



# NONPOINT SOURCE PROGRAM SUCCESS STORY

## Vermont

### Ski Resort Improves Stormwater Management and Restores North Branch Ball Mountain Brook Tributary

#### Waterbody Improved

Sediment in stormwater runoff from roads, parking lots and roadside ditches degraded biological communities in Vermont's North Branch Ball Mountain Brook Tributary #1. As a result, the Vermont Department of Environmental Conservation (VTDEC) placed the tributary on its 1998 Clean Water Act (CWA) section 303(d) list of impaired waters for aquatic life use impairments caused by polluted stormwater runoff. Biomonitoring data in 2010 and 2012 showed that Tributary #1 complied with Vermont's aquatic life water quality standard, prompting the state to remove the segment from the impaired waters list in 2014.

#### Problem

North Branch Ball Mountain Brook Tributary #1 is in a heavily developed watershed of 0.9 square miles in the upper reaches of the West River Basin. This area includes a wide range of land uses and lies almost entirely within the holdings of The Stratton Corporation (Stratton). Stratton owns the Stratton Mountain Ski Resort and associated adjacent properties. VTDEC classified the stream as a Class B water—a designation defined as “suitable for bathing and recreation, irrigation and agricultural uses; aquatic biota sustained by high quality habitat; good aesthetic value; acceptable for public water supply with filtration and disinfection.”

Over the years, VTDEC has assessed the biological integrity of Tributary #1 using several biomonitoring metrics, including the EPT index (short for the macro-invertebrate order names Ephemeroptera, Plecoptera and Trichoptera). The index is a measure of the number and types of pollution-sensitive aquatic insects inhabiting a waterbody. Streams with a high EPT value contain a greater richness (diversity) of pollution-sensitive aquatic insects, indicating higher water quality. VTDEC also assessed macroinvertebrate densities (total number of organisms present), the percentage of macroinvertebrates consisting of pollution-tolerant worms of the taxonomic class Oligochaeta, and the Pinkham-Pearson Coefficient of Similarity-Functional Group (PPCS-F) metric (a measure of functional feeding group similarity to a model, based on the reference streams).

Biological monitoring in the early 1990s found that Tributary #1 did not comply with Vermont's Class B water quality standards for aquatic life. The stream



Jake Riley of VHB, Inc.

Figure 1. Before restoration, urban runoff contributed to stream habitat impairment in Vermont's North Branch Ball Mountain Brook Tributary #1. The right bank visible in this 2007 photograph was one of the areas observed to be directly contributing sediment to Tributary #1 through erosion processes.

had low EPT values, macroinvertebrate density and low EPT/richness. This impaired biological condition was caused by excessive sediment from urban runoff degrading stream habitat (Figure 1). Habitat evaluation revealed a high substrate embeddedness. As a result, VTDEC placed Tributary #1 (0.5 miles long, segment VT11-15.01) on its CWA section 303(d) list of impaired waters in 1998 for sediment impairment. In 2002 VTDEC completed a sediment total maximum daily load that outlined the load reductions necessary to attain water quality standards in the impaired segment.

## Project Highlights

Stratton developed a comprehensive water quality remediation plan (the Stratton Water Quality Remediation Plan, or SWQRP) in 1999 to comply with Vermont's land development law (Act 250), which regulates expansions and new developments involving more than 10 acres, in order to mitigate water quality problems arising from additional development. The development of the plan was a collaborative effort involving the Vermont Agency of Natural Resources (VTANR), the Vermont Natural Resource Council (VNRC) and the Stratton Area Citizens Committee (SACC). Riparian restoration projects implemented as part of the plan included stream corridor enhancements on the golf course, the creation of no-mow zones, and additional stream buffer plantings. Stormwater treatment projects included infrastructure upgrades to the parking lots and catch basins, culvert replacements and better placement of plowed snow during the winter months in the Stratton Village area. Other smaller-scale projects such as ditch re-grading were also implemented. On-mountain stormwater improvement projects included water bar installations and repairs, sediment basin installations, and seeding and revegetation of previously exposed bare earth.

## Results

As a result of restoration work in the watershed, the aquatic habitat of Tributary #1 has improved. Biomonitoring conducted in 2010 and 2012 showed that the macroinvertebrate densities and EPT indices increased, while the percentage of oligochaetes had decreased. All recent data indicate that Tributary #1

meets the Class B guidelines for EPT index score ( $\geq 16$ ), macroinvertebrate density ( $\geq 300$  individuals), percent oligochaetes ( $\leq 12$  percent), and PPCS-F ( $\geq 0.4$ ) (Table 1).

In addition, stream embeddedness, which measures the extent to which fine sediment fills the gaps around rocks and cobbles in the streambed, has declined. Before the restoration efforts, the percent embeddedness was measured to range from 50 percent to 75 percent, and a target goal of less than 25 percent was developed. After restoration, embeddedness decreased to between 5 percent and 25 percent. These data indicate that remediation practices reduced sediment delivery, improved stream habitat and allowed the stream to meet the state's standards. As a result, VTDEC removed the segment from the impaired waters list in 2014.

## Partners and Funding

Partners included The Stratton Corporation, VTDEC, VTANR, VNRC and SACC. VTDEC defined the nature of the problem in the mid-1990s and assisted in development of the SWQRP. Stratton was responsible for the implementation of the SWQRP and remediation of water quality issues. The bulk of the funding for data collection and remediation of the problem was funded by Stratton, in conjunction with redevelopment of Stratton Mountain. Approximately \$20,000 of CWA section 319 funds were used over the years for water quality and biological assessments, SWQRP development, quality assurance/quality control, and review of the data collected by Stratton. In addition, VTDEC expended approximately \$20,000 of state funding toward the project, including many hours of staff time.

**Table 1. Biomonitoring Data for Tributary #1 (1990–2012). Values highlighted in red indicate nonattainment**

Monitoring Year	Assessment Rating	EPT Index	Macroinvertebrate Density (Individuals/ Square Meter)	Percent of Individuals from Oligochaeta	PPCS-F
1990	-	15.0	168	32.14	0.60
1991	-	16.0	102	3.92	0.67
2001	Good-Fair	15.0	326	2.15	0.38
2003	Good	18.0	1128	4.86	0.51
2004	Very Good	19.0	1368	0.88	0.52
2005	Fair	13.0	1314	1.73	0.38
2006	Fair	17.5	609	0.15	0.35
2007	Fair	15.0	476	0.51	0.25
2008	Fair	15.0	484	0.51	0.40
2009	Good-Fair	16.0	386	1.95	0.39
2010	Good	17.0	420	1.99	0.48
2011	Tropical Storm Irene				
2012	Very Good	21.0	882	0.34	0.43
Class B Guideline		$\geq 16.0$	$\geq 300$	$\leq 12.0$	$\geq 0.4$



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## For additional information contact:

**Tim Clear**  
Vermont Department of Environmental Conservation  
802-490-6135 • [tim.clear@vermont.gov](mailto:tim.clear@vermont.gov)