

# Thank you to our Patrons



We will begin our presentation in a few minutes...





**Stanley Consultants**

# **South Pole Station Master Plan**

American Academy of Environmental Engineers & Scientists®

May 7, 2025



## Randy Duzan, AICP, PLA

Principal Planner, Master Planner, Stanley Consultants

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### Presentation

- History – Present and Future
- Master Planning Process
- Plan and Projects
- Renderings

NSF, undated

## Fun Fact:

- Austral winter is Mar to Oct. 24 hours of darkness. Aurora australis is visible.
- Austral summer is Oct to Mar. 24 hours of sunlight.

# Planning at the edge of the world

Young, 2021



New Zealand Standard Time  
18 hours ahead of MST  
4 am tomorrow

# Welcome to the South Pole

M. Lucibella, 2019

# South Pole Station - History

- 1912: Amundsen and Scott expedition. First structure at the South Pole.
- 1957: U.S. Navy builds Amundsen-Scott South Pole Station, now known as “Old Pole”
- 1958: International Geophysical Year
- 1959: The Antarctic Treaty reserves Antarctica for peace & science (12 signatory)
- 1975: U.S. Navy builds the SPS Geodesic Dome to replace the “Old Pole”
- 1982: Presidential Memo 6646 appoints the National Science Foundation (NSF) as steward of U.S. Antarctic Program (USAP)
- 1991: ASMA No. 5: South Pole establishes zones & “sectors”  
(Antarctic Specially Managed Area)



# Present & Future

- The Antarctic Support Contract (ASC) supports NSF
- 2008: Construction of the Amundsen-Scott South Pole Station (“Elevated Station”) completed
- 2008+: Freestanding, external structures and adhoc storage spaces were created as needed
- 2023: Stanley Consultants was contracted by ASC to develop the first ever master plan for the SPS, working closely with the NSF and ASC.
  - The Master Plan provides a vision for the next 30 to 50 years to modernize infrastructure and operations to continue scientific support. The master plan proposes specific projects and studies to improve efficiencies and replace life support facilities.



Elevated Station (65K SF)

An aerial photograph of a construction site at sunset. A long, curved line of balloons stretches across the sky, marking a path. The ground below shows various construction structures and equipment. The sky is a mix of purple, pink, and orange.

# Master Planning Process

NSF, 2016

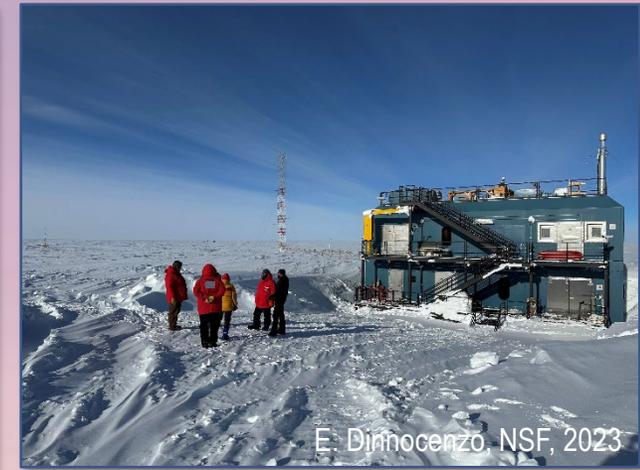
# Science Research

- Atmospheric Sciences
- Astrophysics and Cosmology Sciences
- Geospace Science
- Glaciology
- Seismology
- Medical Research



Ice Cube

NSF, 2023



E. Dinnocenzo, NSF, 2023

ARO



Skiway

NSF, 2023



Troftgruben, undated



G. Neri, NSF, 2020

MAPO

DSL

# Challenges

## Fun Fact:

- Mean avg. - 56° F
- Min. - 8° F, Max. - 117° F

- Arctic Conditions
- Current Building Challenges
- Seasonal Limitations
- Travel Logistics
- Structures



30-day journey from McM to SP



# Existing Conditions

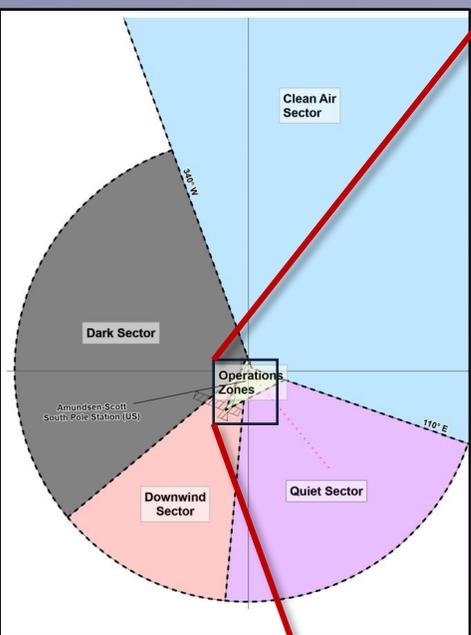
- Blue Buildings
- Elevated Station
- Arches
- Retrograde
- Logistics



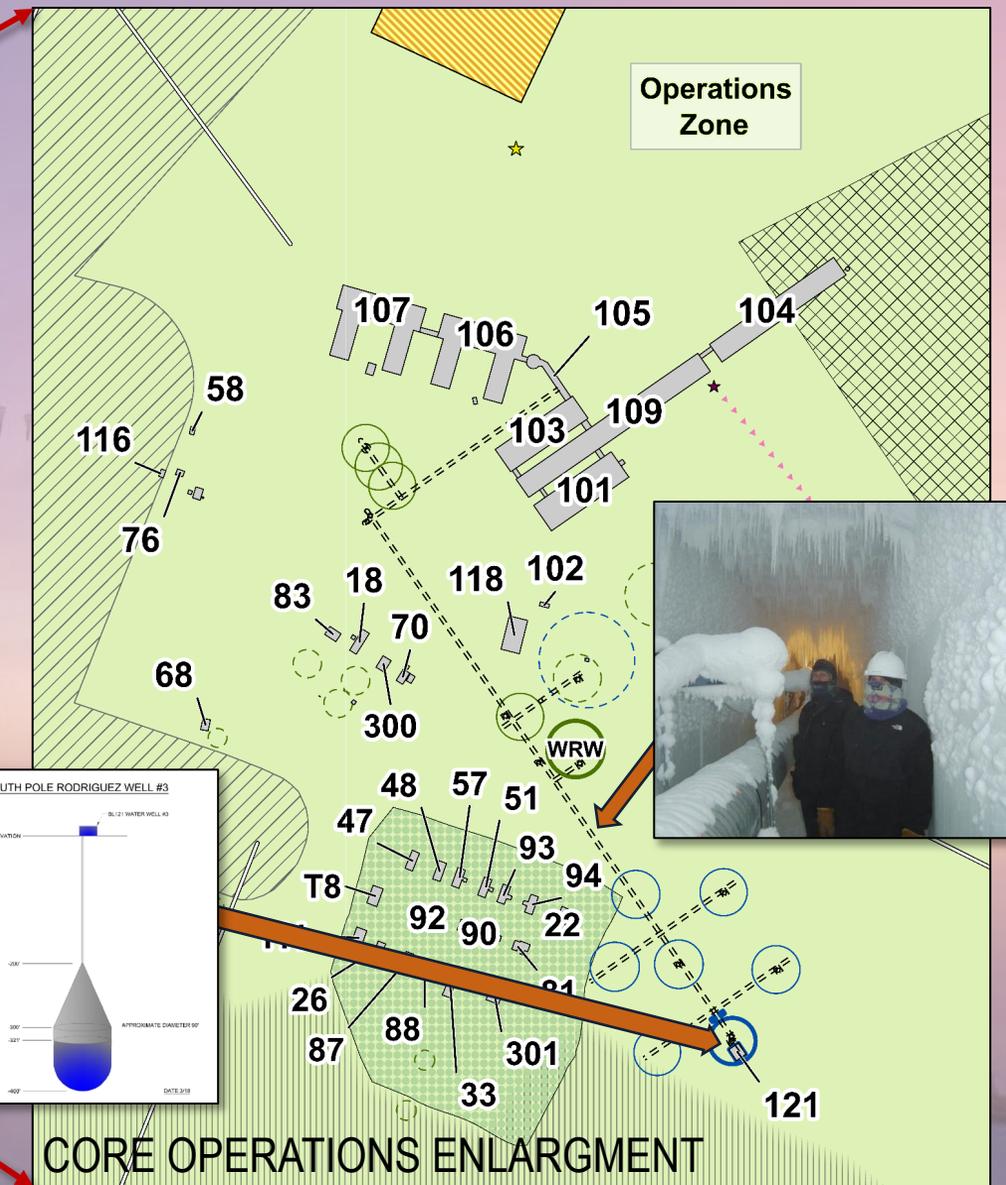
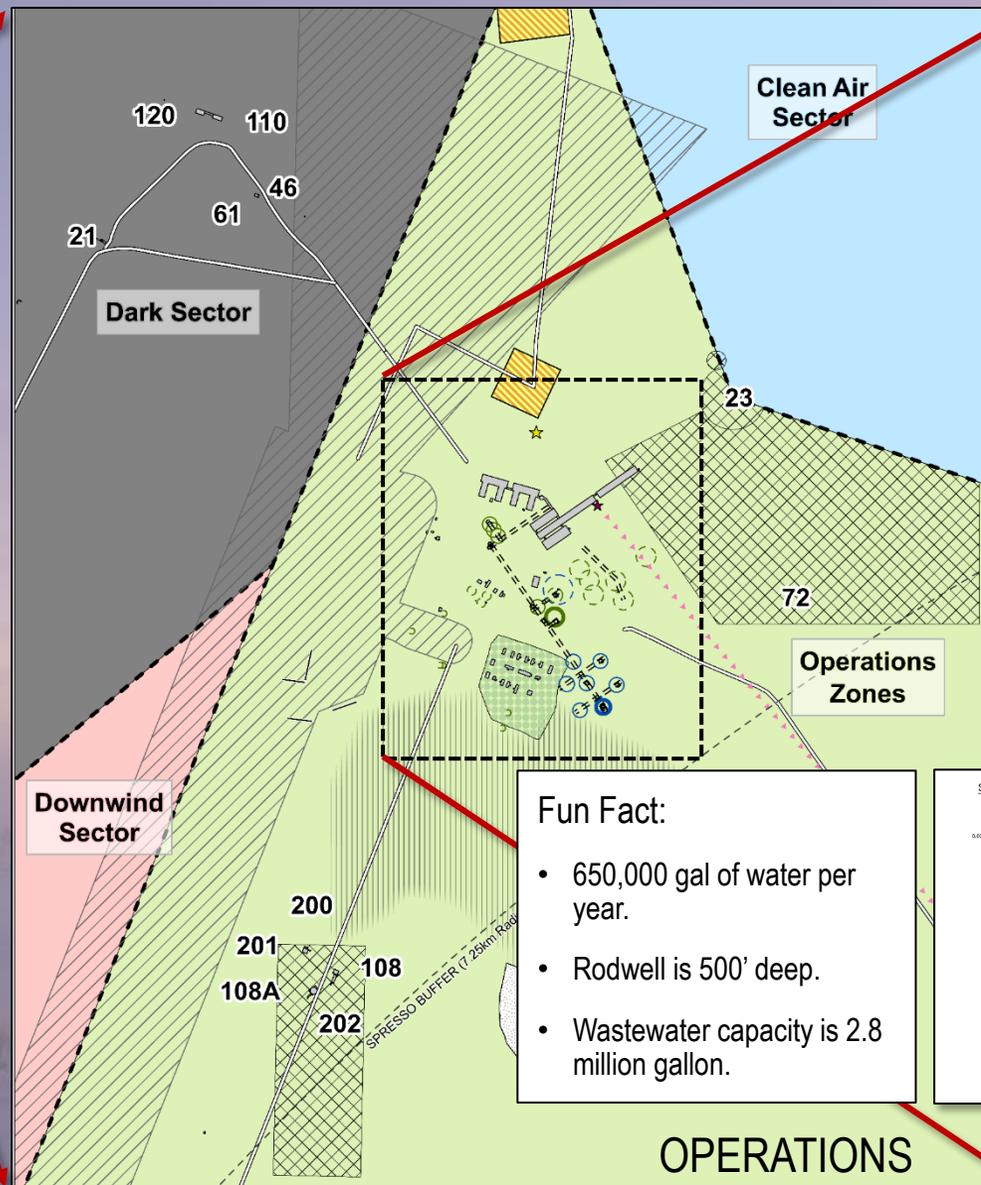
Fun Fact:

- Ice sheet is 8,850' thick sitting on bedrock. It is a glacier.
- Ice sheet moves 10m a year in a northeasterly direction. It is basically a glacier.



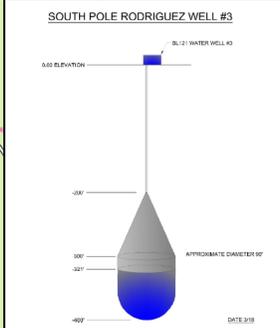


ASMA No. 5



**Fun Fact:**

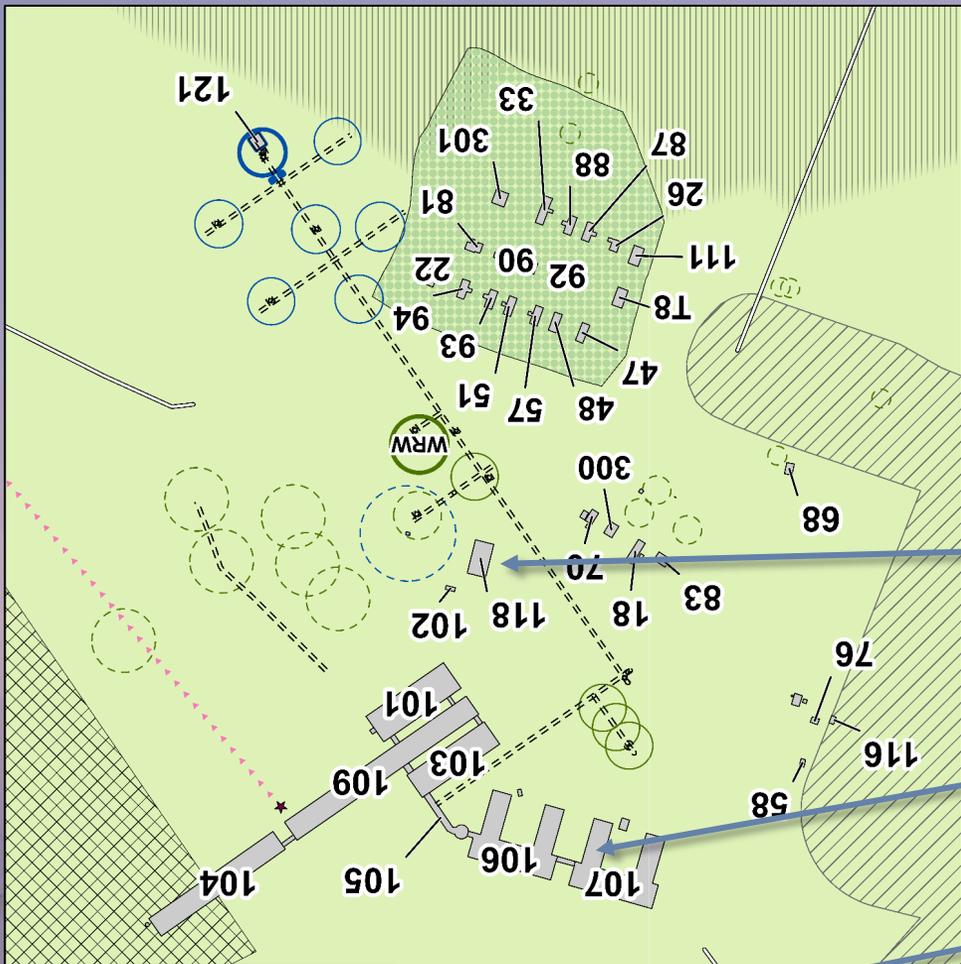
- 650,000 gal of water per year.
- Rodwell is 500' deep.
- Wastewater capacity is 2.8 million gallon.



Site

OPERATIONS

CORE OPERATIONS ENLARGMENT



CORE OPERATIONS



Non-Governmental Agency (NGO)

# Planning Charrette

- Engagement (Virtual)
  - Scientific Community Involvement
  - Concerns and Recommendations
  - MIRO

## Scientific Community Involvement (22)

- University of Chicago
- University of Wisconsin
- MIT
- Argonne National Laboratory
- NJ Institute of Technology
- NOAA
- National Science Foundation
- CRREL
- University of Minnesota
- Department of Interior
- USAP
- South Dakota State University
- Harvard University
- Incorporated Research Institution for Seismology
- University of Washington
- University of Alaska
- NIWC
- University of California – Irvine
- University of Florida
- NASA
- Pennsylvania State University
- United States Army

### Fun Fact:

- Four charrette days (6 hrs. ea.)
- 100+ attendees each day.

# Day 1: Overview



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Stanley Consultants

## General Information

**Agenda**

Time	Topic	Facilitator
1000	Intro, Purpose, MIRO	MIRO
1030	Mission / Vision	MIRO
1100	SPS Overview	MIRO
1130	Opp/Constraints	MIRO
1200	Structures	MIRO
1230	Break	
1300	Operations	MIRO
1330	Infrastructure	MIRO
1400	Utilities	MIRO
1430	Airfield	MIRO
1500	Summary / Homework	MIRO

**Reference Material**

**South Pole Station Photos**

## Information

**1. Introduction**

**2. Opening Comments**

**3. Chartered Purpose and Objectives**

**4. Master Plan Vision, Mission, Goals, & Objectives**

**5. Rules of Conduct**

**6. Homework**

## Overview

**South Pole Station Overview - Seth Pilgrim, Leidos**

**Opportunities & Constraints**

**Greater SP Area**

**Operations Zone**

**Buildings/Numbers**

## Structures & Facilities

**DISCUSSION QUESTIONS:**

- What are the challenges (i.e., climate related, operational, maintenance, day-to-day life) working at the Pole related to your projects? What is needed to overcome the challenges?
- What is working well at the Pole related to your projects?
- Are there operational things that could be improved, changed, eliminated, or added to make the work more efficient?

**Operational Structures**

## Science Facilities

**DISCUSSION QUESTIONS:**

- What are the challenges (environmental, operational, maintenance, day-to-day life) working at the Pole related to your projects? What is needed to overcome the challenges?
- What is working well at the Pole related to your projects?
- Are there operational things that could be improved, changed, eliminated, or added to make the work more efficient?

**Scientific Facilities**

## BREAK

## Operations, Infrastructure & Utilities

**DISCUSSION QUESTIONS:**

- What are the challenges (environmental, operational, maintenance, day-to-day life) working at the Pole related to your projects? What is needed to overcome the challenges?
- What is working well at the Pole related to your projects?
- Are there operational things that could be improved, changed, eliminated, or added to make the work more efficient?

**Utilities**

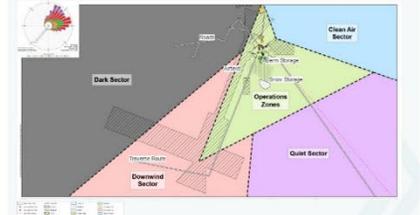
## Operations, Infrastructure & Utilities

**DISCUSSION QUESTIONS:**

- What are the challenges (environmental, operational, maintenance, day-to-day life) working at the Pole related to your projects? What is needed to overcome the challenges?
- What is working well at the Pole related to your projects?
- Are there operational things that could be improved, changed, eliminated, or added to make the work more efficient?

**Operations, Transport, & Circulation**

TIME (MT)	Day One	Day Two	Day Three	Day Four
	Overview	Science	Science	Master Planning
1000	Intro, Purpose, Objectives, MIRO	Intro, Objectives for the day	Intro, Objectives for the day	Intro, Objectives
1030	Mission / Vision	Astrophysics	Seismology	NSF
1100	SPS Overview	Dark Sector	Quiet Sector	Sectors
1130	Opp/Constraints	MAPO, DSL, ICL	Glaciology	Overlays
1200	Structures	Geospace	South Pole Station	Easements
1230	Break	Dark Sector	Break	Site Planning
1300	Break	Break	Break	Break
1330	Operations	Atmospheric	Medical Research	Site Planning
1400	Infrastructure	Clean Air Sector	Field Science	Projects
1430	Utilities	ARO	Science Vision	Priorities
1500	Airfield	Science Vision	Science Vision	Closing comments
1530	Summary / Homework	Summary / Homework	Summary / Homework	Next Steps
1600	Summary / Homework	Summary / Homework	Summary / Homework	Next Steps



# MIRO

# MIRO



## Day 3: Science



leidos



### General Information

**Agenda**

Time	Activity	Facilitator
08:00 - 09:00	MIRO Meeting	Chavez
09:00 - 10:00	MIRO Meeting	Chavez
10:00 - 11:00	MIRO Meeting	Chavez
11:00 - 12:00	MIRO Meeting	Chavez
12:00 - 13:00	Lunch	
13:00 - 14:00	MIRO Meeting	Chavez
14:00 - 15:00	MIRO Meeting	Chavez
15:00 - 16:00	MIRO Meeting	Chavez
16:00 - 17:00	MIRO Meeting	Chavez

**Reference Material**

Material	Location
MIRO Meeting	Room 101
MIRO Meeting	Room 101
MIRO Meeting	Room 101



**List of Buildings/Numbers**

Building Number	Name
101	...
102	...
103	...

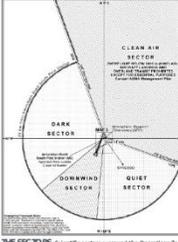


**General Information**

MIRO Meeting is a daily meeting for all MIRO participants. The meeting is held in Room 101.

### Information

- Objectives for the day**
  - Current and Potential Future Science
  - Quiet Sector Science: Medical Research and Field Science
  - Facility and operational requirements.
- Chavette Purpose and Objectives**
  - Facilitate the MIRO meeting and ensure that all participants have an opportunity to contribute.
  - Ensure that the meeting is focused on the key topics and that the time is used effectively.
  - Ensure that the meeting is a positive and productive experience for all participants.
  - Ensure that the meeting is a good example of how to run a meeting.
- Rules of Conduct**
  - Be respectful and courteous to all participants.
  - Be on time for the meeting.
  - Be prepared to contribute to the meeting.
  - Be active and engaged in the meeting.
  - Be respectful of the time and resources of the meeting.
  - Be respectful of the views and opinions of other participants.
  - Be respectful of the confidentiality of the meeting.
  - Be respectful of the intellectual property of the meeting.
  - Be respectful of the environment of the meeting.
  - Be respectful of the safety of the meeting.



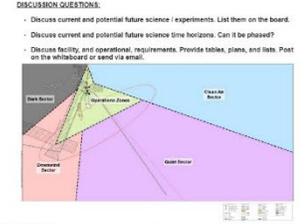
**Buildings/Numbers - Color Coded by Current Use**

Building Number	Name	Current Use
101	...	...
102	...	...
103	...	...

**Glossary**

Term	Definition
...	...
...	...
...	...

### Science



**Quiet Sector**

Medical Research Science Vision

Field Science Vision

**Quiet Sector Science Vision**

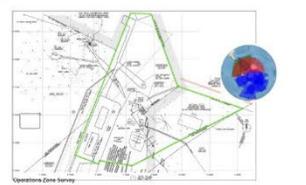
Field Science Vision



**South Pole Station - Operations Zone**

Medical Research Science Vision

Field Science Vision



### Science

**Medical Research Science Vision**

Field Science Vision



**Field Science Vision**

Field Science Vision

**Field Science Vision**

Field Science Vision

### Science



**Air and Land Support**

Field Science Vision

**Air and Land Support Vision**

Field Science Vision



**Air and Land Support Vision**

Field Science Vision



- Pre-Chavette Instructions - Questions**
- Discuss current and future projects in the horizon. Can it be phased? Provide a timeline with lowest or highest focus years.
  - Discuss facility, operational, and funding requirements. Provide status, plans, and risks to plan to be introduced.
  - What are the challenges (i.e. climate related, operations, maintenance, day-to-day level) what is needed to overcome the challenges?
  - What can be improved, changed, eliminated, or added to make operations work more efficient?
  - Be prepared to provide any comments on the Timeline and Budget.
- SPSOP? Additional Questions**
- Does your current building/facility experience any interference, vibration, unneeded traffic, etc. from other station users?
  - If there would be more equipment or infrastructure there?
  - If you have future use building projects, where would they be located? Do you require a minimum separation distance to other buildings?
  - Do you have any concerns with location of the facility, i.e. vehicle or pedestrian?
  - Do you have any storage needs and how many, where do you store things?
  - Do the current operations have any negative impact on your science? If so, what is the impact? Could the impact be mitigated/operational level?
  - Do the plans and thoughts on moving the facility south as the same site/area and how the excavation that the power plant will be moved and updated at some point, power cables may be disturbed for a period of time, what amount of disturbance can your science tolerate and not tolerate?
  - If you conduct field science, what amount of station support do you need, i.e. storage, temporary sheds, etc. supplies, etc.

- Homework**
- Mark up maps you copy out of MIRO to show study locations, boundary changes, etc.
  - Think about how the station could be declassified.
  - Review questions above and provide responses on MIRO or email to Chavette email.

# MIRO

- Documentation
  - Voting on potential projects
  - Sticking Note Comments
  - Recorded Sessions

**CONSTRAINT**

- Ice movement (10m/yr) and snow drift.
- Storage space.
- Quiet sector restrictions on surface activity
- Clean air sector restrictions on pollutants/chemicals
- ICL storage
- vaults fiber optic cable stretched
- EMC and interference.
- Limited preparatory & staging areas (especially DNF staging area) for transient field teams.
- Legacy waste removal/stockpiling/burying
- Power production, power resiliency due to single source power station
- Data transmission bandwidth - additional bandwidth would allow better data quality monitoring and US remote analysis
- Limited and diminishing LC130 airlift capabilities
- Limited steady state diesel fuel power generation.
- Self-imposed constraint to keep current capacities both in people / cargo. Why?



## Sticky note comments

WEBVTT

00:00:10.000 --> 00:00:32.000  
And wanna welcome everybody. Who has joined us. We have several participants from the Science community and also attendees that are general, public, and others.

00:00:32.000 --> 00:01:02.000  
And so the format today is kinda 2 fold. Everybody has called in on a Zoom Webinar site and you're viewing a application called Miro, which is a whiteboard technology that allows interaction by all participants who are part of the panelists and miro allows information to be posted photographs as you can see text and it allows the panelists to

## Conversation transcripts

# Data Collection

- Technical Information
  - Technical drawings
  - Stakeholder/SMEs
  - NSF and ASC review comments

## On site inventories

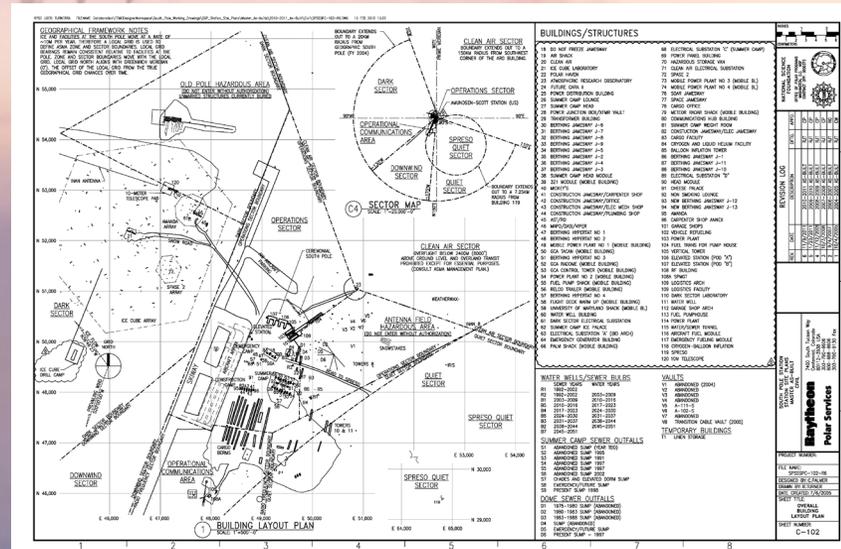
Storage Use Type	Improvised square footages					Totals
	Berms	Out Bldgs	Arches	ES - A	ES - B	
Construction	12,160	0	0	0	0	12,160
Emergency Management	160	0	180	100	0	440
Fleet	6,400	0	3,760	0	0	10,160
Food/Dry Goods	0	560	0	91	0	651
Fuels	160	320	0	0	0	480
Greenhouse	0	0	0	68	0	68
IT/Communications	160	0	0	124	237	521
Janitorial	4,000	0	0	102	99	4,201
Lodging Supplies	0	563	0	48	55	666
Maintenance	22,960	2922	56	8	118	26,064
Medical	0	0	0	0	66	66
Miscellaneous	0	0	0	38	0	38
Postal Service	0	0	0	12	0	12
Recreation	0	0	0	0	100	100
Science	640	1126	0	0	0	1,766
Store Stock	160	0	0	0	0	160
Utilities	4800	0	624	0	0	5,424
Waste	1,160	0	0	0	0	1,160
<b>Totals</b>	<b>52,760</b>	<b>5,491</b>	<b>4,620</b>	<b>591</b>	<b>675</b>	<b>64,137</b>



Operational input

SPSMP Federal Register Review Comments					
ID	Location	Comment	Commentor	Complete (Y/N)	Responses
1	Pg 10	Missing support for deep field activities to support remote autonomous instruments that are important to Atmospheric, Geospace, Seismology and Glaciology sciences...	B. Clauer	y	Deep field activities will be addressed as part of a future Field Activity Master Plan.
3	General	The Scripps CO2 program has been measuring CO2 in flasks collected at SPS since 1957. The Scripps O2 program has been measuring O2/N2, CO2, and Ar/N2 in flasks collected at SPS since 1991. Changes to sampling criteria, sample location, or the addition of local influences has the possibility to impact our time series, so we have read the Master Plan with interest. As proposed we do not have any specific concerns with any of the proposed changes to the Clean Air Sector (which, from the Plan, seems to only be the creation of stricter controls on access to the CAS via an official easement, which we welcome). Thus, our only comment is that if the recommendation CAS 1 is followed (a new NOAA science building is built within the CAS), that the construction of it be carefully coordinated with atmospheric sampling activities (i.e., construction activities are not ongoing within a certain period before and during sampling, agreed upon in advance by relevant stakeholders).	E Morgan	y	Thank you for your comment. Agreed coordination will be required.
4	General	Renew Antarctic Treaty to include all nations under the alliance of the United Nations	T Hurd	y	Thank you for your comment. Beyond the scope of the MP.
5	General	Convert South Pole Station to alternative clean energy.	T Hurd	y	Thank you for your comment. - The use of renewable energy is an on going area of study for the South Pole Station.

SME review comments



Site surveys

# South Pole Station – Plan and Projects

- Master Plan
- Projects
  - Cost
  - Phasing
- Renderings



NSF, undated

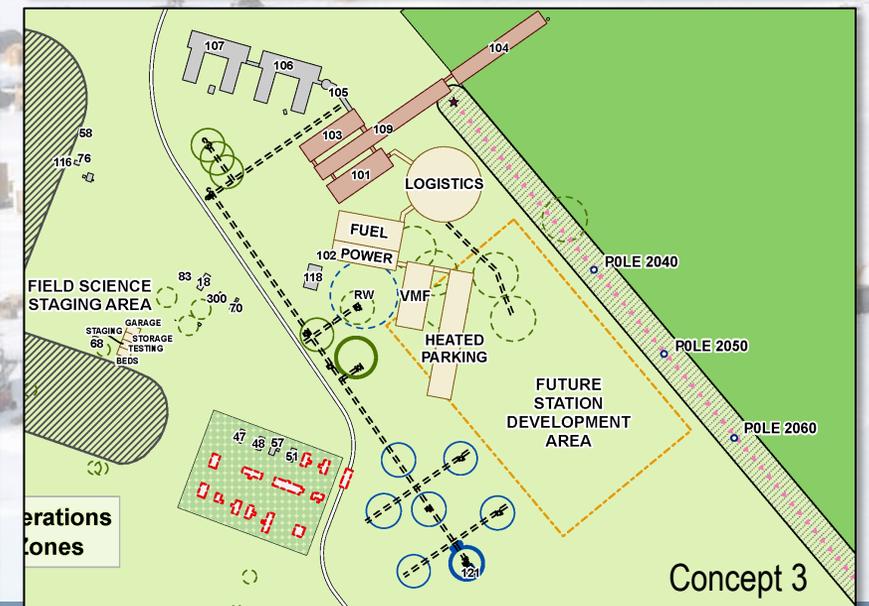
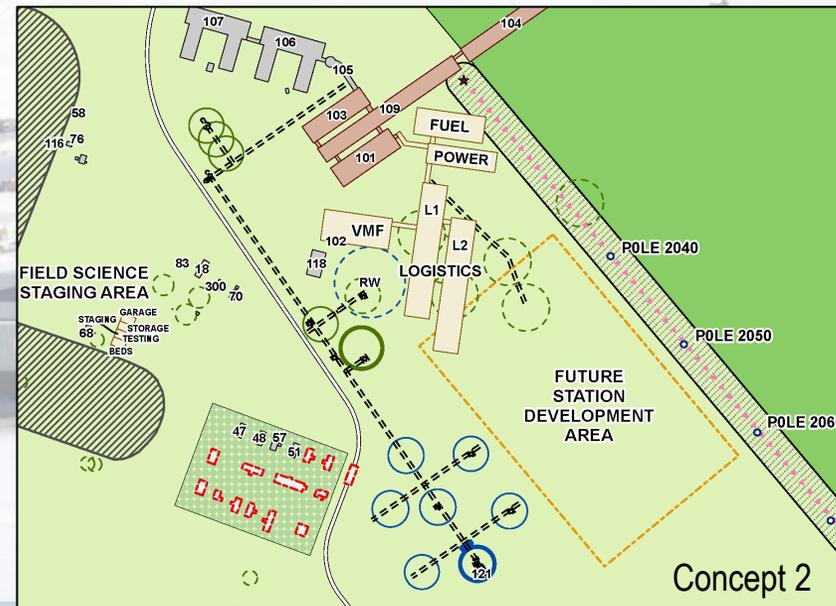
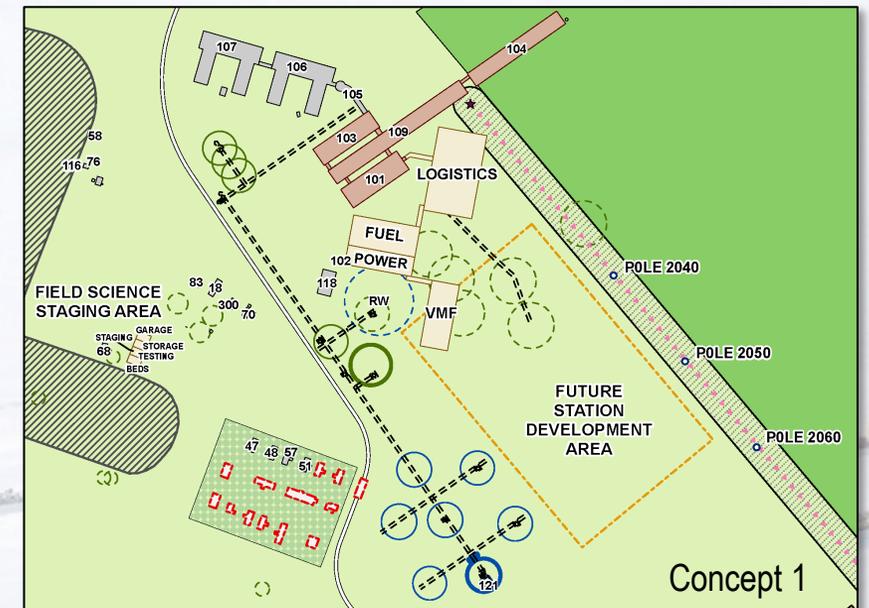
# Plan and Projects

- Structures
  - Three types of structures were considered: elevated, surface, and dome
- Electrical
  - Five generators will be replaced. Transferring power to the new generators will be a challenge.
- Mechanical
  - The cabling network buried in the ice needs to be replaced. New technology will be looked at to address the movement of the ice.
- Communications
  - Communications is critical for transferring data back to CONUS. New system like Starlink are being looked at.
- Airfield
  - One recommendation was to shift the skiway southwest to deconflict departure routes.

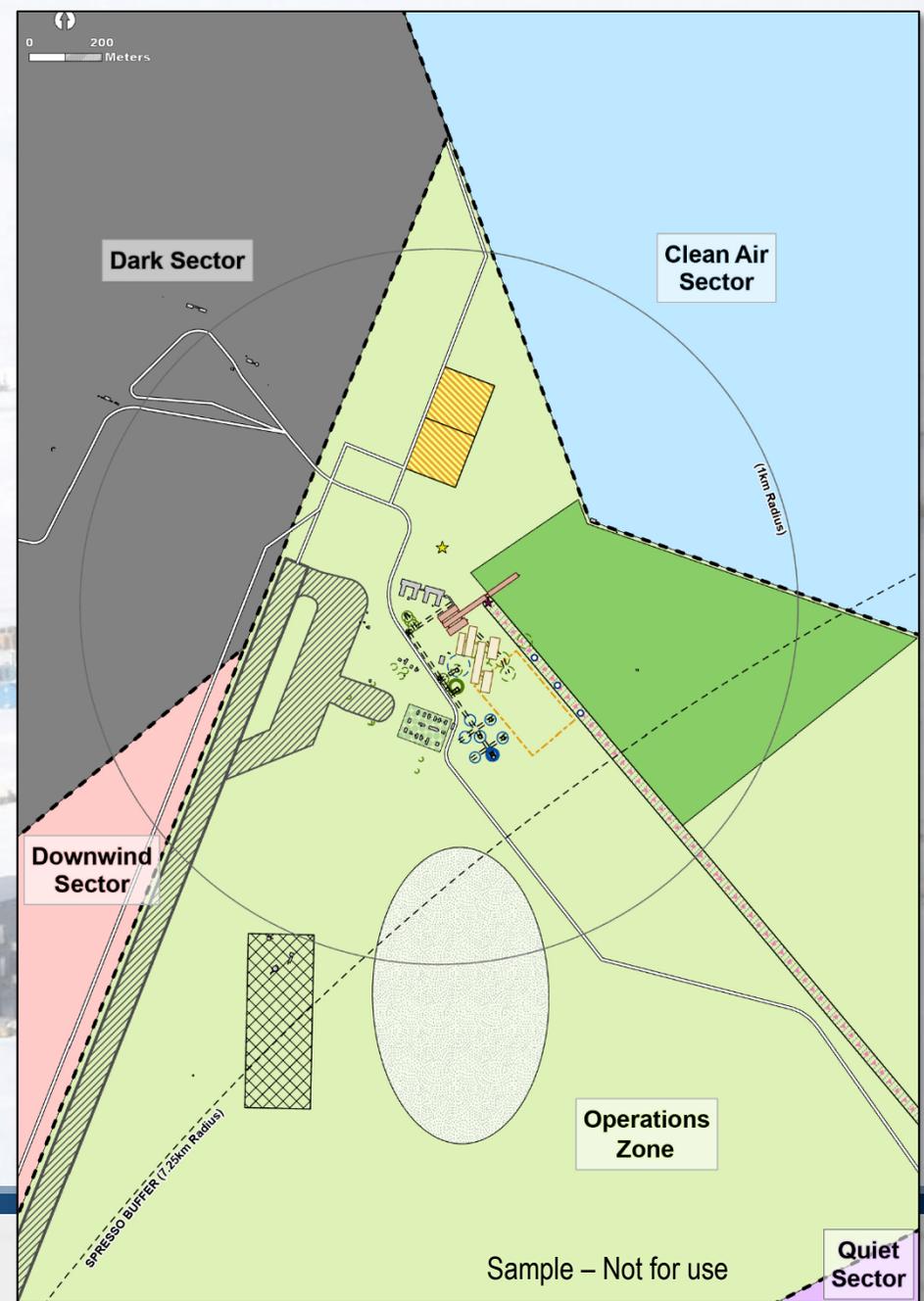
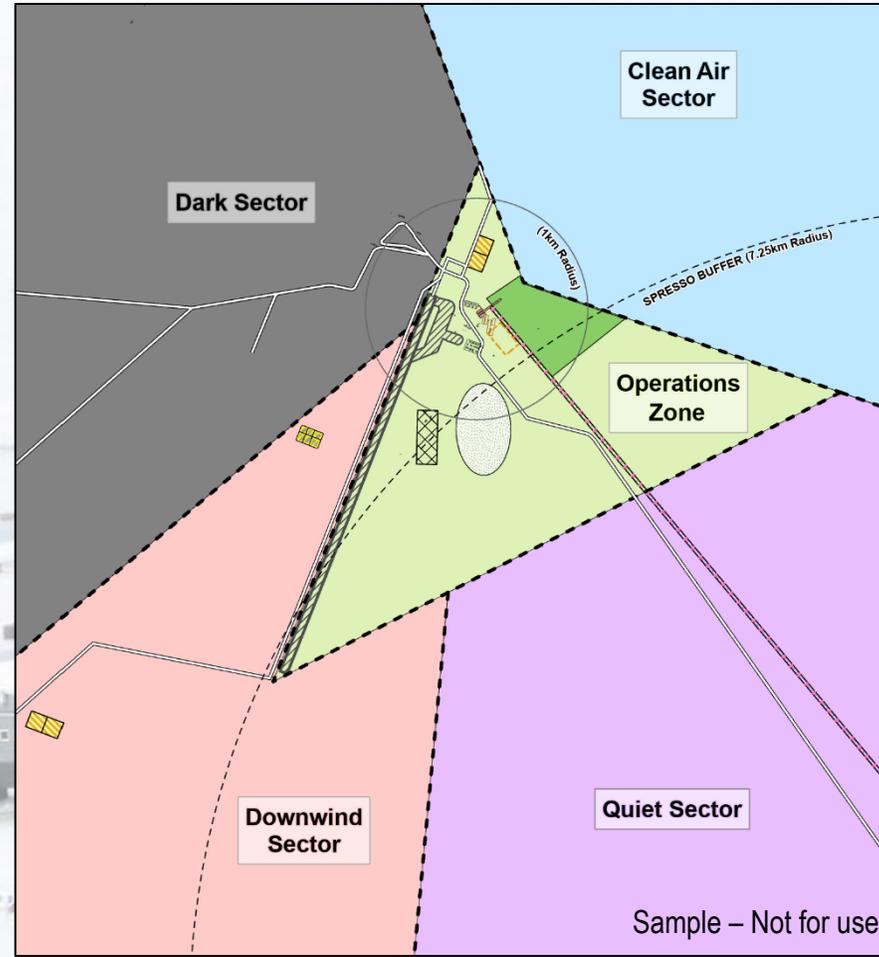
NSF, undated

# Master Plan Concepts

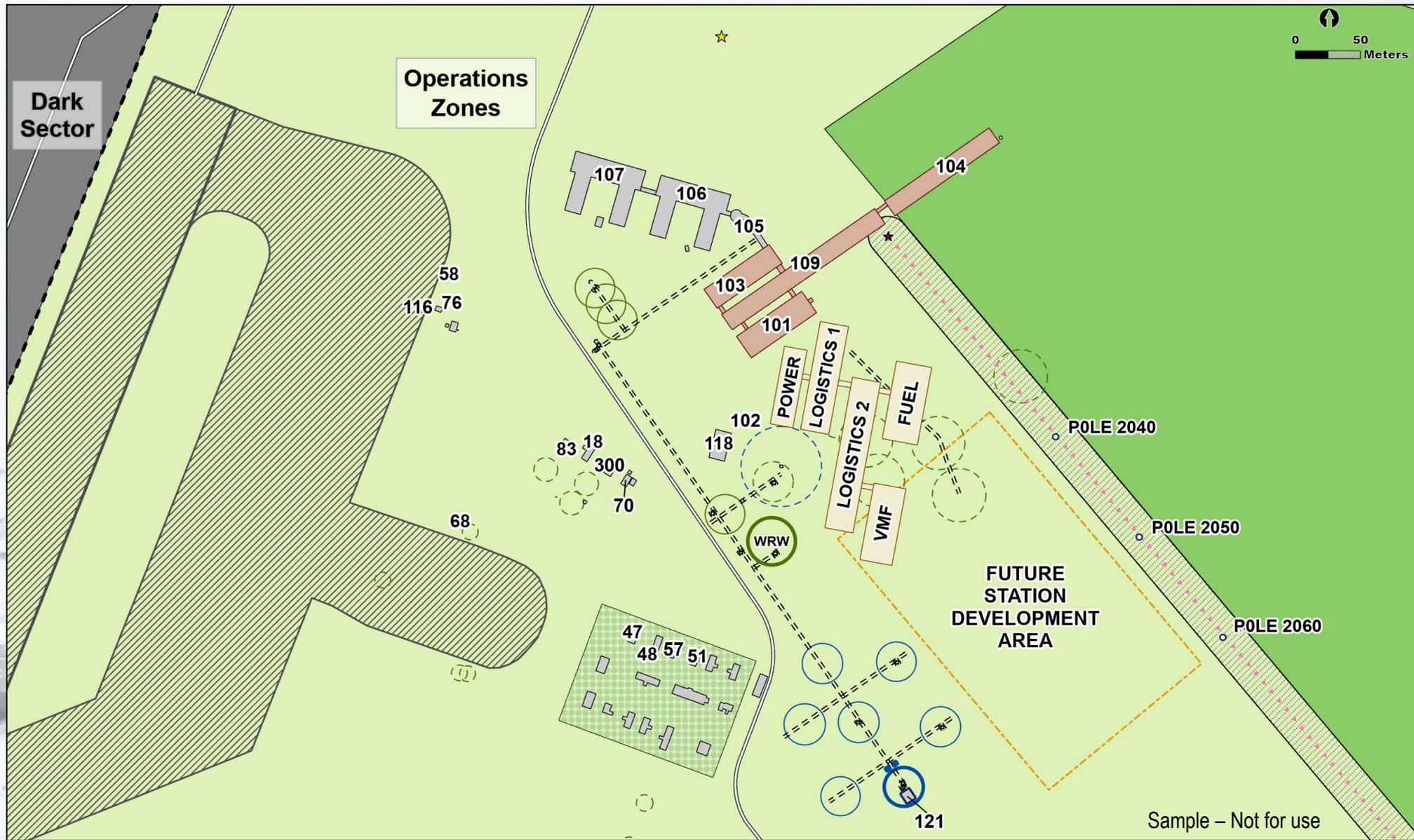
- Developing the Master Plan
  - Concepts



# The Final Plan



# Core Area



# Projects

## Capital Infrastructure Plan – Phasing (30 – 50 years)

### PHASE 1: Mobilization/Construction

This phase prepares SPS and the SPS logistics chain for major construction activities, while also raising smaller utility structures and the deepest buried science structures.

### PHASE 2: Primary Infrastructure

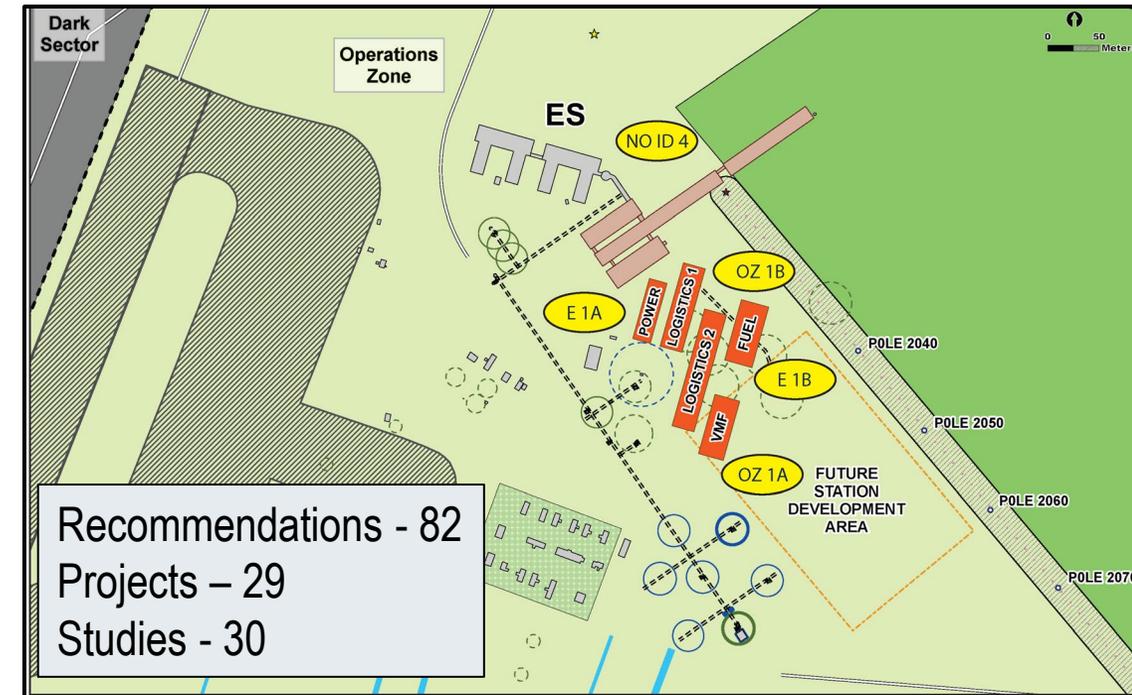
This phase focuses on arch replacements, while also raising additional science structures.

### PHASE 3: Support Facilities

This phase focuses on completing the remaining arch replacement and the Elevated Station raise, while also raising the remaining science structures.

### PHASE 4: Maintenance Cycles

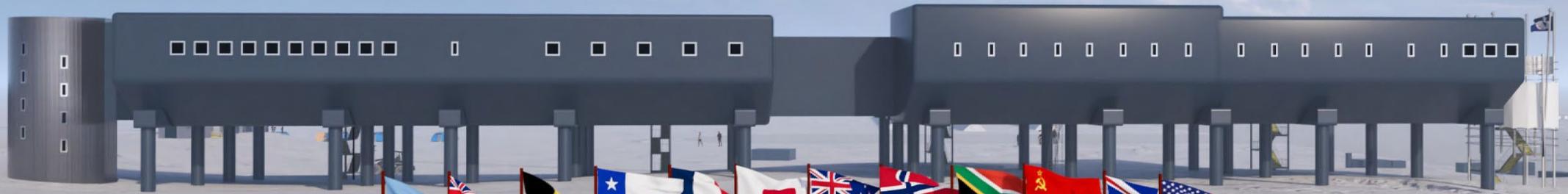
This phase establishes maintenance rhythm for future raises and replacements to prevent future backlogs.



Sample – Not for use

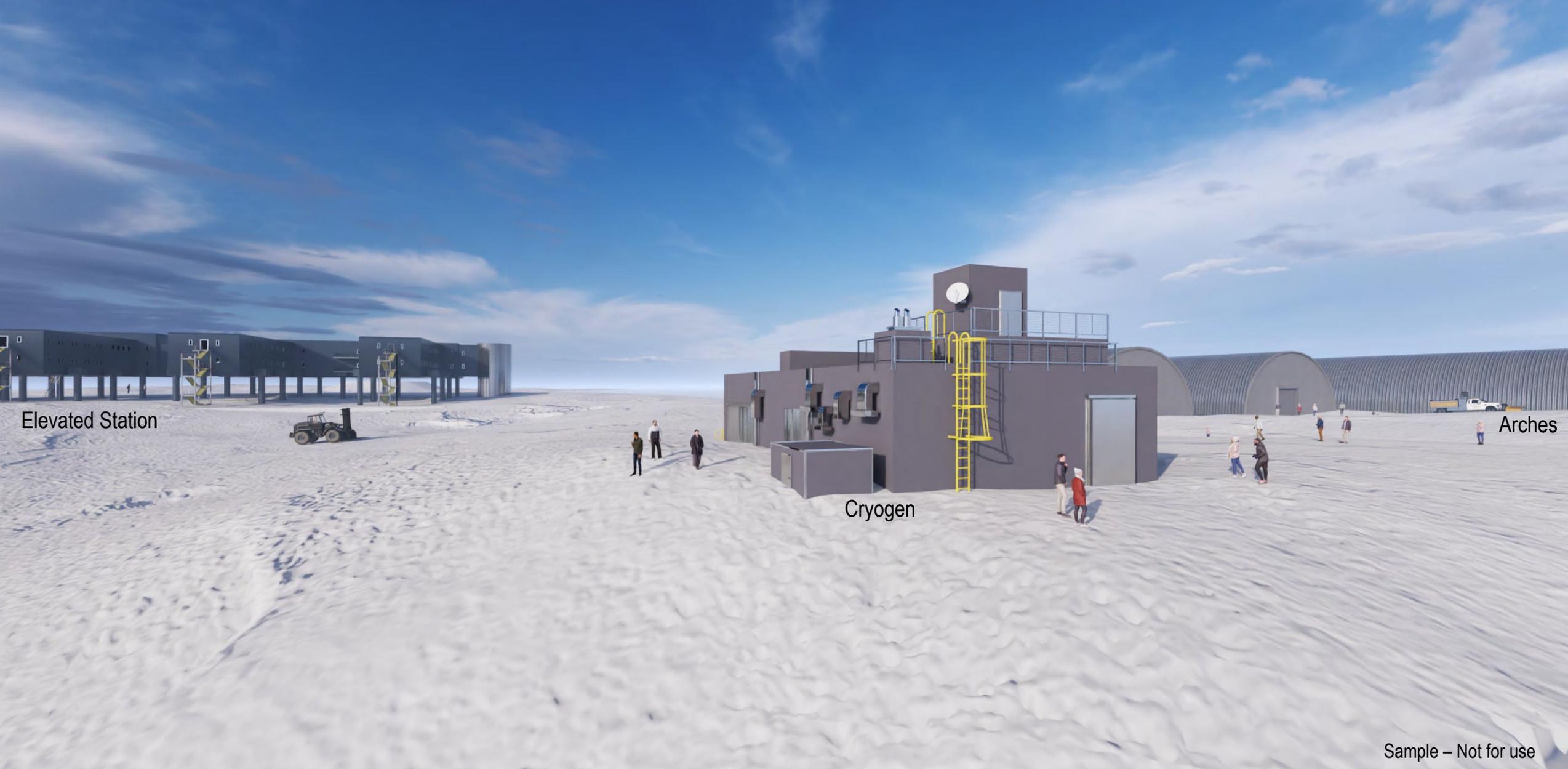
**2025 Master Plan Vision: Modernize infrastructure and operations to continue scientific support at SPS**

# Renderings



Elevated Station

Sample – Not for use

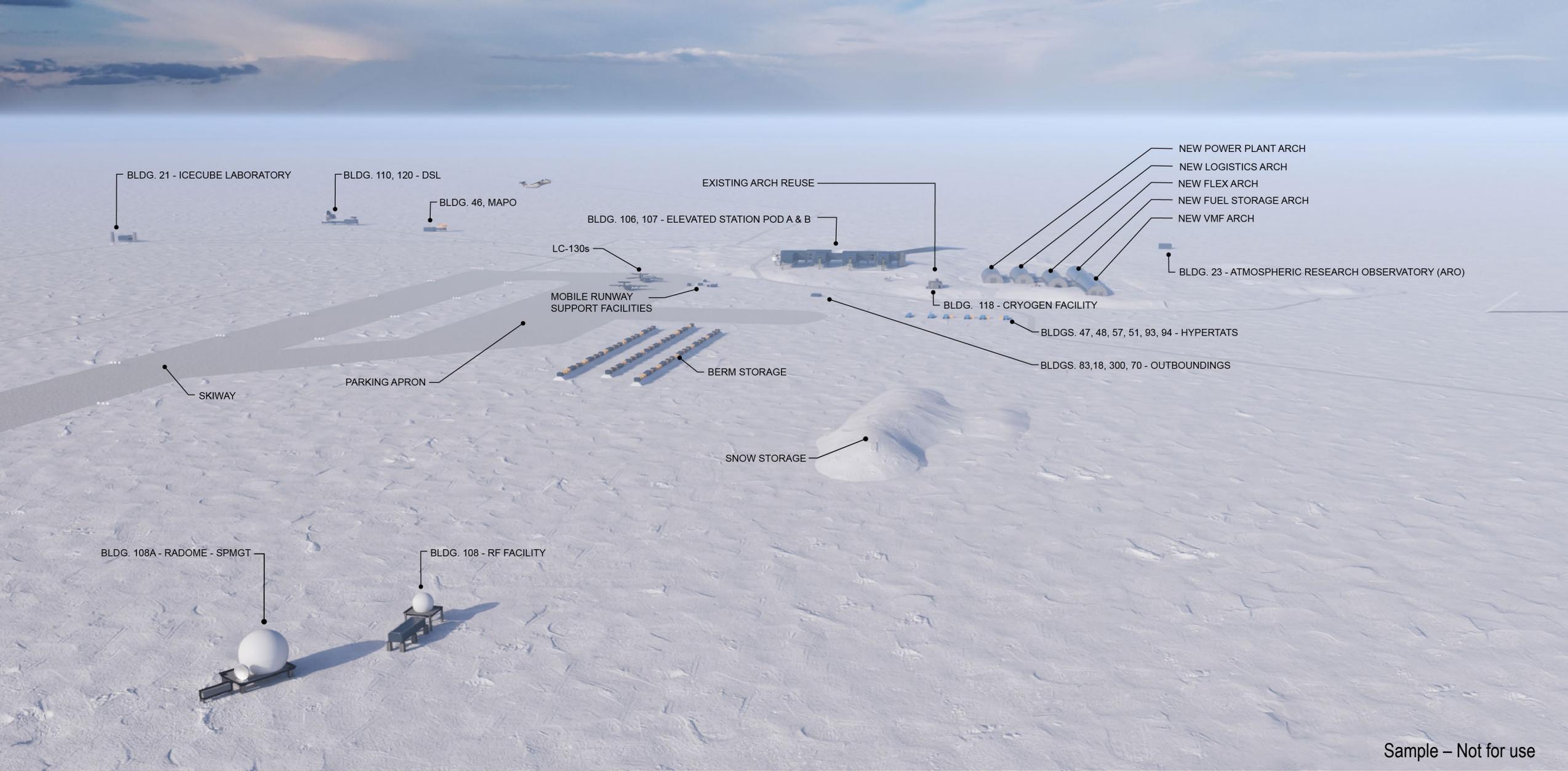


Elevated Station

Cryogen

Arches

Sample – Not for use



BLDG. 21 - ICECUBE LABORATORY

BLDG. 110, 120 - DSL

BLDG. 46, MAPO

EXISTING ARCH REUSE

BLDG. 106, 107 - ELEVATED STATION POD A & B

LC-130s

MOBILE RUNWAY SUPPORT FACILITIES

BERM STORAGE

SNOW STORAGE

NEW POWER PLANT ARCH

NEW LOGISTICS ARCH

NEW FLEX ARCH

NEW FUEL STORAGE ARCH

NEW VMF ARCH

BLDG. 23 - ATMOSPHERIC RESEARCH OBSERVATORY (ARO)

BLDG. 118 - CRYOGEN FACILITY

BLDGS. 47, 48, 57, 51, 93, 94 - HYPERTATS

BLDGS. 83, 18, 300, 70 - OUTBOUNDINGS

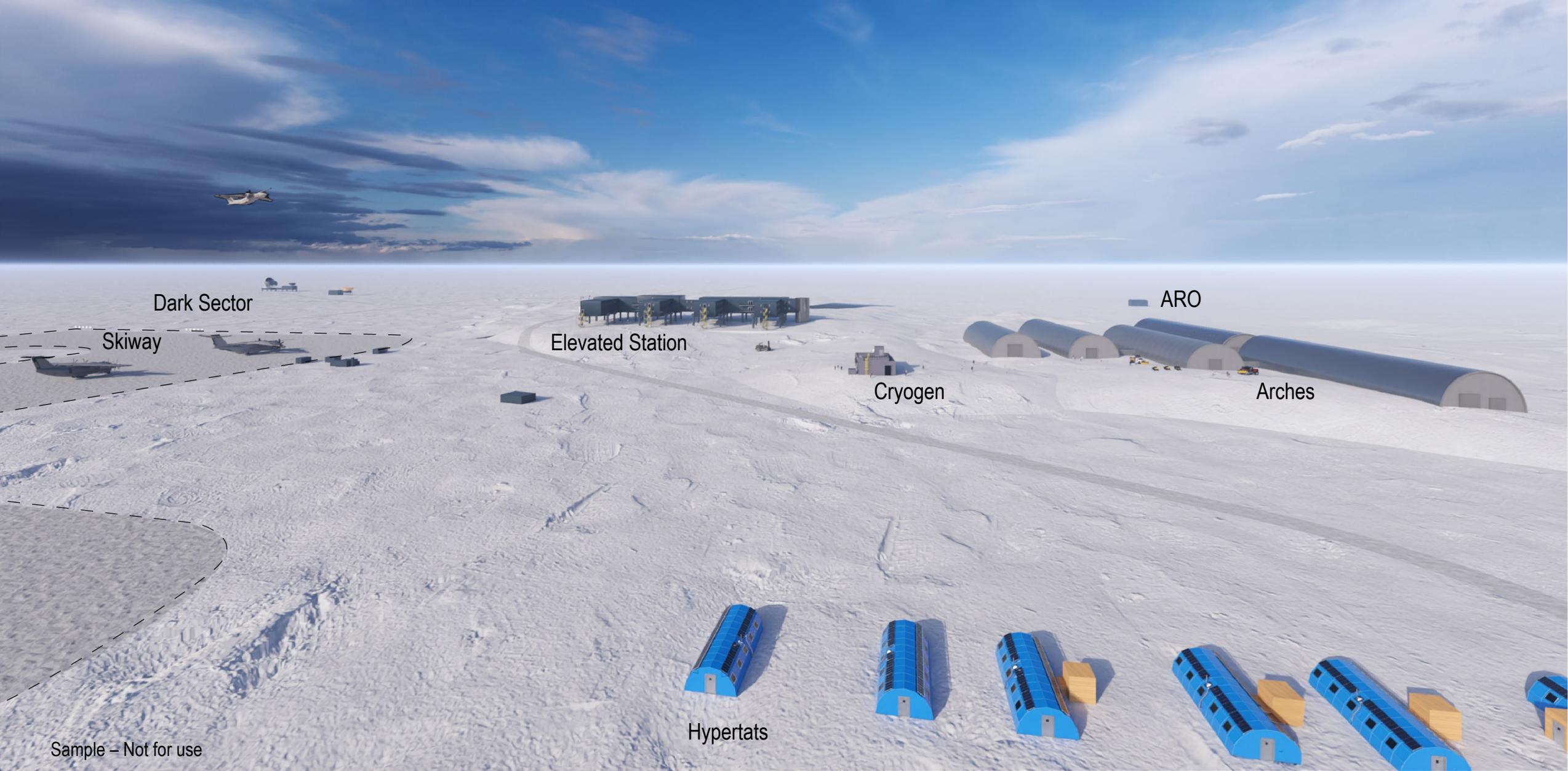
SKIWAY

PARKING APRON

BLDG. 108A - RADOME - SPMGT

BLDG. 108 - RF FACILITY

Sample - Not for use



Dark Sector

Skiway

Elevated Station

Cryogen

ARO

Arches

Hypertats

Sample - Not for use

# Questions

Randy Duzan, AICP, PLA  
DuzanRandy@stanleygroup.com



# Thank you for attending our event today.

## Would you like to attend our next event?

We have several webinars happening in the near future. Go to <https://www.aaees.org/events> to reserve your spot.

## Would you like to watch this event again?

A recording of today's event will be available on our website in a few weeks.

## Need a PDH Certificate?

Board Certified Individuals will be emailed a PDH Certificate for attending this event within the next week.

## Questions?

Email Marisa Waterman at [mwaterman@aaees.org](mailto:mwaterman@aaees.org) with any questions you may have.

