Kennebunk River
Road-Stream Crossing Survey
2010

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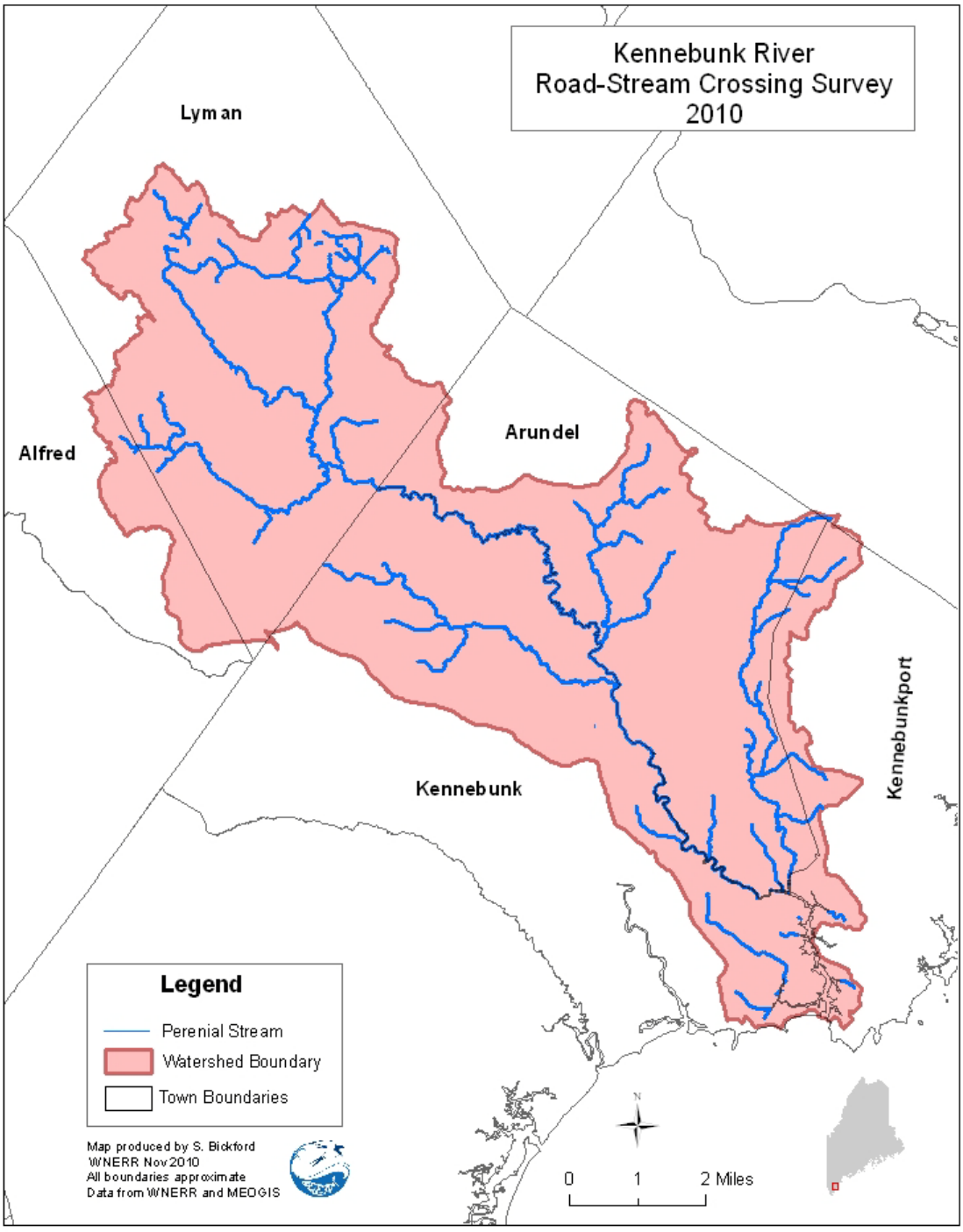
Kennebunk River
Road-Stream Crossing Survey
2010
Lyman
Alfred
Arundel
Kennebunk
Kennebunkport
Legend
Perenial Stream
Watershed Boundary
Town Boundaries
Map produced by S. Bickford
WNERR Nov 2010
All boundaries approximate
Data from WNERR and MEOGIS
N
0
1
2 Miles

Acknowledgements

The 2010 Kennebunk River Road-Stream Crossing Survey Report was produced by MCC Americorps member Ashley Pinkham, and Wells Reserve staff members Jacob Aman and Susan Bickford.

We would like to give special thanks to Alex Abbott at the U.S Fish and Wildlife Service Gulf of Maine Coastal Program (GOMCP) for providing training, lending equipment, and providing vital assistance throughout the project. Many thanks also go out to the University of New England for loaning field equipment, and John Branscom at the Maine Turnpike Authority for providing access to sites on the Maine Turnpike.

We would like to thank Michele Dionne, Ph.D, and Tin Smith of the Wells Reserve, John Burrows of the Atlantic Salmon Federation, and Landis Hudson of Maine Rivers for their continuous support of the survey.

Finally we would like to thank our interns, Colby Chase, Marissa Hammond, Michael O'Brien, Justin Williams, and Erin Lefkowitz for their hard work and dedication to this project.

Cover Photographs

Top: New culvert at the crossing of Lord's Brook and Route 111, in Lyman.

Bottom Left: Tide gate at the outlet of the crossing of a tidal creek and Boothby Road in Kennebunk.

Bottom Right: Outlet of culvert on a tributary of Duck Brook at the Limerick Road crossing in Arundel.

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Summary

This report discusses the results of the 2010 Road-Stream Crossing Survey conducted by the Wells National Estuarine Research Reserve. Staff and volunteers visited 83 road-stream crossings and evaluated numerous aspects of these structures for potential barriers to movement of fish and other aquatic organisms. Of these sites, 21 were determined to pose severe barriers to passage. 20 sites had perched outlets, 5 sites had perched inlets, 2 sites had inlets blocked 50% or more, and 1 site had an outlet blocked by a tide gate. Most of the structures surveyed were undersized, exhibiting large scour pools (25) and lack of substrate within the crossing (30), indicating increased velocity of water moving through the structure. The road-stream crossings that rank as severe barriers mostly occur in the upper reaches of the watershed and on the major tributaries. Road-stream crossings on the main stem of the river were all found to be adequate for fish passage.

Overview

The 2010 Kennebunk River Road-Stream Crossing Survey was conducted by the Wells National Estuarine Research Reserve (WNERR) in partnership with the U.S Fish and Wildlife Service Gulf of Maine Coastal Program (GOMCP), during the summer and fall of 2010. WNERR staff and volunteers spent 7 days in the field collecting data, and several weeks entering the information into a database and analyzing it. The results of this analysis are presented in this report.

Background

The U.S. Fish and Wildlife Service Gulf of Maine Coastal Program (GOMCP) is compiling a statewide database of road-stream crossing that have been surveyed by state and federal agencies to determine whether or not they block upstream or downstream movement of fish and aquatic organisms. Surveys have been conducted in the Penobscot River, Sheepscot River, Saco River, and others. The 2010 Kennebunk Road-Stream Crossing Survey is a part of this greater statewide effort.

The survey is also a component of efforts to restore diadromous fish to the Kennebunk and Mousam River watersheds in York County, Maine. Road crossings are as diverse as the parts of the stream that they intersect, and come in many shapes and sizes. Surveys of crossings in other Maine river systems have shown that the majority of crossings tend to pose a barrier to movement of fish (Abbott, 2008; Abbott, 2009). Identification and removal of stream barriers is essential for successful restoration of diadromous fish, and for improving habitat connectivity for resident fish and aquatic organisms. Data collected from the crossing survey is used to identify priority restoration sites and provide important cost benefit analysis for any proposed restoration. In order to maximize the usefulness of the crossing survey, additional studies must also be conducted regarding the location and quality of fish habitat. Barrier removal efforts should be coordinated with

road improvement efforts by the towns, State of Maine, and the Maine Turnpike Authority, as well as private landowners.

In the summer of 2009, John Burrows and Landis Hudson approached the Wells NERR about conducting a stream barrier survey in the Kennebunk River and Mousam River watersheds, using the GOMCP protocol developed by Alex Abbott. In November the Wells NERR hosted a training on how to plan and implement a survey of road-stream crossings, presented by Alex. Wells Reserve staff and volunteers with the Mousam and Kennebunk Rivers Alliance attended a morning session on planning and conducting a survey with photo examples of crossing types that would be encountered in the field, followed by an afternoon field exercise in survey techniques and data collection. Several sites within the Mousam and Merriland Rivers were surveyed.

Over the course of the winter the Wells NERR developed plans to survey the Kennebunk River watershed road-stream crossings, and to incorporate the survey into a University of New England, summer semester 2010 GIS course, instructed by GIS specialist Sue Bickford. As summer began, enrollment in the course was too low, and the course was canceled. The Wells NERR determined that the survey was still possible and would be carried out by staff and interns from the research and stewardship departments. Two further trainings were then planned. The first was held in early June as a refresher for staff members who would be leading individual teams. The second training was held a few weeks before the survey was scheduled to begin, in order to train the interns and summer volunteers on survey techniques.

Project Area

From its headwaters at Kennebunk Pond to its mouth between Kennebunk and Kennebunkport, the Kennebunk River is approximately 15 miles in length and runs through the towns of Lyman, Arundel, Kennebunk, and Kennebunkport. Major ponds within the Kennebunk River watershed include Kennebunk Pond located in Lyman, Alewife Pond located in Kennebunk, Davis and Brimstone Pond in Arundel. The watershed drains 38 square miles and includes larger tributary streams of Carlisle Brook, Lords Brook, and Ward Brook, and smaller tributary streams such as Duck Brook, East Outlet, Arundel Swamp Brook, Springy Brook, Sunken Brook, and Wonder Brook.

The landscape surrounding the upper reaches of the river, which lies west of Interstate 95, remains mostly rural and undeveloped. Development increases as the river approaches the coast. The river reaches head of tide downstream of the Route 1 Bridge where it transitions from freshwater to brackish saltwater and finally meets the Gulf of Maine in Kennebunkport.

There are two active land trusts within the watershed. The Kennebunk Land Trust owns three preserves on the Kennebunk River: Alewife Woods, a 626 acre parcel that includes Alewife Pond; the 27 acre Wonder Brook Preserve; and the 14 acre Butler Preserve. The Kennebunkport Conservation Trust owns the Town Forest Preserve which lies in the northeastern section of the watershed. In 2001 the Kennebunk River was placed on the

Maine Department of Environmental Protection's Nonpoint Source Priority Watershed List.

Habitat Connectivity

To complete their life cycles, fish and other aquatic organisms must have access to all habitats needed for basic life functions during each stage of development, growth, and reproduction. Fish require access to spawning and nursery habitat, and must move throughout river systems to locate food and escape harmful environmental conditions including low water levels, low oxygen levels, and high water temperature. Culverts which are undersized, blocked, or perched prohibit resident and migratory fish species, aquatic insects, amphibians, and other animals from accessing essential habitat needed to survive, and can adversely alter nearby stream conditions.

Survey Planning

The Kennebunk River watershed was selected to be surveyed because of ongoing fisheries restoration work by the Wells Reserve, Maine Rivers, and the Mousam and Kennebunk Rivers Alliance in the Kennebunk River. These groups hope to conduct a survey of road-stream crossings in the Mousam River watershed as well, but thought that the Kennebunk River would be best to start with due to its smaller size and the proximity of the majority of crossings to the Wells NERR.

GIS Data

Road-stream crossings were identified using stream and road data obtained from the Maine Office of GIS. The watershed was divided into 5 sections and enlarged maps of each section were created to help the survey teams locate crossings in the field. A site index was then created which included unique site identification numbers, GPS coordinates, road name, stream name, and map section number. Crossings at railroads, trails, and private roads were not mapped for this survey.

Survey Protocol

The Maine Road-Stream Crossing Survey Manual (Abbott 2009) was used as a survey guide and protocol. This document outlines culvert types and stream conditions that may be encountered in the field, methods for data collection, data sheets and diagrams, equipment needed, and provides survey planning guidance.

We created a quick reference guide which provides tips for taking difficult measurements out in the field. Several sections of the datasheet were highlighted to aid assessment of specific structure types, tailwater scour pool depth, inlet and outlet terms of importance, and upstream/downstream substrate. We also created a guide to explain how to correctly read the pocket rod and stadium rod, and how to record and save GPS data points. See Appendix A.

Safety in the field is very important. We created a checklist of survey and safety equipment to be used at the beginning and end of each survey day, including a first aid kit, orange traffic cones, and OSHA approved safety vests.

Survey kits with equipment and guides were assembled in backpacks for each survey team. Teams were also provided with a cell phone contact list, a DeLorme map, a site index with GPS locations, site ID numbers for use at unplanned sites, extra batteries and, pencils.

Road-Stream Crossing Database

Data collected from the field was entered into an ERSI Personal Geodatabase (a spatially aware Microsoft Access Database) developed by GOMCP, to aid with future analysis. To assist with data entry using the database a Road-Stream Crossing Database Guide was created. See Appendix B.

Data Summary

Road-Stream crossing sites were identified using road and stream data obtained from the Maine Office of GIS during survey planning. Additional sites were identified and surveyed in the field. Table 1 shows the number of planned survey sites mapped prior to the survey, the total number of unsurveyed sites, and additional surveyed sites that were not identified with GIS. Sites that were not surveyed include 1) bridges adequate for fish passage 2) posted, inaccessible, or nonexistent sites (those that were identified with GIS but were found to be nonexistent in the field) 3) structures that had a span of less than 18 inches.

TABLE 1. PLANNED, UNSURVEYED AND ADDITIONAL SITES

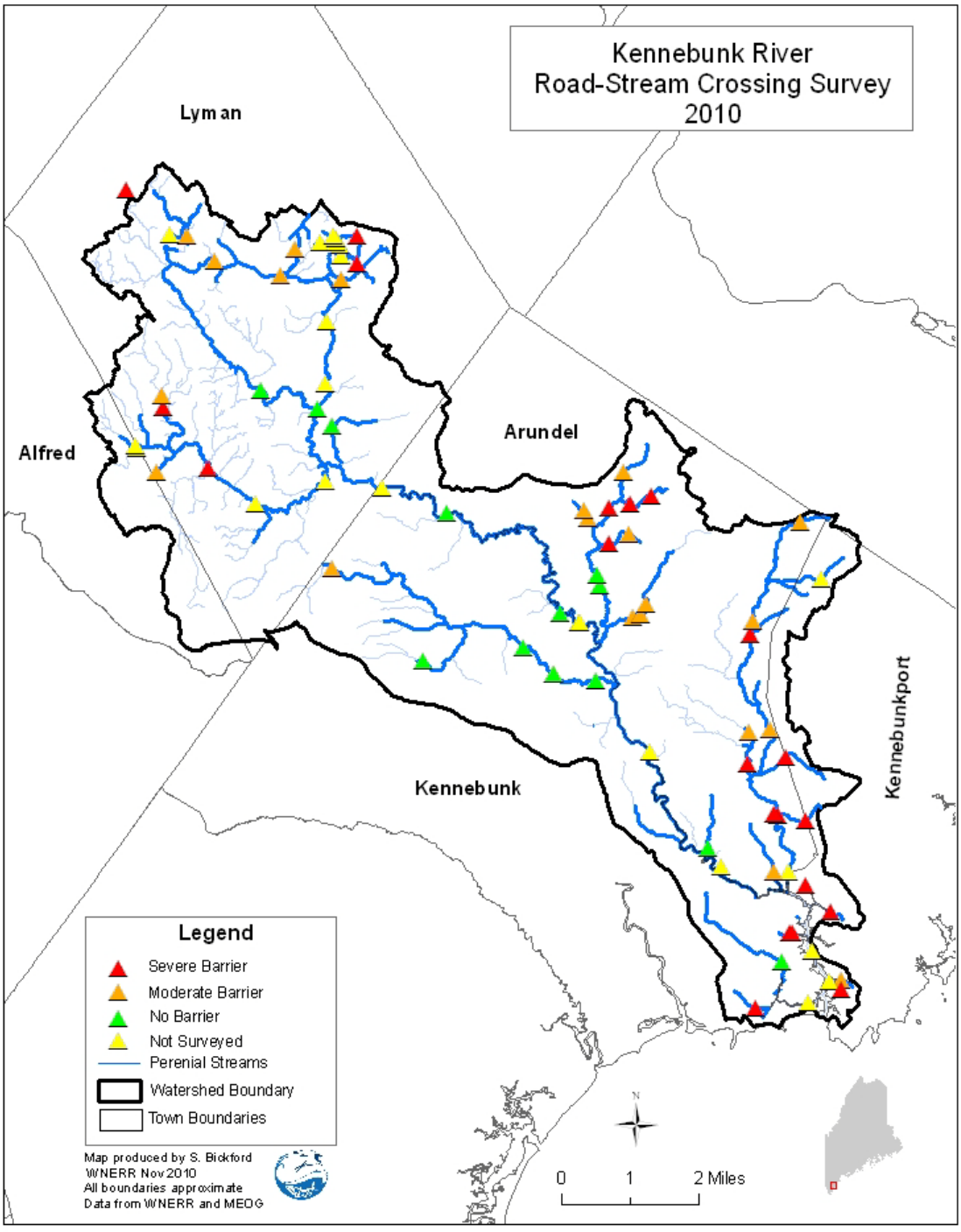
	# of Sites	% of Sites
Planned Sites	76	92%
Additional Sites	7	8%
Total Sites	83	100%
Surveyed	58	70%
Unsurveyed Sites:	25	30%
Bridge Adequate for Passage	11	
Inaccessible	3	
Site Does Not Exist	4	
Total Span < 18 Inches	6	
Dam	1	

Of the 58 sites surveyed, 42 (72%) exhibited more than one factor that would limit passage of fish and other aquatic organism. We found that 20 (35%) sites had perched outlets, inhibiting upstream movement of fish and aquatic organisms. A smaller number of sites (9%) had perched inlets, limiting both upstream and downstream movement. More than half (53%) of sites lacked substrate within the crossing, and 25 (44%) included a large tailwater scour pool. Lack of substrate and scour pools are indicators of increased stream velocity as it passes through an undersized crossing structure. High velocity water can pose a barrier to fish and aquatic organism movement (Eberhardt et al. 2010).

TABLE 2. SURVEYED SITE CONDITIONS SUMMARY

	# Sites	% of Sites
Multiple Culverts	13	23%
Paved Site	46	81%
Unpaved Site	11	19%
Public Road	56	98%
Private Road	1	2%
Trail	1	2%
Blocked Inlets	4	7%
Severely Blocked Inlets (>50% Blocked)	2	4%
Inlet Drop	8	14%
Perched Inlet	5	9%
Deformed Inlet	3	5%
Perched Outlet	20	35%
No Substrate In Culverts	30	53%
Large Tailwater Scour Pool	25	44%

FIGURE 1. ROAD-STREAM CROSSING AND DISTRIBUTION



Barrier Ranking

In order to prioritize sites for restoration they were given one of three rankings: severe, moderate, or not a barrier. To be categorized as a severe barrier a site must have an inlet that is perched or is blocked 50% or more, or have a perched outlet. Severe barriers usually present multiple limiting factors for passage of aquatic organisms. Factors include a perched outlet or inlet, and indicators of increased stream velocity such as a tailwater scour pool or lack of substrate within the crossing structure. This ranking is meant to identify crossings with the most serious and fundamental structural deficiencies related to aquatic organism passage; it is not focused on one species, but does consider fish passage first, and other aquatic organisms second (Abbott 2009).

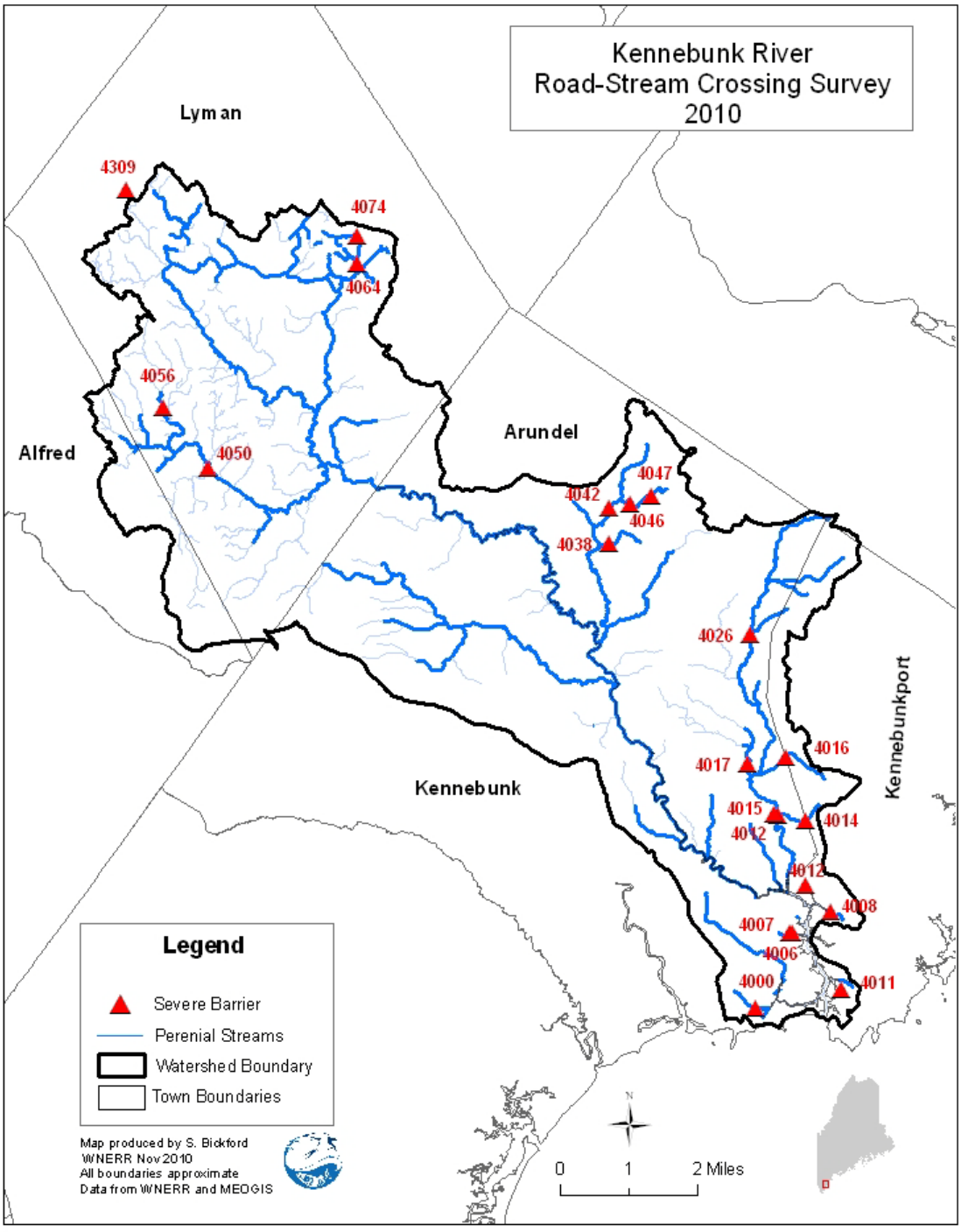
Sites that did not include one of the three severe barrier ranking criteria, but did include indicators of high velocity, were ranked as moderate barriers. If a site demonstrated no sign of blockage and lacked any of these criteria, it was ranked as not a barrier.

TABLE 4 BARRIER RANKING

	# of Sites	% of Sites
***Severe Barriers:**	21	36%
Blocked Inlet (Blocked 50% or More)	2	3%
Perched Inlet	5	9%
Perched Outlet	20	34%
Tide Gate	1	2%
Moderate Barriers	22	38%
Not A Barrier	14	24%
Total Surveyed Sites	58	100%

* Some crossings included more than one factor that would result in a severe ranking.

FIGURE 2 SEVERE BARRIER DISTRIBUTION



Barrier Removal Priorities

Initial analysis of survey data indicates that most of the severe barriers at road-stream crossings are located above known dams in the upper reaches of the watershed around Kennebunk Pond. Any meaningful restoration efforts at these crossings must therefore include establishment of fish ladders or other fish passage structures, or removal of the dam. The cost of barrier removal must also be considered when prioritizing sites for remediation. High priority removal sites will be those which can open access to the most habitat per dollar spent.

Block outlet at Goff Mill Brook crossing on Sinnott Road in Arundel.

While approximately one third of the habitat in the Kennebunk River system is located above the first dam on the main stem, three major tributaries join the river below that point. This is important because this dam is the most significant barrier in the system in terms of the cost required to establish passage.

Ward Brook drains Alewife Pond in Kennebunk and does not pass through any severe or moderate barriers at road crossings. There are no man made dams on Ward Brook, though beaver are active in this stream and any present beaver dams could obstruct fish passage.

Goff's Mill Brook drains the southeastern portion of the watershed in Arundel and Kennebunkport. A small dam is located just upstream of River Road, before the brook converges with the Kennebunk River. There are two severe barriers on the brook. At the crossing on Sinnott Road a large amount of rip rap blocks the outlet of a pipe arch culvert. Upstream at Whispering Fern Way, the outlet of the box culvert is perched during low water periods. In addition three severe barriers exist at crossings on small tributaries of the brook.

Duck Brook drains Davis Pond in Arundel and passes through one severe barrier at the crossing on Limerick Road. This site has perched outlet as well as a partial blockage just upstream, where a structure, possibly an old dam, has been breached. Three severe barriers exist at crossings on small tributaries of the brook as well.

Perched Outlet at Duck Brook crossing on Limerick Road in Arundel.

Next Steps and Conclusions

The road-stream crossings evaluated in this survey represent the majority of potential barriers to fish passage in the Kennebunk River watershed. There are also at least 5 dams throughout the drainage, as well as falls and other natural barriers that will need to be evaluated, including several crossings at trails, railroads, private roads, and land trust properties. An assessment of habitat above and below severe road-stream crossings is planned for 2011 and will allow for further prioritization of restoration efforts.

Work still needs to be done to compile a complete inventory of all barriers to fish and aquatic organisms in the Kennebunk River watershed. A dam and natural barrier survey along with a survey of railroad crossings, trails, and private driveways must also be carried out to evaluate habitat connectivity in the watershed. This data can then be combined with habitat surveys to help prioritize restoration efforts.

Data from this survey indicates that many of the severe barriers are located in headwater streams, and a majority of habitat downstream of the headwaters is connected. The largest portion of the watershed with good to moderate connectivity includes the main stem from the mouth to the Days Mill Dam, Ward Brook, and Alewife Pond. Immediately above Days Mill Dam is another smaller network of well- to moderately well-connected stream habitat which includes portions of Carlisle Brook, Lord's Brook, and Sunken Brook which is the outlet of Kennebunk Pond. A small dam on Sunken Brook is the only major barrier between Kennebunk Pond and the Days Mill Dam. ***Establishment of fish passage at these two dams would connect Kennebunk Pond to the Gulf of Maine and should be a priority for any long term efforts to restore sea-run fish to the Kennebunk River.***

Improvement of habitat connectivity throughout the Kennebunk River Watershed will require collaboration between the state, towns, private land owners, conservation organizations, and community partners in to be successful. Engagement of these groups should be a major component of future restoration efforts.

Bridge over Ward Brook on Alewife Road in Kennebunk.

References

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Appendices

Appendix A: Quick Reference Guide

Appendix B: Database Entry Guide