604B FY 2013
Undeveloped Streams/Shorelines in the Northern Windham Region, Vt.
Windham Regional Commission, Brattleboro, VT
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PROJECT OVERVIEW

Introduction

This report presents the results of a Windham Regional Commission (WRC) project to identify and characterize undeveloped lake and pond shorelines, rivers, and stream segments in the northern and eastern portions of the Windham Region. This includes those portions of the upper West, and Saxtons and Williams River watersheds (upper Basin 11) that fall within the Windham Region, and those watersheds draining into the Connecticut River in Windham County north of Brattleboro (middle Basin 13). Also included in this analysis were small portions of Basin 1 (Batten Kill) and Basin 3 (Otter Creek) that fall in the Windham Region in Winhall and Weston, respectively. This area will be referred to in this report as the "study area." See the "Study Area and Base Features" map for an overview of the study area. Funding for this project was provided through Section 604(b) of the Federal Clean Water Act, administered by the Vermont Agency of Natural Resources.

Identifying and characterizing undeveloped waters was done using Geographic Information System (GIS) data available from the Vermont Center for Geographic Information (VCGI), and data created by WRC in support of regional and town planning efforts. Characteristics of undeveloped waters, besides length and stream order, include the conservation status and town land use planning goals.

Base Data

While the results of this project are confined to the study area, features extending one mile beyond the basin boundary in Vermont were used in the analysis.

Data on lakes and ponds greater than 10 acres, and rivers and streams, are from the cartographic version of the Vermont Hydrography Dataset. The polygon file provided data on lakes and ponds; the line file provided data on rivers and streams.

For the initial GIS analysis, "undeveloped" is defined as those areas greater than 300 feet from an occupied structure or a travelled road. An "occupied structure" is one mapped by the Vermont Enhanced 911 Board as a residential, commercial, industrial, utility, or public structure. Data were extracted from the VGIS data layer ESITE, dated December 2014. Minor edits were made to the data by

WRC where necessary. A "travelled road" is a mapped federal, state, or town highway (excluding impassable Class 4 town highways), named private road, or other major road. A combination of Vermont Agency of Transportation, Vermont Enhanced 911 Board, and WRC data were used.

The term "conserved" means either: lands in public ownership used wholly or in part for open space, recreation, or conservation; privately-owned lands under conservation easement; or lands owned by a conservation organization. Conserved lands data are from a 2013 data set created by the Vermont Land Trust.

Data on town future land use plan districts were compiled from individual town GIS data created by WRC. Each towns' land use district was given a composite code based on the conservation priority of that district as described in the town plan. This work was done under a separate project; details are available from WRC.

PROCEDURE

Development

GIS data representing development was created by buffering structures, travelled roads, railroads, and electric transmission lines a distance of 300 feet, then merging the resulting files. An undeveloped stream was one that would also not have near it cleared vegetation along electric transmission lines and ski slopes, agricultural land, fields, lawns, and the like, along with driveways and other travelled roadways. These features were not represented as development in GIS data, but were identified manually using orthophotos later in this process.

Lakes and Ponds

Lake and pond polygons greater than 10 acres were extracted from polygon features of the cartographic version of the Vermont Hydrography Dataset. Polygons boundaries were converted to lines. Individual shoreline arcs for each lake or pond were merged together, then erased with the development overlay; those areas not within the development overlay were retained as draft undeveloped shorelines. Orthophotos were referenced to verify that these undeveloped areas were truly undeveloped, and contained natural vegetation at least 100 feet from the shoreline. "Closure" arcs, used in the GIS data to separate lake from river polygons, were deleted (these are not shorelines). Arcs for each individual lake or pond were then merged together, and undeveloped shoreline lengths for each lake or pond were calculated. Finally, to assign conservation status and town future land use plan district, these arcs were intersected with conserved lands and town future land use plan data.

Streams vs. Rivers

Flowing water (e.g. brooks and rivers) can be denoted in GIS data by a single line representing the centerline of a narrower streams, or by two lines—often called a "double-lined stream"—representing each bank of a wider stream or river.

For this project, the term "stream" indicates the narrower waterways representing by a single line in the data, while the "river" is reserved for larger, wider waterways represented in the data by two lines, each a bank of the river.

Streams

Stream arcs were extracted from line features of the cartographic version of the Vermont Hydrography Dataset. Artificial path arcs in water bodies 10 acres and greater (those arcs representing flow paths through polygons), and those in rivers, were removed. This results in ponds less than 10 acres essentially being treated as streams. As such, analysis of development is based upon the distance from the centerline (artificial path location) of the pond or stream, instead of the pond shoreline or stream bank, which is a potential source of error.

Any one stream in the source GIS data is broken into separate arcs at each tributary confluence, making analysis of continuous stream segments difficult. To overcome this, the data were dissolved on reach code, stream name, and stream order to create single composite arcs for each stream based on stream order (e.g. a 3nd order stream reach is one arc, and is not broken up into separate arcs at each 1st or 2nd order tributary). Stream arcs are still split into separate arcs where stream order changes, complicating analysis slightly, but there are still fewer individual arc segments.

The resulting stream arcs were erased with the development overlay; those arcs not within the development overlay were retained as undeveloped streams.

Orthophotos were referenced to verify that these undeveloped streams were truly undeveloped and contained natural vegetation at least 100 feet from the stream. Those stream segments within 100 feet of disturbed vegetation were not considered undeveloped and were deleted (cleared vegetation along electric transmission lines and ski slopes, agricultural land, fields, lawns, and the like were considered disturbed vegetation, while logged woodland was not). Additionally, stream segments near driveways or other travelled non-public roads were also not considered undeveloped. Finally, to assign conservation status and town future land use plan district, these arcs were intersected with conserved lands and town future land use plan data.

To help identify the more significant undeveloped streams, 2rd order and greater streams were extracted and analyzed further. (Fifty-four percent of stream reaches are 1st order; many of the 1st order

segments are intermittent.) To help identify larger areas, or clusters, of undeveloped streams, contiguous stream segments were merged together and analyzed.

Rivers

River arcs were extracted from polygon features of the cartographic version of the Vermont Hydrography Dataset. Polygons boundaries were converted to lines. Individual river bank arcs were erased with the development overlay; those areas not within the development overlay were retained as undeveloped river banks. As with streams, orthophotos were referenced to verify that these undeveloped areas were truly undeveloped, and contained natural vegetation at least 100 feet from the river bank. Finally, to assign conservation status and town future land use plan district, these arcs were intersected with conserved lands and town future land use plan data.

RESULTS

Lakes and Ponds

Lakes and ponds 10 acres and greater were considered. There are 21 water bodies in the study area meeting this criterion. Two of these are setbacks of the Connecticut River, while several others are open water in large wetland areas. One waterbody is a pond constructed and entirely diked for snow making, while another is a pool behind a flood control dam. Only a small portion of Bourn Pond is in the Windham Region. A number of the ponds are controlled by dams. Lakes and ponds are shown on the "Lakes and Ponds" map.

Total length of shoreline (lakes and ponds > 10 acres): 29.2 mi.

Percent of *all* shoreline (both developed and undeveloped) conserved*: 74.3% (21.7 mi.)

- several water bodies (Ball Mountain Reservoir, Bourn Pond, Little Pond, Little Mud Pond, and Minards Pond) have all their shoreline conserved (though Ball Mountain Reservoir is a flood control reservoir); Lily and Stratton Pond, 95% and 94% is conserved respectively; on Lowell Lake, 82%.
- no shoreline is conserved on a number of water bodies with all or portions undeveloped, including Adam Pond, Athens Pond, Burbee Pond, Cole Pond, Forester Pond, Herricks Cove, Wantastiquet Lake, and the wetland off Daigel Rd, Westminster.

** conserved = in public ownership or under conservation easement. These lands may still contain development due to the presence of structures, roads, dams, and cleared vegetation; in many cases, no future development on these lands will take place.*

Undeveloped shoreline: 20.7 mi., (70.0% of total shoreline)

- large amounts of undeveloped shoreline exist on Gale Meadows Pond (4.97 mi.), Lowell Lake, (2.19 mi.), Wantastiquet Lane (1.72 mi.), Ball Mountain Reservoir (1.52 mi), and Stratton Pond (1.44 mi.). Minards, Lily (Londonderry), and Little Ponds, along with the wetland in the Westminster Town Forest, all have over one mile of undeveloped shoreline.
- several waterbodies have 100% of their shorelines undeveloped: Adam Pond, Bourn, Little Mud Little, and Stratton Ponds, and the wetland in the Westminster Town Forest. Both Forester Pond and Gale Meadows Pond have 90 percent or more of their shoreline undeveloped.

Conservation status of undeveloped shoreline

- percent undeveloped shoreline conserved: 68.6% (14.2 mi.); some shoreline is conserved, but is considered developed due to cleared land for farming, parks, recreation areas, etc.
- length of undeveloped, unconserved shoreline: 6.5 mi.

Land Use plans of undeveloped, unconserved shoreline

One town in the study area, Athens, does not have a town plan, and therefore does not have any designated land use districts. Most of the undeveloped shoreline in the remaining towns is in land use districts that place a priority on conservation, though in these districts, residential development at low densities is generally allowed.

Lakes and ponds with undeveloped shoreline		
Waterbody name	*Percent undeveloped*	*Town*
Adam Pond	*100*	*Jamaica*
Bourn Pond	*100*	*Stratton*
Little Mud Pond	*100*	*Winhall*
Little Pond	*100*	*Winhall*
Stratton Pond	*100*	*Stratton*
Westminster Town Forest wetland	*100*	*Westminster*
Forester Pond	*93*	*Jamaica*
Gale Meadows Pond	*90*	*Winhall & Jamaica*
Ball Mountain Reservoir	*88*	*Jamaica*
wetland, off Daigel Rd, Westminster	*83*	*Westminster*
Lily Pond	*83*	*Londonderry*
Minards Pond	*82*	*Rockingham*
Lowell Lake	*81*	*Londonderry*
Wantastiquet Lake	*75*	*Weston*
Burbee Pond	*51*	*Windham*
setback, Herricks Cove	*31*	*Rockingham*
Athens Pond	*31*	*Athens*
Cole Pond	*7*	*Jamaica*
Albees Cove	*1*	*Rockingham*

Streams

Note: for this work, the term "stream" is meant to indicate those smaller, narrow, flowing water features that are represented by a single line in the data. The term "river" is reserved for larger, wider, flowing water features represented in the data by two lines, each a bank of the river.

Results are shown on the "Undeveloped Streams" and "Conservation Status of Undeveloped Streams" maps.

Miles of streams in study area: 1132.4 mi.; 516.6 mi. (45.6%) are 2n^{d} order or higher , and 254.8 mi. (22.5%) are 3rd order or higher (according to GIS data).

Total length of undeveloped streams: 530.8 miles/46.9% of all mapped streams (341.6 mi. of these, or well over half, are first order streams—small headwater streams that may be intermittent).

Conservation status of undeveloped streams:

- 162.8 mi. (30.7%) of undeveloped streams in the study area are in public ownership or under conservation easement (i.e. "conserved"); 378.3 mi. of undeveloped streams are not conserved.
- Of these 162.8. miles, 61.5 miles are second order or higher streams, 20.9 mi. are third order streams.

Land Use plans of undeveloped, unconserved streams

One town in the study area, Athens, does not have a town plan, and therefore does not have any designated land use districts. Athens contains 20.6 miles of undeveloped, unconserved streams (over 90% of its undeveloped streams are unconserved).

6.2 mi. of undeveloped, unconserved streams are in land use districts where development is the priority (e.g. Residential (higher density), Village, Commercial, Industrial).

111.2 mi. of undeveloped, unconserved streams are in land use districts where conservation is the only priority (e.g. Conservation, Reserve). In most cases, the intent of the towns is not to put private, unconserved land into a strict conservation land use district. Most of these districts coincide with existing public and conserved land; this is true especially of Green Mountain National Forest lands in Weston, Winhall, and Stratton.

Of the 378.3 mi. of undeveloped, unconserved streams, 164.3 mi. (43.4%) are in land use districts that do not place a priority on conservation, e.g. usually Residential (lower medium to low density) or Rural Residential district. While conservation and open space preservation may be explicitly encouraged, it is of equal or lesser priority than other uses such as residential.

181.6 mi. of undeveloped, unconserved streams are in a land use district that places some emphasis on conservation or the working landscape (e.g. Resource Lands: Agriculture, or Forestry, or Conservation). Residential uses are allowed and may even be encouraged in some areas. In Windham, many streams are in a Forest District, where residential development is discouraged. It should be noted that Jamaica and Grafton have no zoning bylaw, meaning implementation of these planning goals must fall to methods other than zoning.

"Clusters," or contiguous groups of 2nd order and higher stream reaches:

- Winhall River, Winhall and Stratton, 7.3 mi.
- Turkey Mountain Brook, Jamaica, Windham, and Townshend, 5.6 mi.
- Bourn Brook, Winhall, 5.4 mi. (continues downstream into Manchester)
- Willie Brook, Grafton, Windham, and Townshend, 4.9 mi.
- Utley Brook (headwaters), Weston, 3.0 mi. (continues downstream into Mt. Tabor)
- Styles Brook, Townshend and Grafton, 2.9 mi.

Continuous 2nd order and higher stream segments of note:

- Turkey Mountain Brook, Jamaica, Windham, and Townshend, 4.2 mi.
- Bourn Brook, Winhall and Stratton, 4.1 mi. (continues downstream into Manchester)
- Winhall River, Winhall and Stratton, 4.1 mi. (continues downstream mapped as a river)
- Willie Brook, Grafton, Windham, and Townshend, 4.0 mi.
- Eddy Brook, Winhall, 2.6 mi. (continues upstream into Peru)
- unnamed tributary, Winhall River, Winhall and Stratton (north of Stratton Pond), 2.3 mi.
- East Putney Brook, Westminster and Putney, 2.1 mi.
- unnamed tributary, Winhall River, Winhall and Stratton (enters near Kendall Farm Rd), 2.0 mi.
- Howe Brook, upper segment, Grafton and Windham, 2.0 mi.

Rivers

Note: for this work, the term "river" is meant to indicate those larger, wider, flowing water features represented in the data by two lines, each a bank of the river. The term "stream" is reserved for those smaller, narrow, flowing water features that are represented by a single line in the data.
Those waters meeting the definition of "river" for this project include the Connecticut, West, and Williams Rivers, Utley Brook, most of the Winhall River (except the headwaters), and the Saxtons River downstream of the village of Grafton. Only brief results will be presented here. See the discussion section for more details.

There are 184.4 miles of river shoreline in the study area. This figure both sides of all the rivers listed above, with the exception of the Connecticut River; only the Vermont shore of the river was included in this study. This figure also includes the shoreline of any islands in the rivers. In short, this figure is

shoreline miles, not river miles or river length. Of these 184.4 miles of river shoreline, 60.0 miles, or 32.5%, are undeveloped. 23.7 miles, or 39.5%, of this undeveloped river shoreline is conserved.

Some of the undeveloped river segments are short, and in many cases only one of the river's banks was identified as undeveloped. However, there are significant undeveloped segments on all rivers with the exception of the Saxtons, and in a few cases, the entire river—both sides—lack development.

<u>Undeveloped river segments of note, both banks undeveloped:</u>

- Winhall River, Winhall, upstream from Kendall Farm Rd, approximately 4.3 mi. (over 4 miles of the Winhall River mapped as a stream is upstream from this segment)
- West River, Jamaica and Londonderry, above Ball Mountain Reservoir, approximately 2.9 mi (area is subject to inundation by flood control dam)
- West River, Jamaica, in Jamaica State Park, approximately 2.2 mi.
- Utley Brook, Londonderry, upstream from Barker Rd, approximately 1.7 mi.
- Utley Brook, Londonderry, downstream from Barker Rd, approximately 1.0 mi.
- West River, Londonderry, upstream of the confluence with the Winhall River , approximately 0.9 mi.
- Williams River, Rockingham, downstream of Brockways Mills Rd, approximately 0.8 mi.
- West River, Jamaica, downstream of the village of Jamaica, approximately 0.7 mi.

<u>Undeveloped river banks of note, one bank undeveloped, opposite bank developed:</u>

- West River, Jamaica and Londonderry, above Ball Mountain Reservoir, approximately 3.9 mi (area is subject to inundation by flood control dam)
- Williams River, Rockingham, downstream of Brockways Mills Rd, approximately 1.9 mi.
- West River, Weston, downstream of the village of Weston, approximately 1.5 mi
- Williams River, Rockingham, downstream of Parker Hill Rd, approximately 1.0 mi.
- West River, Londonderry, upstream of the village of Londonderry, approximately 0.6 mi
- Connecticut River, Putney, downstream of East Putney Brook, approximately 1.2 mi.
- Connecticut River, Rockingham, downstream of the Springfield town line, approximately 1.0 mi.
- West River, Londonderry, upstream of the village of South Londonderry, approximately 0.7 mi
- Williams River, Rockingham, between Lower Bartonsville and Williams Roads, approximately 0.7 mi
- Winhall River, Winhall, across from Kendall Farm Rd, approximately 0.7 mi.

Along the Connecticut River in Rockingham at Roundys Cove (1.3 mi.) and Albees Cove (1.1 mi.),areas have a convoluted shoreline whose lengths are 1.3 mi. and 1.1 mi. respectively. These are not true river miles, and so whether these constitute a river bank is debatable.

Other shorter sections of undeveloped river banks were identified, and are shown on the maps.