaning vehicle can advance existing dry dock cleaning operations by enabling the removal, collection, and management of problematic fine particulate, and dissolved forms of contamination that are otherwise re-distributed and carried to downstream processes.

These contaminants include trace metals such as copper, lead, zinc, iron, calcium, cadmium, chromium, mercury, nickel and manganese, as well as solvents and oils. Labor requirements for deploying cleaning operations are reduced, and productivity is expected to increase with the use of more effective equipment that can achieve higher cleaning rates and efficiencies. The total cost estimate for PSNS & IMF to implement a single MCV is approximately $210,000. This is a one-time initial cost for the shipyard with annual upkeep/replacement material costs estimated at $10,000 to $15,000. PSNS & IMF is seeking acquisition funding to procure two MCV units for use in dry dock and topside cleaning and contaminant reduction efforts.

## Demonstration of New Strategies for Enhanced Monitored Natural Recovery (EMNR) at Navy Sediment Sites (project no. 522)

**PRINCIPAL INVESTIGATOR:**
**Gunther Rosen (NIWC Pacific)**

This study evaluated the ability of Clean Dredge Material (CDM) to provide a more effective and less expensive thin layer remedy. Remediation using CDM for this effort was typically referred to as natural sediment EMNR (sEMNR), to simulate accelerated natural deposition of clean sediment, resulting in a surface layer of cleaner sediment, with a natural level of contaminant binding capacity, potentially improved habitat

**Sampling a dredged material stockpile for the demonstration of natural sediment EMNR at Pearl Harbor, HI.** (Photo Credit: Gunther Rosen)

for benthic recolonization, and an immediate reduction in surface contaminant concentrations.

The costs savings associated with sEMNR are expected to be primarily associated with eliminating the need to purchase clean sand and eliminating the need to dispose of CDM. In addition, CDM provides an environmentally friendly beneficial use opportunity that may provide good public relations for the Navy.

The developed protocol was used as a guide to design and execute the mesocosm study, which employed Remedy and Recontamination Assessment (RARA) arrays recently developed under the Department of Defense's Strategic Environmental Research and Development Program (SERDP project no. ER-2537). The 10-month field study was conducted at a site (Decision Unit N-2) at PHNSY & IMF. Contaminants of concern at the site include metals (copper, lead, cadmium, zinc and mercury) and polychlorinated biphenyls (PCB).

From a lifecycle perspective, there are clear advantages to sEMNR because:

1. The capital costs are inherently lower than many other sediment remedies.
2. Costs can be further reduced by leveraging with beneficial reuse of dredge material.
3. The remedy also leverages natural processes that will continue to improve conditions at the site with minimal investment and disturbance.

## Structure-function Relationship and Environmental Behavior of Per- and Polyfluorochemicals from Aqueous Film-forming Foams (project no. 527)

**PRINCIPAL INVESTIGATOR:**
**Dr. John Kornuc (NAVFAC EXWC)**

This NESDI project was leveraged by ESTCP project no. ER-201633 and congressional plus-up funding on PFAS retardation. The contributions from the NESDI program included the benefit of additional sampling locations and analyses to provide more complete data sets. A fire fighter training area (FFTA) was sampled using high resolution sampling and analytical techniques. The objective was to determine spatial trends for PFAS associated with AFFF use at Navy sites.

The results of this study provide insight into the type of information which is needed to produce accurate conceptual site models (CSM) at PFAS-impacted sites to design better site investigations, to determine risk, to mitigate PFAS if necessary, and to make other informed site management decisions.

## Technology Evaluation and Sampling for Treatment of Perfluorochemicals (project no. 534)

**PRINCIPAL INVESTIGATOR:**
**Dr. John Kornuc (NAVFAC EXWC)**

As documented in the final report for this project—Investigation of the Effect of Prior Remedial Treatment on the Fate and Transport of PFAS Present at AFFF-Impacted Sites— column studies were conducted using AFFF-impacted soils with varying soil properties and under different treatment conditions to evaluate the effects of various remediation technologies on fate and transport, and redistribution of PFAS and their precursors at AFFF-impacted sites.

These column studies were conducted under both oxidizing and reducing conditions using activated persulfate and HRC treatments, respectively. Under all conditions, initial breakthrough occurred within 20 bed volumes which indicates that soil washing may be an option worth pursuing.

Additionally, results show slight retardation and highly leachability of PFAS under continuous flow conditions. The same trend was observed with a range of concentration levels. Hence, the annual changes in saturation level of the soil pores can have an effect on the attenuation processes for PFAS in the unsaturated soil under field conditions. Although the overall leachability of PFAS was observed by infiltration, it was also dependent on the perfluorinated carbon chain length, PFAS functionality, soil properties (such as soil organic matter) and clay content. The results also show that the PFAS present in the unsaturated zones could serve as the continuous PFAS source for the underlying groundwater.

Given that many of the laboratory studies have demonstrated high leachability of soils ex situ, soil washing could be applied as a remediation technology to remove PFAS from AFFF-impacted soils. Demonstrations of soil washing for PFAS are limited and the soil washings are performed ex situ. Although washing of large volumes of soil might be suitable to reduce the volume of PFAS-impacted waste, soil washing generates two waste streams: soil fine particles (clay rich soils), where more PFAS might be sorbed, and the concentrated leachate. Disposal or treatment of both soil fine particles and the concentrated leachate might be expensive and therefore not cost-effective. However, given the volume of PFAS-impacted soil piles that need to be disposed and because some of the landfills are not accepting the PFAS-impacted waste, informed decisions can be made to clean the soils with less fines using the soil washing method and reduce the PFAS-impacted soil that must be disposed.

Significant knowledge gaps remain in understanding the PFAS redistribution, and fate and transport during treatment at impacted sites, and these could result in uninformed decisions on strategies for site remediation. To better understand the retention processes in soils and the leachability rates there is a need for future studies on how different soil properties and infiltration rates affect the leachability of PFAS at impacted sites.

### Stable Carbon Isotopes for Tracing In Situ RDX Remediation (project no. 537)

**PRINCIPAL INVESTIGATOR:**
**Dr. Tom Boyd (NRL)**

Stable isotopes were used to assess RDX mineralization from groundwater samples amended with 13C-labled RDX. Mineralization products and their stable carbon isotope ratios ($CO_2$ and $CH_4$), dilution corrections and estimates

**Post-push sampling for bacterial mineralization products.** (Photo Credit: Tom Boyd)

for efficiency were used to determine the RDX degradation equivalents at each time-point during push-pull tests designed to assess activity under various conditions (in this demonstration, biostimulation).

The regulatory drivers required confirming contaminant degradation which was not previously possible using indirect measures (concentration change, redox and transient intermediates). In this respect, the demonstration's goals were met and results have been tacitly accepted by regulators. If provided realistic degradation rates over proper spatial and temporal scales, site managers could confidently implement remediation strategies such as monitored natural attenuation (MNA) that could result in significant savings for the DoD.

## Utility Vault Water Treatment (project no. 541)

**PRINCIPAL INVESTIGATOR:**
**Pat Morrow (NSWCCD)**

Testing and evaluation of modified commercially available Hydrocarbon and Contaminant Removal (HCOR) technology from Red Lion Chem Tech, LLC was undertaken as a means to reduce end-of-pipe pollutant concentration resulting from necessary pump-out or removal of water from utility vaults in San Diego area U.S. Navy facilities.

Nine filters were provided to the NAVFAC Southwest Division stakeholder at Naval Base Coronado, CA. Shortly thereafter, the supplier of the HCOR filters discontinued the product line without providing a replacement product.

Utility personnel at Naval Base Coronado used the HCOR filters in ad hoc applications. These uses included supporting critical decontamination efforts resulting from a major shipboard fire that occurred aboard the USS Bonhomme Richard (LHD-6). Though achieving practical, qualitative success in treating residual water from utility vaults during discrete uses, no quantitative information on specific use parameters exists.

**This NESDI project demonstrated a method to decontaminate the accumulated water in utility vaults on board Naval Base Coronado and elsewhere.**
(Photo Credit: Pat Morrow)

## Sewer Gas Elimination Technology (project no. 548)

**PRINCIPAL INVESTIGATOR:**
**Steve Fann, P.E. (NAVFAC EXWC)**

This project studied the use of the Dissolved Air System (DAS) treatment process for controlling dissolved sulfide in domestic wastewater collection systems. This process is designed to be installed at pump stations to increase dissolved oxygen (DO) concentrations in wastewater by injecting airat high pressure (approximately 60 pounds per square inch (psi) in the form of microbubbles. The microbubbles and high pressure maximize the air (oxygen) solubility in water. A technology demonstration was conducted at Naval Amphibious Base (NAB) Coronado, CA. Results of the demonstration showed that the technology can increase DO to 2 micrograms per liter (mg/L) or greater but was not able to sustain


**This dissolved air technology is being demonstrated to mitigate toxic gases from sanitary sewers onboard NAB Coronado.** (Photo Credit: Steve Fann)

it due to the cyclic discharges of wastewater containing high sulfide concentrations into the wet well that rapidly deplete the DO.

Although the DAS by itself was found to be insufficient to fully oxidize the dissolved sulfide in the wet well, it did help to reduce the ferrous chloride dosage. Results show that the dosage was reduced from 27 to 13 gallons per day. Operating DAS together with ferrous chloride injection could result in a cost saving, mainly due to the reduction of chemical costs. The calculated annual cost saving is $22,200 with a payback period of seven years.

## Demonstration of Optimized non-NMP (n-Methyl-2-pyrrolidone) Solvents for Immersion Chemical Depainting (project no. 549)

**PRINCIPAL INVESTIGATOR:**
**Joe SantaMaria (FRCSE)**

This effort evaluated commercially available non-NMP and non-methylene chloride products for depainting. The depainting products were tested on artificially-aged representative military organic coating systems. The results were compared to the legacy NMP chemical immersion depainting product used across the DoD. While the down-selected non-NMP products met all of the testing requirements of the MIL-PRF-83936C specification (Remover, Paint, Tank Type; for Aircraft Wheels, Landing Gear Components, and Other Aircraft and Support Equipment), during the execution of this project, the custodian of the MIL-PRF-83936C specification changed from Department of the Navy to the Department of the Army.

Two of the best performing products from this effort, Cee-Bee E-2013T and B&B 9201, are currently being evaluated by the Army to the requirements of a new D revision of the MIL-PRF-83936 specification.

## Initiation Decision Report of Laser Coating Removal on Naval Aircraft Components (project no. 557)

**PRINCIPAL INVESTIGATOR:**
**Steve Starnes (NAVAIR)**

The goal of this IDR was to determine the risks associated with laser depainting technologies and their applicability to U.S. Navy substrates and coating systems. This IDR includes a review and evaluation of different laser depainting systems and lists the advantages and disadvantages of using lasers for depainting. It also outlines a path forward for NAVAIR. The Non-Program Related Engineering (NPRE) Directed Energy Working Group is active in the revision of the SAE MA4872 specification (Paint Stripping of Commercial Aircraft-Evaluation of Materials and Processes).

NESDI investigators demonstrated an optimized non-NMP solvent for immersion chemical depainting as a drop-in replacement for NMP and methylene chloride use on the F/A-18F Super Hornet and other Navy platforms.
(Photo Credit: MCS Seaman Apprentice Jarrod A. Schad)

The revision of the SAE MA4872 specification is underway and includes thermal depainting methods, which will include directed energy removal methods such as laser depainting and plasma spraying. This specification can be used as a baseline for qualification and programs can conduct additional testing for platform-specific requirements.

## Background Analysis and Tracer Study to Identify Metal Contaminant Source Contributions to Stormwater Runoff (project no. 559)

**PRINCIPAL INVESTIGATOR:**
**Jim Leather (NIWC Pacific)**

The objectives of this project were to determine whether metals in stormwater runoff were naturally occurring or elevated (by either U.S. Navy or other sources) using:

1. A forensic approach that looked at statistical and geochemical distribution of metal contaminants to differentiate sources
2. A comparison technique from a recent SERDP project being conducted at an adjacent creek.

This NESDI project was leveraged with ongoing regulatory studies that were being conducted in San Diego Bay at Chollas Creek. Investigative Order (IO) R9-2015-0058 from the Regional Water Quality Control Board San Diego was issued to evaluate sediment contamination in the Chollas Creek mouth area just north of the piers at Naval Base San Diego (NBSD). The combined goals of the leveraged regulatory study and this NESDI project were to quantify the particle loading and associated chemical contaminant loads of the finer particle size fractions entering the bay from Chollas Creek and from NBSD outfalls near the mouth of the creek. The work entailed collection of large volumes of stormwater from Navy outfalls and Chollas Creek during multiple storm events followed by particle isolation, particle size fractionation and sample analysis of the isolated fractions.

This project's final report provided simple graphical techniques shown in scatter plots of one metal versus another metal, so background and contaminated samples are easier to visualize. Many uncontaminated site samples show the same ratio between metals and therefore plot as a straight line (background trend) on these plots. Contaminated site samples plot as outliers from this background trend with higher contaminant levels, and these contaminated

This NESDI project studied the applicability of current laser depainting systems on composite nose radomes and other Navy aircraft components.
(Photo Credit: Steve Starnes)

samples can serve as potential targets for remedial action. This report also compares the simple geochemical techniques used here with techniques used in a recently completed SERDP project.

The project team obtained buy-in from the RPM at the Chollas Creek demonstration site and presented the initial concepts to the regulators during Chollas Creek IO meetings.

## Source Metal Particle Removal for Stormwater Compliance (project no. 566)

**PRINCIPAL INVESTIGATOR:**
**Jim Howell (NSWCCD)**

Investigators for this NESDI project attempted to expand the application and use of MCV surface cleaning technology to address NESDI need no. N-1150-17 (Source Metal Particle Removal for Stormwater Compliance).

Personnel from the Naval Surface Warfare Center, Carderock Division (NSWCCD) conducted a site visit with NAVFAC SW and Naval Base Coronado (NBC) representatives and developed a jointly reviewed and accepted Test and Sampling Plan. In early 2019, NSWCCD delivered a MCV unit to NBC for staging and subsequent use. Resources were provided by NSWCCD for on-site support functions, including bulk waste disposal services and operator training. During this time, NBC initiated a Toxicity Reduction Evaluation (TRE) Work Plan to identify root causes of acute toxicity levels in their surrounding waters. Evaluation of the MCV was included as a possible Best Management Practice (BMP) in the TRE Work Plan. These two efforts were to work in parallel so that analytical results from this NESDI project would provide sufficient data to show the effectiveness of the MCV and allow NBC to integrate the technology as a BMP.

**Green particle tracer moving downstream away from its source.** (Photo Credit: Kevin Black)

These industrial areas onboard NAB Coronado are the priority targets to be cleaned by the MCV over the course of this NESDI project.
(Photo Credit: Jim Howell)

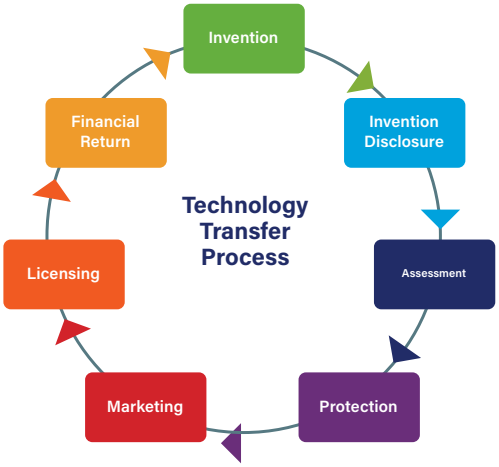
The project team struggled to secure needed on-site coordination for execution of testing because of personnel turnover, reduced execution resources, and an increasing level of effort. While this project was unable to demonstrate the effectiveness and capabilities of the MCV at NAB and NBC, the technology appears to remain a candidate for use as a BMP for on-site environmental management to prevent fine metal particulate from discharging to impacted San Diego waterways.

## Business Processes and Requirements Enabling Technology Integration (project no. 567)

**PRINCIPAL INVESTIGATOR:**
**Marty McMorrow, P.E., PMP**
**(NAVFAC EXWC)**

This project developed a model for predicting the degree to which new technologies, materials, and methods developed by the NESDI program will be adopted and integrated into U.S. Navy activities and organizations. The NESDI project database was mined for available information, and questionnaires were sent to the Principal Investigators and stakeholders of completed projects. A total of 36 completed projects were analyzed to develop logit models for the integration measures of usage, training and ROI.

The resulting predictive tools may, in turn, be used to inform NESDI's project screening process. In particular, data on complexity, command emphasis, trialability, and observability can be applied to relatively simple logit models to predict the likelihood of success in the areas of usage, training, and ROI. These probabilities can be used to inform NESDI management when deciding which projects to prioritize when faced with limited resources. While not accurate enough to be a sole determinant, the outputs of the logit models when combined with other information can serve to provide another data point for inclusion in the decision making process.




This NESDI project provided a clear, practical approach and manual/tool to enable efficient and effective integration of technology, techniques and tools.

## OUR FY22 SCHEDULE

| No. | What | When |
|---|---|---|
| 1. | Conduct NAVFAC Headquarters & OPNAV N4I Installations Division Programmatic Review | 29 – 30 November 2021 |
| 2. | Conduct First "West Coast" In-Progress Review | 26 – 28 April 2022 |
| 3. | Conduct "East Coast" In-Progress Review | 3 – 5 May 2022 |
| 4. | Announce FY23 Needs Solicitation | 1 June 2022 |
| 5. | Conduct Second "West Coast" In-Progress Review | 7 – 9 June 2022 |
| 6. | Close FY23 Needs Solicitation | 1 August 2022 |
| 7. | Screen FY23 Needs | 22 – 26 August 2022 |
| 8. | Evaluate & Rank Needs | 12 – 16 September 2022 |
| 9. | Obtain Sponsor Review & Approval of Needs | 19 September – 21 October 2022 |
| 10. | Quarterly Status Reports Due | 3 January 2022<br>4 April 2022<br>5 July 2022<br>3 October 2022 |

**Check out the NESDI website (https://epl.navfac.navy.mil/nesdi) for the latest version of our program schedule.**


**NESDI investigators demonstrated an optimized non-NMP solvent for immersion chemical depainting as a drop-in replacement for NMP and methylene chloride use on the F/A-18F Super Hornet and other Navy platforms. (project no. 557)**
(Photo Credit: MCS Seaman Apprentice Jarrod A. Schad)

## PROMOTING OUR SUCCESSES

### Quarterly "Electronic" Newsletters

*NESDI News: Highlights and Happenings*—the program's regular electronic publication—brings recent technical project achievements and regulatory concerns to the forefront, along with highlights of significant program events over the course of the year. A history of program newsletters is available on-line at https://exwc.navfac.navy.mil/Products-and-Services/Environmental-Security/NESDI/NESDI-News.


### Project Fact Sheets

In an ongoing effort to promote the program's investments, on-line fact sheets are developed that highlight "new start," ongoing and completed NESDI projects. In FY21, fact sheets for many of the program's "new start" projects were developed. These and all other project fact sheets are available for download on the program's website at https://exwc.navfac.navy.mil/Products-and-Services/Environmental-Security/NESDI/Project-Highlights.


## Enhancements to the Program's Website

Each year, the NESDI program's webmaster (Eric Rasmussen) continues to improve the performance of our website. In particular and over the course of FY21, Eric implemented the following enhancements:

### MIGRATED TO THE CLOUD

The program's website was migrated to Microsoft's Azure cloud which provides overall improvements in security and reduction in maintenance costs.

### ENHANCED PRE-PROPOSAL SUBMISSIONS

Eric enhanced the processing of pre-proposal submissions by automating the assignment of Principal Investigators. This replaced a manual operation and provides investigators with instant access to their submissions.

### IMPLEMENTED ADMINISTRATIVE FUNCTIONALITY

Eric also implemented administrative functionality that provides the ability to drill down and access specific documentation, such as final reports, for all projects in the program's portfolio. This information no longer has to be extracted one project at a time.

### RESPONDED TO FEEDBACK

Eric also implemented multiple fixes/ improvements based on feedback from program participants including clarifying requirements provided in automated emails and augmenting the data delivered in reports and data exports.

## FOR MORE INFORMATION

For more information about the operation of the NESDI program, contact Ken Kaempffe, the NESDI program manager, or members of the TDWG.


**Kaempffe, Ken (Chair)**
**NAVFAC**
805-982-4893
kenneth.c.kaempffe.civ@us.navy.mil

**Bixler, Christy**
**CNIC**
202-685-9313
christy.d.bixler.civ@us.navy.mil

**Earley, Pat**
**NIWC**
619-553-2768
patrick.j.earley.civ@us.navy.mil

**Harre, Karla**
**NAVFAC**
805-982-2636
karla.j.harre.civ@us.navy.mil

**Henning, Jeff**
**NAVSUP**
717-605-2861
jeffrey.a.henning.civ@us.navy.mil

**Hertel, Bill**
**NAVSEA**
301-227-5259
william.m.hertel4.civ@us.navy.mil

**Jordan, Kristin**
**NAVSEA**
202-781-2883
kristin.a.jordan.civ@us.navy.mil

**McCaffrey, Bruce**
**Consultant**
773-376-6200
brucemccaffrey@sbcglobal.net

**Rasmussen, Eric**
**NAVAIR**
732-323-7481
eric.w.rasmussen6.civ@us.navy.mil

**Webb, Tom**
**NAVFAC**
805-982-2574
thomas.h.webb.civ@us.navy.mil

**Webber, Cindy**
**NAVAIR**
760-939-2060
cynthia.k.webber.civ@us.navy.mil

**Youngers, Luzmarie**
**NAVAIR**
904-790-6382
luzmarie.youngers.civ@us.navy.mil



Document preparation assistance and graphic design services were provided by Bruce McCaffrey Consulting, Inc.


**AVAILABLE FOR DOWNLOAD AT:**
**HTTPS://EPL.NAVFAC.NAVY.MIL/NESDI**

Ken Kaempffe
Naval Facilities Engineering
and Expeditionary Warfare Center
1000 23rd Avenue
Port Hueneme, CA 93043

Accomplishments of the

# NAVY ENVIRONMENTAL SUSTAINABILITY DEVELOPMENT TO INTEGRATION PROGRAM

## 2021 YEAR IN REVIEW REPORT

**Available for download at:**
**https://epl.navfac.navy.mil/nesdi**