2019
YEAR IN REVIEW REPORT

BUILDING ALLIANCES WITH
OUR STRATEGIC PARTNERS

NAVY ENVIRONMENTAL SUSTAINABILITY DEVELOPMENT TO INTEGRATION PROGRAM

CONTENTS

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 (6.4) program. The NESDI technology demonstration and validation program is sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45) and managed by the Naval Facilities Engineering Command (NAVFAC). The program is the Navy's complement to the Environmental Security Technology Certification Program which demonstrates and validates technologies important to the tri-Services, U.S. Environmental Protection Agency and the Department of Energy.

BUILDING ALLIANCES WITH OUR STRATEGIC PARTNERS

Ken Kaempffe

Welcome to the Navy Environmental Sustainability Development to Integration (NESDI) program's fiscal year (FY) 2019 Year in Review report.

In accordance with this year's theme—*Building Alliances With Our Strategic Partners*—we highlight the team we have assembled from organizations across the Navy and elsewhere to help us execute our projects—all hands working hard to resolve the most difficult and persistent environmental issues that we face.

To subscribe to *NESDI News*—the NESDI program's quarterly electronic newsletter—visit https://epl.navfac.navy.mil/nesdi then select "Sign up for *NESDI NEWS*."

Each of the organizations that participate in the NESDI program bring special expertise. Our in-house Navy subject matter experts possess a vast amount of technical and corporate knowledge, which is essential to the ongoing success of the program. Individual projects are regularly executed in collaboration with experts from various academic and research institutions, as well as private sector consulting firms and relevant industries. The success of our network of partnerships is demonstrated via a number of NESDI-funded efforts, including many of the projects summarized in this annual report. Among the successful projects highlighted in later sections of this report are:

- NAVFAC Engineering and Expeditionary Warfare Center (EXWC), Project no. 540: *Smart Electronic Tools for Navy Environmental Compliance Monitoring and Reporting*. The objective of this project is to evaluate the performance of smart mobile devices such as tablets and web-based environmental management systems (EMS) such as the Navy's EMSWeb to facilitate efficient data collection while performing audits and inspections at Navy facilities. Feedback from end users has been positive and a strong desire still exists to increase the use of tablets for field data collection.
- Naval Information Warfare Center (NIWC) Pacific, Project no. 522: *Demonstration of New Strategies for Enhanced Monitored Natural Recovery at Navy Sediment Sites*. This project is investigating the use of clean dredged material as both a cost effective and improved substrate relative to clean sand for thin-layer capping for the remediation of moderately contaminated sediments at Navy sites. This study indicates that the use of clean dredged material is a cost-effective and potentially superior substrate.

- Naval Air Systems Command (NAVAIR), Project no. 542: *Naval Air Systems Command Solutions for Engine Washing*. The objective of this project is to customize and demonstrate a new engine washing technology for use at aircraft maintenance facilities. The EcoPower engine wash system has been successfully demonstrated with a number of aircraft platforms planning to incorporate this technology into their ongoing maintenance operations.

This report also includes a case study of another successful NESDI project, *Enhanced Trivalent Chromium Pretreatment for Improved Coloration and Corrosion Performance of Aluminum Substrates* (project no. 514). The case study describes the project from beginning to end, from its original need submittal to the ultimate integration of an enhanced corrosion resistant coating into the maintenance operations at the Fleet Readiness Center Southeast and elsewhere. I would encourage you to read through this case study to observe a project as it proceeds through the four-phase NESDI management process.

Additionally, in this report we highlight the 15 "new start" projects that we launched in FY19. You can read more about all of our projects by selecting the projects tab on our website at:

- Our public website: https://www.navfac.navy.mil/nesdi
- Our restricted website: https://epl.navfac.navy.mil/nesdi (Common Access Card required)

We need your help identifying environmental requirements and implementing the results of our various projects into the ongoing operations of the Navy. So, whenever you can, find a way to use the technologies we demonstrate and the research that we sponsor. Specifically, you can participate in our process and play a vital role by doing any or all of the following:

1. Submitting an environmental need by the end of July of each year (at https://epl.navfac.navy.mil/nesdi/Needs.aspx).
2. Reviewing technologies as they are being developed and providing input to the Principal Investigators and our management committee—the Technology Development Working Group (TDWG).
3. Supporting the integration of our products in your organization or at your installation.
4. Serving as a Principal Investigator on one of our projects.
5. Providing a demonstration site for one of our projects.
6. Staying up-to-date on program activities by regularly visiting our websites.

As the Navy's 6.4 environmental technology demonstration and validation program, we're always looking for ways to do things better and more efficiently as we continue to address the Navy's most difficult and persistent environmental challenges. So if you've got some ideas for us to consider, please contact me or the appropriate member of our TDWG. (See a listing of TDWG personnel at the end of this report.)

I hope you find this Year in Review report to be a valuable resource as you search for additional insights into our projects and the overall operation and continued success of our program in FY20 and beyond.

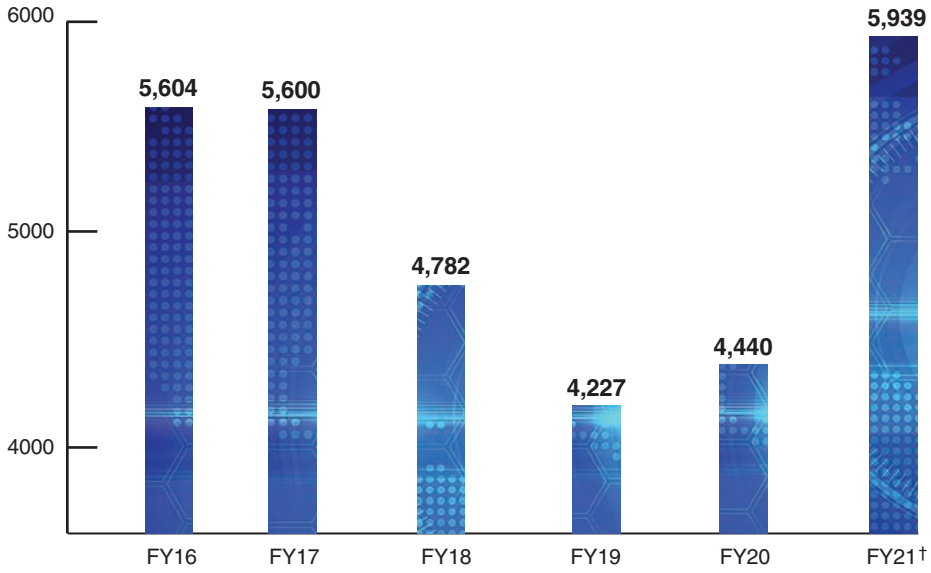
Ken Kaempffe, Program Manager
ken.kaempffe@navy.mil

FINANCIAL HIGHLIGHTS

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) 2016 through FY20, as well as the projected funding level for FY21.

PROGRAM FUNDING (FY16 – FY21)



† Projected

1. Future year funding based on 2020 Department of Navy NESDI Budget Exhibit dated 11 June 2018.
2. Funding in thousands of dollars.

THE NESDI PROGRAM PROCESS

1 COLLECT, VALIDATE & RANK NEEDS

Timeframe: Every Summer/Fall

Unresolved Environmental Issues from End Users

↓

Validated Needs

2 COLLECT, EVALUATE & RANK PROPOSALS

Timeframe: Every Winter/Spring

Draft Proposals from Principal Investigators

↓

Funded Projects

3 EXECUTE PROJECTS

Timeframe: Ongoing
Duration: 2-3 years

User Validated Project Plans from Principal Investigators

↓

Successfully Demonstrated and Validated Projects

4 INTEGRATE SOLUTIONS

Timeframe: Ongoing

Support from End Users & Technical Authorities

↓

Fleet-Transitioned Projects

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 products and other solutions.

In this Year in Review report, we are profiling an already-executed NESDI project to demonstrate how the four phases of the program's management process evolves over the course of a real life NESDI project. In this case, we're highlighting our effort to recolor a non-hexavalent chromium conversion coating (eTCP) that makes it easier for maintenance artisans to visually confirm that the desired coating has been thoroughly applied (usually to the outer moldline of an aircraft). This effort is in-line with other efforts across the U.S. Navy to eliminate the use of hexavalent chromium – a known carcinogen.

THE NESDI PROGRAM PROCESS

The four phases of the program's management process are described in the pages that follow and include the details behind an already-executed NESDI project to demonstrate how this process evolves over the course of an actual NESDI project.

COLLECT, VALIDATE & RANK NEEDS

Unresolved Environmental Issues from End Users

Validated 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 isn't addressed.

Hexavalent chromium—a known carcinogen—is still utilized today in the Navy's conversion coating processes. But a safer alternative to hexavalent chromium—the chemically benign trivalent chromium—is being actively pursued by NESDI investigators.

Colorized trivalent chromium pretreatment (TCP) for improved quality control was first identified and documented by Craig Matzdorf—the then-Head of the Corrosion and Non-Destructive Inspection Branch within the Materials Engineering Division, Naval Air Warfare Center – Aircraft Division (NAWC-AD) Patuxent River, MD. (Craig is also the original TCP patent holder). Craig secured the first two-component TCP patent in 1994. Development of TCP was the first step in reducing the use of hexavalent chromium in the corrosion prevention process. The importance of the new process was confirmed by the Navy's three primary Fleet Readiness Centers (FRC) and documented by members of the Navy's enterprise corrosion team—an informal group of materials engineers who work on common corrosion-related issues.

Early demonstration and validation of TCP was performed at the Fleet Readiness Center East (Cherry Point, NC). A TCP formulation was spray applied to an H-53 Super Stallion helicopter's outer aluminum surfaces prior to the application of primer and topcoat paint.

The original TCP formulation was spray applied to an H-53 Super Stallion helicopter's outer aluminum surfaces prior to the application of primer and topcoat paint. (Photo Credit: Mass Communication Specialist 1st Class Zachary Anderson)

According to FRC Southeast's electroplating and surface finishing shop supervisor, "It was really hard to figure out whether the TCP coating had been applied or not. The applied substrate didn't look all that different from the bare substrate."

This particular conversion coating (TCP) is applied to aluminum, aluminum alloys and other substrates with a concentration on the outer-moldlines (the "outside skin") of the aircraft. The coating provides a base for the primer and improves corrosion resistance and adhesion of the primer.

In 2014, the enterprise corrosion team realized that there was still a need to improve the new TCP coatings in use at all three of its primary FRCs. The team turned to Peter Sheridan, a senior materials engineer at FRC Southeast, and the NESDI program to identify and document the following need as presented in Peter's July 2013 submission (no. N-0952-14: Trivalent Chromium Conversion Coating — Enhanced Coloration of Aluminum Substrates):

> "Currently hexavalent chromium is utilized in conversion coating immersion tank process. Hexavalent chromium is a carcinogen which is known to be harmful to workers and the environment. An alternative chemical to hexavalent chromium is trivalent chromium. Trivalent chromium is chemically benign and therefore safer than hexavalent chromium."

Peter Sheridan air drying an eTCP-coated panel at FRC Southeast.
(Photo Credit: Sjon Westre)

One of the major hindrances in the original implementation of trivalent chromium to the tank immersion process is the inability to visually confirm that the TCP was successfully applied. Widespread TCP usage is impeded by the lack of an obvious color change upon application. A proper color additive could aid in the quality assurance evaluation of conversion coated parts by resulting in a perceptible color change after application.

According to FRC Southeast's electroplating and surface finishing shop supervisor, "It was really hard to figure out whether the TCP coating had been applied or not. The applied substrate didn't look all that different from the bare substrate."

Evaluation of a proper color additive is required with defined performance

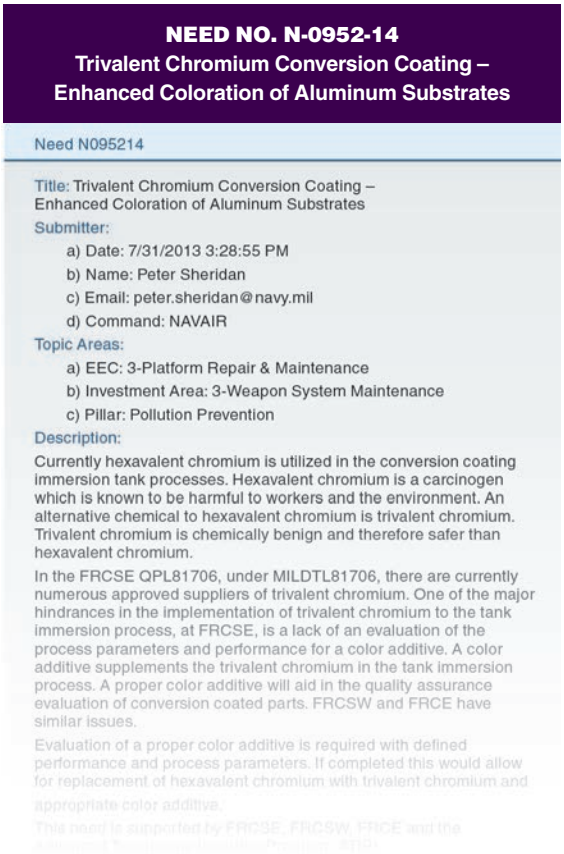
and process parameters. If completed, this would allow for replacement of hexavalent chromium with trivalent chromium and the appropriate color additive.

In addition to support from all three primary Navy FRCs (FRC East, FRC Southeast and FRC Southwest), representatives from the Advanced Technology and Innovation (ATI) team also reinforced the need for this demonstration. The ATI team serves as the FRC integrating entity for initiatives with high Technology Readiness Levels (TRL) that have cost, environmental and/or readiness benefit to FRC-level maintenance.

Peter's documentation also included insights into the ramifications if the need is left unaddressed, key policy or regulatory drivers, any suggested solutions to the need as well as the timeframe for a solution before a major mission or operational impact occurs.

Once the need was submitted, the program's management committee—the TDWG—convened to validate and then rank it along with the other needs submitted during the 2014 solicitation period (64 needs in all). During the initial screening of need no. N-0952-14, TDWG members wondered about the benefit associated with solving this need and what precisely would be demonstrated. In their roles as the Naval Air Systems Command (NAVAIR) representatives on the program's TDWG, Cindy Webber and Lynn Cahoon (now retired) followed up with their own Fleet contacts to verify the relative priority of this need and gather insights from other FRC personnel on their respective support for this need.

Once the screening process is complete, the TDWG sets a ranking for each need—either high, medium or low. The team assigned a ranking of 'medium' to this



NEED NO. N-0952-14
Trivalent Chromium Conversion Coating – Enhanced Coloration of Aluminum Substrates

Need N095214

Title: Trivalent Chromium Conversion Coating – Enhanced Coloration of Aluminum Substrates

Submitter:

a) Date: 7/31/2013 3:28:55 PM
b) Name: Peter Sheridan
c) Email: peter.sheridan@navy.mil
d) Command: NAVAIR

Topic Areas:

a) EEC: 3-Platform Repair & Maintenance
b) Investment Area: 3-Weapon System Maintenance
c) Pillar: Pollution Prevention

Description:

Currently hexavalent chromium is utilized in the conversion coating immersion tank processes. Hexavalent chromium is a carcinogen which is known to be harmful to workers and the environment. An alternative chemical to hexavalent chromium is trivalent chromium. Trivalent chromium is chemically benign and therefore safer than hexavalent chromium.

In the FRCSE QPL81706, under MILDTL81706, there are currently numerous approved suppliers of trivalent chromium. One of the major hindrances in the implementation of trivalent chromium to the tank immersion process, at FRCSE, is a lack of an evaluation of the process parameters and performance for a color additive. A color additive supplements the trivalent chromium in the tank immersion process. A proper color additive will aid in the quality assurance evaluation of conversion coated parts. FRCSW and FRCE have similar issues.

Evaluation of a proper color additive is required with defined performance and process parameters. If completed this would allow for replacement of hexavalent chromium with trivalent chromium and appropriate color additive.

This need is supported by FRCSE, FRCSW, FRCE and the

In July 2013, Peter Sheridan followed the NESDI program's template to submit the need for a proper color additive to aid in the quality assurance evaluation of conversion-coated parts.

need and specified that any pre-proposals would need to be clear on the demonstration and validation of the color addictive that will be done and identify the specific potential benefits to the Navy of recoloring the existing TCP formulation.

This and other ranked needs were sent along to the NESDI program's resource sponsor—the Chief of Naval Operations Energy and Environmental Readiness Division (OPNAV N45)—for the review, comment and approval by their resident subject matter experts. Upon receiving OPNAV N45 approval for this need, the TDWG included it as a priority need in its 2014 request for pre-proposals.

COLLECT, EVALUATE & RANK PROPOSALS

Draft Proposals from Principal Investigators

Funded Projects

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

The TDWG first requests, collects and reviews short "pre-proposals," and then requests more detailed, "full" proposals. The TDWG then recommends to the program's resource sponsor (OPNAV N45) which proposals should receive program support.

In response to the program's request for a pre-proposal to address the challenges presented in need no. N-0952-14, Peter Sheridan submitted a brief (two-page) pre-proposal (no. 197: Enhanced Trivalent Chromium Pretreatment (eTCP) for Improved Coloration and Corrosion Performance of Aluminum Substrates). Like all NESDI pre-proposals, this pre-proposal included a discussion of the problem to be addressed, a brief description of the solution (technology) to be demonstrated and validated, an estimate of the associated costs, an explicit statement of the intended benefits to the Navy, as well as a proposed approach to successfully transition this technology beyond the original proposed demonstration site (FRC Southeast).

During the TDWG's review of this pre-proposal, it was determined that all primary FRCs were on-board with the need to add color to the existing TCP formulation. As a result, the TDWG requested a follow-on full proposal that included an explicit discussion about how integration will occur at all FRCs including NAVAIR Authorization Letters, Local Process Specifications (LPS) and other methods of sanctioning the adoption of the eTCP.

Peter Sheridan then submitted full proposal no. 124. In addition to the information included in the pre-proposal, NESDI full proposals also include details about the proposed technology to be demonstrated and validated including a discussion of the technical objective(s) to be achieved, a discussion of the technology's maturity level, a detailed proposed technical approach as well as a discussion of the potential risks and associated mitigation strategies. Finally, the full proposal includes a schedule of milestones and funding required by performer for each fiscal year of the proposed effort.

As part of the review of Peter's full proposal, Cindy Webber convened a conference call with a number of representatives from the Navy's primary FRCs to sanction the approach presented therein. Craig Matzdorf also reviewed an earlier draft of the full proposal and provided concurring input.

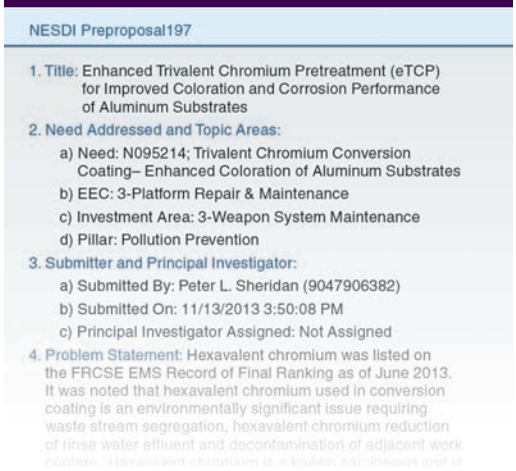
During its final review of this full proposal, the TDWG also posed a number of questions to be addressed in the project management plan for this newly-awarded project:

1. Is this merely a color change or will it require a reformulation (and reauthorization) of the product?
2. How large does the test matrix need to be? Do we only need to verify that the new color won't affect the current formulation of the eTCP? If so, the test matrix should be relatively straightforward.
3. Does the projected savings include all uses of eTCP? And what are the origins of these savings (e.g., personal protective equipment doesn't need to be used, no special safety measures are required)?
4. With regard to the waste generated, are there special handling requirements of the dyed product?
5. How does this effort dovetail into SERDP's and ESTCP's initiatives to eliminate the use of hexavalent chromium?
6. What are the respective roles for personnel at locations other than the FRC Southeast demonstration site (including Pax River, North Island and Cherry Point)?
7. What is the appropriate place to insert a "go/no go" decision (in the event the laboratory testing of the dyed eTCP does not satisfy performance requirements and would require an actual reformulation of the product)?

And again at this full proposal stage, the TDWG reminded Peter to include in his project management plan details on the methods that will be required to sanction the use of the dyed eTCP (including the General Series and/or Type/Model/Series maintenance manuals and LPSs that will need to be updated to reflect the use of the reformulated product).

All new start projects must be approved by the NESDI program's resource sponsor OPNAV N45. Peter's full proposal was submitted to OPNAV N45 by the TDWG and it was approved to become a new start project.

NESDI PRE-PROPOSAL 197
Enhanced Trivalent Chromium Pretreatment (eTCP) for Improved Coloration and Corrosion Performance of Aluminum Substrates

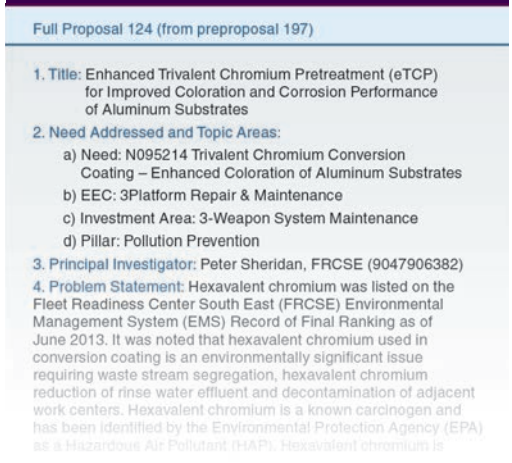


NESDI Preproposal197

1. Title: Enhanced Trivalent Chromium Pretreatment (eTCP) for Improved Coloration and Corrosion Performance of Aluminum Substrates
2. Need Addressed and Topic Areas:
   a) Need: N095214; Trivalent Chromium Conversion Coating– Enhanced Coloration of Aluminum Substrates
   b) EEC: 3-Platform Repair & Maintenance
   c) Investment Area: 3-Weapon System Maintenance
   d) Pillar: Pollution Prevention
3. Submitter and Principal Investigator:
   a) Submitted By: Peter L. Sheridan (9047906382)
   b) Submitted On: 11/13/2013 3:50:08 PM
   c) Principal Investigator Assigned: Not Assigned
4. Problem Statement: Hexavalent chromium was listed on the FRCSE EMS Record of Final Ranking as of June 2013. It was noted that hexavalent chromium used in conversion coating is an environmentally significant issue requiring waste stream segregation, hexavalent chromium reduction of rinse water effluent and decontamination of adjacent work

Peter Sheridan followed the NESDI program's template to submit a short (2-3 pages) and concise pre-proposal to demonstrate and validate an eTCP with a proper color additive.

NESDI FULL PROPOSAL 124
Enhanced Trivalent Chromium Pretreatment (eTCP) for Improved Coloration and Corrosion Performance of Aluminum Substrates



Full Proposal 124 (from preproposal 197)

1. Title: Enhanced Trivalent Chromium Pretreatment (eTCP) for Improved Coloration and Corrosion Performance of Aluminum Substrates
2. Need Addressed and Topic Areas:
   a) Need: N095214 Trivalent Chromium Conversion Coating – Enhanced Coloration of Aluminum Substrates
   b) EEC: 3Platform Repair & Maintenance
   c) Investment Area: 3-Weapon System Maintenance
   d) Pillar: Pollution Prevention
3. Principal Investigator: Peter Sheridan, FRCSE (9047906382)
4. Problem Statement: Hexavalent chromium was listed on the Fleet Readiness Center South East (FRCSE) Environmental Management System (EMS) Record of Final Ranking as of June 2013. It was noted that hexavalent chromium used in conversion coating is an environmentally significant issue requiring waste stream segregation, hexavalent chromium reduction of rinse water effluent and decontamination of adjacent work centers. Hexavalent chromium is a known carcinogen and has been identified by the Environmental Protection Agency (EPA) as a Hazardous Air Pollutant (HAP). Hexavalent chromium is

Once his pre-proposal (no. 197) was reviewed and approval by the NESDI program's management committee, Peter Sheridan submitted a longer (8-page) full proposal that provided the additional and necessary details about his proposed effort to find a suitable color additive for eTCP.

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 implementation of any NESDI project is the completion of the program's project management plan template. Project management plans contain four chapters including a summary 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.

Once the project management plan for project no. 514 had been prepared and approved by the TDWG, Peter Sheridan launched his efforts in fiscal year (FY) 2015 on this project by prescreening the available commercial-off-the-shelf products (dyes), evaluating three TCP manufacturers and three dyes and processing over 200 test specimens. In the second year of the project, Peter down-selected the best performing TCP and dye (CHEMEON's TCP-HF and CC-600) by conducting salt fog testing and paint adhesion evaluation. He also developed an analytical method for determining the appropriate concentration of the dye.

Efforts in FY16 included laboratory testing at NAWC-AD Patuxent River to validate Peter's own results followed in FY17 with efforts to optimize the best performing eTCP from the FRC Southeast and NAWC-AD Patuxent River results and perform the necessary panel testing for corrosion resistance, paint adhesion and color change post-application.

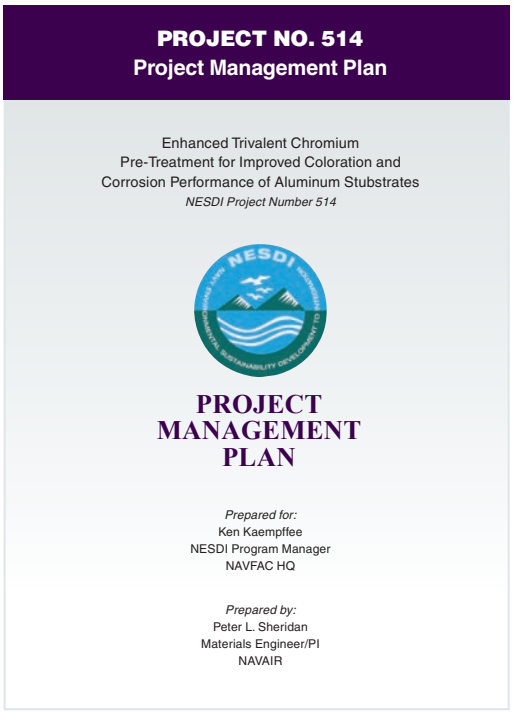
Following the extensive tests conducted by scientists from FRC Southeast and NAWC-AD Patuxent River, investigators discovered challenges with maintaining the eTCP bath stability (they were experiencing heavy precipitation and poor corrosion resistance), the lack of a uniform color change

post-application, problems with the transfer of the dye after wiping and a paint adhesion risk associated with the wiping of the dye.

As a result, FRC Southeast entered into its first-ever Cooperative Research and Development Agreement (CRADA) with CHEMEON Surface Technologies in FY17. The purpose of this CRADA was to design, develop, test and implement the colorized TCP (eTCP) as a pretreatment of aluminum and aluminum alloys, evaluate the effectiveness of various delivery mechanisms (spray application, ready to use (RTU) solutions, touch-up pens and kits) and implement eTCP on other substrates as a post-treatment. These efforts were focused on addressing the roadblocks listed above and meeting the Navy's performance requirements for the eTCP.

After the first year of the CRADA, investigators had laboratory tested 30 new dyes, found that 15 of those dyes produced perceptible color change post-application but only two of the dyes tested (blue and violet) produced acceptable corrosion resistance. This testing was followed by a reformulation of the eTCP with the blue and violet dyes and collaborative testing conducted at CHEMEON's laboratories in Minden, NV. Although both dyes met military specification (MIL-SPEC) requirements for corrosion resistance, the blue dye required adjustment of the formulation to pass salt fog testing whereas the violet dye passed salt fog testing without any modification of the original chemistry.

This CHEMEON laboratory testing was followed by the testing of coated test panels in the salt fog chamber at FRC Southeast's Materials Engineering Laboratory as well as beach exposure of the primed test panels at the Kennedy Space Center.


PROJECT NO. 514
Project Management Plan

Enhanced Trivalent Chromium
Pre-Treatment for Improved Coloration and
Corrosion Performance of Aluminum Substrates
NESDI Project Number 514

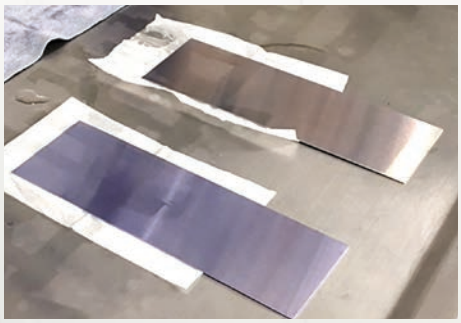
PROJECT MANAGEMENT PLAN

Prepared for:
Ken Kaempffee
NESDI Program Manager
NAVFAC HQ

Prepared by:
Peter L. Sheridan
Materials Engineer/PI
NAVAIR

In the fall of 2014, Peter Sheridan followed the NESDI program's template to submit a project management plan which provided details on his intended efforts to demonstrate and validate a proper color additive to aid in the quality assurance evaluation of conversion-coated parts.

Comparison of dyed panels at the CHEMEON laboratory. Note the distinct color difference among the dyed panels. (Photo Credit: Sjon Westre)



Comparison of an eTCP-coated panel with a TCP-coated panel at FRC Southeast.
(Photo Credit: Peter Sheridan)

Peter Sheridan primes eTCP violet panels at FRC Southeast.
(Photo Credit: Steve Taylor)

Peter Sheridan applies eTCP to aircraft missile launcher at FRC Southeast as part of this NESDI project's demonstration and validation. (Photo Credit: Joe Santa Maria)

The eTCP technology transition is being executed initially at FRC Southeast within the Electroplating Work Center. The work center has established processing capability to include a complete line of preparatory solutions and a tank of the eTCP violet chemistry. As part of the technology transition, the eTCP process tank has been monitored and sampled by personnel from FRC Southeast's Materials Engineering Laboratory to determine critical parameters such as solution depletion (how quickly constituents in the bath chemistry are used up during metal processing), replenishment cycles and general process control.

In parallel to FRC Southeast collection usability and process control data, NAWC-AD personnel will be performing qualification testing of eTCP to MIL-DTL-81706 and MIL-DTL-5541. FRC Southeast personnel will ensure technology transition through updating Local Process Specifications (LPS/JX 320 and LPS/JX 650), training work center artisans in eTCP processing parameters and process control testing eTCP on a routine basis to ensure compliance to military specification parameters.

INTEGRATE SOLUTIONS

Support from End Users & Technical Authorities

Fleet-Transitioned Projects

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.

In FY19, project investigators completed the testing of an eTCP pen on aluminum for touch-up and repair applications. FRC Southeast currently has a fully operational eTCP process line which consists of surface preparation process tanks, rinse tanks and an eTCP processing tank. In addition, CHEMEON engineers are exploring packaging options for the reformulated product (including an RTU solution in a 55-gallon drum or a 100 percent concentrate that would require dilution). Efforts in FY19 also included the publication of an article entitled "Chemeon's eTCP Offers Visual Verification for Coated Parts" in *Products Finishing* magazine (available for download at https://www.pfonline.com/articles/chemeons-etcp-offers-visual-verification-for-coated-parts).

Prior to submitting the eTCP for military specification (MIL-DTL-81706) qualification, the CHEMEON team needed to generate a data package demonstrating eTCP's performance against the specification's requirements. The data showed that the eTCP met or exceeded specification requirements and that formal submission to NAWC-AD Patuxent River for qualification was acceptable. The eTCP was submitted to NAWC-AD for MIL-DLT-81706 qualification across multiple application methods—the immersion (RTU), spray, brush/wipe and in a touch-up pen applicator. Multiple application methods are used during aircraft overhaul at an FRC. For example, spray application is used to coat exterior aluminum surfaces, immersion is used to treat disassembled components and a wipe/brush or pen applicator is used on the production assembly lines to spot-treat bare aluminum areas.

Additionally, FRC Southeast personnel were able to repurpose a 125-gallon TCP tank in their component shop as a replacement for a chromate conversion coating tank.

Products Finishing **magazine article**

Chemeon's eTCP Offers Visual Verification for Coated Parts

Coating has safe trivalent chemistry and distinctive violet-blue hue.

ANGELA OSBORNE
Managing Editor, *Products Finishing*

Chemeon Surface Technology knew it needed to find another way to help pretreatment users move away from hexavalent chromium coatings. While hexavalent chrome has an identifiable yellow-gold hue, TCPs have been colorless or nearly so. Chemeon has a patent pending with its eTCP chemistry that provides a distinct visual colorization that indicates aluminum and other light metal parts are coated and protected.

"There is a substantial quality control problem if you can't tell the coating has been applied," says Dr. Sjon Westre, vice president of technology at Chemeon. "In the past, we've relied on training and spot tests to answer that concern, but the lack of color has been a large barrier to implementation."

Chemeon currently offers a hex-free product (TCP-HF) that has approvals for many aerospace and military applications. The eTCP is a colored version of TCP-HF that it developed to exhibit visual identification for quality control purposes. "Our invention solved the problem of creating a color, while still providing very good performance," says Westre. "The corrosion protection of eTCP is quite a bit better than the TCP coatings."

The product protects aluminum and other light metals from corrosion by

This article from *Products Finishing* magazine highlights the collaboration between personnel from FRC Southeast and CHEMEON to develop a dyed version on an eTCP that meets the Navy's performance requirements.

(For reference, the FRC Southeast hexavalent chromium conversion coating tank is approximately 500 gallons.) The project team used an iterative process to scale-up the eTCP in an industrial setting (in a smaller tank first before increasing to a large volume tank) that results in less material being used, lower implementation costs and less hazardous waste generated over the course of the demonstration.

The long-term goal is to transition eTCP into FRC Southeast's automated process line where tank sizes are approximately 1,800 gallons. NAWC-AD Patuxent River is also conducting two studies to optimize a TCP formulation and analyze the effect of temperature and pH of rinse water baths to produce a non-chromate immersion process that demonstrates consistent corrosion performance on par with the chromate control. Until non-chromate conversion coatings are widely available, eTCP provides a viable alternative and allows FRC Southeast and other maintenance facilities to migrate away from hexavalent chromium-containing coatings.

Implementation will continue to occur through development of engineering documents to include use of eTCP for conversion coating of aircraft components, support equipment and weapons including the update of "LPS/JX 320 Conversion Coatings for Aluminum and Aluminum Alloys" to include eTCP and modifications to the appropriate MIL-SPECs.
In addition, hazardous materials authorized use lists for work centers performing

NEED NO. N-1248-19
Elimination of Hexavalent Chromium from Conversion Coating Processes for Electronic Applications at Fleet Readiness Centers and NIWC Overhaul Depots

Need N124819

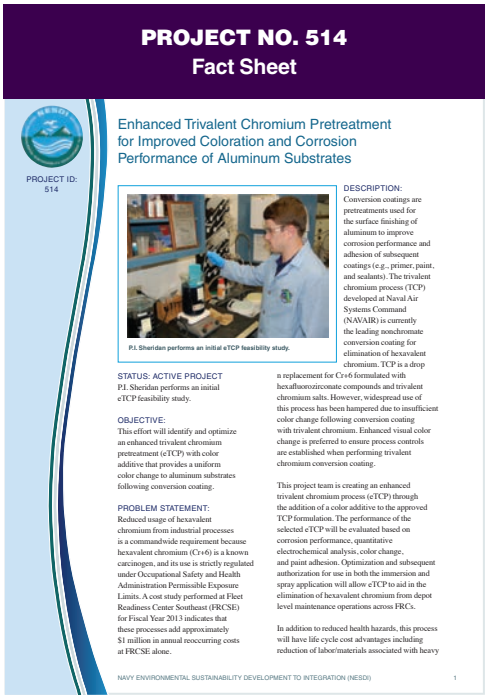
Title: Elimination of Hexavalent Chromium from Conversion Coating Processes for Electronic Applications at Fleet Readiness Centers and C4ISR Overhaul Depots

Submitter:
a) Date: 7/27/2018 10:56:14 AM
b) Name: Felicia Johnson
c) Email: felicia.johnson1@navy.mil
d) Command: SPAWAR

Topic Areas:
a) EEC: TBD
b) Investment Area: TBD
c) Pillar: TBD

Description:
Metal finishing processes are performed at all major NAVAIR Fleet Readiness Centers (FRC) and SPAWAR C4ISR Overhaul and Restoration Depots. Conversion coatings are a common process performed at each of these facilities, described as thin films created from a reaction of the metal surface when exposed to a chemical. The purpose of these coatings are to prevent corrosion and to promote adhesion for followon paints and treatments. Aluminum alloys are widely used for electronics applications in the DoD for

This need (no. 1248-19) resulted in an extension of NESDI project no. 514. NIWC Pacific representatives are now leveraging existing laboratory data, verifying data using NIWC processes and demonstrating eTCP on NIWC aluminum alloy components.



PROJECT NO. 514
Fact Sheet

Enhanced Trivalent Chromium Pretreatment for Improved Coloration and Corrosion Performance of Aluminum Substrates

PROJECT ID: 514

P.I. Sheridan performs an initial eTCP feasibility study.

STATUS: ACTIVE PROJECT
P.I. Sheridan performs an initial eTCP feasibility study.

OBJECTIVE:
This effort will identify and optimize an enhanced trivalent chromium pretreatment (eTCP) with color additive that provides a uniform color change to aluminum substrates following conversion coating.

PROBLEM STATEMENT:
Reduced usage of hexavalent chromium from industrial processes is a commandwide requirement because hexavalent chromium (Cr+6) is a known carcinogen, and its use is strictly regulated under Occupational Safety and Health Administration Permissible Exposure Limits. A cost study performed at Fleet Readiness Center Southeast (FRCSE) for Fiscal Year 2013 indicates that these processes add approximately $1 million in annual reoccurring costs at FRCSE alone.

DESCRIPTION:
Conversion coatings are pretreatments used for the surface finishing of aluminum to improve corrosion performance and adhesion of subsequent coatings (e.g., primer, paint, and sealants). The trivalent chromium process (TCP) developed at Naval Air Systems Command (NAVAIR) is currently the leading nonchromate conversion coating for elimination of hexavalent chromium. TCP is a drop n replacement for Cr+6 formulated with hexafluorozirconate compounds and trivalent chromium salts. However, widespread use of this process has been hampered due to insufficient color change following conversion coating with trivalent chromium. Enhanced visual color change is preferred to ensure process controls are established when performing trivalent chromium conversion coating.

This project team is creating an enhanced trivalent chromium process (eTCP) through the addition of a color additive to the approved TCP formulation. The performance of the selected eTCP will be evaluated based on corrosion performance, quantitative electrochemical analysis, color change, and paint adhesion. Optimization and subsequent authorization for use in both the immersion and spray application will allow eTCP to aid in the elimination of hexavalent chromium from depot level maintenance operations across FRCs.

In addition to reduced health hazards, this process will have life cycle cost advantages including reduction of labor/materials associated with heavy

NAVY ENVIRONMENTAL SUSTAINABILITY DEVELOPMENT TO INTEGRATION (NESDI) 1

This fact sheet with additional details on NESDI project no. 514 is available for download via the program's website.

conversion coating will be updated to include eTCP as an approved material. eTCP will also be incorporated to NAVAIR's Chemicals of Concern listing as a primary alternative to hexavalent chromium pretreatment for acquisition programs.

In July 2018, personnel from the Space and Naval Warfare Systems Command (SPAWAR) Pacific—now the Naval Information Warfare Center (NIWC) Pacific, submitted need no. N-1248-19 (Elimination of Hexavalent Chromium from Conversion Coating Processes for Electronic Applications at Fleet Readiness Centers and SPAWAR Overhaul Depots) for the NESDI program's consideration. The focus of this particular need was on aluminum alloys widely used for electronics applications. These alloys allow for reduced weight, affordability and desirable material properties. Current processes for applying conversion coatings to aluminum parts for electrical applications employ hexavalent chromium-based chemistries. The newest alternate non-hexavalent chromium chemical solutions for electrical applications have no pigment and appear transparent, causing significant variations in coating quality. There is a need to identify a suitable drop-in replacement which is both non-hexavalent chromium-based and pigmented (dyed).

Upon completion of this original effort under project no. 514, the scope and timeframe of the project was expanded to accommodate the new and related requirement from NIWC Pacific and include the necessary laboratory testing, process optimization using NIWC Pacific industrial processes (including cleaners, deoxidizers and aluminum alloys) and process demonstration at NIWC Pacific's San Diego campus.

Peter Sheridan, the original project's Principal Investigator, is now being joined by representatives from NIWC Pacific's corrosion and restoration and additive manufacturing programs to leverage NAVAIR's existing laboratory data, verify data using NIWC processes and demonstrate eTCP on representative NIWC aluminum alloy components (including antenna covers, electronics housings and/or other supporting assemblies). This multi-phase effort will take place over the course of two additional years.

Spray application of eTCP ready-to-use at FRC Southeast to an aluminum panel. Production environment and panel orientation mimic spray conversion coating on aircraft as it is performed at FRC Southeast. (Photo Credit: Sjon Westre)

RESULTS OF OUR FY19 NEEDS SOLICITATION

Each year, the NESDI needs solicitation process is extremely competitive. The program's FY19 solicitation generated 69 needs in all. The program, after screening and ranking all of the needs received, decided to seek proposals for 12 of those deemed highest priorities by the TDWG and the program's resource sponsor (OPNAV N45).

No.	Need	Title	Submitter	Command
1.	N-1241-19	Handheld Stormwater Pollutant Mapper	Len Sinfield	NAVFAC
2.	N-1244-19	Nutrient Compliance Issues at Navy Shipyards	Jamie Evans	NAVSEA
3.	N-1245-19	Evaluation of Alternative Instruments for On-Site Analysis of Vapor Intrusion	Karen Campbell	NAVFAC
4.	N-1248-19	Elimination of Hexavalent Chromium from Conversion Coating Processes for Electronic Applications at Fleet Readiness Centers and NIWC Overhaul Depots	Felicia Johnson	NIWC
5.	N-1253-19	General-Purpose Oceanic Organic Mycelium Biodegradable Apparatus (GOOMBA)	Kimberly Schrock	NAVAIR
6.	N-1264-19	Expanding Knowledge of Radon Decay Products to Avoid Costly Decisions Related to Radon Survey Results in the Workplace	Edward Liu	NAVFAC
7.	N-1275-19	Thermal Paint Application for Water Storage Tanks	Vicky Ngo	NAVFAC
8.	N-1277-19	Minimizing Hazardous Waste from Expired Paint and Associated Solvents from Ships Supplies	Heather Lawton & Jessica Klinkert	NAVSEA
9.	N-1278-19	Low-VOC and Fast Dry Solvent-Borne Aerospace Primers	John (Jack) Benfer	NAVAIR
10.	N-1285-19	Reduction of Sealant Waste for Fleet/Depot-Level Operations	Richard Lee	NAVAIR
11.	N-1299-19	Study of Temporary Cooling Water Total Recoverable Copper Levels During Dry Docking Availabilities	Trevor Richardson	NAVSEA
12.	N-1302-19	Updated Environmental Monitoring Equipment for Regulatory Compliance	Devin Takara	NAVSEA

In addition, the program carried over the following seven needs from FY18 since budget limitations restricted the program's ability to launch any new start projects that year to address those needs.

No.	Need	Title	Submitter	Command
1.	N-1179-18	Cost Effective Main Charge Remediation of Insensitive Munitions for Range Clearance	Lesley Wilhelm	NAVSEA
2.	N-1187-18	Demonstration/Validation of Air Filtration for Indoor Air Quality	Mike Singletary	NAVFAC
3.	N-1188-18	Improving Site Closure Decision Making with Time Integrated Groundwater Samples	Laura Himes & Kendra Leibman	NAVFAC
4.	N-1194-18	Stormwater Piping-Based Pollutant Best Management Practice	Len Sinfield	NAVFAC
5.	N-1196-18	Under Pier Sediment Pile Assessment Tools	Len Sinfield	NAVFAC
6.	N-1220-18	Electromagnetic Interference Shielding Tape (EMIST)	Peter Sheridan	NAVAIR
7.	N-1234-18	Replacement of Cadmium in Ground Support Equipment Avionics Applications	Dane Hanson	NAVAIR

OUR FY19 "NEW START" PROJECTS

With the onset of FY19, the NESDI program launched 15 new projects including two stormwater-related efforts—one project will attempt to successfully demonstrate a handheld technology that identifies and quantifies sources of copper and zinc in stormwater runoff while a second project will evaluate the efficacy of a novel in-pipe treatment system to assist with stormwater permit compliance. Other new start projects include an effort to develop a method to speed vapor intrusion investigations through the on-site and real-time analysis of air and soil gas samples as well as an effort to validate the field application of activated carbon for the in-situ sequestration of per- and polyfluoroalkyl substances. A complete list of these and all other "new start" projects is provided below.

1. Evaluation of Various Real-Time Monitors to Accelerate On-Site Analysis for Vapor Intrusion (project no. 568)
2. Field Demonstration of Colloidal Activated Carbon for In-situ Sequestration of Per- and Polyfluoroalkyl Substances (project no. 569)
3. Improve Cost Effectiveness of Groundwater Monitoring with Long Duration Time-Integrated Groundwater Samplers (project no. 570)
4. Innovative Activated Carbon Filters to Address Vapor Intrusion within Commercial/Industrial Buildings (project no. 571)
5. Flexible Under Pier Sediment Assessment (project no. 572)
6. In-Well Headspace Samplers for Long-Term Groundwater Chlorinated Hydrocarbon Monitoring (project no. 573)
7. Developing Lines of Evidence to Support Nutrient Compliance (project no. 574)
8. Contaminant Monitoring and Mapping for Informing Stormwater Best Management Practices (project no. 575)
9. In-Pipe Stormwater Treatment System (project no. 576)
10. Demonstrating the Use of a Novel, Hybrid Polyelectrolyte/ Hydrophilic Polymer for In-situ PFAS Treatment Applications (project no. 577)
11. Mesocosm Field Testing of In-situ PFAS Treatment Trains (project no. 578)
12. In-situ Biodegradation of 1,4-Dioxane and Chlorinated Solvent Mixtures in Dilute Plumes (project no. 579)
13. 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 (project no. 582)

Summaries of all of these efforts can be found under their respective Commands in the next chapter of this report.

The Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC)

The Naval Information Warfare Center (NIWC) Pacific

The Naval Air Systems Command (NAVAIR)

The Naval Sea Systems Command (NAVSEA)

The Naval Supply Systems Command (NAVSUP)

The Naval Research Laboratory (NRL)

Commander, Navy Installations Command (CNIC)

The Naval Postgraduate School (NPS)

ACCOMPLISHMENTS OF OUR STRATEGIC PARTNERS

In this year's annual report, we provide a summary of the accomplishments of our projects that had significant activity in fiscal year 2019 — 20 projects in all represented in this consolidated chapter. In addition, we have summarized all 15 FY19 new start projects.

To execute these projects, the NESDI program relied on 39 different Principal Investigators from the following six organizations—our strategic partners:

1. The Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC)
2. The Naval Information Warfare Center (NIWC) Pacific (formerly the Space and Naval Warfare Systems Command Pacific)
3. The Naval Air Systems Command (NAVAIR)
4. The Naval Sea Systems Command (NAVSEA)
5. The Naval Supply Systems Command (NAVSUP)
6. The Naval Research Laboratory (NRL)

In addition to the alliances established and maintained with the organizations listed above, we also rely on expertise of representatives from the Commander, Navy Installation Command (CNIC) and the Naval Postgraduate School (NPS)—the former as a participant on our management committee (the Technology Development Working Group), the latter to provide help on our ongoing effort (project no. 567: Business Processes and Requirements Enabling Technology Integration) to improve the NESDI program's ability to predict the successful transition of proposed NESDI projects before any investments are made.

Alliances with all of these organizations help to guide our annual management process and ensure the ongoing success of our projects.

COMPLETED PROJECTS

The NESDI program closed out eight projects over the course of FY19. Those completed efforts are listed in the table below.

No.	ID	Title	Principal Investigator
1.	474	Toxicity Associated with PAHs used in Clay Targets	Kara Sorensen
2.	499	Aerobic Bioaugmentation for Remediation of RDX-Contaminated Groundwater	Steve Hammett
3.	504	Low-VOC and Low-HAP Wipe Solvent and Paint Thinner Demonstration/Validation	Ed Lipnickas
4.	506	Evaluation and Implementation of Compliance Options for NPDES Cooling Water Intake Structures at Existing Facilities	Pei-fang Wang
5.	519	Analysis of the Long-Term Fate of Munitions Constituents on Terrestrial Sites	Tony Danko
6.	531	Management Tools for Radiological Compounds in Environmental Media	Joey Trotsky
7.	532	Multi-Functional Surface Preparation Technology for Maintenance Painting	Pat Morrow
8.	550	A Comprehensive Analysis and Strategy for Contaminated Sediment Management	Joey Trotsky

Naval Facilities Engineering and Expeditionary Warfare Center

MISSION:
Provide research, development, testing and evaluation and in-service engineering to deliver specialized facility and expeditionary solutions to the warfighter. In addition to managing the NESDI program, NAVFAC EXWC Principal Investigators have led projects addressing a range of challenges including demonstrations of PFAS-related assessment and treatment methodologies.

LOCATION:
Port Hueneme, CA

PRINCIPAL INVESTIGATORS:
Hunter Spence, Itzel Godinez, John Kornuc, Jovan Popovic, Marty McMorrow, Sophia Lee, Steve Fann, Tony Danko, Travis Lewis

TDWG MEMBERSHIP:
Ken Kaempffe (Chair), Karla Harre, Tom Webb

NUMBER OF ACTIVE PROJECTS IN 2019:
18 (32 percent of program workload)

FY19 PROJECT ACCOMPLISHMENTS

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

PRINCIPAL INVESTIGATOR:
John Kornuc

This project is providing environmental restoration managers and Remedial Project Managers (RPM) with better tools for building accurate conceptual site models to better manage sites impacted by perfluorinated and polyfluorinated substances. Project accomplishments in FY19 include:

- Completed desktop study and reviewed available data from Naval Installation Restoration Information Solution (NIRIS), NAVFAC Headquarters and RPMs.
- Conducted field sampling at several Navy sites.
- Laboratory results for some sites is now complete. Results from remaining site are pending.
- All sites contained both target types of PFAS (perfluorosulfonic acid (PFOS) and perfluorooctanoic acid (PFOA)).
- Draft final report detailing field sampling and laboratory analyses is underway.
- Draft final report expected in 2020.

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

PRINCIPAL INVESTIGATOR:
John Kornuc

This project studied the effects that various remediation treatments for co-contaminants of perfluorochemicals had on perfluorinated compound composition and distribution, thereby enabling the development of better site models.

Project accomplishments in FY19 include:

- Field sampling was completed at three Navy sites.
- In the laboratory, soil columns were treated with oxidative and reductive methods typically used for fuels and solvents.
- PFAS were analyzed and compared to control (untreated) soil columns.
- Treatments had minimal impact on PFAS composition; however, PFAS were mobilized in both treatment and control columns.
- Soil washing may be an effective treatment
- Draft final report expected in 2020.

Smart Electronic Tools for Navy Environmental Compliance Monitoring and Reporting (no. 540)

PRINCIPAL INVESTIGATOR:
Itzel Godinez

This project evaluated the performance of smart mobile devices such as tablets and web-based environmental management systems (EMS) such as the Navy's EMSWeb in facilitating data collection, manipulation and dissemination while performing audits and inspections at Naval facilities. Project accomplishments in FY19 include:

- Worked closely with the EMS Working Group to establish requirements and a strategy for tablet field demonstration.
- Conducted first demonstration during an external EMS audit at Naval Base Ventura County.
- Tablets were used to create findings in EMSWeb. Initial feedback was positive.
- Initiated field testing at Naval Weapons Station (NWS) Seal Beach for their EMS internal audit program.
- Completed demonstration under Naval Base Point Loma EMS external audit in coordination with personnel from NAVFAC Southwest.

Study of Waste Management and Minimization for AFFF Wastewater (no. 553)

PRINCIPAL INVESTIGATOR:
Hunter Spence

This project intended to develop economic costing factors, cleanout methods, treatment and disposal options in support of Navy facilities aqueous film forming foam (AFFF) system cleanout and transition away from formulations with high perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) concentrations. FY19 project accomplishments are listed below:

- Field and laboratory demonstrations were completed and a draft final report was issued.
- Findings are that triple rinsing will substantially reduce the amount of residual PFOS and PFOA in AFFF concentrate holding tanks.
- The optimal strategy for dealing with AFFF wastewater is to minimize waste volume.

Addressing Temporal Variability in Industrial Buildings during Vapor Intrusion Assessments (no. 554)

PRINCIPAL INVESTIGATOR:
Travis Lewis

This project is refining and demonstrating a vapor intrusion sampling technique that is effective and appropriate for industrial/commercial buildings and worthy of regulatory acceptance. The following are several project accomplishments in FY19:

- Completed a building diagnostic study which validated measurable volatile organic compounds (VOC) within the indoor air to ensure the usability of these sampling zones for this effort.
- The study also validated that the continuous air monitors were properly installed and that monitoring can proceed.

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

PRINCIPAL INVESTIGATOR:
Jovan Popovic

The objective of this project is to obtain data from laboratory studies and field demonstrations to determine the best available technologies for the treatment of groundwater impacted by polyfluoroalkyl and perfluoroalkyl substances at Navy sites. Project accomplishments are:

- Laboratory study challenged AFFF-impacted groundwater at various concentrations with various sorbents, including granular activated carbon as a baseline, then ran batch tests and columns.
- Results showed that most sorbents do not treat short chain PFAS well with the exception of certain anion exchange (AIX).
- Final report will provide details on treatment trials and matrix with groundwater parameters (PFAS species, concentrations, dissolved oxygen content and total dissolved solids) and treatment approach effectiveness as well as guidance for stakeholders.

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

PRINCIPAL INVESTIGATOR:
Marty McMorrow

The objective of this project is to develop a clear, practical approach and manual/tool to enable efficient and effective integration of technology, techniques and other tools with an emphasis on environmental compliance projects at Navy facilities. During FY19, investigators from the Naval Post Graduate School (NPS) completed a user survey which will be used to validate the Measures of Effectiveness model it previously developed for the NESDI program.

FY19 "NEW START" PROJECTS

Investigators from NAVFAC EXWC launched the following six projects in FY19.

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

PRINCIPAL INVESTIGATOR:
Travis Lewis (EXWC)

The objective is effort is to identify the most reliableon-site mobile analyzer for indoor air and soil gas samples to be used as a tool to expedite vapor intrusion investigation.

One of the most challenging health risks facing regulators in recent years is the vapor intrusion (VI) of volatile organic compounds (VOC) from soil or groundwater to indoor air. On-site analysis of air and soil gas samples with real-time results provides the ability to "follow the smoke trail" of the VOC source. This approach can yield investigation results that are timelier and more accurate than

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

conventional investigation approaches. As a result, it has proven popular with a number of VI practitioners.

Project investigators have identified five commercial-off-the-shelf (COTS) instruments for implementation of this proven and effective approach to investigate the VI pathway. Each of these technologies will be evaluated for inclusion in the study based on availability and vendor-reported performance capabilities. The instrument evaluation will be conducted in two one-week phases:

1. A bench-top evaluation using control samples with known concentrations of target VOCs.
2. A field evaluation at a Navy site with known or potential VI concerns.

To ensure comparability, all of the selected instruments will be evaluated together during each phase of the study. Before the bench-top study, the project team will define minimum acceptable criteria for accuracy. Any instrument that does not meet the minimum acceptable criteria will not be retained for the field evaluation.

On-site analysis of air and soil gas samples with real-time results provides the ability to "follow the smoke trail" of the VOC source.

During bench top testing, accuracy and precision will be tested by analyzing control samples with known concentrations of VOC. The same samples will be measured replicate times to determine whether there is any variance in readings. Instruments will be tested for sensitivity by determining the lowest VOC concentration at which accuracy and precision goals can be achieved.

All instruments meeting minimum performance standards during the bench-top evaluation will be carried forward into the field evaluation to be conducted at an actual VI investigation site. The field evaluation will serve to verify the instrument performance and efficiency under actual field conditions. Questions surrounding ease of use (Is special training needed?) and flexibility (Can the instrument's operation be modified for specific applications?) will be reviewed and answered.

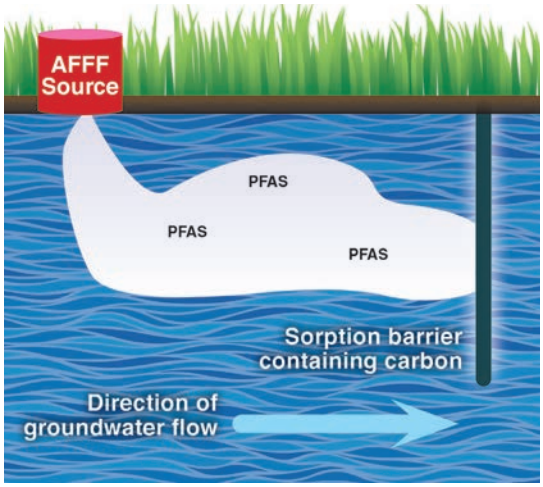
Transitioning the results of this project will be accomplished through development of an electronic planning tool and user guide for Remedial Project Managers that will summarize instrument performance as documented in this study. The layout of the tool and user guide will prioritize easy-to-understand tables and graphics. In addition, guidelines for instrument selection based on specific project requirements (e.g., instrument sensitivity) and practical considerations (e.g., ease-of-use) will be included. The guide also will provide information in instrument costs and purchase/rental options.

Field Demonstration of Colloidal Activated Carbon for In situ Sequestration of Per- and Polyfluoroalkyl Substances (no. 569)

PRINCIPAL INVESTIGATOR:
Tony Danko (EXWC)

The objective for this project is to demonstrate and validate the field application of colloidal activated carbon for in situ sequestration of per- and polyfluoroalkyl substances in groundwater, thus mitigating migration of these contaminants.

At sites contaminated with aqueous film-forming foam (AFFF), PFAS has been found in the soil and groundwater. Because PFAS is highly resistant to treatment and highly mobile, plumes continue to expand, potentially further increasing the number of impacted wells and the overall treatment costs.



This NESDI project will demonstrate and validate the field application of colloidal activated carbon for in situ sequestration of per- and polyfluoroalkyl substances in groundwater. (Illustration Credit: Nancy Horvat)

While ex situ treatment approaches are progressing and full-scale systems are currently operational (primarily granular activated carbon systems added to an existing pump-and-treat infrastructure), there are currently no validated in situ approaches to treat PFAS in groundwater. One promising type of in situ amendment, designed to sorb (through adsorption or absorption) PFAS, is powdered and colloidal activated carbon (CAC). The advantage of CAC treatments is that they can be applied immediately. However, many questions remain regarding the effectiveness, long-term capacity and potential for detrimental effects associated with these treatments. Therefore, there is a clear need for objective research concerning the true effectiveness of CAC treatments.

CAC suspensions have been demonstrated to disperse into aquifer settings under low pressure injection or gravity feed. This material is reported to coat the aquifer matrix with a thin layer of immobilized, highly sorbent CAC. Dissolved contaminants are rapidly sorbed by the applied CAC, effectively reducing dissolved phase concentrations. Based upon laboratory studies, this approach appears to be an effective option for sequestering many PFAS including PFOA and PFOS, thus slowing further plume migration. This project was formed to demonstrate this approach in situ.

After collecting groundwater and aquifer sediment from the demonstration site (yet to be determined), researchers will conduct a treatability study in the laboratory. Groundwater will be added to two columns containing aquifer sediment—one with CAC and one without. The column experiment will provide valuable data on the transport and distribution of CAC in the aquifer sediment as well as the expected adsorption capacity of CAC for representative PFAS from the demonstration site. This experiment will yield data relevant to barrier installation and overall sampling schedule.

There is a clear need for objective research concerning the true effectiveness of CAC treatments.

Next, a monitoring well network will be installed at the site using a direct-push rig and prepacked wells. After installation, baseline sampling will be conducted for PFAS and other VOCs. Over the course of the next two years, groundwater samples will be collected from all of the monitoring wells an additional eight times and analyzed for PFAS, VOCs (if present), anions (including bromide) and basic geochemical parameters. Groundwater sampling data from the monitoring well network, along with estimates of relevant groundwater flow (based on previous site characterization efforts, modeling and tracer sampling data), will be used to estimate mass flux of PFAS over time and thereby the effectiveness of the CAC treatment.

A final report will be prepared for RPMs concerning the correct application of this approach as well as any potential problems.

Improve Cost Effectiveness of Groundwater Monitoring with Long Duration Time-Integrated Groundwater Samplers (no. 570)

PRINCIPAL INVESTIGATOR:
Travis Lewis (EXWC)

The objective for this project is to demonstrate application of a time-integrated sampler for measurement of volatile organic compound concentrations in groundwater.

The amount of VOCs in groundwater can vary dramatically from week to week due to weather events and other factors including temperature, pH, dissolved oxygen content and microbial activity. This high variability hinders groundwater monitoring efforts and limits managers' ability to demonstrate remedy effectiveness. Short-term apparent increases in contaminant concentrations can create regulatory concern regarding plume stability or remedy effectiveness and may trigger requirements for unnecessary, more aggressive remedies. There is a need to transition from traditional grab sampling to long-term time-integrated groundwater sampling and incorporate the latter into the ongoing operation of Navy groundwater management programs.

Deployment of time-integrated groundwater sampler in a monitoring well. (Photo Credit: GSI, Inc.)

The availability of laboratory-measured uptake rates will enhance regulatory acceptance of newly-designed passive sorbent samplers.

This project seeks to demonstrate and validate a time-integrated sampling system that will provide more representative and less variable data to enable significant cost savings to the environmental monitoring program and improve understanding of long-term trends in groundwater concentration data.

The field demonstration and validation of newly-designed passive sorbent samplers will promote regulatory acceptance by generating laboratory-measured uptake rates for the most common Department of Navy VOC contaminants and demonstrating an absence of bias in sampler results compared to conventional groundwater sampling methods. The use of passive sampling will reduce recurring labor costs as well.

The validation of the time-integrated sampler will be presented in peer-reviewed publications and at conferences. Project information for both laboratory and field studies may also be used in NAVFAC technology transfer initiatives such as the Remedial Innovative Technology Seminar (RITS) and training programs including the Navy's Advanced Environmental Restoration course. Investigators will also communicate the results of this effort to regulators through organizations such as the Interstate Technology and Regulatory Council.

Innovative Activated Carbon Filters to Address Vapor Intrusion within Commercial/Industrial Buildings (no. 571)

PRINCIPAL INVESTIGATOR:
Travis Lewis (EXWC)

This project's objective is to demonstrate and validate an air filtration system that will remove trichloroethene (TCE) from indoor air.

One of the most challenging health risks facing regulators in recent years is the vapor intrusion of VOCs from soil or groundwater to indoor air. One of the most pressing problems is the presence of TCE. There is no clear evidence regarding the duration of TCE exposure that may cause an acute health effect, but it is likely shorter than the duration of time required to implement a conventional VI mitigation system. The current best practice for VI mitigation is most often an active soil depressurization (ASD) system, originally designed for radon removal, which imposes a vacuum below the floor using a series of suction points connected to fans or blowers.

Indoor air filtration has a potential benefit over other available solutions because it works much more rapidly and can reduce health risks attributable to VOCs.

Indoor air filtration has a potential benefit over this solution because it works much more rapidly and can reduce health risks attributable to VOCs from both subsurface sources and sources inside the building. Unfortunately, most filters have been tested using different chemicals and/or concentrations than are typically encountered in a VI assessment, so there is little or no data with which to decide how many filters are needed, how often the filter bed should be replaced, or what sorbent is most cost-effective for this application.

Carbon filter used in indoor air filters.
(Photo Credit: Austin Air)

This project team will perform bench-scale laboratory experiments using columns to demonstrate filtration effectiveness and capacity. The most promising technology will be demonstrated in the laboratory to determine efficacy and change-out frequency of the product. Then, results will be evaluated to assess scaling effects. The product will then be field tested at Naval Air Station Corpus Christi. Real-time indoor air concentrations will be monitored prior to and during filter deployment operation. Cost, efficacy, timeframe, mass removed and filter change-out frequency will be studied.

The project team will disseminate cost and performance data and transition the technology to both federal and targeted non-federal sectors such as manufacturing and other operations-intensive industries. An electronic planning tool and user guide will be developed for facilities and environmental managers (including RPMs) to guide the optimal selection, operation and maintenance of air purifying filters for vapor intrusion mitigation. This guide will contain information on heating, ventilating and air conditioning system fan specifications and operational modes, VOCs present, known ranges of concentration, target concentrations post-treatment and timeframe to achieve concentration reductions.

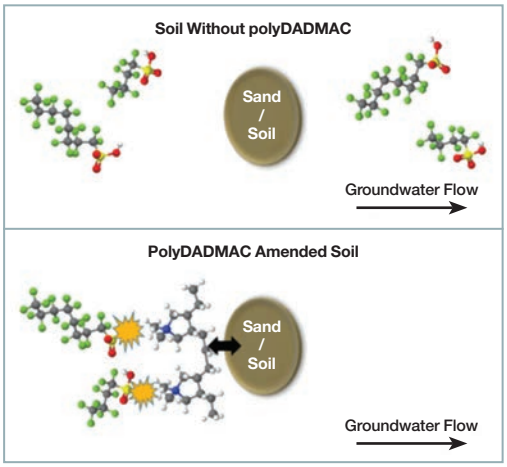
Demonstrating the Use of a Novel, Hybrid Polyelectrolyte/Hydrophilic Polymer for In Situ PFAS Treatment Applications (no. 577)

PRINCIPAL INVESTIGATOR:
Jovan Popovic (EXWC)

The objective for this project is to study the use of polydiallyldimethylammonium chloride (polyDADMAC) as a potential PFAS plume retardant for in situ applications and understand any site-specific environmental factors which may influence PFAS binding to polyDADMAC over time.

Per- and polyfluoroalkyl substances are a family of human-made chemicals that are found in a wide range of products used by consumers and industry. Unfortunately, the same characteristics that make PFAS ideal for firefighting and plating operations—namely impermeability to grease, water and oil—also make them persistent in the environment. Current evidence suggests that the bioaccumulation of certain PFAS may cause serious health conditions in humans as well. As a result, the U.S. Environmental Protection Agency (EPA) has set lifetime health advisory levels for PFOS and PFOA, two PFAS chemicals, in drinking water.

The high molecular stability of PFAS ultimately limits the number of feasible mechanisms that can be used for its degradation. Thus, the only effective treatment options reported to date are high energy destruction and sorption processes. The most prevalent method at this time is the use of an ex situ pump and treat system with activated carbon filters. However, this process can prove expensive and challenging due to the extremely wide-area, dilute formation of the most common PFAS plumes.



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

Furthermore, it is estimated that the annual expenditure associated with commercially available media replacement alone is in the hundreds of thousands of dollars.

Using a low-cost material with high binding specificity for PFAS would ultimately lower operational costs if applied as a plume retardant, especially if frequent filter change-outs and amendments can be avoided. This project is investigating the use of polyDADMAC—an organic polymer which has seen ubiquitous use in water and wastewater treatment processes as a coagulant to enhance sludge dewatering and reduce the formation of harmful disinfection byproduct precursors, oftentimes generated in water and wastewater treatment.

The goal of this project is to demonstrate control of a PFAS groundwater source zone by treating it with a plume retardant.

The goal of this project is to demonstrate control of a PFAS groundwater source zone by treating it with polyDADMAC. The demonstration will begin with bench scale testing with site-specific environmental media to understand the various geochemical parameters which may affect the binding performance of polyDADMAC.

These tests will be conducted in the presence and absence of powdered activated carbon or other forms of pyrogenic carbon to better optimize PFAS/polyDADMAC binding performance specific to the site's subsurface matrix. Additionally, the radius of influence for the injection will also be determined (e.g. slug test) prior to polyDADMAC injection to better understand adequate amendment dosing. Completion of these tasks will ultimately provide relevant empirical design data for field scale-up and elucidate the necessary performance criteria required for a field scale demonstration.

A field demonstration site with PFAS in the groundwater will be selected and the source zone soils will be treated with polyDADMAC. The hypothesis is that introducing polyDADMAC in this matter will boost retention of PFAS which will reduce the flux of contaminants migrating out of the source zone.

The most decisive criteria of success for this demonstration will hinge upon the ability for polyDADMAC to sequester PFAS within the source zone. Spatial and temporal decreases in PFAS concentrations downgradient of the source zone will be monitored to verify its efficacy. These efforts will elucidate any factors affecting performance for in situ source zone PFAS sequestration, as well as provide information as to whether or not adjustment of the injection approach may be necessary.

All information garnered from this demonstration will be disseminated through the RITS and Naval Installation Restoration Information Solution. Final reports and guidance documents will be created to provide direction for subsequent mobilizations across PFAS-impacted Department of Navy (DoN) sites. Additionally, these data will be published in peer-reviewed scientific literature to inform RPMs, environmental restoration subject matter experts and field practitioners.

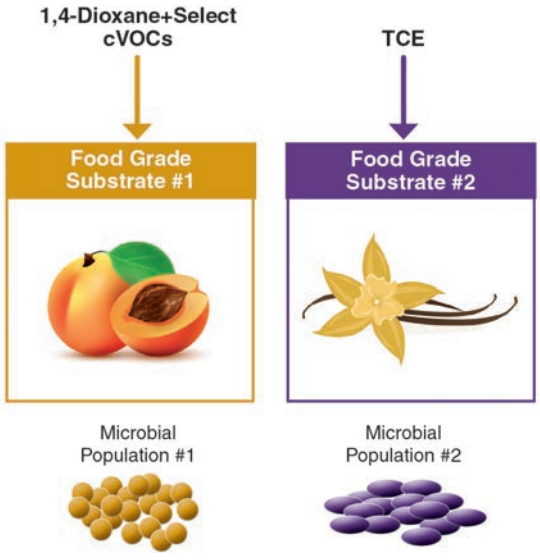
In-situ Biodegradation of 1,4-Dioxane and Chlorinated Solvent Mixtures in Dilute Plumes (no. 579)

PRINCIPAL INVESTIGATOR:
Tony Danko (EXWC)

This project's objective is to demonstrate that soluble, food grade substrates, including specific organic acids or alcohols, can be used to promote the in situ cometabolic treatment of 1,4 dioxane and chlorinated volatile organic compounds.

1,4 dioxane is a chemical found at many federal facilities because of its widespread use as a stabilizer in certain chlorinated solvents, paint strippers, greases and waxes. It is classified by EPA as a likely human carcinogen. Chlorinated volatile organic compounds (CVOC) are an associated class of contaminants widely used as solvents and degreasing agents. CVOCs may contain 1,4 dioxane, along with other chemicals, such as trichloroethylene (TCE).

The project team will first select an appropriate contaminated site and will install wells, if needed,



(Illustration Credit: Nancy Horvat)

to obtain samples. Samples of sediment and groundwater will be collected and a microcosm study conducted. Samples will be placed in serum bottles and subjected to various biostimulation and bioaugmentation procedures with an end goal of producing the food grade substrates benzyl alcohol and 2-butanol.

The investigators for this project discovered the use of food grade substrates to promote aerobic cometabolism of 1,4 dioxane and CVOCs in a current Strategic Environmental Research and Development Program (SERDP) project—Evaluation of Branched Hydrocarbons as Stimulants for In Situ Cometabolic Biodegradation of 1,4-Dioxane and Its Associated Co-Contaminants (no. ER-2303). Using a pure culture *(Rhodococcus rhodochrous 21198)*, they found that 2-butanol was effective in inducing the short chain monooxygenase that transforms 1,4 dioxane and a broad range of CVOCs.

At the end of the microcosm study, the next task will be a series of single-well push-pull tests. Using protocols developed in an earlier Environmental Security Technology Certification Program (ESTCP) project, along with that project's lead investigator, the most promising growth substrate and culture will be pushed into the in situ well. Prior to injection, a conservative tracer (bromide) will be added with the cometabolic growth substrate and reactive surrogate. Dissolved oxygen or hydrogen peroxide as a source of oxygen will also be added.

The test solution will be permitted to reside in the aquifer so that utilization of the growth substrate is achieved under natural gradient conditions. The tests will include a series of steps that will demonstrate the ability to stimulate native or bioaugmented microorganisms, plus their ability to promote the cometabolism of 1,4 dioxane and CVOCs of concern.

During the extraction phase, flow is reversed and concentrations of tracer, reactive solutes and possible reaction products are measured as a function of time at the same well. Tracer concentrations are used to adjust concentrations of test solution components for dilution. Mass balances are computed by integrating dilution-adjusted concentrations during the extraction phase.

The main goal is to determine the ability of native microorganisms to transform the 1,4 dioxane and the CVOCs when grown on these substrates and potentially additional substrates discovered through the team's current SERDP project. Investigators will also determine if the bioaugmentation of *Rhodococcus rhodochrous 2119*8 or *Pseudomonas mendocina KR1* results in more effective in situ remediation. The ability to use food grade organic acids and alcohols as growth substrates is novel and would result in much wider implementation of this technology. In addition, since the cometabolic process transformation is driven by a growth substrate, 1,4 dioxane and CVOCs can be treated to levels below those needed to meet regulatory requirements.

Since the cometabolic process transformation is driven by a growth substrate, 1,4-dioxane and CVOCs can be treated to levels below those needed to meet regulatory requirements.

Technology transfer activities include publication of peer-reviewed papers, presentations at national meetings and participation in technology transfer organizations such as the Interstate Technology and Regulatory Council (ITRC). Additional efforts facilitated by Naval Facilities Engineering and Expeditionary Warfare Center could include a RITS presentation, Open Environmental Restoration Resource (OER2) webinar series and briefings to various Navy workgroups including the Risk Assessment Workgroup (RAW) and the Alternative Restoration Technology Team (ARTT).

Naval Information Warfare Center Pacific

MISSION:
Provide the U.S. Navy and military with essential capabilities in the areas of command and control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR), cyber and space. A recognized leader in the cyber domain and cyberspace, and for autonomous unmanned systems, NIWC Pacific is providing the technological and engineering support critical to naval information warfare. Over the past several years, NIWC investigators have concentrated their efforts on demonstrating more effective methods for characterization of environmental issues including the use of passive samplers for both stormwater and sediment among other efforts.

LOCATIONS:
San Diego, CA, Puget Sound Naval Shipyard (PSNS), Pearl Harbor Naval Shipyard

PRINCIPAL INVESTIGATORS:
Brandon Swope, Cheryl Cooke, Eric Winchell, Ernie Arias, Gunther Rosen, Ignacio Rivera, Iryna Dzieciuch, Jessica Carilli, Jim Leather, Kara Sorensen, Lewis Hsu, Marienne (Molly) Colvin, Nicholas Hayman, Patrick Simms, Pei-fang Wang

TDWG MEMBERSHIP:
Pat Earley

NUMBER OF ACTIVE PROJECTS IN 2019:
18 (32 percent of program workload)

FY19 PROJECT ACCOMPLISHMENTS

Impact of Sediment Resuspension by Propeller Wash and Shore Sediment Dynamics on Remediation Options (no. 551)

PRINCIPAL INVESTIGATOR:
Pei-fang Wang

The objective of this project is to provide RPMs with additional information regarding the effectiveness of various sediment remediation methodologies under real-world stressors such as propeller wash and wave activity. Project accomplishments in FY19 include:

- Three field studies have been completed.
- Six sediment traps data were collected for two dry weather periods and one wet weather period.
- Data for the two dry weather periods have been analyzed.
- Data analysis for the wet weather period is underway.

Demonstration of Improved Toxicity Methodology to Link Stormwater Discharges to Receiving Water Impacts (no. 547)

PRINCIPAL INVESTIGATOR:
Marienne (Molly) Colvin

The objective of this project is to derive, demonstrate and validate an accurate, standardized and scientifically defensible pulsed toxicity testing method for laboratory toxicity testing to assess impacts to receiving waters related to stormwater runoff or other episodic discharges. Accomplishments for this project are as follows:

- This method is being submitted to the U.S. Environmental Protection Agency's Alternate Test Procedure (ATP) program for their review, comment and acceptance.

- It is anticipated that this will lead to the adoption of a new toxicity testing method associated with the realistic assessment of the toxicological impacts of stormwater runoff.

Using a Forward-Looking Infrared Camera for Advanced Discharge Characterization (no. 539)

PRINCIPAL INVESTIGATOR:
Brandon Swope

The goals of this project are to use a novel sensing technology to better define surface mixing adjacent to a discharge outfall and then use these data to improve the capabilities of current hydrodynamic models. Project accomplishments are as follows:

- Data processing and analysis of FLIR images captured from the selected outfall is underway.
- Overall processing has been successful and the ability to capture ambient and discharge conditions has been successful.
- User's guide is in preparation.

Diver-less Deployment System for In-Situ Sediment Samplers (no. 529)

PRINCIPAL INVESTIGATORS:
Jessica Carilli, Bart Chadwick

The objective of this project is to adapt available technologies and demonstrate a rapid, cost-effective system and methodology for diver-less deployment and retrieval of in-situ passive sediment samplers. The intention is to design, deploy and retrieve passive samplers at contaminated sediment sites without putting divers in the water. Accomplishments for this project are as follows:

- Tested passive sampler in San Diego Bay and Pearl Harbor and determined that the system can:
  1. Accommodate multiple types of passive sampling materials.
  2. Install and recover samplers from approximately 20 stations per day.
  3. Deploy and recover samplers (80-90 percent of the time) in a range of water depths, currents and bottom types.
  4. Be deployed easily by a small field team.
- The increased rate of sampler deployment and recovery and increased number of recovered samples both lead to this system being much more cost effective.
- A standard operating procedure (SOP) was developed and information disseminated to potential users through platform presentations and professional networks.
- The technology is already being transitioned to industry. Geosyntec has procured a system and deployed it for at least two field studies.
- The technology has been successfully transferred to other Navy users. Navy Region Southwest has provided funding for a follow-on effort to assess polychlorinated biphenyls (PCB) in San Diego Bay during the dry season to compare and contrast with the wet-season effort conducted during this project.

Integrated Diagnostic Stormwater Monitoring with Passive Sampling (no. 523)

PRINCIPAL INVESTIGATOR:
Gunther Rosen

This project is evaluating the effectiveness of using passive sampling devices to assess the impacts of stormwater runoff and improve stormwater management at Navy facilities. Project accomplishments in FY19 include:

- Demonstration and validation of Diffusive Gradients in Thin Film (DGT) is underway to support the cost-effective monitoring of Navy/DoD investments. Evaluations continue to support Best Management Practice (BMP), End of Pipe (EOP) and Low Impact Development (LID) monitoring at multiple Navy sites in the metro San Diego area. Investigators are identifying opportunities for follow-on leveraging with other interested Navy managers.

- This project has been regularly vetted by end users from PSNS and NAVFAC Northwest.
- This project has resulted in multiple peer-reviewed publications (generally focusing on DGTs/metals) along with local interest from the City of Bainbridge Island and other industry associated personnel.

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

PRINCIPAL INVESTIGATOR:
Ignacio Rivera

This project is investigating the use of clean dredged material as both a cost effective and improved substrate relative to clean sand for thin-layer capping for the remediation of moderately contaminated sediments at Navy sites. Accomplishments include:

- Initial evaluation of the data from the deployment of the Remedy And Recontamination Assessment (RARA) array in Pearl Harbor indicates that clean dredged material performed nearly as well as activated carbon and better than clean sand in the near term (two months) and at least as well as clean sand (the "go to" material for enhanced monitored natural recovery (EMNR) at 10 months ("time final" for the field study).
- This study indicates that the use of clean dredged material is cost-effective and a potentially superior substrate over clean sand.
- A pilot scale demonstration at Pearl Harbor or a similar Navy site would be very valuable towards demonstrating the engineering considerations associated with the used of dredged material and performance at a larger scale. A full proposal has been submitted to the Environmental Security Technology Certification Program (ESTCP).

FY19 "NEW START" PROJECTS

Flexible Under Pier Sediment Assessment (no. 572)

PRINCIPAL INVESTIGATOR:
Jessica Carilli (NIWC)

This project's objective is to develop a simple and cost-effective solution to ascertain the potential magnitude of recontamination occurring from unremediated under-pier sediments slumping into dredged and/or remediatedareas between piers.

Navigation dredging is required to be conducted alongside Navy piers on a frequent basis to enable access for ships. Unfortunately, many Navy harbors contain contaminated sediments from past activities that might also require targeted dredging to remediate. Dredging for navigation and/or to remove contaminated sediments does not typically target under-pier areas, where contaminated sediments can accumulate.

One potential source of recontamination of sediments is the buildup underneath Navy piers where navigational dredging (and, typically, cleanup dredging) does not occur. These neglected and potentially contaminated under-pier sediments may fill in nearby previously remediated sites with new contaminants, confounding cleanup

The NIWC Z-boat in action. (Photo Credit: Chuck Katz)

efforts. A critical need exists for tools to map under-pier bathymetry and collect sediment samples from difficult-to-access spaces under piers.

Sampling underneath the pier prior to understanding the topography of the ocean bed would invite ineffective and thus costly sampling techniques.

To quantify the level and extent of contamination and design effective solutions to remediate under-pier sediments, the volume, contaminant concentrations and slumping potential of under-pier sediments are required. This project will demonstrate and validate several creative solutions to accurately assess under-pier sediments at reasonable cost.

Under-pier bathymetry will be acquired during surveys in San Diego Bay conducted before, immediately after and several months after maintenance dredging to quantify sediment volume and movement from under-pier areas at the demonstration site.

Sediment volume and slumping will be quantified using repeat acoustic-bathymetry surveys conducted with a small, remotely controlled vessel—the Teledyne Z-boat 1800. The Z-boat platform will collect georeferenced high-resolution bathymetric data from which Digital Elevation Models (DEM) and sediment volumetric estimates will be subsequently calculated. The DEMs calculated during each survey will be compared to subsequent surveys to assess erosion rates of a given under-pier area and migration of sediments to surrounding areas.

With volumetric estimates from the processed bathymetric survey data, the team will determine the appropriate depth, layout and method for sediment sampling to assess contaminant concentrations. The most appropriate sediment sampling strategy for a given under-pier area will be selected from a menu of sampling methods. Following the small-scale demonstration, a full-scale demonstration will be performed, building on lessons learned from the initial demonstration.

Standard operating procedures (SOP) will be developed for each aspect of the demonstration. A comprehensive overview of the workflow developed for under-pier sediment assessments will also be completed. The final report, SOPs and other guidance documents will be delivered to the Navy Sediment Management Working Group.

Developing Lines of Evidence to Support Nutrient Compliance (no. 574)

PRINCIPAL INVESTIGATOR:
Eric Winchell (NIWC Pacific)

The objective for this project is to facilitate the development of reasonable Total Maximum Daily Load (TMDL) requirements by developing an approach to identify all nutrient sources that contribute to total discharging outfall nutrient loads and engage regulators in the process.

Nutrient pollution is caused by excess nitrogen and phosphorus in the air and water and is one of the country's most widespread and challenging environmental problems. Nutrient discharges are regulated nationwide, but regulations vary by region. West coast Navy facilities tend to have regulatory permit requirements with associated consequences for violation (e.g., Pearl Harbor Naval Shipyard), whereas east coast facilities (e.g., Norfolk Naval Shipyard) tend to have monitoring

requirements that are in early stages of contributing to TMDL assessments and potential future regulatory obligations.

Waterfront Navy facilities are located at the base of drainage systems carrying contaminants from upland (non-Navy) sources, yet Navy program managers are responsible for compliance with National Pollutant Discharge Elimination System (NPDES) limits, wherever the nutrients may originate. A better understanding of available technology and nutrient sources, coupled with improved management approaches would aid in meeting NPDES requirements.

This project team will conduct a detailed assessment of groundwater and stormwater nutrient loadings and incorporate watershed modeling to support a specific understanding of nutrient sources. Key to this process will be including regulators throughout the process so that they can gain a comprehensive understanding of nutrient sources at Navy facilities.

This improved understanding will lead to more relevant TMDL requirements that take into account specific conditions in the watershed around a Navy facility.

Norfolk Naval Shipyard (NNSY) has been selected as the demonstration site for this project because it is currently required to monitor and report stormwater nutrient impacts. The first step will be the generation of a conceptual model that will establish known sources of nutrients associated with NNSY as either inputs or outputs. Once a conceptual model is generated, the appropriate nutrient monitoring/sampling will be performed. The sample plan will be incumbent upon the nutrient sources identified within the conceptual model.

The port and starboard anchors of the aircraft carrier USS George H.W. Bush (CVN 77) sit in a NNSY dry dock. NNSY has been selected as the demonstration site for this project since the shipyard is currently required to monitor and report stormwater nutrient impacts.

(Photo Credit: Mass Communication Specialist Seaman Steven Edgar)

Following the nutrient sampling, modeling exercises will take place. Four common models will be used to simulate the fate and transport of nutrient loads from the shipyard. The models will generate loading input and discharge concentrations that are simple to understand, which will aid in management decisions with regulatory authorities. As part of the modeling effort, investigators will develop a mass balance to estimate the loading components and nutrient concentrations at given locations. The final product of the mass balance will be an estimation of the contribution from each identified source to the total nutrient loading for NNSY.

This project will also examine radon and radium isotopic ratios within groundwater and/or seepage water to establish the source and nature of the water entering Navy property. Examining isotopic ratios of these elements will help to determine if they are the same source, separate

sources or a mixture of sources. The use of isotopic analysis is a robust method for source identification because there are zero biological or organic processes that impact the result.

This stepwise approach includes identifying sources of nutrient inputs from groundwater, stormwater and facility operations to assure a better nutrient compliance posture for the Navy. This improved understanding will lead to more relevant TMDL requirements that take into account specific conditions in the watershed around a Navy facility.

The results of this effort will be presented in a condensed blueprint that other water program managers and facility compliance officers can follow to maintain compliance with nutrient limits and TMDL requirements.

Contaminant Monitoring and Mapping for Informing Stormwater Best Management Practices (no. 575)

PRINCIPAL INVESTIGATOR:
Patrick Sims (NIWC Pacific)

This project's objective is to demonstrate a handheld technology to identify and quantify sources of copper and zinc in stormwater runoff that provides the information needed to optimize the management practices designed to mitigate those sources.

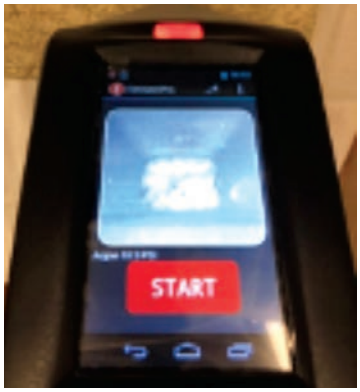
Copper and zinc are ubiquitous contaminants found in stormwater discharges in urban and industrialized areas. At Navy facilities, these contaminants have been identified as commonly exceeding NPDES permit benchmarks. Exceedance of NPDES benchmark levels poses a potential for Notices of Violation as well as civil lawsuits. In addition, numerical limits of copper and zinc discharge allocations are creating even more stringent compliance requirements at certain locations including Navy Region Southwest. Navy facility managers have implemented Best Management Practices (BMP) in an attempt to identify and mitigate these discharges, but a lack of technologies to identify contaminant sources leaves the Navy's water program managers at some risk.

LIBS technology provides an opportunity to quickly evaluate potential source contaminants.

A key element to implementing effective BMPs is to identify and quantify the relative contributions of metals to stormwater runoff from the various sources present on the facility. This project is utilizing laser-induced breakdown spectroscopy (LIBS) technology to identify and quantify these sources and provide the key information needed to optimize management decisions on implementing BMPs to mitigate them.

LIBS is an optical emission technique used to monitor the relative abundance of constituent elements or detect the elemental impurities in materials. This project will demonstrate LIBS efficacy and cost efficiency to identify contaminant sources in bulk and at the outer surfaces of environmental media.

The effort will begin with laboratory testing to detect and quantify contamination on surfaces and within soils. This will include calibration of the LIBS instrument to generate calibration curves and limits of detection. The team will evaluate the detection and quantification of metals and oil/grease contamination in soils,



Measurement acquisition requires only a "point and click" with the analyzer pressed against a sample. (Photo Credit: Patrick Sims)

sediments and urban/industrial surfaces (asphalt, concrete, gravel). LIBS instrument results will be verified against standard laboratory techniques.

Next, measurements will be taken in the field to ensure that the technology is suitable for detecting contaminant sources in cracks and on a variety of urban/industrial surfaces and media, and for its potential in mapping areas of contamination build-up. Sampling and field-testing procedures will be optimized to ensure that field measurements are reproducible, accurate and field analyzable. This will allow for the development of field-deployable methods to pinpoint contamination sources along concentration gradients, to determine if contamination is localized or diffuse over an area, and to provide feedback on whether BMPs (e.g., sweeping, vacuuming, infiltration media) have affected levels of the chemical of concern.

Based on the results of the evaluation, the team will begin a demonstration and validation at two sites—Naval Base San Diego (NBSD) and one other location—conducted immediately before and just after storm events to map and determine the time dependence of source contaminant deposition and removal with sufficient statistical confidence.

To validate the LIBS technology as a means of mapping contamination sources and guiding the implementation of BMPs, a monitoring plan and water samples will be collected to assess the impact at sites prior to and after the implementation of BMPs based on the mapping of contaminants over the course of an entire storm season (October to May). These samples will be tested for total and dissolved copper, lead, zinc and total solids (particles).

These measurements will be used to assess if the amount of source contamination identified via LIBS prior to a storm event correlates with the amount of contamination measured in the water samples. This will ascertain whether identifying sources of contaminants of copper, zinc or lead and applying a remedy to mitigate those areas of concern has a measurable impact on the contaminant discharge levels.

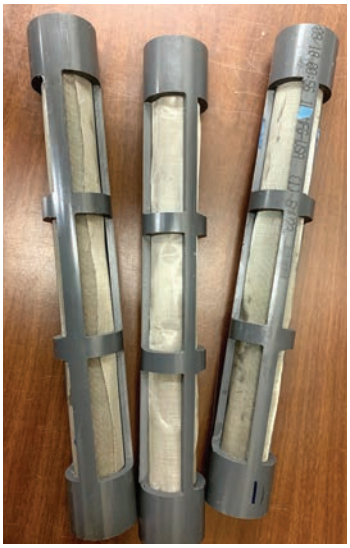
A technical report will be generated to report the methods, results and evaluation of the demonstration and presentations and demonstrations will also be provided to NBSD personnel and other stakeholders.

In-Pipe Stormwater Treatment System (no. 576)

PRINCIPAL INVESTIGATOR:
Brandon Swope (NIWC Pacific)

The objective of this project is to evaluate the efficacy of a novel in-pipe treatment system to aid with stormwater permit compliance.

Stormwater discharges from industrial areas of some Navy installations have been failing regulatory limits (Numeric Action Levels (NAL)) for copper, zinc, oil & grease



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

as well as end-of-pipe acute toxicity. NPDES permits require that BMPs are implemented to meet NALs. Previous studies have demonstrated surface cleaning technologies may be effective at contaminant removal, but to meet the concentrations specified in the NALs, a multifaceted BMP strategy may be required. Therefore, additional BMPs need to be identified and evaluated. This project is proposing one such BMP.

This project seeks to remove particulate matter and other contaminants from stormwater discharges directly within the outfall pipe. The novel system will consist of a series of individual treatment units (ITU) that are connected and deployed in-line within a discharge pipe.

Each ITU can be customized for specific contaminants. ITUs with different mesh sizes will focus on particulate metals removal while ITUs loaded with various media will be able to remove other contaminants such as dissolved metals and oil & grease. The treatment type can be individualized to specific areas and contaminants and can be scalable to larger diameter pipes. A series of multiple ITUs can be attached to a flexible cable and deployed along a segment of pipe, depending on the outfall length.

This effort will begin with bench scale testing which will consist of deploying a series of ITUs in a mock outfall fall pipe. For particle removal, various mesh sizes will be evaluated under different configurations. A standard created with a known concentration of total suspended solids and particle size distribution will be dispersed in the mock outfall. A mass balance of particulate levels will be calculated to evaluate particle removal efficacy. The same process will be done with oil as the contaminant, although the ITUs will be outfitted with different media types and a starting and final concentration of oil will be measured.

Bench scale testing will be followed by a field demonstration, in which a series of ITUs will be deployed in an outfall that is known to have issues with metals and oil. Installation will occur before a storm event. Afterwards, the amount of particles/metals and oil removed by the system will be quantified, and the outfall concentrations will be compared against NALs and historical outfall data.

This project seeks to remove particulate matter and other contaminants from stormwater streams directly within the outfall pipe.

The technology will be working towards receiving a full patent. The project team will also try to identify a commercial partner to help transition this technology into the hands of water program managers across the Navy. The team will present the results of this effort to regional water boards for their acceptance of the new BMP. Team members will also work with end users to establish general operations and maintenance plans which could take the form of a statement of work that water program managers can use to implement this technology at their installations.

Mesocosm Field Testing of In situ PFAS Treatment Trains (no. 578)

PRINCIPAL INVESTIGATOR:
Nicholas Hayman (NIWC Pacific)

The objective for this project is to demonstrate an efficient method to evaluate promising in situ adsorptive amendment materials to tackle the problem of per- and polyfluoroalkyl substances (PFAS) in groundwater.

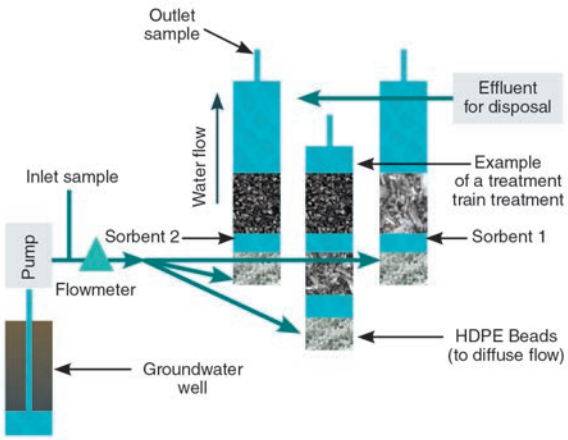
Per- and polyfluoroalkyl substances are a group of chemicals that have become widespread groundwater contaminants at Department of Defense sites largely through their use in aqueous film-forming foams (AFFF), commonly used in fire fighting. The unique properties of AFFF make them ideal for fighting a wide variety of fires.

This project will demonstrate an efficient method to evaluate promising in situ adsorptive amendment materials to tackle the problem of per- and polyfluoroalkyl substances in groundwater.

Current in situ amendments that are generally used for other organic solvents (e.g., activated carbon) are not always suitable for these compounds, partially due to their mobility in the aqueous phase and their recalcitrant properties. Currently, Navy facilities are primarily using pump and treat with granulated activated carbon (GAC) to remove PFAS from groundwater. While this method has proven somewhat effective, it does require frequent and costly GAC replacement. There is also evidence that GAC does not work as well on the short-chained PFAS in newer AFFF formulations. Further, the installation of pump and treat systems can be very costly. A variety of possible sorbent in situ treatments have been suggested, but many of these have not received sufficient scientific scrutiny for application at Navy facilities.

This project team will study various adsorbents for the purpose of PFAS treatment. Several amendments will be tested—GAC, colloidal active carbon (e.g. PlumeStop®), an ion-exchange resin, biochar and Osorb®. Most of these sorbents have shown promise as possible options for in situ amendments, although some amendments (such as GAC) appear to be a more effective treatment for the longer-chained constituents. Further, many of these amendments have had limited studies to determine their efficacy across sites or in comparison with other adsorptive amendments—a knowledge gap this project aims to fill.

A series of laboratory studies will quantify adsorptive capacities for both long- and short-chained PFAS. In addition, the team will assess breakthough potential and bioavailability of the compounds. These laboratory studies will indicate what amendments would be most effective for different PFAS and water quality conditions.



General schematic of field-testing apparatus to be deployed at the test location. (Illustration Credit: Nancy Horvat)

A sequential exposure to multiple amendments may be necessary to achieve cleanup goals of the wide variety of PFAS that occur at contaminated sites. Therefore, the project's second objective is to develop a mesocosm field-testing apparatus to test the efficacy of adsorptive amendments, in parallel and in sequence, at specific field sites. Water will be pumped from a well and split into different vessels, each containing an amendment/treatment or combination of amendments. The water will be allowed to slowly percolate though the amendment and exit through an output line with a valve that will either direct water into a water collection container for chemical analysis, to a secondary treatment container (to replicate sequential in situ treatment), or to wastewater treatment. Materials will be carefully selected to avoid PFAS cross-contamination.

The initial mesocosm test will be deemed successful if at least one sorptive treatment demonstrates sufficient optimization to reduce PFAS concentrations significantly and/or below health advisory levels. If so, a pilot field test at a highly contaminated site will follow. This pilot field testing will demonstrate the utility of the field-testing apparatus and evaluate the technology for site-specific factors, such as water quality and presence of co-contaminants, to be tested across numerous amendments simultaneously.

The field-testing apparatus can be transitioned to site managers and allow them to determine which treatment will work the best at their site, given local soil and water characteristics, in a much more cost-effective manner than installing a large in situ amendment, and will provide more relevant results than simple laboratory experiments.

Sensor Interface and Infrastructure for Monitoring (no. 582)

PRINCIPAL INVESTIGATOR:
Lewis Hsu (NIWC Pacific)

The objective is to develop an integrative approach for near real-time wastewater monitoring that ensures more accurate analytics and data visualization and reduces the manpower requirements associated with current processes.

Navy environmental program managers are responsible for ensuring that wastewater discharges from Navy facilities meet regulatory requirements. For most of these facilities, gathering information about these discharges (effluent) requires the manual operation of monitoring equipment and sensors. While requirements may differ among Navy facilities and regulatory agencies, a common issue is the manpower and time required to gather and analyze effluent data.

A remote monitoring system would help to provide awareness for sulfide levels in the system so that permit violations can be avoided.

For example, Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility (PHNSY&IMF) is required to monitor drydock discharges for volume, nutrients, metals and other water quality parameters. On-site monitoring equipment is available to ensure compliance with sampling or monitoring but requires personnel to manually download data and then process these data offline before being used to assess compliance with permitted levels. Access to each of these monitoring locations is limited and must be coordinated with operators and site personnel. All these factors result in time- and labor-intensive monitoring and data that are out of date.

As a result, mitigating actions may not be executed in time to avoid permit violations and exceedances. Such a scenario has occurred at least twice related to volumetric flow exceedances at PHNSY&IMF in 2018 and may likely recur until equipment is modernized for real-time data collection and telemetry.

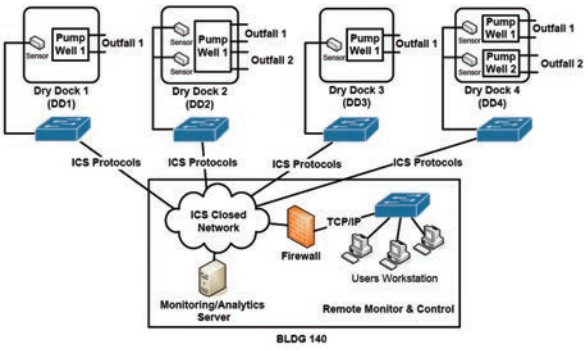
Other sites that have been identified with similar needs related to sulfide monitoring within their wastewater systems are Naval Air Station North Island (NASNI) and Naval Amphibious Base Coronado. Pretreated industrial wastewater is conveyed to treatment facilities through the City of San Diego's municipal sewer system. NASNI in the past has exceeded the city's sulfide limits specified in their discharge permits. Naval Facilities Engineering Command Southwest has installed chemical control systems on site, but consistent control of the dosing to control the sulfide has not yet been realized. A remote monitoring system would help to provide awareness for sulfide levels in the system so that permit violations can be avoided. The goal of this team is to develop a model that is readily adaptable for various base sizes and compatible with current and future sensors and monitoring requirements.

Most sensor modules for water quality measurements are capable of utilizing an Industrial Control System (ICS) communication protocol to report data over a network. This project team plans to utilize standard ICS protocols and updated infrastructure to enable a near real-time monitoring (RTM) solution. A software interface will be developed to manage the data streams from existing sensors, along with a graphical user interface with an emphasis on environmental monitoring and permitting requirements.

Much of the basis for this effort will leverage previous experience with ICS/ Supervisory Control and Data Acquisition (SCADA) cybersecurity projects initially developed for smart energy metering under the Office of Naval Research's Energy Systems Technology and Evaluation Program (ESTEP).

The system will employ a graphical user interface accessible via computer or mobile device. Data can be automatically analyzed to provide notifications to program managers. Depending on specific site requirements, updated infrastructure could include secured RF modems or standard gateways/routers for closed wired network. The team will first test the interface in a laboratory mockup that simulates conditions at a drydock location. Based upon successful performance of the interface and network architecture, a demonstration will take place at PHNSY&IMF. If this demonstration is successful, the physical interface hardware will be installed at PHNSY&IMF to run the software system.

Final training documents and support will be provided to PHNSY&IMF personnel once the system is installed. To reach other end users, a design guide will be developed to assist with meeting guidelines for sensor output and possible interface methods with the near-RTM framework. A final report will also be written to document any lessons learned, cyber security considerations, costs and required operations and maintenance actions.



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

Naval Air Systems Command

MISSION:

To provide full lifecycle support of naval aviation aircraft, weapons and systems operated by Sailors and Marines. This support includes research, design, development and systems engineering; acquisition; test and evaluation; training facilities and equipment; repair and modification; and in-service engineering and logistics support. Recent NAVAIR NESDI-funded projects have concentrated on the elimination of hexavalent chromium-containing aircraft primers and conversion coatings, as well as more effective and efficient oxygen line cleaning and engine washing.

LOCATIONS:

Fleet Readiness Center Southeast (FRCSE) Jacksonville, FL; Fleet Readiness Center East (FRCE), Cherry Point, NC; Fleet Readiness Center Southwest (FRCSW), San Diego, CA; Naval Air Warfare Center – Aircraft Division (NAWC-AD) Patuxent River, MD; NAWC-AD Lakehurst, NJ; Naval Air Warfare Center – Weapons Division (NAWC-WD) China Lake, CA

PRINCIPAL INVESTIGATORS:

Alan Grieve, Jessica Rex, Joe Marchica, Joe Santa Maria, Justin Massey, Kami Carter, Keiko Sapp, Mike Brindza, Peter Sheridan, Steve Starnes

TDWG MEMBERSHIP:

Cindy Webber, Luzmarie Youngers

NUMBER OF ACTIVE PROJECTS IN 2019:

10 (18 percent of program workload)

FY19 PROJECT ACCOMPLISHMENTS

User Friendly Oxygen Cleaning Alternative to Navy Oxygen Cleaner (no. 433)

PRINCIPAL INVESTIGATOR:
Kami Carter

The objective of this project was to eliminate the use of Freon (CFC-113) for oxygen line cleaning. Accomplishments include:

- This project successfully identified an alternative single solvent process for cleaning oxygen components and systems.
- The alternative meets the requirements of the military standard Precision Cleaning and Testing of Shipboard Oxygen, Helium, Helium-Oxygen, Nitrogen and Hydrogen Systems (MIL-STD-1330).
- Upon completion of testing, data were provided to the technical manual owners for their consideration when implementing the new solvent.
- NAVAIR and NAVSEA requirements were included for Navy-wide approval.
- An evaluation from the Navy and Marine Corps Public Health Center and the Navy Experimental Dive Unit resulted in permission being granted to use Solstice for aircraft, surface ship oxygen systems and submarine components.

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

PRINCIPAL INVESTIGATOR:
Justin Massey

This project is verifying the performance of a hexavalent chromium-free primer against a standard chromium product in the laboratory and in the field. FY19 project accomplishments include the following:

- The dem/val is completed on F/A-18 and P-3 doors to prove that the hexavalent chromium-free bond primer is sufficient. No apparent corrosion is present.
- Next steps are the development of local process specifications for three FRCs and a NAVAIR authorization letter.

Enhanced Trivalent Chromium Pretreatment for Improved-Coloration and Corrosion Performance of Aluminum Substrates (no. 514)

PRINCIPAL INVESTIGATORS:
Peter Sheridan

The objective of this project is to investigate the effect of commercially available color additives upon the performance properties of approved trivalent chromium pretreatment formulations. Project accomplishments in FY19 include:

- The demonstration and validation at NAVAIR is now complete.
- Awaiting military specification qualification.
- FRCSE personnel are implementing the pretreatment formulation with the color additive.
- Work is underway to help NIWC Pacific personnel qualify the product for their own use.

Naval Air Systems Command Solutions for Engine Washing (no. 542)

PRINCIPAL INVESTIGATORS:
Keiko Sapp, Kami Carter

The objective of this project is to customize and demonstrate a new engine washing technology for use at aircraft maintenance facilities. FY19 project accomplishments include the following:

- The EcoPower engine wash system has been successfully demonstrated with a number of aircraft platforms planning to use the technology.
- In addition to the savings in the labor hours required to complete these tasks, this enhanced engine washing procedure generates fuel efficiency through cleaner engines.

FY19 "NEW START" PROJECTS

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

PRINCIPAL INVESTIGATOR:
Alan Grieve (NAWC-AD – Patuxent River)

The objective for this project is to develop a simple test protocol for assessing aircraft sealant usability and demonstrate its effectiveness with the intent of reducing hazardous waste and improving Fleet readiness.

Sealants containing polysulfide and polythioether play significant roles in naval aviation. These products have short shelf lives, which often means that materials are already near their expiration date by the time they reach the end of the logistical supply chain. This problem is compounded by the fact that as hazardous materials (HAZMAT), the usage and disposal of these products represents a significant cost to the programs using them.

Current requalification protocols for expired materials require laboratory environments and are impractical in the field which means that a large volume of expired material goes untested and is often scrapped, unnecessarily. At the same time, this may result in a shortage of material for maintenance at the Fleet level.

It is estimated that 20-25 percent of sealant materials purchased by the Navy are expired prior to use, and much of this is disposed of as hazardous waste. This represents an

This NESDI project seeks to develop a simple test protocol for assessing sealant usability of various aircraft programs (including the F/A-18F Super Hornet). (Photo Credit: Mass Communication Specialist Seaman Apprentice Conner Foy)

estimated material cost of $500,000—calculated before additional significant HAZMAT disposal costs are factored in. Aircraft sealant materials, properly stored, can often last well beyond their shelf life.

A recent report from the Navy's Corrosion Action Team (CAT) stated that "Unexpired, in-stock HAZMAT is still significantly lacking while on deployment." Another issue reported by the CAT was that of arbitrary HAZMAT shelf life extensions—often granted without any additional testing or assessment of the material. A simpler, field-based method for which expired materials can be recertified is the goal of this project.

The ability of sealant materials to last beyond their stated shelf life is strongly dependent on several factors—temperature is, by far, the most important. This project is leveraging data being collected by the corrosion prevention team at the Naval Air Station Patuxent River (PAX). This program is embedding temperature sensors in sealants as they travel through the supply chain. Temperature data will be collected through the products' shelf life and beyond with the goal of understanding the conditions faced by materials in different locations and generating data that can be used to develop more realistic temperature profiles.

This team will use the data provided by PAX personnel to develop test protocols for laboratory-based artificial aging of sealants. Then, time-temperature models will be created to better assess sealant condition. From these models, simple test protocols to assess sealant condition will be developed and validated against current laboratory-based methods.

Select sealants will be chosen based on available shelf life data. An emphasis will be placed on sealants most prone to deterioration, and those used most frequently across platforms. Once an appropriate set of tests is defined, an initial testing protocol will be drafted and sent to the FRCs for their review. At the same time, the project team will begin to assemble a testing toolkit for field-level testing. Once the test protocol is defined and validated in-house, FRC/field-level demonstration and validation will begin. The FRCs at Jacksonville and North Island currently perform standard requalification testing on expiring sealants, and it is anticipated that the new protocols may be evaluated

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)

against the standard tests at these locations to determine the efficacy of the limited test protocol. Feedback from the FRCs will be critical in refining these protocols prior to field-level evaluations.

This project is developing a simple test protocol for assessing aircraft sealant usability and demonstrating its effectiveness.

The site for the field-level demonstration has yet to be selected. If the PAX program to track materials in the supply system continues to thrive, a tie-in for demonstration at a site receiving tracked materials would provide the most useful data set, since the testing could be tied in with analysis of the temperature data. Successful demonstration at the field level is of crucial importance to the adoption of this program.

Transition to the end user will be achieved through the development of a testing toolkit and detailed guidance documents explaining the rationale for the tests and details on how to perform the tests and interpret results. By participating in validation of this procedure, the FRCs (likely Jacksonville and North Island) will be familiar with the test protocol by the end of this project and will be able to immediately put it to use.

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

PRINCIPAL INVESTIGATOR:
Joseph Marchica (NAWC-AD – Lakehurst)

This project's objective is to assess the performance issues surrounding zinc-nickel and other cadmium-alternative plating technologies for Electrical Wiring and Interconnect System (EWIS) components.

Cadmium is regulated as a heavy metal because of its toxicity to humans and wildlife. The Department of Defense (DoD) has targeted cadmium for elimination or reduction to minimize the human health and safety risks associated with the plating process and the potential exposure to cadmium dust as the plating corrodes.

Cadmium-plated, Class W, electrical connectors qualified to the MIL-DTL-38999 specification are widely used throughout the DoD for aviation and ground support equipment applications. Alternative finish classes have been qualified to this specification but have met resistance due to inferior field performance, logistics and the lack of a commercially-available supply.

Specifically, Class T (nickel-fluoropolymer) and Class Z (zinc-nickel) are considered the best cadmium replacements. However, the qualification methods for MIL-DTL-38999 do not fully capture the corrosion and environmental degradation that is experienced in real world settings. A new round of laboratory and field testing on current commercially available cadmium alternatives is needed that better represents the service environments these finishes will experience. While Class Z finishes are being tested and validated to be replacements for cadmium on structural steel, they have not been explored for DoD functional applications in the area of EWIS components.

This project will evaluate the most promising cadmium replacement finishes for Navy applications. There are two main components to this project. Task one will assess performance and supply chain logistics of existing cadmium alternatives. The Defense Logistics Agency will facilitate an engineering practice study to determine where and how Class T and Class Z finishes are being utilized. Based on the results of the study as well as current usage and supply data, the team will identify leading candidates to replace cadmium.

Degraded wires
(Photo Credit: NAWC-AD Lakehurst Wiring Laboratory)

Information will then be gathered from other concurrent testing projects at U.S. Navy facilities that are examining cadmium and cadmium alternative EWIS connector finishes. Based on data from these two sources, the team will conduct laboratory suitability testing on the most suitable connector finishes.

This new testbed would allow DoD to fully validate the performance of cadmium-alternative connector assemblies in extreme environments before transition to critical aircraft applications.

One finish, an emerging Low Hydrogen Embrittlement zinc-nickel formulation, originally developed for structural applications, has undergone some evaluation by the U.S. Air Force. It has yielded very good results and will be included in the test matrix for this effort.

Simultaneously, the team will build a new connector assembly testbed called the Navy Electrical System Testbed (NEST) so that alternative plating processes can be tested and evaluated in usage scenarios representative of the harsh environments experienced by aircraft connectors. The NEST will be designed around the MIL-DTL-38999 connector family since it is the most common in the Navy fleet. This capability could be expanded to include other connector families.

This new testbed would allow DoD to fully validate the performance of cadmium-alternative connector assemblies in extreme environments before transition to critical aircraft applications.

Transition paths for the developments under this project include clarification of the finish callouts in existing specifications to remove the variability that yields poor performance; requalification to the new standard would require the testing of interconnected EWIS systems. Potential updates to Navy documents may include Qualified Product Lists, military specifications, materials and process requirements and material/finish design guidance documents; a new Tier 1 standard and test method for EWIS qualification; and a NAVAIR authorization letter for the use of a cadmium alternative for connector applications.

An operator's manual will be developed in conjunction with the NEST unit and provided to all transition sites. Personnel from the Qualified Products Laboratory at NAWC-AD Patuxent River will be able to leverage this asset into wiring system qualification testing and future process improvements.

The V-22 Osprey Automated Wiring Test Set (AWTS) will act as the test bed for this NESDI project.
(Photo Credit: NAWC-AD Patuxent River Wiring Laboratory)

Naval Sea Systems Command

MISSION:
Provide state-of-the-art research, engineering, modeling and test center for ships and ship systems. The Carderock Division addresses the full spectrum of applied maritime science and technology, from the theoretical and conceptual beginnings, through design and acquisition, to implementation and follow-on engineering. This includes all technical aspects of improving the performance of ships, submarines, military water craft and unmanned vehicles, as well as research for military logistics systems. Recent NAVSEA NESDI-funded projects have concentrated on better stormwater management practices at Navy shipyards and other Navy shore-based facilities.

LOCATIONS:
Naval Surface Warfare Center
Carderock, MD

NAVSEA Headquarters
Washington, DC

PRINCIPAL INVESTIGATORS:
Jim Howell, Pat Morrow, Tracy Carole

TDWG MEMBERSHIP:
Bill Hertel, David Kopack

NUMBER OF ACTIVE PROJECTS IN 2019:
7 (12.5 percent of program workload)

FY19 PROJECT ACCOMPLISHMENTS

Analysis of Regulated Garbage Management Processes to Ensure Compliance with Animal and Plant Health Inspection Service Regulations (no. 533)

PRINCIPAL INVESTIGATOR:
Tracy Carole

The objective of this project was to better understand shoreside and shipboard regulated garbage management processes with the aim of creating standard operating procedures and/or best management practices to ensure efficient regulated garbage compliance. Project accomplishments in FY19 include:

- Provided regulated garbage best practices document and training slides to U.S. Fleet Forces Command for posting on the Afloat Environmental Compliance website.
- Attended Afloat Environmental Protection Coordinator (AEPC) course and provided recommendations to improve management of regulated garbage.
- Received a National Stock Number (NSN) for the 3-mil thick regulated garbage bag.
- Observed several-vessel regulated garbage offloads to evaluate best practices and standard operating procedures.

Naval Supply Systems Command

MISSION:
Provide supplies, services and quality-of-life support to the Navy and Joint warfighter. NAVSUP's portfolio includes supply chain management for material support to Navy, Marine Corps, Joint and coalition partners, supply operations, conventional ordnance, contracting, resale, fuel, transportation, security assistance, and quality-of-life issues for U.S. Navy forces, including food service, postal services, Navy Exchanges and movement of household goods. NAVSUP is a recent supporter of the NESDI program with its first funded project concentrating on the development of a process to standardize the procurement of consumable general use hazardous materials.

LOCATION:
Mechanicsburg, PA

PRINCIPAL INVESTIGATOR:
Todd Heintzelman

TDWG MEMBERSHIP:
Jeff Henning

NUMBER OF ACTIVE PROJECTS IN 2019:
1 (5 percent of program workload)

FY19 PROJECT ACCOMPLISHMENTS

Enterprise-wide Hazardous Material Standardization and Minimization of General Use Consumables (no. 556)

PRINCIPAL INVESTIGATOR:
Todd Heintzelman

This project is developing a process to standardize the procurement of consumable general use hazardous materials, and create tools to guide end users of hazardous materials to procure less hazardous products. FY19 project accomplishments include the following:

- Drafted a standard operating procedure (SOP) for pilot and developed metrics for measurable objectives.
- Conducted meeting with personnel from NAVSUP Weapons System Support, NAVSUP Fleet Logistics Center San Diego, NAVFAC EXWC, NBVC Safety Office, Third Party Logistics (3PL), Naval Construction Group ONE and the Navy Supply Corps to provide project overview and the HazMat Ordering Tool to NBVC.
- Solicited feedback from Commands already using the tool to identify gaps in tool and limited Safer Choice product availability.
- Developed green ordering SOP and a memo of instruction for pilot sites.
- Developed flyer to explain greener choices.
- Pilot ran through March 2020 at NAS Oceana and NBVC, which demonstrated a 15 percent increase in the volume of Safer Choice products purchased when users had the discretion to choose.

Naval Research Laboratory

MISSION:
Provide the advanced scientific capabilities required to bolster the U.S. position of global naval leadership. NRL focuses on research that yields immediate and long-range applications in the defense of the United States.

NRL is a recent addition to the NESDI team with its first funded project concentrating on the development of a more accurate method for measuring munitions degradation rates.

LOCATION:
Washington, DC

PRINCIPAL INVESTIGATOR:
Tom Boyd

NUMBER OF ACTIVE PROJECTS IN 2019:
1 (5 percent of program workload)

FY19 PROJECT ACCOMPLISHMENTS

Stable Carbon Isotopes for Tracing in situ RDX Remediation (no. 537)

PRINCIPAL INVESTIGATOR:
Tom Boyd

This project is providing RPMs with a more accurate way of measuring munitions degradation rates to supportknowledge-based remediation strategies including the use of monitored natural attenuation. During FY19, project investigators compiled and analyzed samples at this project's study site—Kitsap/Bangor.

FY19 "NEW START" PROJECTS

In-Well Headspace Samplers for Long-Term Groundwater Chlorinated Hydrocarbon Monitoring (no. 573)

PRINCIPAL INVESTIGATOR:
Tom Boyd (NRL)

The objective for this project is to validate the use of commercially available passive samplers for long-term monitoring of groundwater contaminant concentrations.

Navy Environmental Restoration sites are often contaminated with fuels, chlorinated solvents, explosives and/or heavy metals. Remedies often require long-term operation and maintenance due to contaminant persistence, site complexity or a combination of both. Because site managers must balance risk, costs and outcomes that satisfy regulators and stakeholders, there is a persistent need

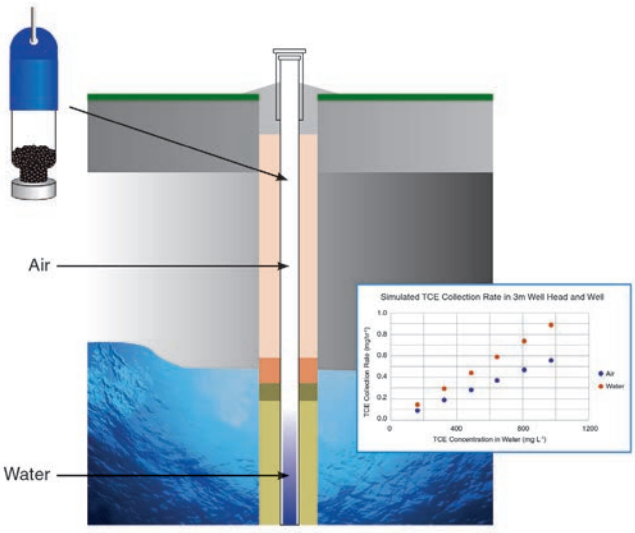
for methodological improvements to provide long-term contaminant fate and transport data.

Discrete (grab) sampling to obtain contaminant concentrations is expensive and may yield inconsistent results. For instance, quarterly or yearly sampling provides only punctuated information on contaminant transport, dynamics and fate. Passive samplers installed in groundwater wells offer an attractive alternative because they can be deployed for longer timeframes and reduce costs by decreasing purge water disposal, equipment use or rental and time spent on-site by personnel. Passive samplers must have sufficient sorptive capacity for the analytes in question, may be subject to diffusive filtration, may experience trapped contaminant biodegradation during longer deployments and may not be able to be deployed in wells with free product (e.g. floating contaminant layers which might overwhelm the sampler during deployment or removal). Time-averaged sampling is widely needed at contaminated sites, but may be difficult given current sampler limitations.

The technology innovation will allow a potentially broader time and space domain for sampling and understanding chlorinated solvent (and other contaminant) distributions on-site.

This project team will deploy modified passive sampling systems within screened groundwater wells. By deploying traps within a well headspace, atmospheric interferences can be eliminated. Biofouling, contaminant biodegradation, diffusive effects and deployment time limitations may also be minimized by this placement.

In-well diffusive samplers can be deployed to collect volatile organic compounds over long durations. Duration can be



TCE mobility is impacted by matrix and matrix transition. By suspending samplers in well headspace (and by adding additional transitions) deployments can be lengthened to integrate in situ concentrations over long collection periods. (Illustration Credit: Nancy Horvat)

"tuned" by taking advantage of differential contaminant permeation rates through phase transitions between water, air and permeation barriers. Collected contaminants can be thus time-averaged and modeled. Zone of Influence (ZOI) models can be used to calculate the sampling volume given hydrogeologic parameters and the contaminants' physical properties. The technology innovation will allow a potentially broader time and space domain for sampling and understanding of chlorinated solvent (and other contaminant) distributions on-site.

This design innovation merges passive in-water and air sampling technologies in an effort to maximize the methodological strengths, minimize weaknesses and increase the time domain for long-term sampling.

Commercially-available diffusion samplers will be suspended in well headspaces above the screen intervals. These samplers are designed to work in high humidity

environments and they accumulate analytes slowly, making them ideal for long-term deployments. The advantage for this type of deployment is that the contaminant of interest must first diffuse from the water phase to the gas phase (in the well headspace). This phase transition increases the time for diffusion into the sampler by a modellable margin. This rate reduction will increase the time a sampler can be deployed before being saturated with analyte. Additionally, the sampler can be deployed within tubing containing permeation barriers with additional phase transitions (water lenses for instance). Tubes could also be deployed as a depth array in the well casing to determine vertical contaminant distribution.

With no direct groundwater contact, biofouling and contaminant biodegradation could virtually be eliminated. Samplers will be deployed in conjunction with in-water passive samplers to determine the comparability. The team plans to use two commercially available samplers that have undergone adequate field testing to be used as passive sampler controls.

The project will begin with laboratory testing, followed by quarterly field deployment at two demonstration sites. In-water samplers, low-flow traditional sampling and new headspace traps will be installed. ZOI modeling will be performed at each test site, followed by sample analysis, performance evaluation and cost analysis.

Results, models and data will be transitioned to end users such as RPMs, contractors and regulators. A seminar will be developed and incorporated into the OER2 webinar series, the Technical Insight and Problem Solving forum and/or the RITS. A guidance document will also be generated for sampler design, use, recovery and analysis.

NESDI BY THE NUMBERS

PROGRAM

651: Program participants
16: Commands supporting the program
35: Activities supporting the program

NEEDS

872: Needs submitted
267: Needs approved
31: Percentage of needs approved
10: Commands submitting needs

PROPOSALS

378: Pre-proposals submitted
232: Pre-proposals approved
61: Percentage of pre-proposals advanced to full proposal stage
8: Commands submitting pre-proposals
232: Full proposals submitted
160: Full proposals approved
69: Percentage of full proposals approved
6: Commands submitting full proposals

PROJECTS

159: Projects launched
82: Participating Principal Investigators
6: Commands participating in projects
11: Activities participating in projects
8: Completed projects (in FY19)

OTHER

3: Program Managers (Scott Mauro, Leslie Karr, Ken Kaempffe)
21: Journal articles/Conference presentations (in FY19)
223: Current active website users
402: Website users since 2007

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

PROMOTING OUR SUCCESSES

Successful NESDI projects were promoted throughout FY19 in a variety of print and online publications. In addition to this Year in Review report, an annual programmatic review and the program's website, the NESDI program also sponsors an electronic newsletter and generates project fact sheets—all available via the program's website.

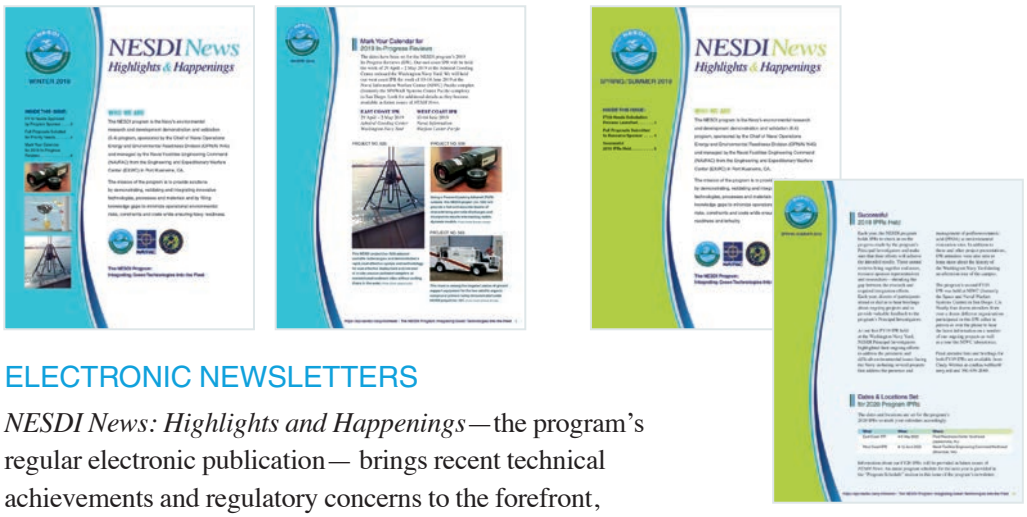
PROGRAM WEBSITE

Over the course of fiscal year 2019, the following enhancements were made to the program's website:

- **Streamlined the Pre-Proposal Submission Process.** Reducing the amount of required data allowed for a shorter and more concise pre-proposal that was easier to read and evaluate.
- **Expanded Options for Displaying Project Fact Sheets.** The use of custom fact sheets (in downloaded pdf form) is now available versus the use of auto-generated fact sheets. These custom designed fact sheets provide more layout flexibility for content display.
- **Improved the Newsletter Distribution Process.** These improvements including providing options to include the newsletter as an email attachment or a download link in the body of the distribution email.
- **Incorporated Master Pages to Consolidate Common Web Content.** These master (HTML) pages are now in use across all site pages in lieu of repeating common content on every page.
- **Reduced Changes to Source Code as Program Participants Change.** Automated notifications previously used embedded contact information such as the program manager and command representatives. This information is now stored in and extracted from the database which eliminates time-consuming changes to the source code when a participant changes.

The program's website is housed at the NAVFAC Information Technology Center (NITC) in Port Hueneme, CA at https://epl.navfac.navy.mil/nesdi (Common Access Card required). The website is regularly updated with "new start" project fact sheets, quarterly newsletters as well as all previously-published Year in Review reports.

To subscribe to *NESDI News*—the NESDI program's quarterly electronic newsletter—visit https://epl.navfac.navy.mil/nesdi then select "SIGN UP FOR *NESDI NEWS*."



ELECTRONIC NEWSLETTERS

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

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 FY19, development of fact sheets for the program's "new start" projects was initiated. These and other fact sheets will be made available on the program's website at https://epl.navfac.navy.mil/nesdi.

PUBLICATIONS & CONFERENCE PRESENTATIONS

Over the course of FY19, a number of NESDI projects published the results of their efforts in a number of peer-reviewed journals and other publications. They also presented those results in real-time at a number of conferences, meetings, workshops and webinars. A list of those publications and presentations is provided below:

Enhanced Trivalent Chromium Pretreatment for Improved Coloration and Corrosion Performance of Aluminum Substrates (project no. 514)

Osborne, A., P. Sheridan (2019). Chemeon's eTCP Offers Visual Verification for Coated Parts. *Products Finishing* magazine. (www.pfonline.com/articles/chemeons-etcp-offers-visual-verification-for-coated-parts) September 7, 2019.

Autonomous Benthic Ecology System (project no. 521)

Cooke, CA, R. Arrieta, J. Jackson, R. Kong, K. Gibson, S. Murphy, T. Rainer and M. Stacy. 2019. The Automated Benthic Ecology System (ABES). Teledyne Marine Technology Workshop. October 2019.

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

Rosen, G., I. Rivera-Duarte, J. Carilli, M. Colvin, J., J. Conder, M. Jalalizadeh, R. Adams, M. Vanderkooy, D. Moore, B. Chadwick, K. Markillie (2020). In situ evaluation of clean dredged material as an alternative to clean sand for Enhanced Monitored Natural Recovery. Platform presentation, PNW SETAC 2020. Bremerton, WA. February 29, 2020.

Rosen, G., I. Rivera-Duarte, J. Carilli, M. Colvin, J., J. Conder, M. Jalalizadeh, R. Adams, M. Vanderkooy, D. Moore, B. Chadwick, K. Markillie (2019). In situ evaluation of clean dredged material as an alternative to clean sand for Enhanced Monitored Natural Recovery. Poster presentation, 40th North American SETAC Conference, Toronto, Ontario, Canada. November 2019.

Rosen, G. (2019). Using Dredged Material to Reduce Contaminant Bioavailability. Webinar presentation for a Web-Based Workshop: Reducing Contaminant SourceImpacts to USACE Maintained Navigation Channels. Hosted by USACE ERDC (Dr. David Moore). September 5, 2019.

Rosen, G., I. Rivera-Duarte, J. Carilli, M. Colvin, J., J. Conder, M. Jalalizadeh, R. Adams, M. Vanderkooy, D. Moore, B. Chadwick, K. Markillie (2019). A Cost Effective In Situ Approach for Concurrent Evaluation of Site-Specific Sediment Remedy Performance and Recontamination Potential. Tenth International Conference on the Remediation and Management of Contaminated Sediments, New Orleans, Louisiana, February 11-14, 2019.

Rosen, G., I. Rivera-Duarte, J. Carilli, M. Colvin, B. Chadwick, J. Conder, D. Moore, K. Markillie (2019). Use of Natural Sediments Towards Enhanced Monitored Natural Recovery. Tenth International Conference on the Remediation and Management of Contaminated Sediments, New Orleans, LA. February 11-14, 2019.

Integrated Diagnostic Stormwater Monitoring with Passive Sampling (project no. 523)

Rosen G, Johnston RK, Hayman N, Guerrero J, Colvin M, Belden J, Strivens J (2020). Integrated diagnostic stormwater monitoring with passive sampling devices, Part 2: Use of polar organic chemical integrative samplers for detection of illicit discharges at Navy Facilities. NESDI Project No. 523 Final Report. June 2020. 53 pages.

Strivens J, Hayman N, Johnston R, Rosen G (2019). Effects of dissolved organic carbon on copper toxicity to embryos of Mytilus galloprovincialis as measured by diffusive gradient in thin films. *Environmental Toxicology and Chemistry* 38:1029-1034.

Hayman NT, Rosen G, Strivens JE, 2019. Evaluating the efficacy of DGT to quantify copper in stormwater at end-of-pipe. *Chemosphere* 235:1125-1133.

Strivens J, Hayman NT, Rosen G, Myers-Pigg A (2020). Toward validation of toxicological interpretation of Diffusive Gradients in Thin Films in marine waters impacted by copper. *Environmental Toxicology and Chemistry* 39:873-881.

Strivens, J., Rosen, G., Schlafer N., Brandenberger, J., & Johnston, R. (2020). Laboratory assessment of diffusive gradient thin-film performance in seawater, Supported with preliminary field data. Time integrated technique to assess bioavailable trace metals. Draft PNNL and NIWC Technical Report. 62 pages.

Hayman N, Rosen G, Rivera-Duarte I, Arias E, Colvin MA (2018). Using integrative passive sampling devices to obtain more meaningful and cost-effective data on metal-associated impacts from stormwater runoff. Platform presentation to Society of Environmental Toxicity and Chemistry (SETAC), 39th North American Annual Meeting, Sacramento, CA. November 8, 2018.

Rosen, G. Navy Stormwater Passive Sampling Project Data Overview. Presented to the City of Bainbridge Island, Washington, October 3, 2018.

Strivens J.E., R.K. Johnston, G. Rosen, N.J. Schlafer, N. Hayman, J.M. Brandenberger, and M. Aylward, et al. (2018). "Diffusive Gradient Thin-Films: Time Integrated Passive Sampling for Metals in Receiving Waters of Puget Sound." Presented by Jonathan E Strivens at 2018 Salish Sea Ecosystem Conference, Seattle, WA. PNNL-SA-133621.

Hayman, N.T., G.H. Rosen, I. Rivera-Duarte, E. Arias, M.A. Colvin, J.E. Strivens, R.K. Johnston. Using Integrative Passive Sampling Devices to Obtain More Meaningful and Cost-Effective Data on Metal-Associated Impacts from Stormwater Runoff. Pacific Northwest SETAC Annual Meeting, Vancouver, WA. April 6, 2019.

Demonstration of Improved Toxicity Methodology to Link Stormwater Discharges to Receiving Water Impacts (project no. 547)

Rosen G, Colvin M, Katz C, Munson-Decker J, Hayman NT. 2019. Pulsed Exposure Toxicity Testing: Method Development and Initial Evaluation for Stormwater Compliance. NIWC Pacific Technical Document #3393. DTIC: AD1082517. 370 pages.

Colvin M, Rosen G, Hayman N, Kowal K, VanVoorhis J, Stransky C. 2019. Validation of Pulsed Exposure Toxicity Methods at San Diego Regional Naval Bases. SERDP/ESTCP Symposium. December 2019.

Colvin M, Kowal K, Hayman N, Rosen G, VanVoorhis J, Stransky C. 2019. Derivation Studies for an Environmentally Relevant Approach for Stormwater Toxicity Testing Compliance Monitoring. SERDP/ESTCP Symposium. December 2019.

Buckley K, Stransky C, Colvin M, Rosen G, Schottle R, O'Connell K, VanVoorhis J. 2019. A Novel Pulsed Study Approach to Storm and Receiving Water Monitoring at the Scripps Institution of Oceanography in San Diego. National SETAC Annual Meeting, Sacramento, CA. November 2019.

Hoang T, Sanchez J, O'Malley K, Colvin M, Rosen G. 2019. Acute toxicity of copper and zinc pulse exposure to *Ceriodaphnia dubia*. National SETAC Annual Meeting, Sacramento, CA. November 2019.

Colvin M, Rosen G, Hayman N, Kowal K, VanVoorhis J, Stransky C. 2019. Validation of Pulsed Exposure Toxicity Methods at San Diego Regional Naval Bases. National SETAC Annual Meeting, Sacramento, CA. November 2019.

Colvin M, Kowal K, Hayman N, Rosen G, VanVoorhis J, Stransky C. 2019. Derivation Studies for an Environmentally Relevant Approach for Stormwater Toxicity Testing Compliance Monitoring. National SETAC Annual Meeting, Sacramento, CA. November 2019.

Colvin M, Rosen G, Hayman N, Kowal K, VanVoorhis J, Stransky C. 2019. Validation of Pulsed Exposure Toxicity Methods at San Diego Regional Naval Bases. National SETAC Annual Meeting, Sacramento, CA. November 2019.

Colvin M, Kowal K, Hayman N, Rosen G, VanVoorhis J, Stransky C. 2019. Derivation Studies for an Environmentally Relevant Approach for Stormwater Toxicity Testing Compliance Monitoring. National SETAC Annual Meeting, Sacramento, CA. November 2019.

Stransky B.C., M. Colvin, G. Rosen, N. Hayman, J. VanVoorhis and K. Kowal. 2019. An Environmentally Relevant Approach for Stormwater Toxicity Testing Compliance Monitoring. California Association Stormwater Quality Association (CASQA) Annual Conference, Monterey, CA. October 2019.

Colvin M, Rosen G, Hayman N, Stransky C, Kowal K. 2019. An environmentally relevant approach for stormwater toxicity testing compliance monitoring. SoCal SETAC Annual Meeting, La Jolla, CA. May 2019.

Schottle R, Stransky C, O'Connell K. 2019. Evolution of a NPDES permit: Novel implementation strategies for storm water compliance monitoring at the Scripps Institution of Oceanography in San Diego, CA. SoCal SETAC Annual Meeting, La Jolla, CA. May 2019.

Buckley K, Stransky C, Colvin M, Rosen G, Schottle R, O'Connell K, VanVoorhis J. 2019. A Novel Pulsed Study Approach to Storm and Receiving Water Monitoring at the Scripps Institution of Oceanography in San Diego. SoCal SETAC Annual Meeting, La Jolla, CA. May 2019.

OUR FY20 SCHEDULE

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

What	When
Request Pre-proposals	14 October 2019
Pre-proposals DUE	5 December 2019
Make Pre-proposals Assignments to FWGs	13 December 2019
TDWG & FWG Comments on Pre-proposals DUE	6 January 2020
Evaluate Pre-proposals	6 – 10 January 2020
Conduct OPNAV N45 Programmatic Review	15 January 2020
Request Full Proposals	14 January 2020
Conduct First FY20 Virtual In-Progress Review	23 – 27 March 2020
Full Proposals DUE	12 March 2020
Screen Full Proposals	30 March – 3 April 2020
Conduct Second FY20 Virtual In-Progress Review	4 – 8 May 2020
FWG & TDWG Comments on Full Proposals DUE	1 May 2020
Principal Investigator Answers to Full Proposal Screening Questions DUE	22 May 2020
Announce FY21 Needs Solicitation	1 June 2020
Complete Evaluation of Full Proposals	4 June 2020
Obtain Sponsor Review & Approval of Full Proposals	5 – 25 June 2020
Conduct Third FY20 Virtual In-Progress Review	15 – 18 June 2020
Announce FY21 New Starts	28 July 2020
Close FY21 Needs Solicitation	3 August 2020
Screen FY21 Needs	10 – 14 August 2020
Evaluate & Rank Needs	14 – 18 September 2020
Obtain Sponsor Review & Approval of Needs	21 September – 14 October 2020
Quarterly Status Reports Due	7 October 2019 6 January 2020 6 April 2020 6 July 2020

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.

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2019

YEAR IN REVIEW REPORT

Accomplishments of the

NAVY ENVIRONMENTAL
SUSTAINABILITY DEVELOPMENT
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