



Summit Station Clean Air Management Plan

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1. Purpose of this Plan

Summit Station was established in 1989 to support the Greenland Ice Sheet Project 2 (GISP 2). The drilling team reached bedrock on July 1, 1993, recovering a total of 3053 meters of ice core. Since the conclusion of GISP 2, the pristine environment of the Greenland ice sheet has made Summit an ideal location for continuing research with a focus on ice core interpretation, physical processes at high latitudes, and climate change.

As the station has grown over the last 20 years, so have the negative impacts of camp fuel consumption and higher populations. Atmospheric chemistry and snow chemistry account for the majority of science experiments at Summit, and they are also the most negatively impacted by local pollution sources.

This document provides guidelines to the station staff and researchers for making decisions that impact air and snow quality in the science sector.

2. Communications and 24-hour alerts

The science community and on-site/off-site management should be included in communications related to this management plan, any variance requests, and updates. (email: cps-summit-science@transport.sri.com)

The science community has agreed to a 24-hour email alert system to allow for on-site decision making during summer operations. This alert system states that any non-emergency variance from the policy outlined below should be, 1) need-based, 2) announced 24-hours in advance, 3) and include a reference to the three-day weather forecast from the DMI. Need-based equipment operation implies that the safety/well-being of those at Summit will be compromised and/or a critical schedule slip will result from delaying operations. The weather forecast should indicate a persistent pattern of north or light variable winds.

3. Managing Clean Air Operations

Managing clean air operations requires an understanding of wind direction (Figure 1) and camp layout (Figure 2). The prevailing wind direction at Summit is nominally from the south (180°), and is between southeast (135°) and southwest (225°) approximately 60% of the time.

SUMMIT, GREENLAND
WIND ROSE
2009 - 2013

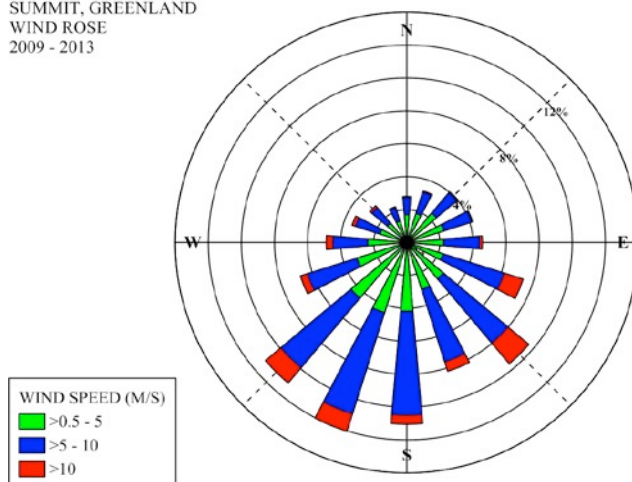


Figure 1: Summit wind rose, 2009-2013, courtesy Tom Mefford, NOAA-ESRL.

To reduce the impact of station activity on science experiments, most science activity is located within the clean air zone (CAZ). The CAZ is positioned south of the generators and skiway in order to mitigate the impact of main camp activity on science experiments. Within the CAZ there are three different sectors, 1) the Clean Air Sector, 2) the Clean Campaign Sector, and 3) the Undisturbed Snow Campaign Sector. There should be no vehicle or foot traffic within the Clean Air Sector, which is indicated on the map as an east-west line to the south of the proposed AWO site. The Clean Campaign Sector, indicated by the 15° wedges off of the Clean Air Sector, is for campaign projects with clean air/snow requirements and minimal traffic. The Undisturbed Snow Campaign Sector, shown as the wedge to the east of the main camp, is designated for projects requiring clean/undisturbed snow and foot/vehicle traffic should be kept to a minimum in this area.

North wind operations are defined as any time the wind direction is between 342° and 72° (i.e. wind is coming from the NNE, 27° +/- 45° AND/OR periods of light variable winds less than two knots.

When winds are from this range, they carry exhaust plumes over the CAZ. During periods of light variable winds, pollution is not readily transported away from camp and can build up or drift into the CAZ. There are numerous wind speed and direction displays located around station. The wind speed and direction can also be relayed verbally by the manager or science techs.

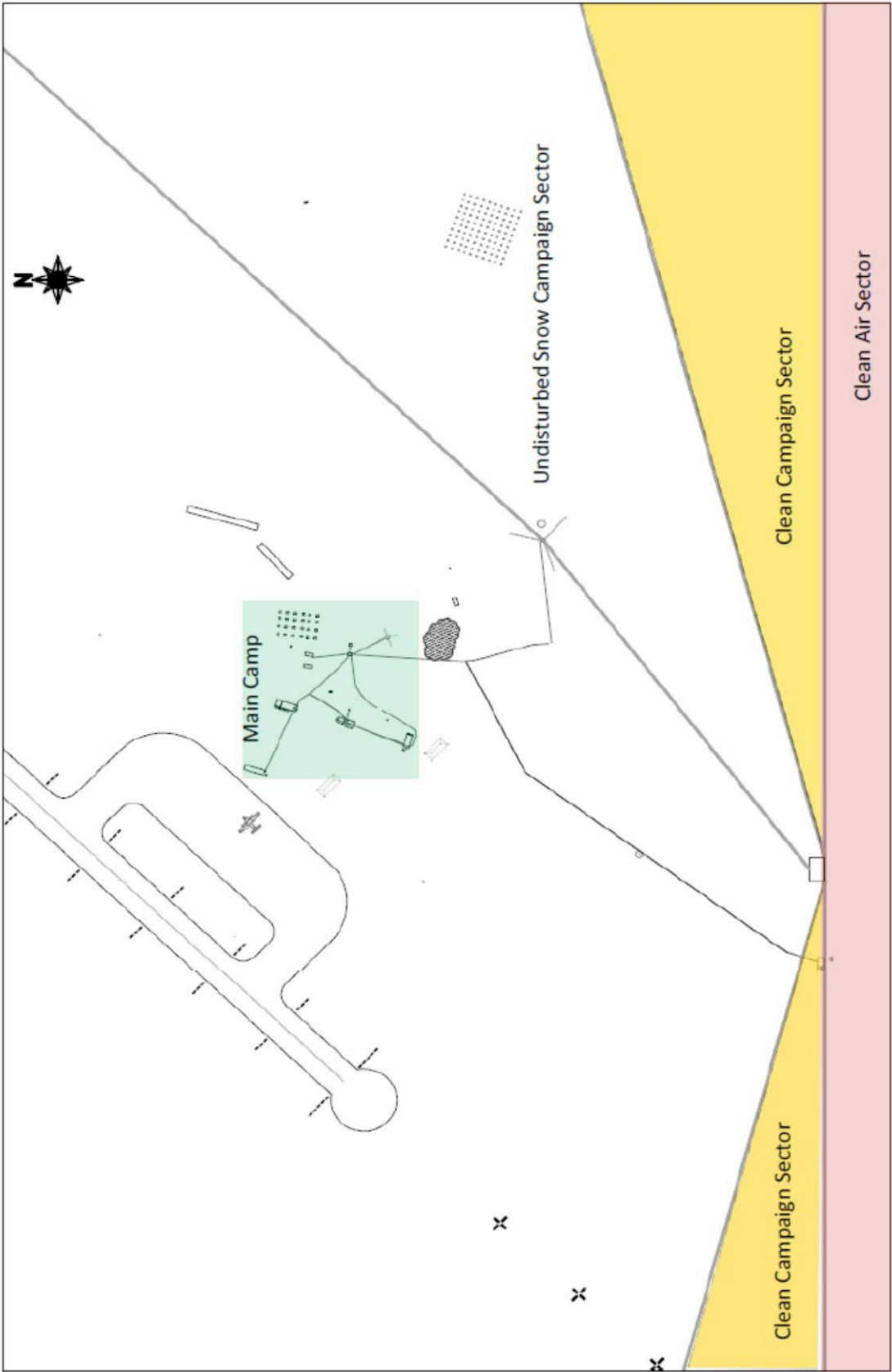


Figure 2: Summit Station site plan.

3.1 North Winds Operations Protocol

During north wind operations, the following protocol must be followed:

- 1) Minimize the use of all internal combustion sources (as summarized in Table 1).
- 2) No internal combustion rolling stock is used unless: A) required for flight operations, B) required for critical camp and/or science operations, or C) required for life safety. If north winds are persistent and begin to impact critical construction/science operations, the 24-alert system may be enacted and the station can proceed with the variance.
- 3) Equipment may be operated on flight days for two hours before the aircraft lands and two hours after the aircraft departs.
- 4) Operators report/record all equipment use (time, type, duration, location) on the clipboard in the Big House office. All skiway grooming is reported and recorded by the heavy equipment operators regardless of wind direction. Science techs record all flights (ANG and Twin Otter).
- 5) Science techs collect the paper copies from the office and update the electronic log weekly prior to the weekly science report.

Table 1: Guidelines for use of internal combustion sources.

Source	North Winds	Non North Winds
Aircraft	As Scheduled	As Scheduled
Camp Generators	Continuous	Continuous
Aux. Generators	Prohibited*	Minimized
Heavy Equipment	Prohibited*	Minimized
Light Equipment	Prohibited*	Minimized

*Except during medical emergency, flight operations, or 24-hour alert to science community.

4. Managing Traffic in the Clean Air Zone

The CAZ is entered routinely by the science techs as part of their daily, weekly, and other science maintenance tasking. The 50-Meter Tower, TAWO, Bamboo Forest, Seismometer Bunker, Snow Pits/Sampling sites are all locations inside the CAZ that are routinely visited. The CAZ is also routinely entered during the summer campaign science season by construction staff, operations staff, and the science community. All traffic must be minimized and regulated along well publicized and flagged walking routes. Any deviations from routine should be documented as described in section 4.2.

4.1 Clean Air Zone Traffic Protocol

The CAZ is a limited traffic zone. Internal combustion vehicles are only permitted under certain conditions:

- 1) In the event of a medical emergency.
- 2) As planned in advance for science staging or construction activities.
- 3) For construction or maintenance, with the permission of the Summit Science Project Manager and the SCO.

Pedestrian traffic is restricted to designated flag lines and walking paths. Routine trips along designated paths do not require approval or additional documentation. Any variances must be documented appropriately and approved by the SCO and Summit Science Project Manager.

Note: Though not strictly in the CAZ, all combustion traffic/activities to the south of the main camp should be kept to a minimum. Specifically, there should be no snowmobile or heavy equipment traffic south of the GISP 2 borehole site without prior approval from the Summit Science Project Manager, SCO, and NOAA representatives.

4.2 Access to Remote Field Camps

For temporary camps situated north of Summit Station, there is no requirement to operate in accordance with the Summit Station Clean Air Management Plan. However, travel between Summit Station and the remote camps must be done in accordance with the Summit Station Clean Air Management Plan and Summit Station Travel Policy (for example, no non-emergency travel to Summit during north wind conditions).

4.3 Documenting Variances from Clean Air Management Plan

Any variances, even those approved by the science community, must be documented. This also includes low-altitude flight activity occurring over the CAZ. The Summit Station science technicians are the point of contact (POC) for this documentation. They maintain a file on the public Summit ftp site:

ftp://isr.sri.com/pub/summit/ftp/data/GEOSummit/Clean_Air_Traffic/

For access to the file, contact your POC.