McMURDO STATION MASTER PLAN

EXECUTIVE SUMMARY 1 APR 2013

ANTARCTIC SUPPORT CONTRACT

Summary

OZ Architecture was engaged by Lockheed Martin in August 2012 to Commence a Master Plan for McMurdo Station, the primary logistical hub of the United States Antarctic Program operations for the National Science Foundation.

The primary objective of this Master Plan is to respond to recommendations from the 2012 Blue Ribbon Panel report, as well as previous Master Plans and studies.

Purpose

This Master Plan will serve as a guide to future development of McMurdo. It shall be a living document, adaptable through time to serve a dynamic set of needs.

Specific areas of focus include:

1. Site, including Fire Protection Storage and Distribution, Electrical Distribution, and Pedestrian/Vehicular circulation.
2. Buildings, to seek arrangements to increase operational efficiency and function.
3. Logistics Management, to optimize warehousing and delivery processes, while reducing footprint.
4. Information Technologies, to decrease complexity and increase reliability.
5. Energy Conservation, to increase facility efficiency, while preparing for renewable energy sources.
6. Quality of Life, to improve both the living and working experience at McMurdo.

General Assumptions:

The following general parameters are determinants of this Master Plan:

- Population is assumed to be approximately 900 in Summer and from 150-250 in Winter, as is currently the practice.
- Operations shall remain in full effect throughout all phases of construction and demolition.
- Phasing of Improvements shall be such that full, long-term operations are possible at the end of each phase, and not be reliant upon execution of forthcoming phases.
- Resupply Frequency is assumed to remain at (1) cargo and (1) fuel vessel per year, but the Master Plan shall allow for potential Biennial resupply.
- Traverse Frequency is assumed to continue to operate at (2) per Summer Season, with potential expansion to (4) per Summer Season.
- Consolidation of like functions shall be a primary goal, to improve logistics efficiency, resource efficiency, reduce footprint, and increase collaboration and synergies between Work Centers and Station amenities.
- Individual building design will incorporate 'Survivability' elements as appropriate for the function. Buildings will be provided with modern fire supression technology. Large buildings will be divided with fire walls to lessen the chance of a catastrophic event.
- Program Size is assumed to generally remain as-is. This Master Plan does reflect reasonable adjustments to program areas by affording one functional area more square footage (as in the case of IT and Traverse OPS) or less square footage due to improved layout and use of space.
- Berthing shall be single-style rooms (similar to those at South Pole) for improved privacy and reduced disease transmission. Surge capacity will be accomodated by converting the Gym or Multi-Purpose Room into temporary living quarters.
- Existing Roadways, Utilities and Structures shall, where appropriate, be demolished and retrograded as new facilities are constructed.

Guiding Principals:

In order to achieve the primary goals of improving: 1) Logistical Efficiency 2) Resource Efficiency and 3) Quality of Life, the following principles have been identified to guide this Master Plan:

- Self-sufficiency in Phasing - so that McMurdo is fully functional upon the completion of each phase, without reliance upon the implementation of subsequent phases.
- Simplicity and Standardization - to promote ease of operations and maintenance, minimizing the reliance upon specialists.
- Reliability - to reduce maintenance staffing and associated costs.
- Walkability - to reduce the reliance uopn vehicles, their associated staffing and maintenance and to improve safety through reduced pedestrial / vehicular conflicts.
- Integrated Social Spaces - to enhance collaboration and the sense of community within McMurdo.
- Flexibility and Adaptability - to allow for the evolving nature of Scientific Inquiry in Antarctica.
- Reduced Footprint - to increase logistical efficiency, resource efficiency and to reduce the reliance upon vehicular traffic.
- Strategic Redundancy - to enhance both on-going operations and disaster recovery.
- Respect the knowledge of the existing environment, weather conditions and terrain with the project designs.
- Consciously revisit the Master Plan on a regular interval of every 2 - 3 years as it is a living document and to confirm the direction of the plan as the needs of Antarctic science and available technologies change.

Observations of broader areas offering opportunities for improvement include the following:

1. Life Safety

- Fire and Medical facilities in need of replacement.
- Overhead power line are a source of potential outages and fire.
- Potential fire transmission within Building 155, specifically the co-location of laundry, food service and berthing. In addition, fire (as well as acoustical) separation between 155 berthing units is deficient.

2. Delivery Traffic

- Pedestrian/Vehicular conflicts.
- Extensive one-item deliveries.
- Extensive aged vehicle fleet.
- A Resultant VMF load that requires excessive number of vehicles, their storage and maintenance and all associated personnel.

3. Materials Storage

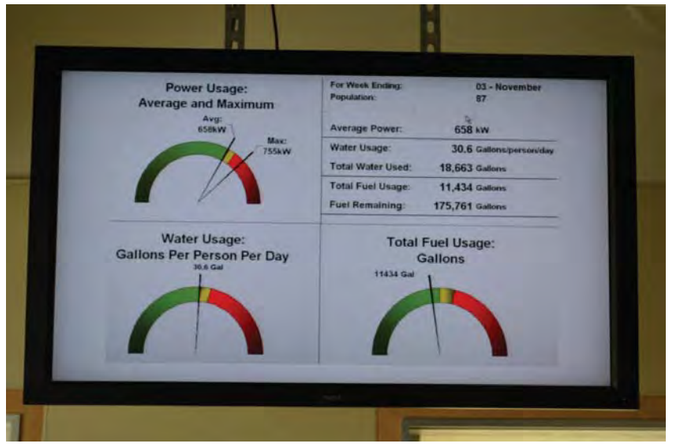
- Primarily one-level storage, resulting in excessive footprint, both within structures and in open yards.

4. Visual Clutter

- Compromised and un-professional pedestrian experience.
- Exposed loading/waste activities.

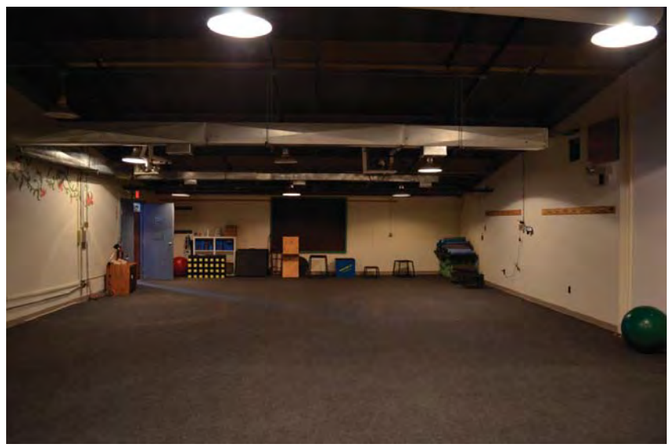
5. Energy Use

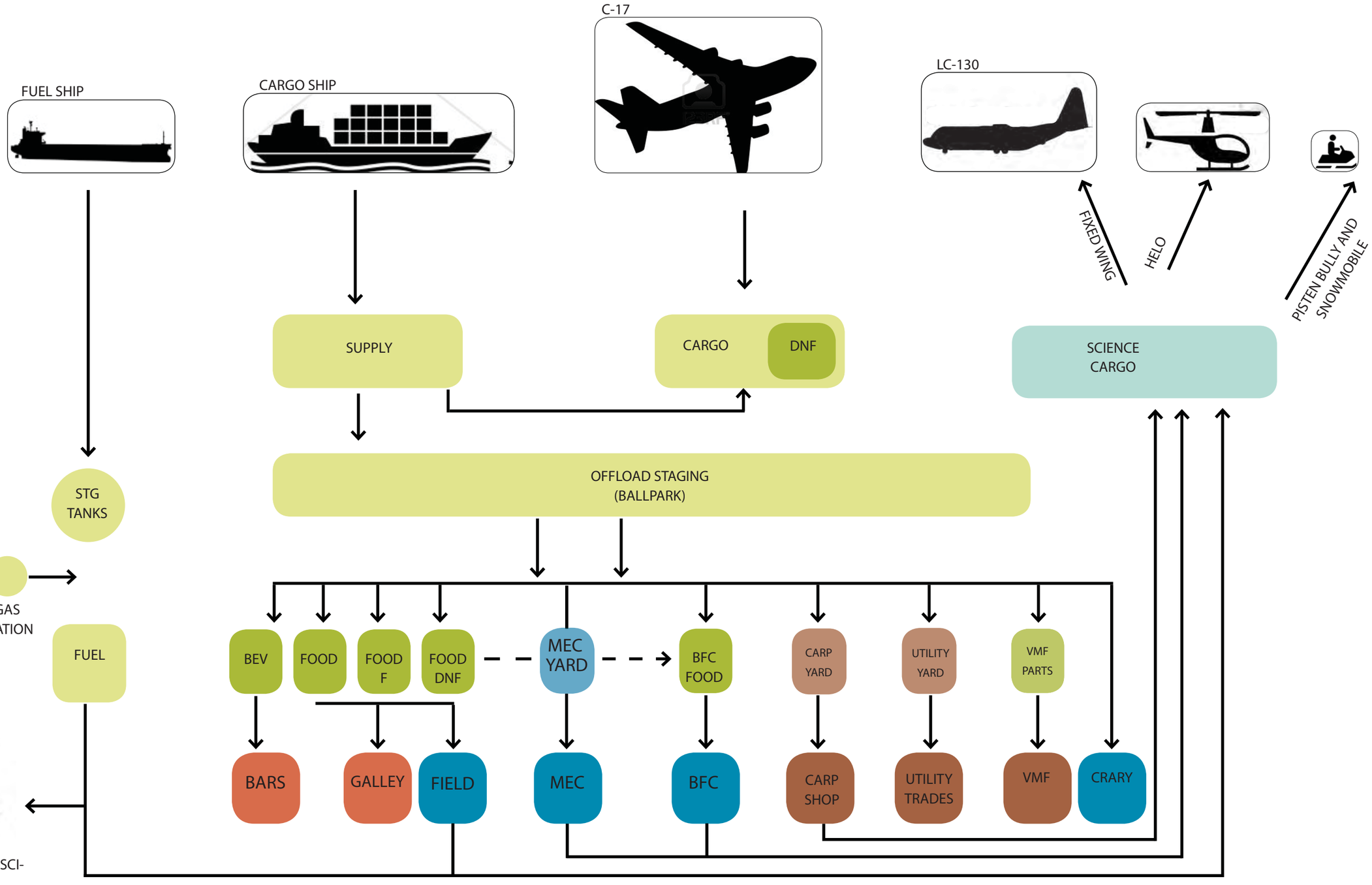
- Ample opportunies for enhanced culture of Environmental Stewardship.
- Little awareness in the community of the environmental impact, as opposed to the monitoring "dashboards" at the South Pole Station as illustrated.



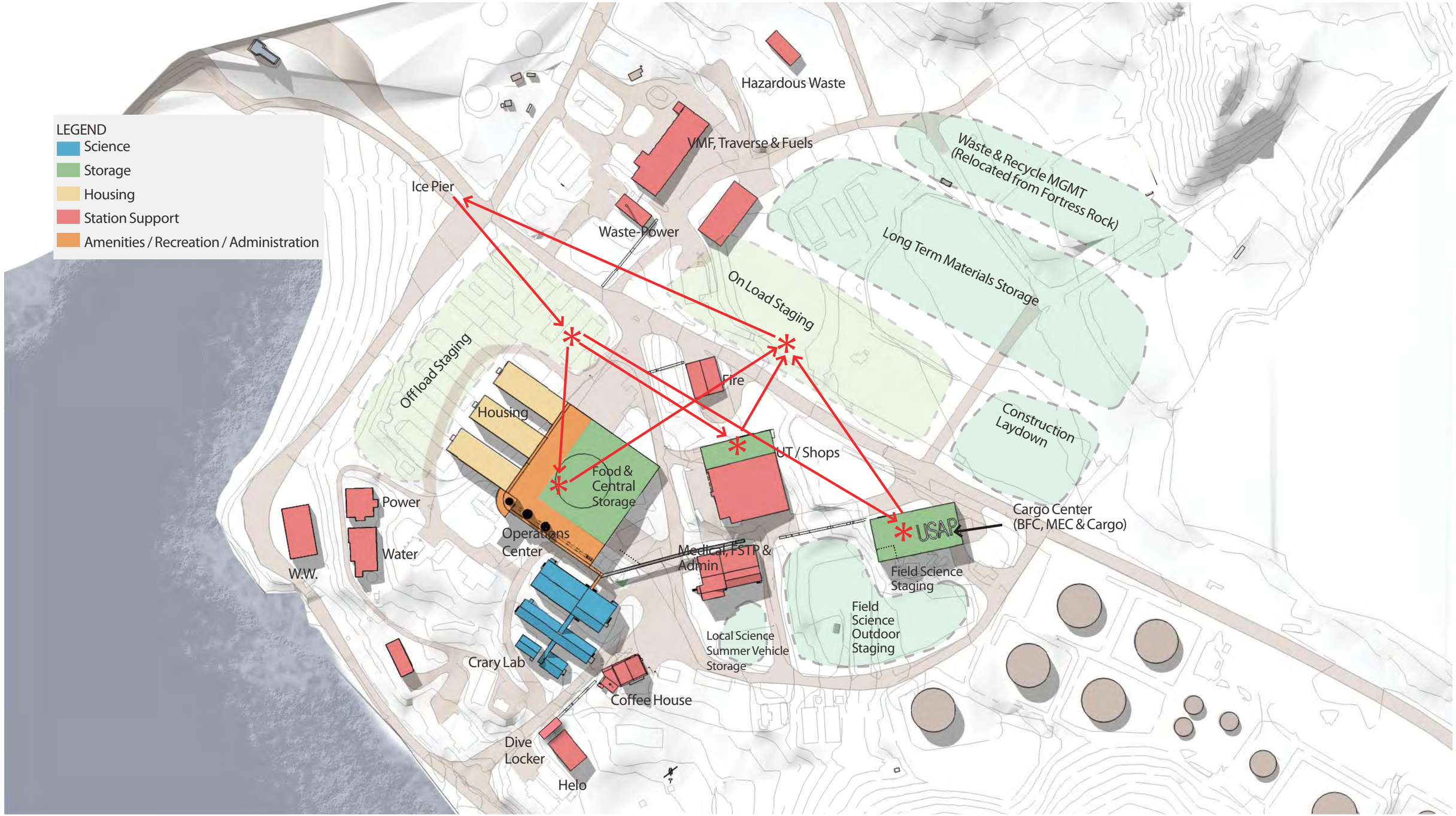
6. Singular-Use Recreation Spaces

- Under-utilization of dedicated spaces, where more multi-purpose facilities could increase efficiencies and reduce footprint.



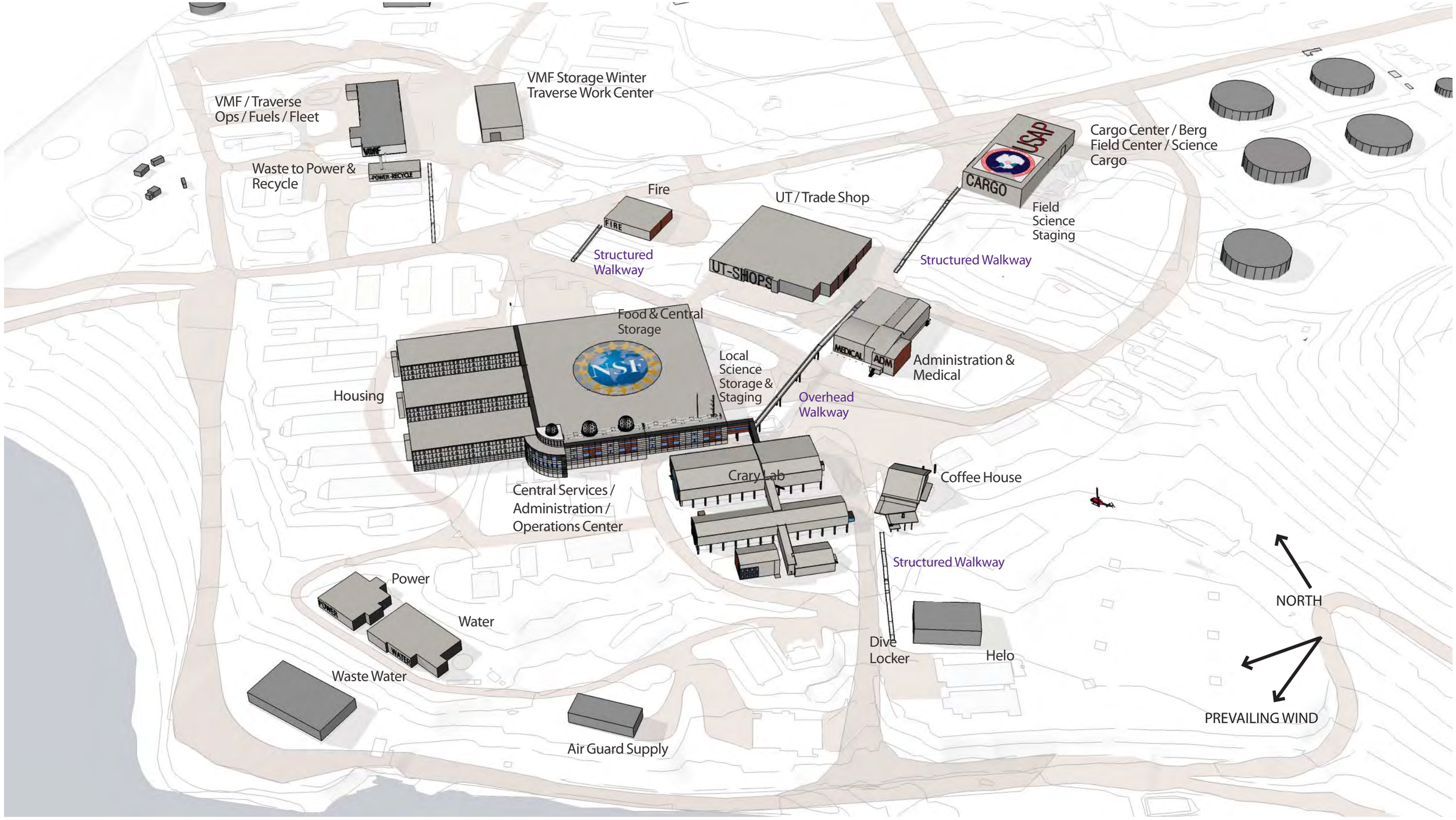


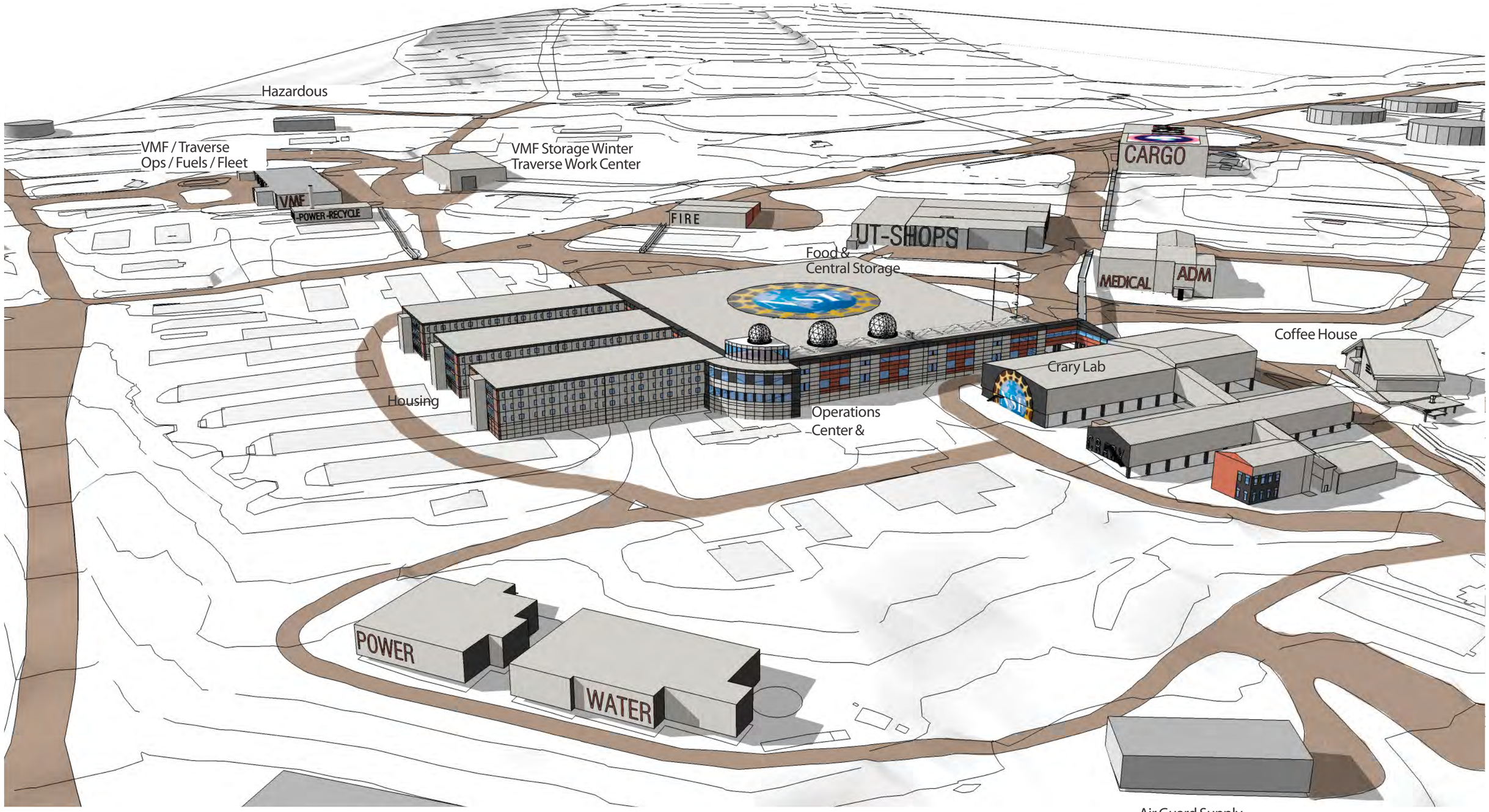
PROCESS FLOW OF MATERIALS



PROPOSED DISTRIBUTION PROCESS

EXISTING MCMURDO STATION


VMF / Traverse
Ops / Fuels / Fleet
VMF Storage Winter
Traverse Work Center
Waste to Power &
Recycle
Fire
Structured
Walkway
UT / Trade Shop
Cargo Center / Berg
Field Center / Science
Cargo
Field
Science
Staging
Structured Walkway
Food & Central
Storage
Housing
Local
Science
Storage &
Staging
Overhead
Walkway
Administration &
Medical
Crary Lab
Coffee House
Central Services /
Administration /
Operations Center
Structured Walkway
Power
Water
Waste Water
Dive
Locker
Helo
Air Guard Supply
NORTH
PREVAILING WIND

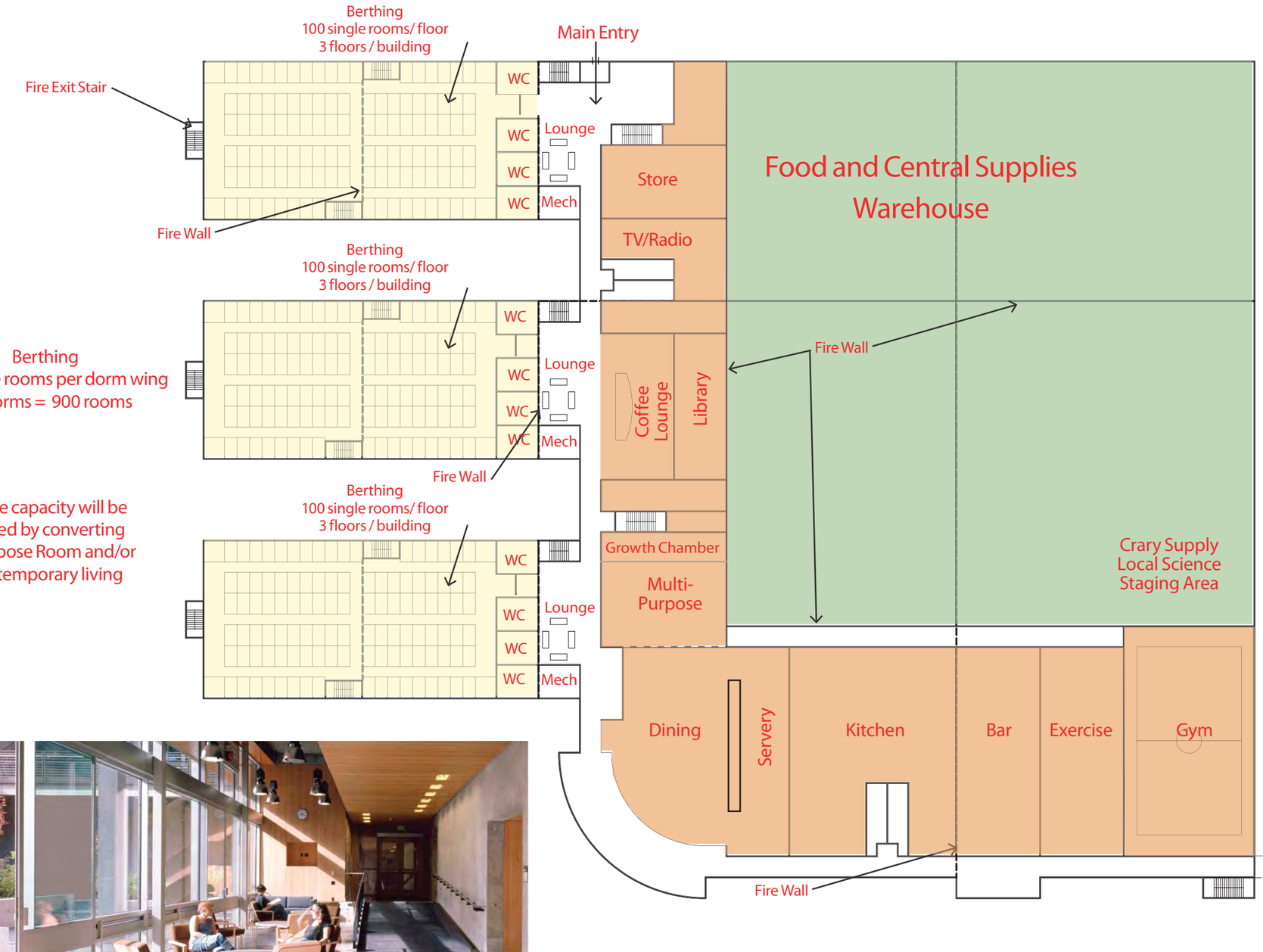


Air Guard Supply

BIRDSEYE FROM SOUTHWEST - FINAL BUILDOUT

BIRDSEYE FROM NORTHEAST - FINAL BUILDOUT

FROM GROUND SOUTHWEST - FINAL BUILDOUT



Berthing surge capacity will be accommodated by converting the Multi-Purpose Room and/or the Gym into temporary living quarters

Circulation / Social Space Character

Survivability Features

- Separate warehousing from commumal spaces using fire walls

- Separate warehousing into smaller sections using fire walls

- Divide Housing pods with fire walls to provide greater protection to occupants

- Provide each housing pod division with 2 fire stairs for greater access to exits

- Incorporate food preparation and emergency food stores into the housing pod that will provide over winter accomodations

Level 1


Berthing
100 single rooms/ floor
WC
WC
WC
WC
Lounge
Mech
Open to
below
Berthing
100 single rooms/ floor
Berthing
300 Single rooms per dorm wing
x 3 dorms = 900 rooms
WC
WC
WC
WC
Lounge
Mech
Administrative &
Operations
Workcenters
Warehouse Below
Berthing
100 single rooms/ floor
WC
WC
WC
WC
Lounge
Mech
IT&C Admin &
Help Desk
Open to
Dining
Below
Administrative &
Operations
Workcenters
Open to
Gym Below
Bridge & Walkway to
UT / Carp and Cargo Center
Lounge Above
Lounge
Level 3
Level 2

Master Plan Approach

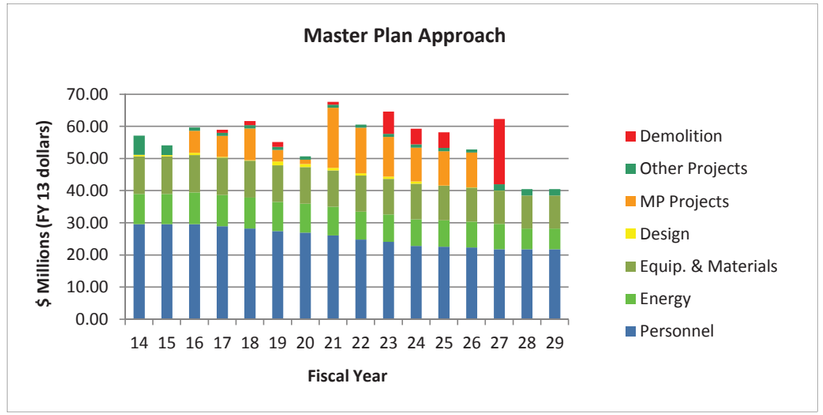
FY	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Personnel	29.60	29.60	29.60	28.94	28.28	27.44	26.96	26.12	24.86	24.14	22.82	22.58	22.34	21.80	21.80	21.80
Energy	9.37	9.37	9.84	9.71	9.56	9.09	9.04	8.88	8.68	8.48	8.33	8.18	8.03	7.88	6.48	6.48
Equip. & Materials	11.70	11.70	11.70	11.62	11.50	11.40	11.37	11.33	11.19	11.09	11.03	10.78	10.61	10.26	10.26	10.26
Design	0.47	0.45	0.65	0.27	0.14	1.18	0.91	0.80	0.69	0.70	0.71	0.12	0.12	0.12	0.00	0.00
MP Projects	0.00	0.00	6.89	6.52	9.90	3.56	1.40	18.68	14.18	12.32	10.56	10.66	10.76	0.00	0.00	0.00
Other Projects	6.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
Demolition	0.00	0.00	0.00	0.90	1.27	1.51	0.00	0.89	0.00	6.90	4.84	4.84	0.00	20.26	0.00	0.00
FY Total	57.14	54.12	59.68	58.97	61.66	55.18	50.68	67.69	60.61	64.63	59.28	58.15	52.86	62.32	40.54	40.54
		Phase	1	2	3	4	5	6	7	8	9	10	11	12		

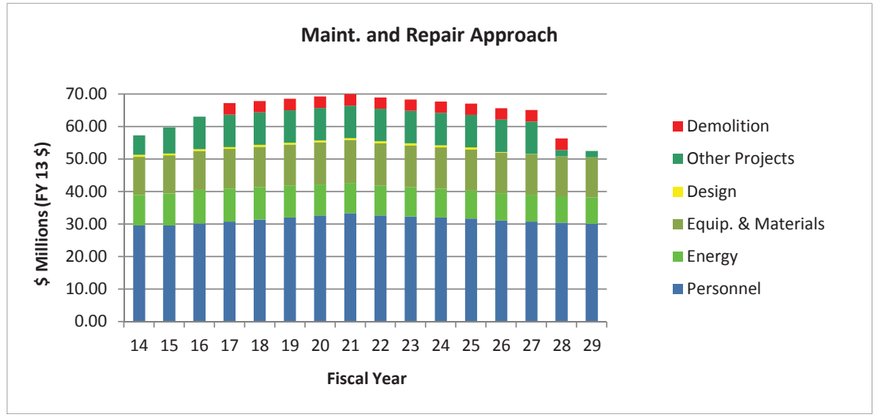
Comparison

FY Delta (M&R - MP)	-0.13	5.62	3.38	8.22	6.19	13.35	18.55	2.26	8.36	3.69	8.41	8.91	12.79	2.73	15.79	11.99
FY Delta vs MP Cost		5.62	-3.51	1.70	-3.71	9.79	17.16	-16.42	-5.82	-8.63	-2.15	-1.75	2.03	2.73	15.79	11.99
Cumulative Delta	-0.13	5.49	1.98	3.69	-0.02	9.77	26.93	10.51	4.68	-3.94	-6.10	-7.84	-5.81	-3.08	12.71	24.70

Maintenance and Repair Approach

FY	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Personnel	29.60	29.60	30.19	30.80	31.41	32.04	32.68	33.33	32.67	32.34	32.02	31.70	31.06	30.75	30.45	30.14
Energy	9.37	9.84	10.33	10.12	9.92	9.72	9.53	9.34	9.15	8.97	8.79	8.61	8.44	8.27	8.11	8.11
Equip. & Materials	11.70	11.70	11.93	12.17	12.42	12.66	12.92	13.18	13.04	12.91	12.78	12.66	12.53	12.41	12.28	12.28
Design	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.12	0.12	0.00	0.00
Other Projects	6.00	8.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	2.00	2.00
Demolition	0.00	0.00	0.00	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	0.00
FY Total	57.27	59.74	63.06	67.19	67.85	68.53	69.23	69.95	68.96	68.32	67.69	67.07	65.65	65.05	56.33	52.53

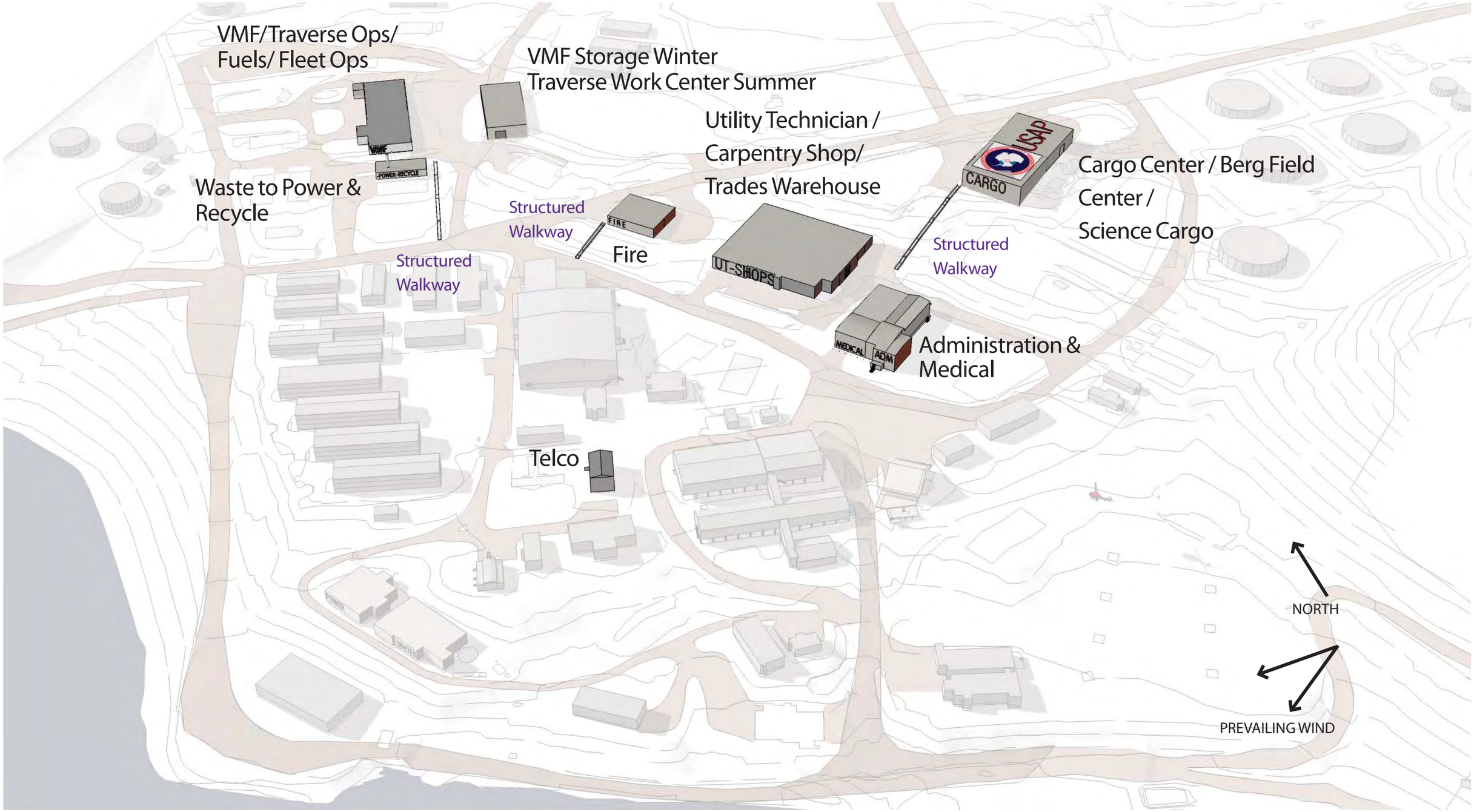




Approach: Invest strategically over a 13 year period starting with design in FY 14, procurement/shipping in FY15, and construction starting in FY16. Total capital infusion of $105 M begins reaping energy and operational savings early as the footprint is reduced. This chart assumes project phases continue sequentially each year. The two approaches become cost neutral approx. 12 years after phase 1 begins, but yearly costs will be approx. $12 M per year less after 13 years with this approach since station is smaller, modernized, and efficient.

Approach: Replace or renovate buildings as they begin failing. Implement operational efficiencies where possible, but footprint will remain much as it is today. Due to the age of the current buildings and utility systems, this will require approx. $10 M per year beginning in two years. The investment is higher over time since it is costly to keep older facilities operating and buildings being replaced will require work around solutions.

MASTER PLAN VS. MAINTENANCE & REPAIR COMPARISON


VMF/Traverse Ops/
Fuels/ Fleet Ops
VMF Storage Winter
Traverse Work Center Summer
Utility Technician /
Carpentry Shop/
Trades Warehouse
Cargo Center / Berg Field
Center /
Science Cargo
Waste to Power &
Recycle
Structured
Walkway
Structured
Walkway
Fire
Structured
Walkway
Administration &
Medical
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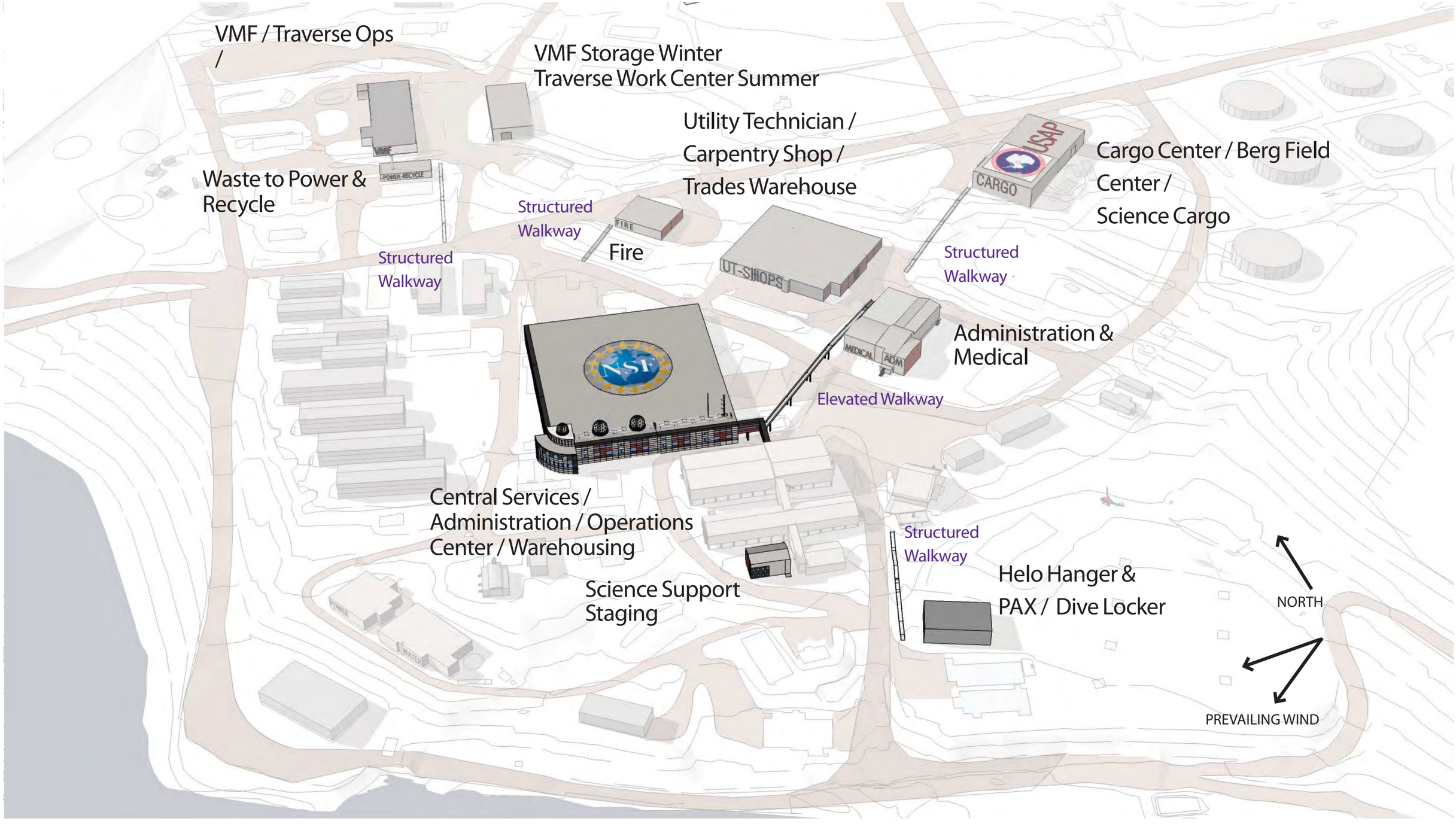
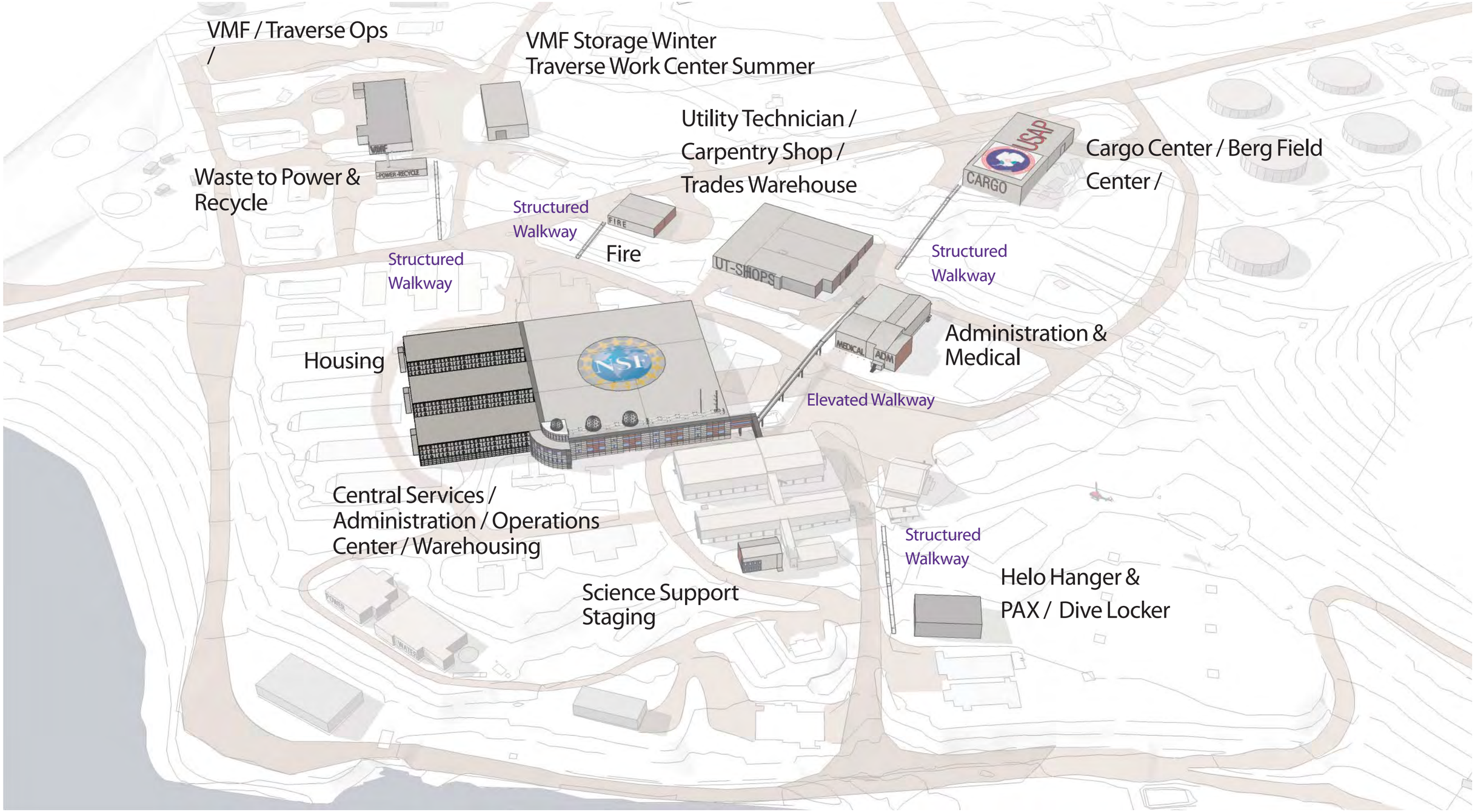

VMF / Traverse Ops
/
VMF Storage Winter
Traverse Work Center Summer
Utility Technician /
Carpentry Shop /
Trades Warehouse
Cargo Center / Berg Field
Center /
Science Cargo
Waste to Power &
Recycle
Structured
Walkway
Structured
Walkway
Fire
Structured
Walkway
Administration &
Medical
Elevated Walkway
Central Services /
Administration / Operations
Center / Warehousing
Science Support
Staging
Structured
Walkway
Helo Hanger &
PAX / Dive Locker
NORTH
PREVAILING WIND
USAP
CARGO
FIRE
UT-SHOPS
MEDICAL
ADM
NSF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Fire
Structured
Walkway
Structured
Walkway
Housing
Administration &
Medical
Elevated Walkway
Central Services /
Administration / Operations
Center / Warehousing
Science Support
Staging
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Walkway
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PAX / Dive Locker
FIRE
UT-SHOPS
CARGO
USAP
MEDICAL
ADM
NSF
POWER-RECYCLE