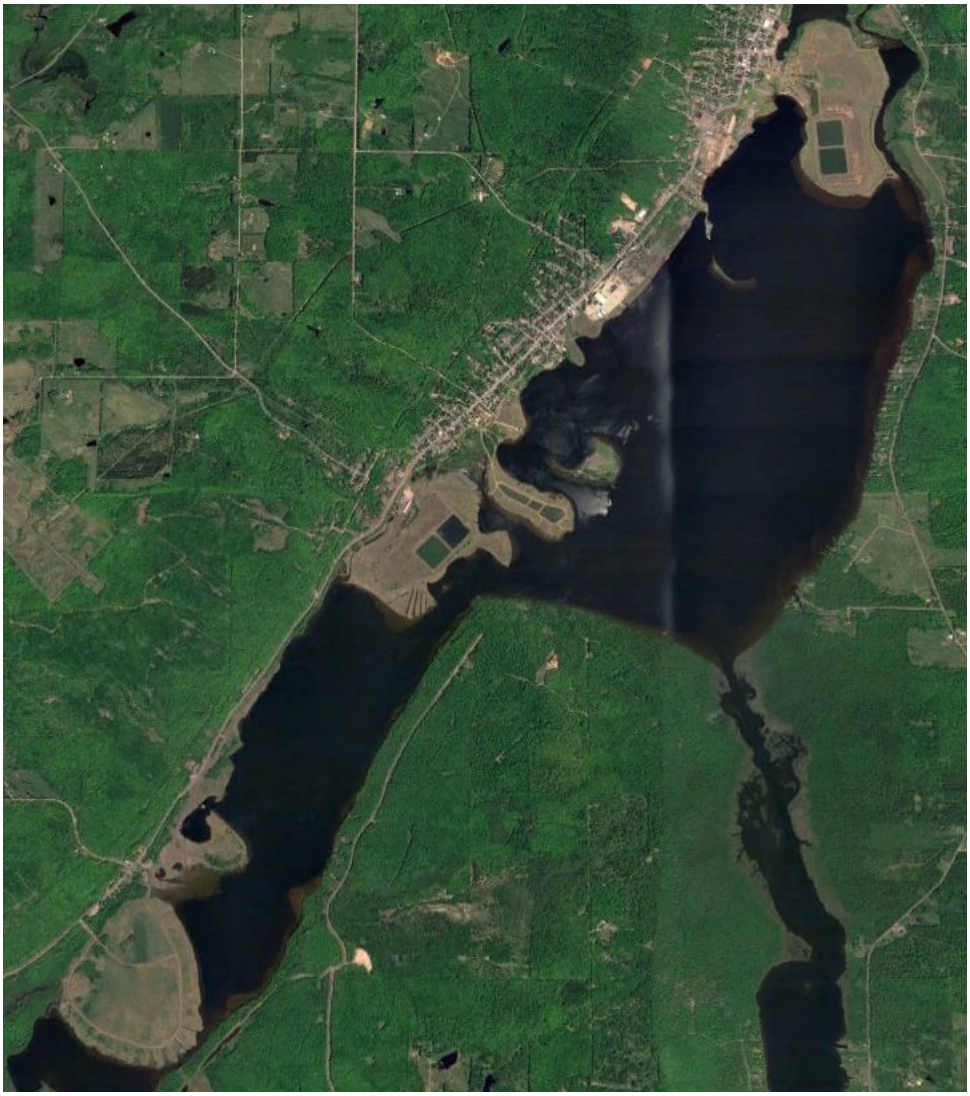
iTree Academy
April 2020

Tree Resources Inventory: Torch Lake Sands
ASSESSMENT ON THE COMMUNITY BENEFITS OF A SUPERFUND FOREST



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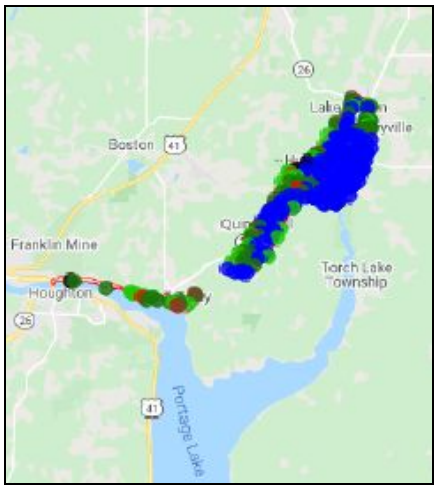
Introduction

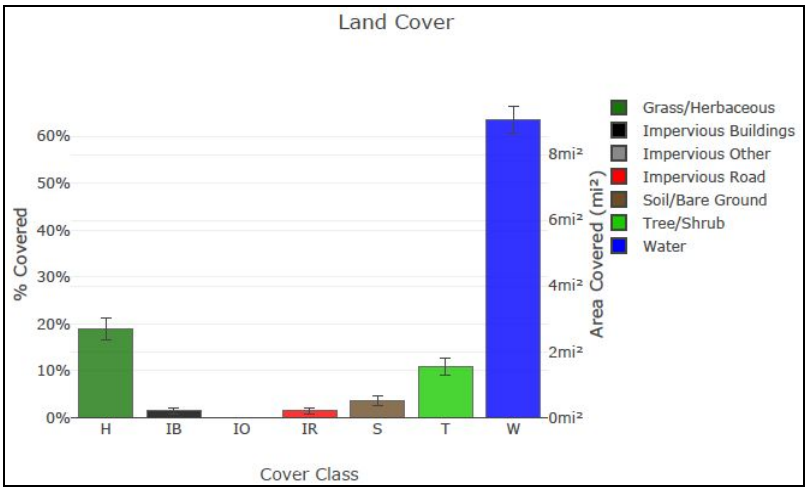
The Torch Lake Superfund site in Houghton County, Michigan is a complex of aquatic and terrestrial environs polluted by extensive copper mining operations that took place for a century 1868-1968. Over 200 million tons of mine tailings were dumped in and around Torch Lake, and today, over 30 organic and inorganic compounds have been identified as contaminants of concern (COCs). Poor natural recruitment of tree cover along remediated sediments has left large, artificial areas of grasses and ruderal vegetation along the lakeshore. The Torch Lake Sands area, located on the western shore of Torch Lake, is today home to the communities of Dollar Bay, Tamarack City, Hubbell, and Lake Linden. Historical locations of milling, smelting, dredging, and transportation have left a legacy of toxic compounds that continue to be found at elevated levels in lake sediments, as well as shoreline sediments and soils. In 1986, Torch Lake was listed as a national priority for clean-up. Remedial actions spanning the 1990s-2000s included the removal of debris, addition of soil amendments, and revegetation of contaminated slag piles. As some areas have been removed from the national priority list, it is a turning point in the ecological restoration of Torch Lake Sands.

This report seeks to assess the success of tree regeneration on superfund sites to-date, to quantify the benefits of existing tree cover to local communities, and to consider how continued reforestation along the western lakeshore could be a path forward to improving the health and resiliency of people and ecosystems.

I. Current Tree Cover

From aerial images of Torch Lake, land cover type was classified at 275 points in iTree Canopy software to estimate the proportion of tree canopy cover compared to other cover types (Figures 1.1 and 1.2). Water accounts for 9.05 mi2 of assessed area, and land 4.47 mi2 (Table 1.1). Grass and herbaceous vegetation is the most common cover type, accounting for 60% of the land area. Trees cover 35% of the land area. Bare ground or exposed soils cover 12%, and 9% is developed.





Figures 1.1. and 1.2. Land Cover Type Survey Results

Table 1.1. Torch Lake Sands cover types by area

Abbr.	Cover Class	Description	Points	% Cover ± SE	Area (mi²) ± SE
H	Grass/Herbaceous		52	18.98 ± 2.37	2.70 ± 0.34
IB	Impervious Buildings		4	1.46 ± 0.73	0.21 ± 0.10
IO	Impervious Other		0	0.00 ± 0.00	0.00 ± 0.00
IR	Impervious Road		4	1.46 ± 0.73	0.21 ± 0.10
S	Soil/Bare Ground		10	3.65 ± 1.13	0.52 ± 0.16
T	Tree/Shrub		30	10.95 ± 1.89	1.56 ± 0.27
W	Water		174	63.50 ± 2.91	9.05 ± 0.41
Total			**274**	**100.00**	**14.25**

II. Tree Cover Benefits

The currently existing tree cover provides measurable benefits to the lakeshore community. Trees reduce stormwater runoff, intercepting more than 30,000 gallons/mi2 annually. Trees improve air quality by removing harmful gasses and particulate matter from the air we breathe. This study estimates tree cover along the western shore of Torch Lake removes more than 75,000 lbs of air pollutants annually, and sequesters 1,360 tons of carbon dioxide from the air.

Tree Benefit Estimates: Hydrological (English units)

Abbr.	Benefit	Amount (gal)	±SE	Value (USD)	±SE
AVRO	Avoided Runoff	217.90	±37.54	$2	±0
E	Evaporation	37,129.50	±6,397.03	N/A	N/A
I	Interception	37,330.76	±6,431.70	N/A	N/A
T	Transpiration	53,146.79	±9,156.64	N/A	N/A
PE	Potential Evaporation	289,542.89	±49,885.22	N/A	N/A
PET	Potential Evapotranspiration	235,836.95	±40,632.25	N/A	N/A

Currency is in USD. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Hydrological Estimates are based on these values in gal/mi²/yr @ $/gal/yr:
AVRO 139.634 @ $0.01 | E 23,793.410 @ N/A | I 23,922.386 @ N/A | T 34,057.650 @ N/A | PE 185,545.541 @ N/A | PET 151,129.578 @ N/A (English units: gal = gallons, mi² = square miles)

Tree Benefit Estimates: Air Pollution (English units)

Abbr.	Description	Amount (lb)	±SE	Value (USD)	±SE
CO	Carbon Monoxide removed annually	891.77	±153.64	$11	±2
NO2	Nitrogen Dioxide removed annually	4,859.49	±837.24	$16	±3
O3	Ozone removed annually	48,934.58	±8,430.92	$1,160	±200
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	16,486.05	±2,840.37	$941	±162
PM2.5	Particulate Matter less than 2.5 microns removed annually	2,373.19	±408.88	$2,334	±402
SO2	Sulfur Dioxide removed annually	3,095.58	±533.34	$4	±1
Total		**76,640.66**	**±13,204.39**	**$4,465**	**±769**

Currency is in USD. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Air Pollution Estimates are based on these values in lb/mi²/yr @ $/lb/yr:
CO 571.466 @ $0.01 | NO2 3,114.070 @ $0.00 | O3 31,358.372 @ $0.02 | PM10* 10,564.627 @ $0.06 | PM2.5 1,520.794 @ $0.98 | SO2 1,983.717 @ $0.00 (English units: lb = pounds, mi² = square miles)

Tree Benefit Estimates: Carbon (English units)

Description	Carbon (kT)	±SE	CO_2 Equiv. (kT)	±SE	Value (USD)	±SE
Sequestered annually in trees	1.36	±0.23	5.00	±0.86	$232,509	±40,059
Stored in trees (Note: this benefit is not an annual rate)	34.24	±5.90	125.54	±21.63	$5,839,169	±1,006,028

Currency is in USD. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Carbon sequestered is based on 0.874 kT/mi²/yr. Carbon stored is based on 21.940 kT/mi². Carbon is valued at $46,513.84/kT. (English units: kT = kilotons (1,000 tons), mi² = square miles)

III. Township-Scale Priority Planting

The major superfund areas of Torch Lake Sands are divided among four townships. Lake Linden Recreation Area, Torch Lake Backwater Area, and the Lake Linden Sands Area are within Torch Lake Township (Figure 3.1). Hubbell and Lake Linden Processing Areas and the Hubbell Slag Dump and Beach Area area within Schoolcraft Township. Ahmeek Mill and Tamarack Processing Areas, Tamarack Sands Area, and Quincy Mill Complex Area are within Osceola Township. The Quincy Mill Coal Docks are within Franklin Township. The benefits of new tree plantings was assessed at the township scale using iTree Landscape

Software. Townships were compared by plantable space, tree cover per capita, total air pollution removal, and floodplain area. Franklin and Osceola townships were identified as priority planting divisions by these criteria (Figure 3.2). Both townships have less canopy cover and greater proportion of plantable space.

IV. Tree Planting in Osceola Township Superfund Areas

Tree planting in Osceola Township could improve air and water quality, community health and aesthetics. Reclaimed mining substrates currently surround the municipal wastewater treatment plants and other publicly owned lands. Tree cover is very limited, and the primary vegetation consists of grasses and ruderal species. While natural tree regeneration is poor, facilitated plantings may yield successful reforestation outcomes. Current forest types in the township are summarized in table 4.1, and could serve as a foundation for a tree planting palette.

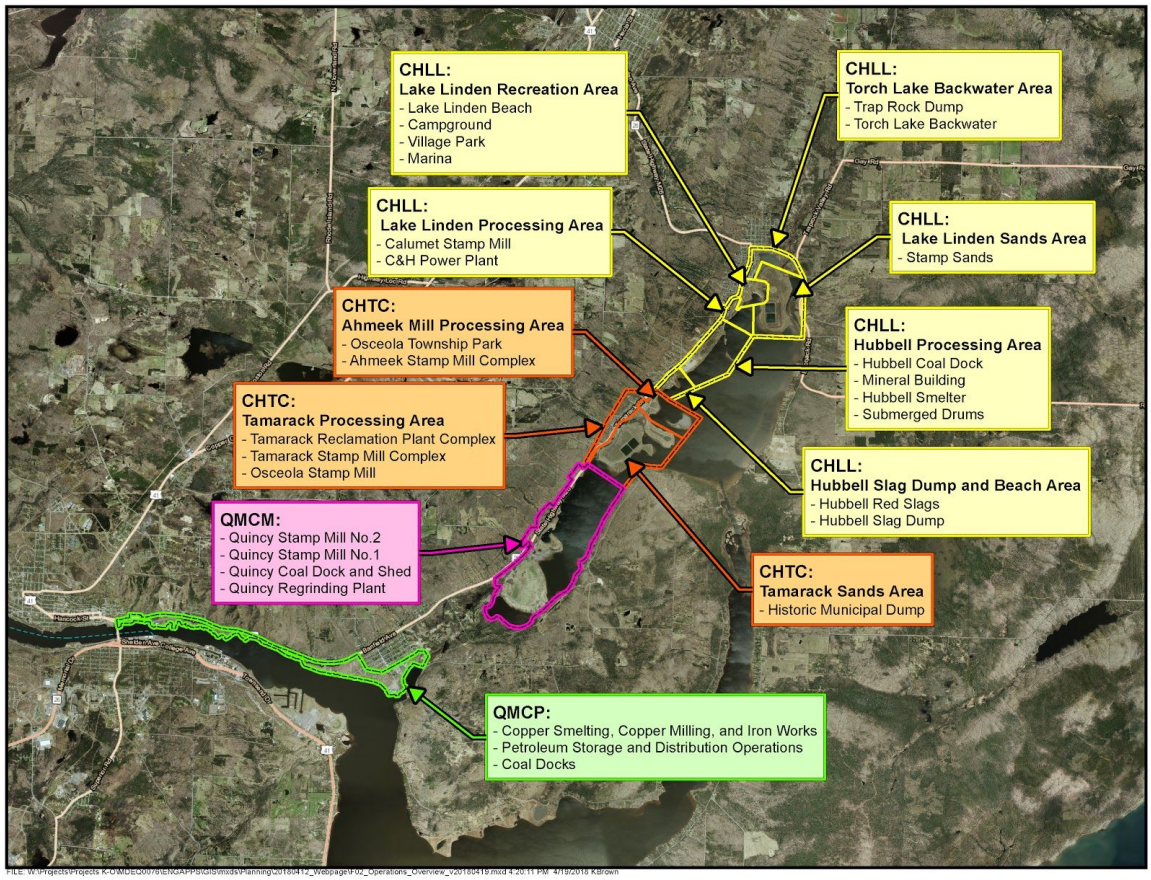


Figure 3.1 Torch Lake Sands Superfund Areas

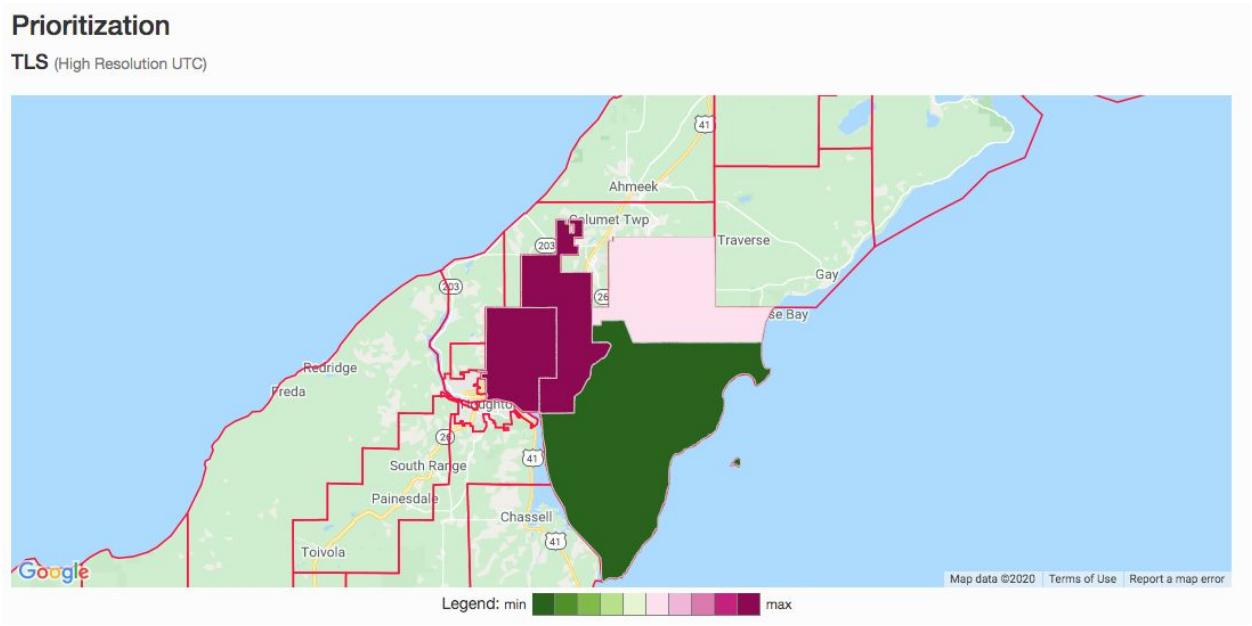


Figure 3.2. Priority planting areas generated by iTree Landscape

Table 4.1 Current Forest Details

NLCD 2011	County Subdivisions	Osceola	2606161260	• Aspen/Birch (75.34%) • Elm/Ash/Cottonwood (0.26%) • Spruce/Fir (22.48%) • White/Red/Jack Pine (1.93%)	• Acer spp., maple spp. (369595 ft²) • Acer saccharum, sugar maple (240414 ft²) • Quercus spp., oak spp. (142077 ft²) • Quercus rubra, northern red oak (142077 ft²) • Acer rubrum, red maple (130021 ft²) • Abies spp., fir spp. (74056 ft²) • Abies balsamea, balsam fir (74056 ft²) • Thuja occidentalis, northern white-cedar (59310 ft²) • Populus spp., cottonwood and poplar spp. (41746 ft²) • Populus tremuloides, quaking aspen (41348 ft²) • ...	1,537,281.0