5-Year Review of Forest Action Plans and Effective Water Quality Protections

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State Forestry Agency water quality accomplishments through five years of Forest Action Plans

Executive Summary

The 2008 Farm Bill included the requirement that forestry agencies in each state, U.S. territory and the District of Columbia develop assessments of the forests within their boundaries and strategies for addressing threats to these forests. The resulting *Forest Action Plans*, known technically as *Statewide Forest Resource Assessments and Strategies*, collectively provide a comprehensive strategic plan for the nation's forests and a roadmap to care for them. The plans were completed in 2010 and as of 2015 the plans developed by each state and U.S. territory are reaching their 5-year anniversary.

This report provides an overview of the *Forest Action Plans* and reviews the specific plans in three states and one island territory to evaluate accomplishments related to protecting water quality in the five years since they were completed. The findings of this review support the conclusion that these plans provide a valuable tool for thoughtfully and thoroughly addressing threats and opportunities across diverse forests. The plans provide a nationwide overview to support high-level decision making while also supporting local actions through state-specific priorities. To support the full benefits of the plans it is vital that identified data gaps be addressed, including the critical need for complete and up-to-date resource inventory information (e.g., Forest Inventory and Analysis (FIA) program activities). Also, there is value in periodic review and updating of the plans as needed on an approximately five-year cycle in order to measure progress and apply new information.[1] The *Forest Action Plans* are available in their entirety, along with supporting information, via the website: www.forestactionplans.org/

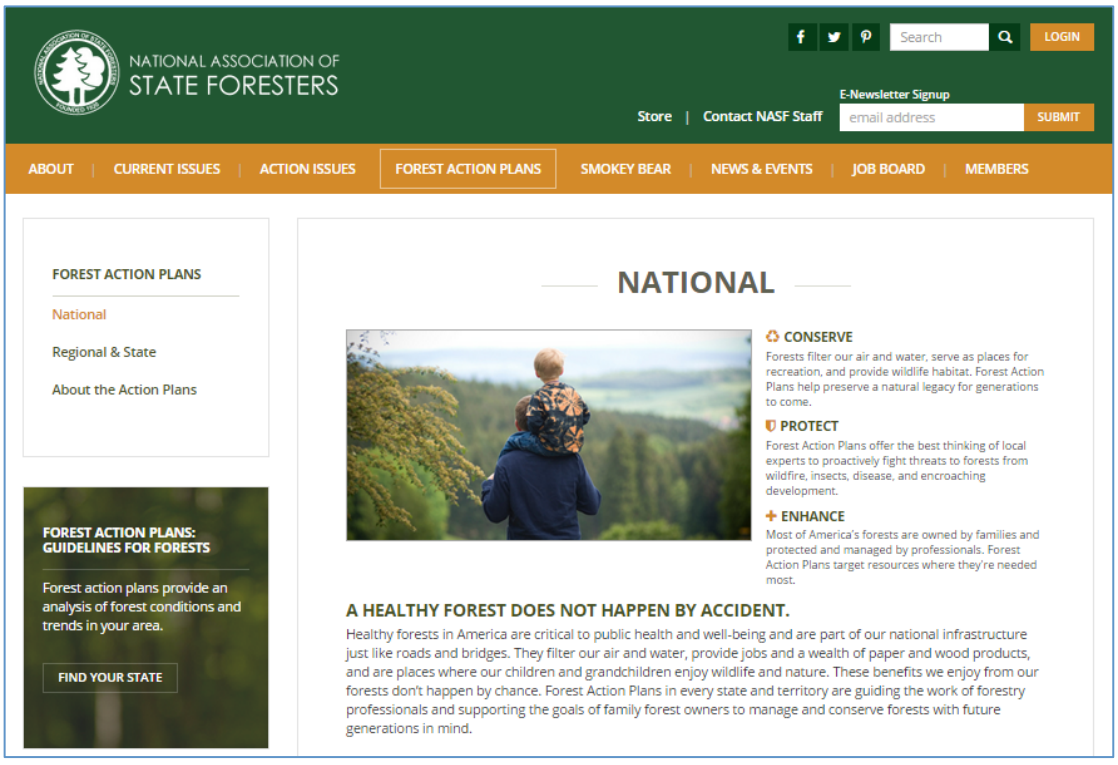


Figure 1. Forest Action Plans Website

[1] At a minimum, plans are required to be reviewed by Fall 2015, and revised by 2020.

Introduction

This report provides a brief background on *Forest Action Plans* and the process that was used to develop them. Additionally, the focus of this report is on evaluating the effectiveness of the plans in addressing water quality protections. Water quality was one major category of threat to forests identified by many states in their assessment process. The plans illustrate diverse concerns related to water throughout the country – including quality and quantity considerations. This report includes an overview of how water quality is addressed in the *Forest Action Plans* and the outcomes from four locations – Maryland, Georgia, Utah, and the Northern Mariana Islands (located in the western Pacific Ocean) - in the first five years of implementing their plans.

Forest Action Plans

The 2008 Farm Bill included the requirement that forestry agencies in each state, U.S. territory and the District of Columbia develop plans for the forests within their boundaries and strategies for addressing threats to these forests.[2] The resulting *Forest Action Plans*, known technically as *Statewide Forest Resource Assessments and Strategies*, collectively provide a comprehensive strategic plan for the nation's forests and a roadmap to care for them. The assessments provide an analysis of forest conditions and trends and also identify priority forest landscapes. The strategies included in the plans are intended to provide long-term direction for addressing priority needs and opportunities. The plans were completed in 2010 and are available in their entirety, along with supporting information, via the website: www.forestactionplans.org

The National Association of State Foresters (NASF) is a non-profit organization that represents the leaders of all 50 state forestry agencies, the eight U.S. territories (American Samoa, the Federated States of Micronesia, Guam, the Northern Marianas Islands, Palau, Puerto Rico, Republic of the Marshall Islands, and the U.S. Virgin Islands), and the District of Columbia. NASF periodically collects information across its membership to evaluate and report on forestry activities and accomplishments. In partnership with the USDA Forest Service, NASF provides a comprehensive and collaborative strategy for understanding the condition of forests across the country and the threats and opportunities related to them. Since the *Forest Action Plans* were completed, NASF has worked to support the effective use and monitoring of the plans.

When the *Forest Action Plans* were completed in 2010, the primary trends and threats facing the nation's forests that were identified and addressed in the state assessments included:

- changing ownerships of private lands,
- forest fragmentation,
- increased urbanization and conversion of forestlands to other uses,
- increased wildland-urban interface (WUI) areas,
- the effects of climate change,
- wildfire, and
- invasive species.

The assessments recognized that these issues are interconnected and that visible impacts to communities could have their origins in a combination of threats. For example, reduced water quality can stem from expanded development and also relate to forest fragmentation and increased WUI concerns, including wildfire risks. Many of the trends and threats affecting forests are interconnected while also being regionally diverse. For example, the land conversion issues in one region may be related to urban expansion while in other regions the expansion of agricultural cropping or livestock grazing provide the most substantial pressure for land use change.

[2] This report uses "states" as an inclusive term for states, territories and the District of Columbia.

Forest Action Plans and Regional Water Concerns

Water is a significant concern throughout the United States for a number of reasons. Forests provide clean water and are a preferred land use in municipal watersheds.[3] Forested watersheds are the source of clean drinking water for more than 180 million people in the United States. As areas of urbanization and development increase and forests are fragmented, there are associated decreases in forest health and water quality.

Forests provide essential watershed protections through the very nature of their structure (Figure 2). At the most basic level, tree canopies, including widespread forest cover, intercept rainfall. The tree canopies stand between the rainfall and the ground. By intercepting rainfall, the trees dissipate some of the momentum and energy in the rainfall that might otherwise lead to erosion. The intercepted rain also reaches the ground at a delayed interval, which mitigates the volume of water contributing to runoff during a storm event. An average tree is estimated to have the capacity to intercept about 100 gallons of water before becoming saturated[4], and across a forested landscape the impact can be significant. When forest cover is reduced in a watershed (and non-forest land uses are increased), downstream flooding, stream channel erosion, sedimentation, and overall water quality can be significantly negatively impacted.

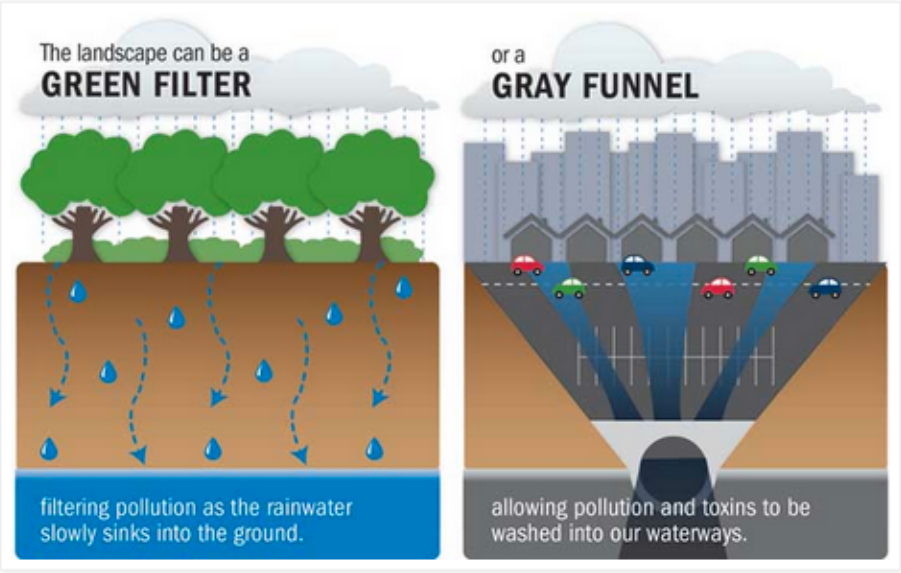


Figure 2. Forests Provide Green Infrastructure
Source: www.mappingvirginia.com/2014/02/paving-paradise.html

The *Forest Action Plans* address widespread concerns about water quality and water quantity as watershed functions are impacted by land use change, urbanization, rural-residential development and other activities. Water concerns are also linked to watershed degradation resulting from diverse impacts on forest conditions, including wildfire, invasive species, and insect or disease outbreaks.

The benefit of rainfall interception by trees, which leads to reduced runoff and greater water infiltration into the soil, is also significant in urban or developed regions. Many *Forest Action Plans* address Urban and Community Forestry, recognizing the opportunities associated with trees and forests within populated areas. Without careful consideration of the urban forest, the costs for storm water management and infrastructure can be overwhelming for a community.[5] States have identified a range of strategies in their *Forest Action Plans* to continue protecting, monitoring, and/or restoring high-priority watersheds, headwaters, riparian areas, and wetlands.

[3] For further discussion of the positive connection between forested watersheds and municipal water supplies, see the Dovetail report, "Growing Forests for Water", available at: http://www.dovetailinc.org/report_pdfs/2012/dovetailforestsforwater0912.pdf
[4] MacPherson, Greg and Karps, Jennifer. "How Trees Can Retain Stormwater Runoff". Arbor Day Foundation – Tree City USA Bulletin. No. 55, 2010. http://www.fs.fed.us/psw/programs/uesd/uep/products/11/800TreeCityUSABulletin_55.pdf.
[5] For further discussion of storm water management through green infrastructure, see the Dovetail report, "Innovative Municipal Stormwater Management Approaches", available at: http://www.dovetailinc.org/report_pdfs/2012/dovetailstormwatermgmt0712.pdf

The membership of NASF is divided into three regions – West, Northeast and South (Figure 3). According to an analysis of the original 2010 assessments and strategies, water shortages from drought and changes in weather patterns are of significant concern for arid Western states, states in the South also are expressing concern about water shortages and supplies; and clean and safe drinking water is one of the most valued commodities in the Northeast.[6] Other common themes in the plans include protecting and enhancing the health of urban watersheds and using forest ecosystems as a solution to address nonpoint source pollution on agricultural lands.

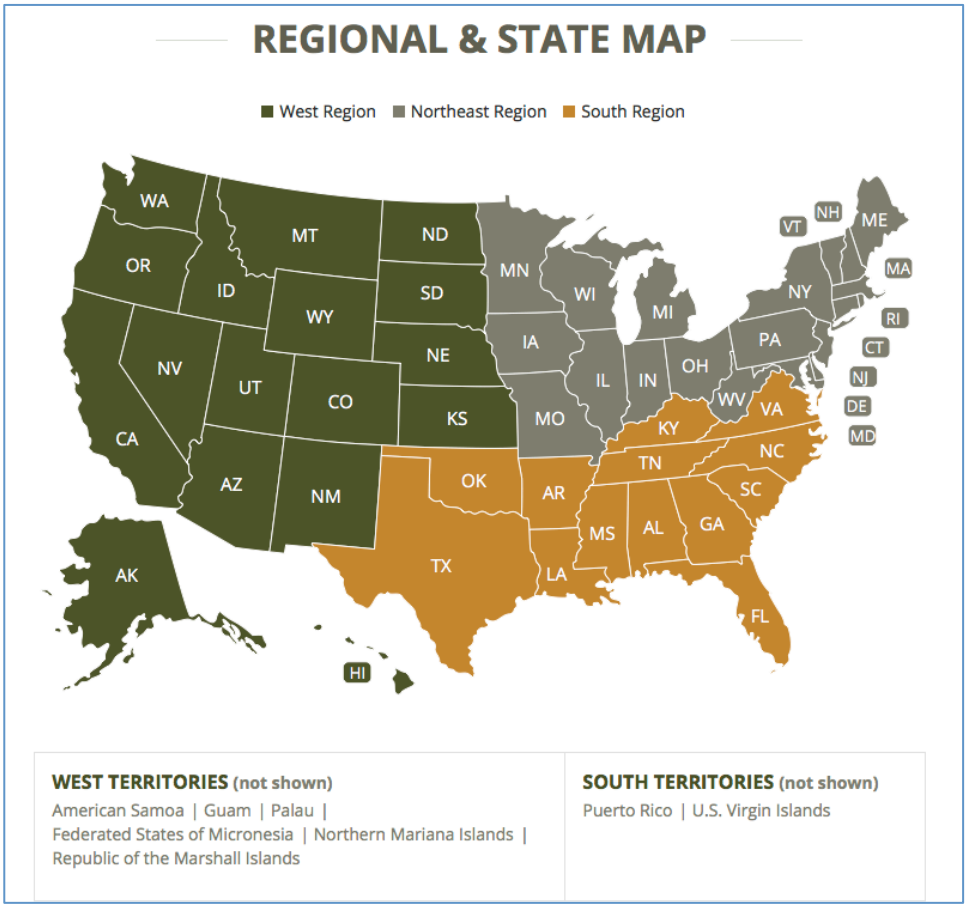


Figure 3. Map of Forest Action Plan Regions

Water Concerns: Northeast Region

Over 175 million acres of forest – close to 23 percent of forestland in the nation - are found in the heavily populated Northeastern and Midwestern region of the United States. Seventy-four percent of this forested land is privately owned, contributing to a complex pattern of land ownership across the landscape. The region faces a range of issues related to forest health, urban forests, climate change, forest fragmentation, wildfire, and many others.

Regional description provided by NASF (http://stateforesters.org/region/northeast)

In eastern regions, where land use change associated with development and residential expansion is most widespread, the *Forest Action Plans* emphasize increasing forest cover in high-priority watersheds, including those watersheds that provide public water supplies or are known to suffer impaired water quality. Planting

[6] The complete summary and analysis is available in this publication: USDA Forest Service. 2010. Summary and Analysis of the Statewide Forest Resource Assessments and Strategies 2010.

trees, addressing forest health, restoration of stream channels and wetland functions are all identified as important strategies in these watersheds. States within this region utilize a range of tools to address water quality concerns across the landscape and on diverse public and private ownerships. Land acquisition, conservation easements, incentives, education programs, and regulation enforcement are approaches used to protect the integrity of watersheds critical to public water supplies. In the Midwest, watershed concerns in forested regions include impacts from rural-residential development as well as areas that are at risk for increased wildfire. Beyond the forested region of the Midwest, there are substantial areas dominated by agricultural cropping land uses and there is increasing recognition that addressing water quality concerns throughout the Midwest will require that management strategies be applied to these land use conditions. The *Forest Action Plans* identify a need for research to identify where and under what conditions riparian forests may have occurred in these regions in the past and strategies for their successful reestablishment.

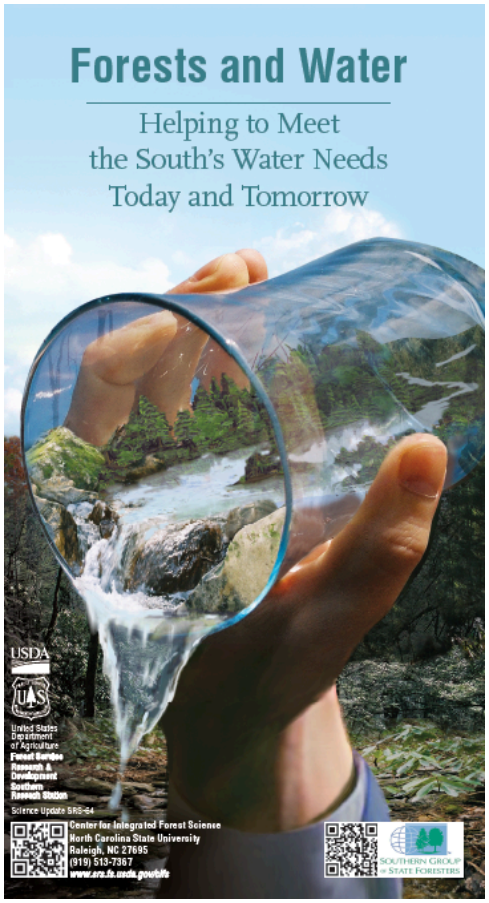


Figure 4. Forests and Water in the Southern Region
Source: www.southernforests.org/water

Water Concerns: South Region

The Southern region is home to vast and diverse forest resources. Forests account for a large portion of land in the South, with some states having two-thirds or more of their land area in forests. Nearly 90 percent of Southern forests, about 200 million acres, are privately owned by over five million landowners. Southern forests are being shaped by several trends, including population growth, urbanization, changing landowner characteristics and extreme weather and fire events. To sustain healthy forests and protect water resources, viable economic markets, careful forest management and well-targeted forest conservation efforts are critical.

Regional description provided by NASF (http://stateforesters.org/region/southern-region) and the Southern Group of State Foresters (http://www.southernforests.org/water).

States throughout the South are concerned with continued degradation of watershed conditions caused by urbanization and rural-residential development, which typically involves forest removal or intrusion into existing forests. As noted above, forests allow interception and infiltration of precipitation, slow runoff and recharge aquifers. When lands are developed, downstream flooding, stream channel degradation, and sediment deposition occur, and water quality and water supplies are diminished. Substantial costs for stormwater and water supply infrastructure are being incurred as development continues to displace forest cover in the Southern Region.

According to regional projections, the South is expected to see a 30% population increase in the next 50 years. Water shortages and competition for water are already occurring in the region and will escalate as population grows. Efforts to protect water quality in the South include promotion of Best Management Practices (BMPs) through a regional approach that incorporates meetings between multiple states and through the organizational leadership of the Southern Group of State Foresters. The regional partners also collaborate on monitoring the implementation of BMPs and the effectiveness of state programs. Technical assistance, including training, research, and guidance are provided to support the success of the programs.

Water Concerns: West Region

Forests of the West contain an incredible assemblage of resources. They cover about 365 million acres (49 percent of the nation's total forested area) and are managed by a diversity of owners, both public and private. The issues facing western forests — wildfire, invasive species, changing ownership patterns and markets, fragmentation, and climate change — affect all lands and all people, threatening basic assets we need and often take for granted: clean air and water, safe communities, open space, and economic opportunities. Regional description provided by NASF (http://stateforesters.org/region/western-region)

In the West Region, water concerns include the negative impacts associated with a reduced snowpack. In many areas, snowfall in higher elevation forests is a significant source of freshwater. An adequate snowpack is essential to storing water during the early season to reduce the risk of flooding and then gradually releasing the water overtime to be effectively used. Annual precipitation variations, drought cycles, and increased water supply pressures due to increasing development and growing populations impact these water resources. Forest management can be applied to help manage the snowpack and melt and release rates, but significantly greater effort is needed to mitigate widespread changes in watershed function associated with drought, climate change, wildfire and forest health declines. Past land use practices, including road building, land management, and abandoned mines also contribute to water concerns in the West Region. Given the mix of public and private ownership in the west, collaboration is key. Specific practices, including stabilizing and restoring stream channels and riparian areas, improving wildlife habitat, and reducing erosion are essential across all ownerships. Managing water quantity can also be achieved by addressing specific forest conditions, including decreasing the number of trees per acre and allowing more moisture and sunlight to reach the forest floor in order to support greater understory biodiversity. These diversified forest conditions can better prevent soil erosion, slow runoff, and reduce risks of high intensity wildfire. Greater use of forest thinning in conjunction with prescribed fire is an important strategy for improving watershed conditions in the West.

Along the Pacific Coast, forests provide important water quality functions for flood control and protection of municipal water supplies. Urbanization, rural development, agriculture and wildfire can all have significant impacts. Development activities, including roads and construction, can increase runoff, sedimentation, and flood risks. These changes can increase costs for flood control and water treatment and also impact public safety. Changes in climate may cause more precipitation to occur as rainfall (rather than snow), which may further exacerbate flooding concerns. Watershed programs in the region are focused on impaired waterways, specific habitats for salmon and steelhead, and other aquatic restoration opportunities. Actions for water quality protection include water conservation measures, riparian forest and mountain meadow restoration, and reduction of soil erosion through use of BMPs. Mountain meadow restoration provides opportunities for groundwater recharge and storage to occur and can mitigate for reduced snowpack.

For Islands and U.S. Territories, concerns related to water resources include continued urbanization and rural development. There are risks for increased sedimentation and nutrient loading due to erosion rates. Maintenance of riparian forests and protection of steep slopes are important strategies, but may be insufficient with increasing high-intensity precipitation events. The clearing of forests for agriculture and development are contributing factors to declining water quality, including the use of agricultural fertilizers and other pollutants. Erosion rates are impacting water quality, contributing to reductions in agricultural productivity, and impacting coastal resources and marine habitats. Actions to address these concerns include tree planting, use of BMPs, improvement of stream buffer zones, and urban forestry. Bioengineering projects have been undertaken to allow for greater water infiltration and to filter runoff.

Case Studies

Four examples – Maryland, Georgia, Utah, and the Northern Mariana Islands – illustrate in greater detail the water protections included within individual *Forest Action Plans* and the activities and accomplishments of the first five years of plan implementation.

Maryland

The state of Maryland includes approximately 2.5 million acres of forestland, nearly 2 million of which are family-owned. There are more than 155,000 woodland owners in Maryland. Each year the Maryland Department of Natural Resources Forest Service provides assistance to nearly 1,500 landowners and over 18,000 acres of forestland are covered by new or revised stewardship plans. The Maryland Forest Service assists more than 500 urban forestry programs serving over 80% of Maryland's residents.

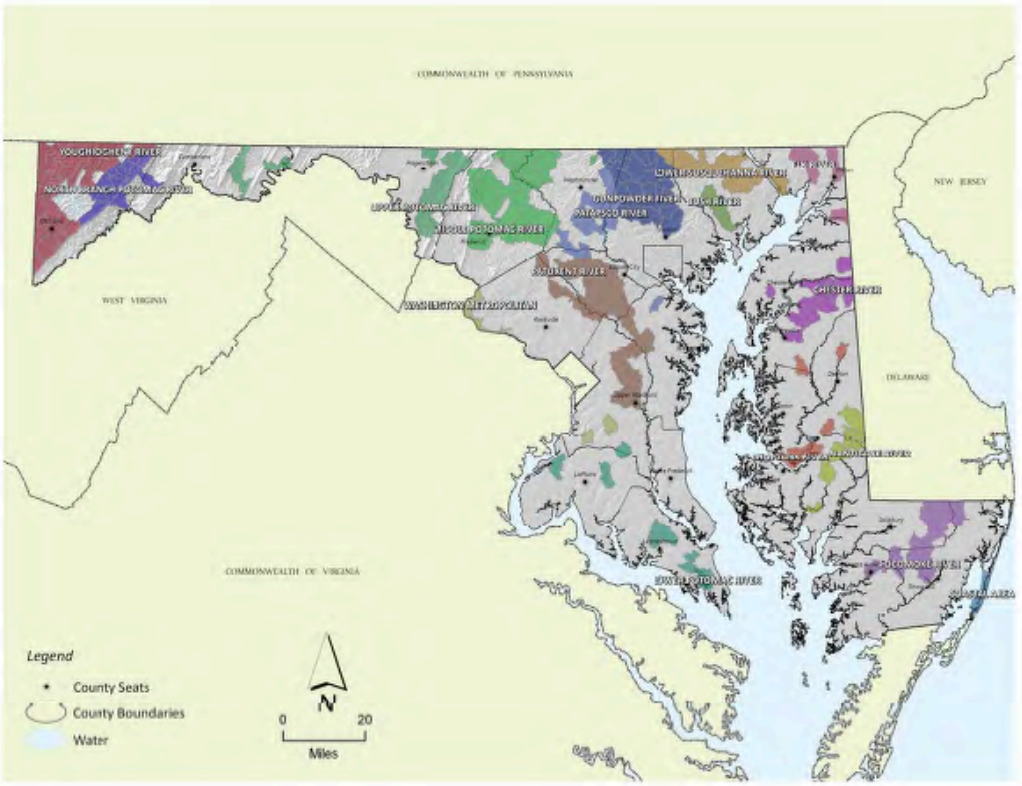


Figure 5. Maryland Water Quality - Core Forestry Priority Watersheds

The protection, restoration, and management of municipal water supply watersheds are key issues for Maryland. The subject of water quality has been extensively studied in Maryland due to the many years of research and restoration efforts focusing on the Chesapeake Bay. The Maryland Forest Resource Assessment completed in 2010 identified priority areas for water quality and supply. The assessment also reviewed the forestlands that are adjacent to surface water bodies and the amount of forestland in each watershed. Maryland includes over 1,000 watersheds, with an average size of 6,200 acres.[7] Of these, 227 (21%) were identified as forest priority areas for water quality and supply (Figure 5). In Maryland, there are almost 17,000 miles of streams and 7,500 miles of shorelines. The assessment found that 36% of these areas lack adequate vegetated buffers (e.g., 100 feet or more). Two-thirds of the waterways that lack adequate buffers were in rural areas and the other third in developed areas. Adequate vegetated buffers are a key strategy for the protection of the Chesapeake Bay and Coastal Bays. Research has consistently demonstrated nitrogen removal rates of 60 to 90% in forest buffers over 100 feet wide. These buffers also provide wildlife habitat, aesthetic benefits, and water cooling effects via shading. The assessment reported that on average approximately 76% of the area within 100 feet of streams in Maryland had some form of forest cover, although shorelines have substantially less forest (28%).

[7] 12-digit Hydrologic Unit Codes

Forests are considered the "first line of defense" for Maryland's drinking water resources. Most residents rely on surface water supplies and maintaining forest land use is fundamental for protecting these resources. Large reservoirs supply water to millions of people in the Baltimore and Washington, D.C areas, including over 63% of Maryland's population. Additional smaller reservoirs are critical to local communities. About 20% of the forestland in the reservoir watersheds is publicly owned. The responsible stewardship of the other 80% depends upon partnerships with many diverse organizations and stakeholders.

Maryland's comprehensive Watershed Program integrates forest stewardship, wildfire prevention, urban forestry, and forest health. Each of these areas of focus is recognized to have potential impacts on water quality, and preventative measures can avoid or mitigate these impacts. The key priorities for avoiding negative impacts include maintaining and enhancing riparian forest buffers, supporting and participating in watershed partnerships, protecting reservoirs that provide drinking water supplies, conserving forests through land use programs and incentives, and ensuring the widespread use of forestry BMPs (currently 80% adoption rate).

Maryland's Watershed Forestry and Forest Health Programs include several innovative approaches to engaging residents and property owners. The *Backyard Buffer* effort provides 20 to 30 small seedlings of appropriate trees and shrubs to homeowners with water on their property. Seventeen (17) of Maryland's 23 counties are now participating in this program, and about 1,000 landowners are engaged in the program each year with 24,000 seedlings distributed. The cost per county is less than $2,500.

Figure 6. Maryland's Catoctin Forest Alliance, MCC Crew, Park Service, and Forest Service - Falls Trail Planting, April 2011

To protect the drinking water supply for the city of Frederick, Maryland, a Forest Conservation Plan was established for the City Watershed forests in 2005. Since then, active forest management has been re-instituted on the City Watershed, incorporating review by an interdisciplinary team with clear goals to maintain a healthy forest that provides high quality water supplies. One of the most recent projects Maryland has undertaken since establishing their *Forest Action Plan* is a landscape-scale project around reservoirs in Western Maryland and Pennsylvania. The project began in 2014 and includes partnering with The Nature Conservancy to increase sustainable forestry within the watershed forests for the communities of Cumberland, Hagerstown, and Waynesboro. The work is underway for the three-year project, including field data collection and initial landscape stewardship planning events. The final impacts are expected to benefit at least three major watersheds and improve stewardship on more than 20,000 acres.

Water quality in the region is supported by significant partnerships involved in buffer restoration issues, including technical assistance from the Maryland Forest Service as well as collaboration with the Farm Service Agency (FSA) and Natural Resource Conservation Service (NRCS) to provide funding through the Conservation Reserve Enhancement Program (CREP) to develop farm conservation plans.[8] Additional state cost-share and state-funded easement programs support this work. Assessments that quantify buffer function are supported through funding from the USDA Forest Service (USFS). Partnerships with The Nature Conservancy (TNC) and the University of Maryland Center for Environmental Sciences – Appalachian Lab aid in targeting

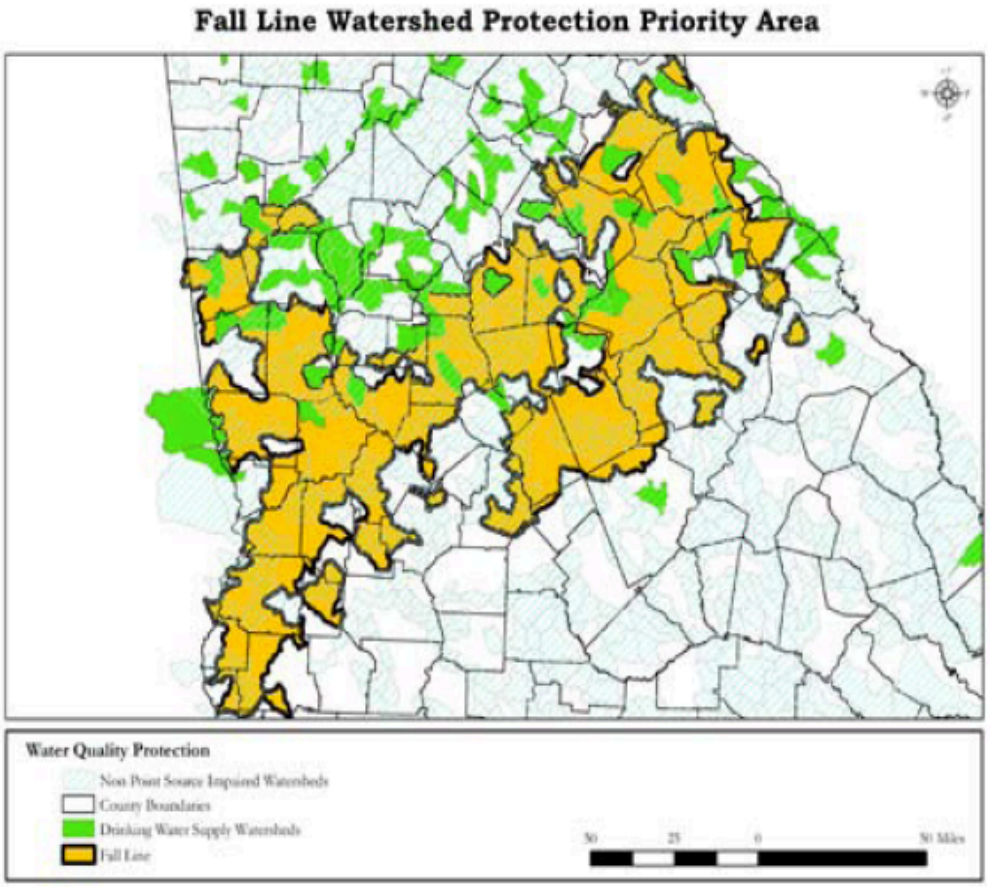
[8] For more information about CREP and the partnerships supporting this program, visit: https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-enhancement/index

efforts based upon the results of these assessments. The U.S. Fish and Wildlife Service (USFWS) is a partner for replanting and maintenance in the target watersheds while diverse local non-profits provide volunteers to do the plantings. In recent years, state efforts have paired schools with targeted buffer restoration activities and coincided with Governor O'Malley's *Stream Restoration Challenge* that provided a competitive grant program to establish 1,000 acres of streamside forest by 2015.

More information about Maryland's Forests and their *Forest Action Plan* is available at:
http://stateforesters.org/forest-action-plans/maryland

Georgia

The forests of Georgia cover nearly 25 million acres, including over 18 million acres of family forestlands. The Georgia Forestry Commission (GFC) reports that on an annual basis nearly 20,000 landowners receive technical assistance or educational services in the state. More than 100,000 acres of new or revised forest stewardship plans are prepared each year. The state's urban forestry program engages 192 communities impacting more than 6 million Georgia residents.



Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 7. Fall Line Priority Area, Georgia *(Fall Line Area shown in yellow; drinking water supply watersheds shown in green)*

Georgia's *Forest Action Plan* identified water quality and quantity as an important strategic issue. In fact, protecting, conserving and enhancing water quality and quantity produced by forests were the highest ranked priority issues in GFC's public stakeholder survey. Impacts from droughts, resulting water use restrictions, and conflicts with neighboring states contributed to a concern that the water supply needs to be addressed. The statewide assessment also recognized that the loss of forestland to urbanization is the greatest threat to Georgia's water quality and many of the riparian buffers in the state are insufficient.

To address the findings of the assessment and concerns about water quality, Georgia's *Forest Action Plan* emphasized the role and importance of the GFC to provide leadership in BMP development and implementation, with support from the Environmental Protection Agency (EPA) and in partnership with diverse stakeholder groups, including the American Tree Farm System, Trout Unlimited, local governments, developers, landowners, and recreational interests. The assessment identified priority areas for addressing water quality issues, including impaired stream segments, public drinking water supply watersheds, trout streams, wetlands, and sensitive areas. For example, the Fall Line Priority Area (Figure 7) contains 23 public drinking water supply watersheds (show in green in the figure). The *Forest Action Plan* for Georgia set goals for continuing to increase overall statewide BMP implementation and resulting water quality benefits through monitoring, technical assistance, education, and partnerships with local governments and others. The plan also called for continuing to provide investigation and mediation of forestry concerns raised by the public and stakeholders.

The GFC Water Quality Program is funded through the EPA and includes education, monitoring, and technical assistance activities. The GFC has been the state's lead agency for forestry BMPs since 1977. The state's BMPs were first developed in 1981 and have been updated in 1999 and 2009. The state's *Forest Action Plan*, which includes goals for the implementation of BMPs, was completed in 2010.

The GFC is responsible for BMP monitoring across 272 watersheds, including 2,700 miles of streams. Georgia has prioritized water protection through the Governors Comprehensive Water Plan Study Committee. The GFC is also engaged in the State Water Council. There are individual regional plans to address water concerns and regional councils work closely with GFC foresters.

Today, about a dozen professionals staff the GFC's Water Quality Program and provide services as regional specialists or water quality foresters. These individuals deliver more than 100 presentations on BMPs each year (reaching nearly 2,500 people annually). In 2014, the Water Quality Program hosted 26 field days to demonstrate BMP implementation. Also in 2014, water quality foresters investigated 57 complaints across the state, which involved 122 site visit inspections. These foresters made 190 site visits to inspect pre-harvest conditions. In 2014, Georgia's water quality foresters completed the 9th Statewide Silvicultural BMP survey.[9] This monitoring activity included 209 randomly selected sites to be inspected for effective BMP implementation. The most recent results found 89.9% compliance, up from 64.9% in 1991.

Since water crosses boundaries, Georgia and the GFC partner with neighbors on several multi-state issues, including working with Kentucky in addressing the hemlock woolly adelgid threat[10]; working with Alabama and South Carolina to address the cogongrass threat[11]; working with Alabama on water quality and quantity concerns to sustain working forests to provide clean, dependable water and support watershed ecosystems; and working across the region to address long-leaf pine and increase acres of long-leaf pine to increase forest product opportunities, increase wildlife habitat, and decrease forest management costs.[12]

More information about Georgia's Forests and their *Forest Action Plan* is available at:
http://stateforesters.org/forest-action-plans/georgia

[9] Field work completed in 2013; final report released in 2014.
[10] For more information about this invasive insect and the threat to Eastern hemlock trees, visit: http://www.invasivespeciesinfo.gov/animals/hwa.shtml
[11] For more information about this invasive plant species, visit: http://www.invasivespeciesinfo.gov/plants/cogongrass.shtml
[12] For more information about GFC's Regional Longleaf Pine Restoration Initiative, visit: http://www.gfc.state.ga.us/forest-management/recovery/longleaf-pine-restoration-initiative/index.cfm

Utah

There are more than 18 million acres of forestland in Utah, including more than 3 million acres of family forests (about 66,000 landowners). The vegetation in Utah's forests is strongly influenced by local conditions and the availability of water is a primary factor. The Utah Department of Natural Resources (Utah DNR) reports that on an annual basis nearly 40,000 acres of new or revised forest stewardship plans are prepared. The Department provides education and assistance to landowners, local communities, volunteer fire departments, and urban forestry programs throughout the state.

The Utah DNR Division of Forestry, Fire and State Lands developed their Statewide Forest Resource Assessment & Strategy Guide in 2010. The assessment included evaluation of a full range of forest resource considerations, including wildland fire, stewardship forestry, wildlife habitat, water quality and riparian areas, forest health, land management, urban & community forestry, forest conservation programs, and climate change.

Within the consideration of water quality and riparian areas, the assessment acknowledged that Utah is the second driest state in the nation[13] and that high elevation forests provide nearly all of the state's freshwater sources. Population increases, invasive species and other threats are impacting these critical headwater regions. The state utilizes a statewide watershed approach to comprehensively address resource concerns through collaboration with diverse local, state and federal agencies and stakeholders. The Utah Forest Water Quality Guidelines (FWQG) provide BMPs to protect soil and water resources in areas of forest management. The state's Forest Practices Act provides additional authority for protecting water quality.

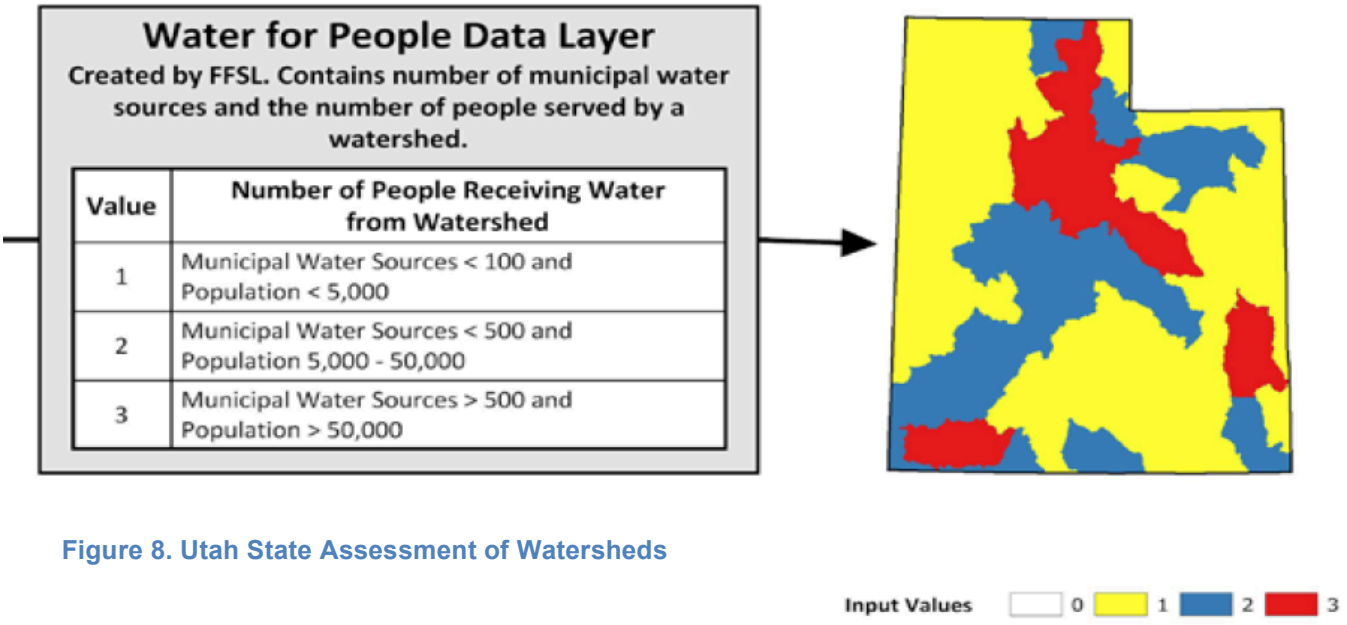


Figure 8. Utah State Assessment of Watersheds

The assessment identified priority watershed areas throughout the state, including critical public drinking water supplies (Figure 8). The assessment also identified priority actions to include education-addressing BMPs, leadership to reduce invasive species in riparian corridors, and assistance to communities with urban tree projects adjacent to rivers and streams.

[13] Nevada is the driest state, also see: http://www.currentresults.com/Weather/US/average-annual-state-precipitation.php

In 2015, Utah reviewed the Utah Forest Action Plan to include additional watersheds and incorporate Sage Grouse Management Areas.[14] A comprehensive update is planned in 2016 that will include addressing additional wildlife, wildfire, and other issues.

More information about Utah's Forests and their *Forest Action Plan* is available at:
http://stateforesters.org/forest-action-plans/utah

Northern Mariana Islands

The Northern Mariana Islands' official name is the Commonwealth of the Northern Mariana Islands (CNMI) and includes fourteen islands in the Pacific Ocean about 3,900 miles west of Hawaii (Figure 9). Three islands, Saipan, Tinian, and Rota are populated (Figure 10). The islands encompass about 180 square miles. There are about 74,000 acres of forestland on the Northern Mariana Islands, including approximately 4,000 acres that are family forestlands. The CNMI Department of Lands & Natural Resources is responsible for programs that promote the health and productivity of CNMI's forestlands and rural economies.

Figure 9. Northern Mariana Islands *(MapQuest, 2015)*

The islands receive an average of 89 inches of rainfall per year and 75% of the rainfall occurs during the wet season from June to November. One of the water quality risks for CNMI is saltwater intrusion into the aquifers if they are allowed to run low during the dry months. As land is cleared for agriculture or development, the runoff rates can increase and aquifer recharge rates can decrease. Runoff can also contribute to contamination from chemicals and damage to coastal ocean habitats. Maintenance of healthy forests and reforestation of grassland areas are important components of watershed management for the islands. Productive vegetative cover and reforestation are needed to reduce flooding risks during heavy rainstorms and typhoons.

The public water supply system is inadequate for meeting growing demands from commercial development and population increases in the CNMI. Desalinization and rainwater catchment systems are used in addition to wells that utilize underground aquifers. An additional concern is sea-level rise associated with climate change, which may impact water quality in the aquifers as well as displace coastal residents on the islands.

[14] For more information about Sage Grouse Management Areas in Utah, visit: http://wildlife.utah.gov/learn-more/greater-sage-grouse.html

The CNMI's *Forest Action Plan* recognizes deforestation and runoff as threats to water quantity and quality. To address these challenges, CNMI-Forestry works collaboratively with other government agencies and diverse stakeholders to implement conservation and enhancement projects. One example is a partnership focused on catching runoff and enhancing aquifer recharge rates while also reducing soil erosion. This work includes reforesting open areas that are currently grasslands or degraded. The Bureau of Environmental and Coastal Quality (BECQ) is the lead agency for these projects and CNMI-Forestry provides planting materials and technical assistance. These partners are also engaged in stormwater treatment initiatives. Education is a key activity to engage farmers, ranchers, and property owners in the management and reduction of chemical use. The CNMI's Statewide Assessment and Resource Strategy was developed in 2010 and included a review of issues related to watershed conditions and water shortages. Priority watersheds were evaluated and mapped as part of the assessment, including areas that are critical to public wells and aquifers (Figure 10).

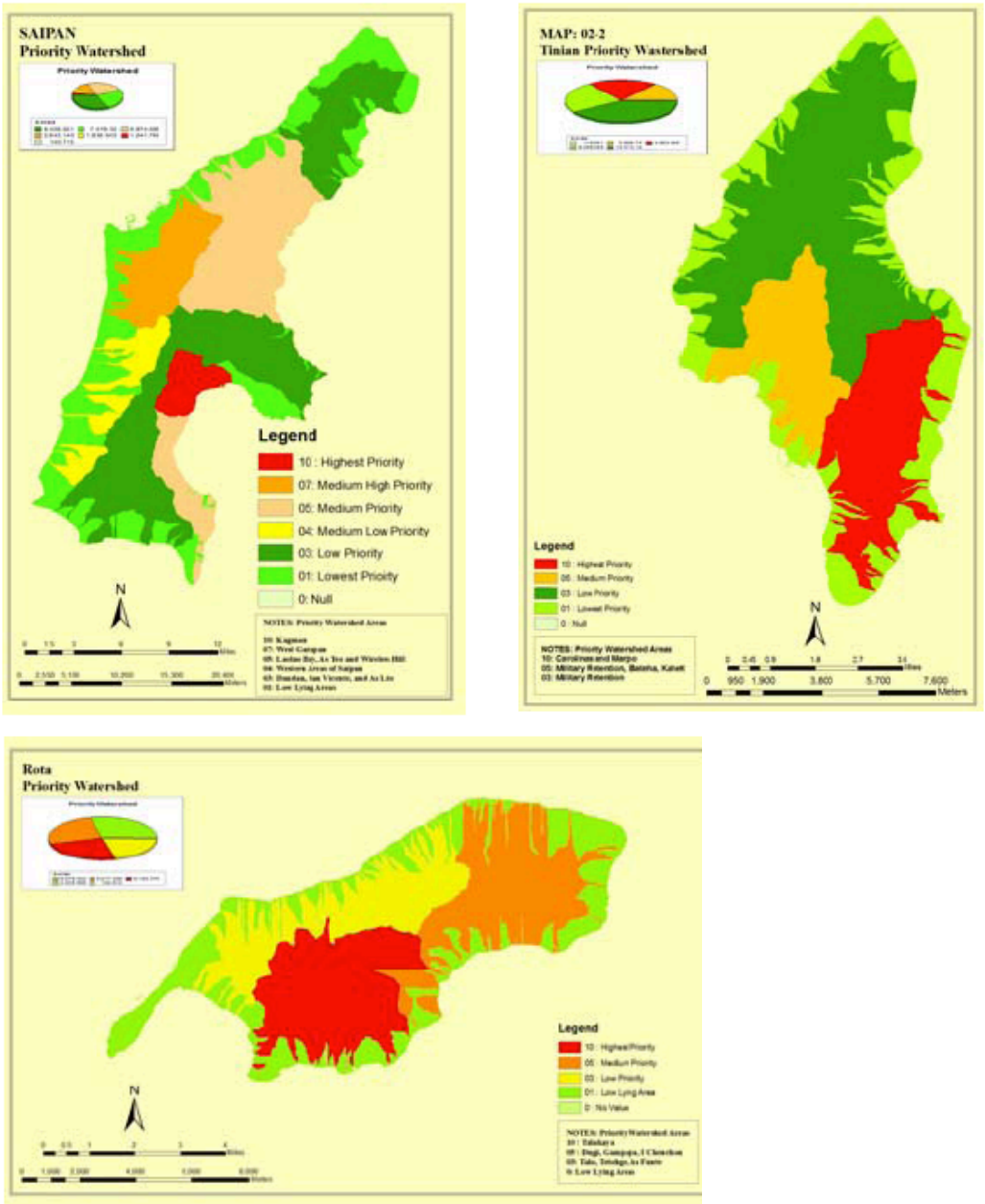


Figure 10. Priority Watershed Areas for the islands of Saipan, Tinian, and Rota, CNMI. ***(Red = high priority watershed; Orange/Yellow = medium levels; Green = low priority)***

Figure 11. CNMI Forestry, Reforestation Project

In the first five years of the CNMI's *Forest Action Plan*, progress has been made on partnering with other agencies to accomplish shared goals. The plan provided a basis for reaching out to communities and other stakeholders to support discussing successful approaches and methods. To date, the work on reforestation, including the *Badlands Revegetation Project* has been an important example of the impact of the planning process (Figure 11). For this project, key agencies such as the National Oceanic and Atmospheric Administration (NOAA) as well as BECQ and CNMI-Forestry joined efforts to inter-plant suitable plant species, reforest open spaces, address soil erosion, reduce coral-reef contamination, and improve fresh water infiltration to recharge water aquifers. The plan has also resulted in enhancing biodiversity by inter-planting native tree and plant species in key areas and reducing the threat of invasive species. Community engagement in these conservation and management practices has helped their success.

More information about the Mariana Islands' Forests and their *Forest Action Plan* is available at:
http://stateforesters.org/forest-action-plans/northern-mariana-islands

Bottom Line

This report reviews the *Forest Action Plans* in three states and one island territory to evaluate accomplishments related to protecting water quality in the past five years since the plans were completed. The findings of this review support the conclusion that the *Forest Action Plans* provide a valuable tool for thoughtfully and thoroughly addressing threats and opportunities across diverse forests. The plans provide a nationwide overview to support high-level decision making while also supporting local actions through state-specific and watershed-focused priorities. To support the full benefits of the plans it is vital that identified data gaps be addressed, including the critical need for complete and up-to-date resource inventory information. Also, there is value in periodic review and, when deemed necessary, updating of the plans on an approximately five year cycle to measure progress, share results, and apply new information.

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