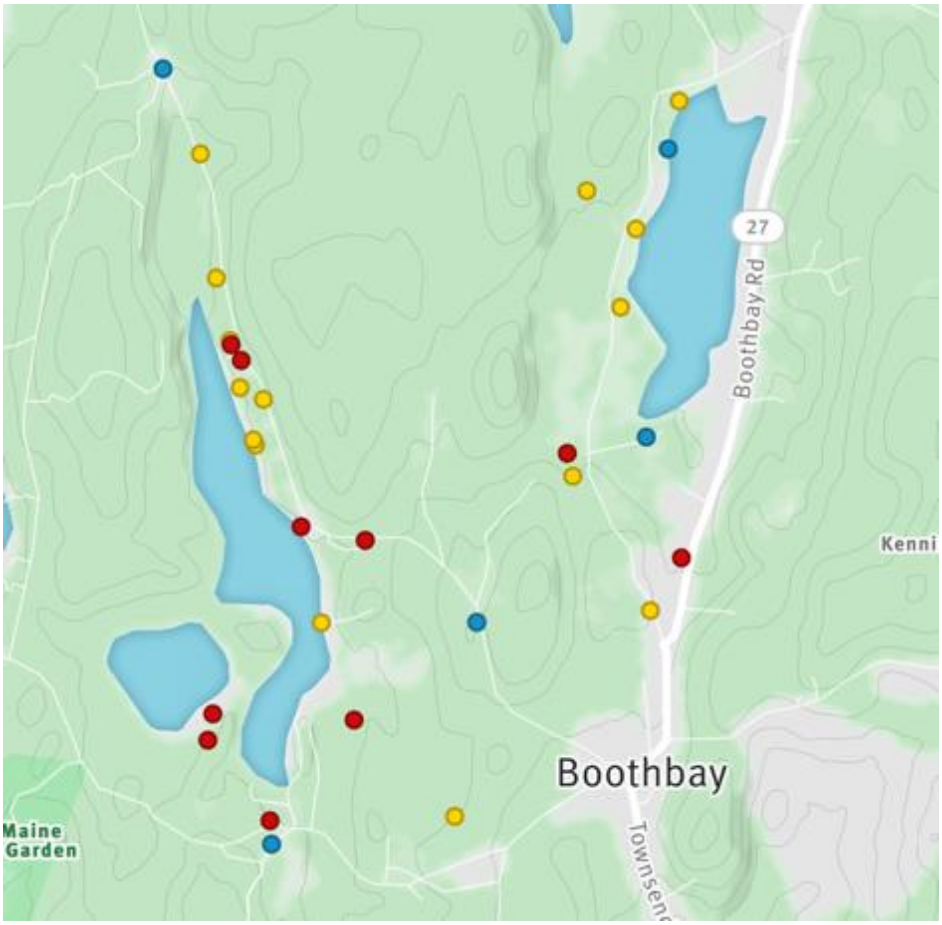
Plugging the Leaks

Addressing Non-Point Source Pollution
in
Adams Pond and Knickerbocker Lake watersheds
2015-2017



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Introduction

Adams Pond and Knickerbocker Lake are the public water supplies for the towns of Boothbay, Boothbay Harbor and Southport, serving about 3500 customers with over 200 million gallons of potable water each year. Water quality in these lakes has been adversely affected by non-point source pollution associated with human development; this type of pollution poses the greatest threat to both lakes. Non-point source (NPS) pollution reaches a waterbody as it travels over and through the ground. NPS pollution sources include stormwater runoff and septic systems. Because of their threatened status, Adams Pond and Knickerbocker Lake are listed in Chapter 502 of the Maine Stormwater Law as "Most at Risk from New Development" and on Maine's Non-Point Source (NPS) Priority Watersheds List.

In 2014, the Boothbay Region Water District (BRWD), in collaboration with the Maine Department of Environmental Protection (DEP) and local organizations, surveyed both public water supply watersheds to identify NPS pollution sites, focusing on sites where unfiltered runoff enters waterways or causes soil erosion. Since that survey, BRWD has worked with local partners to fix NPS sites under three federal/state grant programs and has offered technical and financial assistance to watershed property owners so they could fix NPS problems. This report summarizes NPS remediation activities in the Adams Pond and Knickerbocker Lake watersheds during 2015-2017.

Watershed survey and planning

Stormwater runoff, as it travels over the ground, can pick up nutrients and other contaminants from eroded soil, roads and other surfaces, and deliver it to streams and lakes. Phosphorus, a basic element and essential nutrient for plants, is attached to soil particles and is an important runoff constituent for lake ecosystems. In undisturbed lake watersheds, phosphorus is in very limited supply and its relative unavailability keeps algae growth in check. However, in developed areas, erosion and runoff can add significant amounts of phosphorus to surface waters, which stimulates algae growth. The goals of the 2014 watershed survey were to identify erosion/runoff sites in the watersheds, prioritize them based on their impacts and develop plans to fix them. Although septic systems are another potential source of nutrients and contaminants to Adams Pond and Knickerbocker Lake, they were not the subject of this survey.

Fifty-two NPS pollution sites were identified in the Adams Pond and Knickerbocker Lake watersheds. Based on their size, location and likely effect on lake water quality, 13 sites were classified as high impact, 26 as medium impact and 13 as low impact. Most NPS pollution sites were associated with private, town and state roads (48%) and private residences (31%).

After the survey was completed, BRWD contacted property owners to discuss opportunities to remedy problems. BRWD also hired Dirigo Engineering and Field Geology Services to develop plans to remediate medium and high impact sites. Knox Lincoln County Soil and Water Conservation District (KLSWCD) was also hired to develop plans for a few sites in the Knickerbocker Lake watershed, including Camp Knickerbocker. These plans were reviewed with Maine DEP, the Town of Boothbay and individual property owners, and permits were sought where necessary. Ten sites identified during the original survey were removed from further planning for a variety of reasons, primarily because likely effects were low, remediation was determined to be unnecessary or would cause more problems than current conditions or because remediation was not agreed to by property owners.

BRWD was able to secure federal and state grants to raise funds to fix NPS sites and committed its owns funds to this endeavor. Grants obtained to fix NPS sites included two Maine Center for Disease Control Source Water Protection grants, an EPA/DEP 319 NPS pollution control grant and a Maine Natural Resource Conservation Program Grant. BRWD, with financial assistance from a Maine CDC grant, also established a local lake grant program to provide technical and financial assistance to watershed property owners to help them address erosion and runoff on their properties.

Site remediation

Between 2015 and 2017, 32 NPS pollution sites in Adams Pond and Knickerbocker Lake watersheds were remediated. Fourteen sites were fixed with financial support from the EPA/DEP 319 grant, five sites were remediated with CDC funds, six sites were improved by property owners under the BRWD Lake-Friendly watershed grants and one site was remediated with a MNRCP grant (which also provided funds to preserve a 70-acre watershed property). In addition, six NPS sites were fixed by property owners without any financial assistance. The most notable of these private fixes were the stormwater improvements installed around Boothbay Center and the Boothbay Village Market. For the 27 projects rectified under grant programs, the BRWD distribution crew did the majority of the site work; the Town of Boothbay public works department, private contractors and private property owners accomplished the rest.

NPS remediation work done included stabilizing and improving drainage at roadside pullouts on Adams Pond Road, stabilizing eroding culvert embankments, ditches and road shoulders on Adams Pond and Back River Road, addressing severe surface erosion downstream of road culverts on private property by installing catch basins and plunge pools, stabilizing slopes and surfaces with Geoweb and jute mat, replacing failing and undersized culverts, installing stone fords at stream crossings and improving private roads and driveways (Table 1). Additional sites are planned for remediation in 2018.

Case studies

The project is perhaps best understood by looking closely at a few examples in each watershed.

Boothbay Region YMCA Camp Knickerbocker

The access road to this summer youth camp's swimming and boating area on Little Knickerbocker Lake was experiencing severe erosion with runoff to the lake. Moderate erosion and bare soils associated with camp shelters, a nearshore path and shoreside changing areas also contributed runoff. In 2016 and 2017, the YMCA, with financial and technical assistance from BRWD and KLSWCD, worked to improve shoreside conditions and remediate pollution sources.

To alleviate runoff and erosion problems, the entire gravel access road at the lake front was resurfaced with ledgepack and properly crowned so runoff disperses off the roadway, and runoff diverters were installed. A roadside ditch was lined with rock and a plunge pool was installed near the shore to intercept runoff and sediments. Erosion around shelters was stabilized with ledgepack, as well. Access to the eroded shoreside trail was rerouted to a new trail farther away from the waterfront and properly mulched. The unstable access road to the swimming area was stabilized

with vegetated terraces and about 60’ of Geoweb filled with rock and mulch. Mulch was applied to bare soils. Future plans include a vegetated buffer and more native plantings.

Figure 1. Before and after photos of camp road.

Figure 2. Beach access road in 2015, 2016 and 2017.

Figure 3. Boat access/storage site with bare soils and runoff in 2016. In 2017, road resurfaced; ditch/plunge pool installed and boats stored upland from shore.

Figure 4. Bare soils around changing area 2016, mulched in 2017. Changing stalls will be removed and this area replanted in 2018-2019.

Figure 5. Shoreside trail through wetland discontinued. Will be planted in 2018.

BRWD Knickerbocker Lake access

Figure 4. The dock access to Knickerbocker Lake at the BRWD water intake site was eroding with runoff to the lake. Infiltration steps were installed and the site stabilized with jute mat and seeded.

Adams Pond Road near Watershed Tavern

A steep, gravel road shoulder continually eroded and each year, gravel was replaced only to erode again. Road shoulders along about 500' of road were bare, with runoff entering a stream that crosses under Adams Pond Road. Remediation included paving the short stretch of steep, eroding road shoulder, stabilizing the rest of the road shoulder with jute mat and seeding, an unstable culvert embankment at the stream crossing was stabilized with riprap and a level spreader created to intercept runoff and reduce erosion. Work in 2018 will address parking lot runoff.

Figure 5. Eroded road shoulder at north end of road was paved and stabilized and seeded.

Figure 6. Unstable stream culvert at south end of site, before and after.

Figure 7. Road shoulder erosion, before and after stabilization and seeding.

Adams Pond Road pullouts

Figure 8. Lake access sites used for parking were eroding with bare soils and runoff to the lake. To remediate the sites, Geoweb was installed and filled with stone to create a stable, more permeable parking base. Paths were mulched with erosion control mix and bare soils planted. Additional planting will occur along Adams Pond Road in 2018.

Summary and Conclusions

NPS pollution represents the greatest threat to the water quality of Adams Pond and Knickerbocker Lake. Since the 2014 watershed survey, a community effort has resulted in remediation of many of the significant NPS sites identified during the survey. This work will continue in 2018. Since on-the-ground conditions are not static, continued efforts to identify problem sites and rectify existing sites are necessary to protect water quality.

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Table 1. Summary of NPS work in Adams Pond and Knickerbocker Lake watersheds completed in 2015-2017

Site ID	Problem Description	Remediation completed
1.1	Culvert in roadway broken/failed	Replace with two culvert rock sandwich
1.3, 1.4	Road shoulder and surface erosion at lake access	Install geoweb, rock, erosion control mulch and plantings
1.7	Logging road, impounded stream, severe erosion	Remove corduroy road and timber ford; restore stream channel and habitat
1.8	erosion from driveway, upland runoff	pave and superelevate driveway
1.9	road shoulder and surface erosion, bare soil, winter sand buildup	riprap slope; pave concrete curb/headwall, direct runoff to vegetated ditch
1.13	culvert erosion at stream crossing, parking lot runoff.	Riprap culvert outlet, install level spreaders to absorb runoff
1.20, 1.10	severe road shoulder erosion directed to storm drain	pave road edge, armor culvert
1.24	Severe rosion of woods road, culvert undersized	install stone ford
1.25	Culvert failure in woods road	replace culvert with larger culvert; stabilize trail
2.2	Severe surface erosion; crushed culvert trail crossing stream	install stone ford, stabilze bankss wth jute mat& seed
2.3	Surface erosion from parking area; unstable culvert inlet	Limit parking near stream; erosion control mulch on paths, armor culvert
2.7	steep eroding driveway	resurface&crown driveway, redirect away from shore
2.8	Severe surface erosion; bare soil from road culvert	install catch basin; replace&redirect culvert at shore to plunge pool; ECM, stabilize parking area and embankment
2.13	eroding ditch, road shoulder erosion, plunge pool filled.	install check dams
2.14	Surface erosion at lake access	stabilize access with infiltration step
3.21	Bank erosion at culvert/road crossing	Stabilize bank shoulder with riprap
3.23	Inadequate vegetated buffer along shore	Plantings
3.5	Eroding beach access roads and trail	resurface&crown roads, install ditches&plunge pool; vegetated terraces
3.51	erosion/bare soils	restore shoreline, GEOWeB/erosion control mulch
4.1	eroding ditch and clogged culvert	reconstruct ditchline and riprap, plunge pool at culvert outlet
4.3	Roof drip erosion/inadequate vegetation	Install infiltration trench; vegetate and mulch bare soils
4.5	Roof drip erosion/inadequate vegetation	Install infiltration trench; vegetate and mulch bare soils
4.6	erosion at Knickerbocker stream culvert	Stabilize road shoulder embankment with geoweb/jute; reestablish plunge pool
4.8	erosion at culvert and downstream	cut back culvert and install small plunge pool