THE INFLUENCE OF LAND USE CHANGES ON WATER QUALITY IN SALMON LAKE AND MCGRATH POND

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Introduction

Land use patterns within a watershed significantly impact the water quality in nearby water bodies. Nutrient loading and runoff rates each affect water quality and are influenced by land use types. Some land uses are considered beneficial for water quality due to their low pesticide and chemical contribution and ability to filter runoff by absorbing nutrients and pollutants. Development tends to facilitate erosion and contribute nutrients that harm the water body and the watershed itself.

Study Area

Salmon Lake and McGrath Pond are located in the Belgrade Lakes Region of Kennebec County, Maine. The watershed falls within the towns of Belgrade and Oakland. Salmon Lake and McGrath Pond have a combined surface area of 470 hectares (ha), a mean depth of 5.5 meters (m) and a total volume of 31,192,385 m³ (PEARL 2009).

Watershed Land Use Trends

Development: Increased

The most significant change in overall land use from 1965/66 to 2007 was a 91.9 (ha) increase in residential areas, from 6.2% of the watershed to 12.0%.

The three youth camps in the Salmon/McGrath watershed have expanded by 96.75% overall. This includes the conversion of 4.8 ha of mixed forest into a golf course at the Maine Golf and Tennis Academy.

There has been a 529.19% (11.8 ha) increase in commercial and municipal land, most of it converted from forested areas.

Septic systems, when constructed properly, do not contribute significant amounts of phosphorus into the water body. However septic systems built too close to the lake or not maintained properly are the largest contributor of phosphorus to the water body.

Our survey categorized 35% of the camp roads as ‘fair’ and 23% as ‘poor’. These roads are likely to contribute more phosphorus into the water body due to high erosion and runoff.

Forested Areas: Decreased

There was a 74.6 ha decrease in forested areas, from 71.5% of the watershed to 65.0%. Most of this forest was logged or converted to developed areas.

Logged Land: Increased

Logged land has significantly increased since 1965/66. The 151.3% increase has drastically reduced the forest cover of the watershed.

Open Land and Cropland: Decreased

Open land and cropland decreased by 78.8 ha. Just over half of this land reverted to forest while the remaining land was developed.

Phosphorus Levels

Although current water quality is good in McGrath Pond (10.6 parts per billion, ppb) and acceptable in Salmon Lake (13 ppb), phosphorus concentrations are at a tipping point. The critical phosphorus threshold for the formation of algal blooms is between 12 and 15 ppb. Additional phosphorus loading into the water body could result in the formation of algal blooms. Given current patterns of land use change, a 3% increase in phosphorus loading can be expected by 2020.

Percent land cover of Salmon/McGrath watershed in 2007 using the values calculated from the DOQ from the Maine Office of GIS (16th) and the percent of total phosphorus input resulting from each land use type (17th).

Implications for Phosphorus Loading

Developed land is characterized by the presence of large areas of impervious surfaces (such as rooftops and pavement) and high levels of anthropogenic disturbance. These factors prevent nutrient-rich water and sediments from seeping into the ground before reaching the water body, which increases nutrient loading to the lake. The expansion of the youth camps could have an especially significant impact on phosphorus loading due to their proximity to the water body and large number of seasonal residents. Forests act as a natural buffer that help protect the water body from nutrient runoff and erosion. The loss in forest cover to development and logging also increases the phosphorus loading potential to the lake.

Recommendations

Land uses close to the water body have a higher impact on water quality. Extra steps should be taken to minimize nutrient or chemical loading from land uses located near the shoreline. Maintaining as much forest cover as possible will also have a positive effect on nutrient loading in Salmon Lake and McGrath Pond. Effective buffer strips on shoreline lots are a key strategy for mitigating nutrient loading from different land uses within the watershed. An effective buffer strip helps to reduce direct flows of water, nutrients, and sediment into the lake.

Further Resources

It is important to continue to build upon and support these efforts. Please see the following for more information:

The McGrath Pond/Salmon Lake Association (www.salmonlake.org)

The Volunteer Lakes Monitoring Program (www.mainelakesmonitor.org)

The Maine Department of Environmental Protection’s LakeSmart Program (www.lakesmart.org)

The Belgrade Regional Conservation Alliance (www.belgradelakes.org)