

**Great Smoky Mountain Rain Gauge Network Field Report 16 August 2017**

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**Table 1: Gauge visits during the summer 2017. Comments: DD=gauge data download, MN=general gauge maintenance (cleaning, re-level), CA= rain gauge calibration, CV= vegetation clearing, and BR = data logger battery replacement.**

Date	Gauges Visited	Technicians	Comments
5/26/2017	11	Doug, Marianna, Elizabeth	DD, MN, CV
7/7/2017	3; 11; 107; 109	Doug	DD, MN, CV
7/10/2017	2; 5; 8; 106; 10	Doug	DD, MN, CV
7/12/2017	4; 104, 110, 105	Doug	DD, MN, CV
7/14/2017	108;	Doug, Marianna	DD, MN, CV
7/17/2017	111, 112, 311	Doug	DD, MN, CV
7/19/2017	101, 102, 103, 100T	Doug	DD, MN, CV
7/21/2017	303s, 306, 308	Doug	DD, MN, CV
7/26/2017	304, 307, 205, 309, 310	Doug	DD, MN, CV
8/9/2017	301, 302, 300	Doug, Ethan	DD, MN, CV

Gauge visitation in support of the Duke Great Smoky Mountain Rain Gauge Network (GSMRGN) during the summer 2017 occurred over 10 days spanning a period of five weeks from July – August 2017. The primary purpose of the visits in the summer 2017 was [1] to perform downloads of gauge tip observations since the previous gauge visits in the spring 2017, [2] to complete maintenance tasks, [3] to clear vegetation and tree limbs and, [4] where necessary, to replace lithium batteries that had drained to a low voltage over the summer months. Four technicians and volunteers (listed on the front page) made the visits and performed the required work. It is important to note that the volunteers were NOT directly involved in any of the gauge visit tasks, but were volunteering to assist with personal safety should someone get injured during a particular series of gauge visits.

The general tasks completed at **every** gauge visit consist of (1) gauge data download from the data loggers [DD in Table 1], (2) general gauge maintenance and ML1 logger condition monitoring [MN in Table 1], (3) clear vegetation within a five foot radius of the rain gauge [CV in Table 1], and, (4) if necessary, replacement of lithium data logger or HOBO batteries [BR in Table 1]. Specialized tasks were to install a new gauge (g011) at a location close to old g001, which had been run over by a bulldozer in January 2017 and the trimming of tree limbs using an extension saw at several locations to improve the sky view. Task (1) merely required a serial port link between the field study laptop and the gauge data logger and consisted of pulling the data (often in files having raw [\* .txt] and CSV formats) onto a desktop folder on the laptop, checking for completeness of the data, and comparing the data logger time and date to the actual GPS time and date (making a screen capture of the time comparison). The standard that has been chosen for this study is to maintain the clocks on Eastern Daylight Time, since most of the “warm” precipitation will be occurring during the season when EDT is in effect. Most ML1-FL data logger times have been adjusted (using “TA” command) during previous gauge visits to

coincide with the EDT given by the GPS locator. The lithium battery voltage of the ML1-420 and ML1-FL loggers was uniformly good (greater than 3.50 Volts) at all of the gauge locations during the summer months. Battery voltage and internal temperature files (DUBVT) were downloaded from most of the ML1-420 loggers and emailed to engineers at Hydrological Services of America to aid in the diagnoses of why battery voltage drains rapidly in the newer loggers. The voltage of each battery was tested using a multi-meter to insure an accurate battery voltage reading. The status voltage provided in the WinComLog software ('st') is unreliable and can be subject to additional voltage supplied to the flash memory of the data logger from the laptop itself. Task (2) required the cleaning of debris from the funnel filter, cleaning the tipping buckets of debris (if necessary), cleaning the gauge drain ports and siphon, re-leveling the gauge if it has come unlevelled, and fixing or replacing the gauge mesh if it had been damaged. Task (3) consisted of cutting briars, tree branches, rhododendron, and mountain laurel within a five foot radius of the gauge using clippers or a saw. Six gauge sites (g110, g105, g311, g103, g308, and g300) had tree limbs removed using an extension saw and two locations (g304 and g305) will need tree limbs cleared during the autumn 2017 visit. Task (4) was found to be unnecessary during the summer 2017 gauge visit campaign.

Challenges encountered during some of the gauge visits in the summer 2017 were; (i) the severe clogging of the siphon at g107 (Lookout Point) that resulted in missed tips after ~ 13 May 2017 due to debris from the surrounding field that had become more overgrown than usual [a conversation with the land owner indicated the overgrowth may be a more regular occurrence since a number of their cattle had been sold and the trimming of vegetation due to grazing would be reduced], and (ii) the overgrowth of a single briar plant at g305 which likely resulted in undercatch during the summer months. Otherwise, the gauge network was functioning as smoothly as is possible. It should be noted that a new Davis Pro weather station has been installed near the Mount Sterling fire tower (which is now locked, but we have a functioning key!), next to g310. The owner of the weather station (and data) at Duke Power is being pursued so the observations can be used to help diagnose the phase of falling precipitation during the cold season.

Details of every gauge visit along with precipitation raw and CSV files (and some internal temperature and battery voltage files) can be found via Google Drive at <https://drive.google.com/open?id=0B9P8oUaRiBOwU1B5ekFKVkJFuRDQ> which contains sub-folders for each gauge that consist of the individual data files (often having at least two different formats), pictures taken at the gauge site during the visit, screenshots of the GPS (laptop) and ML1 logger time comparison, and a MS Word document that mirrors the notes made in the field journal during the visit.

Plans for the autumn months of 2017

**Table 2: Planned gauge visits during the autumn 2017. Comments: DD=gauge data download, MN=general gauge maintenance (cleaning, re-level), and BR = data logger battery replacement (ALL loggers).**

<b>Date</b>	<b>Gauges Visited</b>	<b>Technicians</b>	<b>Comments</b>
10/??/2017	304, 307	Doug, Student #1, Student #2	DD, MN, BR
10/??/2017	11, 3, 10	Doug, Student #1	DD, MN, BR
10/??/2017	2, 5, 8, 106, 4	Doug, Roger, Student #1	DD, MN, BR
10/??/2017	111, 112, 104, 105, 106, 107, 109	Doug, Student #1	DD, MN, BR
10/??/2017	101, 102, 103, 110, 108	Doug, Student #1	DD, MN, BR
11/??/2017	305, 309, 310	Doug, Student #1, Student #2	DD, MN, BR
11/??/2017	303s, 306, 311	Doug, Student #1, Student #2	DD, MN, BR
11/??/2017	300, 301, 302, 308	Doug, Student #1, Student #2	DD, MN, BR

Gauge visitation in support of the Duke GSMRGN during the autumn 2017 will occur over at least eight days spanning October and November 2017. The primary purpose of the visits will be to download precipitation observations that were made since the previous gauge visits in July - August 2017 [DD in Table 2], perform maintenance and check if the ML1 logger times have drifted between visits and make the corresponding needed adjustments [MN in Table 2], clear vegetation (and tree branches) from overhanging gauges [CV in Table 2], and replace ML1 or HOBO batteries at **ALL** rain gauge locations [BR in Table 2] in anticipation of the long time gap between the autumn 2017 and spring 2018 visits. Calibrations at **ALL** rain gauge locations will take place during the spring 2018 gauge visit campaign due to the increased availability of daylight hours (over autumn) and to the seasonal (March, April, May) minimum in precipitation observed in the Pigeon River Basin (to be published in WaF later in 2017).

Details of every gauge visit along with each gauge precipitation record will be posted online and shall contain sub-folders for each gauge that consist of the individual data files (often having at least two different formats), pictures taken at the gauge site during the visit, screenshots of the GPS (laptop) and ML1 logger time comparison, and a MS Word document that mirrors the notes made in the field journal during the visit.

New undergraduate research students at UNC Asheville will be recruited as field technicians for the Duke GSMRGN project during an informational meeting to be held in the ATMS Department early in the autumn 2017 semester. The current technician roster during the 2017-2018 academic year consists of Rachel Dunn, Ben House, Jackie Hoyle, Carly Narotsky, Samuel O'Donnell, and Zachary Tuggle. Students William Clark, Kyle Noel, Bonnie Thompson, and Ethan Wright graduated from UNC Asheville in May 2017.

**Table 3: The Duke Great Smoky Mountain Rain Gauge Network is currently (valid as of 16 August 2017) composed of 32 tipping bucket rain gauges.**

Gauge #	Location	Latitude	Longitude	Altitude
RG001	Deep Gap	35°23.8' N	82°54.7' W	3794 ft.
RG002	Lickstone Bald	35°25.5' N	82°58.2' W	5680 ft.
RG003	High Top	35°23.0' N	82°54.9' W	5280 ft.
RG004	Lickstone Ridge S	35°22.0' N	82°59.4' W	6305 ft.
RG005	Deep Gap	35°24.5' N	82°57.8' W	4986 ft.
RG008	Double Summer Gap	35°22.9' N	82°58.4' W	5700 ft.
RG010	Beaty Summer Gap	35°27.3' N	82°56.8' W	4849 ft.
RG011	near Deep Gap	35°23.7' N	82°54.9' W	4081 ft.
RG100T	Purchase Knob	35°35.1' N	83°04.3' W	4905 ft.
RG101	The Swag	35°34.5' N	83°05.2' W	4986 ft.
RG102	Hemphill Bald	35°33.8' N	83°06.2' W	5365 ft.
RG103	JR Property	35°33.2' N	83°07.0' W	5539 ft.
RG104	Cat. Ski Area	35°33.2' N	83°05.2' W	5208 ft.
RG105	KH Property	35°38.0' N	83°02.4' W	4412 ft.
RG106	Pinnacle Ridge	35°25.9' N	83°01.7' W	3969 ft.
RG107	Lookout Point	35°34.0' N	82°54.4' W	4459 ft.
RG108	Utah Mountain	35°33.2' N	82°59.3' W	4188 ft.
RG109	Eaglesnest Ridge	35°29.7' N	83°02.4' W	4922 ft.
RG110	JH Property	35°32.8' N	83°08.8' W	5128 ft.
RG111	Hurricane Ridge	35°43.7' N	82°56.8' W	4573 ft.
RG112	Ore Knob	35°45.0' N	82°57.8' W	3884 ft.
RG300	Camel Hump Knob	35°43.5' N	83°13.0' W	5110 ft.
RG301	Mt Guyot	35°42.3' N	83°15.3' W	6570 ft.

RG302	Snake Den Ridge	35°43.2'N	83°14.8'W	6104 ft
RG303s	Mt Cammerer	35°45.7'N	83°09.7'W	4887 ft
RG304	Big Cataloochee	35°40.2'N	83°10.9'W	5971 ft
RG305	Mt Sterling 1	35°41.4'N	83°07.9'W	5349 ft
RG306	Sunup Knob	35°44.7'N	83°10.2'W	5039 ft
RG307	Balsam Mountain	35°39.0'N	83°11.9'W	5327 ft
RG308	Cosby Knob	35°43.8' N	83°10.9'W	4826 ft
RG309	Mt Sterling 2	35°40.9'N	83°09.0'W	5262 ft
RG310	Mt Sterling 3	35°42.1'N	83°07.3'W	5761 ft
RG311	Big Creek	35°45.9'N	83°08.4'W	3398 ft