your guide to:

MILLER CREEK
INTERPRETIVE TRAIL

MILLER CREEK

INTERPRETIVE TRAIL

Miller Creek Interpretative Trail History

Lake Superior College was first built as the Duluth Area Vocational Technical Institute in 1968 on nearly one hundred wooded acres, with Miller Creek running through the western edge of the campus.

In 1999, a Conservation Partners Grant was obtained from the Minnesota Department of Natural Resources to restore the northern hardwood forest community that was historically present on the site. This work focused on planting white pine, red oak, sugar maple, and associated species along the creek corridor.

In 2007, an interpretative hiking trail was established with numbered sites highlighting stream ecology with an emphasis on brook trout, the geology of the ravine, and the northern hardwood forest restoration installed, along with trail signage. Today, the trail is used by LSC's biology, geology, environmental science, and civil engineering technology departments as a natural laboratory. It is also used by other departments, including physical education and art.

LEARNING

Lake Superior College students want to share their

WALK IN THE WOODS

"The trail will be designed to do interpretion of the geology, the forest and Miller Creek's stream ecology, which – in this part of the stream – is in decent shape."

WALK | *Trail will be open to the public*

The record-breaking, June 2012 flood damaged many of Duluth's 42 creeks and rivers and adjoining trails and bridges. The Miller Creek Interpretative Trail on the Lake Superior College campus was one of them. Both bridges spanning the creek were washed downstream and stream-monitoring equipment was destroyed.

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LSC faculty, staff, students and the Duluth community pitched in to repair the damage done to this designated trout stream. Total cost to repair flood damage was approximately $3,000 for bridge supplies. The trail bridges were re-designed by Larry Sampson from the Superior Hiking Trail Association and located to new crossings. Volunteers, including LSC Fire Technology students, helped with bridge construction, installation and creating additional tread walkways, including stone stairways.

The $5,000 stream monitoring equipment was replaced through


June 2012 flood

FEMA funding. Jerry Henneck with UMD's Natural Resources Research Institute (NRRI) reinstalled this equipment, which provides real-time temperature, oxygen, turbidity, flow, and conductivity data to the LakeSuperiorStreams.org database.

Bridge locations and connecting trails were altered so the new trail system was re-mapped by LSC Civil Technology students. A Civic Engagement class designed and installed a new trail entrance sign and way-finding arrows. Building Construction faculty member John Calcaterra built the new cedar trail sign holders.

MILLER CREEK INTERPRETIVE TRAIL

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 connects 14 sites of ecologic and geologic interest in the creek ravine and surrounding area. The trail is less than a mile long. 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.

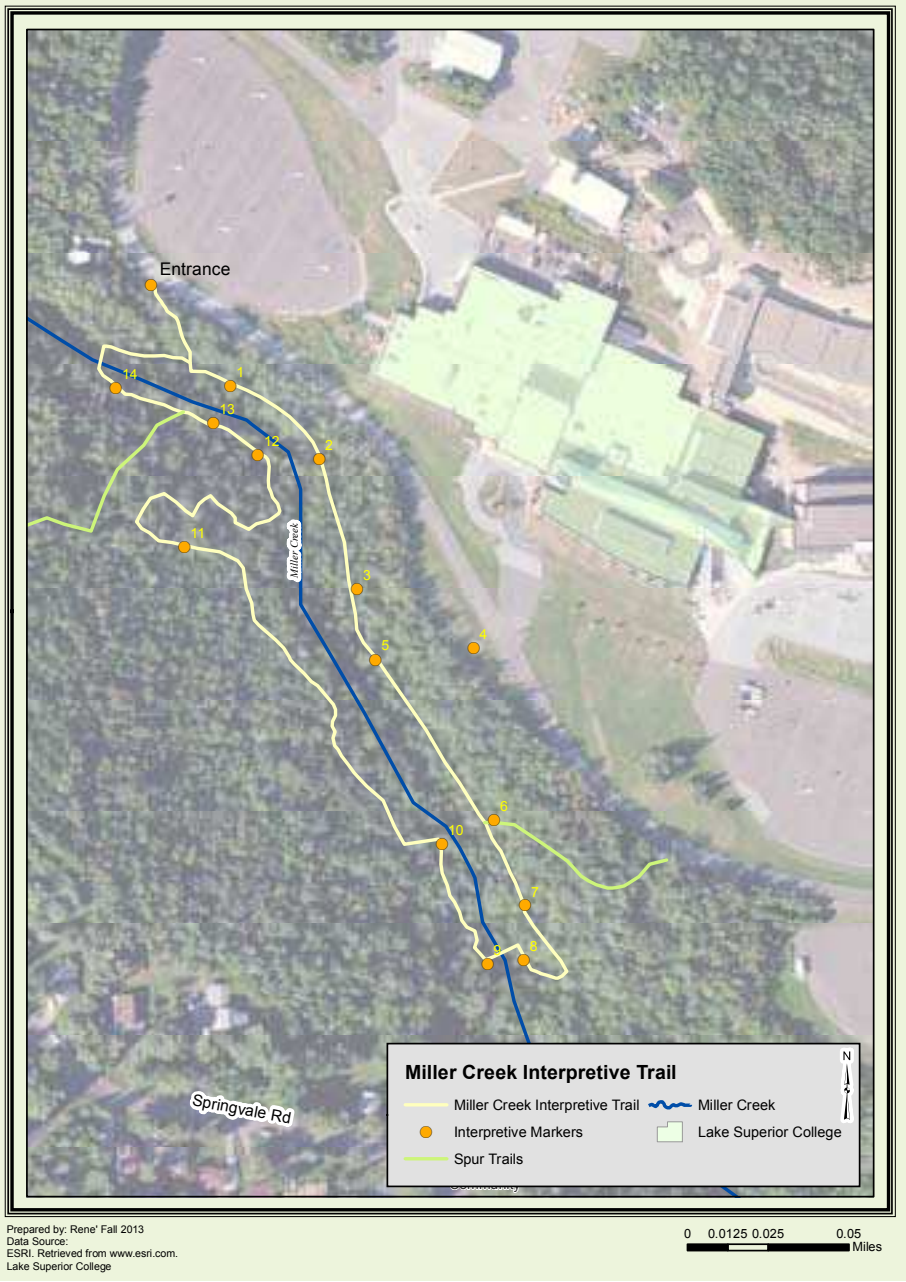
MILLER CREEK INTERPRETIVE TRAIL

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 of others who are also here to enjoy the peaceful solitude of this area.
- No littering.

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



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Site 1: Stormwater

The gully to your right was eroded by stormwater runoff from Lake Superior College's west parking lot. Stormwater is untreated runoff from weather events, along with sediment and other contaminants, which makes its way directly to surface waters such as Miller Creek.

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. Runoff from a portion of the west 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 after rain storms.

The health of watersheds depends on our behavior as individuals and communities. We need to remember that the trickles, rivulets, storm sewers, and creeks that carry water from our lawns and streets flow directly to Lake Superior.

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Site 2: 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 streams with riffles, pools, and woody debris. Gravel is required for brook trout spawning redds. Diverse substrates of sand, gravel, cobbles and boulders provide habitat for invertebrate prey. 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 gravels beds where brook trout eggs are deposited in the fall or wash away young trout in the spring.

In the summer in this ravine, Miller Creek's brook trout are blessed with a seepage of cool groundwater. This cool water has protected the trout from the high temperatures found upstream in the Miller Mall corridor.

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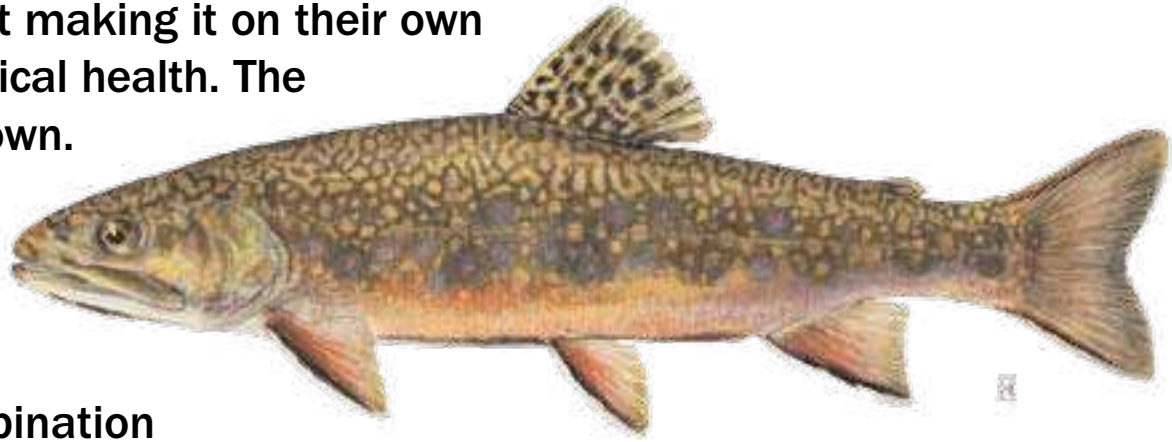
Brook Trout as an Indicator of Environmental Quality

The brook trout (*Salvelinus fontinalis*), a member of the charr family, are slow growing and short-lived in Minnesota's small trout streams but have been long cherished by anglers as little jewels. 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. The stream is threatened, but holding its own.



Recently, brook trout in Miller Creek have experienced poor reproductive success. The precise cause for this reproductive difficulty is likely a combination of factors that are being witnessed in other urban streams as well. These threats include warming of the stream, 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.

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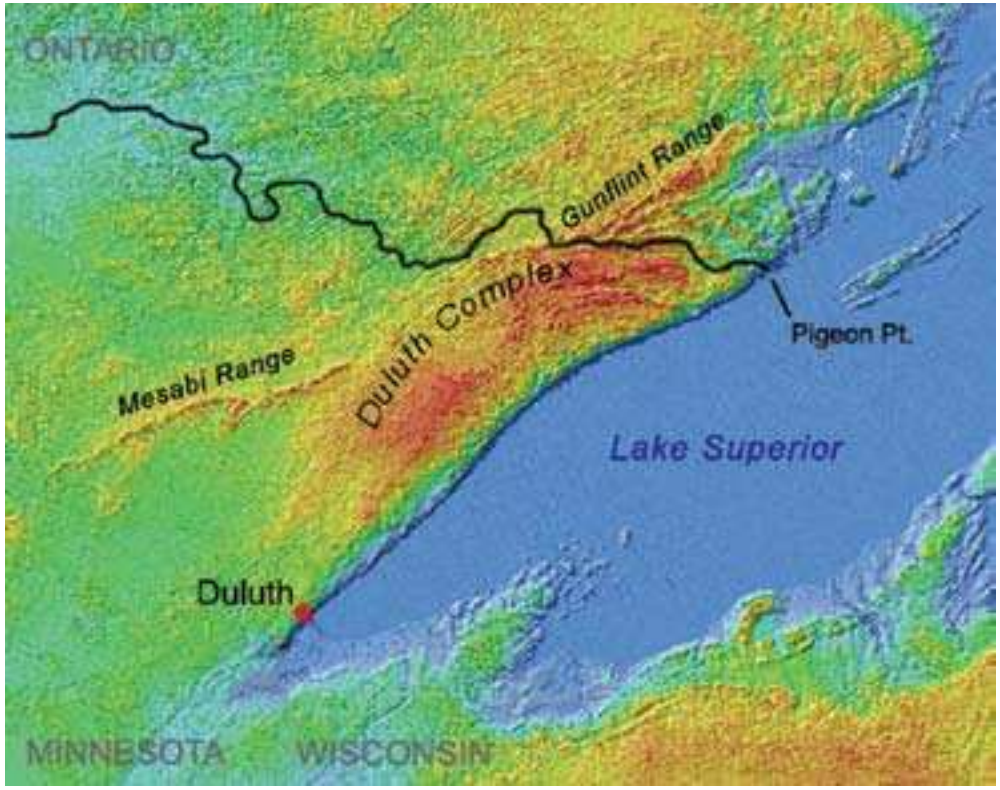
Site 3: Bedrock

The bedrock outcrop in front of you is gabbro, a common igneous rock found throughout Duluth and northeastern Minnesota. Note its coarse crystalline texture and assemblage of dark minerals.

The Duluth Complex is a group of igneous rocks that extend in an arc from Duluth over toward Ely and up to Pigeon Point along the North Shore. Gabbro is just one of the rocks that comprise this group. Dating of isotopes in the Duluth Complex suggest it is approximately 1.095 billion years old, slightly younger than the basalt lava flows found nearer to the lakeshore. Both rock units formed as North America began to separate along the mid-continent rift, a 1000-mile 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.



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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 which scratches 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 Minnesota's North Shore – shown in the image to the right.

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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 overlaid 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.

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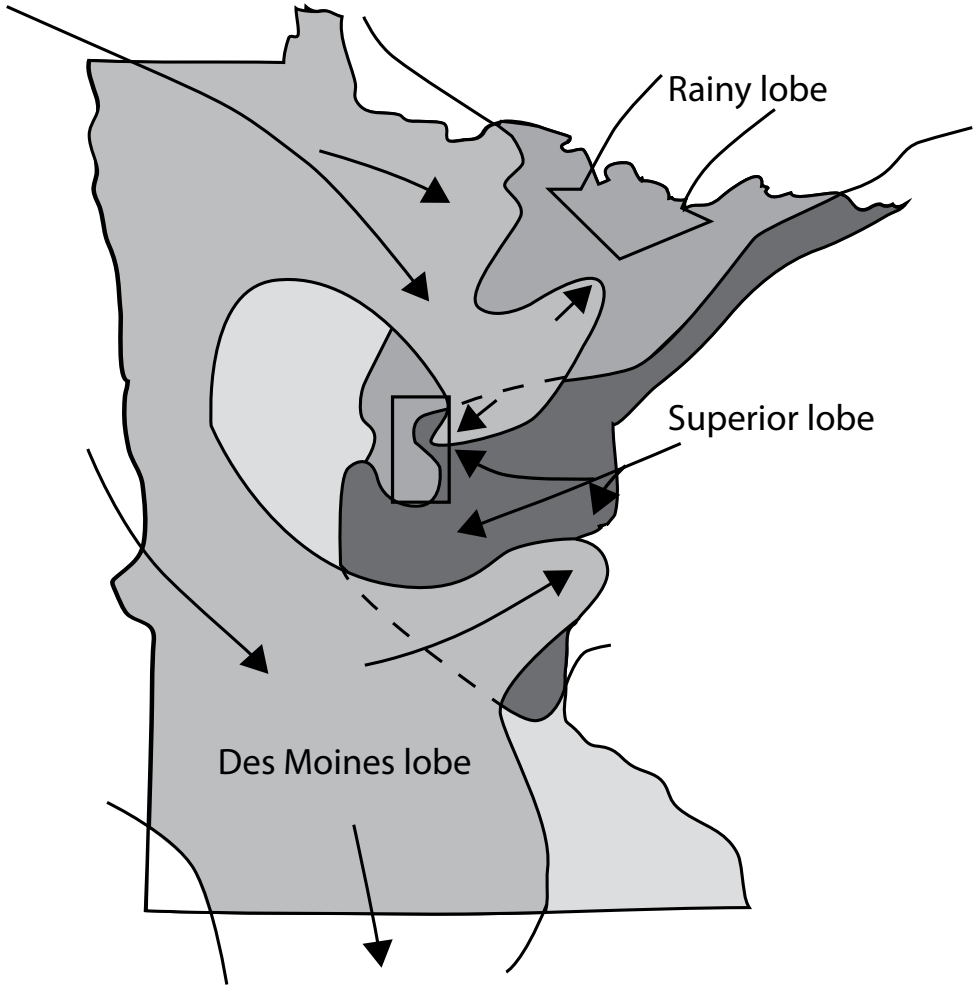
Site 6: Glacial Till

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 of Lake Superior. 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. An image of the Superior lobe is shown at right.



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Site 7: The Western Lake Superior Sanitary District's Hermantown Intercept Sanitary Sewer Line

This manhole proves 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 Western Lake Superior Sanitary District's (WLSSD) regional waste water 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 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 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)

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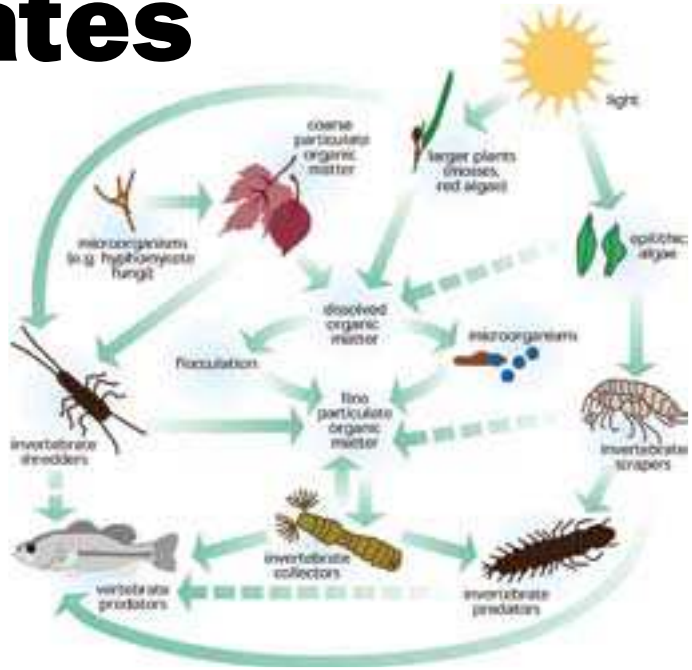
Site 8: Macroinvertebrates and Energy Flow



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 such as Miller Creek comes from the leaves and other plant matter that falls or washes into the stream, especially in autumn.

FEEDING STRATEGY	FOOD CATEGORY
I. Shredders	dead leaves/live macrophytes
II. Collectors	fine organic particles (live/dead)
filter feeders	particles in water column
miners	buried particles
browsers	bottom surface deposits
III. Scrapers	live benthic algae (diatoms)
IV. Piercers	live filamentous algae
V. Predators	other invertebrates + small fish

The entire community of macroinvertebrates 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.

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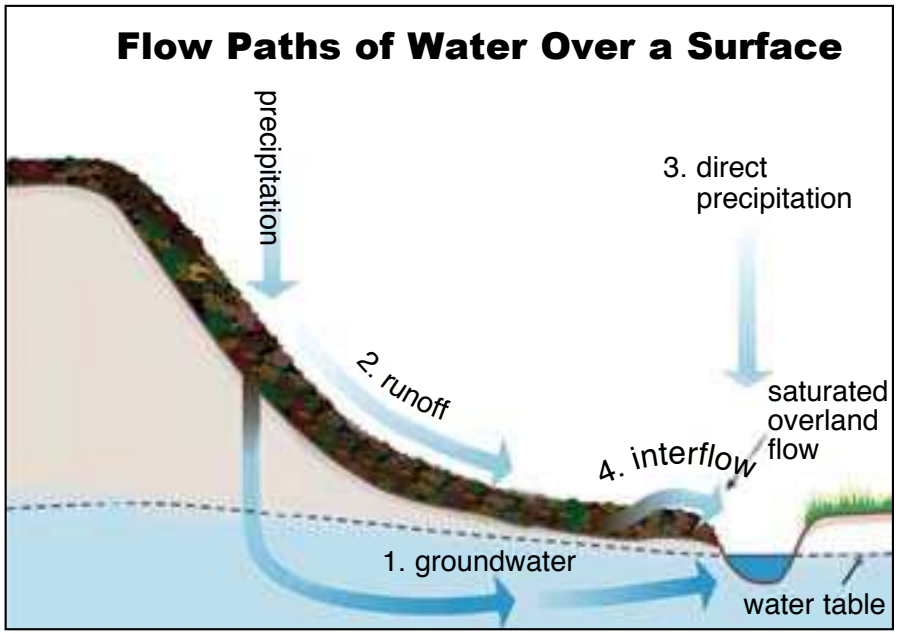
Site 9: Miller Creek Hydrology

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. 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 as shown by the rising limb of a hydrograph (see illustration). Eventually those additional sources of water taper off, and as a result water levels and volumes drop, during the receding limb.

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Site 10: White Pines of the North Shore

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 the sawmills of a bygone era. 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 F. 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.

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Site 11: Northern Hardwood Forest Restoration

This forest restoration began in 1999 when Lake Superior College received funding from the Minnesota Department of Natural Resource's Conservation Partners Program. 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 and Jay Cooke State Park.

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.

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Deer Exclosures

The exclosures you see are intended to protect planted seedlings from browsing by deer and rabbits. As the trees in the exclosures grow it is hoped they will become big enough to provide the shade and forest floor conditions necessary for the beautiful spring ephemeral flowers found in northern hardwood forests. Prior to the leaves in the tree canopy coming out in May flowers such as large-flowered trillium, pale bellwort, hairy Solomon's seal, Canada mayflower, bloodroot, white baneberry, red baneberry, and violets bloom in abundance in northern hardwood stands before falling into dormancy for the rest of the summer. 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.

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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 fern, jack in the pulpit, and spotted jewel weed to thrive. Additionally, yellow birch, white cedar, and black willows can be found next to the stream.


Ostrich fern


Jack in the pulpit

Riparian plant communities shape stream communities by preventing erosion, providing shade, and dropping their leaves into the stream each fall to provide the macroinvertebrate community with an abundance of food.


Spotted jewel weed

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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 spawing beds exposes the eggs to gentle upward currents that help to prevent silt deposition, ensuring circulation of oxygenated water through the gravel the eggs are resting in. The eggs will hatch in late March or early April.

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. Approximately 95 percent of fry die over the course of the summer. Called parr by mid-summer, the young brook trout can feed on larger prey items such as small insect larvae and other aquatic invertebrates. 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 a 1000, making the adult "brookies" we see and catch true survivors.

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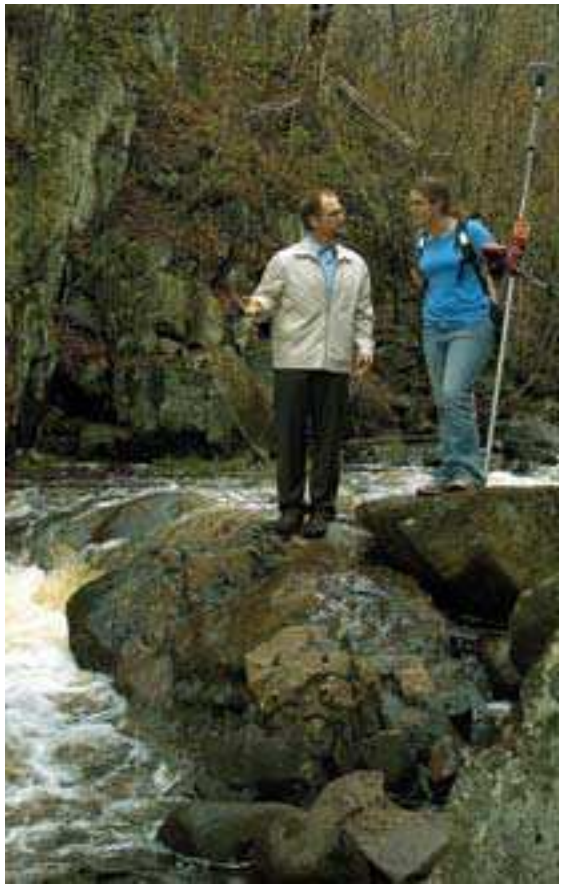
Site 14: A Resource that Belongs to Us

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 for the future if we value 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/
- 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

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Miller Creek Tree and Shrub List

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 (Fraximus 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)

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The Other Fish of Miller Creek

EASTERN BLACKNOSE DACE

Blacknose dace are one of the most common stream fishes found in north shorestreams. 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 turbulent 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 predominately 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, rosy color and develop at least four large tubercles on each 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 wetlands 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, 5 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 much 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.

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Resident Birds of the **Miller Creek Ravine** and **LSC Campus**

Compiled by Terry Wiens

American Redstart
Red-eyed Vireo
Mourning Warbler
Veery
Black-capped Chickadee
Ovenbird
Song Sparrow
Chestnut-sided Warbler
House Wren
Common Yellowthroat
Brown-headed Cowbird
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

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COOPERATORS: Since 2001, we have received assistance in the development and maintenance of the Miller Creek Interpretive Trail from many sources.

- MN DNR – Ecological Services - A Conservation Partners Grant
- MN DNR – Division of Waters
- MN DNR – Youth Conservation Corp
- South St. Louis County Soil and Water Conservation District
- Natural Resources Research Institute (NRRI) Center for Water & the Environment
- Superior Hiking Trail Association
- Lake Superior College Student Life and Student Senate
- Lake Superior College Emergency Response Training Center students
- Lake Superior College Biology, Environmental Science & Geology Departments
- Lake Superior College Sustainability Council and student employees
- Lake Superior College Civil Engineering Technology Department
- Lake Superior College Civic Leadership Students