INARCH Basin/Site Information Form

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| Basin/Site Name | Wolf Creek Research Basin |

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| Country; Province/State | Canada; Yukon Territory |

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| Website (If Available) | <http://www.wolfcreekresearchbasin.ca/> |

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| Operational Management | McMaster Watershed Hydrology Group, McMaster University;  Water Resources Branch, Yukon Environment;  Centre for Hydrology, University of Saskatchewan |

Basin/Site Location (Centroid Coordinates)

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| Coordinate Format | Latitude | Longitude |
| Decimal Degrees | 60.52°N | 135.13°W |

Oversight/Contacts

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| Name | Role | Contact Information |
| Dr. Sean Carey | Professor and Director of Watershed Hydrology Group, McMaster Univ. | Email: [careysk@mcmaster.ca](mailto:careysk@mcmaster.ca)  Phone: 1-905-525-9140 ext. 20134 |
| Dr. John Pomeroy | Director, INARCH & Centre for Hydrology, Univ. Saskatchewan | Email: [john.pomeroy@usask.ca](mailto:john.pomeroy@usask.ca)  Phone: 1-306-966-1426 |
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Purpose/Scientific Focus

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| Wolf Creek Research Basin (WCRB) is located on the traditional territory of the Kwanlin Dün First Nation, Ta’an Kwäch’än Council and Carcross/Tagish First Nation. In 1992, the WCRB was established in the sub-Arctic mountainous headwaters of the Yukon River, near Whitehorse, Yukon, Canada and is representative of many headwater basins along the far northern reaches of the North American Cordillera. WCRB was established to provide science-based evidence for decision-making in the across of water, climate and the biosphere and to provide a test-bed to help resolve deficiencies in hydrological models in cold climates. The foundation of research in WCRB is to improve the understanding of cold region hydrological processes and their interaction with climate and vegetation and to better represent this understanding through improved conceptualization and parametrization of numerical hydrological and related models. |

Basin/Site Characteristics

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| Location (Physiographic Region) | WCRB is a subarctic headwater basin, situated within the Watson Highlands Boreal Cordillera Ecological Region of North America, with a long and cold snow season characterized by low precipitation. |
| Area (km2) | 179 km2 |
| Elevation (m; Mean, Maximum, Minimum) | Min: 660 m; Max: 2080 m; Mean: |
| Description (Physical–Ecological–Climatic Characteristics) | Mountainous landscape with a complex geology and glacial history, and thick till deposits. Sporadic permafrost at high elevations and north-facing slopes (~30% of WCRB). Cold subarctic climate; conditions are somewhat continental as the basin is situated leeward of higher, glaciated mountains in coastal B.C. and Alaska. Distinct ecological biomes include alpine tundra, shrub tundra and taiga, and boreal forest. |
| Drainage/River System | Located near Whitehorse, Yukon within the Upper Yukon River Basin; representative of much of the interior Subarctic Cordilleran landscape. |
| Site History or Historical Context | Initiated as a long-term multidisciplinary research project in 1992. See “History of WCRB”: <http://www.wolfcreekresearchbasin.ca/history.html> |
| Years of Data | 1993 – present |

Other Info

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| Glacierized Area (% and year(s) measured) | No glaciers, but some small perennial snow drifts on leeward slopes at high elevations. |
| Main Land Cover(s) | Dense Boreal Forest at lower elevations, sparse forest, open meadow and shrub tundra at the higher elevations, and exposed alpine areas with mostly bare rock at the highest elevations. |
| Lithology/Soils | Primarily sedimentary rocks capped by a mantle of till at least 2 m thick, as well as glaciofluvial and glaciolacustrine deposits. Well drained soils with coarse parent materials. Lower elevation forest soils are clay to gravel texture, while upland soils are sandy loam to gravely sandy loam texture. Surface organics commonly extend to depths of 0.1 m and are deepest in riparian areas and north-facing slopes. |
| Mean Monthly and Annual Temperature (°C) | J F M A M J J A S O N D A  -14.2; -12.1; -9.6; -2.2; 4.6; 9.4; 11.0; 9.4; 4.0; -2.4; -10.6; -12.9; -2.1 (average from Alpine, Buckbrush, and Forest stations; 1993–2019) |
| Mean Total Monthly and Annual Precipitation (mm) | J F M A M J J A S O N D A  26.4; 17.2; 16.9; 11.4; 20.8; 42.1; 47.6; 44.3; 36.8; 33.7; 28.0; 23.6; 348.7 (average from Alpine, Buckbrush, and Forest stations; 1993–2019) |
| Snow Characteristics | Above treeline, snow is highly redistributed due to wind and blowing snow—deep drifts form on leeward slopes and in sheltered terrain. Snow or hoarfrost can frequently build up on sensors in midwinter. Seasonal, dry snow, lots of depth hoar, high density in alpine. Snowmelt dominated runoff with peak flows in late May or early June and low flows in March. |
| Additional Noteworthy Characteristics of Basin/Site | Road access by truck/ATV in summer and snowmobile in winter. Nearby accommodation available. Major airport and upper air station in Whitehorse. Year-round measurements now available due to two-full time technical staff on-site. |

Data and Observations

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| **Available Geospatial Data** | **Notes (e.g., Source, Resolution, Error/Uncertainty, Date, etc.)** |
| Elevation | Digital elevation model (DEM) with 30 m resolution—available from and described by Rasouli et al. (2019) <https://doi.org/10.5194/essd-11-89-2019>  Updated LiDAR from August 2018. Flown by Brian Menounos. Not published. Point density of 12/m2. |
| Landcover and Soils | Landcover types in Wolf Creek Research Basin—Raster file available from and described by Rasouli et al. (2019) <https://doi.org/10.5194/essd-11-89-2019>  Updated by Landsat 7 and 8; LiDAR |
| Stream/River Network | Location of the streams; Location of the lakes—Shapefiles available from and described by Rasouli et al. (2019) <https://doi.org/10.5194/essd-11-89-2019> |
| Basin Delineation/Shapefile | Boundary of Wolf Creek Research Basin—Shapefile available from and described by Rasouli et al. (2019) <https://doi.org/10.5194/essd-11-89-2019> |
| *Other Geospatial Data (add rows as necessary)* |  |

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| **Observation Stations (Specific Instrument/Sensor Details to be Filled Below)** | | | | | |
| **Type** | **Station Name** | **Latitude** | **Longitude** | **Elevation** | **Notes/Details** |
| Meteorological | Shrub Tundra–Taiga Station (Buckbrush) | 60.522°N | 135.197°W | 1250 m | East-facing moderate slope |
| Meteorological | Alpine Tundra Station (Alpine) | 60.567°N | 135.150°W | 1615 m | Windswept ridge top plateau |
| Meteorological | White Spruce Forest Station (Forest) | 60.596°N | 134.953°W | 750 m | Gently undulating terrain |
| Meteorological | Whitehorse WSO | 60.733°N | 135.083°W | 706 m | At Environment Canada site |
| Hydrometric | Upper Wolf Creek | 60.491°N | 135.292°W | 1295 m | Drainage area: 14.4 km2 |
| Hydrometric | Coal Lake Outlet | 60.510°N | 135.162°W | 1190 m | Drainage area: 70.5 km2 |
| Hydrometric | Granger Creek | 60.546°N | 135.185°W | 1312 m | Drainage area: 7.6 km2 |
| Hydrometric | Alaska Highway | 60.600°N | 134.950°W | 703 m | Drainage area: 179 km2 |
| Groundwater Well | Wolf Creek Well | 60.574°N | 134.962°W | 750 m | Water level and temperatures |
| *Other Stations (add rows as necessary)* |  |  |  |  |  |

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| **Data Availability and Access (Please provide links/DOIs to published or available data and descriptions; Add rows as necessary)** |
| Rasouli, K., Pomeroy, J. W., Janowicz, J. R., Williams, T. J., and Carey, S. K.: A long-term hydrometeorological dataset (1993–2014) of a northern mountain basin: Wolf Creek Research Basin, Yukon Territory, Canada, Earth Syst. Sci. Data, 11, 89–100, <https://doi.org/10.5194/essd-11-89-2019>, 2019. |
| Wolf Creek Research Basin Realtime and Historical Data: <http://www.wolfcreekresearchbasin.ca/data.html> |

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| **Meteorological Variables and Sensor Details** | | | | | |
| **Variable** | **Station** | **Sensor(s)** | **Height/ Depth (m)** | **Record Period and Frequency** | **Notes/Details** |
| Air temperature and Relative Humidity | Alpine | Vaisala HMP35CF  HM45C212 (post-2005) | 2.05  2.05 | 1993 – present  Hourly |  |
| Buckbrush | Vaisala HMP35CF  HMP45-212 (post-2005) | 2.6  2.6 | 1993 – present  Hourly |  |
| Forest | Vaisala HMP35CF  HMP45-212(post-2007) | 21.34  21.34 | 1993 – present  Hourly |  |
| Solar Radiation | Alpine | LiCor Li200S  Kipp & Zonen CMP3-L (post 2005) | in: 2.93  out: 1.69 | 1993 – present  Hourly | Both incoming and outgoing solar radiation measured |
| Buckbrush | LiCor Li200S  Kipp & Zonen CMP3-L (post 2006) | in: 4.8  out: 4.4 | 1995 – present  Hourly | Both incoming and outgoing solar radiation measured |
| Forest | LiCor Li200S  Kipp & Zonen CMP3-L (post-2007) | in: 20.43  out: 14.33 | 1995 – present  Hourly | Both incoming and outgoing solar radiation measured |
| Longwave Radiation |  |  |  |  |  |
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| Net Radiation | Alpine | REBS Q6.0  NR-Lite (post 2004) | 1.68  1.68 | 1993 – present  Hourly |  |
| Buckbrush | REBS Q6.0  NR-Lite (post 2006) | 3.10  3.18 | 1993 – present  Hourly |  |
| Forest | REBS Q6.0  NR-Lite (post 2006) | 19.82  19.82 | 1993 – present  Hourly |  |
| Wind Speed/Direction | Alpine | NRG 40 cup anemometer  NRG 200P | 2.75  2.75 | 1993 – present  Hourly |  |
| Buckbrush | NRG 40 cup anemometer  RM Young 5103 | 4.6  4.98 | 1993 – present  Hourly |  |
| Forest | NRG 40 cup anemometer  RM Young 5103 | 19.82  20 | 1993 – present  Hourly |  |
| Precipitation | Alpine | Texas TE525M TBRG  Geonor T200B | 1.87 | 1993 – present  Daily |  |
| Buckbrush | Texas TE525M TBRG  Standpipe  OTT Pluvio version 200  Geonor T200B | 4.76 | 1993 – present  Daily |  |
| Forest | Texas TE525M TBRG  Geonor T200B | 21.34  1.75 | 1993 – present  Daily |  |
| Atmospheric Pressure |  |  |  |  |  |
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| Ground Heat Flux | Alpine | REBS HFT3 | –0.08 | 1994 – present  Hourly |  |
| Buckbrush | REBS HFT3 | –0.11 | 1993 – present  Hourly |  |
| Forest | REBS HFT3 | –0.16 | 1994 – present  Hourly |  |
| *Other Variables (add rows as necessary)* |  |  |  |  |  |
| **Additional Notes and Details on Meteorological Observations** | | | | | |
| Other stations within Granger Creek Sub-Basin have been in operation for limited periods of time:   * Granger Basin 2 (GB2); 2000 – 2009 * Granger Basin 3 (GB3); 1998 – 2004 * Granger Basin 4 (GB4); 1998 – 2004 * Granger Basin 5 (GB5); 1999 – 2008 | | | | | |

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| **Hydrological Variables and Sensor Details** | | | | | |
| **Variable** | **Station** | **Sensor(s)** | **Height/ Depth (m)** | **Record Period and Frequency** | **Notes/Details** |
| Evaporation |  |  |  | 30-minute average | Eddy covariance |
| Snow Water Equivalent | Buckbrush | Snow pillow, Sommer SSG, 2Kr SSC, Geonor, Pluvio |  | 30-minute |  |
| Snow Depth | Alpine | CSI UDG01  UDG01 (post-2005) | 1.65 | 1993 – present  Hourly |  |
| Buckbrush | CSI UDG01  SR-50 (post-2005) | 1.67 | 1993 – present  Hourly |  |
| Forest | CSI UDG01  SR-50 (post-2007) | 1.41 | 1993 – present  Hourly |  |
| Soil Moisture | Alpine | CSI CS615 TDR | –0.05,  –0.15 | 1997 – present  Hourly |  |
| Buckbrush | CSI CS615 TDR | –0.05,  –0.15,  –0.30,  –0.80 | 1996 – present  Hourly |  |
| Forest | CSI CS615 TDR | –0.05,  –0.15,  –0.30,  –0.80 | 1997 – present  Hourly |  |
| Soil Temperature | Alpine | YSI 40328 | 0.0,  –0.03,  –0.05,  –0.15 | 1997 – present  Hourly |  |
| Buckbrush | YSI 40328 | –0.05,  –0.10,  –0.15,  –0.30,  –0.80 | 1996 – present  Hourly |  |
| Forest | YSI 40328 | 0.0,  –0.05,  –0.15,  –0.30,  –0.80 | 1997 – present  Hourly |  |
| Stream Level/Discharge | Upper Wolf Creek | Solinst Logger Level |  | 1994 – present  Hourly | Local rating curve developed using Flowtracker velocity meter |
| Coal Lake Outlet | Solinst Logger Level |  | 1994 – present  Hourly |
| Granger Creek | Solinst Logger Level |  | 1998 – present  Hourly |
| Alaska Highway | Various Instrumentation |  | 1993 – present  Hourly |
| Groundwater Level | Wolf Creek Well | HOBO (2001–2007)  Solinst (2008–present) baro pressure loggers |  | 2001 – present  Hourly |  |
| *Other Variables (add rows as necessary)* |  |  |  |  |  |
| **Water Quality Variables** | | | | | |
| Water Temperature | Upper Wolf Creek | Solinst/OTT |  | Hourly |  |
| Coal Lake Outlet | Solinst/OTT |  | Hourly |  |
| Granger Creek | Solinst/OTT |  | Hourly |  |
| Alaska Highway | Solinst/OTT |  | Hourly |  |
| Isotope Types (18O, D, T) |  |  |  | Weekly | 18O, D |
| Water Conductivity |  | HOBO |  | 30-min frequency in Summer |  |
| Turbidity |  |  |  | Weekly |  |
| Sediment Load (Gravels) |  |  |  |  |  |
| Water Sampling Hydro-geochemistry (Elements) |  |  |  | Weekly | fDOM, DOC, Ions |
| *Other Variables (add rows as necessary)* |  |  |  |  |  |
| **Additional Notes and Details on Hydrological Observations** | | | | | |
| Other methods used for measuring stream discharge during early spring (e.g., salt dilution). Shorter-term or intermittent measurements of stream discharge and other variables have been made in other streams within WCRB. | | | | | |

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| **Other Hydrological and Cryospheric Measurements and Observations** | | | |
| **Measurement** | **Instrumentation Description** | **Spatial/Temporal Resolution and Coverage** | **Notes/Details** |
| Terrestrial Laser Scanner | N/A |  |  |
| UAV Sensors | DJI Mavic, eBee |  |  |
| Time-lapse Photographs |  | Daily | Above canopy at Forest station |
| Snow Pits/Snow Surveys | Snow depth rod and Mt. Rose sampler | 1993 – present; Monthly; surveys near Alpine, Buckbrush, Forest stations | Each has a 25 point transect for snow depth. Snow density measured at 5 out of 25 points. Relationship between snow depth and density used to estimate density across the transect; measured and estimated snow density used to estimate SWE. |
| Glacier Surface Elevation | N/A |  |  |
| Debris Covered Ice Elevation | N/A |  |  |
| Glacier Mass Balance | N/A |  |  |
| Glacier Ice Thickness | N/A |  |  |
| *Other Measurements (add rows as necessary)* |  |  |  |
| **Additional Notes and Details on Other Hydrological and Cryospheric Measurements** | | | |
| At many times over the history of WCRB there have special, focused field campaigns and intensive observations (e.g., detailed and repeated snow surveys, snow pits, vegetation and soil moisture surveys, permafrost and active layer depth surveys, hydrological investigations on flow pathways and runoff responses, turbulent fluxes, blowing snow and snow redistribution, and more). These have mostly been conducted within the Granger Creek sub-basin and nearby parts of the WCRN. Data are archived with the McMaster Watershed Hydrology Group and University of Saskatchewan Centre for Hydrology. | | | |

Relevant Modelling Activity (Model Applications, Purpose, Advancements, etc.)

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| WCRB has been a testbed for many cold regions hydrological modelling developments and applications over the past three decades. In particular, the Cold Regions Hydrological Modelling (CRHM) platform (see <https://doi.org/10.1016/j.jhydrol.2022.128711>) has been advanced by work at WCRB to improve representation of snow–shrub interactions, forest canopy snow interception, blowing snow, snowmelt and infiltration to frozen soils, and runoff generation (<https://research-groups.usask.ca/hydrology/documents/pubs/papers/pomeroy_et_al_2010.pdf>). |

Additional Information (Key Papers, Articles/Media, Photographs, etc.)

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| The WCRB website (<http://www.wolfcreekresearchbasin.ca/>) contains many relevant details, including history, publications, current projects, maps and photographs, and more. As part of the Changing Cold Regions Network ([www.ccrnetwork.ca](http://www.ccrnetwork.ca)), an information brochure was developed, explaining the changes that are taking place here and describing the basin and the research: <https://ccrnetwork.ca/documents/wolf_creek_changes.pdf>.  See also Wolf Creek 25 year science summit (<https://ccrnetwork.ca/science-programme/workshops/2017-wolf-creek-science-summit.php>) and hear about the 30 year anniversary celebration in 2022 (<https://www.cbc.ca/player/play/2058405955736>).  Follow on Twitter: <https://twitter.com/WolfCreekYT> |