
Report of Installation of Co-located N-CON Collector and ETI Gage at 11TN-NTN Site Great Smoky Mountains National Park, TN

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1.0 Site Activities

Environmental, Engineering, and Measurement Services, Inc. (EEMS) performed the installation of the N-CON bucket collector and ETI NOAH-IV electronic rain gage at the co-located 11TN-NTN site on November 3rd and 4th, 2013 at the Elkmont monitoring site at Great Smoky Mountains National Park, TN. The instruments were provided by the USGS and assistance was provided by the Park Service NADP site operator and supervisor.

The wet deposition collection system was successfully installed and operational upon completion of the visit. A calibration check of the rain gage was conducted. Photos of the instruments, and measurements from the instruments to other monitoring equipment and obstacles were taken to document the layout and exposure of the system.

2.0 Installation Summary

Two new pedestals were installed to serve as the mounts for the co-located equipment. Both pedestals are comprised of two-inch diameter galvanized steel pipe mounted in concrete.

A shallow trench was dug between the two new pedestals, and from the gage mount to the existing power post. A power cord was run in conduit from the power post to the new gage and from the new gage to the new collector mount. The event recorder signal cable was included in the conduit from the collector to the gage with the collector power cord.

Following the installation of the co-located equipment, operational and calibration checks were conducted. Site information data regarding the positions of the new equipment were collected. A site sketch was generated which depicts the distance and direction of other site objects relative to the co-located collector. Data and comments regarding the site instrumentation are provided in the following sections. The 11TN-NTN site sketch is provided in Appendix A. Photographs of the co-located instruments, site overview, and directional exposure of the N-CON collector are provided in Appendix B.

2.1 ETI – NOAH-IV Rain Gage

The rain gage was mounted and leveled on the new pedestal nearest the TN11 electronic gage. The gage was mounted so that the height of the orifice was within one foot of the other site instrument openings.

The gage was not shipped with an internal 12 amp/hour battery. However, one was obtained and installed by the site supervisor. Bluetooth communication was established between the site operator's PDA and the rain gage. Operational checks conducted included:

- Date and time check
- Optical sensor blocking
- Optical sensor response to mist
- Collector lid openings monitored
- Calibration check from zero to six inches

Since the gage was previously operated at NADP site CAN6, the data logger program contains the site identification (site ID) CAN6. The site operator and the CAL were made aware of this condition and corrections will be addressed with a new data logger program to match the current site location.

The co-located rain gage calibration data are provided in Table 2.1. At the request of the site supervisor, the calibration of the existing TN11 gage and the backup Belfort gage were verified. The calibration results are presented as the response of each gage to the addition of each weight, and the results of the total accumulation of all six weights. The responses of each co-located gage (Belfort and 11TN) are also compared to the site's primary gage (TN11). The standard deviation of all three responses to each test point is also provided in inches.

Table 2.1 Calibration Results – All Gages

Inches added	Compared to TN11		Gage Response			Standard Dev of Response
	Belfort	11TN	TN11	11TN	Belfort	
1	0.001	0.013	0.999	1.012	1.000	0.006
2	-0.009	0.000	0.999	0.999	0.990	0.004
3	-0.022	0.012	0.992	1.004	0.970	0.014
4	-0.036	0.010	0.996	1.006	0.960	0.020
5	-0.092	0.002	1.002	1.004	0.910	0.044
6	-0.080	0.001	1.000	1.001	0.920	0.038
					average =	0.021
Cumulative						
1	0.001	0.013	0.999	1.012	1.000	0.006
2	-0.008	0.013	1.998	2.011	1.990	0.009
3	-0.020	0.025	2.990	3.015	2.970	0.018
4	-0.026	0.035	3.986	4.021	3.960	0.025
5	-0.078	0.037	4.988	5.025	4.910	0.048
6	-0.068	0.038	5.988	6.026	5.920	0.044
slope =	0.984	1.006			average =	0.025

2.2 N-CON Bucket Collector

The N-CON bucket collector was received in fairly good condition. The collector was installed on the pipe support with the orifice within one foot of the height of the other instrument openings.

Some screws had come loose during shipping. In order to repair the loose screws, the bucket used during shipping was removed and the collector housing was opened. The four setscrews that secure the motor driveshaft adaptors were removed and tightened with Loctite.

The two internal relays were reseated in the power supply circuit board. The collector was reassembled and tested. All indications were that it would operate properly.

The sensor was tested and responded properly to 5 passes through the open path. The dry-side protector was adjusted to within approximately one inch of the lid-liner when the collector is in the open position. The angle of the dry-side protector was adjusted to limit the impact of rain and snow exposure of the protector when the collector is the open position at the request of the site supervisor.

Photographs were taken to document the collector installation and directional exposure. The collector orientation was adjusted to as closely match that of the existing TN11-NTN collector as possible. Data regarding the height of each instrument relative to the co-located N-CON bucket collector are presented in Table 2.2.

Table 2.2 Height of Instrument Openings

Object	Angle (degrees)	Distance (meters)	Height Difference From N-CON (CM)
11TN N-CON	0	0	0
E-Gage 11TN	22	5.6	+ 10
E-Gage TN11	79	5.8	+ 9
Belfort	170	10.1	+ 8
ACM NTN	145	5.3	+ 12
ACM MDN	211	6.6	not measured

2.3 Siting Criteria

The installations of the co-located collector and gage were performed with the goal of matching the conditions and exposure of the existing TN11-NTN collector and gage as closely as possible. The site supervisor was responsible for selecting the positions of the equipment, and they were installed according to the site plan which was presented to the USGS project sponsor. All

collectors and gages are mounted in as small a footprint as possible while still meeting the NADP 5-meter rule. They should all be representative of the same conditions present at the site during precipitation and fog events.

2.4 Operational Checks and Sample Bucket Installation

On Tuesday November 5th EEMS visited the site with the site operator to complete the operational checks of the equipment. Procedures for changing the sample bucket and retrieving the precipitation data were reviewed with the site operator. The procedures for installing washers under “short” collection buckets were discussed. The collector tools and spare washers were left with the site operator.

A clean sample bucket was installed and collection began that day for the co-located equipment. The first co-located sample will correspond with the standard TN11 sample installed that day.

3.0 Results and Recommendations

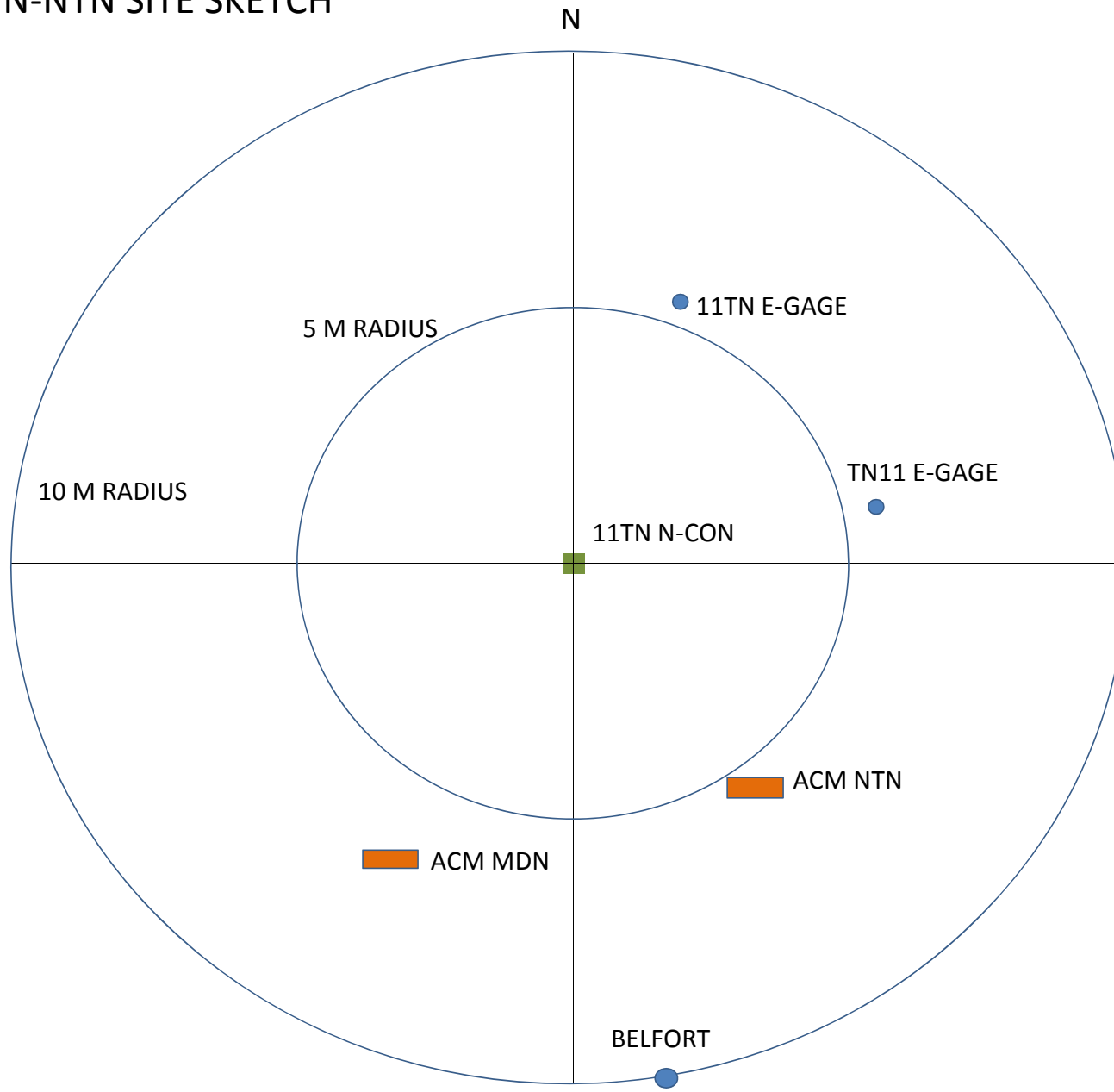
At the conclusion of site activities on November 5th, 2013, the instruments were operational and collecting precipitation sample and volume data. The site PDA was able to communicate with both electronic gages. The CAL had been notified of the site installation and the necessity for the revised data logger program required for the newly installed ETI gage. The site operator was briefed regarding the siting criteria issues and the operation of the N-CON collector.

As always EEMS is pleased to provide any assistance that the USGS might require with regards to the continued or improved operation of the NADP quality assurance program.

Appendix A

11TN-NTN Site Sketch

11TN-NTN SITE SKETCH



Appendix B

11TN-NTN Site Photos



