# *TOOLIK FIELD STATION*
## *The Second 20 Years*

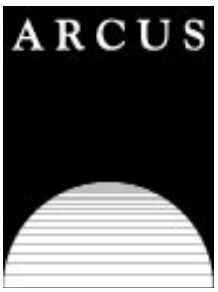
*Recommendations on the Science Mission*
*and the Development of Toolik Field Station*

Front Cover: *Toolik Lake* by David Mollet, 36" x 48", oil on canvas, 1994.
Mollet's painting was commissioned by the Institute of Arctic Biology, University of Alaska Fairbanks, for the Artist in Residence Program. The painting shows the Toolik Field Station and includes two new field laboratories funded by the National Science Foundation. The laboratories were dedicated in August 1994 at a formal ceremony attended by Neal Lane, Director of the National Science Foundation, Principal Investigators from various universities, and representatives of the Institute of Arctic Biology, the University of Alaska, and the Arctic Research Consortium of the United States.

# TOOLIK FIELD STATION: The Second 20 Years

## Recommendations on the Development of Toolik Field Station

**September 1996**

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# Foreword

This report is the product of a broad survey of the arctic research community and of those affected by arctic research activities. The main body of the report was written at a workshop held in February 1995 at the Bodega Marine Laboratory and attended by scientists, experts in the development and logistical support of remote field research stations, and managers of Toolik Field Station (TFS) and adjoining lands. Following the workshop, the report was reviewed by members of the arctic community.

The research community, wanting to ensure that excellent science continues to be conducted in the arctic, and specifically at TFS, initiated the planning process leading to these recommendations. In the summer of 1991, during the Arctic LTER site review sponsored by the National Science Foundation (NSF) Division of Environmental Biology, researchers urged NSF to upgrade research facilities at TFS. In 1992, TFS was identified as one of the key sites for the intensive process studies and observations planned for the U.S. Arctic System Science Program. NSF initiated a series of planning meetings and discussions with the research community, with the goal of preparing a detailed assessment of current and future needs at TFS.

The Institute of Arctic Biology at the University of Alaska Fairbanks, the managers of TFS, began developing a long-term plan for TFS. The TFS Steering Committee identified the need for a new science mission statement, a facilities plan, and a management plan. In 1992, the Institute asked the Arctic Research Consortium of the United States (ARCUS), as an organization representative of the arctic science community, to provide coordination and advice on the formulation of the planning documents. NSF subsequently asked ARCUS to conduct a community workshop and prepare recommendations looking at least ten years into the future. I accepted the invitation to chair the workshop and guide the development of these recommendations.

I would like to extend appreciation to the organizing committee and to workshop participants who added their perspectives to this report. Gus Shaver, Josh Schimel, and Anne Hershey prepared the first post-workshop draft of the report. Gus and Josh deserve special mention for the many hours spent working on subsequent drafts. I also thank reviewers for the many thoughtful comments that resulted in substantial improvements to earlier drafts. Various members of the arctic research community contributed photographs. The Institute of Arctic Biology provided information for figures and tables. This report owes much to ARCUS for its development and production. The exceptional support provided by Wendy Warnick, Kristjan Bregendahl, and the other staff at ARCUS was essential to its completion.

Finally, on behalf of the arctic scientific community, I thank the Office of Polar Programs at NSF for financial support and for the opportunity given to participate actively in the planning process.

Dr. Robert J. Naiman
University of Washington

*Sarah Hobbie near her research site at Toolik Field Station. (Photo by Terry Chapin)*

# Executive Summary

Toolik Field Station (TFS) has developed over the past 20 years into a premier, internationally important site for field research in the Arctic. TFS is located on the shores of Toolik Lake, in the northern foothills of the Brooks Range, Alaska, and is accessible by an all-weather road, the Dalton Highway (see Figure 1). TFS is owned and operated by the Institute of Arctic Biology (IAB) at the University of Alaska Fairbanks. Since 1975, research at TFS has focused on the environmental and basic ecology of tundra and freshwater ecosystems and their responses to climate change and disturbance. By any standards, this research has been exceptionally productive and has attracted both national and international attention. Most researchers come from outside Alaska, including 39 states and 25 foreign countries (see partial list in Appendix 1, TFS Users).

In this report, the scientific mission and goals of TFS for the next 20 years are defined and the needs for improvement of facilities, management, and funding are described. The main body of the report was written at a workshop held 16-17 February 1995, at the Bodega Marine Laboratory in Bodega Bay, California, and attended by 35 arctic scientists, logistics experts, land managers, and representatives of the indigenous people of Alaska. Comments and suggestions were then solicited from other members of the arctic community. This report is thus the product of a broad survey of the arctic research community and of those affected by arctic research activities.

A review of the mission, goals, and needs of TFS is both timely and important, for two principal reasons:

- Over the past 20 years the growth of TFS has been rapid but driven largely by the short-term needs of individual projects and the immediate availability of funds.
- The needs of arctic research are changing, and TFS is ideally situated to play a major role in the future development of this research.

Improvements and additions to TFS have been made primarily on an ad hoc basis, as demand increased and small increments of funding became available. As a result, many of the TFS facilities were not designed for long-term use. Many needed improvements have not been made due to a lack of adequate planning and lack of a stable funding source. At the same time, both individual scientists and the federal funding agencies that support them have made long-term commitments to research based at Toolik Lake (e.g., the National Science Foundation's [NSF] Long-Term Ecological Research [LTER] and Arctic System Science [ARCSS] programs), but the logistic needs for support of these existing commitments have not been integrated into long-term plans for TFS.

To maintain its current role in the future development of arctic research, TFS must first upgrade and then expand its year-round capabilities for support of integrated, multidisciplinary research programs as well as research by individual investigators. Future needs include supporting research at large spatial scales involving regional studies and interactions with the regional and global atmosphere and climate. Eventually this could lead to development of an educational and training capability in addition to the dominant research activities. Overall, the capacity of the laboratory and living facilities needs to increase by about 50% over the next 10-20 years, incorporating these qualitative improvements. In all of its activities, TFS needs to increase its commitment to involvement of the indigenous people of Alaska.

To meet these needs and to accommodate change and growth in the use of TFS, the following *Science Mission Statement* for Toolik Field Station was adopted:

> ***The mission of Toolik Field Station is to support field research and education that will lead to greater understanding of the arctic region and its relationship to the global environment.***


**Figure 1.** *The location of Toolik Field Station. (Illustration by Paul Salvatore)*

To complete its mission, TFS must:

- provide modern, general-use laboratory space with electric power, sufficient computer and network capacity, and telecommunications facilities. Winter facilities should be available for limited use.
- provide efficient and flexible housing, food, meeting, and support services for scientists and students at reasonable rates.
- work with the owners and neighbors of the surrounding land (BLM and the North Slope Borough) to develop plans for minimizing impacts of the research itself, and avoiding conflicts among researchers, while retaining some areas in undisturbed condition.
- facilitate research at mobile satellite field camps by serving as a scientific support center.
- provide access to information about TFS, its environs, and the North Slope through the Internet, publications, archives, long-term data sets, and biological reference collections.
- encourage the application of research results by enhancing communications with state and federal agencies, private interest groups, and the local communities.
- involve indigenous peoples in research and education.

*Jon Holmgren, in December 1994, cutting a trench in a large snow drift at Imnavait Creek to expose the snow stratigraphy and to sample for thermal conductivity measurements and density. There is an increasing need for winter access to the TFS area and for winterized living facilities for researchers. (Photo by Matthew Sturm)*

Specific recommendations for achieving the goals of the *Science Mission Statement* include:

- Improvements to and expansion of the TFS facilities,
- changes in the TFS management structure, and
- changes in the TFS funding structure.

**Facilities Improvements**

Improvements to existing facilities at TFS are the greatest immediate need. Overall expansion of the camp should proceed cautiously and in phase with expected research needs; many improvements could be implemented now with appropriate funding. Two immediate priorities identified at the workshop were (1) improvements to electrical, water, waste treatment, and communications facilities to meet both existing demands and codes, and (2) construction of a new, multifunctional meeting room.

NSF and IAB have already begun responding to priority needs identified during preparation of this report. Upgrades initiated include improved communications, a storage facility, laboratory furniture, boardwalks for access to research sites, and a separate multifunctional meeting room. Planning for electrical, water, and waste-handling upgrades has been funded. Neither the communications upgrades nor the meeting room fully address the recommendations outlined in this report, however.

The highest remaining priorities are (1) completing improvements to communications facilities and the multifunctional meeting room; (2) improving the freshwater supply and treatment system; (3) developing a better, less expensive method of greywater disposal; (4) upgrading the electrical system, including generator housing; and (5) providing improved housing for investigators, including a winterized 10-person living unit and a 40-person residence unit. Expanded housing will require a less costly, higher capacity method of sewage disposal or on-site treatment. These high-priority improvements will cost approximately $3 million.

Once immediate needs for improved facilities are met, recommendations include expansion of existing capabilities to support additional activities and people, along with continued improvements and upgrades to better support current usage levels. High-priority needs include improvements to helicopter landing and refueling facilities, and expansion or replacement of the existing kitchen and food preparation areas. The cost of these high-priority upgrades is estimated at $500,000-850,000.

General improvements recommended include construction of a new washing facility, a workshop, and family housing, at an estimated combined cost of $225,000-400,000. Longer term needs include ongoing replacement of laboratories and housing with new facilities.

**Management Structure**

The current management structure is generally appropriate for the future use and development at TFS. Several recommendations for more effective use of the management structure emerged from workshop discussions. Lack of funds for meetings and for support of managers' salaries has to some extent hindered management capability. High-priority recommendations include annual meetings of the existing Science Users Advisory Group (SUAG). The SUAG should also communicate regularly with the existing TFS Steering Committee. Other recommendations are:

- the formation of a Strategic Advisory Panel composed of representatives of scientific users, the local community, government, and industry,
- the appointment of a salaried, full- or part-time Scientific Director,
- coordination of the use by researchers of the Toolik Lake Research Natural Area and other local field sites, and
- increased communication and collaboration with agencies such as the Bureau of Land Management (BLM, the landowners) and NSF.

The development of linkages and collaborations with research stations elsewhere in the Arctic presents an important future opportunity for management, scientists, and local community members.

**Toolik Field Station Funding Plan**

Nearly 100% of the costs of running TFS are currently borne directly by research grants. As a result, research at TFS appears expensive to funding agencies and reviewers relative to research done at other sites. A high priority is the development and implementation of a mixed funding plan involving block funding for the fixed costs of running the Station and for improvements, combined with user charges that cover the incremental costs associated with daily station use. Long-term planning and budgeting is difficult when revenues are tied directly to daily use, and that use depends almost entirely on the funding of individual research grants with three-to-five-year funding periods. A funding plan under which long-term improvements can be better addressed and that separates logistics from the science costs of proposals will enhance both TFS operations and research conducted there.

*Sarah Hobbie, Margaret Torn, and Chris Lund weed experimental plots to examine plant competitive relations. Coordination of the use of the Toolik Lake Research Natural Area and other local field sites by researchers is an increasingly important management responsibility. (Photo courtesy of Sarah Hobbie)*

# Toolik Field Station: Planning for The Second 20 Years

Toolik Field Station (TFS), operated by the Institute of Arctic Biology (IAB) of the University of Alaska Fairbanks (UAF), has served as a base for field research in northern Alaska since 1975. Over the past 20 years, research done in the landscape in and around Toolik Lake has attracted worldwide attention and scientific collaborations. The area has become one of the most thoroughly studied in the Arctic. This report defines the scientific mission and goals of TFS in order to develop the best possible plans for operation and improvement of TFS over the next 20 years.

This report results from a broad survey of the arctic research community and of those affected by arctic research activities. The main body of the report was written at a workshop held at the Bodega Marine Laboratory in Bodega Bay, California, 16-17 February 1995. Representatives of three main groups of people attended: scientists, including current users of TFS and researchers from disciplines that have not been, but could be, active at Toolik; experts in the development and logistical support of remote field research stations; and managers of TFS and adjoining lands, including UAF, the Alaska North Slope Borough, and the Bureau of Land Management. Subsequent to the workshop, the report was reviewed by members of the arctic community.

Several key points formed the basis for developing the mission statement and goals for the next 20 years:

- TFS has become nationally and internationally recognized as a premier arctic research station.
- Future development of TFS must be accomplished in the context of national and international arctic science goals.
- Development of TFS must include the capacity to support additional types of research not currently conducted at the station.
- Improvements to TFS must be accomplished in a manner that strengthens, rather than diminishes, the long-term financial viability and stability of TFS and its established research programs.
- The future development of TFS must be community-oriented, both with respect to the scientific community and to the indigenous Inuit community of the North Slope of Alaska (see Appendix 2, Developing Community Contacts).

*A view of Toolik Field Station looking north. In the foreground are open-top warming chambers and a snow fence in moist tussock tundra, part of the U.S. International Tundra Experiment (see page 8). The snow fence causes large drifts to accumulate during the winter and persist long after normal snow accumulation has disappeared. (Photo by Andy Parsons)*

Specific questions guiding the discussions at the workshop included:

- What are the broad research areas likely to be addressed at TFS?
- What is the role of TFS within the scope of the national and international arctic research agenda?
- What types of research will be undertaken (observational, experimental, etc.)?
- What are the facility requirements to support this research?
- How would implementation of these requirements affect TFS?
- What priorities can be established in developing TFS?
- How might these efforts be funded and sustained?

Careful consideration of all of these questions is essential to ensure that TFS remains at the forefront of arctic research.

*Steven Oberbauer calibrating a Li-Cor portable photosynthesis system at Toolik Field Station. (Photo by Mike Abels)*

**Organizations Represented at the Workshop**

**Alaska North Slope Borough**
- Department of Energy Management
- Mayor's Office

**Arctic Research Consortium of the United States**

**Cold Regions Research and Engineering Laboratory**

**Colorado State University**
- Rangeland Ecosystem Science Department

**Marine Biological Laboratory**
- The Ecosystems Center

**National Science Foundation**
- Office of Polar Programs

**Organization for Tropical Studies**

**Pacific Northwest Laboratory**

**San Diego State University**
- Global Change Research Group

**Sandia National Laboratories**
- Environmental Characterization and Monitoring Systems Department

**State University of New York–Albany**
- Atmospheric Science Research Center

**United States Department of the Interior**
- Bureau of Land Management

**United States Geological Survey**
- Water Resources Division

**University of Alaska–Fairbanks**
- Institute of Arctic Biology
- Water Research Center
- Alaska Quaternary Center

**University of California–Berkeley**
- Department of Integrative Biology

**University of California–Santa Barbara**
- Department of Ecology, Evolution and Marine Biology

**University of Colorado**
- Institute of Arctic and Alpine Research

**University of Minnesota–Duluth**
- Department of Biology

**University of Nebraska–Lincoln**
- Polar Ice Coring Office
- Snow and Ice Research Group

**University of Toronto**
- Department of Botany

**University of Washington**
- College of Forest Resources
- Department of Zoology
- Center for Streamside Studies

# Toolik Field Station in Context

## Trends in Arctic Research

Terrestrial and aquatic research in the Arctic over the last several decades has focused on understanding the functioning of a unique environment and landscape and on exploring the adaptations and interactions of plants and animals in a harsh environment. Research in these areas has significantly increased our understanding of the Arctic, and paid dividends by increasing our understanding of basic biology, climatology, hydrology, and ecology. In many ways, arctic ecosystems are particularly appropriate model systems for basic environmental research because of their low species diversity, the low stature of the vegetation, and the strong climatic and microclimatic gradients. Scientists working at Toolik Field Station have been among the leaders, for example, in the use of whole-ecosystem manipulations to understand how resource limitation (e.g., light, water, and nutrients) interacts with community composition (plants, herbivores, carnivores) to determine overall ecosystem structure and function. Many of these experiments would be much more difficult or even impossible to perform in other parts of the world.

The key event in the development of TFS was the construction of the Alyeska oil pipeline and the Haul Road (later named the Dalton Highway) in 1974-1976. Before that time, access to interior regions of the North Slope was limited by the lack of roads and the small number of widely scattered locations where aircraft (mostly fixed-wing) could land, take off, and be fueled or serviced. Completion of the Dalton Highway in September 1974 opened up an environmental transect across the heart of northern Alaska. Toolik Lake and the Upper Kuparuk River lie near the center of this transect, and ecologists and other environmental scientists were quick to exploit the opportunities for new research in the surrounding area.

In addition to its ideal location and the access to diverse sites provided by the Dalton Highway, a major attraction of TFS as a field site is the large background of research done there beginning in 1975. The more that is known about a specific site, the easier it is to interpret new, specific information and its relative importance in the context of the larger ecosystem. For this reason, intensive descriptive and experimental studies of the tundra, lakes, and streams in the area surrounding TFS are expected to continue and remain an important consideration in developing future plans.

Integrated research projects have been based at TFS from its earliest days, starting with the NSF-funded Research on Arctic Tundra Environments (RATE) project from 1975-1977. A series of aquatic research projects supported by the NSF Office of Polar Programs (NSF-OPP) continued through the mid-1980s. These included the Arctic Lake Process Study (ALPS) and Tests of Arctic Predictions (TAPS). Other large, integrated research projects based at TFS include the Response, Resistance, Resilience, and Recovery from Disturbance (R4D) program, funded by the Department of Energy (DOE), and the ongoing LTER program funded by NSF.

The current ARCSS Land/Atmosphere/Ice Interactions (LAII) program advances integration by linking biological, hydrological, and atmospheric dynamics. Terrestrial studies are also linking with marine studies. For example, the DOE Atmospheric Radiation Measurement (ARM) program is examining radiation and cloud dynamics over the North Slope of Alaska and the adjacent Arctic Ocean, which in turn links with the Surface Heat Budget of the Arctic Ocean (SHEBA), a part of the ARCSS Ocean/Atmosphere/Ice Interactions (OAII) program.

Current research in the Arctic, at TFS and elsewhere, increasingly depends upon an integrated, interdisciplinary approach to regional and global problems. Major research questions now include the role of the Arctic in:

- Global climate, both through the snow/ice-albedo effects on the energy budget and through carbon dioxide ($CO_2$) and methane ($CH_4$) dynamics,
- terrestrial ecosystem productivity and the role of arctic ecosystems in global carbon and nutrient storage,
- aquatic ecosystem productivity, food web controls, and the impact of global warming and other perturbations on these ecosystem processes,
- river runoff and nutrients, and their effects on productivity and circulation of the Arctic Ocean and the global ocean system, and
- herbivore and plant community dynamics, especially with respect to changes in species distributions and abundance with changes in climate.

Current research involves geographic as well as disciplinary integration, as studies target process dynamics at the landscape and regional scales to evaluate the role of the Arctic in the larger Earth System.

Current and future arctic research depends on TFS as a site for intensive, localized process and manipulation studies. Future studies will also need at least one high-quality base providing scientific and logistic support for research spread across the North Slope of Alaska. Since 1975, TFS has been a centerpiece and springboard for arctic research in Alaska. It is well-positioned, therefore, to respond to the needs of a maturing, interdisciplinary scientific community, and to remain an instrumental base for arctic research well into the twenty-first century.

## Overview of the Station

Toolik Field Station is a unique and valuable center for arctic research because of its history of and investment in process-oriented research that includes long-term monitoring of climate, hydrology, biodiversity, and physiological and ecological processes, as well as manipulations on a whole-ecosystem scale. Researchers from 39 states and 25 foreign countries have worked at TFS over the past 20 years (see partial list in Appendix 1, TFS Users). Over 300 scientific papers and two books have been written based on research done there (see Appendix 6, List of Toolik-Based Publications and Theses). The value of this research was recognized recently by the BLM when the entire watershed of Toolik Lake and the nearby headwaters of the Kuparuk River were named a Research Natural Area.

TFS is now a critical component of several ongoing national and international research programs including the LTER program, the International Tundra Experiment (ITEX), the Global Change in Terrestrial Ecosystems (GCTE) transect study, and the ARCSS Program. Its location on the Dalton Highway between Fairbanks and Prudhoe Bay makes TFS part of a dramatic and easily accessible environmental gradient from the interior of Alaska to the northern coastal plain. The foothills region of the North Slope, where TFS is located, contains a variety of different-aged landscape surfaces in a relatively small area that are uniquely suited for studying the role of landscape variation in controlling ecosystem processes.

At present, the facilities at TFS are adequate for the support of about 40 researchers through the summer season and up to 70-80 for short periods. The physical plant consists of 20 prefabricated, mobile trailer units adapted for use as laboratories and dormitories. One semi-permanent building now serves as a dining hall, kitchen, and communications facility. One new laboratory is outfitted for sustained operation during the winter.

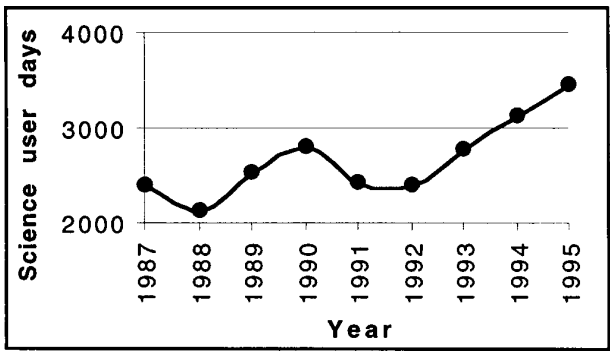



**Figure 2.** *Science user days at Toolik Field Station, 1987-1995. Information provided by Mike Abels.*

With the exception of three new laboratory buildings added in 1994, all of these structures were purchased used and have served well beyond their initial, expected lifetimes. Most are worn out. (See Appendix 4, Figure 5, Diagram of Toolik Field Station.)

The continued success of the research programs based at TFS is placing an increasing strain on the Station's facilities (see Figure 2). Many of these programs, such as LTER and ITEX, have made long-term commitments to research in the surrounding tundra, lakes, and streams. Given the ideal location, plus the expanding background of knowledge about the area, there is little doubt that demand for use of TFS facilities will continue to grow in the future.

Researchers at TFS have shown that they can be successful at obtaining support for research based there, but comprehensive long-term planning and funding for TFS itself has always lagged behind the growth of research programs. The expansion of TFS since 1975 has been driven primarily by short-term needs of researchers and by occasional availability of small increments of funding from various sources, primarily NSF and DOE. As the research based at TFS becomes more long-term by design (e.g., the NSF-funded LTER project, in operation at TFS since 1987), there is a corresponding need to design the Station's facilities to meet its expected long-term needs.

The productivity, impact, and long-term nature of current research at TFS indicates clearly that the Station will remain an essential resource for arctic research in the future, but that the facilities must be modernized and upgraded to meet these existing commitments. New directions in arctic research will require additional capabilities, and TFS is well-situated to provide them. Research based at TFS in the future will likely expand from the current areas to include such important issues as:

- Sustainability of arctic subsistence economies in response to anthropogenic environmental change,
- controls of biodiversity and consequences of biodiversity for ecosystem function,
- the role of Quaternary and modern hydrologic and periglacial processes in shaping the arctic landscape,
- questions of plant and animal environmental physiology, especially in relation to long-term ecosystem studies,
- controls over local and regional climate and how they regulate ecological processes, and
- long-term monitoring of changes in biota and environment.

As the TFS facilities are improved, research on these topics could be conducted during a greater portion of the year, further enhancing long-term studies.

# Science Mission

*The mission of Toolik Field Station is to support field research and education that will lead to greater understanding of the arctic region and its relationship to the global environment.*

The TFS science mission will be accomplished most effectively by providing access to field research sites, living accommodations, and laboratory facilities, and by protecting core research areas. If this science mission is to be successful, TFS must:

- Provide modern, general-use laboratory space with electric power, sufficient computer and network capacity, and telecommunications facilities. Winter facilities should be available for limited use.
- Provide efficient and flexible housing, food, meeting, and support services for scientists and students at reasonable rates.
- Work with the owners and neighbors of the surrounding land (BLM and the North Slope Borough) to develop plans for minimizing impacts of the research itself, and avoiding conflicts among researchers, while retaining some areas in undisturbed condition.
- Facilitate research at mobile satellite field camps by serving as a scientific support center.
- Provide access to information about TFS, its environs, and the North Slope in general through the Internet, publications, archives, long-term data sets, and biological reference collections.
- Encourage increased understanding and the application of research results by enhancing communications with state and federal agencies, private interest groups, and the local communities.
- Involve indigenous peoples in planning and implementing research programs.

Meeting these goals will require coordinated effort with respect to Station facilities development, management, and funding. In the following sections of this report, each of these topics is discussed individually, with specific recommendations for improvements. These improvements should be phased in over time, as growth in the Station's capabilities should anticipate, but not exceed, growth in user demand. Future development must be flexible, adjusting to emerging priorities and new directions in arctic research. Immediate priorities are explicitly stated in each section, with longer term needs expressed in general terms.

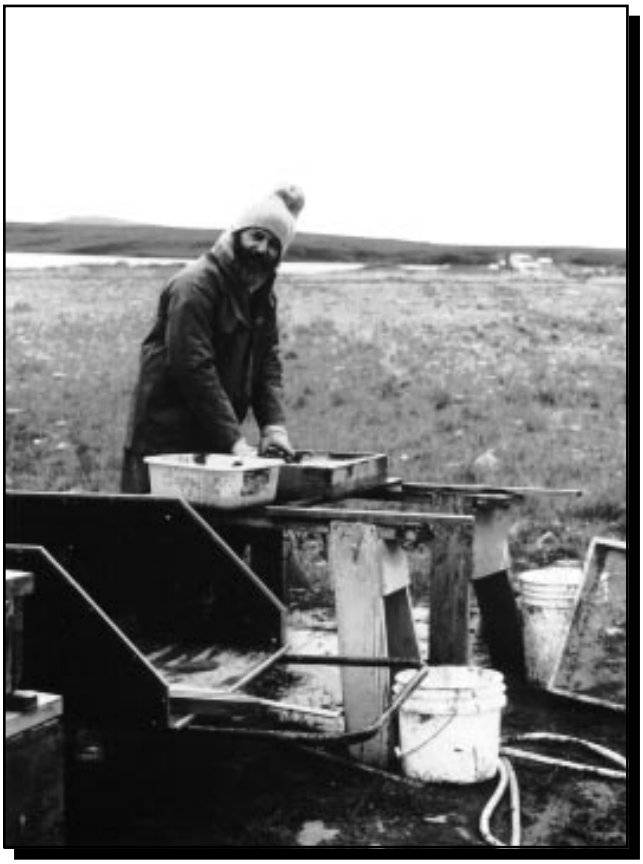
*Arctic LTER researchers working at a stream in the Kuparuk River drainage. TFS provides a convenient logistics base for research in the area. (Photo courtesy of Mike Abels)*

*George Kling measuring pH and conductivity and taking samples for dissolved gases in a small tundra stream near TFS in the summer of 1994. (Photo courtesy of Mike Abels)*

*Gus Shaver sampling a tussock plot near TFS. (Photo by Marty Downs)*

*Kaye Everett installing a weir on Imnavait Creek in the summer of 1992. (Photo courtesy of Mike Abels)*

*Matthew Sturm digging a trench in March 1992 to examine the micro-topographic variations in the snow and to relate the snow properties to individual tussocks. In the background is a tower with a sonic sounder that recorded the snow depth hourly through the winter, indicating periods of snow accumulation and erosion. (Photo courtesy of Matthew Sturm)*



*Terry Chapin at TFS in August 1994 washing roots for weighing. (Photo courtesy of Sarah Hobbie)*

# Facilities Development

## History of Facilities

TFS was initially established in 1975 to support an aquatic program designed to obtain base-line data on the North Slope and inland coastal ponds. This research was an extension of the International Biological Program (IBP) from which a number of projects were retained and known as RATE (see page 7). RATE was coordinated under a proposal funded by NSF as part of the Man and Biosphere Program (MAB), Project 6, Impact of Human Activities on Mountain and Tundra Ecosystems.

In 1975, a 16-foot travel trailer belonging to the UAF Institute of Marine Science was placed at the north end of the lake. A 10' x 50' modular unit containing a kitchen/dining area, a laboratory room, and a sleeping room was added in 1976. Researchers brought their own sleeping tents. In 1978, a new kitchen/dining unit was added and the original unit was modified into five laboratory cubicles. In 1980, a 10' x 50' laboratory unit was added. In 1982, an additional 10' x 40' laboratory unit was added, with its ultimate use designated as a hygiene/washing-up facility. Two vehicles were funded by NSF in 1978 and 1979 as part of the ALPS Program logistics. In 1981 and 1982, DOE made contributions of $20,000 per year for field station operation. A number of small temporary wooden structures were added during these six years and used for scientific work and storage. Excluding these temporary units, there were 1,400 sq. ft. of lab space and 500 sq. ft. for food service.

In 1983, the Station was relocated to the southeast end of Toolik Lake. Thirteen surplus Transalaska Pipeline modular units were purchased used from the Alyeska Pipeline Service Company, upgrading the station to 17 units. Eight 12' x 20' Hanson Weatherport tents were acquired as in-kind support of the IV International Conference on Permafrost. The tents provide 1,920 sq. ft. of work or storage space. The 1983 upgrade was funded by a $30,000 grant from DOE and $7,000 of IAB overhead recovery.

In 1984, the Alaska Legislature made a special $35,000 appropriation which was used to upgrade the wastewater collection system and kitchen. A $10,000 award from UAF was used to upgrade the kitchen trailer in 1985. In 1986, NSF awarded $60,000, with a $30,000 UAF match, to upgrade TFS. A dining facility was built, connecting the dining and kitchen trailers. The added 960 sq. ft. of floor space released the dining trailer which was redesigned as the communications office to accommodate general-use computers and communication equipment.

In 1988, NSF awarded $74,250, with a $78,250 UAF match, for the acquisition of equipment and improvement of facilities. An electrical cable tray distribution system was installed from the generators to each building. The generators were placed inside an Arcticpac trailer that dampens the sound and provides shelter for the equipment and a method to ship the generators to Fairbanks each winter for service. Other equipment included three snowmachines, a gas chromatograph, a wet/dry fall collector, a water filtration system, a stereo-zoom microscope, a spectrophotometer, a leaf-area meter, two balances, and a freeze dryer. Items purchased in 1994 include two weatherport tents, two Gateway 2000 486SX computers, one Apple Macintosh Centris 610 computer and printer, and an 8000 gallon generator fuel storage tank. The upgrade included a survey and improving the interior electrical systems of the existing lab trailers and kitchen.

In 1994, with support from NSF-OPP, three new laboratory buildings were added, more than doubling the available laboratory space (see Appendix 4, Figure 5, Diagram of Toolik Field Station).

## Planned Facilities Development

With the exception of the new laboratories added in 1994, the physical facilities at TFS still are marginally adequate to meet existing user needs, let alone future needs at the station. Upgrade of the facilities is essential to allow TFS to serve the needs of the scientific community (see Appendix 3, Table 2, Upgrade Priorities). Issues that must be considered in developing upgrade plans include:

- Development plans should be phased and should include a 5-year, 10-year, and 20-year schedule to guide improvements. The plans must be flexible to accommodate growth and expansion of arctic research.
- Expansion of laboratory, logistic, and living facilities should be based on likely increases in user demand. Estimates developed during the workshop suggest that by the turn of the century, 65 scientists will use TFS throughout the summer and 10 scientists during winter. By the year 2005, it is estimated that there will be 80 summer users and 15 winter users.
- Expansion of the user base at TFS is partly constrained by the heavy use of field sites in the immediate vicinity of the Station. This may be avoided if the current trend toward using the Station as a base for more remote field operations continues. The facility should be flexible enough to support on-site and remote types of research.
- Laboratories, dormitories, and other facilities that are obsolete or inadequate to meet existing needs should be replaced with new facilities as soon as possible.

- Facilities must be designed so that parts of TFS can be opened or closed down separately according to demand.
- Operating costs must be kept level or reduced where possible, as cost currently limits Station use. Facilities should be designed to reduce maintenance and operating costs. Replacement of old facilities with new, higher quality facilities will reduce maintenance costs substantially.
- Improvements should reflect an environmental ethic, particularly since TFS is recognized as a premier site for arctic environmental research. Alternative energy sources and recycling of wastes should be fully explored.

## General-Use Facilities

### Conference room

Collaborative projects need to meet regularly at the field site. Short-term visitors (site reviewers, international visiting scientists, LTER scientists from other sites, and others) have become common. During peak season, evening meetings are an almost daily occurrence, and daytime seminars are common. The dining hall is the only space now available for meeting, and it is unavailable much of each day. Books, papers, and other materials cannot be left set up through mealtimes. TFS should:

- Provide a separate conference facility for meetings and conferences to nurture interdisciplinary research and scientific exchange. A facility meeting room should allow flexible use and be able to hold approximately 50 people.

### Communications

The existing communications system at TFS (two lines for voice, fax, and data) is seriously inadequate for current use, let alone the anticipated growth. The existing system makes little use of advances in communications technology. As a high priority, TFS should:

- Provide a minimum of five lines (two data, two phone, one fax). A high-band-width digital telecommunications link is highly recommended.
- Expand computer and network support. This includes establishing a local network with Internet access for TFS laboratories and living areas.

### Kitchen and Dining

The existing kitchen has been modified and expanded several times over the past 20 years, but has reached its capacity and cannot be further modified for greater efficiency. Food storage capacity is extremely limited and inefficient. It is recommended that TFS:

- Replace the existing kitchen/food storage facility with an expanded facility including separate food preparation and food storage areas.

### Heliport

Use of helicopters has increased greatly in the last few years. Helicopters are now used daily during peak season.

- A heliport should be built at TFS that allows safe landings and takeoffs. Fuel storage, fuel containment, and a facility for safe refueling should be included.

*Researchers planning the day's work; a typical scene in the area between the dining hall and wash-up trailer. (Photo by Mike Abels)*

### Multi-Purpose Workspace

Storage space is extremely limited at TFS. Winter security of stored equipment is a particular concern. As part of planned improvements, TFS should:

- Provide a multi-purpose building for vehicle and equipment storage and maintenance, for use as a workshop, and for general storage. The building should be heated and accessible for winter use.
- Construct a shipping/receiving space for efficient loading and unloading of supplies and equipment for distribution to and from laboratories, dormitories, and kitchen. This system should include indoor, short-term storage space.
- Consider installation of an alarm system routed to the Alaska State Troopers, contingent on their agreement.

**Table 1. Permanent Facilities at TFS (in sq. ft.)**

| Facility | 1983 | 1994 | 1995 |
|---|---|---|---|
| Laboratory | 2,500 | 2,700 | 6,390 |
| Stable Isotope Laboratory | — | 160 | 160 |
| Kitchen | 500 | 500 | 500 |
| Dining | 240 | 960 | 960 |
| Manager/First Aid | 300 | 300 | 300 |
| Residence | 2,500 | 3,000 | 3,000 |
| Winter Storage | 400 | 400 | 400 |
| Workshop | 400 | 400 | 400 |
| Office/Communications | — | 240 | 240 |
| **Total, sq. ft.** | **7,720** | **9,540** | **13,230** |

## Research Facilities

### Electric Power

The current electrical system at TFS does not meet safety codes in several respects. When TFS is full, the Station's generators are running at capacity most of the time. Increasingly, experiments conducted at TFS require electric power in the field, but many measurements (e.g., micrometeorological gas flux measurements) must be uncontaminated by fumes associated with Station activities or generators. TFS should:

- Upgrade the electrical supply system and generators to meet existing safety codes and anticipated demand.
- Provide electric power at some remote sites. Long lines connected to a station generator could meet this need, provided that the total power supply is sufficient.
- Evaluate the usefulness of solar cell arrays for the provision of some electrical needs.

### Winter Access

The Arctic experiences winter conditions approximately 75% of the year, but important atmospheric, hydrologic, and biological processes that occur during this time have been only partially investigated and are not fully appreciated. Some winter researchers use established facilities at Prudhoe Bay or temporary camps elsewhere and commute to a variety of sites, rather than using the Toolik facility. This arrangement hinders important research links to the summer activities at TFS. Although excellent, winterized laboratory space was added in 1994, the current facilities for wintertime sleeping, eating, and washing at TFS are minimal and inadequate for sustained use.

TFS must provide adequate winter support with a modular subunit to facilitate winter access to TFS for approximately ten people. Sleeping facilities, an eating and washing area, toilets, and work space are needed. The unit should be designed for easy shutdown when not in use.

### Laboratory Work Space

Current laboratory space consists of two new 24' x 60' modular laboratories, one new 12' x 50' module, and five older 10' x 50' modules. The new labs provide high-quality wet lab space with individual instrument rooms, chem-resin benches, fume hoods, and running water in at least one module. The older units have been converted to dry labs and office space. The total amount of work space is adequate for the current user population of 40-50 people during peak season and could likely accommodate a moderate increase in users. The older units, however, are over 25 years old and in poor condition. They present an increasing maintenance problem.

- The long-term plan should include replacing the older laboratory units, as they wear out, with new facilities. There should be no net loss of work space from the existing levels.

*One of the new 24' x 60' modular laboratories funded by NSF in 1994. (Photo by Mike Abels)*

*Approximately one-third of TFS users now sleep in personal tents. This photo was taken early in the season, before peak use at TFS. (Photo by David Witt)*

## Living Facilities

### Accommodations

The existing sleeping units will hold 40 people but are of low quality and are insufficient to accommodate current users of TFS. Approximately one-third of users now sleep in personal tents. While many users prefer this option, the space available for tents is limited and could easily become overused. An increase in the number of regular users of the station will require additional sleeping accommodations.

- TFS should provide high-quality living facilities for a minimum of 40 people as soon as possible.
- In the longer term, the existing dorm facilities should be replaced by a new residence unit or units, bringing the Station capacity to approximately 80 people.

### Family Housing

TFS should make use of the Station's facilities possible for researchers who are accompanied by their families, including children. The availability of family facilities would provide broader and more equitable access to research opportunities, especially for researchers in mid-career. These needs could best be met by:

- providing family housing units that can also serve other purposes when no families are present at TFS.

### Toilets

TFS is currently served by an outhouse facility with three seats. This capacity is inadequate for current users in both quality and quantity. TFS should:

- Provide additional toilet facilities, preferably located in or near the living quarters and in proximity to the laboratory buildings.
- In the longer term, flush toilets should be provided.

### Sanitation

Existing sanitation facilities include a wash trailer equipped with one sink with hot and cold running water, one clothes washer and dryer, a single shower with inadequate control of hot and cold water, and a wood-burning sauna next to Toolik Lake. Sanitation facilities should be upgraded by:

- expanding washing and cleaning facilities, with additional facilities incorporated into new living units.

### Waste Management

Although an adequate fresh water supply exists in Toolik Lake itself, wastewater management is already a major problem and expense. Greywater will increase rapidly as showers and other sources of running water are implemented. Sewage will increase with greater use of the Station and expanded housing. Toolik Lake is, however, a pristine, nutrient-poor lake, and even small nutrient inputs could significantly alter it. At present, wastewater is collected in tanks that are periodically emptied and trucked to Prudhoe Bay for disposal. The capability to handle wastewater and sewage at or near Toolik Lake must be developed. TFS should:

- develop a wastewater and sewage treatment and/or disposal plan, in conjunction with expanded and improved living quarters.
- thoroughly investigate new environmentally sensitive technologies for handling waste.
- ensure that nutrients from wastes do not enter the Toolik Lake watershed.

# Station Management

TFS is managed by the Institute of Arctic Biology (IAB) of the University of Alaska Fairbanks (UAF). Policies are set by the IAB Director and Executive Officer who work with a TFS Steering Committee. The Steering Committee is composed of UAF faculty and staff members and, currently, representatives of the Bureau of Land Management (BLM) and the Arctic Research Consortium of the United States (ARCUS). Policies are carried out by a smaller Toolik Management Group. Both of these groups meet regularly throughout the year. A Science Users Advisory Group (SUAG), made up of researchers from outside UAF, provides advice on important management issues (see Figure 3).

The users of TFS agree that management by the IAB has been good, especially under the constraints of unpredictable funding and difficult-to-predict shifts in the needs of arctic research. The existing management structure works reasonably well. Some components, such as the Science Users Advisory Group, have not been fully implemented. Several changes are recommended to accomplish more effective and efficient long- and short-term planning, and to improve relationships with the local communities. The key to effective management of TFS is an interactive structure with close ties to the science users, land managers, local communities, and the general public. Specific recommendations for improving management and coordination follow.

*Those present at the TFS dedication in August 1994 included representatives of the National Science Foundation, the University of Alaska Fairbanks, users of TFS, and other members and supporters of the arctic research community. From left to right, Noreen Walsh, Wendy Warnick, Joan Wadlow, Ray Cameron, Neil Sullivan, Jean James, Jerome Komisar, Josh Schimel, Robert White, Neal Lane, Vera Alexander, Doug Kane, John Hobbie, and Patrick Webber. (Photo by Kathy Berry)*

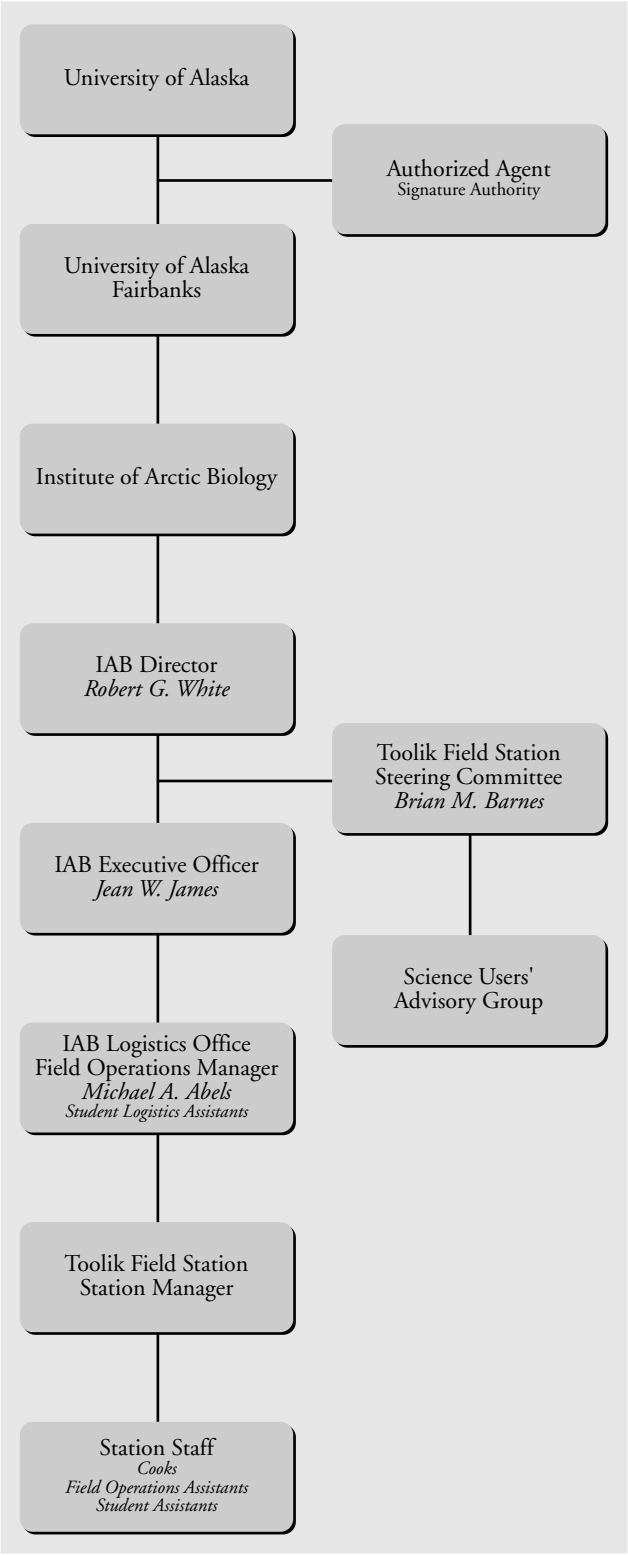



**Figure 3.** *Current Toolik Field Station management and organization. (Figure courtesy of IAB)*

## Facilities Management

The Science Users Advisory Group (SUAG) is viewed as pivotal to the continued success of TFS. Organization of the SUAG should be formalized and it should take a larger role in setting policies and direction for TFS. The composition, terms of service, and meeting schedule of the SUAG should be specified in writing. In particular, the group should meet annually, and two of its members should attend key meetings of the TFS Steering Committee, such as those when user per diem charges are set. The Toolik Management Group, Steering Committee, and Science Users Advisory Group should continue to work as they are currently conceived.

A Strategic Advisory Panel should be added to the TFS management structure. The Toolik Strategic Advisory Panel should draw its members from outside the scientific user community to provide a broader policy perspective, improved communications with the Alaska North Slope community, and to develop links to the wider arctic research community. This group could help cultivate new funding sources and increased involvement of the Inuit people in projects at TFS.

TFS should hire a full- or part-time Scientific Director. This has been an effective approach to better scientific coordination taken by other major field stations. A director would be responsible for facilitating the scientific and educational missions of the station, managing a site Geographic Information System (GIS) and other databases, seeking funding for station upgrades or special maintenance, and ensuring strong public support for the facility. The Scientific Director would not set a scientific agenda nor direct individual scientists or their projects.

As the station grows there will be a need for a clear facilities policy, to clarify such issues as responsibility for removing buildings that are beyond repair, moving equipment that is needed for other research, or adjusting to the termination of funding. A formal agreement should be developed with NSF for management and ownership of NSF-provided facilities at TFS.

In the long term, TFS will develop best with community-wide involvement and commitment. The Toolik Management Group and the TFS Steering Committee should take steps to engage the financial support and oversight of those U.S. and international institutions whose researchers depend on TFS as a base for arctic research. The involvement of a coalition of geographically distributed users representing a variety of disciplines and research programs will broaden the funding base, expertise, and influence brought to bear on decisions affecting TFS development.

## Research Management

The local tundra, lakes, and streams surrounding TFS are actively used by researchers and, increasingly, there are incompatible projects conducted in the same areas. Undisturbed areas including a typical range of local landforms and community types have not been set aside for future reference. The locations of sites used historically and prehistorically by Native peoples are not always known or recognized by researchers based at TFS, and it is possible that these sites may be damaged unintentionally. To limit research conflicts, to ensure availability of pristine areas for study in the future, and to avoid damage to important Native sites, the participants recommend expanding the role of TFS managers in coordinating the use of the Toolik Lake Research Natural Area and other local field sites. This must be accomplished in close collaboration with the BLM and the North Slope Borough, who are the landowners and neighbors. Several changes would improve coordination of research projects. Toolik Field Station, BLM, and the North Slope Borough together should:

- maintain a Geographic Information System (GIS) of existing, recent, historic, and prehistoric sites in the area, to facilitate development of new research, integration and collaboration with past research, and conservation of the landscape.
- identify and set aside a representative array of undisturbed areas for future reference and comparison.
- develop a zoning plan to minimize potential conflicts among research efforts, and establish a formal mechanism for resolving conflicts.

TFS should also improve communications with other arctic field stations and develop mechanisms for facilitation of cross-site studies. Such coordination may also help to stimulate useful and exciting international collaboration among arctic field stations.

# Station Funding

Operating funds for TFS come principally through daily charges to users. Additional funds for facilities improvements are obtained through occasional federal grants, with matching funds from the IAB. The current funding mechanism has major drawbacks. In particular:

- Planning is difficult when revenues are tied so directly to actual use, and use is not known precisely until each summer season ends.
- High per diem costs are a source of criticism from grant proposal reviewers and can make it difficult to obtain research funds to work at TFS. The 1996 user-day charge is $145 per day, while user fees for other remote field stations range from $5-50 per day. For example, the Swedish Abisko facility charges $10-15 per day, the Churchill Northern Studies Center charges $42 (CAN) per day, and the La Selva Biological Station in Costa Rica charges $42 per day for senior researchers. At the U.S. Antarctic research stations, per diem costs are not charged against research grants but come from a separate funding source.
- High per diem rates limit extended use by projects currently working at TFS.
- High per diem costs greatly limit student access to the station. Many projects cannot afford to support students while the students are in the early, exploratory phases of dissertation research.

A mixed funding plan including both block funding and user charges is recommended for TFS. The block funding should cover the core, fixed costs of running the station, including electricity, communications infrastructure, salaries for camp staff, administration, maintenance, and meetings of advisory groups. Associated with this would be co-payment by the individual projects to pay for the marginal costs of using the Station, such as food and waste handling. About ⅓ to ½ of the current total cost would be defined as marginal costs. Of the current user-day charge of $145 per day, about $75-95 support fixed costs and $50-70 support marginal costs (See Figure 4).

Most funding for future Station improvements, such as the addition of new buildings, will either be provided through specific facilities grants or through direct purchase and ownership by a funding agency. In the past, agency-funded upgrades have required that UAF contribute to the cost of upgrades as well. Such a requirement can be an impediment to continued improvements because the majority of Station users are not from the University of Alaska, and the University should not be the sole organization responsible for cost-sharing. If the granting agency retains ownership of the improvements, agreements for maintenance and eventual removal of facilities must be worked out with the granting agency.

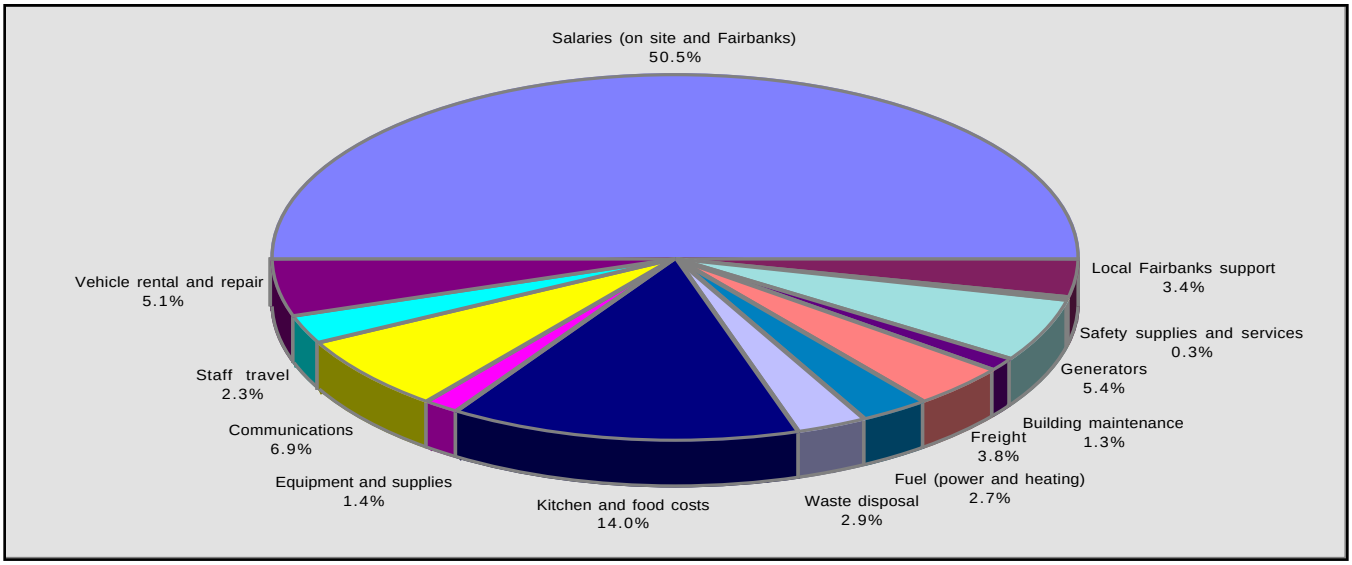



**Figure 4.** *Breakdown of support costs, field season 1995. (Figure prepared by Mike Abels)*

# Summary and Priorities

Toolik Field Station is now, and will continue to be, an internationally important field station for arctic research. An upgrade and expansion of TFS facilities is well-justified, as indicated by:

- the high productivity of past research at TFS,
- the proven ability to attract researchers from throughout the United States and internationally,
- the existing commitments of both reseachers and funding agencies to research based at TFS, and
- the ideal location for future integrated, regional, and global environmental research programs.

In addition to improvements to the physical facilities recommended in this report, a reorganization of the funding mechanisms of TFS is urgently needed. The existing management structure is appropriate, but could be more fully implemented and expanded to improve long-term planning, interaction with the local communities, and communications among TFS users.

The development and growth of TFS must be carefully planned and coordinated with current and future needs of the research based there. For this reason a phased, 20-year plan for improvements is needed, with clear priorities. First, the existing facilities should be upgraded to meet current research needs. Additional upgrades should be completed within the context of an expansion of the Station's capacity and capabilities, so that within ten years it can support about 80 scientists in summer and 15 scientists in winter. Within 20 years all improvements should be completed, including replacement of existing laboratory and dormitory facilities with new, higher quality structures.

A number of improvements have already been made or are underway, in response to the recommendations in this report, including improvements to communications systems, meeting and storage facilities, and planning for electrical, water, and waste-handling upgrades. The highest remaining priorities are:

- completing improvements to communications facilities and the multifunctional meeting room,
- improving the fresh-water supply and treatment system,
- developing an improved method of greywater disposal,
- upgrading the electrical system and generator housing,
- providing new housing for investigators, including a winterized 10-person living unit and a 40-person residence, and
- developing a less-costly, higher capacity method of sewage disposal and/or on-site treatment.

Implementation of these high-priority improvements can begin immediately and may cost $3 million. The next improvements should expand existing capabilities of TFS to support additional activities and people, along with continued improvements and upgrades. These include:

- construction of helicopter support facilities,
- expansion or replacement of the existing kitchen and food preparation areas,
- construction of a new station washing facility, and
- ongoing replacement, with expansion, of existing laboratories and housing, including family housing.

These latter improvements should be completed within the next five years and are expected to cost an additional $1.5-2.5 million (see Appendix 3, Table 2, Upgrade Priorities).

*Toolik Field Station in June 1995, looking south toward the Brooks Range. (Photo by Paul Salvatore, courtesy of BLM)*

# Toolik Field Station Users 1988-1996, Universities and Organizations

Alascom
Alaska Helicopters
Alaska West Air
Antarctic Support Services
Arctic Research Consortium of the United States
Arizona State University
Botanisches Institut der Universitat, Switzerland
Bowling Green State University
Brown University
Bureau of Land Management
Central Washington University
CHEDD/ANGIER Productions
Cold Regions Research and Engineering Laboratory
Colorado State University
Danish Polar Center
Duke University
East Carolina University
Florida International University
Forestry, Tasmania, Australia
FPE/ROEN
Freshwater Institute, Canada
Idaho State University
Institute of Soil Science and Photosynthesis
Ketchum Air Service
Marine Biological Laboratory
Michigan State University
Murray State University
National Science Foundation
New Mexico State University
North Slope Borough
NSI Tech. Services Inc.
Oak Ridge National Laboratory
Oregon State University
Paul Scherrer Institute
Providence Journal Company
Rice University
Rijksuniversiteit Groningen, The Netherlands
Russian Field Station, Russia
Rutgers University
SAIC, San Diego
San Diego State University
Science Magazine
Scott Polar Research Institute
Seattle Times
Smithsonian Institution
State of Alaska
- Department of Natural Resources
- Division of Geological and Geophysical Surveys

Stanford University
State University of New York - Albany
Tages-Anzeiger
Tallinn Botanical Garden, Estonia
The Ohio State University
Trans-Alaska-Helicopters
U.S. Geological Survey
University of Alabama
University of Alaska–Fairbanks
- Geophysical Institute
- Institute of Arctic Biology
- Institute of Marine Science
- KUAC-TV
- Water Research Center

University of California–Berkeley
University of California–Irvine
University of California–Riverside
University of California–San Diego
University of California–Santa Barbara
University of Cincinnati
University of Colorado
- Institute of Arctic and Alpine Research

University of Connecticut
University of Georgia
University of Göteborg, Sweden
University of Heidelberg, Germany
University of Houston
University of Illinois
University of Joensuu, Finland
University of Kansas
University of Michigan – Ann Arbor
University of Minnesota – Duluth
University of Mississippi
University of Nebraska–Lincoln
University of New Hampshire
University of New Mexico
University of North Carolina–Chapel Hill
University of North Carolina–Greensboro
University of Notre Dame
University of Puerto Rico
University of South Carolina
University of Tennessee
University of Toronto
University of Turku, Russia
University of Virginia
University of Washington
University of Wisconsin–Madison
University of Wyoming
Universidad Austral, Chile
Universite Laval, Canada
University O.F.S., South Africa
U.S. Department of Agriculture
- Pacific Northwest Experiment Station

U.S. Environmental Protection Agency
- Environmental Laboratory

WBUR-FM, Boston
West Virginia University

*User information was provided by the Institute of Arctic Biology, University of Alaska Fairbanks. Information from 1975-1987 is not available.*

# Developing Community Contacts

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INSTITUTE OF ARCTIC BIOLOGY
Fairbanks, Alaska 99775-0180 U.S.A.
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FAX: (907) 474-6967

6 August 1996

Dear Toolik Field Station Investigator:

In discussions during the February, 1995, N.S.F. sponsored workshop developing a Science Mission Statement for the Toolik Field Station it emerged that, as good neighbors, investigators using Toolik or doing research elsewhere in Northern Alaska should consider visiting communities of The North Slope Borough to communicate about their science. I'm writing today to provide a contact name, address and phone number for those wishing to arrange ahead with officials of the North Slope Borough to schedule a visit. The North Slope Borough is the "county" that consists of much of Northern Alaska.

Contacts between researchers and North Slope residents could consist of visits to the city of Barrow's K-12 science classes to give a talk about your work, visiting Barrow's Arctic Sivunmun Ilisagvik College, and/or being interviewed on Barrow's radio station KBRW. Currently you may send copies of papers or reports from work done in the Borough, but a personal visit is the best possible way to meet the community and involve them in your work.

The new Barrow Arctic Science Consortium -- Richard Glenn, President, and Glenn Sheehan, Executive Director -- can help make arrangements for visits and presentations.

Contact: Betty Smith, Barrow Arctic Science Consortium, phone (907) 852-4881; fax (907) 852-8213; address P.O. Box 955, Barrow, Alaska, 99723; email basc@barrow.com

Sincerely,

Brian M. Barnes
Chair, Toolik Field Station Steering Committee
email ffbmb@aurora.alaska.edu

# Upgrade Priorities

**Table 2.** *A number of upgrades have been initiated in response to the initial workshop recommendations. This table of upgrade priorities, indicating upgrades already underway and current priorities, was prepared by the Toolik Management Group. The priority recommendations and costs in Table 2 are based on workshop recommendations, a user survey, and management organization and funding agency discussions. Updated 27 August 1996.*

| **Projects currently underway or completed** | **Cost (in thousands of dollars)** |
|---|---|
| Planning services for upgrades to electrical, water, and waste-handling systems (NSF) | 69 |
| Two 125 kW generators (NSF property) | 38 |
| Multifunctional meeting room/library/work space (provided by IAB funding) | 35 |
| Communications (two additional phone lines) (NSF) | 20 |
| Furniture for new laboratories (NSF) | 13 |
| Boardwalks for access to research sites (NSF) | 15 |
| Shipping/receiving/storage/winter vehicle facility (NSF) | 100 |
| **Subtotal** | **290** |
| | |
| **Immediate improvements recommended to meet existing needs** | **Estimated Cost (in thousands of dollars)** |
| New generator building and electric switch gear to upgrade system | 200 |
| Water supply and treatment system | 100 |
| New greywater disposal system | 500 |
| One two-story living unit (40-person, bathrooms, showers, and common space – replacement) | 750 |
| Winter facility (combination dormitory/kitchen/generator for 10 people) | 250-500 |
| Improved sewage handling/disposal capability | 800 |
| Upgrade roads, gravel pad, drainage | 100 |
| Fork Lift/Loader | 120 |
| **Subtotal** | **2,820-3,070** |
| | |
| **Short-term expansion and upgrades (one to five years)** | **Estimated Cost (in thousands of dollars)** |
| New kitchen, dining hall, and food storage facility (convert old kitchen into meeting room) | 500-750 |
| Helicopter support facility including safe landing pad and fuel storage and delivery | 25-50 |
| Double-wide lab facility No. I (replacement) | 500 |
| Double-wide lab facility No. II (replacement) | 500 |
| Laundry and mud room facility | 50-100 |
| Workshop (replacement) | 100-200 |
| Tent platforms, walkways (tenting area) | 25 |
| Family housing | 75 |
| Mobile lab | 100 |
| **Subtotal** | **1,875-2,300** |
| | |
| **Long-term expansion and upgrades (five to ten years)** | **Estimated Cost (in thousands of dollars)** |
| Second two-story living unit (40-person, bathrooms, showers, and common space – replacement) | 850 |
| Double-wide lab facility No. III (replacement) | 600 |
| Stable isotope laboratory (replacement) | 50 |
| **Sub-total** | **1,500** |
| | |
| **Total** | **6,485-7,160** |

# Diagram of Toolik Field Station

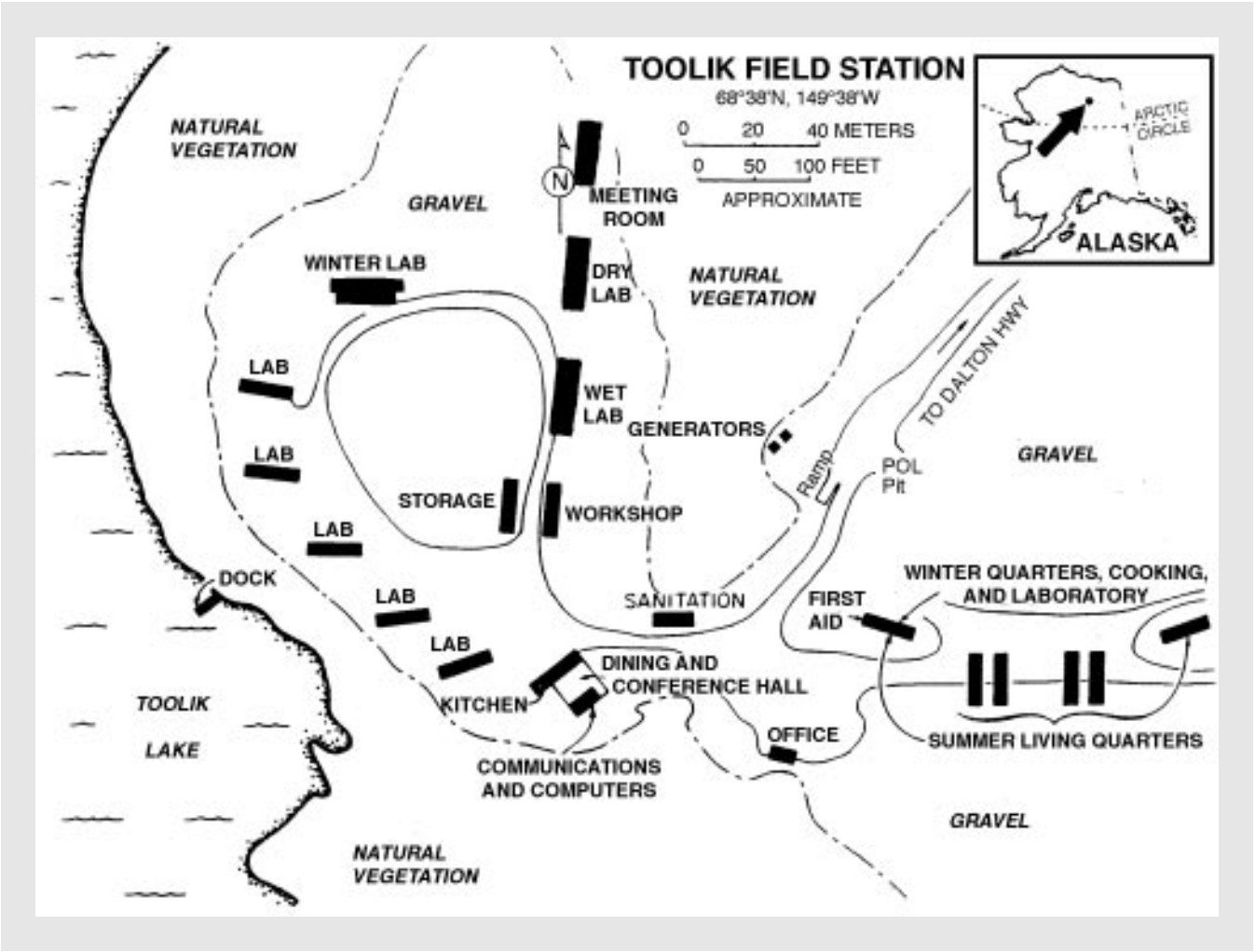


**Figure 5.** *Diagram of the layout of Toolik Field Station in August 1996. (Prepared by Mike Abels)*

# Contributors, Reviewers, and Workshop Participants

*The names of the workshop organizing committee members are in bold*

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## Appendix 5.4

# List of Toolik-Based Publications and Theses

### Publications

*This list of publications and theses is not assumed to be comprehensive. ARCUS will maintain this bibliography on the ARCUS Web site through December 1996, at which time it will be turned over to IAB. Send missing publications and corrections to ARCUS at arcus@polarnet.com. The updated bibliography will be accessible through <http://arcus.polarnet.com>.*


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