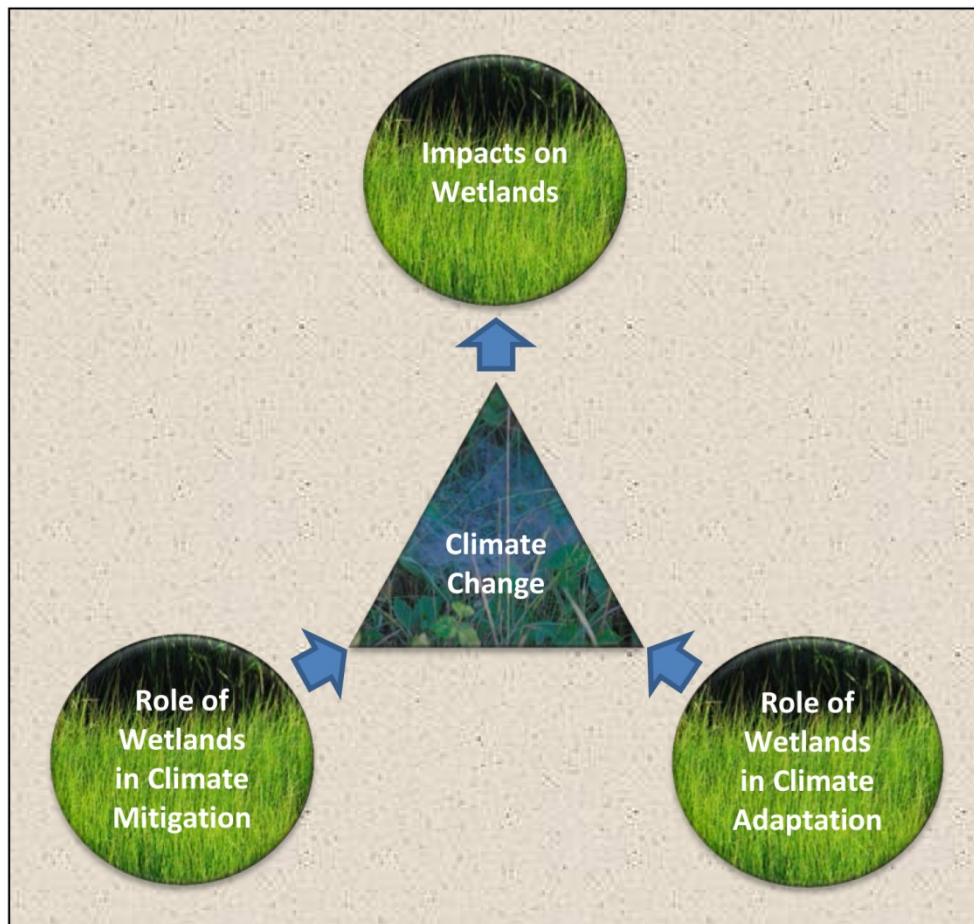


# Wetlands and Climate Change: Considerations for Wetland Program Managers

Association of State Wetland Managers

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With shifts in climate patterns already upon us and expanding changes projected for the indefinite future, climate change has become an overarching consideration in many aspects of resource management. It is also clear that the scope of climate change is far too great to be addressed by any one entity; rather, we must find ways to collectively tailor our work to minimize the causes of and adapt to the consequences of climate alteration.

Wetlands are water resources, and as such are at the heart of many climate-related concerns. Integration of climate change mitigation and adaptation with ongoing wetland management inevitably leads to other related topics – from agriculture and natural hazard management to issues of endangered species protection and securing clean sources of drinking water. For purposes of this paper, we are organizing wetland climate change issues into three broad topics:

- The potential adverse impact of climate change on wetland ecosystems and their ecological functions, as well as societal benefits.
- The role of wetlands in mitigating the causes of climate change, through carbon sequestration and related measures.
- The role of wetland management – including protection of existing wetlands and restoration or creation of new wetland systems - to meet the need for adaptation to the current and anticipated impacts of climate change. This role includes support for the natural world as well as provision of human needs for wetland related ecological services.

One goal of this paper is to recommend some initial priorities and direction for the Association of State Wetland Managers (ASWM) regarding climate change actions at this point in time, and to update 2009 ASWM recommendations for wetlands and climate change initiatives. Collaboration among national and global entities has advanced greatly in recent years, along with increasing understanding of climate impacts and management approaches. The second purpose of this paper is to share our ideas with professionals working in related areas either in policy development or in on the ground management of land and water resources. We expect that response to climate issues will be a component of our work for the foreseeable future.

The Association of State Wetland Managers (ASWM) is a national non-profit organization established to promote and enhance protection and management of wetland resources, to promote application of sound science to wetland management efforts, and to provide training and education to our members and the public.

[www.aswm.org](http://www.aswm.org)

## The Relationship between Wetlands and Climate Change

Many national scale climate change assessments tend to focus on current or anticipated impacts on our human population. Priority concerns typically include: sea level rise; hydrologic changes (especially those leading to drought or flood conditions, and the availability of water for drinking, agriculture and other uses); severe storms; new or changing threats from disease; food production; and other equally high priorities. Broader reports also address the impacts on fish and wildlife and their habitat. Except for discussion of coastal areas, wetlands are typically not a major topic although they are acknowledged in more detailed discussions of impacts and in relationship to water management and habitat. Given the scope of climate change impacts, these priority topics are understandable.

However, in thinking about our response to climate change, it is clear that wetland management is a strong thread running through climate issues and actions. The fact that wetlands are by definition an interface between one aquatic system and another, between land and water, often between surface and ground water, and even – in the case of storm systems – between air and land means that wetlands often have a place in the front line of both adaptation and mitigation actions even while wetland ecosystems are themselves under threat.

Wetlands will be directly affected by sea level rise, and also buffer other land uses against rising water levels and severe storm events. We know that wetland ecosystems can be severely impacted or even destroyed by drought, but also provide water storage and often groundwater recharge capacity which can contribute to drought management. Wetlands may be negatively impacted by increases in contaminated runoff resulting from changed rainfall patterns, but can also provide flood storage and filter at least some pollutants from runoff reaching other waters. Wetland habitat can be altered by hydrologic changes, and by shifting plant and animals populations following temperature alterations, but can also provide migration pathways and refuge for some species. And wetlands sequester significant amounts of carbon as compared to other ecosystems – estimated at 12% of the global carbon pool - and if left undisturbed should continue to do so. One role of wetland managers as we organize our collective thinking on climate change management will be to advise other entities about both the role of wetlands and potential impacts to wetlands.

Sorting out the multiple roles of wetlands in response to climate change – which is likely to suggest increased wetland protection in some instances and more intensive management in others - will require a clear understanding of the pros and cons of various approaches. The “correct” action will not always be the same – there is no one-size-fits-all solution. Many, if not most, decisions regarding wetland management will depend on local climate impact as well as other individual considerations such as regional land use patterns and extent of development, and available adaptation alternatives. Consequently, it should be expected that state, tribal, and local agencies will play a major role in climate related decisions, as they do with wetland management in general.

Moreover, the management entities having an interest in climate strategies may not be typical stakeholders in wetland policy decisions. They are likely to have diverse needs and goals which may create potential for conflict as decisions are made. For example, is it better to provide for increased flood storage, or to protect existing habitat? Is it more important to use the filtration capacity of a natural wetland to remove pollutants that would otherwise reach a stream system, or to limit damage to the wetland itself? In drier regions, ongoing debates regarding the allocation of water among natural and human uses may also intensify.

Of course, these same diverse interest groups provide significant opportunities for collaboration and development of more desirable options. In many instances the question will not be either/or, but will be one of the extent of acceptable wetland use or alteration, or of managing wetland resources to meet multiple objectives. Encouraging a positive, collaborative effort will require a thorough and informed analysis on the pros and cons of various adaptation approaches, understanding of the needs and concerns of the various stakeholders, and effective and purposeful communication. Professional wetland managers can play a significant role in assisting multiple partners and interests, as can a strong communication strategy.

While it is well beyond the scope of this paper to outline all of the potential impacts on and roles of wetlands in climate change planning, the following sections highlight some typical issues. Again, we are dividing this information into three categories: impacts to wetland systems; the role of wetlands in climate mitigation; and the role of wetlands in climate adaptation.



**Potential impacts to wetlands** include the following:

- Overall modification or loss of ecosystem types, primarily in response to changes in hydrology and temperature. Significant alterations of water supply and/or hydroperiod are often discussed as the most significant factor likely to impact wetlands. Current and anticipated hydrologic impacts range from sea level rise (and salt water intrusion), to increased inundation on a seasonal or annual basis, to the opposite problem of loss of soil moisture in drought conditions (e.g. in prairie pothole regions).
- Shifts in biological communities. Changes in both temperature and hydroperiod can lead to alteration of plant community structure. Some animal populations will react directly to changes in the plant community, while others may be affected by temperature changes, resulting in a shift in home range or the loss of populations where migration is not possible. As changes in plant and animal communities occur, there may be desynchronization of events that support migration or reproduction, e.g. the availability of a particular food supply at a particular time.
- Impacts to rare species. Wetlands support a high percentage of rare plant and animal species and communities. Because of their sensitivity to ecosystem structure and conditions, these species may be especially vulnerable to climate change impacts. More extreme or controversial measures – such as assisted migration – may be proposed to address the needs of listed species. Protection for remaining suitable habitat may be given a high priority.
- Increased pressure from invasive species. Changes in an ecosystem, in particular the loss of dominant populations of plants or animals, may lead to an increase in invasive species which tend to take advantage of unstable and degraded conditions.

- Sedimentation and water quality impacts resulting from increased runoff associated with severe storms or higher volume precipitation. While the ability of wetlands to buffer such impacts may in some instances be considered a climate adaptation measure, loading of sediment and other pollutants may also have negative impacts on wetland systems.
- Intentional alteration to provide functions such as flood storage, resulting in the overall modification of the wetland ecosystem.

**Potential strategic and management actions** in response to modification or loss of wetlands could include the following.

- Gather and summarize research information and potential options to minimize impacts of climate change on wetlands. Make information available to a wide range of interest groups, including local land use planners as well as resource managers.
- Participate in cross-cutting interest groups engaged in addressing climate, water, habitat, and other land use issues. Wetland managers can encourage recognition of likely impacts on wetland systems, including both the direct effects of climate change and potential secondary impacts resulting from modification or use of wetlands to provide new functions.
- Identify and encourage regulatory and non-regulatory measures as appropriate to protect priority wetland systems. Special protection may be needed for wetlands with a defined essential role in climate management (e.g. that provide a high level of carbon sequestration) or where protection is needed for other reasons (e.g. new wetlands established to allow migration during sea level rise).
- The relationship between climate change concerns and existing regulatory guidelines – including the Corps of Engineers public interest review and the EPA 404(b)(1) guidelines, along with parallel state and tribal regulations – needs additional exploration. Development of additional climate adaptation best management practices is needed.



### **The role of wetlands in climate change mitigation through sequestration of greenhouse gases**

Wetlands contain a significant percentage of the carbon that is sequestered in natural systems. While wetlands cover only 6% of the world’s land surface, they contain about 12% of the global carbon pool. Peatlands contain 30% of global soil carbon. Coastal wetlands cover only a very small percentage of the ocean surface yet contain up to 70% of carbon sequestered in marine environments.

While reversing atmospheric carbon concentrations will almost certainly require global actions related to fossil fuel production and consumption, the protection and expansion of natural carbon sequestration systems can also make a contribution that should not be overlooked. Carbon storage in land ecosystems has offset around 17% of U.S. fossil fuel emissions of greenhouse gases over the past several decades. On the other hand, thawing of permafrost and drying of other wetlands may result in

increased release of greenhouse gases. Wildfire in peatlands that have been subjected to drying exacerbates this effect.

The net impact of wetlands on greenhouse gases is, however, a complex one, in that wetlands can also serve as a source of methane and carbon depending on multiple physical and chemical conditions. Recent studies indicate that northern peatlands and forests produce a higher amount of methane than once believed. However, other extensive research demonstrates that the net long term wetland effect is as a sink, not a source of greenhouse gases, given the long-term carbon storage provided. Additional research regarding the potential for wetlands to contribute to climate mitigation, and the management practices needed to facilitate this, are still needed - and will likely be supported given the interest in carbon “banking”.

#### **Research needs and potential management actions:**

- Support additional investigation of existing and potential carbon sequestration in wetland systems. Support analysis of the scope of carbon release potentially associated with loss or degradation of wetlands.
- Control drainage of wetlands to prevent oxidation of wetland soils and the resulting releases of carbon into the atmosphere.
- Investigate the legal relationship between the need for carbon sequestration to regulatory guidelines (COE public interest review, 404 (b)(1) guidelines). Assist states and tribes in overcoming resistance to new considerations in regulatory decision making.
- Identify and support wetland management measures such as rewetting of peatlands that provide multiple benefits, including carbon sequestration.
- Determine with greater specificity how much methane is produced by wetlands. Continue to investigate the relationship between wetland conditions and loss of methane to the atmosphere, and to identify management measures that minimize methane release.



#### **The potential role of wetlands in adaptation to climate change**

Both existing and created/restored/managed wetlands can provide multiple ecosystem services that play a role in climate adaptation. Depending upon geographic location, ecological type of wetland, management measures, and climate impacts, these services may include the following:

- Flood storage, which may be increased depending upon the configuration and existing land use within adjacent floodplains. Storage of precipitation and runoff in wetland pockets high in a watershed – including isolated wetlands – can help to minimize downstream flooding, while wetland floodplains lower in the watershed can store and gradually release larger volumes of runoff.

- Buffering of the impacts of more intense storms, minimizing flooding, erosion and property damage.
- Filtration and processing of nonpoint source pollutants and sediment from runoff associated with more intense storm events. This may occur in rural areas where agricultural or forest lands are adjacent to stream corridors, or in more highly developed areas where wetlands can be incorporated into a network of built and “green” infrastructure.
- Storage of water in drought prone areas, and recharge of groundwater.
- Habitat for numerous plant and animal species, and maintenance of biodiversity. In many instances, wetlands provide corridors for the movement of species, and may facilitate a shift in range in response to warming climate or related impacts. Remaining wetlands may also provide a refuge for species needing wetter conditions in drought prone areas. More extreme measures to maintain biodiversity – such as assisted migration – remain controversial but may become essential in some instances.

**Potential strategic and management actions to incorporate wetlands more fully into climate adaptation plans.**

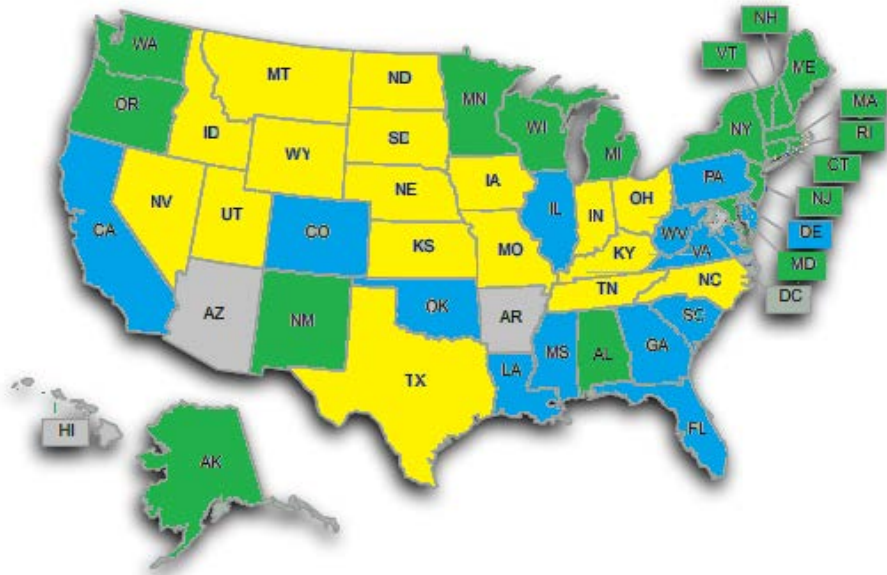
- Identify and promote protection of wetlands that provide key ecological services and functions in a given location.
- Encourage integration of wetland restoration/creation/management into local adaptation plans. Collaborate with local planners to provide information regarding the importance of wetland systems, and potential for no-regrets wetland strategies for nonpoint source and climate management.
- Collaborate with water managers, including floodplain programs, drinking water programs, and drain engineers and others to consider wetland options for climate strategies.
- Work with fish and wildlife and other habitat conservation groups to define concerns and to help define an appropriate balance between habitat measure and water management where there may be competing needs. Promote restoration to fill gaps in wetland corridors.
- Collaborate with EPA and Corps of Engineers to define and address regulatory concerns. As noted above, some wetlands may need added protection in light of climate change. However, general permits and other measures may help to facilitate permitting associated with wetland restoration or management to meet climate adaptation needs.
- Evaluate emerging (and often controversial) “novel ecosystem” concepts and identify concerns with this approach. Seek balance in protection of existing wetland types, acceptance of inevitable alteration of existing systems, and wetland values.

## Status of State Wetland Program Climate Change Actions

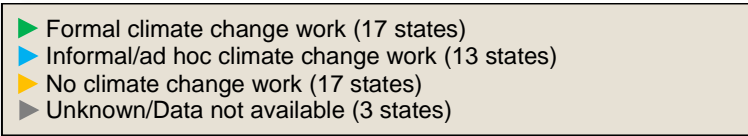
ASWM is currently in the process of completing a year-long study of state wetland programs, collecting and compiling information on EPA's Four Core Elements, climate change work and integration activities. The following excerpt from the study's status and trends report identifies key results from this study. This information is currently being verified by state wetland program staff. All data is a snapshot of state wetland programs as of December 2014.

**Background:** Wetlands provide many functions and services that can reduce the impacts of climate change, from providing water storage to reduce flooding and drought, reduce the risk of wildlife, infiltrate stormwater, and provide buffers for storm surge and sea level rise. ASWM worked with states to verify whether or not through their wetland programs they were doing anything formally or informally to address climate change.

**Results:** Seventeen states wetland programs are *formally* working on or engaged in this work. Twelve states share that they do some limited work on climate change on an *informal/ad hoc basis*. Informal involvement with climate change and wetlands includes participation in conversations, thinking through how specific permitting and other activities should be adapted to address climate change and others. Many of these informal activities are related to studying or planning for sea level rise, drought and impacts on specific weather-dependent industries (e.g. ski industry). These are activities which are not being *labeled* as formal climate change work, but are working to address the concept of climate change. Seventeen state wetland programs *do no climate change work related to wetlands*. This is a sensitive issue for several of the states with political restrictions on climate change efforts;



consequently this report does not identify which states are in this position.



Additionally, while state wetland programs may not be making these connections at the *state-level*, many state wetland staff reported that some work on climate change or adaptive planning related to these kinds of events is happening openly at *regional and/or local levels* (e.g. UT, WY).



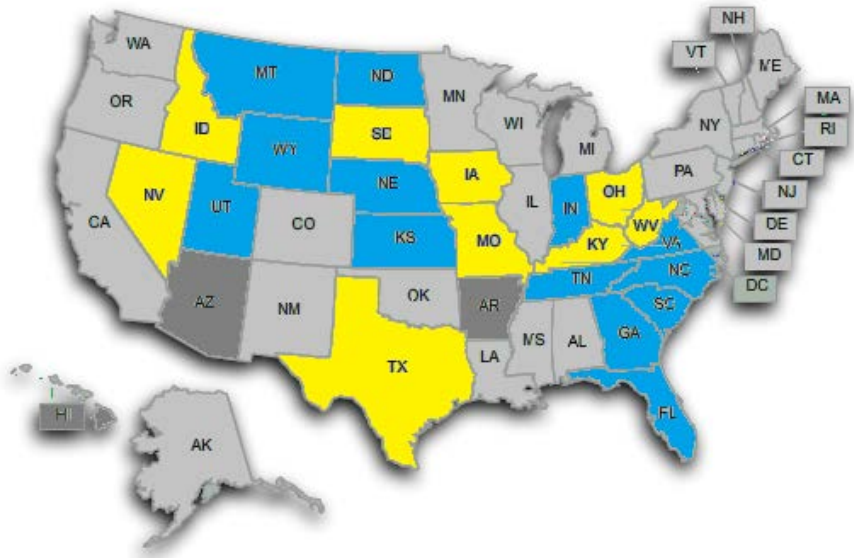
## State Wetland Programs and Other Adaptation Work

**Background:** In addition to the formal and informal climate change activities already mentioned, ASWM has identified a significant body of adaptation planning that is occurring under non-climate change terms or guises in states where climate change work is a “non-starter” that engages wetland program staff. Through this project, ASWM has found a lot of work “non-climate change” work related to addressing natural hazards and extreme precipitation events.

**Results:** Building on the results on climate change connections on the previous page, this map show that thirteen of the states that verified their state wetland program does no formal or informal work on climate change issues, *do other types of adaptation work*. Goals for this work may address climate-related issues as a

byproduct, but their goals and focus are on non-climate change issues. Examples of these adaptation efforts include stormwater management, water retention projects, integrated floodplain management, sea level rise/storm event planning, culvert replacement, and others.

The study identifies a need to look at a broader range of sources, including municipal planning, ordinance/code work, emergency management and other areas to identify work that addresses climate-related, but not climate change focused issues.



- ▶ State wetland programs involved in “other” adaptation work that do not do climate change work (13 states)
- ▶ State wetland programs that do no climate change work or other related adaptation work (9 states)
- ▶ State wetland programs engaged in either formal or informal climate change work (25 states)
- ▶ Unknown/Data not available (3 states)

**Conclusions:** Wetland program managers and those that support them may also need to think more broadly about how states can address extreme weather events. With many state wetland programs not actively engaged in climate change work or at least not encouraging climate change efforts in ways that are engaging wetland program staff, there is a need to look more broadly at state activities (e.g. water retention projects, stormwater management) to find points of action that can be supported by state wetland programs. States also need to think in terms of both threats to wetlands and the benefits wetlands can provide when looking at integration opportunities.

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