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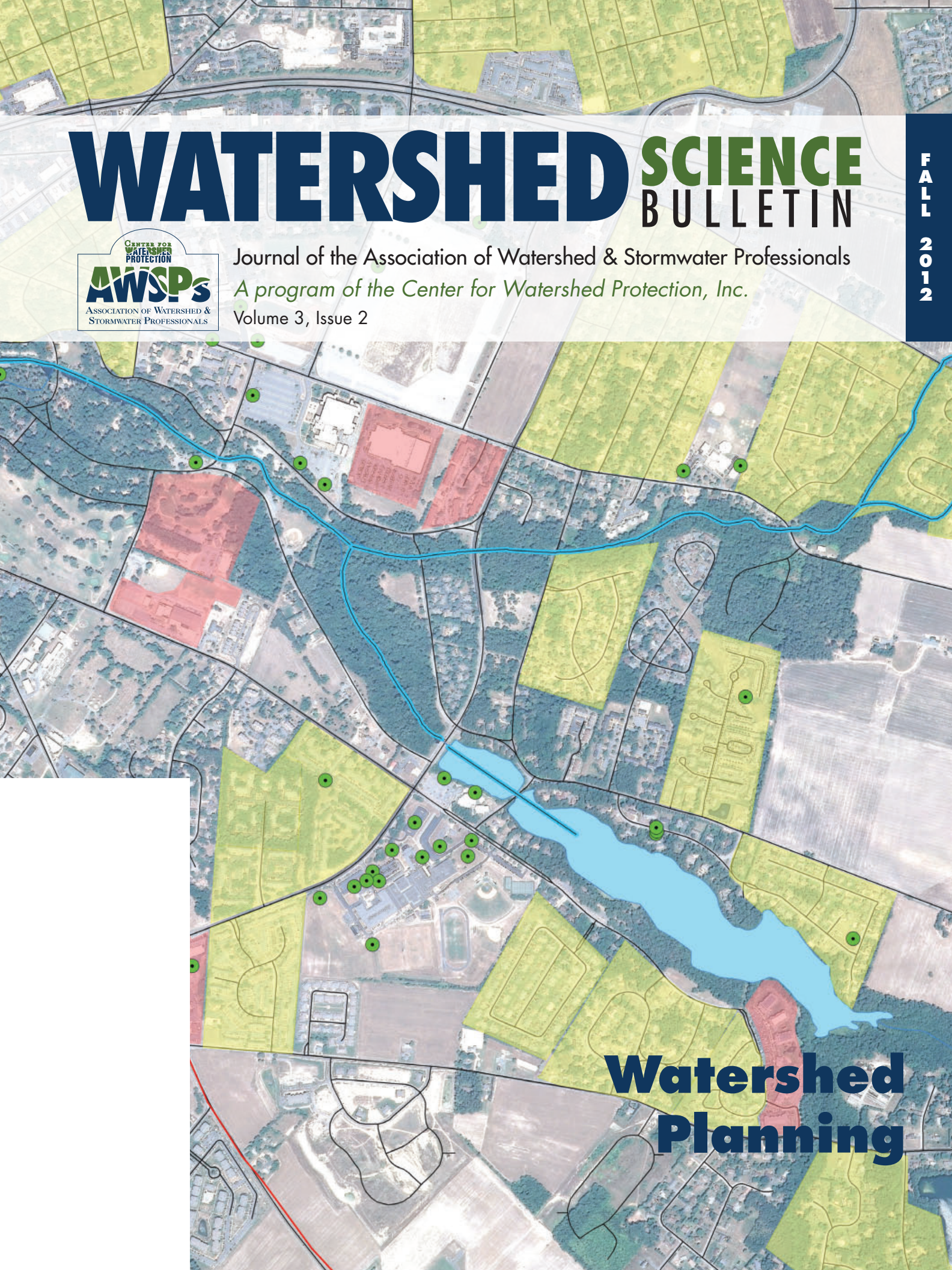

Watershed Planning

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Cover photo courtesy of the Center for Watershed Protection
showing Wicomico River watershed field assessment locations in Salisbury, Maryland.

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Watershed Planning for Coral Reef Watersheds: Experience from the Caribbean and Pacific Regions

Threats to coral reef health are both global and local. Globally, corals are threatened by rising ocean temperatures, sea levels, storm activity, and ocean acidity. These threats alone can severely compromise coral health, but they are compounded by localized land-based sources of pollution (LBSP) and overfishing of key reef-managing species. Pollutants, such as nutrients, bacteria, and sediment, become major stressors and threats to coral health when they collect in the nearshore environment (Figure 1). These local threats can reduce the resiliency of coral reef ecosystems in confronting the broader, global impacts. Bryant and colleagues estimate that up to 22% of the world's coral reefs are threatened by soil erosion and other LBSP, and up to 50% are threatened on islands with wide-scale land clearing.

Figure 1. Example of a sediment plume entering Coral Bay. Photo courtesy of: Coral Bay Community Council.

For these reasons, the National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program (CRCP) has put renewed emphasis on building local capacity to protect coral reefs though watershed-based management approaches.

Watershed planning is a powerful tool to help understand and act on local LBSP; however, watersheds in coral jurisdictions face some unique challenges. For example, the amount, intensity, and variability of rainfall make the management of runoff very challenging. According to Giambelluca and colleagues, some areas on the same island may receive no more than 25 cm of rainfall per year, while others receive well over 250 cm. The variability of island geology also presents a challenge. Areas of volcanic origin tend to have steep slopes and small drainage areas that result in high-energy systems with elevated erosion potential. Limestone areas are characterized by the rapid movement of pollutants into sole-source drinking water supplies and, ultimately, coral lagoons.

Island land management practices often exacerbate LBSP. Practices such as burning vegetation to abet hunting, the proliferation of poorly constructed dirt roads, insufficient erosion control during construction activities, and inadequate treatment of stormwater and wastewater (including the widespread use of cesspools) lead to increased loads of sediment and other pollutants. Watershed planning, however, needs to be sensitive to the isolation and institutional capacity of coral jurisdictions, which often have limited access to the technical resources and materials that are readily available on the mainland.

The bottom line for coral watersheds is that there is a direct and palpable link between the land and the water resource. While this relationship is certainly not unique to islands, the window of opportunity to "get it right" with coral watersheds is present and compelling. The presence of coral can be an important part of the identity—not to mention economy—of many of these islands. Fortunately, watershed planning in coral watersheds is evolving and has strong support from environmental agencies at all levels of government, as well as through partnerships with the nongovernmental sector.

As a way to focus funding and implementation, priority coral watersheds are designated through a consensus process between local and federal resource managers based on relative coral health and other factors (e.g., the presence of a Marine Protected Area). Watershed planning also works in conjunction with other planning efforts, such as local action strategies that address marine and land-based resource protection issues, the Nature Conservancy's conservation area planning process, and planning for Marine Protected Areas.

With support from NOAA, the US Department of Agriculture, the US Environmental Protection Agency, and local jurisdictions, the Center for Watershed Protection (the Center) and the Horsley Witten Group (HW) have been involved with assessment and planning in a number of priority island

watersheds over the last few years. These efforts, which have involved many dedicated local agencies and individuals as well as allied partners from universities and nonprofits, have led to a number of ongoing watershed planning and implementation initiatives, such as those described below.

Nonprofits Championing Implementation in US Virgin Islands Watersheds. With support from federal and territorial agencies, nonprofits have played a major role in the management of a number of priority watersheds. The 2008 *Coral Bay Watershed Management Plan* on St. John, developed by the Center, has led to more than $1 million in implementation funds to hire watershed staff, stabilize dirt roads, and install stormwater retrofits through the Coral Bay Community Council. In 2011, HW completed a plan for the 31 km^2 rural watershed draining to the St. Croix East End Marine Park (the first marine protected area in the US Virgin Islands). The St. Croix Environmental Association secured funding from the US Department of Agriculture to advance engineering designs for stream restoration, rain garden installation, and unpaved road drainage planning projects.

Figure 2. Island agencies, NOAA, HW, and the Center construct Saipan's first rain garden.

Building Stormwater Program Capacity in the Commonwealth of the Northern Mariana Islands (CNMI). In 2006, the US Environmental Protection Agency and the CNMI Division of Environmental Quality hired HW to develop the *CNMI and Guam Stormwater Management Manual*, which established specific criteria for best management practices (BMPs) in limestone and volcanic soils using updated rainfall statistics. Subsequently, HW developed a contractor certification program for erosion and sediment control (the Republic of Palau soon followed suit with a stormwater manual and erosion and sediment control training program). In 2009, a pollution prevention workshop conducted by CRCP, HW, the Center, and local agency staff led to an inventory of pollution sources, storm drain stenciling, and the ultimate launch of the Blue Starfish program to encourage local businesses to minimize stormwater pollution in Garapan. In addition, island agencies, with assistance from NOAA, HW, and the Center, installed the island's first rain garden early in 2012 (Figure 2).

Promoting Green Infrastructure in American Samoan Watersheds. The Center and HW are developing engineering designs and implementation strategies for stormwater retrofits to support the 2012 *Faga'alu Watershed Plan*, which was completed by local villagers, the American Samoa Environmental Protection Agency, and NOAA. Other exemplary efforts—such as long-term sediment monitoring by San Diego State University, construction by the American Samoa Environmental Protection Agency of the Pacific's first Leadership in Energy and Environmental Design–certified building (with green roof, permeable pavement, and bioretention facilities), and preliminary work on updating the island's stormwater standards—indicate a real commitment to protecting local water resources. Based on these efforts, NOAA has designated the Faga'alu watershed as a coral priority for restoration funding over the next several years.

Convening Pacific Island Watershed Practitioners in Hawaii. In 2010, the first Pacific Island Watershed Institute was held on Oahu. The conference included participants from the Hawaiian Islands, Guam, CNMI, American Samoa, Palau, and the Federated States of Micronesia. The training utilized local watershed planning and restoration activities conducted by Hui o Ko`olaupoko and the Mālama Maunalua watershed organizations. Each island developed a list of watershed-related priorities for building local watershed capacity or implementing existing watershed plans. NOAA subsequently funded implementation for some of these priority projects, including demonstration rain gardens and the expansion of island stormwater BMP design guidance.

Focusing Federal Dollars on the Coordinated Restoration of Guánica Bay, Puerto Rico. The Center developed the 2008 *Guánica Bay Watershed Management Plan* for the 391 km^2 urban and agricultural watershed located in the southwestern corner of Puerto Rico. Historically, the area was associated with some of the most pristine reefs on the island; now these reefs are impacted by pollutants, such as nitrogen, sediment, bacteria, polycyclic aromatic hydrocarbons, DDT, and polychlorinated biphenyls, along with other critical issues (e.g., upland erosion in the coffee-growing regions, instream channel erosion, loss of historic Guánica Lagoon, and sewage treatment). NOAA and the National Fish and Wildlife Foundation have provided funding toward the implementation of the plan's recommendations for the past two years. Current efforts, facilitated by Ridge to Reefs, include implementing BMPs for coffee growers, conducting an agricultural use assessment study, developing plans for a wetland treatment system at the wastewater treatment plant, constructing retrofit and stream restoration projects within the watershed, and establishing a local nonprofit organization to orchestrate some of these activities.

Protecting Aquifers and Surface Water Quality in Guam. Priority surface waters, such as the Piti Bomb Holes Marine Preserve, are an important resource for Guam, with unique natural features as well as a high level of human use. Guam's sole-source drinking water aquifer sits below highly permeable limestone and is subject to contamination threats from stormwater injection through ponding basins as well as potential overuse, particularly in light of significant military base expansion plans. Over the past several years, CRCP, the Center, and HW have conducted a series of watershed planning, site design, and stormwater training activities for island agencies and private sector stakeholders. A two-day field reconnaissance of the Piti and Asan watersheds conducted in 2009 has led to the finalization this year of a watershed management plan by Guam's Coastal Management Program. In addition, the Center and HW developed an addendum to the *CNMI and Guam Stormwater Manual* that contains detailed specifications for four innovative island stormwater BMPs: island bioretention, permeable pavement, rainwater harvesting, and multicell ponding basins.

Watershed planning for coral reef protection is a key component to overall coral reef protection strategies. This work has shed light on a few guiding principles for watershed planning in coral jurisdictions. It is important to adapt watershed planning elements and procedures to work on islands. As watershed planning and modeling become more sophisticated for mainland watersheds, one should keep in mind that islands may have to ramp up to these more sophisticated approaches, focusing initially on elements that have a high probability of being implemented. NOAA, island jurisdictions, and stakeholders could collaborate on a "short list" of essential watershed planning elements. Watershed planning should make appropriate use of outside expertise, balancing this with local knowledge and traditions that will be meaningful and motivating for island residents. Island-based universities are also playing an important role in developing and disseminating local approaches. As with other efforts, much of this work is about building relationships and trust, and interim achievements should be fully celebrated.

Watershed planning for coral reef protection is a key component to overall coral reef protection strategies.

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