Waters of the Oconee River Basin:
Uses, Benefits, and Flow-Related Metrics for Water Planning

Description of Maps and Layers

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This project focused on 1) ways that people use and benefit from the water resources of the Oconee River Basin and 2) how some of those uses and benefits vary with streamflow or lake levels. We drew on scientific and technical studies on the rivers in the basin as well as information from users of the basin's water resources. Products from the project include three online maps. This document describes the contents and the layers of three maps produced through this project:

The links above take you to the section of this document describing that map. The section header for each map is linked to connect directly to that map. References and other information sources are included in the last section of this document (p. 8-11).

Map: Participant Input on Important Uses and Benefits (click to access map)

An interactive map was developed to collect and compile input from water users and other stakeholders in the basin. The final map showing all the location-specific input has seven layers, each of which presents similar water uses or benefits. Layers can be turned on and off by selecting the layer's check box in the bar on the left. The details that people provided about different uses and benefits can be seen by clicking on the individual symbols. This section provides general information on the Oconee River Basin and the seven categories of use and benefit identified by project participants.

Water supply

Surface water is withdrawn for water supply from streams, rivers, and lakes throughout the basin and used for public water supply as well as industrial and agricultural use. Groundwater is also used for

these purposes but, since this project is focused on surface water resources, those withdrawals are not illustrated on the map.

Sixteen local governments or utilities in the Oconee basin have state permits for surface water withdrawals to provide public water supply. These water providers hold a total of 26 municipal surface water withdrawal permits, ten of which were not in use in 2020 (permits may be based on projected demand that has not yet developed or systems may be under construction but not operational). Entries on the map summarize the number of withdrawals in an area but, for security reasons, the specific locations of municipal withdrawals are not mapped.

Industrial water supply in the basin largely comes from groundwater, with a few notable exceptions shown on the map. Kaolin mining and processing is a distinctive industry in the middle part of the basin and best management practices (BMPs) have been established for that industry to conserve water and manage water quality impacts in surface water bodies.

Withdrawals for agricultural water use include water for irrigation of crops, animal operations and for nursery operations. Like industrial use, most of the agricultural demand in the basin is met by groundwater withdrawals.

Water quality and wastewater processing

Treated wastewater is returned to surface waters in the basin through discharges from municipal and industrial wastewater systems. Wastewater is treated to levels established in state discharge permits to meet water quality standards for the receiving water body. The flows of wastewater return water that was withdrawn for water supply, contributing to the water available downstream of discharge points.

Discharge of treated wastewater takes advantage of the natural capacity in each waterbody to process or assimilate pollution through physical, chemical, and biological action. This assimilative capacity helps maintain water quality in the river or stream, but it is not unlimited. If more pollutants enter a river or stream than it can assimilate, water quality will decline with negative impacts on other uses, including water supply, recreation, and habitat for aquatic animals and plants.

Treated wastewater is not the only source of pollutants. Runoff after rains carries a range of pollutants from the land surface, often contributing higher levels of pollution than permitted wastewater discharges. The pollutants carried in stormwater are a major contributor to water quality problems and the map shows some locations where resource users have specific concerns about water quality.

Direct economic benefit

Hydroelectric power production

Four hydropower dams are currently in operation or recently operated in the Oconee River basin. The two hydropower dams in the upper basin are older and smaller. They operate as run-of-river structures, meaning they have little storage above the dam and inflow is released within a short period. Run-of-

river hydropower dams alter habitat and block connectivity between river segments, affecting fish populations and recreational use. However, their impacts are generally less extensive than larger dams with storage.

Wallace Dam, which creates Lake Oconee, and Sinclair Dam, which creates Lake Sinclair, are newer and larger. Wallace Dam is operated for pumped storage, meaning that water is released through the dam to generate electricity during peak power demand hours; some water is then pumped back at night during off peak and lower cost power hours. Pumped storage operations result in relatively stable levels in the two lakes, which contributes to the value of waterfront property. The two lakes are also important recreational resources. As the downstream most dam, Sinclair is managed to meet a minimum required flow intended to mitigate impacts of hydropower operations on the river downstream.

Waterfront property

Property along waterways can provides a variety of direct benefits to property owners, including access to water-based recreation, more productive agricultural or forest lands, land-based recreation that is enhanced by connections to the waterway, and attractive scenery. These benefits are often reflected in higher monetary value for waterfront land compared to local land that is not on a waterway. This layer of the map highlights a few examples along major rivers in the basin as well as the notable examples of Lake Oconee and Lake Sinclair.

Recreation on rivers and lakes

Recreation uses on rivers and lakes in the basin include motorized and non-motorized boating, fishing, swimming, wading and more. Features shown on the map are largely located on the large rivers and lakes, although tributaries are also use for recreation and other purposes. The map includes some of the many public areas, private locations, and outfitters where people access the basin's waterways. Some locations are undeveloped sites used for kayak and canoe access, while others are developed with amenities that support multiple uses. The public and private boat ramps and marinas on the map are largely located on large rivers and lakes, with a smaller number on tributaries.

The Oconee River and its tributaries provide a wide variety of fishing opportunities throughout the year. Fishing hotspot symbols on the map indicated a few areas identified in documents as particularly good fishing locations. There are a wide variety of fishing opportunities throughout the year in the different habitats along the basin's rivers and lakes. Native sunfishes (e.g., bluegill, redbreast, crappie, largemouth bass), channel cats, and bullheads are sought by anglers. Sport fishes include the Altamaha bass, a native redeye unique to the Ocmulgee, Oconee, and Altamaha rivers, which is found in the rocky drainages that still provide good habitat. A few invasive species such as spotted bass and flathead catfish also provide valued angling opportunities. Shad, chain pickerel (jackfish), and other specialized fisheries such as mullet and suckers add to the value of the basin's water for anglers.

Aquatic habitat and species

A variety of habitat types contribute to the natural productivity and diversity of plants, fish, mussels, crayfish, and other organisms in the Oconee River basin. The habitats, and the communities of aquatic plants and animals they support, are additional benefits of the basin's water resources. Examples of many habitats are noted on this layer of the map and described here.

Looking first at streams and rivers throughout the basin, valuable aquatic habitat includes alternating series of shoals, pools, and runs. Shoals are short segments with shallow water, rocky bottoms, and faster, more turbulent flow. These areas generally have high dissolved oxygen and less sediment than other habitats. As a result, they are highly productive areas that support an array of aquatic plants, invertebrates, and fishes.

In the basin's larger rivers, shoal areas are also a recreational resource, adding value for kayakers and canoers. These areas have benefited humans historically as well as today. Native Americans built rock structures called fish weirs at some shoal areas. During and after European colonization, shoals were utilized for river crossings. The change in elevation at shoals made good sites for mills and small dams in 18th and 19th centuries, with some of these historic features remaining in and along the river today. The larger hydroelectric dams built in the basin in the 20th century were located at shoal complexes for the same reason.

Pools have deeper depths with slower current and soft substrates, providing a different habitat preferred by some invertebrates and fish species. Water temperatures may be lower in the deeper water, creating a thermal refuge for fish during hot periods and adding value for swimmers. Runs lie below pools and shoals and are characterized by moderate depth and current with a smooth, unbroken surface, contributing further to the diversity of aquatic habitats.

In some of the lower-lying areas throughout the basin, larger rivers create parallel channels with dry land in between. These are called braided channels, which move over time through erosion of the channel bed and banks with reworking and deposition of sediments as flow levels change. Woody debris can predominate in braided channels, providing hard substrate, food, and shelter for invertebrates and fish. These debris, however, can be an obstacle for boaters.

In the southern half of the basin, the river's gradient decreases and the geology is conducive to formation of oxbows, sloughs, and oxbow lakes. These common features provide distinctive aquatic habitat and can be locally-significant recreation resources. Oxbows are meanders in the river formed and maintained by differences in velocity and sediment transport that occur along the river. Velocity differences affect the substrate form on each side of the river. Loose sediments accumulate in slower areas, providing habitat for animals that prefer sandy or silty habitats and lower flows. Stable sandbars created in these areas can be valuable recreation areas.

At high water, the river sometimes cuts through the neck of an oxbow, creating the curved or U-shaped lakes known as oxbow lakes. Depending on specific configurations at each location, oxbow lakes may

remain partially connected to the river at moderate flows or they may only be connected at high or extremely high water. Over time, particularly if the river and oxbow lake are only connected at high water, the depth of oxbow lakes will decrease through deposition of sediment and plant material, creating swampy or marshy habitat known as sloughs. Oxbow lakes and sloughs provide habitat for animals that prefer slow or standing water, like native sunfish, and for wet-adapted plants. The periodic connection to river flow brings nutrients that support the natural productivity of these features. Oxbow lakes are particularly important as breeding areas for fishes, including some sport fishes.

Lake Oconee and Lake Sinclair are impoundments created by dams. In impoundments like these, the running water habitat of a river is shifted to standing or flatwater habitat. Some native plants and animals, including some fish and mussels, prefer or tolerate standing water habitat and these populations have become more important in the food web that developed in the impounded waters. The Georgia Wildlife Resources Division has also stocked hydrid bass and other fish in the lakes. While stocking changes the aquatic diversity and habitat in the lakes, it also adds value for recreational fishing and related uses.

Overall, the Oconee River Basin has a rich mix of aquatic species and aquatic habitats. However, 14 of these species have been identified as species of special concern for biodiversity conservation and some species have been lost from parts of the basin. The shad run that was historically significant, for example, has been blocked from the upper basin by dams and no longer occurs. In the upper basin, the Chattahoochee crayfish and the Altamaha shiner are listed by the state as threatened. In the lower basin, the the Altamaha shiner, the Altamaha arcmussel, and the Oconee burrowing crayfish are listed by the state as threatened and the shortnose sturgeon and Atlantic sturgeon are listed as endangered under the federal Endangered Species Act. The robust redhorse, a fish in the sucker family, historically occurred in the upper and lower basin, but no observations in the basin have been recorded since 2013. The robust redhorse is now listed by the state as endangered.

Channel and habitat maintenance

Rivers are naturally dynamic, with physical forces balancing out in a river's channel form in ways that maintain a mix of habitats. The level and velocity of flow, groundwater contributions, and sediment transport and retention all vary along the length of the river and can also vary across the river's channel. They also vary over time, contributing to shifts in the location of main and secondary channels within the floodplain and the creation of oxbow lakes and sloughs. These dynamic forces shape and maintain aquatic habitat and biodiversity, habitat and biodiversity on lands along rivers, and human benefits from waterways and adjacent land.

It is important to recognize that river channels and habitat also change in due to human activities. In upper basin, channels were straightened to improve drainage, with adjacent floodplain drained for agricultural use. In the lower basin, the Oconee River's channel was altered to improve passage of steamboats carrying freight and passengers. Historical alteration for steamboat passage shapes aquatic habitat and recreational experiences to this day.

This layer of the map includes examples of locations where these dynamics, or their benefits to people, are evident. Some examples highlight groundwater contributions, which can help maintain low flows during dry periods. Other examples relate to sediment transport and retention. The Oconee basin is among those where sediment dynamics have been affected by a large increase in erosion that started with land clearing during European colonization and was furthered by agricultural practices common into the 1930s. Studies indicate that, in the Piedmont, much of the eroded material continues to augment sediment loads in rivers like the North, Middle, and Oconee. That load is also supplemented by current-day eroded material. The basin's two large impoundments, Lake Oconee and Lake Sinclair, capture a substantial amount of the sediment load, which decreases the effects of historic and current day sediment loading in the Coastal Plain portion of the Oconee River.

Recreation and habitat on lands along rivers and lakes

Recreation along rivers and lakes

Water resources of the Oconee basin also support and enhance recreation on lands that lie along streams, rivers, and lakes. There are large number of areas along waterways in the basin that are managed for outdoor recreation, including hiking, picnicking, birding and wildlife observation, camping, hunting, and bank fishing. These include public parks and greenways, private hunting land lands, state wildlife management areas, and US Forest Service lands.

This layer of the map includes many of lands along the basin's waterways that have outdoor recreation as a major objective for their management. Some of these lands are also managed to maintain habitat for plants and animals in addition to other uses.

Habitat for plants and animals along rivers and lakes

Lands adjacent to the basin's rivers and lakes also provide a diversity of habitats for plants and animals, contributing to the natural productivity of the ecosystem and adding value to recreation and other uses of the basin's waterways. This layer of the map includes examples of important habitat types as well as many of the basin's lands protected as conservation areas. Management of these lands emphasizes maintenance of biodiversity and ecosystem function, and public access may be limited or restricted.

The connections between the major rivers and their floodplains are particularly significant here. Floodplain habitats include bottomland forests and wetlands, both of which are high value for biodiversity. Bottomland forests, for example, are regularly flooded and feature hardwood trees that are tolerant of flooding (water tupelo, black gum, bald cypress, and some oaks). A notable Southeastern ecosystem that can be highly productive, these forests are home to diverse wildlife, including neotropical migratory bird species, and plants that are specially adapted for wet habitats. Wetlands are moist or covered with standing water much of the time, supporting distinctive plant and animal communities and contributing to the naturally high productivity of the floodplain. The input of nutrients from periodic flooding associated with high river flows is essential to their diversity and productivity.

The swampy characteristics of floodplain and wetland habitats have limited human activity and development in many areas, maintaining the natural interesting array of wildlife and plant

species. Floodplains filter pollutants that run off adjacent uplands and store water during wet periods, which helps mitigate flooding in other areas, control erosion, recharge groundwater, and support low flows during dry periods.

As noted above, Lake Oconee and Lake Sinclair are impoundments created by dams. Since water levels in these impoundments are managed to only vary within a small range, the lakes and adjacent lands do not have the same kind of hydrologic connections as rivers and their floodplains. As a result, the habitat on adjacent lands is generally dry, terrestrial habitat and examples are not included in this layer of the map.

Environmental and historical education

This layer includes lands that are managed for, or provide, water-related educational opportunities. Examples on this layer of the map include nature centers, designated historic sites, and historic structures that demonstrate the importance of water resources in the region's development. Many sites like this also provide recreational opportunities.

New Planning Metrics: Recreation; Species and Habitats (click to access map)

When regional water plans are updated every five years, a technical analysis of water availability is completed by the Georgia Environmental Protection Division (Georgia EPD) in coordination with the Water Planning Council in each region. Planning metrics for flow-dependent uses are applied in the technical analysis to flag time periods with undesirable conditions for a specific use. Water planners use metrics to see how often beneficial or undesirable conditions occur now for a specific use and then see how those conditions may change with increased water demand in the future.

Georgia EPD uses standard metrics for water supply and wastewater discharge. This project identified new planning metrics for two other uses: 1) recreation and 2) aquatic habitats and species. The new planning metrics drew on input from people in the basin as well as scientific and technical studies. We first identified thresholds for river flows or lake levels that are expected to maintain recreational opportunities or aquatic habitat and species. Metrics that indicates beneficial or undesirable conditions were created by counting the number of days that flow is above or below a threshold at a specific location.

This map has three layers. The first layer shows locations where the United States Geological Survey (USGS) monitors flow levels. These flow gages are places where metrics are evaluated during the technical analysis of water availability. The second layer shows metrics for recreational opportunities and the third layers shows metrics for aquatic habitats and species. Layers can be turned on and off by selecting the layer's check box in the bar on the left. Metric details can be seen by clicking on a symbol on the map or an entry in the sidebar.

Metrics for recreational opportunities indicate flows that are either too low or too high for boating or boat access. Many contributors identified boating as a valuable use of large rivers and lakes. Many of the Metrics address flows for canoeing and kayaking or flows or lake levels for motorboating.

Metrics for species and habitats identify conditions that put the long-term survival of the basin's diverse aquatic resources at risk. They are based on thresholds for different functions of flow that maintain habitats and species over time. Metrics include a baseflow threshold for fish reproduction, a summer and fall baseflow threshold, and thresholds for river-floodplain connection and channel maintenance.

If flows below the threshold for fish reproduction become more frequent or last longer in the future, negative impacts on fish reproduction are expected and fish populations may decline. Similarly, flows above a summer and fall baseflow threshold are needed for long-term survival of fish, aquatic plants, and aquatic insects. These species can survive some periods of low water but, if those stressful conditions become more frequent or last longer in the future, the long-term survival of plants and animals at the base of the food web is at risk and impacts on sport fishing may be seen.

High flow years with more frequent connection between the river and floodplain are also important for species and habitats. River-floodplain connections give fish access to feeding areas and habitat for juveniles, allow exchange of nutrients, and support reproduction and survival of trees like water tupelo and bald cypress. Flooding can also limit the spread of some introduced plants. If river-floodplain connections occur less often or are shorter in the future, the benefits from this mix of species and habitats may decline over time.

Volunteer Water Quality Monitoring Sites (click to access map)

Two organizations submitted a map of locations where their members monitor water quality. The Upper Oconee Watershed Network (UOWN) has had a volunteer monitoring program since 1998. UOWN monitors streams and rivers in multiple counties in the upper portion of the basin (see uown.org for more information). The Greater Apalachee Regional Community's (GARC) monitoring program is more recent. GARC monitors tributaries to the Apalachee River and the mainstem of the river itself.

References and Information Sources

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