NOAA'S NEXT-GENERATION STRATEGIC PLAN

VERSION 4.0

Draft for Public Review
23 June 2010

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NOAA's Mission:
Science, Service & Stewardship

To understand and anticipate changes in climate, weather, oceans, and coasts,
Share that knowledge and information with others, and
To conserve and manage marine resources

Enterprise Science & Technology

- a holistic understanding of the earth system through research
- accurate, reliable, data from integrated earth observations
- an integrated environmental modeling system

Climate Adaptation & Mitigation

- improved understanding of climate
- integrated climate assessments
- mitigation, adaptation from climate service
- a climate literate public

Weather Ready Nation

- reduced loss of life, property, disruption
- improved water management
- transportation efficiency, safety
- healthy people, communities
- secure, reliable infrastructure

NOAA's Vision of the Future: Resilient Ecosystems, Communities & Economies

Healthy ecosystems, communities, and economies that are resilient in the face of change

Resilient Coastal Communities & Economies

- resilient coastal communities
- ocean and coastal planning
- safe, efficient marine transportation
- improved coastal water quality
- arctic access, management

Healthy Oceans

- improved understanding of ecosystems
- recovered, rebuilt living marine resources
- healthy habitats
- safe, sustainable seafood

Enterprise Engagement

- an engaged and educated public for informed environmental decisions
- integrated services for evolving demands of regional stakeholders
- international partnerships and policy leadership

Enterprise Organization & Administration

- a modern information technology infrastructure
- diverse capabilities, evolving workforce
- sound management of capital investments

NOAA'S NEXT-GENERATION STRATEGIC PLAN

OVERVIEW OF NOAA'S STRATEGY

Through its longstanding mission of science, service, and stewardship, NOAA generates tremendous value for the nation – and the world – by advancing our understanding of and ability to anticipate changes in the Earth's environment, by improving society's ability to make scientifically-informed decisions, and by conserving and managing ocean and coastal resources.

NOAA's Mission: ***Science, Service, and Stewardship***
To understand and anticipate changes in climate, weather, oceans, and coasts,
Share that knowledge and information with others, and
To conserve and manage marine resources

NOAA's mission is central to many of today's greatest challenges. Climate change. Severe weather. Natural and human-induced disasters. Declining biodiversity. Ocean acidification. Threatened or degraded ocean and coastal resources. These challenges convey a common message: Human health, prosperity, and well-being depend upon the health and resilience of natural ecosystems. NOAA's vision of the future is one where societies and natural ecosystems reinforce each other and are mutually resilient in the face of sudden or prolonged change.

NOAA's Vision of the Future: **Resilient Ecosystems, Communities, and Economies**
Healthy ecosystems, communities, and economies that are resilient in the face of change

Resilient ecosystems, communities, and economies can maintain and improve their health and vitality over time by anticipating, absorbing, and diffusing change. This vision of resilience will guide NOAA and its partners in our collective effort to reduce the vulnerability of communities and ecological systems in the short term, while helping society avoid or adapt to long-term environmental, social, and economic changes. To this end, NOAA will focus on four long-term outcomes within its primary mission domains:

NOAA's Long-Term Goals:

Climate Adaptation and Mitigation:
An informed society anticipating and responding to climate and its impacts

Weather-Ready Nation:
Society is prepared for and responds to weather-related events

Healthy Oceans:
Marine fisheries, habitats, and biodiversity are sustained within healthy and productive ecosystems

Resilient Coastal Communities and Economies:
Coastal and Great Lakes communities are environmentally and economically sustainable

NOAA cannot achieve these goals on its own, but neither can society achieve them without NOAA. This Plan describes the long-term outcomes that NOAA will contribute to in each of these areas, along with the specific objectives that NOAA will pursue over the next five years. As a whole, NOAA's capacity to achieve these goals and objectives will depend upon the continued strengthening and integration of NOAA's enterprise-wide science and technology, stronger partnerships and stakeholder engagement, and effective organizational and administrative functions.

NOAA'S NEXT-GENERATION STRATEGIC PLAN

DRAFT 4.0
23 JUNE 2010

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Letter from the NOAA Administrator

[Letter from Administrator Forthcoming]

NOAA's Mission:
Science, Service, and Stewardship

NOAA generates tremendous value for the nation – and the world – by advancing our ability to understand and anticipate changes in the Earth's environment, by improving society's ability to make scientifically-informed decisions, and by conserving and managing ocean and coastal resources. NOAA's world-class research and information services continuously advance our scientific understanding of a changing climate and its impacts. NOAA monitors and models the environment to forecast daily weather, warns us of hurricanes, tornados, and tsunamis, and supports private enterprise with information necessary for sustainable economic growth. NOAA is directly responsible for managing our nation's fisheries, and for supporting the responsible management of coastal habitats and species. NOAA is a global leader in understanding the processes by which ecosystems provide services crucial for human survival on Earth, and in helping to educate businesses and federal, state and local decision makers about how the health of human society and the health of the environment are interconnected.

NOAA's mission statement summarizes the agency's fundamental mission responsibilities.

> **NOAA's Mission:** ***Science, Service, and Stewardship***
> To understand and anticipate changes in climate, weather, oceans, and coasts,
> Share that knowledge and information with others, and
> To conserve and manage marine resources

Science at NOAA is the development of knowledge through research and analysis, observations and monitoring, and environmental modeling. NOAA science includes discoveries and new understanding of the oceans and atmosphere and the application of this understanding to such issues as the causes and consequences of climate change, the physical dynamics of high-impact weather events, the dynamics of complex ecosystems, and the ability to model and predict future states of these systems. Science provides the foundation and future promise of the service and stewardship elements of NOAA's mission.

Service is the communication of data, information, and knowledge to others for use in their businesses, communities, and daily lives. NOAA services include climate predictions and projections; weather and water reports, forecasts, and warnings; charts and navigational information; and the continuous delivery of an enormous range of earth observations and scientific data sets used throughout the public, private, and academic sectors.

Stewardship is NOAA's direct use of that knowledge to protect people and the environment, where NOAA exercises its direct authorities for regulating marine fisheries, protecting endangered marine species, restoring habitats, conserving marine sanctuaries and other protected places, responding to emergencies, and aiding in disaster recovery.

The foundation of NOAA's longstanding record of scientific, technical, and organizational excellence is its people. NOAA's diverse functions require an equally diverse set of skills and constantly evolving abilities in the workforce. Also underlying NOAA's continued success is its unique infrastructure: NOAA's core mission functions require satellite systems, ships, buoys, aircraft, research facilities, and high-performance computing. Furthermore, NOAA invests in and depends heavily upon the science, management, and engagement capabilities of its partners. Collectively, NOAA's people, infrastructure, and partnerships provide the foundation for NOAA's strategy: They provide the enterprise capabilities that will advance NOAA toward its long-term vision and goals.

NOAA's Vision of the Future: Resilient Ecosystems, Communities, and Economies

Through its mission of science, service, and stewardship, NOAA helps society address some of the most pressing questions of our time. Can we secure an economic future that is both prosperous and environmentally sound? Can we spare future generations the potential calamities foretold by unchecked greenhouse gas emissions? Can we improve public safety and security of our communities in the face of high-impact weather and water events? Can we both use and preserve the ocean and coastal ecosystem resources upon which the nation's communities and economy depend?

These challenges reveal the intimate connection between people and the natural environment. Human health, prosperity, and well-being depend upon the health and resilience of natural ecosystems. Earth's weather, climate, oceans, and coasts provide valuable services that support people, communities, and economies. Similarly, human well-being requires preparing for and responding to changes within these natural systems. NOAA's vision of the future is one where societies and natural ecosystems reinforce each other and are mutually resilient in the face of sudden and prolonged change.

> **NOAA's Vision:** ***Resilient Ecosystems, Communities, and Economies***
> Healthy ecosystems, communities, and economies that are resilient in the face of change.

Resilient ecosystems, communities, and economies can maintain or improve their health and vitality over time by anticipating, absorbing, and diffusing change. This vision of resilience will guide NOAA and its partners in our collective effort to reduce the vulnerability of communities and ecological systems in the short term, while helping society avoid or adapt to potential long-term environmental, social, and economic changes. Achieving this vision will require understanding current Earth system conditions, projecting future changes, and helping people make decisions to reduce their sensitivity to and ability to cope with environmental hazards and stresses that emerge over time.

A resilient ecosystem – including humans and their institutions – is environmentally sound and economically sustainable for generations to come. To this end, NOAA will focus on four long-term outcomes that are central determinants of resilient ecosystems, communities, and economies—and which cannot be achieved without the agency's distinctive mission capabilities:

> **NOAA's Strategic Goals:**
>
> ***Climate Adaptation and Mitigation:***
> An informed society anticipating and responding to climate and its impacts
>
> ***Weather-Ready Nation:***
> Society is prepared for and responds to weather-related events
>
> ***Healthy Oceans:***
> Marine fisheries, habitats, and biodiversity are sustained within healthy and productive ecosystems
>
> ***Resilient Coastal Communities and Economies:***
> Coastal and Great Lakes communities are environmentally and economically sustainable

Unified by an overarching vision of resilience, these goals are mutually supportive and complementary. Just as economic prosperity depends upon a healthy environment, the sustainability of ocean and coastal ecosystems depends upon society's ability to mitigate and adapt to climate change. Similarly, sustainable economic growth along the nation's coasts, in arid regions, and in countries around the world depends

upon regional-scale climate predictions and projections. Likewise, the resilience of coastal communities depends upon their understanding of and preparedness for sudden or prolonged weather and water conditions. By responding to these interconnections, NOAA can magnify the effect of each goal on its common vision of resilient ecosystems, communities, and economies.

As a science-based organization, NOAA's unique enterprise capabilities provide the foundation for achieving NOAA's long-term strategic goals: a world-class earth system research capability that spans natural and social science disciplines; accurate and sustained environmental observations and data on physical, chemical, and biological systems; and numerical models, projections, and predictions of possible future conditions of the earth's systems. Even more fundamentally, to address the interconnected and complex challenges associated with a changing climate, uncertain weather and water extremes, and overstressed ocean and coastal resources, NOAA must be agile and possess the ability to deploy highly trained scientific and technical experts and specialized infrastructure and information technology assets, as well as to collaborate effectively with a diverse network of global and local partners.

Long-term goal: Climate Adaptation and Mitigation

An informed society anticipating and responding to climate and its impacts

Climate-related changes projected for the future include increased global temperatures, melting sea ice and glaciers, rising sea levels, increased frequency of extreme precipitation events, increased acidification of the oceans, modifications of growing seasons, increased storm frequency and intensity, alterations in species' ranges and migration patterns, earlier snowmelt, increased drought, and altered river flow volumes. The impacts of these changes are regionally diverse and affect numerous sectors, including water, energy, transportation, forestry, tourism, fisheries, agriculture, and human health. A changing climate is anticipated to alter the distribution of water resources and exacerbate other human impacts on fisheries and marine ecosystems, such as overfishing, habitat destruction, pollution, and excess nutrients in coastal waters. Sea level rise is expected to amplify the effects of other coastal hazards, and rising temperatures are expected to increase invasions of non-native species. Climate change can also have a direct impact on commerce, transportation, and the economy. For example, in the Arctic retreating sea ice is allowing the northward expansion of commercial fisheries and providing increased access for regional oil and gas development, commerce and tourism.

These changes have profound implications for society, underscoring the need for scientific information to aid decision makers in developing and evaluating options for mitigating the human causes of climate change and adapting to foreseeable climate impacts. While the nation has made significant progress in our understanding of climate, more work is needed to specify the causes and effects of these changes, produce accurate predictions, identify risks and vulnerabilities, and inform decision-making. No single organization can do this alone: Building upon a strong scientific foundation and decades of engagement with interagency, academic, and private sector partners, NOAA will advance this long-term goal by strengthening our scientific understanding of climate, producing integrated climate assessments, developing and delivering climate services at global to regional scales, and improving public knowledge of a changing climate and its impacts. Given its stewardship responsibilities and expertise, NOAA will improve its capacity to understand and predict the impacts of a changing climate on weather patterns, water resources, and ocean and coastal ecosystems.

Objective: Improved scientific understanding of the changing climate system and its impacts

A pressing need exists to advance our understanding of the climate system and climate impacts to improve climate predictions and projections and to better inform adaptation and mitigation strategies. Key scientific uncertainties limit scientists' ability to understand and predict changes in the climate system. This is particularly true for the monthly to decadal timescales and at the regional and local levels, scales that are highly relevant for planning and decision making. Research on the connections between weather and climate, for example, is necessary to understand how a changing climate may affect severe weather, precipitation patterns, and hurricanes. On decadal to centennial timescales, research is needed to understand the feedbacks between atmospheric greenhouse gases and the rate of global-to-regional climate impacts (such as changes in sea level, heat waves, and droughts). International, national, state, and local efforts to limit greenhouse gases require reliable information to support emissions verification, as do efforts to track climate changes and mitigate impacts. Adaptation and mitigation strategies must also be informed by a solid scientific understanding of the climate system. For example, research is needed to understand how changes in the global ocean circulation affect the climate system and subsequent impacts on coastal regions, including sea level rise, ocean acidification, and living marine resources.

To achieve this objective, NOAA will continue its world-class observation, monitoring, research, and modeling efforts and increase efforts to close gaps remaining in our understanding of the climate system. This effort will require expanding and sustaining comprehensive, global and regional-scale climate observing and monitoring networks that provide high-resolution information; conducting and sponsoring fundamental physical, chemical, and biological research to discover new approaches and opportunities to understand the climate system, along with research to explore the effects of a changing climate on social and economic systems; conducting and sponsoring research on how climate variability and change affect selected regions that are especially vulnerable to climate impacts, such as the Arctic; characterizing key uncertainties (e.g., ocean variability, ocean circulation and heat content, clouds, aerosols, precipitation, ice sheets, global energy budget, biogeochemical cycles, and socio-economic parameters) and integrating this knowledge into models to improve predictive capabilities; increasing the number and quality of climate predictions through high performance computing and model advancements; and actively engaging the external research community through competitive research programs.

Over the next five years, evidence of progress toward this objective will include:

- More accurate, precise, and comprehensive knowledge of greenhouse gases and other climate forcing agents;
- Advanced understanding of key oceanic, atmospheric, hydrologic, biogeochemical, and socioeconomic climate uncertainties related to a changing climate;
- Improved predictive performance of global and regional climate models for monthly to centennial timescales;
- Reduced uncertainty in assessing and predicting climate impacts; and
- Quantitative, daily to decadal projections of Arctic sea ice extent, concentration, and type.

Objective: Integrated assessments of current and future states of the climate system that identify potential impacts and inform science, services, and decisions

Stakeholders and the general public need a clear understanding of the best available science describing the state of the climate and the likely impacts of climate change. Scientific assessments at the global, national, regional, and local levels integrate knowledge from many disciplines to provide decision-makers with authoritative information on climate impacts, identify gaps in understanding, and help prioritize future research and service development efforts to fill those gaps. When pursued on a sustained basis, assessments build relationships between researchers and users and provide context for climate services developed and delivered by NOAA and others.

To achieve this objective, NOAA will play a leading role in international and national assessments that survey and summarize current scientific understanding about the causes and consequences of global climate change and its impacts. NOAA will work closely with partner agencies and the external research community to ensure that these assessments are of the highest scientific quality. Internationally, this objective entails sustained contributions to and leadership of scientific assessments such as those of the Intergovernmental Panel on Climate Change (IPCC) and the international assessments of ozone layer depletion. Special attention will be given to generating state-of-the-art simulations of future climate conditions and ensuring model simulations and analyses are directed to informing an assessment of impacts, adaptation, and vulnerability. This objective requires continuing NOAA's work on assessing potential climate change impacts in the United States. NOAA will develop high-resolution climate information that identifies key vulnerabilities and informs the development of climate services to meet the needs of targeted audiences. To supplement its own work, NOAA will rely on and support efforts undertaken by partners at other agencies and research institutions around the world to understand economic, environmental, and social risks, and to communicate these findings. Given its stewardship responsibilities and expertise, NOAA will play a leading role with respect to assessing economic and environmental risks to ocean and coastal ecosystems, living marine resources, and water resources.

Over the next five years, evidence of progress toward this objective will include:

- Potential climate change impacts and key international, national, and regional vulnerabilities are identified and inform the development of useful climate services;
- Model simulations and analyses inform the IPCC assessments of climate impacts, adaptation, and vulnerabilities;
- Potential climate change impacts for the United States and key regional vulnerabilities are identified and inform climate service development; and
- National and regional assessments address particular needs of NOAA's unique stewardship responsibilities for ocean and coastal ecosystems, living marine resources, and water resources.

Objective: Mitigation and adaptation efforts supported by sustained, reliable, and timely climate services

Human-induced changes in Earth's climate, as well as natural climate variability, complicate our ability to effectively plan for the future, manage resources, support national security, and sustainably develop our economy. Resource managers, state, local and tribal governments, public and private businesses and organizations are recognizing that climate change complicates their ability to achieve their goals. Existing information is not readily available to those who need it or formatted in a way

that makes it easy to use. The nation needs a comprehensive, authoritative, and coordinated source of climate information to support adaptation and mitigation strategies and to incorporate into risk assessments and related decision-making processes.

To achieve this objective, NOAA will build upon its strong scientific foundation and external partnerships to develop and deliver climate services. These services will include up-to-date descriptions of the state of the climate; regional information derived from global climate models; useful predictions of likely climate impacts; and the timely delivery of climate information, short-term and long-term forecasts, and early warnings. These products will be accompanied by services that help decision makers use climate information and model output and understand the associated uncertainties. NOAA's initial service development efforts will focus on producing climate predictions, information, and ecosystem impact assessments for the water, coastal, and living marine resources sectors, including improved sea level rise and ocean acidification monitoring, predictions, and information on related ecosystem and infrastructure impacts. Over time, NOAA will also develop and improve similar services for other sectors such as health, traditional and renewable energy, agriculture, transportation, terrestrial resources, tourism, and national security. Developing services that meet these diverse needs will require increased coordination and collaboration across NOAA and with other government agencies, tribal governments, academia, non-governmental organizations, and the private sector. To ensure that a diverse community of customers can access and use NOAA's data products and information services, NOAA will produce new and improved data management and access systems—including a NOAA Climate Services Portal—that enhance the communication and dissemination of climate information and products.

Over the next five years, evidence of progress toward this objective will include:

- National, state, local, and tribal governments are more informed about drought, better prepared for fire seasons, and can more confidently manage water resources;
- Coastal and marine spatial planners incorporate a greater understanding of the risks of sea level rise as they manage ocean and coastal resources;
- Coastal decision-makers and marine resource managers understand ocean acidification trends and begin to adapt to changing conditions; and
- Decision-makers in the electricity, agriculture and other industries have better information regarding climate extremes, including deviations in temperatures and precipitation patterns.

Objective: A climate-literate public that understands its vulnerabilities to a changing climate and makes informed decisions

The success or failure of climate adaptation and mitigation in the United States and around the world will depend on the ability of leaders, organizations, institutions and the public to understand the challenges and opportunities climate change presents. The routine incorporation of climate information into decisions requires an awareness of how climate change may affect individuals, families, businesses, and communities. A society educated about climate change and actively engaged in dialog about its causes and effects will better address today's problems and plan for tomorrow.

To achieve this objective, NOAA will work with diverse partners in academia and elsewhere to increase understanding of the likely impacts of climate variability and change through investments in climate awareness efforts, capacity building, education, and outreach. NOAA will engage stakeholders at multiple levels, foster community dialog, and educate citizens and students both formally and informally. Engagement efforts will be highly adapted to meet the needs of various

segments of society. NOAA will work to ensure continuous and sustained dialogue among partners to understand capabilities and identify climate-related risks that are of the most urgent concern to decision makers and the public. This engagement will also help NOAA understand how user needs for climate services are changing, how users perceive climate risks and uncertainty, and consequently how to design future climate products and services. In addition to data and products, the NOAA Climate Services Portal will offer a broad array of climate communications and educational materials that stem from NOAA's climate research, observations, modeling, and services.

Over the next five years, evidence of progress toward this objective will include:

- Key segments of society understand climate risks and use that knowledge to increase resilience to likely climate impacts;
- Consumers of climate information understand climate uncertainty and utilize this knowledge in their decision-making processes; and
- Educators and other outreach professionals increase their use of climate science resources.

Long-term goal: Weather-Ready Nation
Society is prepared for and responds to weather-related events

The increasing concentration of people and businesses in weather-sensitive areas will elevate society's vulnerability to weather and water conditions. Tsunamis bring surge events, flooding, and debris flows, and hurricanes add strong winds to this mix of coastal threats. Tornadoes take lives and property at a more local and unpredictable scale. Communities along rivers and other inland waterways face increasing disruption from more frequent and devastating floods, while others face extreme drought, straining municipal water supplies and putting the sustainability of entire businesses and communities at risk. Winter storms paralyze metropolitan areas for days. Space weather, predicted to peak over the next few years, can radically disrupt communications and electricity transmission. As more people become vulnerable to these events, environmental information—including forecasts and warnings—will become ever more critical to the safety and well-being of those exposed to sudden or prolonged hazards.

Over the long-term, climate change may increase the intensity and even the frequency of adverse weather events, ranging from drought and flooding to wildfires, storms and hurricanes. Changing weather, water and climate conditions affect industry location, renewable energy generation, and transportation system efficiency and safety. Trusted and timely environmental information is essential for sustaining the nation's competitive advantage, expanding economic growth, and protecting lives and livelihoods. Achieving a weather-ready nation means that society will be able to prepare for and increase its resilience to environmental events that affect safety, health, the environment, the economy, or homeland security.

Objective: Reduced loss of life, property, and disruption from high-impact events

An essential component of a weather-ready nation is integrated, impact-based forecasts and information so citizens, businesses, communities, governments, and first responders are prepared, ready to act, and able to recover. To be effective, the information must clearly communicate risk, impacts, and uncertainties, and be delivered through multiple channels. Increased and enhanced availability and use of weather-related information by citizens, businesses and government can reduce the impact of weather-related events on lives and livelihoods.

To achieve this objective, NOAA will maximize the use of weather-related information and decision support services to promote actions that minimize adverse impacts from environmental events. Key requirements include improving and expanding information services for hurricanes, severe weather, and fire weather; providing consistent, reliable, and accessible forecasts and warnings focused on specific impacts, risks, and confidence levels; and leveraging new technologies to ensure data is available, accessible, and timely. In collaboration with its partners, NOAA will provide direct, interpretive support to public sector officials and emergency responders, and expand environmental education and weather safety programs. This objective also requires: research and development to quantify forecast uncertainty and to understand the weather-climate linkage as well as human behavior and decision-making; sustained and improved observation networks; high resolution Earth system models; the development and implementation of a four-dimensional weather information database; and next-generation "warn on forecast" capabilities for convective weather.

Over the next five years, evidence of progress toward this objective will include:

- Fewer weather-related fatalities;
- Decreased economic loss from unnecessary evacuations and property damage; and
- Increased number of communities certified as TsunamiReady™ or StormReady®.

Objective: Improved water resource management

Water resources are one of the most significant challenges facing the United States in the 21st century. Demands for water continue to escalate, driven by agricultural, energy, commercial and residential usage. Sustained growth requires viable long-term municipal water supplies and, by extension, sophisticated predictions and management practices. Through a federal consortium, NOAA provides water resources observations and forecasts to water resource managers. The nation's water managers need new and more integrated information to more effectively and efficiently manage limited water supplies in a changing and uncertain environment.

To achieve this objective, NOAA will enhance the integration and utility of services for weather and water forecasts and information. With partners such as the U.S. Geological Survey (USGS) and the Army Corps of Engineers (USACE), NOAA will develop integrated decision support tools and services, offering a seamless suite of high-resolution, summit-to-sea forecasts. NOAA will also expand services to provide forecasts for such parameters as water flow, temperature, quality, dissolved oxygen content, and soil moisture conditions for inland and coastal watersheds. Developing integrated water forecasts also will require new technologies to improve information access and dissemination, as well as research and development to improve understanding of cloud and precipitation processes, advance hydrologic and hydraulic models, and integrate long-range weather and water forecasting. NOAA also will develop high-resolution, coupled models for rivers, lakes, and estuaries within an Earth system framework, and better quantify hydrologic forecast uncertainty.

Over the next five years, evidence of progress toward this objective will include:

- Less economic loss and property damage from flooding as a result of impact-based decision support;
- More efficient and effective management of municipal water supplies using integrated water forecasts, and
- Economic benefits from increased efficiencies in water usage in the transportation, hydropower, and agriculture sectors.

Objective: Improved transportation efficiency and safety

Weather accounts for approximately 70 percent of all air traffic delays within the Unites States, costing billions of dollars to the U.S. economy. Winter storms can cripple surface transportation networks for days at a time and are a tremendous hazard to drivers. Marine transportation is disrupted by hurricanes and storms at sea causing delays and loss of cargo and lives. Volcanic ash can cause widespread flight cancellations. In partnership with local and state government as well as other federal agencies, NOAA can provide improved observations and services to minimize the impacts of weather-related events on the national transportation system.

To achieve this objective, NOAA will develop and deploy a four-dimensional environmental database to inform decisions, initially to support the next-generation air transportation system but ultimately to benefit all sectors, including marine and surface transportation. NOAA will provide consistent, reliable forecasts and warnings focused on transportation-related impacts and risks. This objective also requires better forecasts of low clouds, fog, turbulence, visibilities, and precipitation type and duration, as well as improved methods for quantifying forecast uncertainty. Research on human behavior and decision-making also is needed to improve forecast delivery. Modeling enhancements will improve storm prediction accuracy and coastal wave modeling. NOAA also will seek to increase the scope of available data by integrating observations from road, marine, aircraft, and other mobile sources, while seeking to improve data in remote areas such as the Arctic.

Over the next five years, evidence of progress toward this objective will include:

- Fewer aviation delays;
- Reduced grounding or sinking of cargo vessels; and
- A reduction in transportation fatalities and economic losses due to weather-related events.

Objective: Healthy people and communities through improved air and water quality

Poor air quality causes people to suffer from chronic respiratory illnesses and is responsible for up to 60,000 premature deaths in the United States each year, while clean, safe water is a growing concern for communities and ecosystems. Our rivers and estuaries –and the species living in them – are being affected by changing water temperatures and increases in salinity, nutrients, and other pollutants. Such pollutants impact fish and shellfish populations and lead to harmful algal blooms, expansive dead zones, and increased incidents of human illness. NOAA is in a unique position to combine predictive weather information with its understanding of weather, water, climate, oceans, and coasts to develop integrated environmental predictions and analyses that can improve the health of ecosystems and communities.

To achieve this objective, NOAA will develop and deploy a suite of integrated, nationwide health- and ecosystem-based weather and water information services to address regional needs. Key requirements include high-resolution ozone, smoke, and dust forecasts; data on extreme temperatures; and improved water quality forecasts. Enabling this objective are strong, collaborative partnerships with local, state, tribal, and national health, water, and environmental managers. NOAA scientists and partners will conduct research and development for health and ecological based predictions, scenarios, and projections for multiple time and space scales. Observations will be expanded in partnership with public health agencies to support environmental monitoring. NOAA will improve modeling and prediction capabilities within an Earth system framework for air and water quality and

initiate development of an ecological forecasting system, coupling air, land, water, and sea with biological, geological, chemical, and ecosystem processes.

Over the next five years, evidence of progress toward this objective will include:

- Broader understanding of the linkages among human health, weather, water and climate and the causes of air and water quality issues;
- Fewer fatalities attributable to air pollution; and
- Positive economic and ecological impacts from improved water quality forecasts.

Objective: Secure, reliable infrastructure for energy, communications, and agriculture through timely and accurate environmental information

Our capacity to increase renewable energy generation, which is fundamental for economic security and sustainable development, is based in part on our ability to predict and harness rainfall (for hydropower), and wind patterns (for wind energy generation). Geomagnetic storms affect electrical grid stability. And the productivity of U.S. agriculture requires weather and climate information over a wide range of time scales. Timely and accurate weather, climate and water information and forecasts can make a significant contribution to a secure, reliable infrastructure for energy, communications, and agriculture.

To achieve this objective, NOAA will develop integrated environmental information services for the unique needs of the energy, communications, and agriculture sectors, including solar, wind, and oceanographic information critical to the development, production, and transmission of renewable energy; forecasts and warnings of space weather and geomagnetic storms that are within the accuracy and confidence levels required for decision making; and enhanced modeling and prediction capabilities needed to address global food supply and security challenges. Through partnerships with other federal agencies, the United Nations, as well as the energy, communication, and agriculture industries, NOAA will support sector-specific planning and decision-making with the right environmental information. Key components include improving long-range forecasting and regional downscaling; increasing the accuracy of space weather models, predictions, and forecasts; expanding our ability to observe, understand, and model planetary boundary layer processes, especially in complex terrain and offshore; and providing easily-accessible, real-time environmental data and information.

Over the next five years, evidence of progress toward this objective will include:

- Production gains in renewable energy through better information;
- Mitigated economic loss due to advanced warning of geomagnetic storms; and
- An integrated suite of information targeted to food security needs.

Long-term goal: Healthy Oceans
Vibrant marine fisheries, habitats, and biodiversity sustained within healthy and productive ecosystems

Ocean and coastal resources are already stressed by human uses and habitat changes. This has resulted in depleted fish and shellfish stocks, increased numbers of species at-risk and declining marine and coastal biodiversity. As long term environmental, climate and population trends continue, global needs for

seafood, escalating recreational use of the marine environment, and other pressures on habitats and over-exploited species will increase. Concerns about the sustainability of ecosystems and safety of seafood will rise commensurately. Depleted fish stocks and declines in iconic species such as killer whales, salmon and sea turtles result in lost jobs and economic opportunities along the coasts. In addition, climate change impacts to the ocean—sea level rise, acidification, and warming—will alter habitats and the relative abundance and distribution of species as well as the productivity of coastal and marine ecosystems, affecting recreational, economic and conservation activities.

Responding to these challenges requires an ecosystem-based approach to management that accounts for the complex connections between organisms (including humans), their physical, biotic, cultural, and economic environments, and the wide range of processes that control their dynamics. Recovery of the marine environment and sustainable use of living marine resources are dependent upon one another, and effective management of these resources requires a better understanding of ecosystem processes. By working toward sustainability of all species, NOAA will also ensure, for present and future generations, that seafood is a safe, reliable, and affordable food source; that seafood harvests, recreational fishing opportunities and non-consumptive uses of living marine resources continue to support vibrant coastal communities and economies; and that species of cultural and economic value can flourish.

Objective: Improved understanding of ecosystems to inform resource management decisions

Fully implementing ecosystem approaches to management requires ongoing scientific exploration in our marine, coastal, and riverine systems, and increased understanding of the complex linkages among the human, biological, and physical components of the ecosystem. We do not yet fully understand how complex ecosystems will respond to a changing climate, or to many of the approaches that could be taken to manage living marine resources. Decision-makers in fishery management, protected species recovery, and coastal and marine spatial planning will need to consider the effects of alternative actions on ecosystems, individual species, and the human communities with which they interact.

To achieve this objective, NOAA will coordinate internal and external research on the linkages between biological, physical and human components of aquatic ecosystems. Key components include maintaining observations platforms to collect global, regional, and local ecosystem data and exploring innovative technologies such as genomics, ecosystem models, and alternative sampling techniques to improve our ability to accurately assess the status and health of living marine resources and the ecosystems on which they depend. Just as importantly, NOAA will work to enhance coordination and cooperation between scientists, policy-makers and stakeholders to ensure that this work is well understood and incorporated in management practices. NOAA also will support socioeconomic research and policy analyses to evaluate management strategies with respect to both ecological and social outcomes, and will assist partners in the development of ecosystem-based plans that include all aspects of the biological, social and economic environment. NOAA will ensure that this information is used in transparent regulatory and policy decision-making processes, and that it is well-communicated to a wide range of stakeholder communities.

Over the next five years, evidence of progress toward this objective will include:

- Increased use of ecosystem-based approaches, such as integrated ecosystem assessments, that incorporate climate considerations in fishery and protected resource decisions and in coastal and marine spatial planning processes;

- Next-generation fish and protected resource stock assessments incorporate habitat, ecosystem, and climate change information;
- Increased numbers of ecosystem assessments in aquatic and linked ecosystems; and
- Social and economic indicators are developed and used in management strategy evaluation.

Objective: Recovered, rebuilt, and sustained living marine resources

Living marine resources are already under pressure from human use and changes to the environment, including global climate change. NOAA has statutory responsibility for over 500 fish stocks or stock complexes under the reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSA), for marine mammals under the Marine Mammal Protection Act (MMPA), and for species and population segments that are threatened, endangered, or of concern under the Endangered Species Act (ESA). Yet our understanding of many of these species is limited; in many instances, we have virtually no data. Adequate assessments have been performed for less than 60 percent of the key fish stocks and complexes, less than 25 percent of all protected species, and an even smaller percentage of essential habitats for these species. To ensure the sustainability and resilience of living marine resources and the ecosystems that support them, federal, state, tribal and local governments, non-governmental organizations, and industry require science-based policy guidance, economic incentive programs, and sound regulations and enforcement.

To achieve this objective, NOAA will understand and reduce adverse impacts on at-risk species, eliminate overfishing, rebuild overfished and imperiled species, and improve the long-term economic stability of fisheries harvests through such practices as catch share programs. Central contributions to this objective include developing and implementing robust recovery, conservation and fisheries management plans for listed, at-risk, and overfished species. To ensure that the best plans are developed and implemented, NOAA will incorporate ecological knowledge in co-management regimes; improve our understanding of how populations and species respond to natural and human-induced threats, as well as to alternative management and conservation strategies; produce accurate status assessments for harvested, protected, and potentially at-risk species, based on enhanced, consistent, long-term observations; and conduct effective consultations, permitting processes and similar conservation efforts. The international dimensions of this objective require participation in international species management, such as anadromous and highly migratory species of fish, marine mammals worldwide, and fisheries in the Arctic and Antarctic.

Over the next five years, evidence of progress toward this objective will include:

- Increased abundance of species and stocks that are currently depleted, threatened, endangered, overfished or subject to overfishing;
- Increased numbers of assessed species and populations;
- Fewer fish stocks classified as overfished or subject to overfishing;
- Increased allowable catch levels as fish stocks reach rebuilt status;
- Decreased bycatch of target and non-target species; and
- Increased number of distinct population segments moved from endangered to threatened, and from threatened to de-listed.

Objective: Healthy habitats that sustain resilient and thriving marine resources and communities

Marine, coastal and riverine habitats are under increasing pressure from many human and natural threats including climate change, ocean acidification, fishing practices, human population growth, onshore and offshore development and extreme events like storm hazards and oil spills. NOAA has the responsibility to protect the critical habitat of species listed under the Endangered Species Act (ESA) as well as essential fish habitat, including Habitat Areas of Particular Concern, under the Magnuson-Stevens Fisheries Management and Conservation Act (MSA). Healthy habitats not only sustain healthy marine ecosystems, but also provide economically valuable services. For example, they have the capacity to filter water, and can buffer the impacts on communities of hurricanes and flooding. We must significantly increase the scale and effectiveness of habitat conservation to sustain and improve ecosystem services.

To achieve this objective, NOAA will increase the availability, quantity, and quality of marine, coastal, estuarine and freshwater habitats. This effort requires both scientific information and effective policy measures. NOAA and its partners will collect and synthesize information on the status and trends of marine, coastal and riverine habitats and the ecosystem services they provide; assess habitat condition to prioritize protection and restoration efforts; assess the socioeconomic impacts of habitat conservation and restoration efforts; and understand the likely effects of climate change and other anthropogenic perturbations on habitat conditions and the ecosystem services they provide. NOAA will coordinate habitat protection and restoration efforts, and will use economic incentive programs as well as Coastal Zone Management Act authorities to help local governments incorporate habitat conservation into coastal management plans and local development programs.

Over the next five years, evidence of progress toward this objective will include:

- Increased habitat quantity and quality achieved through strengthened habitat conservation policies, restoration programs, partnerships and on-the-ground habitat conservation;
- Habitat conservation targets set and priority areas identified for habitat protection and restoration;
- Increased assessment and use of habitat condition information in integrated ecosystem assessments and coastal and marine spatial planning efforts; and
- Habitat assessments address the quantity and condition of habitat and the links between habitat and the productivity of living marine resource stocks and result in management actions to protect and restore priority habitats.

Objective: Safe and sustainable seafood for healthy populations

As human populations grow, demand for protein sources, including seafood, will also increase. However, current demand is already depleting natural fish stocks, driving down harvest opportunities and reducing jobs along the coasts. Seafood-related health hazards, such as paralytic shellfish poisoning and industrial toxics in harvested species, are in the rise, yet only a very small percentage of seafood in the United States is inspected for toxics and disease. Imported seafood—more than 80 percent of the seafood consumed in the United States— typically is inspected less frequently. Improving opportunities for aquaculture and economically viable harvest strategies can help coastal communities and contribute to long-term food security for the nation.

To achieve this objective, NOAA will pursue science and policies that promote sustainable aquaculture practices, and will improve seafood inspection efforts. This will require strengthening the enforcement of regulations concerning international imports and exports; providing information and guidance to implement effective and ecologically-sustainable aquaculture; and improving the economic stability of harvest regimes. This objective also will require increasing the inspection of

seafood and the development of health hazard warning systems; characterizing ecological, social and economic impacts of seafood culture with state, tribal, and industry partners, and incorporating this information in harvest management planning and implementation; developing innovative land- and ocean-based feed technologies and evaluations of aquaculture production to improve best practices, siting guidelines and coastal and marine spatial planning processes; and supporting the use of eco-marketing and branding tools to promote sustainable seafood industries and raise public awareness of ocean sustainability.

Over the next five years, evidence of progress toward this objective will include:

- An aquaculture research program;
- Sustainable aquaculture facilities that do not adversely impact the larger ecosystem;
- Increased numbers of seafood monitoring programs for human health; and
- Increased proportion of inspected seafood.

Long-term goal: Resilient Coastal Communities and Economies

Coastal and Great Lakes communities that are environmentally and economically sustainable

The complex interdependence of ecosystems and economies will grow with increasing uses of land, marine, and coastal resources, generating economic and environmental pressures that bear particularly heavily on the nation's coastal communities. For example, continued growth in coastal populations, economic expansion, and global trade will further increase the nation's need for safe and efficient maritime transportation. Similarly, the nation's profound need for conventional and alternative energy presents many economic opportunities, but also will result in greater competition for ocean space, challenging our ability to make informed decisions that balance economic and environmental considerations. At the same time, the interdependence of ecosystems and economies makes coastal and Great Lakes communities increasingly vulnerable to chronic—and potentially catastrophic—impacts of natural and human-induced hazards, including climate change, oil spills, harmful algal blooms, and severe weather hazards.

NOAA's long-term coastal goal will invigorate coastal communities and economies, and lead to increased resiliency and productivity. Comprehensive planning will address competing uses to protect coastal communities and resources from the impacts of hazards and land-based pollution on vulnerable ecosystems, as well as to improve water quality and foster integrated management for sustainable uses. Geospatial services will support communities, navigation, and economic efficiency with accurate, useful characterizations, charts and maps, assessments, tools, and methods. Coastal decision makers will have the capacity to adaptively manage coastal communities and ecosystems with best available natural and social science. NOAA, our strategic partners in coastal communities, and the nation will understand the challenges we need to address, so the benefits, beauty, and heritage of our coasts can be appreciated by current and future generations.

Objective: Resilient coastal communities that can adapt to the impacts of hazards and climate change

Coastal communities contain over one half of the U.S. population, generate nearly 60 percent of U.S. economic output, and account for hundreds of millions of dollars in flood loss claims. Their vulnerability to coastal hazards increases with growing populations, declining coastal ecosystems, and

changing climate conditions. The overarching need is to improve the resilience capacity of the nation's coastal communities to 1) absorb impacts while maintaining an acceptable level of functioning; 2) reduce the amount of time and resources needed to return to full level of functioning; and 3) adapt to future risks by learning from past disasters and adopting risk reduction measures. Reducing vulnerabilities depends on healthy coastal economies; on proactively adapting to climate change impacts; on land use, conservation, hazard response and recovery planning; on mitigating chronic stressors; and on infrastructure decisions made at the federal, regional, state, and local levels. Coastal decision makers need current science-based information, accurate tools and technology, and the skills to apply them to effectively reduce their communities' vulnerabilities.

To achieve this objective, NOAA will develop and provide coastal decision makers with updated decision support tools, technical assistance, training, and management strategies related to adaptation, risk communication, hazard response and recovery, and resource conservation. Spatially relevant and integrated data, including social and economic data, will be delivered to support risk analyses, mapping, scenario analyses, adaptation planning, and implementation. State of the coast analyses and trend information on ecosystem status and valuation, along with community risk and vulnerability assessment methods as well as policy assistance, will be provided to support implementation of resilience adaptation strategies. Hydrodynamic models, forecasts, and visualization tools, based on an improved geospatial framework, will improve understanding of the impacts of coastal hazards and climate impacts on livelihoods and ecosystem services. NOAA will continue to work with partners to acquire, protect, and restore habitat and ecosystem services to support the resilience of both ecosystems and the built environment.

Over the next five years, evidence of progress toward this objective will include:

- An increase in the percentage of U.S. coastal states and territories demonstrating annual improvements in resilience to coastal weather and climate hazards;
- Coastal decision-makers and community leaders understand and use appropriate science-based tools and information for assessing hazard risk, vulnerability, and resilience;
- Effective community plans and strategies that improve community readiness to cope with natural and human-induced coastal hazards; and
- Healthy natural habitats, biodiversity, and ecosystem services support local economies and communities.

Objective: Comprehensive ocean and coastal planning and management

The nation's coastal zones are becoming busy places, with people living and recreating alongside a wide array of existing and emerging ocean-dependant industries. While an increasing range of uses will allow coastal communities to create diverse ocean-based economies, care must be taken to ensure continued access to coastal areas, sustained ecosystems, maintained cultural heritage, and limited cumulative impacts. A coastal and marine spatial planning framework is a comprehensive management approach that is designed to support sustainable uses and ensure healthy and resilient ocean and coastal ecosystems. Combined with its capacity to collaborate with state, territory, and federal partners, NOAA's expertise in ocean and coastal management and planning is needed to provide leadership and support for the development of regional and place-based spatial plans as well as the data streams, research, and tools necessary for implementation. In some areas, NOAA and its partners collaboratively protect and manage critical coastal and ocean ecosystems.

To achieve this objective, NOAA will promote sustainable resource use and stewardship by continuing to implement key NOAA mandates, including the National Marine Sanctuaries Act and

the Coastal Zone Management Act, and further its programmatic efforts to support coastal and marine spatial planning and management. In these efforts, NOAA will seek to balance the use of coastal and ocean resources with long-term conservation of special places in the planning and management of coastal and marine areas; support institutional infrastructure needed to coordinate and facilitate the planning process, engage stakeholders, and execute management actions; enhance geospatial data and visualization tools; require and sustain resource monitoring networks that are capable of integrating across spatial and temporal scales to determine the effectiveness of local management actions; develop and disseminate models, tools and best practices for long-term planning and management; and conduct social and economic studies needed to evaluate and improve the effectiveness of management decisions.

Over the next five years, evidence of progress toward this objective will include:

- National, regional, and local stakeholders engaged in the coastal and marine spatial planning process;
- Coastal and Great Lakes managers use new or enhanced models, data, tools, and best practices for informed spatial planning, management and stewardship of resources and ecosystems;
- Predictable and transparent regulatory mechanisms for ocean and coastal energy and other sectors; and
- An enhanced geospatial framework and data are available to underpin decision support tools.

Objective: Safe, efficient and environmentally sound marine transportation

The U.S. Marine Transportation System (MTS) reaches from our ports and inland waterways across our coastal waters and oceans to support commerce, recreation, and national security. The MTS is the backbone of the country's economy, with more than 77 percent by weight and 95 percent by volume of U.S. overseas trade carried by ship. By 2020, the value of domestic maritime freight is forecast to nearly double. An expanding MTS becomes increasingly vulnerable to natural and human-caused disruptions, potentially resulting in enormous losses to the U.S. economy. Increased maritime activity can also stress sensitive marine environments and increase the risk of marine accidents. Improving the reliability and resilience of the U.S. MTS will lessen risks to the economy and the environment.

To achieve this objective, NOAA will support operational decisions on our oceans and coasts with such fundamental services as marine weather forecasts, nautical charts, the underlying surveying and mapping data, real-time oceanographic information, oceanographic predictions and forecasts, and an accurate national positioning framework. NOAA will also bring its sciences and search and rescue functions to bear on emergency preparedness and response in the MTS to help save lives and mitigate the environmental and economic impacts of hazardous incidents, including oil spills. To ensure efficient and environmentally sound operations throughout the MTS, NOAA will continue to work with federal, state, and local partners on technology infusion and improvements to MTS products and services, including reducing the hydrographic survey backlog in navigationally significant areas. NOAA will also strengthen international partnerships to encourage the production and distribution of navigation information, and to ensure that global standards and policies are consistent with U.S. interests.

Over the next five years, evidence of progress toward this objective will include:

- Reduced maritime incidents in U.S. waters through timely and accurate navigational information;
- Increased capacity in the Marine Transportation System to promote greater efficiency and economic growth;
- Improved national geospatial framework for increased accuracy of navigation products and services;
- Reduced hydrographic survey backlog in navigationally significant areas;
- Increased percentage of national ports with access to real-time navigation products and services; and
- Increased preparedness and response to maritime incidents and emergencies.

Objective: Improved coastal water quality supporting human health and coastal ecosystem services

U.S. coastal communities and economies including tourism, recreation, and commercial fisheries rely on healthy coastal environments. Through work and recreation, over 70 percent of the U.S. population comes into contact with coastal waters that can contain a diverse array of chemical contaminants, excessive nutrients, pathogens, biotoxins, and marine debris that degrade habitat quality and can negatively impact human health and the services provided by ecosystems in the coastal zone. Beach advisory days due to biological contamination have more than tripled, levels of contaminants in coastal waters have risen, and marine debris has become one of the most widespread pollution problems in the world's oceans and waterways. More than 10 percent of coastal waters are considered unfit for designated uses, and over 50 percent of the nation's estuaries experience hypoxia. In the face of these trends, state, tribal, and federal partners need early warning networks to identify and predict threats to human and ecosystem health, and to implement effective and timely management efforts.

To achieve this objective, NOAA will research the fate and transport of chemicals, nutrients, sediments, pathogens, harmful algal blooms, toxins and marine debris in waterways; collect chemical, biological and economic and other social data; develop appropriate marine and biological sensors; and monitor, assess, and predict ecological and human health threats. Efforts to remove marine debris from coastal habitats will continue, and research will more clearly identify the damage marine debris causes to coastal economies and habitats. NOAA will develop, implement and improve advanced water quality protection programs for nationally significant areas and trust resources, and establish ecological forecasts and early warning networks to improve resource managers' knowledge of ecological stressors and management effectiveness. Additional contributions to this objective will include expanded coastal habitat characterizations; enhanced water quality monitoring and research activities, and improved early warning modeling and prediction efforts.

Over the next five years, evidence of progress toward this objective will include:

- Greater understanding of the effects of natural and human-induced contaminants on the health of humans and marine life;
- Reduced impacts to human health and ecosystem services due to degraded water quality;
- Faster detection of sediments and contaminants in coastal waters;
- Accelerated recovery and restoration of coastal resources and revitalization of coastal communities through improved water quality.

Objective: Safe, environmentally sound Arctic access and resource management

No single region better exemplifies the complex interdependence of communities and changing climate and ecosystem conditions than the Arctic. There is evidence of widespread, dramatic change in the Arctic region, with local to global implications. National security concerns are increasing as reductions in sea-ice bring opportunities for economic development and increased access to Arctic resources. These economic drivers can further threaten ecosystems and Arctic inhabitants already impacted by the rapidly changing climate. The breadth and complexity of the cultural, societal, economic, and environmental impacts within this region requires a concerted, systematic and rapid effort with partners from local to international levels.

To achieve this objective, NOAA will build on the capabilities noted in its other strategic objectives such as climate, marine weather, and increased observing capacity to support Arctic coastal communities and safe navigation to and through the Arctic. Modernizing the Arctic geospatial framework will provide the foundation for many of NOAA's activities in the region, including effective climate adaptation, community resilience, and coastal resource and marine spatial planning strategies. NOAA will support the Arctic region with accurate land and tidal elevations to monitor sea level and ice conditions, build flood protections, make infrastructure more resilient, ensure safe and efficient marine transportation, model storm surge, and support habitat restoration. Accurate weather and navigation tools, building the capacity to respond to natural and human-induced coastal hazards, and research to improve Arctic oil spill response and restoration capabilities are essential services NOAA will bring to the region. Arctic communities will also find NOAA a reliable source for climate information to inform decisions about moving communities, human health, and other adaptive strategies. Throughout this effort, NOAA will engage domestic and international partners to promote cooperation and sharing of data, observational platforms, and intellectual resources.

Over the next five years, evidence of progress toward this objective will include:

- Reduced risk and impact of maritime incidents on the Arctic environment;
- Arctic communities and ecosystems prepared for climate change and weather events with adaptation strategies and plans;
- A stronger foundational geospatial framework to better support economic and community resilience and inform policy options and coastal management responses to the unique challenges in the region; and
- Increased international collaboration to strengthen NOAA and U.S. policy objectives in the region.

NOAA's Enterprise Objectives

NOAA's strategy would be incomplete without detailing the enterprise-wide capabilities that will be required to achieve the environmental, social, and economic outcomes targeted by NOAA's strategic goals. NOAA's enterprise functions comprise three groups: the foundational science and technology functions that generate research and development, models, and environmental observations; the distinct functions for engaging partners and customers; and the underlying administration and management functions that support all of NOAA's work. These cross-cutting functions define NOAA's distinctive capabilities as an organization, and the objectives set forth below represent cross-cutting requirements for addressing NOAA's strategic goals as a whole.

NOAA's Science & Technology Enterprise

NOAA's vision centers on a holistic understanding of the interdependencies between human health and prosperity and the health and resilience of natural ecosystems. Achieving this level of understanding presents an overarching, long-term scientific and technical challenge to NOAA: *to develop and apply holistic, integrated Earth system approaches to understand the processes that connect changes in the atmosphere, ocean, space, land surface, and cryosphere with ecosystems, organisms and humans over different scales*.

While developing this holistic and integrated understanding will require broad national and international collaborations, NOAA is uniquely positioned to address this challenge due to the diverse science requirements within and across its strategic goals and the distinctive research, observation, and modeling capabilities at the center of NOAA's scientific and technical enterprise. Understanding the connections between changes in the physical Earth system and its biological components, including human interactions, will drive NOAA's long-term progress toward climate mitigation and adaptation, a weather-ready nation, healthy oceans, and resilient coastal communities and economies. To address this long-term challenge and meet the science requirements within and across its strategic goals, NOAA must simultaneously pursue three objectives within its core scientific and technical enterprise: a holistic understanding of the Earth system; accurate and reliable data from sustained and integrated earth observing systems; and an integrated environmental modeling framework.

Objective: A holistic understanding of the Earth system through research

NOAA's strategic progress and future operational capacity will depend upon a strong and vibrant scientific enterprise that draws from NOAA research capabilities and the extended community of public, private, and academic researchers with whom NOAA collaborates routinely. NOAA's long-term goals hinge on an enhanced understanding of the complex interrelationships that exist across NOAA's climate, weather, ocean, and coastal domains. A holistic understanding of these interrelationships requires a rich, interdisciplinary characterization of the physical, chemical, geological, biological, and social components of the earth system. To explore, observe and understand ecosystem dynamics and enable the nation to make informed decisions about our changing environment, NOAA needs to advance innovative research that pushes the boundaries of scientific understanding and integrates information across scientific disciplines.

To achieve this objective, NOAA will need to build and maintain a reliable, accessible suite of climate, weather, marine ecosystem, living marine resource, and geospatial information; improve the understanding of key environmental processes; build capacity in the social, behavioral, and economic sciences to support the valuation of ecosystem services, risk and vulnerability assessments, and decision-support services; and develop advanced technologies in sensors, computing and networking, and user interfaces to better observe, understand, model, and communicate knowledge of complex systems. Connecting new capabilities to operations will require test-beds to accelerate the transition of these technologies to operational use. NOAA will balance technology development, deployment, and relatively low-risk applied research with an appropriate level of high-risk research to foster unpredictable, radical innovation that can transform our science and mission functions. Across all domains, NOAA will need to characterize the uncertainties associated with scientific information, and effectively communicate scientific information and its associated uncertainties to policy makers, the media, and the public.

Over the next five years, evidence of progress toward this objective will include:

- Acquiring and incorporating knowledge of human behavior, societal values, and economics into our weather, climate, and ecosystem assessments to enhance our understanding of the interaction between human activities and the Earth system;
- Understanding and quantifying the interactions between atmospheric composition and climate variations and change, including the chemical, physical, and biological effects of these changes;
- Understanding and characterizing the role of the oceans in climate change and variability and the effects of climate change on the ocean and coasts, including biological, chemical, and geophysical effects (e.g., sea level rise, ocean acidification, living marine resources);
- Assessing and understanding the roles of ecosystem processes and biodiversity in sustaining ecosystem services and the connections among ecosystem condition, resilience, and the health of marine organisms, humans, and communities;
- Improved understanding of the water cycle from global to local scales to improve our ability to forecast weather, climate, water resources and ecosystem health; and
- Developing and evaluating approaches to substantially reduce environmental degradation, overfishing, and climate change in ways that maximize benefits and minimize adverse impacts.

Objective: Accurate and reliable data from sustained and integrated earth observing systems

NOAA's science, service, and stewardship mission is rooted in Earth and space observations. The nation's efforts to mitigate and adapt to a changing climate requires accurate and comprehensive climate data records. Weather forecasters require observations of the state of the atmosphere and oceans to initialize and verify the models and to make accurate forecasts. Fisheries cannot be sustained without data on current and historical states of the stocks and their living environment. Coastal communities need observations to understand changing coastal ecosystem conditions and sustainably manage coastal resources. Nautical charting and navigation activities require consistent observations of the ocean surface and floor. All of these capabilities draw upon the diverse observing system assets, including satellites, radar, manned and unmanned aircraft, ground stations, sea-going vessels, buoys, and submersibles. The varied and growing requirements levied upon these systems greatly exceed the current capacity. NOAA's observing system portfolio needs to balance growing demands with continuity concerns and implementation of emerging technologies. Over the long term, NOAA must sustain and enhance atmospheric-oceanic-terrestrial-biological and human observing systems—and their long-term data sets—and develop and transition new observing technologies.

To achieve this objective, NOAA will gather environmental data by developing, deploying, and operating systems to collect remote and in-situ observations, and manage and share data through partnerships and standards. To this end, NOAA will develop the next generation of satellites to serve future space-based observations and provide data continuity; launch and operate environmental observation satellites; maintain and develop the next generation of research vessels and aircraft to serve multiple observation requirements; deploy Autonomous Underwater Vehicles (AUVs) and Unmanned Aircraft Systems (UASs) to explore hard-to-observe regions such as deep oceans and the Arctic; calibrate climate sensors to maintain the integrity of NOAA's climate data records over time; integrate ground-based networks maintained by different domestic entities in the National Mesonet to maximize the effectiveness of ground-based weather observations; assimilate and fully exploit the observations data from the next generation of polar and geostationary satellites, space weather observing systems, ground based radars and in-situ sensors, airborne sensors, unmanned observing platforms, and ship-deployed systems such as buoys and submersibles. Throughout this effort,

NOAA will pre-plan the transition of research observing platforms to operations, and will maintain strong partnerships with domestic and foreign partners through agreements to share expertise, instrumentation, data, data processing, and related costs.

Over the next five years, evidence of progress toward this objective will include:

- Enhanced horizontal, vertical, and temporal coverage of the Earth from deep ocean to space;
- Integrated and sustained observing networks over larger domains;
- Improved data interoperability and usability through common standards, calibration methods, data storage and access solutions, and long-term stewardship; and
- Lower observing system life-cycle costs.

Objective: An Integrated environmental modeling system

To fulfill current and emerging science and service requirements toward all of NOAA's strategic goals over the long term, the agency ultimately must evolve toward a comprehensive Earth-system modeling enterprise that links atmospheric and oceanic models—and integrated modeling backbone that connects environmental models across time, space, and phenomenological scales. Developing and integrating information will require collaboration across all scientific disciplines: chemical, physical, geological, biological, social, behavioral, and economical. There is significant modeling research and development supported by NOAA and other federal agencies, and carried out by broad external research communities across the nation. The complexity of NOAA's modeling requirements and the challenges of transitioning research and development capabilities into operations will require extensive internal coordination within NOAA, interagency coordination for the effective utilization of national investments, and external collaboration with the environmental modeling community in the academic and private sectors.

To achieve this objective, NOAA will develop a comprehensive modeling backbone; integrate models, products, and services; and foster a culture of collaboration within and external to NOAA. To this end, NOAA will develop collaborative strategies involving internal and external partnerships and community-wide standards to ensure interoperability; integrate research monitoring and prediction plans for NOAA's strategic goals, including regional-scale climate models and integrated ecosystem modeling; and institute a well-functioning governance structure for NOAA's environmental modeling enterprise.

Over the next five years, evidence of progress toward this objective will include:

- Enhanced scope and predictive accuracy of models that integrate multiple components of the earth system (physical, biological and social) for global, national, and regional applications, and for specific phenomena;
- Increased volume and diversity of data and information assimilated into models, particularly at different global, national, regional and local scales; and
- Enhanced NOAA service capabilities such as greater access to, ease-of use of, and reliance upon NOAA's models.

NOAA's Engagement Enterprise

As the challenges NOAA addresses become more complex over time, NOAA will need increasingly sophisticated organizational mechanisms for understanding user needs and engaging stakeholders and customers across local, regional, and international levels. Many of the challenges that NOAA helps address do not stem from a lack of information, but from an uneven distribution of information. Often the best way for NOAA to meet the needs of its stakeholders is by better delivering the data and knowledge that we already possess to those who have not yet been able to use it. Conversely, the breakthrough research, development, operational improvement, or policy action that NOAA needs to achieve may depend upon the unique knowledge or needs of a partner or customer.

The capacity for NOAA to effectively engage individuals and other organizations will determine its success over the long-term. Scientists must engage with their peers, but also with colleagues in other disciplines and with the public at large. Managers of NOAA environmental data and information services must engage with the decision makers in local governments and industries. Regulators must engage with the communities they regulate, as well as with their regulatory counterparts in other nations.

Objective: An engaged and educated public with an improved capacity to make scientifically informed environmental decisions

Among the many environmental challenges facing the nation, responding to climate change and balanced use of coastal and marine resources are paramount. To address these challenges, NOAA must rely not only on its own capabilities, but also on the ability of leaders, organizations, institutions and the public to understand environmental conditions and the forces that affect them. Many stakeholders and the public face a considerable challenge of understanding climate and ecosystem dynamics, parsing estimates of potential impacts, and integrating environmental information, and uncertainties, into routine decision-making. Conversely, engagement is needed for NOAA's program development, which requires an intimate knowledge of its stakeholders, their particular information needs, and ways of doing business. Finally, there is a widening gap between the science most U.S. students learn in school and the knowledge they will need in the 21st-century to foster the nation's innovation and competitiveness. To support climate, weather, ocean, and coastal science and management needs of the next generation, NOAA must foster an environmentally literate society and the future environmental workforce.

To achieve this objective, NOAA will engage stakeholders and the public at multiple levels to build awareness of environmental science, services, and stewardship responsibilities, foster community dialog, and educate citizens and students. To this end, NOAA will work with partners to increase climate, weather and ocean literacy through investments in extension, training, education, outreach and communications; reach out to community leaders and decision makers; use innovative technologies to engage stakeholders and the public; develop strategic connections with science education communities to advance scientific and technical education opportunities and attract populations who are currently underrepresented in the science workforce; and coordinate with other agency's education and outreach initiatives, including those of other federal scientific and environmental agencies.

Over the next five years, evidence of progress toward this objective will include:

- Improved public understanding of climate change, weather, ocean and coastal environments through an integrated program of education, outreach, extension, training and communications;

- Stakeholder needs for NOAA science, service, and stewardship are continually and adequately assessed; and
- NOAA employees and partners are better prepared to effectively engage key stakeholders, and the public to enhance literacy of climate, weather, ocean and coastal environments.

Objective: Integrated services meeting the evolving demands of regional stakeholders

The challenges that NOAA's partners and customers face do not always fall neatly into the domain of a single NOAA business unit or strategic goal. However, they are often particular to communities within geographic regions. For example, the changing weather, water quality, and water quantity conditions in the Great Lakes will affect the region's livelihood including transportation, recreational, and extractive needs. Similarly, there are unique environmental, sociological, and economic conditions in the North Atlantic, Mid-Atlantic, West Coast, Central region, Gulf of Mexico, Southeast and Caribbean, as well as in Alaska and the Pacific Islands. NOAA's capacity to meet its strategic goals and objectives will require organizational flexibility to tailor its capabilities and services to meet distinctive regional needs. As regional and local conditions change, NOAA will need to quickly assess changes in user and stakeholder priorities and develop collaborative solutions that draw on the full range of capabilities available from NOAA and its community of partners.

To achieve this objective, NOAA will tailor services to meet regional demands by coordinating and integrating the capabilities of multiple line offices within that region. Through regional collaboration and engagement strategies, NOAA will seek to improve the use and usability of its services and adapt rapidly to changing local and regional conditions and requirements. In particular, NOAA will focus on supporting and collaborating with established and emerging regional ocean governance initiatives.

Over the next five years, evidence of progress toward this objective will include:

- Integrated, regional-scale information tailored to the decision needs of NOAA's stakeholders and customers;
- Organizational agility in providing products and services as user needs evolve;
- More effective decision support for state and local governments, drawing on the entirety of NOAA's mission capabilities; and
- Effective support for and collaboration with regional ocean governance initiatives.

Objective: Full and effective use of international partnerships and policy leadership to achieve NOAA's mission objectives

NOAA's mission extends far beyond the borders of this country: oceans, ecosystems, and the atmosphere do not conform to political boundaries. Global climate change has further drawn attention to the international nature of the many challenges and opportunities that the nation faces. NOAA plays a key leadership role in international ocean, fisheries, climate, space, and weather policies. For example, NOAA's stewardship responsibilities under the Magnuson-Stevens Fishery Conservation and Management Act encompass both domestic and international fisheries, and NOAA promotes stewardship of trans-boundary and other living marine resources and their ecosystems through leadership and participation in domestic and international activities. NOAA's many assets—including research programs, vessels, satellites, laboratories, and a vast pool of internationally recognized experts—make it an essential international resource. NOAA is well positioned to assist

other nations in improving their understanding and ability to predict changes in climate and other environmental conditions that will affect natural resources, population safety, and economic activity. In addition, with more countries launching their own satellites, and ocean- and ground-based observing networks, there are more opportunities to leverage investments made by foreign partners. As such, the need for common data standards, service level agreements, and memoranda of understanding have increased.

To achieve this objective, NOAA will leverage multilateral and bilateral partnerships to take full advantage of the research, observations, environmental science, and ecosystems management expertise and resources from outside the United States. Continued international engagement will enable NOAA, working on behalf of the United States, to promote goals and practices that can be adopted and adapted regionally or globally to advance NOAA's strategic goals. Through these efforts, NOAA will improve the standardization, availability, and utility of environmental data for the nation and our global partners.

Over the next five years, evidence of progress toward this objective will include:

- Full implementation of the provisions of the Magnuson-Stevens Fishery Conservation and Management Act to combat Illegal, Unregulated and Unreported fishing and bycatch of protected living marine resources in international fisheries;
- Fulfillment of the Coral Triangle Initiative objectives;
- An International Marine Mammal Conservation Action Plan;
- Expanded collaborations and partnerships on international climate observing systems, assessments, and services; and
- Fewer confrontations and litigations over violations of international law.

NOAA's Organization & Administration Enterprise

Supporting all of the functions above is the management of resources, an essential function of any organization. NOAA's managers, whether at headquarters or in the field, have common responsibilities to manage the investment of tax-payer dollars, deploy physical infrastructure, and retain a qualified workforce. NOAA's managerial efforts avail the rest of the agency of the staff, the infrastructure, and the financial capital it needs to get the job done. Effective management of these resources fosters an organizational environment in which core competencies can be realized and final products can reach their fullest potential.

Objective: Diverse and constantly evolving capabilities in NOAA's workforce

At the heart of NOAA operations is the creative work of scientists, engineers, technicians, managers, and administrative staff. It is only by building this stock of intellectual capital that NOAA can provide the public scientific knowledge, information services, and environmental stewardship capabilities that are the necessary ingredients for NOAA to achieve its strategic goals. As the challenges that face our nation develop, NOAA will increasingly require a workforce not only of top-tier scientists and leaders, but science communicators and science managers. Focusing on social and environmental outcomes will require not only the best skills in the scientific and engineering disciplines, but the best skills in interdisciplinary work. Understanding a dynamic ecosystem, which includes natural, social, and economic systems, will require expertise in the social and economic

sciences. And with a substantial portion of its workforce ready for or approaching retirement, NOAA will need to attract, hire, train, and retain the next generation of professionals needed to accomplish NOAA's strategic goals.

To achieve this objective, NOAA will recruit and maintain world class professionals with disciplinary, interdisciplinary, and managerial expertise. NOAA will conduct systematic analyses of current workforce capabilities and future workforce needs in order to recruit, retain and develop its workforce. NOAA will focus on hiring and developing people with expertise and developing performance plans that reflect NOAA priorities and NOAA strategic goals. We will strengthen the NOAA Corps and leverage the operational expertise and interdisciplinary experience of officers to lead implementation of new observation technologies. We will increase our collaboration with academia and create opportunities to support undergraduate and graduate students to participate in NOAA activities and foster their interest in NOAA related scientific study and future career consideration.

Over the next five years, evidence of progress toward this objective will include:

- Increased leadership and managerial training and certification in the career development of NOAA professionals and NOAA Corps Officers;
- Increased numbers of interdisciplinary professionals and science translators to enable functions of engagement and integration;
- Increased use of social scientists for research, service development, and operations;
- Increased capacity of the NOAA Corps to lead integration of advanced technologies into NOAA's missions; and
- Increased numbers of underrepresented groups in the NOAA workforce.

Objective: A modern IT infrastructure for a scientific enterprise

NOAA's evolving mission requires a transformed, agile and secure Information Technology (IT) infrastructure to propel its scientific and operational goals with advanced computing capabilities. World class delivery of reliable and scalable IT services is essential to meet growing demands to efficiently process and disseminate ever increasing volumes and types of environmental information. High Performance Computing (HPC) enables environmental modeling and thus all of NOAA's predictive products, such as weather forecasts, climate analyses, as well as the transfer into operations of mature research systems. Additionally, consumer and professional use of social networking sites is becoming increasingly (and inextricably) intertwined, and there is an increasing scale, scope, and geographic dispersal of NOAA's various scientific mission offices. Modern collaborative technologies are essential to enabling NOAA's diverse and distributed staff to more effectively share knowledge NOAA-wide, and to enable customers and stakeholders to transparently and effectively engage with the extended NOAA community.

To achieve this objective, NOAA will implement enterprise-wide solutions to gather, process, and disseminate environmental information, enable effective collaboration, and improve operational cost effectiveness, efficiency, and service quality. NOAA is committed to modernizing the IT infrastructure through the development of a common architecture and consistent approach to making decisions based upon the service needs of NOAA staff and stakeholders. NOAA will make available computing platforms, networks, data storage and information analytics to efficiently collect, analyze and disseminate the massive quantities of observational data needed by the public and our partners for reporting and warning. Significant and sustained investments will be required to establish and maintain an HPC architecture that meets NOAA's weather and climate modeling needs. Desktop

services will include cloud computing, virtualization, and state-of-art business intelligence products and tools. NOAA will provide secure and flexible social media environments, collaboration tools, and web portals to promote innovation across mission, line, stakeholder and user boundaries. The agency will support unified communications by efficiently and reliably switching traffic across formats, media and channels. It will support responsible and sustainable IT development in alignment with NOAA's overall sustainability efforts in "going green."

Over the next five years, evidence of progress toward this objective will include:

- A common architecture and framework for IT services and solutions;
- Evolving environmental modeling requirements are adequately supported by high performance computing;
- Enterprise-wide protection from cyber security threats; and
- A high-performing workforce of the future.

Objective: Sound, life-cycle management of capital investments

NOAA's unique mission is particularly capital intensive, and it requires equally unique capital investments in land, structures, satellites, ships, aircraft, unmanned systems, sensors, equipment, intellectual property (e.g., software), and information technology (including IT service contracts). NOAA must acquire and maintain special facilities and major systems, particularly for observing and modeling. Data collection functions require not only observation platforms and sensors, but also the installations to receive, transmit, store, and process the data. Weather forecasts depend upon a network of local forecasting stations around the country. Research functions require state-of-the-art laboratories and libraries. Oceanic and atmospheric observations require a fleet of technically advanced ships, aircraft, and unmanned systems. NOAA's entire workforce and its partners require safe, secure facilities to conduct their work. The responsible management of these systems requires a long-term perspective in order to operate them effectively and efficiently over their entire life cycle. Beyond physical infrastructure, a large part of NOAA's mission requires investing in the capabilities of its partners through grants and cooperative agreements, such as Cooperative Institutes. These investments, too, must be managed responsibly and for the long-term.

To achieve this objective, NOAA will validate mission requirements and establish consistent and systematic agency-wide reviews to ensure optimal solutions are identified for achieving NOAA's strategic goals and objectives. This effort will entail a mission requirements baseline, and a validation process that ensures that solutions continue to meet requirements throughout their life cycle. Consistent with this life-cycle approach, NOAA will set high standards for energy efficiency and the overall environmental performance of its facilities.

Over the next five years, evidence of progress toward this objective will include:

- Improved facility condition index;
- Increased percentage of building square footage certified by the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED); and
- Recapitalization of NOAA's fleet of ships and aircraft according to schedule to ensure technically advanced science platforms that meet the evolving needs of the agency.

Strategy Execution and Evaluation

The objectives identified in this plan are the basis for NOAA's corporate planning, performance management, and stakeholder engagement over the next five years. Objectives are specific outcomes NOAA can achieve on the path to broader, long-term goals and toward a more capable, flexible enterprise. They are measureable and can be affected by specified activities over a five year period. NOAA's Line and Staff offices will be accountable for executing the strategy laid out in this document. Where there are shared capabilities to achieve an objective, there will also be joint accountability for budgeting, executing, and performing toward that objective.

NOAA will systematically monitor and evaluate performance toward the outcome-oriented goals and objectives in this plan. Evaluating performance will allow NOAA to learn from its successes and failures and continually improve itself as an organization and better deliver on the promise of its mission of science, service, and stewardship. NOAA's performance measures, including those required under the Government Performance and Results Act, are published annually in the NOAA Annual Performance Plan and Performance Accountability Report.

The NOAA Strategic Plan supports the Department of Commerce (DOC) Strategic Plan and Annual Performance Plan. There is a direct relationship between NOAA's goals and objectives and the goals and performance measures included in the annual budget submission to DOC. DOC uses this information for its Annual Performance Plan and Performance and Accountability Report, which integrate outcomes and performance measures across the Department.

Strategic Partnerships

Integration among NOAA's Line and Staff offices alone cannot achieve the strategic outcomes set forth in this plan. External collaboration and partnerships are and will continue to be central to every aspect of NOAA's work. NOAA is part of an extended network of institutions in the public, private, and academic sectors that will collectively drive progress toward the vision of healthy ecosystems, communities, and economies that are resilient in the face of change. Major partners in NOAA's long-term strategy include:

Climate Adaptation & Mitigation

NOAA is a key part of international global climate enterprise that has already made significant progress in our understanding of climate variability and change. Sustained partnerships among federal agencies; international, state, local and tribal governments; academia; non-governmental organizations; and the private sector are needed to improve scientific understanding, produce more useful climate predictions, identify climate risks and vulnerabilities, deliver climate-relevant information to inform decision-making, and better inform society about climate variability, change, and their impacts. NOAA will build upon decades of engagement with external partners to improve its ability to develop and deliver climate products and services that meet needs at global to local scales. Given its stewardship responsibilities and expertise, NOAA will focus its collaboration activities on the impacts of a changing climate on the nation's ocean and coastal ecosystems, living marine resources, and salt and freshwater resources.

Weather-Ready Nation

The nation's weather enterprise is composed of unique partnerships among government, private sector entities, and the academic and research community. Their contributions are complementary and at times overlapping. NOAA provides information to support protecting life and property and enhancing the national economy. To carry out this mission, it develops and

maintains an infrastructure of observing, telecommunications, and prediction systems on which the public (federal, state, and local government agencies), private, and academic sectors rely. Academia advances the science and educates future generations of participants in the enterprise. The private sector (weather companies, meteorologists working for private companies or as private consultants, and broadcast meteorologists) creates products and services tailored to the needs of their company or clients and works with NOAA to communicate forecasts and warnings that may affect public safety.

Healthy Oceans

Achieving healthy oceans and sustainable ocean ecosystems will require strong coordination and integration across NOAA and with federal, state, local and tribal stakeholders. Collaboration with academic institutions, non-governmental organizations, federal agencies and NOAA's operational and research programs will help to provide the scientific foundation for ocean resource management decisions and strengthening ecosystem science. Strong partnerships and enhanced coordination and cooperation among our scientists, policy-makers, the Fishery Management Councils, our strategic partners in the commercial and recreational fishing industries, non-governmental organizations, and academic centers will ensure a transparent and effective approach to the management of ocean resources.

Resilient Coastal Communities & Economies

Resilient coastal communities and economies cannot be achieved without strong partnerships. NOAA will build on existing strategic partnerships with federal agencies, such as the U.S. Coast Guard, to help provide services to adapt to coastal hazards and provide safe conditions in the Arctic; with the Department of the Interior, to conserve special marine and coastal places; and with the Environmental Protection Agency, to improve coastal water quality and encourage smart growth. Comprehensive ocean and coastal planning will require an unprecedented level of engagement and collaboration with our federal, state, local and tribal partners, as well as a wide range of stakeholders in the private and academic sectors. The complex and interdependent vulnerabilities that the coasts face will require enduring partnerships to help to develop environmentally and economically sustainable community practices.

References

For further information on the consultations and analyses that NOAA used in developing this plan, including NOAA's *Scenarios for 2035* and the results of NOAA's extensive stakeholder consultations, please visit:

www.noaa.gov/ngsp