# Susitna Hydrology Project

# ESGFA104-4 Groundwater Station

# Data Measurement and Recording Standards

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**Groundwater Station**

Data-Collection Objectives: Meteorological data to evaluate the potential for hydro-electric power generation in the Susitna River region.

Time Recording Standard: **Always** Alaska Standard Time (UTC – 9).

Datalogger Scan Interval Standard: 60 seconds.

Time Measurement Standards:

* Hourly readings are recorded at the end of the hour; therefore, the hourly average water temperature, for example, with a 60-second scan interval and a time stamp of 14:00 is measured from 13:01 to 14:00:00. For a 60-second scan interval, the hourly average would be the average of 60 min = 60 values.
* Quarter-hourly readings are recorded every fifteen minutes starting at the top of the hour.
* Instantaneous readings are taken at the time specified by the time stamp.
* A day begins at midnight (00:00:00) and ends at midnight (23:59:55). All daily data are from the day prior to the date of the time stamp. For example, if the time stamp reads 09/09/2007 00:00 or 09/09/2007 12:00:00 AM, the data are from 09/08/2007.

Data Retrieval Interval: Data will be retrieved hourly.

Data Reporting Interval: Hourly

# Sap Flow Measurements 1

Sensor: 22 TDP30 Thermal Dissipation Probe Sensors

Installation: Sensors comprised of two thermocouples and heater are inserted in tree. Three or four sensors per tree.

Height: TBD meters

Output Units: Depends on the measurement.

Scan Interval: 60 seconds

Output to Tables:

* TableDT (Hourly):
	+ Hourly Average Differential Thermocouple Temperature (°C): Average of the 60 one-minute readings for the previous hour. (one value for each sensor).
* TableHR (Hourly):
	+ Hourly Accumulated Sap Flow (g/hr): Accumulated sap flow, sum of the 60 one-minute readings for the previous hour. (one value).
* TableTC (Hourly):
	+ Hourly Sample Average Differential Thermocouple Temperature (°C): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Maximum Differential Thermocouple Temperature (°C): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Thermocouple Sap Velocity (cm/hr): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Thermocouple Sap Flow (g/hr): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Thermocouple Status: Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Thermocouple Heater Voltage (V): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
* TableTDP (Hourly):
	+ Hourly Sample TDP Sap Flow (g/hr): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample TDP Sap Flow Index: Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample TDP Status: Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
* Daily Raw Table:
	+ Hourly Sample Sensor String: Recorded at the top of each day (midnight AST). TDP Type, Index Area, dTM1, SA1, dTM2, SA2, dTM3, SA3 for each sensor.
* TableDY (Daily):
	+ Sample Daily Total Sap Flow: Accumulated total daily sap flow for the previous day ending at midnight AST. (one value for all sensors).
	+ Sample Daily Maximum Sap Flow: The highest reading from the previous day. (one value for each sensor).

# Sap Flow Measurements 2

Sensor: 10 TDP50 Thermal Dissipation Probe Sensors

Installation: Sensors comprised of two thermocouples and heater are inserted in tree. Three or four sensors per tree.

Height: TBD meters

Output Units: Depends on the measurement.

Scan Interval: 60 seconds

Output to Tables:

* TableDT (Hourly):
	+ Hourly Average Differential Thermocouple Temperature (°C): Average of the 60 one-minute readings for the previous hour. (one value for each sensor).
* TableHR (Hourly):
	+ Hourly Accumulated Sap Flow (g/hr): Accumulated sap flow, sum of the 60 one-minute readings for the previous hour. (one value).
* TableTC (Hourly):
	+ Hourly Sample Average Differential Thermocouple Temperature (°C): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Maximum Differential Thermocouple Temperature (°C): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Thermocouple Sap Velocity (cm/hr): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Thermocouple Sap Flow (g/hr): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Thermocouple Status: Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample Thermocouple Heater Voltage (V): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
* TableTDP (Hourly):
	+ Hourly Sample TDP Sap Flow (g/hr): Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample TDP Sap Flow Index: Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
	+ Hourly Sample TDP Status: Hourly sample (point) reading recorded at the top of the hour. (one value for each sensor)
* Daily Raw Table:
	+ Hourly Sample Sensor String: Recorded at the top of each day (midnight AST). TDP Type, Index Area, dTM1, SA1, dTM2, SA2, dTM3, SA3 for each sensor.
* TableDY (Daily):
	+ Sample Daily Total Sap Flow: Accumulated total daily sap flow for the previous day ending at midnight AST. (one value for all sensors).
	+ Sample Daily Maximum Sap Flow: The highest reading from the previous day. (one value for each sensor).

# Water Height

Sensor: One CS451 (Campbell Scientific, inc) pressure transducer, SDI-12 type sensors

Pressure Measurement Range: 0-7.25 psig

Output Units: cm, ft (water height above sensor), psig

Scan Interval: 60 seconds

Output to Tables:

* Fifteen-Minute Water Height Table:
	+ Fifteen-Minute Sample Water Height: Fifteen minute sample (point) reading recorded at the top of the hour, 15, 30, and 45 minutes past the hour.
	+ Fifteen-Minute Average Water Height: Fifteen minute average of all 15 readings recorded at the top of the hour, 15, 30, and 45 minutes past the hour.
	+ Fifteen-Minute Maximum Water Height: Fifteen minute maximum of all 15 readings recorded at the top of the hour, 15, 30, and 45 minutes past the hour.
	+ Fifteen-Minute Minimum Water Height: Fifteen minute minimum of all 15 readings recorded at the top of the hour, 15, 30, and 45 minutes past the hour.
* Hourly Climate Table:
	+ Hourly Sample Water Height: Sample at the top of each hour. This table is for the Current Conditions page on the Diag Site only.
* Daily Table:
	+ Daily Average Water Height: Average of all readings for the previous day.
	+ Daily Maximum Water Height: Maximum water height for the previous day.
	+ Daily Minimum Water Height: Minimum water height for the previous day.

# Water Temperature

Sensor: One CS451 (Campbell Scientific, inc) SDI-12 Sensors

Operating Range: -10°C to 80°C

Output Units: °C

Scan Interval: 60 seconds

Output to Tables:

* Fifteen-Minute Water Level Table:
	+ Fifteen-Minute Sample Water Temperature: Fifteen minute sample (point) reading recorded at the top of the hour, 15, 30, and 45 minutes past the hour.
	+ Fifteen-Minute Average Water Temperature: Fifteen minute average of all 15 readings recorded at the top of the hour, 15, 30, and 45 minutes past the hour.
	+ Fifteen-Minute Maximum Water Temperature: The highest reading taken during the previous fifteen minutes.
	+ Fifteen-Minute Minimum Water Temperature: The lowest reading taken during the previous fifteen minutes.
* Hourly Climate Table:
	+ Hourly Sample Water Temperature: Sample at the top of each hour. This table is for the Current Conditions page on the Diag Site only.
* Daily Table:
	+ Daily Average Water Temperature: Average of all readings for the previous day.
	+ Daily Maximum Water Temperature: the highest reading taken during the previous day.
	+ Daily Minimum Water Temperature: the lowest reading taken during the previous day.

# Battery Voltage

Sensor: CH200

Output Units: V.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Sample CR1000 Battery Voltage: Measured at the top of the hour.
	+ Hourly Average CR1000 Battery Voltage: Average of the 60 one-minute readings for the previous hour.
	+ Hourly Maximum CR1000 Battery Voltage: The highest reading from the previous hour.
	+ Hourly Minimum CR1000 Battery Voltage: The lowest reading from the previous hour.

# Battery Current

Sensor: CH200

Output Units: A.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Sample CR1000 Battery Current: Measured at the top of the hour.
	+ Hourly Average CR1000 Battery Current: Average of the 60 one-minute readings for the previous hour.
	+ Hourly Maximum CR1000 Battery Current: The highest reading from the previous hour.
	+ Hourly Minimum CR1000 Battery Current: The lowest reading from the previous hour.

# Load Current

Sensor: CH200

Output Units: A.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Sample Load Current: Measured at the top of the hour.
	+ Hourly Average Load Current: Average of the 60 one-minute readings for the previous hour.
	+ Hourly Maximum Load Current: The highest reading from the previous hour.
	+ Hourly Minimum CR1000 Battery Current: The lowest reading from the previous hour.

# Solar Panel Voltage

Sensor: CH200

Output Units: V.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Sample Solar Panel Voltage: Hourly reading at the top of the hour.
	+ Hourly Average Solar Panel Voltage: Average of the 60 one-minute readings for the previous hour.
	+ Hourly Maximum Solar Panel Voltage: The highest reading from the previous hour.
	+ Hourly Minimum Solar Panel Voltage: The lowest reading from the previous hour.

# Solar Panel Current

Sensor: CH200

Output Units: A.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Sample Solar Panel Current: Hourly reading at the top of the hour.
	+ Hourly Average Solar Panel Current: Average of the 60 one-minute readings for the previous hour.
	+ Hourly Maximum Solar Panel Current: The highest reading from the previous hour.
	+ Hourly Minimum Solar Panel Current: The lowest reading from the previous hour.

# Datalogger (CR1000) Panel Temperature

Sensor: CR1000 Internal thermistor

Output Units: °C.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Average CR1000 Panel Temperature: Average of the 60 one-minute readings for the previous hour.

# Voltage Regulator (CH200) Temperature

Sensor: CH200

Output Units: °C.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Average CR1000 Panel Temperature: Average of the 60 one-minute readings for the previous hour.

# Battery Capacity

Sensor: CH200

Output Units: AHr.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Sample Previous Battery Capacity (NEWBATTCAP): Hourly reading at the top of the hour.
	+ Hourly Sample Present Battery Capacity (BattCap): Hourly reading at the top of the hour.

# Daily Cumulative Battery Current

Sensor: CH200

Output Units: AHr.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Sample Cumulative Battery Current In: Hourly reading at the top of the hour; cumulative to midnight.
	+ Hourly Sample Cumulative Battery Current Out: Hourly reading at the top of the hour; cumulative to midnight.

# Battery Charge Power

Sensor: CH200

Output Units: W.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Average Power to Charge Battery: Average of the 60 one-minute readings for the previous hour.
	+ Hourly Maximum Power to Charge Battery: Maximum of the 60 one-minute readings for the previous hour.
	+ Hourly Minimum Power to Charge Battery: Minimum of the 60 one-minute readings for the previous hour.

# Load Power

Sensor: CH200

Output Units: W.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Average Power Used by Load: Average of the 60 one-minute readings for the previous hour.
	+ Hourly Maximum Power Used by Load: Maximum of the 60 one-minute readings for the previous hour.
	+ Hourly Minimum Power Used by Load: Minimum of the 60 one-minute readings for the previous hour.

# Charger State

Sensor: CH200

Output: -1 = regulator fault, 0 = no charge, 1 = current limited charging, 2 = cycle charging, 3 = float charging, 4 = battery test.

Scan Interval: 60 seconds

Output to Tables:

* Hourly Diagnostics Table:
	+ Hourly Sample Charge State: Hourly reading at the top of the hour.

# Resulting Final Storage Data Tables:

See Datalogger Output Files Excel Document

**Notes**

Definitions:

Scan interval = sampling duration = scan rate

Time of maximum or minimum values is not recorded

Sample reading = instantaneous reading

Beginning of the hour = top of the hour