

## 2.8 Upper Junction Creek Subwatershed



### General Description

- **Total Area :** 160.5 km<sup>2</sup>
- **Drainage:**
  - The main channel of Junction Creek is a low-gradient system, measuring 34.3 km long, with a maximum elevation of 329.5 m and minimum elevation of 243.4 m resulting in a slope of 2.5 m/km.
  - It originates in Garson Township and flows southwesterly to its final outflow into Kelly Lake where it is joined by several cold-water tributaries. The headwaters of the stream, often known as the East Branch, flows from Garson and past the conservation authority owned flood control structure, Maley Dam, after which it passes through the Provincially Significant Ponderosa Wetland and continues to flow towards downtown Sudbury. The west branch of the creek flows south from the Township of Blezard and is traversed by another Conservation Sudbury owned flood control structure – Nickeldale Dam. The branches come together and flow toward Downtown Sudbury where the creek is joined by Nolin Creek. As it proceeds southwest, it receives water from Copper Cliff Creek and then enters Kelly Lake, which also receives drainage from the Ramsey Lake subwatershed.
- **Topography:** Characterized by a very diverse topography ranging from large rock outcrops to low lying marshy areas. The drainage characteristics of the subwatershed varies from well drained to very poorly drained with imperfect to poor drainage being the most prevalent. The mean elevation of the subwatershed is 282.9 m.a.s.l., while the maximum elevation is 350.9 m.a.s.l., resulting in a mean slope of 5.2%.
- **Geology:**
  - **Bedrock Geology:** Precambrian bedrock, mainly of the Huronian Province, with some intrusions from the Superior Province. The most northern extent of the subwatershed falls within the Sudbury Igneous Complex.
  - **Quaternary Geology:** Bedrock makes up the main material along the outside edges of the subwatershed, while outwash deposits are present throughout the center. Within this outwash valley, glaciofluvial outwash deposits of gravel and sand are dominant to the north, while glaciolacustrine deposits of silt and clay become more prevalent moving south toward Kelly Lake.
  - The Wanapitei Esker overlays the majority of the headwaters, from Garson to New Sudbury.
- **Soils:** The primary surface substrate is stable bedrock, with a large area of sand identified throughout the communities of Garson and New Sudbury.

- **Groundwater:** The low-lying areas of the subwatershed associated with the valley of Junction Creek and its tributaries, are heavily covered by both 'Significant Groundwater Recharge Areas' (SGRA) and 'Highly Vulnerable Aquifers' (HVA).
  - Surveys of the creek completed in 2017 revealed iron staining throughout the subwatershed, indicating groundwater inputs.
- **Land Cover:**
  - Community/Infrastructure covers 45.9 km<sup>2</sup>, 28.6 % of the subwatershed.
  - Forest covers an area of 43.8 km<sup>2</sup>, 27.3% of the subwatershed.
  - Mining and Extraction Operations cover an area of 31.1 km<sup>2</sup>, 19.5 % of the subwatershed.
  - Exposed bedrock covers an area of 29.3 km<sup>2</sup>, 18.2% of the subwatershed.
  - Wetlands cover an area of 12.2 km<sup>2</sup>, 7.6 % of the subwatershed.
  - Lakes cover an area of 10.4 km<sup>2</sup>, 6.5 % of the subwatershed.
- **Land Use Type:**
  - **Zoning:** 141.2 km<sup>2</sup> (88%) of this subwatershed are subject to the City of Greater Sudbury's Zoning By-law. Of this area, 72.8 km<sup>2</sup> (51.6%) is industrial, 19.3km<sup>2</sup> (13.7%) is residential, 19.0km<sup>2</sup> (13.5%) is rural and 14.9km<sup>2</sup> (10.6%) is open space. The remainder are small areas designated as institutional, park, future development and commercial.

#### Indigenous Communities and Traditional Territories

- This subwatershed falls within the Robinson-Huron Treaty Area #61, of 1850. It also lies within the traditional territory of both the Wahnapiatae First Nation and the Atikameksheng Anishnawbek First Nation.

#### Development Pressure

**Overall:** High. This subwatershed has the highest amount of disturbed land from mining and urban activities, and the lowest percentage of forest or natural cover of all subwatersheds.

- **Settlement Area:** 55.6 km<sup>2</sup> (34.7%) is designated as settlement area under the CGS's Official Plan. This includes the settlements of Sudbury (48.5 km<sup>2</sup>), Garson (5.51 km<sup>2</sup>) and Lively (1.67 km<sup>2</sup>).
- **Municipal Wastewater Facilities:** All communities within this subwatershed are serviced by the Sudbury Wastewater Treatment Plant at Kelly Lake. Garson also has its own set of lagoons which are occasionally used for wastewater storage during wet weather events.
- **Forestry:** Located within the Sudbury Forest, there are no areas identified for harvest within this subwatershed, in the 2020-2030 Sudbury Forest Management Plan.
- **Aggregates:** There are currently 7 active and 1 inactive aggregate operations, covering an area of 1.34 km<sup>2</sup>.
- **Mining :**
  - Currently, there are 3 producing mines: Garson Mine, Copper Cliff North Mine, and Cooper Cliff South Mine all owned and operated by Vale. These underground operations mine primarily nickel and copper. There are also several processing facilities, including Vale's Clarabelle Mill, Nickel Refinery and Copper Cliff Smelter. Vale also operates an

extensive tailings and water management regime on their own property in accordance with provincial and federal legislation.

- Historically, 6 additional mines operated within this subwatershed: Kirkwood Mine, Copper Cliff Mine, Copper Cliff No. 1 Mine, Copper Cliff No. 2 Mine, Evans Mine and Kelly Lake Quartz.
- There are currently no active Mining Plans and Permits registered to this subwatershed.
- Within the last year, there have been no reported exploration activities.

### Recreational Use

- Recreation in this subwatershed is mainly restricted to city or privately owned facilities and properties such as trails, parks and open space, often used for hiking, cycling and outdoor appreciation, such as Fielding Park and the Junction Creek Waterway.
- Nepahwin beach is 1 of 7 municipal beaches, located on the shores of Lake Nepahwhin.
- Many of the urban lakes within this subwatershed are used for boating, canoeing, kayaking and fishing.
- Blueberry picking is a common activity, particularly in the sandy areas around Garson and New Sudbury.
- The less developed northern areas of the subwatershed are used unofficially by off-road vehicles.
- Conservation Sudbury has 3 conservation areas located within this subwatershed.
  - Maley Conservation Area: contains unofficial trails and Timberwolf Golf Course (privately owned)
  - Nickeldale Conservation Area: contains the New Sudbury Historical Trail (Rainbow Routes). The Walden Mountain Bike Club also maintains a trail system in the Nickeldale CA for all season mountain biking.
  - New Sudbury Conservation Area: contains the Rotary Park Trail/Junction Creek Waterway (Rainbow Routes) and Adanac Ski Hill and soccer fields (CGS).
- There are 4 golf courses within this subwatershed – Cedar Green and Timberwolf Golf Courses and a portion of both the Idylwilde Golf Course and Stonehill Golf Course.

### Water Control Structure

In total, 8 dams, 2 major culverts and 2 berms help to regulate water levels in this historically flood-prone subwatershed.

- **Maley Dam:** Owned and operated by Conservation Sudbury this dam is located on the east branch of Junction Creek. The dam, built in 1971, is an earth fill structure draining an area of approximately 29 km<sup>2</sup> in the headwaters of Junction Creek. The dam's main function is to retain stormwater and provide control of water released downstream via Junction Creek.
- **Nickeldale Dam:** Owned by Conservation Sudbury the dam, built in 1980, is an earth fill structure controlling a drainage area of approximately 10.5 km<sup>2</sup>. The dam's main function is to retain stormwater up to the Regional Flood level and to provide control of water released into Junction Creek.

- **Flood Dam:** Owned by Conservation Sudbury, this dam was constructed in 1968 to alleviate some of the flooding in Sudbury's Downtown Core resulting from Junction Creek and its tributaries.
- **Box culvert:** A large box type structure, known as the Junction Creek Culvert, measuring approximately 3.7m x 8.3m, runs beneath the city from the intersection of Elm Street and Notre Dame Ave to the C.N.R. crossing at Brady Street. A second box culvert, measuring 2.7m x 6m, surrounds a portion of Nolin Creek from College St to its confluence with the Elm St. culvert.
- **Kelly Lake Weir:** Owned by Conservation Sudbury to manage water levels in Kelly Lake, this concrete weir is about 18.3m long and 1.22 m high. It is located within Fielding Park.
- **Nepahwin Dam:** Owned and operated by Conservation Sudbury, this 3-bay dam serves to control water levels in Nepahwin Lake and downstream.
- **Private Dams:** A number of private dams are present within this subwatershed including:
  - Unnamed Dam - Copper Cliff Creek at Kelly Lake Rd.
  - Lady MacDonald Lake Dam and an unnamed dam within the Copper Cliff mining complex
  - Kirkwood Dam, owned by Vale, is a water retention pond dam controlling water levels at the old Kirkwood Mine site.
- **Rutherglen Berm and Maley Dyke (Lillian Berm):** Constructed by Conservation Sudbury, a large mound of earth constructed along Rutherglen Crescent and Lillian Blvd were built to prevent flooding of residential properties in these areas.

#### Water use

- There are currently 37 active Permits to Take Water within this subwatershed, held mainly by Vale, as well as 2 operating golf courses.

#### Notable Waterbodies

- **Kelly Lake** (aka Kelley Lake) is a medium urban lake measuring 340.8 ha, with a maximum depth of 18 m. Kelly Lake has 1 permanent and no seasonal residents.
- **Lake Nepahwin** is a small urban lake measuring 127.0 ha, with a maximum depth of 22m. This lake has 1822 permanent and 3 seasonal residents.
- **St. Charles Lake** is a small urban lake measuring 41.3 ha. The lake has 259 permanent and 9 seasonal residents.
- **Robinson Lake** is a small urban lake measuring 33.6 ha, with a maximum depth of 2m deep. The lake has 38 permanent and no seasonal residents.
- Other waterbodies of small and medium size in this subwatershed are well known and have been part of long-term monitoring programs.
  - **Hannah Lake** – 27.7 ha, 8m deep; 38 permanent and 4 seasonal residents.
  - **Middle Lake** - 28.1 ha, 12m deep; 46 permanent and 15 seasonal residents.
  - **Crooked Lake, Bennett Lake, and Johnny Lake**

## Previously Identified Management Issues

### **Flooding:**

- Flooding has historically been a problem in the Flour Mill area and downtown core as many parts of the natural floodplain were built up into these neighborhoods. Exposed bedrock, thin soils and the lack of vegetation result in a rapid runoff rate, exacerbating flooding. The construction of Frood, Clarabelle, Maley and Nickeldale Dams and Reservoirs as well as the Nolin/Junction Creek Box Culvert were all in an attempt to prevent ongoing flooding issues. Even today, some of these areas are the first to see localized ponding and flooding during the spring freshet and heavy rain events.
- Simulations carried out during the development of the Junction Creek Flood Plain Mapping (1980) identified areas of Copper Cliff where extensive flooding is expected due to rapid runoff rates and constrictions to flow downstream. Severe flooding along Lily Creek (between Martindale Rd and Ramsey Lake), and potential washout of Martindale Rd were also identified during the Junction Creek Flood Plain Mapping study (1980).

### **Erosion and sedimentation:**

- Streambank erosion and sedimentation has been an issue in Junction Creek and Nolin Creek due to the nature of the substrate (silt and sand) as well as the high urban and mining impacts to the surrounding landscape. The main solution proposed was to revegetate the watershed.
- More recently, a “high level of bank erosion” was identified throughout the section of the creek downstream of the underground box culvert. (Junction Creek Subwatershed Study and Stormwater Master Plan).

## Natural Hazard Identification and Regulation

Hazards and features regulated by Conservation Sudbury include flood and erosion hazards, wetlands, unstable soils, rivers, streams, creeks, and small inland lakes. More on these regulations can be found in the Conservation Authorities Act, O. Reg. 686/21 that addresses the risks of natural hazards.

- **Floodplain mapping:** Developed for Junction Creek, in 1980, to the Timmins and 100-year flood levels. This flood mapping also included tributaries to Junction Creek, such as Nolin Creek, Lily Creek and Copper Cliff Creek. Conservation Sudbury is in the process of developing new floodplain mapping for the Upper Junction Creek subwatershed. This is expected to be completed in 2025.
  - In the absence of floodplain mapping, flood hazards are estimated based on site conditions. Typically, the extent of the flood hazard is estimated at 1.2 m above the bank full or high-water elevation.
- **Erosion hazard mapping:**
  - Field surveys of erosion and bank stability problems along Junction Creek and its major tributaries were completed in 1982 (Junction Creek Watershed Management Study, 1982).

- Active erosion sites were also surveyed along the creek and its tributaries in May 2017 (Junction Creek Subwatershed Study, 2017).
- The watercourse has been subject to significant historic realignment. A section of the watercourse north of downtown is scheduled for a major dredging and channel armouring beginning 2025.
- Currently, erosion hazards are evaluated based on the general guidance from the MNRF for confined and unconfined systems.

### **Drinking Water Source Protection**

- Garson Well 1 and 3 and their associated Well Head Protection Areas (WHPA) are in the north end of this subwatershed. Garson Well 2 is located just outside of the subwatershed, however its WHPA does fall within it. These wells services the east end of Garson.

### **Water Quality Indicators**

#### **Surface Water:**

- Historically, Junction Creek water quality was very poor due to a variety of impacts including logging, mining and smelting operations and urban development, progressively deteriorating as it moved from its headwaters, downstream through Sudbury (NDCA Watershed Inventory, 1980).
- Water quality from the east branch of Junction Creek had extremely high total phosphorus, impaired dissolved oxygen and elevated metals and ammonia levels, all indicating high organic and industrial inputs to the system.
- The west branch of Junction Creek was heavily polluted by heavy metals and organic waste from both organic and mine discharges.
- Long-term data collected through the PWQMN program (see Data available section) on the Junction Creek at the outlet of Kelly Lake, indicate that metals such as copper and nickel still regularly exceed the provincial water quality objectives, while others such as aluminium and iron only periodically exceed these objectives. Other parameters such as total phosphorus and chloride are also mostly above provincial objectives. This is further supported by consistently high conductivity level, relative to other streams in the region.
- Nolin Creek was heavily polluted with heavy metals and organic waste from industrial discharges and municipal sewage effluent.
- Benthic invertebrate and fish diversity in the creek and its tributaries was severely impaired.
- Though positive change has occurred throughout the creek and its tributaries, a more recent analysis revealed that the main stem of Junction Creek continues to exceed provincial water quality objectives for most water quality parameters.
- More recently, Copper Cliff Creek had several samples where chloride was above the Provincial Water Quality Objectives. Road salts were the main suspect in these loadings. (Vermilion River Watershed Surface Water Quality Report on Current Conditions, 2017)

- Vale is currently working on their 'Slag East Project' to redirect and contain surface and groundwater originating from their mine sites so they are treated properly before being discharged. This project is to be completed by 2029.

#### **Lakes:**

- The CGS's lake water quality program has identified that the following lakes are:
  - Eutrophic: Kelly Lake
  - Mesotrophic: Lake Nepahwin, St. Charles Lake, Crooked Lake and Robinson Lake (nearly eutrophic)
  - Oligotrophic: Hannah Lake, Middle Lake

#### **Groundwater:**

- The Garson wells have detectable levels of tetrachloroethylene (PCE) which have gradually increased over time, though still well below the maximum acceptable concentration. Four groundwater wells have been added to the system to monitor this chemical of concern.

#### **Significant Features**

- There are no provincial parks, conservation reserves or ANSI ecological areas of interest.
- There are no wildlife values identified in this subwatershed.
- Candidate Provincial ANSI identified in the City of Greater Sudbury Official Plan are:
  - Kelly Lake Shatter Cones
- Candidate Regional or Local ANSIs identified in the CGS OP are:
  - Robinson Lake-Ramsey Lake Pecors Formation
- **Ponderosa Wetland:** Located in the center of the city, this 154-ha wetland was designated a Provincially Significant Wetland (PSW) in 2017. It plays a valuable role providing ecosystem services such as flood attenuation and water filtration, while also providing a sanctuary to wildlife and plants.
- A large area of wetlands in the vicinity of Lily Creek, Robinson Lake and Kelly Lake was also identified as a 'substantial feature' due to their good connectivity to each other and other natural features supporting the ecological function of the subwatershed.
- Conservation Sudbury has 3 Conservation Areas located within this subwatershed:
  - **Maley Conservation Area:** Covering an area of 381.8ha, this space was acquired by the Conservation Authority leading up to the construction and opening of the Maley Dam and Reservoir in 1971. Many of the lands are low in fertility, with shallow, poorly drained soils that experience periodic flooding. The other dominant feature is the outcrops of Precambrian rock, which historically held little to no vegetation, but today support young forest communities. Today, this area supports several unofficial trails used by the local community. It is also occupied by a golf course.
  - **Nickeldale Conservation Area:** Covering an area of 50.4 ha, this land was acquired by the Conservation Authority for the development of the Nickeldale dam and reservoir. The most common topographical features are the rocky Precambrian outcrops and the lowland areas adjacent to Junction Creek. It also hosts a well-used recreational trail.

- **New Sudbury Conservation Area:** located in an area characterized by rocky hills and lowland areas and intersecting with the PSW Ponderosa Wetland, this area, identified as hazard land, plays an important role in water retention and flood management within the Junction Creek subwatershed. It also supports a section of the Junction Creek Waterway Trail, the Rotary Park Trail, a recreational sports field and Adanac Ski Hill as well as the former Barrydowne Arena.

## Management and Stewardship

- **Wahnapitae First Nation and Atikameksheng Anishnawbek First Nation:** Their traditional territories include the area within these subwatersheds. They are land holders of the area and, as such, are stewards of the land.
- **Junction Creek Stewardship Committee:** An active organization dedicated to improving the state of Junction Creek. They have completed many research and improvement projects, including pioneering the Junction Creek Waterway Trail, the daylighting of Junction Creek at Garson Park, many garbage cleanups, shoreline stabilization studies, invasive species monitoring, water quality monitoring, annual brook trout releases and monitoring, riparian plantings and sediment and erosion monitoring. They also completed the evaluation of the Ponderosa Wetland which led to its designation as a 'Provincially Significant Wetland' in 2017.
- **City of Greater Sudbury Regreening Program and VETAC:** Historically, areas of this subwatershed were described as barren or sparsely vegetated with scrub on a terrain of shallow or absent soil cover. This area, damaged by poorly regulated mining activities in the mid-1900s, was the result of acid and sulphur depositions and soil erosion which took place over several decades. Since then, many areas within the Sudbury 'barren and semi-barren' zones have been revegetated thanks to the efforts of the CGS regreening program and have left the formerly barren landscapes covered in vegetation. The CGS's regreening program has completed regreening work on 55.2 km<sup>2</sup> (34.4%) of this subwatershed.
- **Rainbow Routes Association** – Advancing and promoting trails to provide citizens with active, healthy and affordable recreation. Their vision is to link communities and meet diverse outdoor recreation and healthy living needs.
- **Lake Nepahwin Watershed Stewardship**
- **St. Charles Lake Watershed (Middle and Hannah Lakes)**
- **Robinson Lake Initiative**

**Data available**



- **Provincial Stream Water Quality Monitoring Network:** Conservation Sudbury, in partnership with the Ministry of Environment, Conservation and Parks, has collected surface water quality at 2 locations in this subwatershed:
  - Lily Creek at Paris, monitoring the outflow of the Ramsey Lake subwatershed as it empties into Lily Creek, a tributary to Junction Creek.
  - Junction Creek downstream of Kelly Lake, since 1968, at the outlet of the subwatershed.
  - Historically, several other locations were sampled sporadically between 1968 and 1996 including upstream of Kelly Lake, Kelly Lake Rd., Lasalle Blvd., King St., Orell St., and many others.
- **Provincial Groundwater Monitoring Network:** Conservation Sudbury, in partnership with the Ministry of Environment, Conservation and Parks, have collected groundwater quantity and quality data at 1 well located near Lively, though water quality data is sparse at this site.
- **Water Survey of Canada – Active Stream Gauging Stations** monitoring water level and discharge:
  - Junction Creek @ Sudbury – St. 02CF005 – active 1958-1987, 2006-present
  - Nolin Creek was also monitored from 1959-1994.
- **Conservation Sudbury – Active Stream Gauging Stations** monitoring water level:
  - Junction Creek @ Maley Dam – 2017 to present.
  - Junction Creek @ Leslie St – 2017 to present.
- **Junction Creek Stewardship Committee:** Has collected a variety of biological data, including angling surveys, benthic surveys and amphibian surveys. They also conduct monthly water samples at 10 sites between Garson and Kelly Lake and ongoing water monitoring with data loggers.
- **Vermilion River Stewardship** group funded the collection of water quality samples from 27 sites within the Vermilion River watershed between 2013 and 2015, 1 of which was located within the Lower Junction Creek subwatershed.
- **City of Greater Sudbury:** Lake Water Quality Program collects spring total phosphorus data from Kelly Lake, Nepahwin Lake, Robinson Lake, St. Charles Lake, Crooked Lake, Middle Lake, and Hannah Lake.
- **City of Greater Sudbury – Water and Wastewater:** Raw water and treated water from the Wanapitei River are sampled and tested regularly, as required by O. Reg. 170/03.
- **Co-operative Freshwater Ecology Unit:** The following lakes were identified as ‘Urban Lakes’ and sampled by the CFEU at various intervals for various programs: Crooked Lake, Hannah Lake, Johnny Lake, Kelly Lake, Lady MacDonald Lake, Middle Lake, Nepahwin Lake, St. Charles Lake and Robinson Lake. Hannah and Middle Lake have also been sampled monthly as part of the ‘Intensive’ lakes program, since the 1970s.
- **Lake Partner Program:** Nepahwin Lake, Robinson Lake, Kelly Lake, St. Charles Lake, Middle Lake, Hannah Lake and Crooked Lake have all been sampled for total phosphorus and occasionally secchi depth as part of this provincially run, volunteer-based program.
- **Public Health Sudbury and District:** Collects water samples from public beaches in the Sudbury area to identify any health hazards.

- **Vale Canada Ltd** and **Glencore Sudbury Integrate Nickel Operations** both collect a variety of environmental data (air, surface water, groundwater) to monitor and ensure compliance with ISO 14001 standards for environmental management and performance.

### **Supporting Documents**

City of Greater Sudbury, **Junction Creek Subwatershed Study and Stormwater Master Plan**, December 2019.

Conservation Sudbury, **Vermilion River Watershed Surface Water Quality Report on Current Conditions**, March 2017.

City of Greater Sudbury, **Water and Wastewater Master Plan – Existing Water Systems**, 2017.

Conservation Sudbury, **Greater Sudbury Source Protection Area - Assessment Report**, September 2, 2014.

City of Greater Sudbury, **Greater Sudbury Natural Heritage Report**, May 2013.

Nickel District Conservation Authority, **Nickeldale Dam - Operation, Maintenance, Surveillance and Emergency Preparedness Manual**, 2010.

AMEC Earth & Environmental, **Dam Break Inundation Study – Nickeldale Dam**, 2006.

AMEC Earth & Environmental, **Maley Dam Break Inundation Study**, 2004.

Dennis Consultants, **Nolin Creek Flood Control Project – Final Report**, June 1997.

Northland Engineering Ltd, **Junction Creek Watershed Preliminary Engineering Report – Flood Damage Reduction and Erosion Control**, October 1982.

Nickel District Conservation Authority, **NDCA Watershed Inventory**, September 1980.

Kilborn Ltd, **Flood Plain Mapping of Junction Creek** - Tech Report & Summary Report, 1980

Dillon Consulting, **Environmental Impact Statement – Nickeldale Dam and Reservoir**, Jan 1980.










Nickel District Conservation Authority, **Maley Conservation Area Draft Masterplan**, 1979.

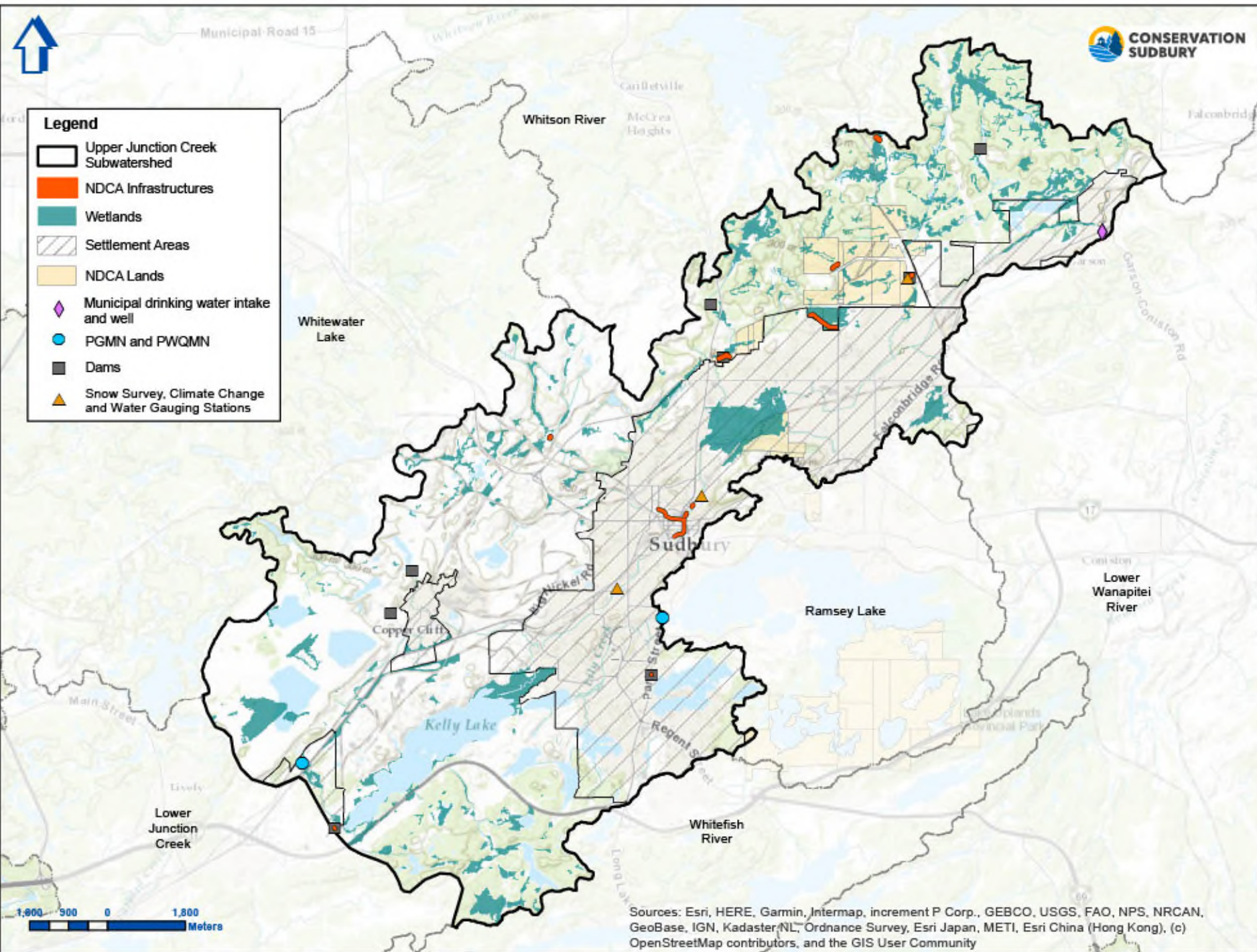
Nickel District Conservation Authority, **Nickeldale Conservation Area Draft Masterplan Report**, 1979.

Ontario Water Resource Commission, **Biological Survey of the Streams and Lakes of the Sudbury Area**, 1968.



**Legend**

-  Upper Junction Creek Subwatershed
-  NDCA Infrastructures
-  Wetlands
-  Settlement Areas
-  NDCA Lands
-  Municipal drinking water intake and well
-  PGMN and PWQMN
-  Dams
-  Snow Survey, Climate Change and Water Gauging Stations



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster/NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community