

## History of Toilets at High Camps on Mount Rainier

### Toilets at Camp Muir:

At Camp Muir, two stone buildings were constructed on the north side of the public shelter in the 1920's. Ramps were built under the seats, and the waste solids would fall into a crevasse at the bottom of the slope behind the buildings. If there was a buildup of solids, the climbing ranger would rake the material down hill into the crevasse. The system was redesigned by the late 60's and utilized five gallon cans lined with plastic bags under the seats. The full bags were then disposed into the crevasse.

The first pit toilet at Camp Muir was constructed in 1966 and the second in 1971. The permafrost made digging the pit difficult and time consuming; only about 6 inches per day could be dug on a warm day, with 2 inches per day the average. The pit toilets were four feet by four feet by six feet (depth). Both toilets were open during the summer, and one was kept open during the winter. Park personnel would use a posthole digger and scoop shovel to place waste material into 55-gallon drums. The pits were cleaned out twice a year and the drums, containing primarily solids, were flown out by helicopter.

In 1968 a propane assisted toilet was installed at Camp Muir in order to incinerate wastes. However, serious injuries occurred while a user was incinerating the wastes and the toilet was abandoned.

In 1972 a Jet-O-Matic Chemical Toilet was installed at Camp Muir. This system required five to six gallons of ethylene glycol in order to charge the reservoir tank and three gallons of a formaldehyde based solution placed in the holding tank solution for each 160 uses. When the sewage holding tank was full, the materials, including solids, liquids, and chemicals, were flushed into 55-gallon drums and flown out. Several problems occurred that forced the abandonment of this system. An adequate supply of water was not available to the system and the flush water did not recirculate, causing piles of materials to accumulate directly beneath the seat. The material in the full tank was difficult to flush into the 55-gallon drums because the concentration of solids was too high. At least 660 gallons of waste from the chemical alone had to be flown off the mountain in one year.

In 1974 an indoor toilet system was installed in the public shelter at Camp Muir. A curtain was placed around a toilet seat in the corner, and plastic bags were supplied. Plastic bags were then placed in 55-gallon drums and later flown out. However, many visitors preferred more private locations and the system was eventually abandoned.

In 1978 four vault toilets were installed at Camp Muir. Two were eventually replaced with pit toilets and the remaining vaults were removed in 1984. The urinals did not drain well due to the permafrost. Consequently, liquids and solids had to be removed by hand and stored for helicopter removal at the end of the season. The used vaults were exchanged several times a week for empty ones and stored in racks.

In 1983 a waste composter bin had been proposed for installation in a crater steam cave. This system included a basket approximately one foot square made of wire mesh that would hold the waste and allow aerobic bacteria to encourage decomposition. Installation was planned for one of the vent caves where temperatures remain above freezing. However, a suitable vent cave could not be located and the project was abandoned.

In 1984 a prototype solar assisted composting toilet was installed at Camp Muir with the assistance of the U.S. Public Health Service and the Maintenance and Engineering personnel at the NPS Denver Service Center under the Remote Area Management Waste Disposal (RAWAD) project. The RAWAD project was an effort made by the NPS to document and identify appropriate systems for backcountry human waste disposal by assessing performance of existing facilities; installing demonstration facilities; and to identify and review new or potential technological applications that might be available. The cost to design, construct, install and modify the solar assisted structure (at Camp Muir) was from \$50,000 to \$75,000.

Although significant biological decomposition of human wastes would be difficult at high elevations on the mountain, the effort was directed towards reducing the volume of wastes by evaporating the liquids and drying the solids. The drying process was assisted by heating the air and/or the liquid, so solar energy was used to provide as much thermal energy as possible. However, the number of uses this facility received (6,000 in less than two months) and other mechanical problems resulted in the accumulation of liquids which were evaporating at a very slow rate and resulted in at least 500 gallons of liquids that had to be flown off the mountain (not sure what year or years). In 1988 a leach field was installed and approximately 400 to 600 gallons of waste liquid was run into the ground below the permafrost level. As a result the solids were reduced in weight by 50% with a 75% total waste reduction. However, the overall ecosystem effects of the disposal of waste liquids through the leach system are unknown. This toilet remained in use until 1999. The large vault that the liquids went into was a block of ice for most of the year and never fully melted even in August. Liquids did flow out of the toilet into the leach field. In 2000 the toilet building was removed and the remaining liquids and ice removed from the vault. Approximately half of the vault was filled in with soil and rock and the rest of the vault was used as a pit for a toilet, which was primary used in the winter (October through May). The drain to the leach field, which was installed in 1988, is still in use in 2016. Approximately 100 gallons

of solid waste is removed from this toilet each year (2000 through 2016). To remove the waste Park staff use posthole diggers and place the waste in 55-gallon drums, which are flown off the mountain in either June or September.

In 1998 the first of three “solar dehydrating toilets” was installed at Camp Muir. This type of toilet was first used at Camp Schurman, where it was installed in August of 1996. The design was a modification of the 1984 prototype solar assisted composting toilet. Instead of having the large vault to collect liquids the liquids went into a four-inch deep pan four feet by four feet with a drain where any remaining liquids went into the leach field below the toilet. The solid wastes were collected in stainless steel baskets above the pan. The baskets and pan were in an enclosed structure on the south side of the toilet made of Lexan, a clear polycarbonate sheet. Solar radiation heated the enclosure during the day to well over 100 degrees F on a sunny day. The toilet was designed this way to enhance evaporation of liquids from the pan and dehydrate the solid wastes in the baskets. To further assist dehydration and remove smell, a four inch 12-volt fan was installed and run off a battery charged by a photovoltaic panel. The chamber where the waste accumulated was large enough to store 6 baskets. Each basket could hold up to 10 gallons of solid waste. The baskets were rotated in the chamber about every third day (depending on use) to allow for the solids to dry in the chamber. Under perfect conditions each basket would remain in the chamber for 15 to 20 days and would then be removed and dumped into a 55-gallon drum. This would allow for the maximum dehydration of the solids, which would reduce the number helicopter flights required to remove the waste from the high camps.

The last of the solar toilets at Camp Muir was installed in 2000 and three toilets were in use during the summer from 2001 to 2016. All four of the toilets (3 at Muir and 1 at Schurman) have been very smelly. This is largely due to the fact that the urine and feces are mixed together in the baskets and then the urine collects in the pan below the baskets. This mixture of fecal bacteria, urine and heat created an odor problem. The pan where the urine is collected usually has a two-inch thick layer of slime by the end of the summer season. In addition, this design means that the liquids exiting the pan are extremely contaminated with fecal material before entering the leach field. Although the toilets have vents and fans to move air through the heat chamber, they were poorly designed and very ineffective at removing the smell from the toilet. In addition, any odor that was removed was blown out into the Camp Muir area at about 6 feet above the ground, making the whole Camp smell of human waste.

In 2013, Mount Rainier staff designed a toilet to hopefully eliminate the problems associated with the previous toilets. First a leach field was designed by an engineer and installed below the proposed toilet. The new toilet is being constructed in the northeast corner of the Camp so hopefully the prevailing southwest winds will carry any odors away from Camp most of the time. A solar hot water heating system is being installed to

keep liquids from freezing until they can be dosed into the leach field during the summer (July through mid-September). Construction on the new toilet began in 2014. In 2016 the Park purchased three urine separating toilets (ToiletTech Behind-the-Wall (or BTW) seats) for use in the toilet when completed. Due to logistical issues, the new toilet may not be functional until 2020.

The three existing solar toilets at Camp Muir were modified to accommodate the TTS BTW urine separating toilets in the summer of 2016. The first toilet was modified and the urine separating toilet installed in early July. The other two toilets were converted in August and September.

The urine separating toilets at Camp Muir worked well and there was a noticeable improvement of the smell in the toilets. The solid human waste from the toilets was collected directly into a 55-gallon barrel. This eliminated the need to transfer waste from the collection baskets in the old solar toilets to 55-gallon barrels. Previously, this was a difficult and unpleasant task. The liquid from the toilets that are now piped directly into the leach field below the toilets is urine only, as source separation happens prior to urine passing through fecal matter.

The biggest concern that Park staff have is how well the system will work in the late spring (May-June) when there are increased numbers of climbers but the temperature is below freezing most of the time. The existing toilets at Camp Muir that were retrofitted to accommodate the urine separating toilets currently have no external heat source. There is the possibility that solar hot water panels could be added to the existing toilets to provide heat. The new toilet, which is being constructed, should have enough warmth from the solar system and propane heater to allow the liquids to flow into the storage tank.

### **Human Waste Collection away from Camp Muir and Camp Schurman**

Before 1980 climbers using areas without waste disposal facilities have been asked to step off the trail to relieve themselves to minimize aesthetic and public health concerns. Despite these efforts, sightings of human waste along popular climbing routes were common on Mount Rainier.

In 1981 Park Rangers distributed biodegradable bags to climbing parties to use on routes where no nearby toilets or latrines are provided. Climbers were then directed to deposit bags down crevasses. This met with mixed success, and many bags were left throughout the climbing routes, littering the area. Although the practice of disposing of human waste down was an approved method in some areas such as on Mount Denali, little is known about the environmental effects of this practice.

In 1983 a voluntary “pack it in – pack it out” program known as the “blue bag system” was initiated. The idea was a modification of the Apollo Program “fecal-collection system/defecation-collection device” developed to remove and dispose of crewman waste matter. Climbers were provided with disposable bags to deposit their waste in and were asked to place them in receptacles provided at Camp Muir and Camp Schurman. The receptacles were flown off the mountain at the end of the season and disposed of at the park sewage treatment plants. A device known as the “muffin monster” was purchased for the sewage treatment plant to safely accommodate the plastic bags in the disposal process. This process proved to be very labor intensive and exposed workers to human waste and the practice was abandoned after a couple of years.

Although the climbers’ response to the system was positive, several problems did occur. The receptacles for depositing the used bags at Camp Muir filled rapidly and became a nuisance because of odor and a potential public health threat; ravens frequented the open receptacles and often spread the blue bags over the ridge. Barrels with closable lids were placed at the high camps, which resolved these problems. Beginning in 1987 park policy prohibited helicopter use for non-emergency projects after June and before Labor Day which prevented removal of the waste receptacles until early September. Climbing Rangers from 1984 through 1988 reported most climbers were familiar with the blue bag system and would frequently request them when they registered to climb. In the late 1980s the climbing routes still were littered with piles of human waste. In the 1990s all climbers were given “blue bags” and told to use them when away from toilets at Camp Muir or Camp Schurman.

This included use at Emmons Flats and Ingraham Flats, which at one time had latrines. In 1982 on the snowfield at Emmons Flats a latrine was created and surrounded by a four-sided blind, called a “privacy screen” to concentrate waste in a private setting and for easy disposal into crevasses. Visitors reacted positively to these latrines and one was installed at Ingraham Flats in 1983. The practice of crevasse disposal was discontinued in 1983 and waste was shoveled into 55 gallon drums and flown off the mountain. In the early 1990s this practice was changed to having the drums available at Ingraham and Emmons Flats for people to deposit “blue bags” into. Empty drums were flown up to these locations in June and full drums were flown off in September. This practice was continued through 1999. From 2000 through 2003 smaller barrels were carried to Ingraham and Emmons Flats for the summer. Weekly a Park employee would hike to the sites and carry back to contents to Camp Muir or Camp Schurman. Starting 2004 the Park required climbers to bring their own blue bags back to the high camps or the trailhead.

Collection barrels were also placed at Camp Hazard and the “Fan” on the Kautz Glacier Climbing Route. These locations were difficult to service and these locations were only

used for a couple of years in the late 1990s. Collection were also placed at Paradise, at the White River Campground and on the Westside Road. These locations are still in use and approximately one-third of all “blue bags” collected from climbers are deposited at these locations.

In general, this system has worked well. Most climbers are familiar with the “pack-in pack-out” system since it is used in many other areas in the USA and throughout the world. At Mount Rainier about 2,000 pounds of waste is collected in “blue bags” each year.

Since sometime in the late 1980s, disposal of “blue bags” has been accomplished by incinerating them. Once the blue bags were flown off the mountain they were packaged in cardboard boxes. The boxes were collected by a waste disposal company and transported to a waste disposal facility where the boxes were incinerated. This system is still in use at Mount Rainier.