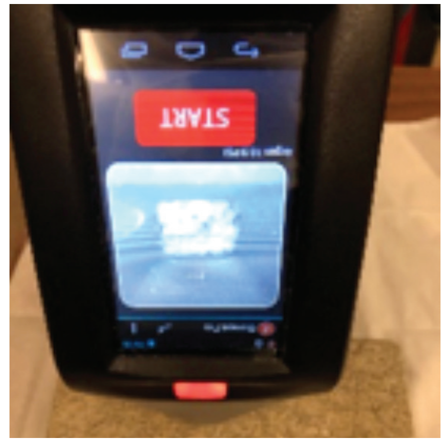
PROJECT ID:
575

# Contaminant Monitoring and Mapping for Informing Stormwater Best Management Practices

**The LIBS analyzer will be used to measure contaminants on urban/industrial surfaces and within soils.** (Photo Credit: Patrick Sims)



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

## OBJECTIVE:

This project will demonstrate a handheld technology to identify and quantify sources of copper and zinc in stormwater runoff that provides the information needed to optimize the Best Management Practices (BMP) designed to mitigate those sources.

## PROBLEM STATEMENT:

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 National Pollutant Discharge Elimination System (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 risk.

## DESCRIPTION:

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 to detect the elemental impurities in materials. A high-power short laser pulse is used to create a micro-plasma on the sample surface. Commercial off-the-shelf LIBS instruments are currently hand-held devices with similar capabilities as hand-held X-ray fluorescence instruments, without the requirement of an ionizing radiation source. Current state-of-the-art models can detect nearly every element. Because of this, LIBS technology provides an opportunity to quickly (under 10 seconds) evaluate potential source contaminants (e.g. brake dust, paint chips, runoff residue) in cracks, and potentially in sediments and soils.

This project will demonstrate LIBS efficacy and cost efficiency to identify contaminant sources in bulk and at the outer surfaces of environmental media.

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

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

Next, preliminary field testing will take place. During this task, measurements will be taken 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 contamination of concern. Different use scenarios will also be employed, potentially including:

1. Before and after evaluation of pier-side sweeping and/or vacuuming
2. Evaluation of areas in proximity to metal surfaces to assess leaching of zinc and copper as a means of improving models such as the WinSLAMM model (NESDI project no. 455: Modeling Tool for Navy Facilities to Quantify Sources, Loads, and Mitigation Actions of Metals in Storm Water Discharges)
3. Measuring surfaces for metal contamination above and below bioswales
4. Measuring lead concentration at skeet ranges.

These use scenarios will be based on the knowledge gained from other NESDI projects.

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 yet to be determined. This work will leverage ongoing efforts supported by the NESDI program or other sponsors where BMPs have been or will be implemented. This demonstration/validation will be 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 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.

## TRANSITION DESCRIPTION:

A technical report will be generated to report the methods, results and evaluation of the demonstration. Presentations and demonstrations will be provided to NBSD personnel and other stakeholders. It is anticipated that the results of this effort will also be presented at technical venues such as scientific conferences and Navy/Department of Defense workshops.

## CONTACT:

For more specific information about this project, contact the Principal Investigator at 619-553-0828. Contact the NESDI Program Manager at 805-982-4893 for more general information about the program.

## ABOUT THE NESDI PROGRAM

The Navy Environmental Sustainability Development to Integration (NESDI) program is the Navy's environmental research and development demonstration and validation program, sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities Engineering Systems Command from the Engineering and Expeditionary Warfare Center in Port Hueneme, CA. The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes and materials and by filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Navy readiness and lethality.

Visit the program's public website at https://www.navfac.navy.mil/NESDI for more information.