

# CAMP - Comprehensive Androscoggin Management Plan

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## Mission Statement

To restore all reaches of the Androscoggin River upriver of Merrymeeting Bay to unimpaired status for all recreation purposes by 2025.

## History

Over the past 200 years, the Androscoggin River has been used heavily for industrial and municipal purposes. Dating back to the 1800's, numerous dams were erected along the lower reaches of the river along with mills for textiles and lumber (maine.gov). Furthermore, in the early 1900's, larger pulp and paper mills were constructed portions of New Hampshire and Maine (Rumford and Jay). This relatively rapid industrialization resulted in immense amounts of toxic pollution being discharged into the river. By the 1960's, the water quality of the Androscoggin River was extremely impaired, ranking as one of the most severely polluted in the United States and experiencing hypoxic conditions in areas where dissolved oxygen was non-existent, making it uninhabitable for aquatic species (mainerivers.org).

With the passage of the Clean Water Act in the 1970's, the water quality of the Androscoggin improved moderately as discharge was now being regulated. Despite this however, in the late 1980's the highly toxic chemical dioxin was discovered both in the fish and water below the paper mills, making them neither fishable nor swimmable (mainerivers.org). Today, certain portions of the river are still visibly impaired, with clarity and odor issues along with the overall water quality deficiencies. Another issue with river, as will be discussed later on, includes the loss of major fish runs due to the construction of dams along the river, thus hindering the spawning habits of species like salmon and shad (mainerivers.org).

## Matrix of Problems, Causes, and Solutions

### Water Quality Impairments

Priority	Problem	Cause	Solution
1.	Legacy PCB and dioxin contamination of sediments	Paper mills and other industry discharging waste chemicals--much of the discharging has ceased, but contaminants remain bound to sediments (difficult to address)	Enhance burial and/or expensive sediment removal

2.	Fish unfit for human consumption	Legacy chemicals PCB and Dioxin.	(See #1) Increase fish tissue sampling
3.	Low Dissolved Oxygen	Paper mills discharging organic matter --decomposition process removes dissolved oxygen	More stringent discharge controls on paper mills  Install bubblers to aerate impaired sections of the river  Cap and trade

### Loss of Fish Species

1.	Loss of anadromous fish species (ie. salmon and shad)	Fish unable to traverse dams  (Also water quality issues noted above)	Evaluate feasibility of enhanced fish passage  Remove dams that do not serve an important purpose
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## Androscoggin River Overview

### Watershed Characterization

The Androscoggin River is the third largest river in the state of Maine, with a total length of 177 miles and a drainage area of 3,450 square miles. Its headwaters are at the Umbagog Lake, positioned on the border of both Maine and New Hampshire, the river first travels southwest into New Hampshire before looping back east into Maine where it eventually merges with the Kennebec River at Merrymeeting Bay (fig. 1) (maine.gov). The vast majority of the drainage area in the basin, nearly 80 percent, lies within the state of Maine (2,730 square miles), with the remainder in New Hampshire (maine.gov). Upon re-entering Maine, the river passes major towns including Bethel, Rumford, Mexico, Dixfield, Jay, Livermore Falls, Lewiston, Auburn, Lisbon, Lisbon Falls, Durham, Brunswick, and Topsham (maine.gov). In many of these lower towns, sediments deposited along the river have resulted in extremely rich soils that produce some of the best farmland in the New England region (bethelhistorical.org).

Over the course of its 264km journey, the river drops more than 1,500 vertical feet, making it a fast-flowing river with numerous falls and rapids (mainerivers.org). As a result of this, despite its large size, the river has been largely unnavigable by vessels of any size. Since

navigation was near impossible, the river instead became highly industrialized, with dams and mills being erected to harness the available power from the fast-paced current (bethelhistorical.org) (fig. 3).

## Land Cover

Androscoggin River Watershed: Land Cover 2011

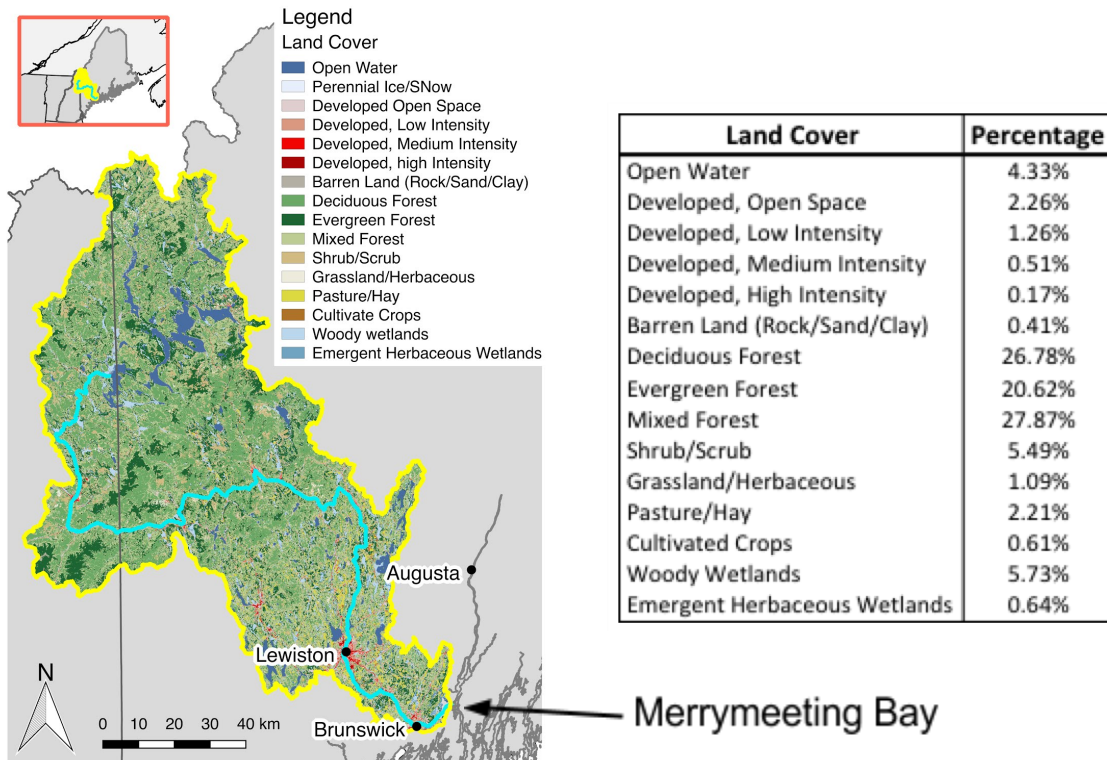


Figure 1: Land use in the Androscoggin River watershed

The Androscoggin River watershed is relatively undeveloped. Seventy-five percent of the watershed is comprised of deciduous, evergreen or mixed forest, 4.2% is observed as developed in any way (Yin et al., 2011), and 1% is listed as impervious cover (Xian et al., 2011). Agriculture is limited in the Androscoggin watershed, comprising less than 3% of the total watershed area. The Androscoggin watershed traverses the Maine and New Hampshire border, also skirting along the Canadian border in the north. Lakes and open water comprise 4.33% of the Androscoggin watershed, primarily in the northern reaches of the watershed. The northern reaches of the watershed are heavily forested, with a gentle transition towards development, cropping, and pasture cover moving south along the river towards Brunswick.

## Water Quality

Water quality is listed as impaired in many reaches of the main stem of the Androscoggin, as well as tributaries (fig. 2). It is challenging to determine the true extent of impairment based on

Maine DEP and EPA records due to the cross-boundary nature of the watershed, and disjointed reporting of water quality statistics by Maine and New Hampshire. Of the 7,023km of waterways in the Androscoggin watershed in Maine, 5.9% are classified as AA status by the Maine DEP, 42% are class A, 48.1% are class B, and 4% are class C. It should be noted that EPA lists all waters in the state of New Hampshire as impaired, but report the status of far fewer rivers in Maine. Fig. 2 shows the comparison of water quality status between EPA and the Maine DEP. The EPA lists dioxin and PCB contamination from industry and paper mills as the primary causes of impairment in the Androscoggin (STORET). Trends in the health of the Androscoggin are clearly visible in the Maine DEP status, which transitions from class AA, pristine and outstanding natural rivers in the north, to class C along the main stem downriver of Rumford. A full description of the Maine DEP water quality classification is available in Title 38, article §465 Standards for classification of fresh surface waters of the Maine legislature.

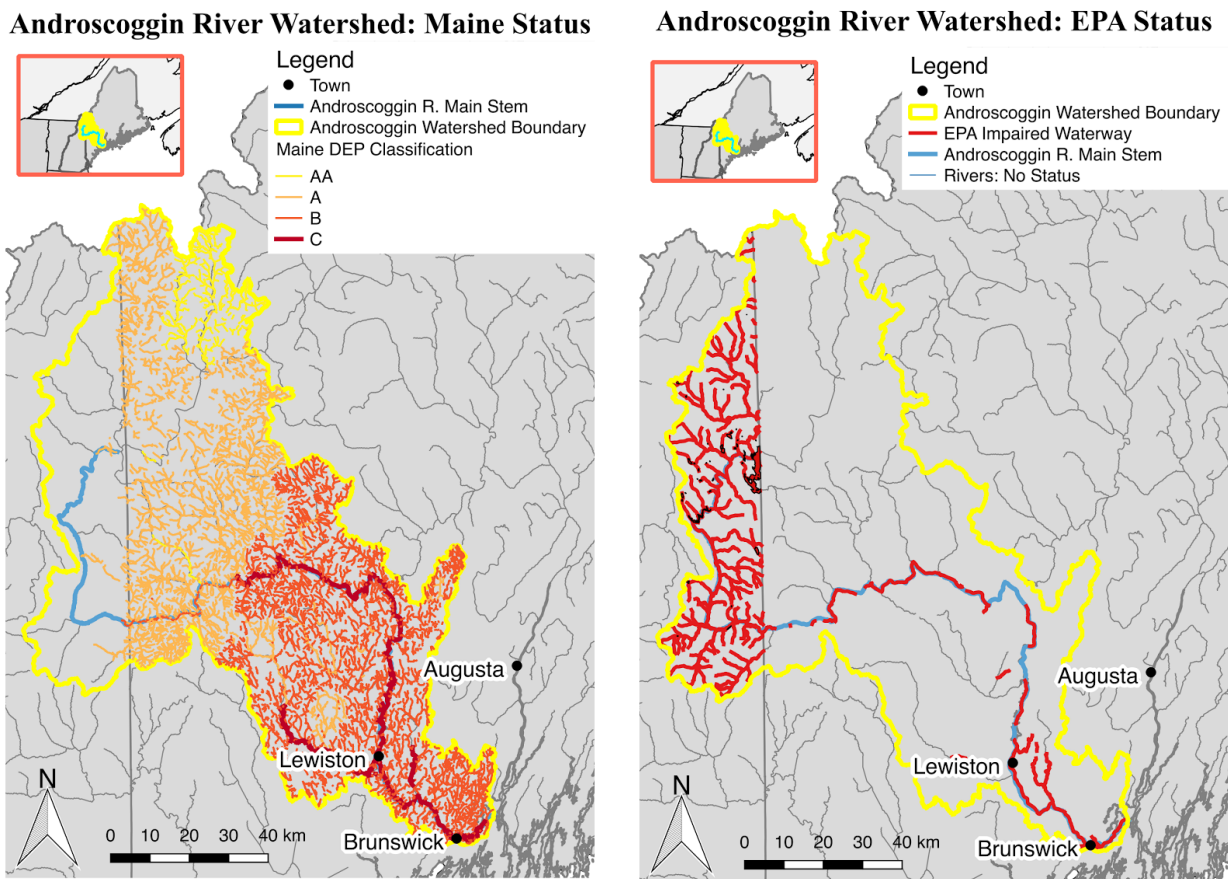


Figure 2: EPA and Maine DEP water quality in the Androscoggin River watershed

### Dams

The Maine and New Hampshire databases list 203 dams in the Androscoggin watershed. The purpose of these dams varies along the river; in total 63 are listed as having recreation as their primary purpose, 25 as hydro electric power generation facilities, 11 as flood control structures, and 22 as water supply structures. The New Hampshire database shows 34 dams

listed in ruin status. The largest structures are hydro-electric facilities, in Brunswick and Lewiston, Maine, and just upriver of the New Hampshire border in Gorham and Berlin. Hydroelectric facilities are generally 30 feet or greater above the downriver waters, with the largest facility at Gorham listed at 63 feet. The Brunswick-Topsham hydroelectric dam is the first structure upriver of Merrymeeting Bay and the ocean, with a hydraulic height of 20 feet.

### Androscoggin River Watershed: Dams and Impoundments

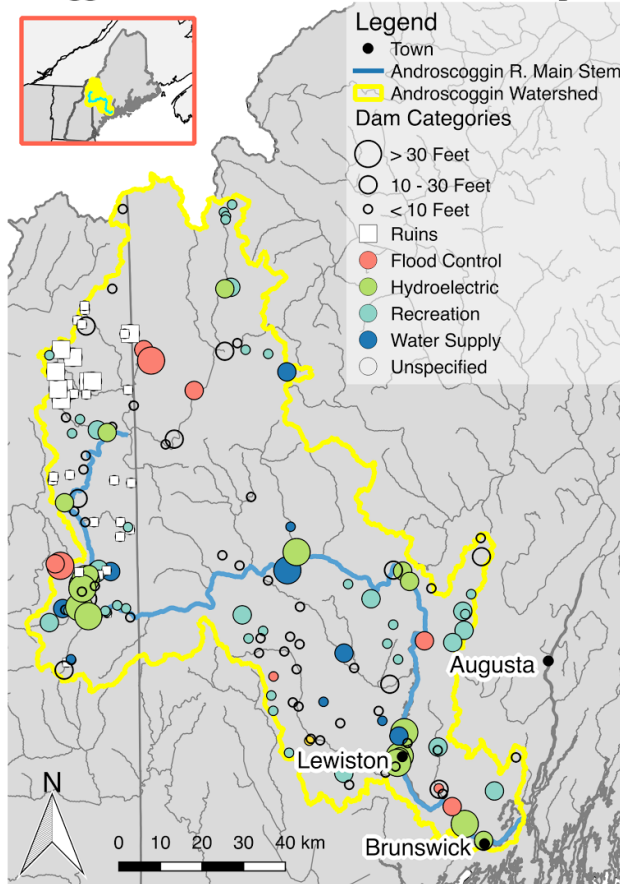


Figure 3: Dams in the Androscoggin River watershed

### Androscoggin Governance

In the early 20<sup>th</sup> century, several industries, largely paper mills, took advantage of the river's location and suitable characteristics to dump chemicals waste and byproducts into the Androscoggin River. The resulting effect was significantly degraded water conditions culminating with a intense sulfuric odor enveloping downstream communities. The Androscoggin River achieved notoriety as one of the top ten most polluted rivers in the country. The industrial condition and environmental damage to the Androscoggin River were a primary catalyst for several improvements to water resource regulation.

The Androscoggin River crosses several jurisdictions and is subject to multiple policies and regulations. The river flows through Maine and New Hampshire, crosses six counties, 18 towns and cities, three congressional districts, approximately 21 state senate districts and the watershed shares an international border with Canada. The different jurisdictions add to the challenge of creating effective regulations. Enacting policy requires the review and passage of several legislative and executive bodies from each jurisdiction.

There are three governing organizations that intersect to regulate the Androscoggin River; Federal, State and Local, and Non-Government organizations. The relevant agencies are listed and briefly described in Table 1.

### **Federal**

Improving the Androscoggin River's water quality required concerted regulations between the federal government, states, local municipalities, and stakeholders. The river's deteriorated environmental state was a primary catalyst for the Federal Clean Water Act in 1974. The primary drafter of the legislation (U.S. Senator Ed Muskie, Maine), grew up along the Androscoggin river in Rumford ME. The Clean Water Act's principal achievement was the establishment of similar interstate standards for pollution control and water quality. These standards provided minimum requirements for water quality ensuring no competitive advantages could exist between the states. Credit for the Androscoggin's recovery is due in large part to the Clean Water Act. The Androscoggin is also considered a navigable waterway under the Rivers and Harbors Act of 1899 giving the US Army Corps of Engineers jurisdiction over various projects to control bank erosion and dredging operations.

### **State and Local**

There are several state agencies regulating activity on the Androscoggin River. States implement additional regulations provided they meet the minimum standards of the Federal Regulations. States designate agencies to set and enforce pollution standards and manage their resources. In Maine, this includes a patchwork of separate agencies to manage the different interests. See Table 1 below.

### **Non-Government Organizations**

While the paper industry was contributing to the Androscoggin's pollution, Maine was busy promoting itself as a wilderness destination for outdoors activity. Maine has developed a culture of conservation and environmentalism. NGOs provide research and policy guidance and convey stakeholder perspectives on governance concerns. There are 107 active environmental non-governmental organizations in Maine, with 25% of them focused specifically on water resources.

Table 1: Agencies and their scope of responsibility or interest with respect to the Androscoggin River.

Name	Level	Mission
Environmental Protection Agency (EPA)	Federal	<ul style="list-style-type: none"> <li>-EPA's Region 1 administers the Clean Water Act provisions for the Androscoggin River.</li> <li>-Setting standards and assessing penalties.</li> <li>-Works to clean contaminated sites and clearing abandoned industrial facilities.</li> </ul>
Federal Energy Regulatory Commission (FERC):	Federal	<ul style="list-style-type: none"> <li>-Licensing and inspecting Hydro Electric power companies to ensure their compliance with standards.</li> </ul>
NH Department of Environmental Services (NHDES):	State	<ul style="list-style-type: none"> <li>-Reviews proposals to develop or expand public water supplies</li> <li>-Conducts sampling, facility inspections, operator licensing, education programs, and technical assistance for industry.</li> </ul>
Maine Department of Environmental Protection (DEP)	State	<ul style="list-style-type: none"> <li>-Sets environmental standards for ME.</li> <li>-Regulations meet all EPA minimum standards.</li> <li>-Partners with EPA on clean-up projects around the state.</li> <li>-Active in setting regulations (TMDL) standards and monitoring compliance for the Androscoggin</li> </ul>
Maine Department of Conservation (DOC)	State	<ul style="list-style-type: none"> <li>-Protects wilderness through conservation -Fostering awareness through recreation. -Protects Maine's natural resources. The -- Balances conservation with responsible resource use.</li> <li>-Several different departments: Bureau of Parks and Recreation, Maine Forest Service, Bureau of Geology and Natural Areas, Land Use Regulation Commission, and Natural Areas Program</li> </ul>
Maine Department of Marine Resources (DMR)	State	<ul style="list-style-type: none"> <li>-Conserve and develop marine and estuarine resources.</li> <li>-Sponsor scientific research and promote and develop coastal fishing.</li> <li>-Partners with local, state, and federal agencies to administer environmental regulations.</li> </ul>
Maine Department of Inland Fisheries and Wildlife	State	<ul style="list-style-type: none"> <li>Regulates licensing of inland fishing and hunting.</li> </ul>
Maine Environmental Policy Institute	NGO	<ul style="list-style-type: none"> <li>-Promotes the importance of a healthy ecosystem to Maine communities.</li> <li>-Sponsors research and makes reports to public and to policy makers.</li> </ul>
Natural Resources Council of Maine	NGO	<ul style="list-style-type: none"> <li>-Restore, protect and conserve Maine's natural environment.</li> <li>-Promotes science and policy to protect Maine's natural resources.</li> <li>-Focus on improving the water quality of Maine's rivers.</li> </ul>
Androscoggin River Watershed Council	NGO	<ul style="list-style-type: none"> <li>-Improve environmental quality &amp; promote healthy, prosperous communities on the Androscoggin.</li> <li>-Advocate sustainable development.</li> <li>-Provides environmental education</li> <li>-Encourage sustainable planning partnerships.</li> <li>-Participate in grassroots environmental activities.</li> </ul>

## Problems

There are three main issues that impair the Androscoggin river. These three issues are legacy pollutants, point sources of organic discharge and impaired fish passage. The first two problems result from paper mill practices past and present, respectively. The last issue is caused by existing dams.

Legacy pollutants are those pollutants that are no longer discharged into the river but remain as problems or potential problems to proper functioning of the ecosystem. In particular, paper mills formerly employed a process that produced persistent organic pollutants (POPs) as a byproduct. These POPs were discharged into the river where some bound to sediments on the river bottom. While paper mills now use more benign processes which no longer produce POPs, the POPs still exist in the food chain and sediment.

Certain POPs, like dioxin, enter the aquatic food chain and make large fish species unfit for human consumption. Furthermore, the POPs pose health risks not only to humans but long-lived aquatic organisms as well.

The second issue in the Androscoggin arises from the discharge of current paper mills. Paper mills release waste pulp material into the river. This discharge is high in organic matter and depletes dissolved oxygen in downstream waters through bacterial respiration of the organic matter. Because of its oxygen depleting qualities, this discharge is categorized as high in biological oxygen demand, or BOD. Low oxygen in the river results in localized ecosystem degradation and impose de facto barriers to migration along a river.

The last main issue facing the Androscoggin is impaired migration of anadromous fish. Over 200 dams along the river impede the upstream migration of fish and many important fish species rely on this migration for reproduction. Salmon, shad, herring, alewife are all anadromous species. The American eel is catadromous and also requires migration along the river for reproduction.

While these dams pose major issues for fish species, they also provide important services to local communities. Dams provide flood control, low carbon energy, and reservoirs for water withdrawal. Broad legislation for the wholesale removal of dams is likely to face significant opposition.



## Solutions

All major problems facing the Androscoggin currently result from industry. While it may be tempting to force these industries to relocate, we realize that the communities along the Androscoggin benefit in many ways from their existence along the river. Our towns receive dependable sources of employment, tax revenue, and electricity without air emissions.

Rather than force industry out, we propose to incentivize environmentally friendly business practices through market mechanisms. Concerning high BOD discharges from paper mills we will employ a cap and trade program. Total BOD releases will be capped for the entire river, with mills receiving permits to release BOD proportional to recent historical production. Each year, the allotted permits will decrease in BOD quantity, annually lowering the total cap on BOD. Furthermore, each plant may buy/sell BOD permits (up to a certain threshold - to avoid localized hot-spots of BOD discharge) to other mills to increase economic efficiency of this regulatory action.

The other issue addressable through market mechanisms is fish passage. We recommend to remove those dams that do not serve important purposes. We also recommend identifying dams that are in poor structural condition, for either repair or demolition. For dams that serve important purposes, we will implement a minimum threshold for successful fish migration beyond the dam. It will be up to the company/municipality to identify the best solution to achieve this minimum threshold. Dam license renewals are granted by the state and can be withheld if the dam operator fails to meet minimum fish passage thresholds. If a dam operator, shows it reasonably believed its fish passage strategies would meet thresholds in good faith, temporary exceptions can be made.

While BOD and fish passage can be solved through the market, not all issues can be solved this way. Legacy pollutants arise from industrial practices decades ago. To solve POPs, we propose a three pronged approach. We will establish a committee to investigate the feasibility of removing sediments that are most contaminated with POPs. Second, we will identify those sediments most at risk of resuspension and biological uptake. We will take a variety of measures to mitigate the likelihood of resuspension and biological uptake of these sediments, for example by creating exclusion zones for boaters.

Lastly we address POPs through raising awareness of the issue. We will re-initiate a fish tissue sampling program that existed in the 1990s. Though tissue sampling is costly, we believe it is important to provide the public with accurate information on safe levels of fish consumption according to species and location. Furthermore, the decrease in tissue concentrations of POPs over time from our efforts can be tracked and monitored. The public can benefit from tangible measures of the improvement of the Androscoggin, and experience the dividends on the allocation of societal resources to this effort.

## References

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