NADP Manual 1984-01

INSTRUCTION MANUAL

NADP/NTN SITE SELECTION AND INSTALLATION

NATIONAL ATMOSPHERIC DEPOSITION PROGRAM

A Cooperative Research Program of the
State Agricultural Experiment Stations
and other Federal, State, and Private
Research Organizations ● IR-7

The National Atmospheric Deposition Program (NADP) was organized by the North Central Region of the State Agricultural Experiment Stations to address the problem of atmospheric deposition and its effects on agriculture, forest, rangelands, and fresh water streams and lakes. It is necessary to determine both the composition and amount of atmospheric deposition and its distribution on a national scale in order to assess the magnitude of the effects, both beneficial and deleterious. It is also necessary that these measurements be carried out over an extended period of time in order to determine the long-term trends. For this purpose, the National Atmospheric Deposition Program has established a nationally distributed regional atmospheric deposition monitoring network. In addition to the State Agricultural Experiment Stations and the Department of Agriculture, programs of the NADP are now supported by the Environmental Protection Agency, the Department of the Interior, the Department of Energy, the department of Commerce, various state agencies, public utilities, and industry.

In 1983, as a result of its experience in designing, organizing and operating a national-scale regional atmospheric deposition monitoring network, NADP was given the responsibility to coordinate and provide services for the National Trends Network (NTN) of the National Acid Precipitation Assessment Program (NAPAP). Since common siting criteria and operational procedures are employed by both networks, a merger was possible resulting in a majority of the monitoring sites being designated as NADP/NTN. Various instruction manuals and data reports now published by the NADP serve both the NADP and NAPAP monitoring programs.

INSTRUCTION MANUAL

NADP/NTN SITE SELECTION AND INSTALLATION

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1.0. INTRODUCTION

1.1. The NADP and NTN Atmospheric Deposition Monitoring Programs: A Background

The amount of substances dispersed in the atmosphere and deposited by precipitation, aerosols, and gases is expected to continue to increase throughout North America. Thus, there is an increasing need for careful measurement of the amounts, nature, and effects of these substances in agricultural, forest, and aquatic ecosystems of the United States. In addition, these measurements are crucial to the validation of transport models and the evaluation of National and North American emission control strategies.

The National Atmospheric Deposition Program (NADP) was created by the Association of State Agricultural Experiment Stations (North Central Regional Project NC-141 now Interregional Project IR-7) to conduct research on atmospheric deposition and its effects on surface waters and agricultural and forest lands in cooperation with federal, state, and private research agencies. The National Trends Network (NTN) was designed under the direction of the Task Group on Deposition Monitoring, Interagency Task Force on Acid Precipitation, in accord with the 1982 National Acid Precipitation Assessment Plan, to gain a better understanding of the spatial and temporal variability of acidic atmospheric deposition in the United States. Through the continued development and maintenance of these atmospheric chemical deposition monitoring networks, and through research on the effects of chemical changes in atmospheric deposition, scientists are discovering and characterizing biologically important spatial and temporal trends in the chemical climate of North America.

1.2. Sampling Strategy

In addition to a strict set of siting criteria, which this manual presents, other essential ingredients of a successful network design and operation include; uniformity of sampling protocol, uniformity in analytical techniques and procedures, and a long-term monitoring commitment. The NADP and NTN programs accomplish this by (1) designating specific precipitation collection equipment to be used throughout the network

which allows precipitation to be recorded, collected and verified; (2) requiring this equipment to be maintained in good working order at the original location specified on the SITE DESCRIPTION QUESTIONNAIRE; (3) specifying a strict weekly sampling protocol and a clear definition of sample types; (4) requiring every sample to be analyzed at a single laboratory, the Central Analytical Laboratory (CAL) operated by the Illinois State Water Survey, Champaign, Illinois, and (5) expecting each site to operate continuously for a 5-10 year period. The NTN network further utilizes a finite number of regionally distributed sites as a part of its design.

Because the success of the network depends upon each site's continuing commitment to strictly follow this protocol, the acceptance of a site into the NADP and NTN networks is based in part on the site's ability to implement the program outlined here and presented in more detail in the INSTRUCTION MANUAL FOR NADP/NTN SITE OPERATION.

2.0. SITE SELECTION

2.1. General Considerations

Monitoring sites for the networks are selected to represent major physiographic, agricultural, aquatic and forested areas within each cooperating state, region or ecoregion. Wherever possible, collection sites include locations where watershed, marine, freshwater, or other hydrological research is already underway, or where research is being conducted on nutrient cycling, air pollution, or atmospheric chemistry. Additional consideration is given on the basis of available knowledge of emission sources, prevalent forms of deposition, frequency of precipitation events and other meteorological and atmospheric processes that influence the deposition of substances in each area. This background information permits meaningful interpretations of spatial, seasonal and temporal variations in the chemistry of wet and dry deposition both regionally and nationally.

2.2. Co-location With Other Programs

The co-location of monitoring equipment with other programs is encouraged. Some precautions, however, need to be observed when co-locating sampling or monitoring equipment.

Sampling sites can be overused to the point where one program becomes compromised by the addition of extra equipment. Besides violating the siting criteria outlined in Section 2.3, increased visitation to a site increases the chance of contamination to the sampling receptacles. Disturbances in air movement about the site by other than natural phenomena can reach a point where what is sampled is no longer representative of the region but only represents the local congested environment.

2.3. COLLECTOR and RAIN GAGE Siting Criteria

2.3.1. Regional Requirements

The RAIN GAGE and COLLECTOR should be located in an area that typifies a region and minimizes the impact of local point or area sources. However, if a region is characterized by a certain type of agricultural land use or industrialization, the COLLECTOR should be located to provide representation of such extensive deposition sources.

Specific sources of concern include industrial operations and suburban/urban area related sources. Industrial operations such as power plants, chemical plants and manufacturing facilities should be at least 10 km away from the collector. If the emission sources are located in the general upwind direction (i.e., the mean annual west-east flow in most cases) from the COLLECTOR, then this distance should be increased to 20 km. This same criteria also applies to suburban/urban areas whose population approximates 10,000 people. For larger population centers (i.e., greater than 75,000) the COLLECTOR should be no closer than 20 km. This distance is doubled, to 40 km, if the population is upwind from the COLLECTOR. Beyond 50 km both industrial and urban sources are generally assumed to blend in with the typical characteristics of the region.

2.3.2. Local Requirements

Transportation related sources, agricultural operations and surface storage of certain types of products are typically the most troublesome sources to identify and quantify once regional requirements for industrial sources have been met (Section 2.3.1). No moving sources of pollution, such as air, ground, or water traffic or the medium on which they traverse (e.g., runway, taxiway, road, tracks, or navigable river) should be within 100 meters of the COLLECTOR. The local road net around the site is of particular concern. Traffic volume and type will largely determine the impact of these types of sources on the site. Feedlots, dairy barns, etc. , in which large concentrations of animals are housed should be no closer than 500 meters from the COLLECTOR. Grazing animals, and pasture should be no closer than 20 meters from the COLLECTOR. Surface storage of agricultural products, fuels, vehicles, or other source materials should be kept at least 100 meters from the COLLECTOR. Parking lots and maintenance yards also need to be kept at least 100 meters from the collector. Local sources, whether point, line or area sources, will greatly influence the suitability of a site to serve as a long-term regionally representative station. Land development in future years may further compromise the site’s usefulness as a station. For these reasons consideration should be given to alternate sites in the event that the original site is no longer representative of the region.

2.3.3. On Site Requirements

The site should be accessible in both summer and winter and be a low risk to vandalism. Further, the COLLECTOR and RAIN GAGE should be sited to conform as nearly as possible with the following:

1. The COLLECTOR should be installed over undisturbed land on its standard 1 meter high aluminum base. Naturally vegetated, level areas are preferred, but grassed areas and slopes up to ±15% will be tolerated. Sudden changes in slope within 30 meters of the collector should also be avoided.

   Ground cover should surround the collector for a distance of approximately 30 meters. In farm areas a vegetated buffer strip must surround the collector for at least 30 meters.

2. Annual vegetation within the site should be maintained at less than two feet in height.

3. No object or structure shall project onto the COLLECTOR or RAIN GAGE with an angle greater than 45° from the horizontal (30° is considered optimal, but 45° is the highest angle acceptable). Therefore the distance from the sampler to the object must be at least equal to the height of the object (preferably twice the height of the object). Residential dwellings must be kept twice their height from the collector (30°). Pay particular attention to anemometer towers and overhead wires (Fig. 2.1).

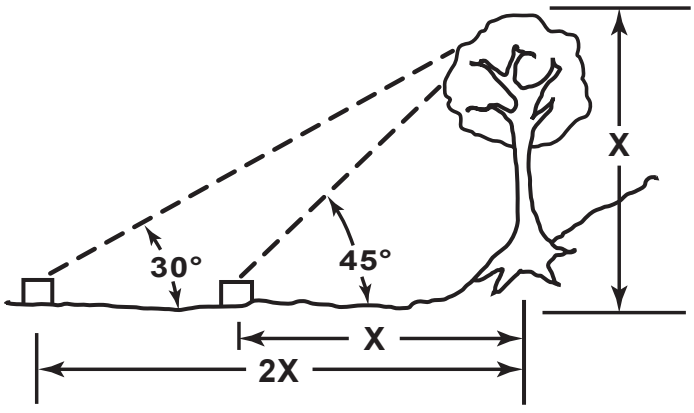

Fig. 2.1

4. Residential structures within 30 meters of the COLLECTOR should not be within the 30° cone of the mean wind direction (Fig. 2.2).

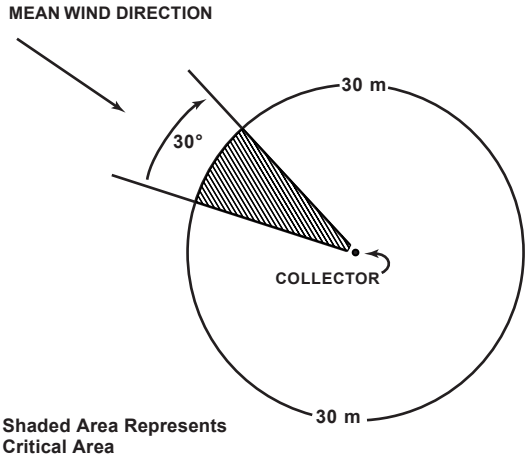

Fig. 2.2

5. The base of the COLLECTOR should not be enclosed. Further, any object over 1 meter high with sufficient mass to deflect wind should not be located within 5 meters of the COLLECTOR. Alter wind shields and open fences are excluded from this requirement.

6. The RAIN GAGE should be within 30 meters of the COLLECTOR but no closer than 5 meters. Its orifice should be located within one foot of the same plane as the, orifice of the COLLECTOR. In snow accumulation areas this may require a separate platform for the rain gage.

7. In areas where more than 20% of annual precipitation is snow, rain gages must be equipped with an alter wind shield. This shield should be installed such that the pivot axis of the shield is at the same level as the top of the rain gage.

8. In areas having an accumulation of over 0.5 meters of snow per year, the COLLECTOR and RAIN GAGE may be raised off the ground on a platform. The platform should be no higher than the

maximum anticipated snow pack. In general, platforms are discouraged. Note: The 5 meter separation between the rain gage and collector must be maintained (item 6).

9. COLLECTORS located in areas which normally receive snow should have a properly counterweighted snow roof installed on the moving lid of the COLLECTOR only if problems with the opening and closing are encountered. If installed, the roof will be left on year round. (See counterweighting, Section 4.2.1).

10. Changes or modifications to established or approved sites or to its equipment must be submitted to the Program Coordinator's Office prior to implementation. This includes moving the site, siting other equipment in close proximity to the existing collectors (30 meters), installation of snow roofs, etc. In the event additional equipment is added to the site or a change in location becomes necessary, the following information is needed:

    a) A brief letter to the Program Coordinator's Office requesting the change and documenting its need.

    b) Sites moving within the 30 meters surrounding the original location of the collector will be required to file a new site sketch with pictures and negatives, along with a letter stating when and why the site was moved.

    c) Sites moving greater than 30 m but less than 10 km will be required to file a new Site Description Questionnaire, site sketch map and pictures with negatives. A new topographical map will be required only if the site moves off the old quad.

    d) Sites moving further than 10 km or into a different type of topography, ecoregion or land use must reapply for admission to the network as a new site. Such a move requires submission of a complete set of siting documents to the coordinator's office for approval. A new site name, CAL code and station number will be assigned to the new site.

11. All COLLECTOR location changes (orientation, moves on or off platforms, elevation, short moves, long moves, etc.) will be documented so that data users have the ability to determine if a change in data correlates with some physical change at the site.

2.4. Classification of Network Sites: Operational Status

Once a site has been identified, sites will be classified into one of three levels:

Provisional

Each site will be initially classified Provisional based upon the information provided with the Site Description Questionnaire, if the questionnaire has been properly completed. Pictures showing the COLLECTOR in place, topographical map and a site drawing are required to obtain Provisional status.

Interim

Interim status will be given to those sites which after visitation by a network site reviewer are verified as having met all of the siting criteria outlined in Sec. 2.3 of this manual and as having all of the required sampling equipment including the Aerochem Metrics or equivalent WET/DRY precipitation COLLECTOR; the weighing, recording RAIN GAGE equipped with an EVENT RECORDER; the pH and conductivity meters and a 20 kg capacity balance. If a representative of the Coordinator's Office installs the site then Interim status may be granted at the time of installation.

Certified

Final certification will be made after several years of routine operation of each site.

Sites will become Certified when data analysis determines that the site is operating according to established protocol and that the site is a regionally representative site not significantly biased by local sources.

3.0. SITE DESCRIPTION QUESTIONNAIRE

The following paragraphs discuss the topics covered in the Site Description Questionnaire. The questionnaire is included in Appendix A. All measurements should be reported in the metric system and directions in degrees from magnetic north. Throughout the questionnaire when a distance is requested the distance from the collector should be inserted. If additional space is needed for extended remarks concerning local problems, please attach additional pages and key these remarks to the questionnaire.

This form should be completed for each proposed site and returned to the Program Coordinator's Office as soon as possible.

3.1. Site Identification (Section A)

The STATION NAME should be descriptive and unique to the site, though it need not be unique to the NADP/NTN network. Together with the COUNTY and STATE, the station name should allow easy identification of the site to the funding/operating agencies, site supervisors and researchers. A more precise location is established when the LONGITUDE, LATITUDE and ELEVATION of the collector are reported. These coordinates further allow computer handling of location information network wide. The STATION NUMBER, CAL CODE and ECOREGION are assigned to each site by the Coordinator's Office after receipt of a completed questionnaire.

3.2. Administration (Section B)

The three names and corresponding addresses requested refer to three different roles performed by site associated personnel. In some cases one person may perform all of the roles, however, most of the time at least two different people are involved.

First and foremost is the SITE OPERATOR'S name and the address where United Parcel Service (UPS) should deliver the weekly collector buckets. Site correspondence will also be mailed to this address. The second name and address should be that of the SITE OPERATOR'S SUPERVISOR. This name and address is requested to help resolve scheduling conflicts and personnel changes at the site and in general promote good relationships between the site operator, his supervisor, the funding agency and the Network. The final name and address identifies a person other than the site operator WHO WILL RECEIVE PRELIMINARY SITE DATA as well as a

copy of the correspondence being sent to the site operator. Usually this person is someone who can evaluate the preliminary data and help determine whether the data is reasonable and reflects the local situation.

3.3. Instrumentation at or Near the Site (Section C)

The COLLECTOR TYPE and MODEL along with PRIMARY source of POWER are used to help determine the site's potential to operate in all types of weather and to resolve operational "down time" problems. For AC operation only the VOLTAGE is required. For DC operation the AMPERAGE of the battery or output rating in the case of a solar panel is requested. For solar installations please indicate the surface area of the panel.

In addition to the wet/dry collector, the network requires a Belfort recording RAIN GAGE equipped with an event recorder to be co-located within 30 meters of the collector. The questions in this section pertain to this required gage.

The ALTERNATE GAGE or nearest gage establishes what historical precipitation records are available for the area if the co-located gage has been operating for only a brief period. Ideally a CLIMATE NORMAL station record will be used as the alternate gage. A 'climate normal' station is an official National Weather Service station that has a 30 year precipitation record. Together with available WIND information these measurements are used to interpret the local site climatology. As records are accumulated, the site climatology will be continuously updated and compared with the nearby long-term records to detect anomalous behavior and to ascertain the regional representativeness of the site location.

3.4. Related Scientific Activities (Section D)

The questions in this section further characterize the SCIENTIFIC ACTIVITIES at the site which complement the NADP/NTN network data. Of particular interest are those measurements being taken within 0.5 km of the collector. Please be sure to indicate when no instrumentation is co-located by checking the NONE category.

3.5. Potential Local Contributors to Deposition at the Site (Section E)

A topographic map and a state or regional map of the site are invaluable in completing this section. The questions are designed to

identify both stationary and mobile sources of potential site contamination as well as differentiate between ground, air and water sources. Since the distance from the COLLECTOR, as well as the type of source, determines the potential impact the source will have at the site, the sources have been grouped into distance categories. The categories used represent the distance from the COLLECTOR at which the source becomes part of the regional influence on the COLLECTOR and ceases to be a local, unrepresentative site contaminant. In completing this section, unusual or intermittent sources such as quarry operations, stockpiles of coal, farm wastes, and similar materials should be recognized as potential sources of contamination under high wind conditions. Careful evaluation of these items is critical in determining the quality of the site and in evaluating anomalies in the data.

3.6. Laboratory Facilities (Section F)

Both networks are committed to producing the best possible field pH and conductivity measurements of weekly sampled precipitation. For this reason sites are required to have the capability of making these measurements in close proximity to the sampling site. A “good” laboratory facility would be one that is clean, heated and has a specific area set aside for the pH and conductivity meters, the balance and related supplies. The area should be free of clutter and out of transient traffic areas.

3.7. Other (Section G)

A picture is indeed worth a thousand words and for this reason a topographic map, scale drawing and photographs are REQUIRED before a site is accepted into the NADP program.

A 1:24,000 scale TOPOGRAPHIC MAP which includes your site can be obtained through the U.S. Geological Survey. The maps are indexed by State. The maps are used to assess the site‘s proximity to line, point or area sources and to establish further physiographic information about the site.

Use a circled X to clearly show the site location on the map. If the site is at or near the map border, please include the adjoining map(s).

The SITE SKETCH should include the 30 meters surrounding the collector using a scale of 1 centimeter on the map equals 10 feet on the ground. All objects surrounding the collector should be shown and labeled. Particular attention should be given to those items identified in Section E1.

The PHOTOGRAPHS of the site should show the area surrounding the collector in 8 directions at 45° intervals. For proper perspective we would prefer 3x5 black and white or color photographs, with negatives, taken with a 35 mm camera and wide angle lens (35 or 28 mm). The pictures should be taken from a distance of 15 ft (20 ft is preferred if a 50 mm lens is used) and show the collector in the foreground but concentrate on the surrounding area. A few pictures taken from a greater distance (including aerial photographs) are also useful and appreciated. All photographs should be clearly labeled on the back as to the site, date and the direction the camera was looking when the photo was taken.

If available, Soil Conservation Service (SCS) SOIL SURVEY MAPS of the site are useful in characterizing the site environment.

Maps are obtained by contacting your local or state U.S. Department of Agriculture (USDA), Soil Conservation Service office or through the extension service at your state land-grant college or university. An annual “List of Published Soil Surveys” lists all current surveys by the state and county. If available, please list the name of the predominant soil series type within 1 km of the site.

4.0. SITE INSTALLATION

Field installation can be completed more effectively if the wet/dry collector and weighing rain gage are preassembled prior to arriving on site. Preassembly is especially useful if electric power is not available on site, event recorder installation is necessary or rain gage calibration is to be attempted.

4.1 Power Requirements

4.1.1 110AC Operation

For sites located in rural areas where line power is frequently interrupted, trickle charged battery backup is recommended. However, only charging arrangements which cannot interrupt AC power are acceptable. See Figures 4.1 and 4.2.

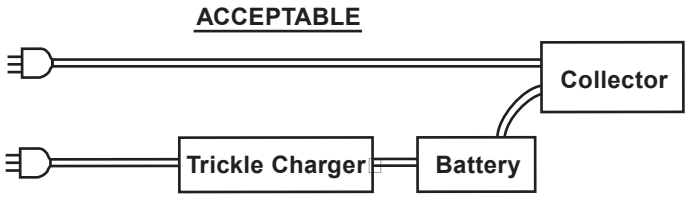

Figure 4.1

If a battery failure occurred in Figure 4.2, line power would not reach

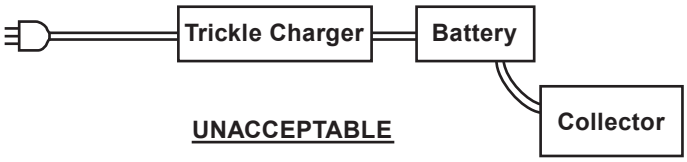

Figure 4.2

the collector and the trickle charger would become the source of power for the collector. Trickle charger output is not generally sufficient to power the collector. Certain trickle chargers further have the ability to over charge batteries and ruin them. In Figure 4.1, the collector would run on one power system or the other, not one power system through the other as in Figure 4.2. In Figure 4.1, line power to the collector is independent of battery and trickle charger units.

Aerochem Metrics makes an acceptable trickle charge option for its wet/dry collector. The charger is built into the motorbox. Contact Aerochem Metrics for details.

4.1.2 DC Operation

Battery power is not a recommended method of powering the Aerochem Metrics Collector, however, the use of a solar panel to continuously charge a 12 VDC source is an acceptable alternative when AC power is not available.

If battery operation is the only alternative for powering the collector then it is essential that the battery be properly sized and have a generous amount of reserve capacity.

4.1.2.1 Batteries: Only deep cycle marine rated batteries should be used to power the collector. Ordinary automotive batteries, though cheaper, are not designed to be continuously drawn down and recharged (you might get 20 cycles); deep cycle marine batteries are rated for 2000 cycles. Gel type batteries as opposed to lead-acid batteries (the most common type of battery) have the additional advantages of being 1/3 to 1/2 the weight per ampere hour, sealed (do not leak acid) and do not freeze when the temperature drops and there is less than a full charge on the battery.

When sizing panels or batteries the following collector electrical power consumption figures should be realized. During wet status the collectors draw 0.06 watts to power the event pen, 6.6 watts for the sensor heater and 9.0 watts while the lid cycles. During dry status the collector draws only 0.6 watts to motorbox. If the temperature drops below 4°C (40°F), the collector draws 6.6 watts continuously to power the sensor heater regardless of its wet or dry status. This creates the following power requirements:

dry status	0.05 amps continuous
cycle	0.75 amps duration of cycle
wet status	0.60 amps continuous
cold status	0.55 amps continuous

Battery requirements would then be calculated as per Table 4.1.

The required capacity (from Table 4.1) divided by the battery rating determines the number of batteries or battery changes needed per week.

4.1.2.2 Solar power/trickle charging: Solar panels and trickle chargers are rated to deliver a certain number of amps/hr at a given voltage. A trickle charger delivers this current as long as it is powered by an AC source. A solar panel delivers this rated current only during peak daylight hours. For this reason it is extremely important to estimate the number of effective solar hours per week at your site before determining the size or number of panels required to operate the site. Typically effective solar hours vary from 4 hrs/day in the east to 6 hrs/day in the southwest. These estimates do not take into account local solar easements such as trees or building shadowing a solar site.

Table 4.1 An Example Site: Worst case - winter

Collector Activity		Hrs/wk		Amps		Total
Temperature less than 4°C		168	x	0.55	=	92.4
Precipitation occurs and temperature is greater than 4°C	+	0	x	0.60	=	0
No. of precipitation events (6 sec cycle x 2* x .75)	+	7	x	0.02	=	0.14
Remainder of hours in a week (168 hrs.)	+	0	x	.05	=	0
Amperes-hrs per week						92.5
Cold weather battery efficiency (80°F-100%, 32°F-65%, 0°F-40%) 50% is used for this example						+ 46.3
Reserve capacity 20%						+ 18.5
Required capacity amp-hrs/wk						157.3

*Open and close cycle

If we had used a 90 ampere-hour marine battery in the above battery example, 67.3 amp-hr of extra capacity would still be needed to meet our winter site requirements. If we used a trickle charger for all 168 hours of the week, then the charger would have to have an output capacity of 0.4 amperes/hour (67.3/168) to meet our extra capacity demand. Note, however, that in order to operate the site week after week under the example conditions, the full 157.3 amps must be replaced every week! The charger then would have to deliver 0.94 amperes/hour to keep up with our weekly demand. A solar panel rated to deliver 2.0 amperes/hour and operating at peak capacity 12 hrs/day 7 days ofthe week would barely meet our example sites needs.

Using the 4 hours/day estimate of effective solar hours, we would need 3 solar panels to keep our battery fully charged week after week. The Coordinator's Office has experience in sizing panels and is available for advice.

4.2 Wet/Dry Collector[1]

If available, please refer to the manufacturer's instructions.

[1]From Aerochem Metrics "Assembly and Operation Instructions Automatic Sensing Wet/Dry Precipitation Collector".

4.2.1. Assembly

1. Open the shipping carton on the side marked “Open This Side.” The collector chassis is placed in the box with the bottom side facing up and with loose items packed in the bottom opening. Remove the packing material from the bottom opening. You will find the precipitation sensor, fuses, legs, mounting kit, bolts, and a bucket cover. While the unit is still in the box, cut the box at the corners for a distance of about 12 inches and fold the sides of the box down. Fasten legs in place with 1/4-20 bolts and nuts. It may be necessary to ream some holes with a 1/4" drill or rat tail file. Next, bolt the two sections of aluminum angle that are approximately 36 inches (91 cm) long to the outside of the pairs of legs across the narrow dimension of the collector so that one face of the angle rests on the floor with its edge oriented away from the collector.

2. Install the counterweight and rod between the ends of the long arms. If your collector was supplied with a peaked snow roof the counterweight will be in two parts.

   Note: We recommend that the snow roof and corresponding counterweight (the smaller of the two) not be installed on the collector until a clear need for this accessory has been demonstrated. In addition to serving as a snow roof, the peaked roof also acts somewhat as a wind “sail”. This “sail” causes the lid to lift off of the wet side bucket during high winds) thereby allowing dry deposition to intrude into the wet side bucket.

   Check that the counterweight is centered on the 3/8" rod and that the Waldes rings are positioned so that they are pressed firmly against the ends of the counterweight. If your collector does not have a commercially manufactured) matched snow roof counterweight or if modifications have been added to the collector roof, proper counterweighting must be achieved as follows:

   a) Turn the box and enclosed unit right side up and lift off the shipping carton. Cut the two black bands holding the roof and buckets in place.

   b) From underneath the base, remove the single bolt that holds the drive arm mechanism to the clutch arm on the motor box. (The end of the drive arm mechanism is cut down to provide clearance as it cycles with the clutch arm). With the lid in mid-travel and the drive arm mechanism supported with your hand up to the level of the clutch, add weight to the rod or existing counterweight until the lid remains in mid position unassisted. A very

close approximation of the proper amount of counterweighting is achieved if you add twice as much counterweight as lid weight. A muffler clamp attached to the existing counter weight and/or washers can be used to increase the counterweight to the necessary weight.

3. To mount the precipitation sensor, remove the four screws located around the hole in the corner of the chassis at the “dry” collector end. Insert the cannon plug through the hole and fasten the sensor in place with the sensor oriented so that it faces away from the dry collector. Connect the cannon plug to the motor box.

4. If connected to a 110 AC 50-60 Hz source, the unit is now ready to operate. For 12 VDC operation, disconnect from the AC source and remove the 1/2 amp fuse from the AC fuse holder (Also see Section 4.1, Power Requirements). Connect a source of 12 VDC to the spade lugs located on the side of the motor box. Observe the polarity markings on the box. Place a 2 amp fuse in the fuse holder above the spade lugs. The unit should now operate. During the first cycle the roof should move to cover the “wet” bucket which is located at the end away from the rain sensor. Remove the cardboard inserts placed between the roof and the bucket. Short the rain sensor grid to the base plate with a coin, a drop of water or a moistened finger; the roof will move to Cover the “dry” bucket and thus expose the “wet” bucket.

4.2.2. Mounting the Collector

All techniques require the collector be mounted level with the wet side bucket to the West and the sensor facing North.

Because of its large cross-section and relatively low weight, the precipitation collector is susceptible to being blown over in high winds. Therefore, it is essential that the unit be firmly anchored when placed in the field. THE INSTRUMENT WARRANTY DOES NOT APPLY TO DAMAGE INCURRED DUE TO IMPROPER MOUNTING. Numerous anchoring techniques are available including stakes, rocks, sandbags or cement blocks placed across the protruding ends of the cross members. Alternatively, 7 inches of each of the protruding ends can be cut off and then bolted to the remaining portions of the cross members so that the short sections project downward. Four small holes are dug to accommodate the downward-protruding sections. The collector is then mounted in place, carefully leveled, and concrete poured into the holes. (In order to obtain a better set in the concrete, you may wish to first drill several holes in the aluminum angle.)

4.3 Event Recorder

For those sites not having rain gages with event recorders, the event recorder is installed as follows:

1. Remove housing of the weighing rain gage by removing top, bucket, and screw from center of bucket holder. Remove the bucket holder. Remove the five screws from around the base, then remove the outside housing.
2. Referring to figure 4.3, remove the screws and nuts holding the event recorder pen in the aluminum protector. Place the pen assembly in position on the frame, with the cutout surrounding the upper bail pivot bracket. Hold the event recorder assembly tightly and drill a No. 28 hole through the upper hole of the pen assembly. Put one of the 6-32 screws through the upper hole just drilled and secure with a nut. Drill through the bottom hole and secure with the remaining 6-32 screw and nut.
3. Remove the remaining screw from the shipping protector and slip the lower end of the pen assembly behind the pen arm pivot, line up the holes and secure the assembly to the frame with the two 6-32 screws and nuts.
4. Feed a two conductor wire of sufficient length to reach the Aerochem collector through one of the yellow-capped holes in the base. Connect the wire to the two terminals of the event recorder. Install such that strain relief prevents tension being placed on the wire at the terminals.
5. Connect the other end of the wire to the screw terminals under the middle fuse of the precipitation collector. Note: Early models of the collector did not have the third fuse and the two screw terminals. If your collector does not have the three fuses on the face of the motor box and the connector with the two screw terminals, we suggest that you remove motor box and return it to the manufacturer for modification.
6. Adjust the position of the pen tip by loosening the screw and block holding the pen arm pivot. This provides adjustment of the pen in all directions. Adjust the pen scribe approximately between the 5 1/2 and 6 1/2 rainfall line of the chart and four hours to the left of the position of the rain gage pen. This permits the rain gage pen to pass up and under the event marker pen in case of rainfall in excess of 5 1/2 inches.
7. Adjust the pen pressure against the chart by tilting the top of the pivot U in closer to the frame.

4.4. Rain Gage

The rain gage should be located 5-30 meters from the wet/dry collector in an area where an anchoring base can be installed. A suitable base can be made inexpensively from angle iron if a

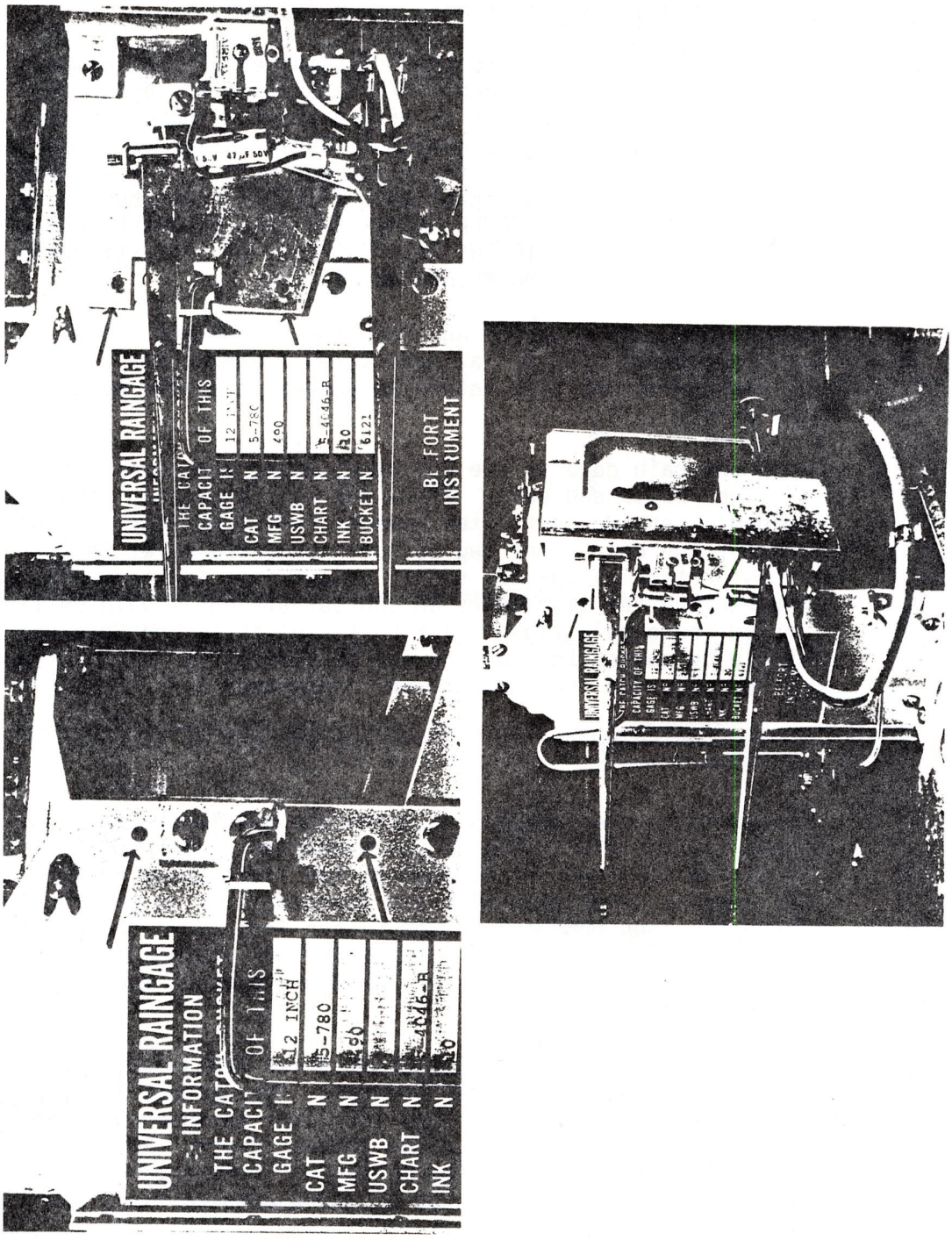
UNIVERSAL RAINGAGE
INFORMATION
CAT N
MFG N
USWB N
CHART N
INK N
BUCKET N
6122
BELFORT
INSTRUMENT

Fig. 4.3

commercially available base is not available (Fig. 4.4). The installation of the gage with this base is as follows:

1. Bolt two of the stakes to the cross member of the tee base using 5/16ths x 1 1/2 inch x 3/4 inch shankless bolts and nuts. Drive these stakes to within about 6 inches of the surface. When the cross member is level, drive the remaining stake to the same horizontal plane and bolt. If this leveling is done with care, the instrument will be level when it is bolted to the base. NEVER HAMMER THE BASE OR STAKES WHILE THE RAIN GAGE IS BOLTED TO THE BASE, AS THIS WILL LIKELY DAMAGE THE RAIN GAGE WEIGHING MECHANISM.
2. Remove the rain gage top and then the weighing platform by unscrewing the center flat-head screw. Remove the outer case by unscrewing the five retaining screws about the bottom of the skirt.
3. Bolt the rain gage to the tee base, using the three 3/8 x 2 1/2 inch bolts and nuts. Place the rain gage such that the welded extension on the tee base extends from under the base nearest the door. The two bolts through the holes in the cross portion of the tee should extend from the rain gage base through the tee base where an appropriate nut should be firmly locked reasonably tight. The bolt closest to the gage door should be passed through the tee base first up into the inside of the gage and the nut screwed firmly upon it.
4. Remove the shipping tie holding the pen arm to the pen shifter.
5. Loosen the mechanism locking screw and nut found above the pivot towards chart side of the mechanism. Back out the screw until the top lever is stopped by the limit screw. Retract the locking screw a turn or two farther; lock in position with its nut. Then remove the stop sleeve from about the movement bracket limit screw. Do not disturb the setting of the other two limit screws, their positions are a part of the gage’s calibration.
6. Remove the wrapping from the chart drive mechanism, and unscrew the mechanism from the base. The dashpot is mounted to the mechanism base with two identical thumbscrews. Remove the thumbscrews and push up the dashpot cover. Pull the dashpot out from between the mechanism frame and fill the dashpot with 3 1/2 oz. of the silicone damping fluid supplied. Replace the dashpot.
7. Replace the chart drive mechanism.
8. Remove thumbnut from chart drive mechanism spindle. Mount chart cylinder (with chart clip) supplied on the spindle,

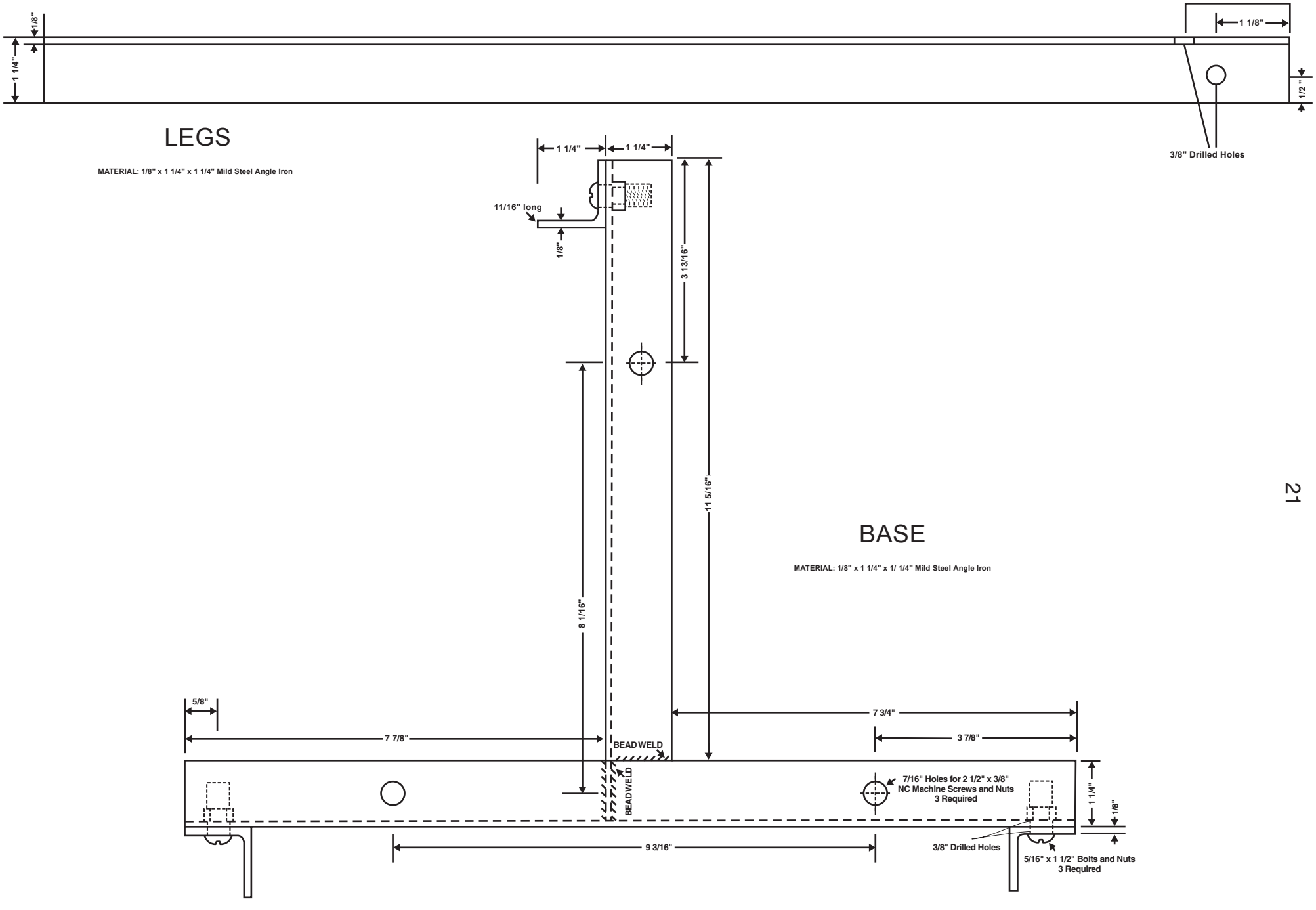
1/8"
1 1/4"
1 1/8"
1/2"
3/8" Drilled Holes
LEGS
MATERIAL: 1/8" x 1 1/4" x 1 1/4" Mild Steel Angle Iron
1 1/4"
1 1/4"
11/16" long
1/8"
3 13/16"
11 5/16"
8 1/16"
BASE
MATERIAL: 1/8" x 1 1/4" x 1/ 1/4" Mild Steel Angle Iron
5/8"
7 7/8"
BEAD WELD
BEAD WELD
7 3/4"
3 7/8"
7/16" Holes for 2 1/2" x 3/8"
NC Machine Screws and Nuts
3 Required
1 1/4"
1/8"
9 3/16"
3/8" Drilled Holes
5/16" x 1 1/2" Bolts and Nuts
3 Required

Fig. 4.4

making certain that the mechanism pinion and the cylinder gear are meshed. Do not replace the thumbnut.

9. Replace the gage housing, positioning it on the mechanism base so that the chart drive and pen arm are accessible from the sliding access door.

10. Fasten the housing in place with the five screws. Replace the bucket platform on the movement bracket, and fasten it in place with the washer and screw. Replace the collector on the gage housing. The gage is now ready to be put into operation.

11. If the installation is done in the winter months, the rain gage should be winterized according to the instructions provided in the INSTRUCTION MANUAL FOR NADP/NTN SITE OPERATIONS.

4.5. Testing the Station

Once installed the following field checks should be made to determine if the station is operating properly. If deficiencies are noted, refer to the appropriate instrument manual or the INSTRUCTION MANUAL FOR NADP/NTN SITE OPERATION to troubleshoot the problem.

1. Short the sensor on the collector with water or a coin.
   During the cycling of the lid you should observe the following:
   a. the voltage across the event terminals on the motorbox should to be between 11 and 17 vdc when the lid is in the full open position. Voltage at any other time indicates a motor malfunction.
   b. the lid should travel at an even rate to cover the dry side bucket.
2. After the cycle is complete and with the sensor wet or the coin still in place.
   a. the event pen should be elevated on the rain gage chart.
   b. the sensor should heat to become hot to the touch within 2-3 minutes.
   c. the lid should be centered snuggly on the dry bucket, forming an “air tight” seal.
   d. the lid should be “locked” on the dry bucket and not easily dislodged (~ 1 inch of lid travel is normal).
3. Remove the coin after the cycle is completed.
   a. the lid should be centered snuggly over the wet bucket forming an “air tight” seal.

b. the lid should be “locked” on the wet bucket and not easily dislodged.

c. the event pen should have returned to the “normal” position on the rain gage chart.

4. Testing of the rain gage.

a. zero the raingage.

b. slowly push down on the bucket of the rain gage; the lower pen should return to the zero line of the rain gage chart.

c. there should be an ink tracing for both the event pen and (from 4.5.1-4.5.3) and the lower rain amount pen.

APPENDIX A

Please refer to Section 3.0 of the NADP/NTN SITE SELECTION AND INSTALLATION INSTRUCTION MANUAL before completing this questionnaire.

NATIONAL ATMOSPHERIC DEPOSITION PROGRAM IR▾7
NADP/NTN SITE DESCRIPTION QUESTIONNAIRE

_____
Date Prepared

_____
Reason (New site, change, revision)

A. SITE IDENTIFICATION

1. Station Name _____ 2. County _____ 3. State _____
4. Station Number _____ 5. CAL Code _____
6. Operating Agency _____
7. Funding Source _____
8. Site Ownership _____
9. Latitude _____°_____' 10. Longitude _____°_____' 11. Elevation _____ (m)
12. Ecoregion_____
13. Map Name _____
Available USGS Topographic Map Revision Year Scale (1:24,000 preferred)

B. ADMINISTRATION

1. Site Operator _____
_____
Mailing Address To Which UPS Will Deliver Buckets
_____
Phone _____/_____
2. Site Operators Supervisor_____
_____
Mailing Address _____
_____
Phone _____/_____
3. _____
Supervisory Official Who Will Receive Preliminary Data Reports
Mailing Address _____
_____
_____
Phone _____/_____

C. INSTRUMENTATION AT OR NEAR THE SITE

1. Collector

Type _____ Model _____
Primary power _____ Voltage _____ Amp _____ Panel Area _____

2. Rain Gage

a. Required Rain Gage (Co-located within 30 meters of the Collector)
Type:
None ____ Recording _____ Non-Recording _____
Weighing _____ Tipping Bucket _____ Other _____
Opening _____ (cm) Manufacturer _____ Model _____
Equipped with event recorder ___Yes ___No
Background:
Distance _____(m) Direction _____ Alter Shielded ____ Yes ____No
Years _____ Annual Precipitation _____/_____/_____ (mm)
Total Rain Snow Depth

b. Alternate Nearest Rain Gage
_____ _____
(Location) (Years)
Distance _____(km) Direction_____
Annual Precipitation _____/_____/_____ (mm)
Total Rain Snow Depth

c. Nearest Climate Normal Gage
_____ _____
(Location) (Years)
Distance _____ (km) Direction_____
Annual Precipitation _____/_____/_____ (mm)
Total Rain Snow Depth

3. Wind Instrumentation at Site:

a. Wind (Co-located within 0.5 km of the NADP/NTN Collector)
None _____
Speed: None ____ Recording ____ Non-Recording ____
Direction: None ____ Recording_____ Non-Recording _____
Travel: None ___ Recording ____ Non-Recording____
Manufacturer _____ Model _____
Distance _____ (m) Direction _____
Height above ground _____(m) _____(m) _____(m)
(Please attach wind rose if available)

b. Alternate Nearest Measurement
_____
(Location)
Distance _____(km) Direction _____
(Please attach wind rose if available)

D. RELATED SCIENTIFIC ACTIVITIES

1. Additional Sampling:

a. Aerosol samplers

i. Check those aerosol samplers co-located within 0.5 km of the NADP/NTN collector.

_____ None

_____ Inertial Cascade Impactor

_____ Integrating Nephelometer

_____ Hi Volume Filter

_____ Other

_____

_____

_____

_____ Dichotomous Particulate Sampler

_____ Inhalable Particulate Sampler

_____ Condensation Nucleous Counter

_____ Aerosol Size Analyzer

_____ Membrane Filter & Vacuum Pump

ii. What chemical constituents on the filters are analyzed?

_____

iii. By what analytical technique and/or through what agency?

_____

_____

b. Gas measurements

i. Check those gas measurements made within 0.5 km of your NADP/NTN collector.

_____ None

Continuous Measurements	Bubbler Gas Sampler	Other
_____ SO_2	_____ SO_2	_____
_____ NO	_____ NO_2	_____
_____ NO_x	_____ H_2S	_____
_____ HNO_3	_____ NH_3	_____
_____ 0_3	_____ 0_3	_____
_____ $H_2 SO_4$	_____ Aliphatic Aldehydes	_____
	_____ CO	_____

c. Meterological instruments

i. Check those meteorological instruments co-located within 0.5 km of the NADP/NTN collector, which are <u>in addition</u> to the previously described rain and wind instrumentation.

_____ None		
_____ Wind Run (transport)	_____ Dial Hygometer	_____ Thermograph
_____ Sonic Anemometer (wind speed)	_____ Wet Bulb Thermometer	_____ Max-MinThermometer
_____ Cup Anemometer (wind speed)	_____ Tipping Bucket Rain Gage	_____ Hygrothermograph
_____ Propeller Anemometer (wind speed)	_____ Snow Gage	_____ Tower (3 meter)
_____ Hot wire Anemometer (wind speed)	_____ Rate of Rainfall Gage	_____ Tower (10 meter)
_____ Wind Vane (direction)	_____ Standard US Weather Bureau 8" Rain Gage	_____ Tower (Other __ meters)
_____ Pitot Tube (wind speed)	_____ Alter Windshield	_____ Soil Moisture
_____ Ceilometer	_____ Precipitation Detector	_____ Snow Depth (pillow)
_____ Transmissiometer	_____ Barograph	_____ Snow Depth (core)
_____ Fog Detector	_____ Aneroid Barometer	_____ Lightning Count Recorder
_____ Sight Clinometer	_____ Mercurial Barometer	_____ Potential Gradient Recorder
_____ Rawinsonde	_____ Sunshine Duration (Campbell Stokes)	_____ Other
_____ Evaporimeter	_____ Pyranometer	_____
_____ Evaporation Pan	_____ Radiometer, Spot	_____
_____ Dew Point Temperature (LiCl)	_____ Radiometer, Integrated	_____
_____ Dew Point Temperature (cooled mirror)	_____ Pyreheliometer	_____
		_____
_____ Relative Humidity	_____ Shadowband	_____
_____ Hair Hygrometer	_____ Net Radiometer	_____
_____ Psychrometer		_____

2. Associated acid rain effects research going on within 0.5 km radius (Project: Sponsor:Principal Investigator:Address).

_____

_____

_____

3. Does a calibrated watershed exist within 0.5 km of site?

Area _____ Hectares

Slopes _____

Cover type _____

Method of flow gaging _____

Kind of chemical analysis performed

_____

4. If other air quality or precipitation chemistry data or publications specific to the site are available, please describe:

_____

_____

_____

_____

E. POTENTIAL LOCAL CONTRIBUTORS TO DEPOSITION AT THE SITE

1. Within 30 m of the COLLECTOR identify all objects that are taller than the COLLECTOR.

a. Structures none _____

(1) Type _____ Use _____

Height _____(m) Distance _____(m) Direction _____

(2) Type _____ Use _____

Height _____(m) Distance _____(m) Direction _____

b. Trees none _____

(1) Species _____ Max. Height _____(m)

Distance _____(m) Direction _____

(2) Species _____ Max. Height _____(m)

Distance _____(m) Direction _____

(3) Species _____ Max. Height _____(m)

Distance _____(m) Direction _____

c. Other (e.g., overhead wires, masts, etc.) none ____

(1) Object _____

Height _____ (m) Direction _____ Distance _____ (m)

(2) Object _____

Height _____ (m) Direction _____ Distance _____ (m)

(3) Object _____

Height _____ (m) Direction _____ Distance _____ (m)

(4) Object _____

Height _____ (m) Direction _____ Distance _____ (m)

(5) Object _____

Height _____ (m) Direction _____ Distance _____ (m)

d. Is public road access to site in summer: ____ Good, ____ Fair, ____ Poor?
and
winter: ____ Good, ____ Fair, ____ Poor?

e. Type of public road surface? _____

f. How far from the public road will collector be sited? _____(m)

g. Is there other than public road access to the site? If so, please describe.

_____

_____

_____

h. How close can a vehicle approach the collector? _____ (m)

i. How is site secured against vandalism, etc.? _____

j. Are there any special logistical problems? Please describe. _____

_____

_____

_____

2. Within 200 m of the site identify:

a. Predominate land use in the area:

Use 1 _____ , ____ % Use 2 _____ , ____% All Others ___ %
(cultivated, orchard, lawn, pasture, forest, water, swamp, residential)

b. Unpaved roads and parking areas: None _____

(1) Unpaved road: Distance _____ (km,m) Direction from collector_____

Traffic volume _____

(2) Unpaved road: Distance _____ (km,m) Direction from collector_____

Traffic volume _____

(3) Parking lot: Distance_____ (km,m) Direction from collector_____

Unpaved _____ Surface material _____

Traffic volume _____

(4) Parking lot: Distance_____ (km,m) Direction from collector_____

Unpaved _____ Surface material _____

Traffic volume _____

3. Within 1 km of the site identify significant agricultural operations such as feedlots, dairy barns, cultivated fields, etc.

   None _____

   a. Type _____

      Distance _____(km,m) Direction from collector _____

   b. Type _____

      Distance _____(km,m) Direction from collector _____

4. Within 10 km of the site identify transportation related sources.

   a. (1) Main highways or expressways: None _____

      Route #_____ Traffic volume _____

      Distance _____ (km,m) Direction from collector _____

      (2) Main highways or expressways:

      Route # _____ Traffic volume _____

      Distance _____ (km,m) Direction from collector _____

   b. (1) Other paved roads: None _____

      Route # _____ Traffic volume _____

      Distance _____ (km,m) Direction from collector _____

      (2) Other paved roads:

      Route # _____ Traffic volume _____

      Distance _____ (km,m) Direction from collector _____

   c. Lake/river or rail traffic: None _____

      barge _____ , lake steamer _____ , ocean vessels _____ , rail _____

      Distance _____ (km,m) Direction from collector _____

      Traffic volume _____

   d. Airport: None _____

      Distance _____ (km,m) Direction from collector _____

      Traffic volume _____

   e. Other transportation related sources _____

      _____

      _____

5. Within 60 km of the site identify stationary sources:

a. Power plant(s): None _____

(1) Name _____

Distance _____ (km) Direction from collector _____

Fuel _____ Electrical capacity _____ (KW_e , MW_e)

(2) Name _____

Distance _____ (km) Direction from collector _____

Fuel _____ Electrical capacity _____ (KW_e , MW_e)

(3) Name _____

Distance _____ (km) Direction from collector _____

Fuel _____ Electrical capacity _____ (KW_e , MW_e)

b. Industry: None _____

(1) Type/product _____

Distance _____ (km) Direction from collector _____

Comment _____

(1) Type/product _____

Distance _____ (km) Direction from collector _____

Comment _____

c. Other stationary sources: None _____

(1) Type/product _____ Distance _____ Direction _____

(2) _____

_____

_____

_____

6. Within 60 km of the site identify significant area sources: None _____

a. Population Centers:

_____
(Name) (Population)

Distance _____ Direction _____

b. Other:

_____

_____

_____

_____

F. LABORATORY FACILITIES

1. Available lab Space: None _____ Good _____ Fair _____ Poor _____

Distance _____ (km) Shared: _____ Yes _____ No

2. pH Meter: None ____ Manufacturer _____ Model _____

Probe _____ Manufacturer _____ Model _____

3. Conductivity Meter: None _____ Manufacturer _____ Model _____

Probe _____ Manufacturer _____ Model _____

4. Balance _____ None _____ Manufacturer _____ Model _____

5. Type of low conductivity water available:

deionized _____ distilled _____ bottled _____

6. Special problems: _____

_____

_____

_____

_____

_____

G. OTHER

The Program Coordinator's Office requires the following submitted with the questionnaire.

1. Topographic map, listed in Section A11-14.
   Enclosed _____
   Will send _____
   Not available _____

2. A scale drawing of the site to 30 meters where 1 cm = 10 ft.
   Enclosed _____
   Will send _____
   Not available _____

3. 3x5 or larger photos and negatives of the site in the 8 directions.
   Enclosed _____
   Will send _____
   Not available _____

4. Soil Conservation Service map reference _____

   Soil Series _____
   (Name)
   Enclosed _____
   Will send _____
   Not available _____

H. PERSON WHO FILLED OUT THIS FORM:

Name _____

Position _____

Phone # _____

Address_____

_____

_____

APPENDIX B

Appendix B

Condensed siting criteria for establishing regionally representative NADP/NTN sites.

Critical distances (see Section 2.3 for more details)

Sources	Distance from the collector	
	Minimum	Becomes background**
Regional Requirements:		
Heavy industry (chem plants, power plants)	10 km (20 km if upwind)	50 km
Suburban/Urban populations	10 km (20 km if upwind)	50 km
if population >75,000	20 km (40 km if upwind)	50 km
Local Requirements:		
Moving sources	100 m	10 km
Feedlots/dairy barns, etc.	500 m	1000 m
Grazing animals	20 m	
Surface storage	100 m	1000 m
Parking lots	100 m	200 m

On-Site Requirements:	Minimum	Maximum
Rain gage (must be in same plane as the collector ±1 ft)	5 m	30 m
Critical angles		
Buildings	Outside 30° cone of mean wind direction	
Projection angle	45°	
Slope	level	15%

** Distance from the collector beyond which source is thought to be undistinguishable from background.