Welcome
To the Miller Creek Interpretive Trail

The Miller Creek Ravine provides opportunities for education, solitude, recreation, and stewardship of natural resources.

The Miller Creek Interpretive Trail is less than a mile long and connects 14 sites of ecologic and geologic interest. The sites are marked by numbered sign posts. Information on each site is included in this brochure. Feel free to keep it or leave for others in the box.
Guidelines

While visiting, please respect these guidelines:

- Please hike single file along the trail; watch your step as it can be slippery and rough.
- Pets must be on a leash and picked up after, in accordance with Duluth laws.
- Hiking and snowshoeing only please, no mountain bikes.
- Please be courteous to others here to enjoy the peace and solitude of this area.
- No littering.

To stay on track, watch for the green “Hiker” symbol along the trail.

Site 1: Stormwater

The gully to your right was eroded by stormwater runoff from Lake Superior College’s west parking lot. Developed watersheds such as Miller Creek send stormwater to streams more rapidly than their undeveloped counterparts.

After a rainstorm, water flows from parking lot and road surfaces to streams, carrying fine sediments and car-related pollutants, including road salt. Not only does that erosion do damage to the landscape, but the fine sediments carried from the paved surfaces and the eroding landscape become deposited in the pools and riffles of the stream. This degrades the physical habitat available to stream insects and brook trout by eliminating the clean gravel that insects depend on for shelter and feeding, and the trout rely upon for spawning habitat.

Lake Superior College is actively seeking ways to reduce its impact on Miller Creek as the campus develops. Runoff from a portion of the western parking lot is now treated in a rain garden, which reduces the volume and pollutants, as well as slowing the flow of water to the stream following rain storms.

Everytime we learn more about the connections between landscapes and the watersheds within them, it becomes clear that the health of watersheds depends on our behavior as individuals and communities. We need to always remember that the trickles, rivulets, storm sewers, and creeks that carry water from our lawns and streets flow directly to Lake Superior.
Site 2: Brook Trout as an Indicator of Environmental Quality

The brook trout (Salvelinus fontinalis), with an olive back covered by wormlike markings, red spots with blue halos on the flanks, and orange-tinged fins with white leading edges, is one of the most colorful freshwater fish. As a member of the char family, “brookies” are slow growing and short-lived in Minnesota’s small trout streams but have been long cherished by anglers.

In Miller Creek, brook trout reproduce naturally and the population is not supplemented with stocked fish. For Minnesota DNR fisheries managers, the presence of brook trout making it on their own is a testimony to Miller Creek’s ecological health. It is threatened, but holding its own.

Brook trout require an environment that is in good condition. In Miller Creek and other North Shore streams that means water temperatures that are usually less than 68° F with dissolved oxygen that is abundant. Brook trout also benefit from streams with abundant riffles, pools, and woody debris. These stream features oxygenate the water, offer cover to trout, and provide habitat for the invertebrates that brookies feed upon.

Recently, brook trout in Miller Creek have experienced poor reproductive success. The precise cause for this reproductive difficulty is likely to be a combination of factors that are being witnessed in other urban streams as well. Trout in urban streams face many threats related to development. These threats include warming of the stream related to loss of shade, excessive road salt, fine sediment from roads and parking lots, and flashy stream levels as a result of increasing amounts of impervious surface as development occurs throughout a watershed. These factors interact to degrade the water quality and habitat brook trout depend upon.

Trout Habitat

Brook trout are native to the lower reaches of streams on Minnesota’s North Shore of Lake Superior and have been introduced into suitable small streams throughout northeastern Minnesota dating back to the late 1800s. They require well-oxygenated, cool water with riffles and pools that typically have sand, gravel, and rock bottoms. Upstream portions of these streams may flow through bogs and wetlands with large amounts of soft sediments. Like many North Shore streams, Miller Creek’s physical conditions are a challenge for brook trout. The Miller Creek ravine is like a funnel for spring snowmelt and heavy rains, sending high volumes of water through a confined, rocky channel. These high flows can scour gravel beds where brook trout eggs are deposited in the fall or wash away young trout in the spring.

Because Miller Creek relies on precipitation to sustain most of its flow, summer dry spells can create low water conditions that lead to temperatures exceeding 70° F which can stress or possibly kill brook trout. On Duluth’s hillside, Miller Creek’s brook trout are blessed with a seepage of cool groundwater. This cool water has protected the ravine’s trout from the high temperatures found upstream in the Miller Mall corridor.

Winter can be difficult for stream life too. Periodically, cold winters with little snow create anchor ice (ice attached to the stream bottom in shallow spots) in North Shore streams. Sites where anchor ice occurs can be identified by smooth, often bluish ice building over a stream’s surface in areas where flow is blocked by ice attaching to the stream bottom. This eliminates habitat and limits movement of trout, especially in small streams with limited groundwater input. Extensive anchor ice in small streams can kill over 50 percent of the brook trout population. Recent occurrences of this on the North Shore were in 2007, 2003, and 1976.
Site 3: Bedrock

The bedrock outcrop in front of you is a good example of a common igneous rock found throughout Duluth and northeastern Minnesota. Its coarse crystalline texture and assemblage of dark minerals make this rock a gabbro, just one of the many types of rock that make up the Duluth Complex – a group of igneous rocks that extend in an arc from Duluth over toward Ely and up to Pigeon Point along the North Shore. Dating of isotopes in the Duluth Complex suggest it is approximately 1.095 billion years old, slightly younger than the basalt lava flows found near to the lakeshore.

Both rock units formed as North America began to separate apart along the mid-continent rift – a 1000-mile long line that extends from Lake Superior down into Kansas along which the earth’s crust began to separate, pushing Wisconsin to the east and Minnesota to the west.

Site 4: Glacial Striations

Look closely at the polished surface of this bedrock exposure. You will see a series of faint scratches and grooves, that may become clearer if the surface if the rock is wet, and reflecting sunlight. These grooves and scratches are called glacial striations. Striations are created by stones and other debris trapped at the base of a glacier scratching the underlying surface as the ice flows under its own immense weight. These marks are a lot like the grooves left behind after sanding wood with sandpaper. This process, known as glacial abrasion, is just one of the ways that glaciers can wear away a landscape. You should be able to recognize these glacial marks elsewhere in Duluth and along the polished, striated bedrock surfaces of the North Shore – shown in the image to the right.
Site 5: The Earth’s Changing Surface

The entrenchment (down cutting) of Miller Creek into the surrounding geologic materials has created the valley you are standing in, with over-steepened river banks that give you a cross-sectional view of the geologic materials that can be found most places around Duluth. The lowest geologic material is the bedrock – which is Duluth Complex in this case, but can be other rock types depending upon your location. The bedrock here is overlain by glacial deposits – of varying thicknesses ranging from 20-200 feet thick in some locations. The superposition of glacial drift (drift is a generic term applied to all unconsolidated sediments of glacial origin) on top of bedrock also gives you a sense for the order in which these layers were formed, by their respective geologic processes, with the bedrock forming first and the glacial drift being deposited on top of the existing formation. Next, turn your attention to the large boulder in mid-stream, which looks as though it has fallen from the cliff on the opposite side.

Why did it fall?
Perhaps glacial ice plucked it free, a much larger Miller Creek could have also played a role, or maybe it was simply gravity, pulling this big stone off its perch into a more stable position. Regardless, unlike some of the smaller stones in the river, the sharp angular corners on the stone tell us it hasn’t traveled very far, for if it had they would have been worn away by abrasion, a stream process that over time shapes the materials that lie within the channel, creating recognizable features within a visible reach of stream length.

Site 6: Glacial Till

The soil you see here is an unsorted mixture of sand, silt, clay and rocks (some large enough to be called boulders) referred to as glacial till. Till forms as a glacier erodes and wears away the landscape over which it flows. This same flow and weight of the overriding ice plasters till to the land surface below and pushes it forward until it reaches the glacier’s margin where it accumulates as a moraine. Look closely at some of the stones in the till and you may recognize some of the rocks, as those you’ve seen closer to the lakeshore. Pick up a handful, rub it between your thumb and forefinger, and you may also notice this till has a sandy texture and reddish brown color. This is due largely in part to the Superior lobe eroding sandstone bedrock as it flowed out of the Lake Superior Basin 20,000 years ago. A map of the Superior lobe is shown at right.
Site 7: The Western Lake Superior Sanitary District’s Hermantown Intercept Sanitary Sewer Line

This manhole provides access to a concrete pipe buried several feet below the surface. This “interceptor” pipe is part of a 75-mile network of large diameter pipes carrying wastewater to the Western Lake Superior Sanitary District’s regional wastewater treatment facility in Duluth, located on the St. Louis River near its junction with Lake Superior.

Sewer pipes are often situated along existing stream corridors to take advantage of the natural topography of watershed drainage which carries water to its lowest level in the landscape. Using gravity to move wastewater reduces the need for mechanical pumps and the energy necessary to run them. Manholes provide access for inspection and cleaning to prevent sewage overflows resulting from obstructions or cracks that can be caused by tree roots in the wooded reaches of the stream.

Originally built to serve the Naval Air Station in 1964, this large pipe now carries wastewater from many sources including the Air National Guard base, the Federal prison, the Pike Lake community, businesses along the Miller Trunk Highway Corridor, and residential neighborhoods in Hermantown and Duluth. Moving at a rate of 10 feet per second, approximately two million gallons of wastewater flow through this 15" diameter pipe daily to the WLSSD treatment facility, where it is cleaned and discharged to the St. Louis River.

(Susan Darley-Hill, Environmental Program Coordinator, Western Lake Superior Sanitary District)

Site 8: Macrinovertebrates and Energy Flow

Miller Creek as an ecosystem is typical of most streams on Minnesota’s North Shore. The ultimate source of energy for any ecosystem is solar energy which drives the process of photosynthesis and allows plants to create tissues. Miller Creek, for most of the growing season, is well shaded by its riparian vegetation and tree canopy. This prevents much photosynthesis from taking place in the stream except for early in the spring and during October. As a result, the greatest source of energy to a stream like Miller Creek comes from the leaves and other plant matter that falls or washes into the stream, especially in autumn.

<table>
<thead>
<tr>
<th>Feeding Strategy</th>
<th>Food Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Shredders</td>
<td>dead leaves/live macrophytes</td>
</tr>
<tr>
<td>II. Collectors</td>
<td>fine organic particles (live/dead)</td>
</tr>
<tr>
<td>- filter feeders</td>
<td>particles in water column</td>
</tr>
<tr>
<td>- miners</td>
<td>buried particles</td>
</tr>
<tr>
<td>- browsers</td>
<td>bottom surface deposits</td>
</tr>
<tr>
<td>III. Scrapers</td>
<td>live benthic algae (diatoms)</td>
</tr>
<tr>
<td>IV. Predators</td>
<td>invertebrates + small fish</td>
</tr>
</tbody>
</table>

The entire community of macrinovertebrates in Miller Creek process the plant matter that grows within the stream (algae and macrophytes) and outside of the stream (leaves and woody debris). These organisms can be grouped by how they function in the processing of this plant matter.
Site 9: Miller Creek
Hydrology

Miller Creek flows from the Superior Uplands into the St. Louis River estuary along a regional gradient toward the topographically low Lake Superior Basin. The water in Miller Creek has four primary sources:

1. Groundwater contributes water to Miller Creek throughout the year. Its steady, constant seeping into the creek channel provides the base flow which runs year round, even in hot dry summer months.

2. Surface water runoff after rainfall and from other tributaries and impervious surfaces runs over the land surface and eventually enters Miller Creek. Melting snow pack can also contribute to streams in the spring, causing their levels to rise.

3. Direct precipitation is water that falls directly into the stream channel during a rain storm.

4. Interflow contributes water from nearby soil formations, as water soaks into the ground and drives additional moisture toward the channel.

The addition of numbers 2-3 during and after rain cause the volume of water to increase.

Site 10: White Pines of the North Shore

Sandwiched between temperate deciduous forests to the south and the boreal forest to the north, the Great Lakes pine forest was once found in a belt extending from mouth of the St. Lawrence River at the Atlantic Ocean westward to north central Minnesota. From the time of European settlement until the early 1900s the white pines of this mixed forest community were extensively harvested. The lumberjacks of Minnesota’s early history removed an estimated 98 percent of the state’s white pine to feed sawmills which produced the lumber for the ships and buildings of a bygone era. Trees with diameters of five feet or more could yield up to 6000 board feet of straight-grained lumber. Harvest of the white pine along Lake Superior’s North Shore began in the 1880s. By 1900 railroads supplied three million board feet in logs daily to sawmills in Duluth. By the mid-1920s the white pine boom along the North Shore was over. (Thomas E. Waters, The Superior North Shore).

Today white pine is found in stands along stream corridors near Lake Superior. It shares these ravines with white cedar, white spruce, and paper birch. These cool ravines make great places to cool off on hot summer days. Nice examples of this community can be found in Duluth along Amity Creek in Lester Park, Chester Creek near Chester Bowl, and up the North Shore in the Encampment River area north of Two Harbors.

White pine is also found as a member of northern hardwood forest communities, where it typically exists in low density stands mixed with sugar maple, red oak, and yellow birch in the glacial soils deposited by the Superior lobe. Examples of these beautiful forests can be found at Jay Cooke State Park, Spirit Mountain, Tettegouche State Park, and Crosby-Manitou State Park.
Site 11: Northern Hardwood Forest Restoration

In 1999 Lake Superior College received funding from the Minnesota Department of Natural Resource’s Conservation Partners Program to restore a two-acre site to its historic northern hardwood forest community. Currently this site is dominated by mature paper birch, pin cherry, and mature American mountain ash. Based on the soils present here and the scattered presence of sugar maple, yellow birch, white pine, and white cedar there is strong evidence that this site was once occupied by a northern hardwood community similar to those found at Spirit Mountain, Jay Cooke State Park, and next to the nearby Arlington Road Soccer Fields in Duluth.

Northern hardwood communities are a climax community characterized by sugar maple, American basswood, yellow birch, and red oak. Scattered white pine, white spruce, and white cedar make these hardwood-dominated forests distinct from the maple-basswood communities farther south and west in Minnesota. These forests build rich organic soils over glacial deposits that include enough clay to support moisture-loving species such as yellow birch and white cedar on upland locations. Understory trees include shade tolerant species such as mountain maple, beaked hazel, and ironwood.

In the spring northern hardwood forests produce an array of ephemeral flowers prior to the leaves coming out in the tree canopy. They include large-flowered trillium, nodding trillium, Dutchman’s breeches, large-flowered bellwort, pale bellwort, hairy Solomon’s seal, Canada mayflower, bloodroot, white baneberry, red baneberry, and many violet species. As shade develops in the early summer, these plants move into dormancy and disappear until the next spring.

Deer Exclosures
The exclosures you see are intended to protect sugar maple, red oak, and white pine seedlings from browsing by deer and rabbits. As the trees in the exclosures grow they will become big enough to provide the shade and forest floor conditions necessary for the beautiful spring flowers. When conditions are right spring ephemeral flowers and other herbaceous plants native to northern hardwood communities will be reintroduced. By scattering plantings of white pine, northern red oak, sugar maple, and basswood it is hoped that this site will eventually be returned to a condition that reflects the other stands of this forest community along Minnesota’s North Shore.

Site 12: Alluvial Riparian Community

The soil below your feet here is special. It is composed of coarse-grained materials like sand, gravel, and pebbles that were deposited by Miller Creek in the past, when it flowed at a higher level. The gravel allows water to move through it more easily, which in turn has allowed a riparian (streamside) plant community of green ash, speckled alder, ostrich ferns, jack in the pulps, and spotted jewel weed. Additionally, yellow birch, white cedar, and black willows can be found next to the stream.

Riparian plant communities shape stream communities by preventing erosion, providing shade, and dropping their leaves into the stream each fall to provide the macroinvertebrate insect community with an abundance of food.
Site 13: Brook Trout Spawning and Life History

In late September and early October when stream temperatures range from 40° to 49°F adult brook trout move into riffles at the downstream ends of pools. Here female trout that are typically two and a half to three and a half years old will excavate a small depression in the gravel with their body and tail. The female will then rest in the depression or “redd” and as they are courted by a male. Females deposit eggs and males release sperm into the redd where fertilization occurs as the female uses her tail to cover the eggs with gravel. The location of the redd at the tail of a pool near the head of a riffle (and possibly near a groundwater seep) exposes the eggs to gentle upward currents that help to prevent silt and debris deposition, ensuring circulation of oxygenated water through the gravel the eggs are resting in. The eggs will hatch in late March or early April after spending the winter under the ice of Miller Creek.

Upon hatching, the young brook trout are known as alevin. Complete with a small yolk sac to nourish them, they live in the gravel when they first hatch. After the yolk sac is depleted they leave the gravel and are known as fry. They must now capture their own very small prey while avoiding predators and strong currents. Approximately 95 percent of fry die over the course of the summer. By mid to late summer, the brook trout will approach two inches in length and have dark vertical bands on their sides. Now called parr, the young brook trout can feed on larger prey items such as small insect larvae and other aquatic invertebrates. By the time they are parr, brook trout must avoid potential predators such as other fish, mink, herons, and kingfishers. As the trout near five to six inches in length, they lose their parr marks and become juveniles by their second spring. By the time they are a year and a half old in their second fall, the fish are nearing sexual maturity and are referred to as adults.

Most brook trout that survive to adulthood live two to four years in the stream and attain lengths of six to ten inches. Very few survive long enough in North Shore streams to grow to lengths exceeding twelve inches. The survival from an egg in the redd to spawning adult has a likelihood of less than 1 in 1000, making the adult “brookies” we see and catch true survivors.

Site 14: A Resource that Belongs to Us

The Miller Creek ravine provides evidence that a high quality natural environment can exist within an urban setting. It provides opportunity for education, solitude, recreation, and stewardship of natural resources. It reminds us of the environmental quality that is desired and at risk on Minnesota’s North Shore and across the country. Stewardship of natural resources and environmental quality leads to stronger communities and economies wherever it occurs, but requires learning from past mistakes and insightful planning if we wish to be true stewards of the natural environments in our neighborhoods.

There are many places to learn more about the watersheds and streams of Lake Superior and how we can protect them as a community. Visit and explore the websites below for more information.
- Lake Superior Streams - www.lakesuperiorstreams.org
- Minnesota Sea Grant - www.seagrant.umn.edu
- Minnesota DNR - www.dnr.state.mn.us/fishing/trout_streams/index.html
- Minnesota Pollution Control Agency - www.pca.state.mn.us/netscape4.html
- Stormwater - www.pca.state.mn.us/water/stormwater/index.html
- Impaired Waters - www.pca.state.mn.us/water/tmdl/index.html
- Superior Hiking Trail Association - www.shta.org
Miller Creek Tree and Shrub List
* common along the creek and trail

Coniferous Trees
- White Cedar (Thuja occidentalis)
- Balsam Fir (Abies balsamea)
- Eastern White Pine (Pinus strobus)
- Jack Pine (Pinus banksiana)
- Red Pine (Pinus resinosa)
- Black Spruce (Picea mariana)
- White Spruce (Picea glauca)

Deciduous Trees
- American Mountain Ash (Sorbus americana)*
- Black Ash (Fraxinus nigra)
- Green Ash (Fraxinus pennsylvanica)*
- Big-tooth Aspen (Populus grandidentata)
- Quaking Aspen (Populus tremuloides)
- Balsam poplar (Populus balsamifera)*
- Paper Birch (Betula papyrifera)*
- Pin Cherry (Prunus pennsylvanica)
- Red Maple (Acer rubrum)
- Sugar maple (Acer saccharum)
- Northern Red Oak (Quercus rubra)
- American Basswood (Tilia americana)
- Black Willow (Salix nigra)

Shrubs
- Speckled Alder (Alnus rugosa)
- Blueberry (Vaccinium sp.)
- chokecherry (Prunus virginiana)
- Red-osier Dogwood (Cornus stolonifera)
- Red-berried Elder (Sambucus pubens)
- Gooseberry (Ribes sp.)
- Beaked Hazel (Corylus cornuta)*
- Hawthorn (Crataegus sp.)
- Highbush Cranberry (Viburnum trilobum)
- Bush Honeysuckle (Diervilla lonicera)
- Fly Honeysuckle (Lonicera canadensis)
- Juneberry (Amelanchier sp.)
- Mountain Maple (Acer spicatum)*
- Ninebark (Physocarpus opulifolius)*
- Raspberry (Rubus sp.)*
- Thimbleberry (Rubus parviflorus)*
- Wild Rose (Rosa sp.)*
- American yew (Taxus canadensis)

The Other Fish of Miller Creek

Eastern Blacknose Dace
Blacknose dace are one of the most common stream fishes found in north shore streams. In late spring and early summer, dace spawn in riffles over gravel and rubble where both the male and female construct a nest of small pebbles. Dace feed on all types of aquatic insect larvae, worms, and algae.

Longnose Dace
Longnose dace are slightly larger than the blacknose dace found in streams of the north shore. Both species prefer small streams and are often found in the same stream. The longnose dace sometimes is found living in turbid waters. From late spring to early summer, dace spawn in riffles over gravel and rubble where both the male and female construct a nest of small pebbles.

Central Mudminnow
This mudminnow is a small fish (3 1/2 inches or less) with a rounded tail. It has vertical bars on its sides. Mudminnows spawn in April. Pairs move to shallow water, where the female deposits 200 to 2,000 adhesive eggs, which separately stick to vegetation. In North Shore streams mudminnows are most commonly found in slow-flowing reaches of streams with mucky, organic sediments. Mudminnows are tolerant of the low oxygen levels commonly found in these boggy stream reaches. The adults are predominantly plankton and insect eaters.

Creek Chub
The creek chub is a medium-sized minnow that can reach lengths of 8-10 inches. Throughout most of the year creek chubs appear black or bluish above and silvery below, though during the spring spawning season male creek chubs take on a bright, rusty color and develop at least four large tubercles on either side of their heads. The male creek chub builds and carefully guards a mound of small stones in which the eggs are deposited.

Northern Redbelly Dace
The redbelly dace occurs in small lakes and in reaches of streams with slow to moderate current speeds, often in cool, darkly stained waters of creeks originating in woodlands such as Miller Creek. The redbelly dace spawns in the spring and early summer, May to early August. It has been observed that at least some females spawned twice a year because two size classes of maturing eggs were found. Spawning takes place on clumps of filamentous algae. A female accompanied by one or more males darts from one algal mass to another. During each spawning episode, five to 30 non-adhesive eggs are released and become entangled in the algal filaments, where they hatch in about 10 days. The diet of the redbelly dace includes small plant material, including diatoms and filamentous algae, as well as zooplankton, insects, and occasionally fish.

Brook Stickleback
Brook sticklebacks are found in quiet, vegetated reaches of headwater streams with mud or sand sediments along with the central mudminnow. During breeding season the males of this common species display red pelvic fins.
Resident Birds of the Miller Creek Ravine and LSC Campus
Compiled by Terry Wiens

Black-capped Chickadee
Common Yellowthroat
Northern Flicker

Ovenbird
White-breasted Nuthatch
Black-&-white Warbler

Song Sparrow
American Redstart
Red-eyed Vireo
Mourning Warbler
Veer
Black-capped Chickadee
Ovenbird
Song Sparrow
Chestnut-sided Warbler
House Wren
Common Yellowthroat
Brown-headed Cowbird
Northern Flicker
Northern Cardinal
American Robin
American Goldfinch
American Crow
Chipping Sparrow
Blue Jay
European Starling
Rock Pigeon
Tree Swallow
Gray Catbird
Black-&-white Warbler
White-throated Sparrow
White-breasted Nuthatch
Supporters:
Since 2001 Lake Superior College has received assistance in the development of the Miller Creek Interpretive Trail from many sources.
MN DNR – Ecological Services - Conservation Partners Grant
MN DNR – Division of Waters
MN DNR – Youth Conservation Corp.
South St. Louis County Soil and Water Conservation District
Superior Hiking Trail Association
Western Lake Superior Sanitary District (WLSSD)
Lake Superior College Student Life
Lake Superior College Biology & Geology Departments