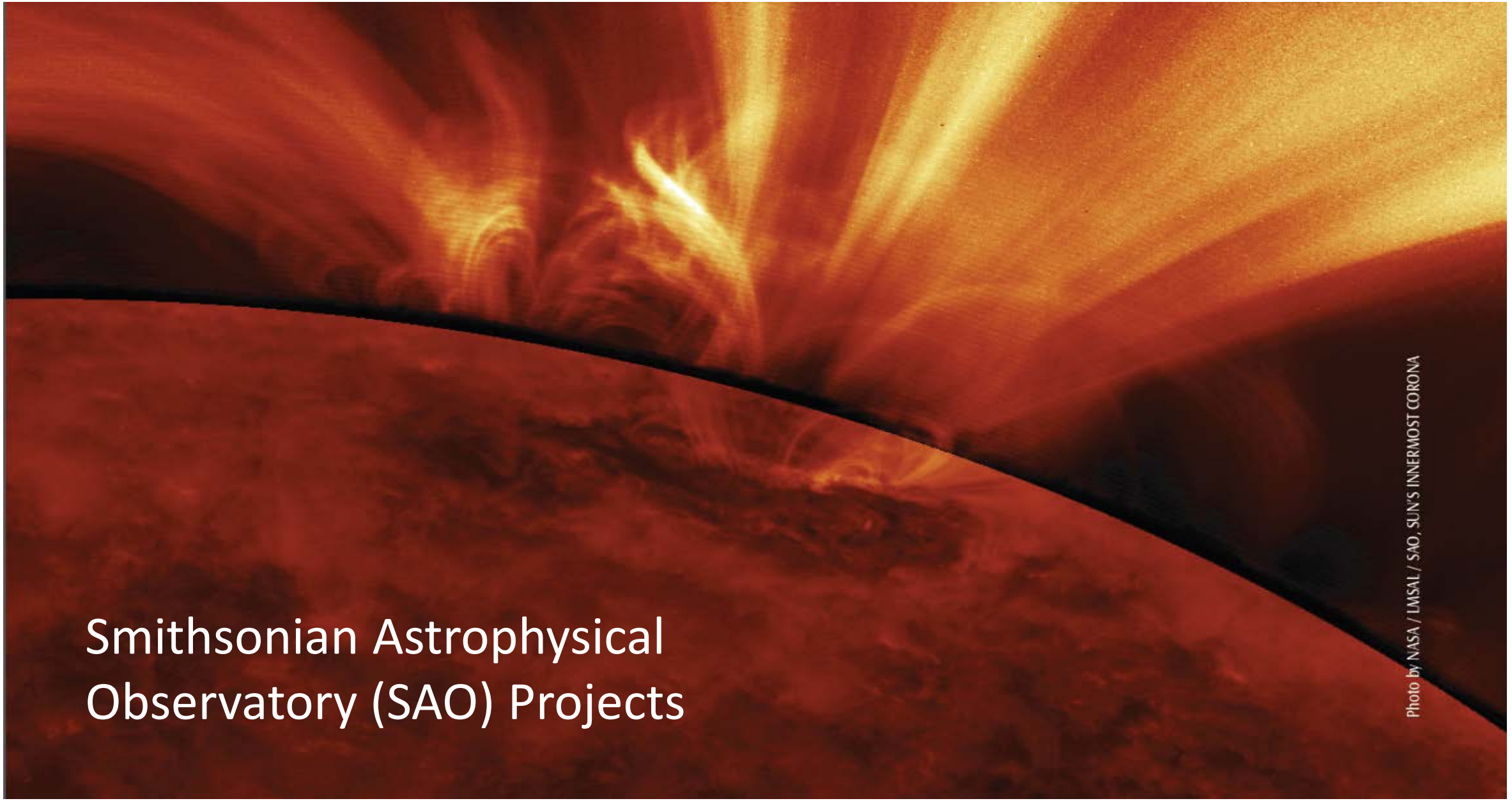
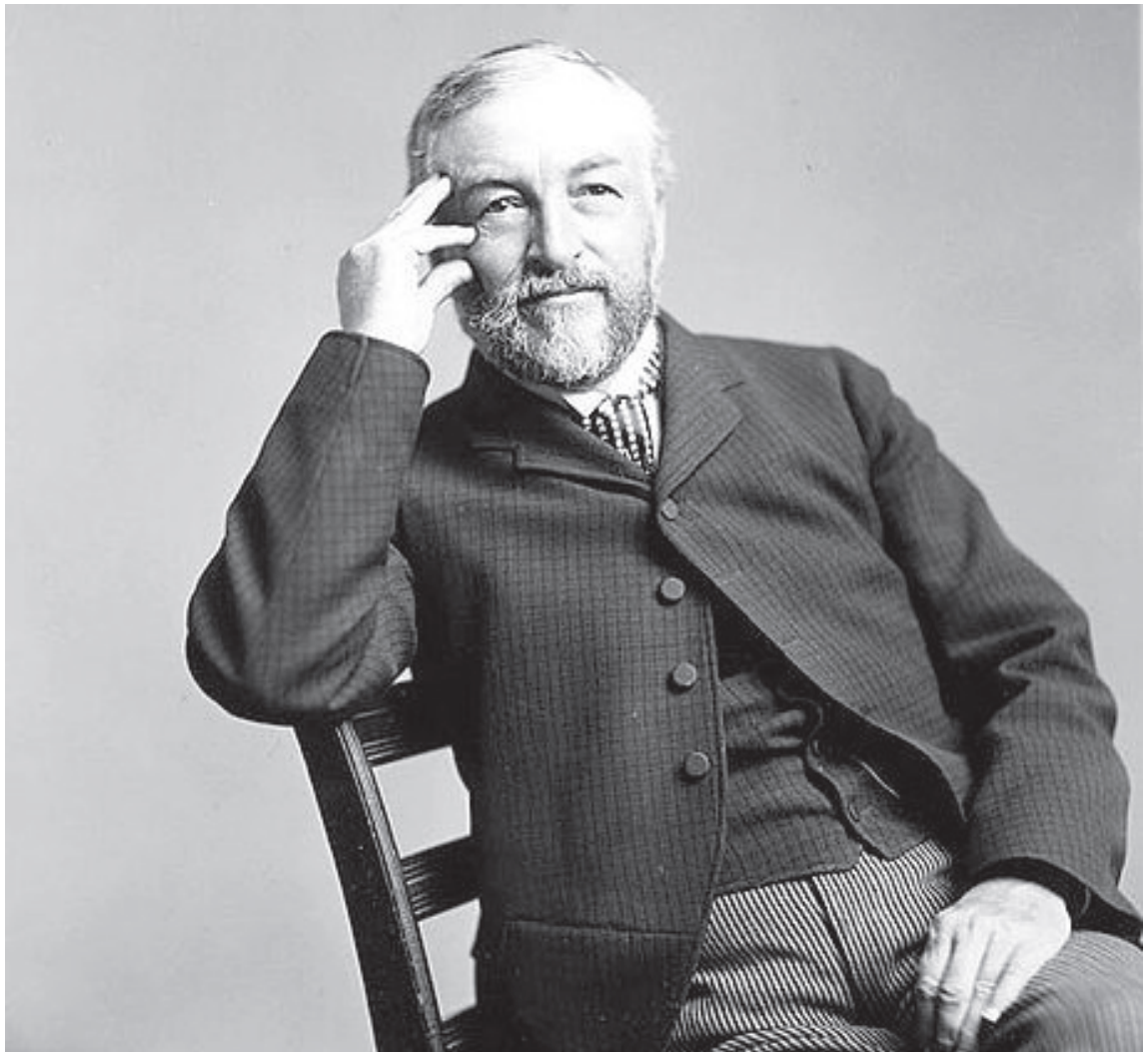


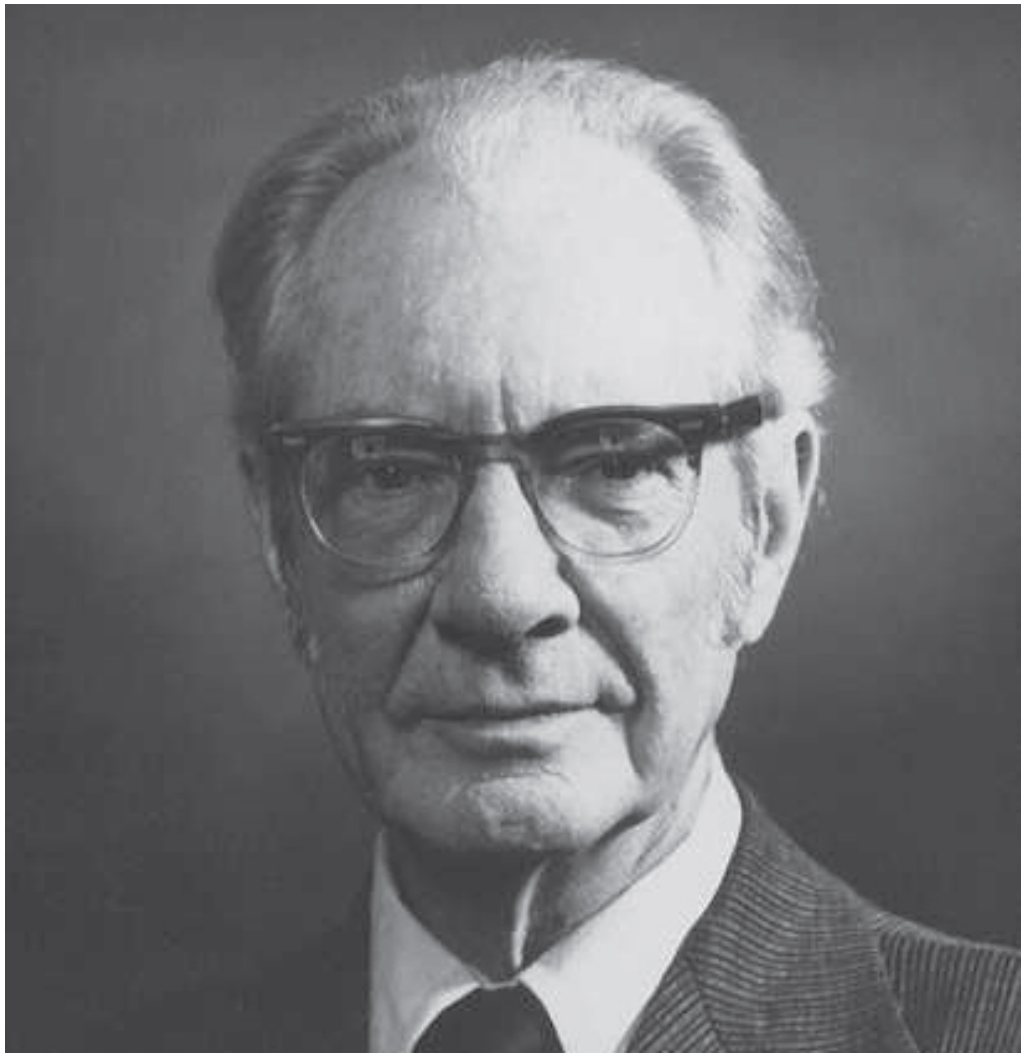
Smithsonian Astrophysical Observatory (SAO) Projects

Common Challenges

- Extreme Climactic Conditions
- Facility Complexity
- Leased Properties and Sites
- Native American Lands
- Respect for Natural Habitat
- 24/7/365 Operations
- Aging Infrastructure
- Fiscal Planning Cycles
- Funding Constraints
- Competitive Science
- Tight Deadlines
- Maintenance
- Decommissioning



Samuel Pierpont Langley, 3rd Secretary of the Smithsonian
Founder of Smithsonian Astrophysical Observatory 1887



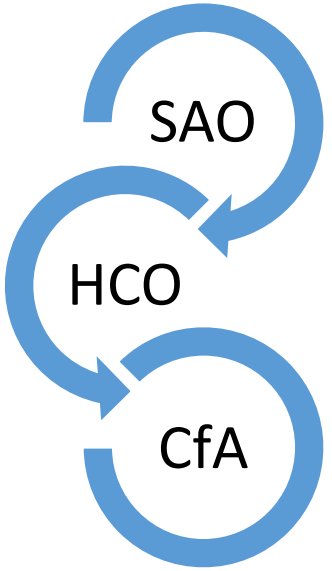
Fred Lawrence Whipple, Director Smithsonian
Astrophysical Observatory 1955-1973

Harvard-Smithsonian Center for Astrophysics

July 1, 1973: Smithsonian Institution and Harvard University formalize their collaboration as the Harvard-Smithsonian Center for Astrophysics (CfA)

Coordinated strengths and combined staffs
in six research divisions:

Atomic and Molecular Physics;
High Energy Astrophysics;
Optical and Infrared Astronomy;
Radio and Geoastronomy;
Solar, Stellar, and Planetary Sciences; and
Theoretical Astrophysics.

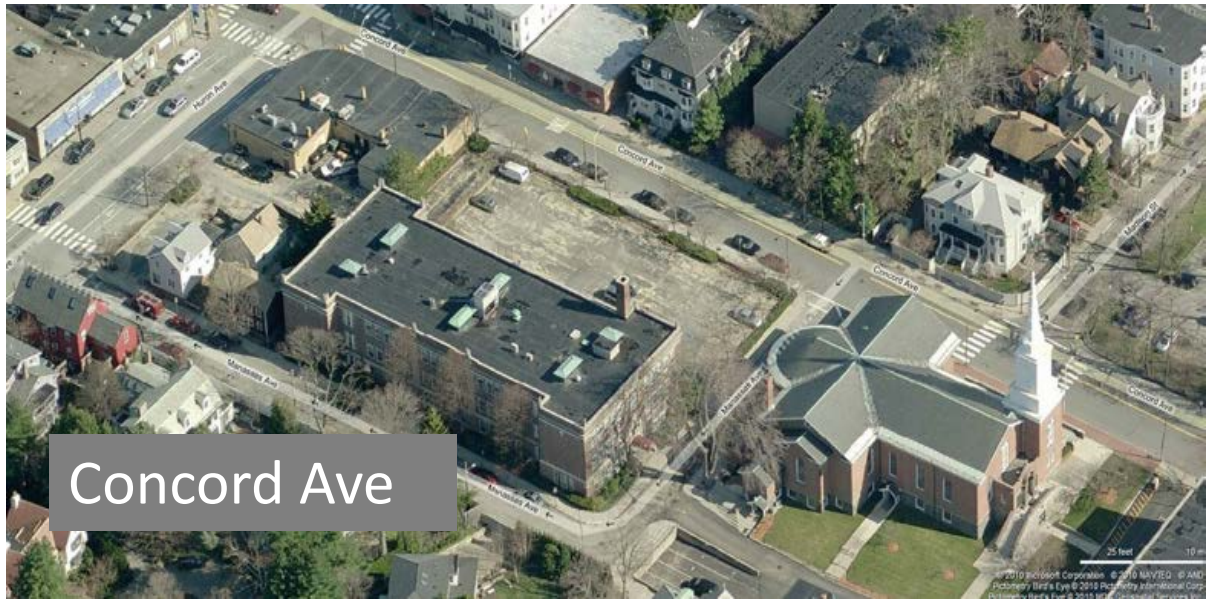


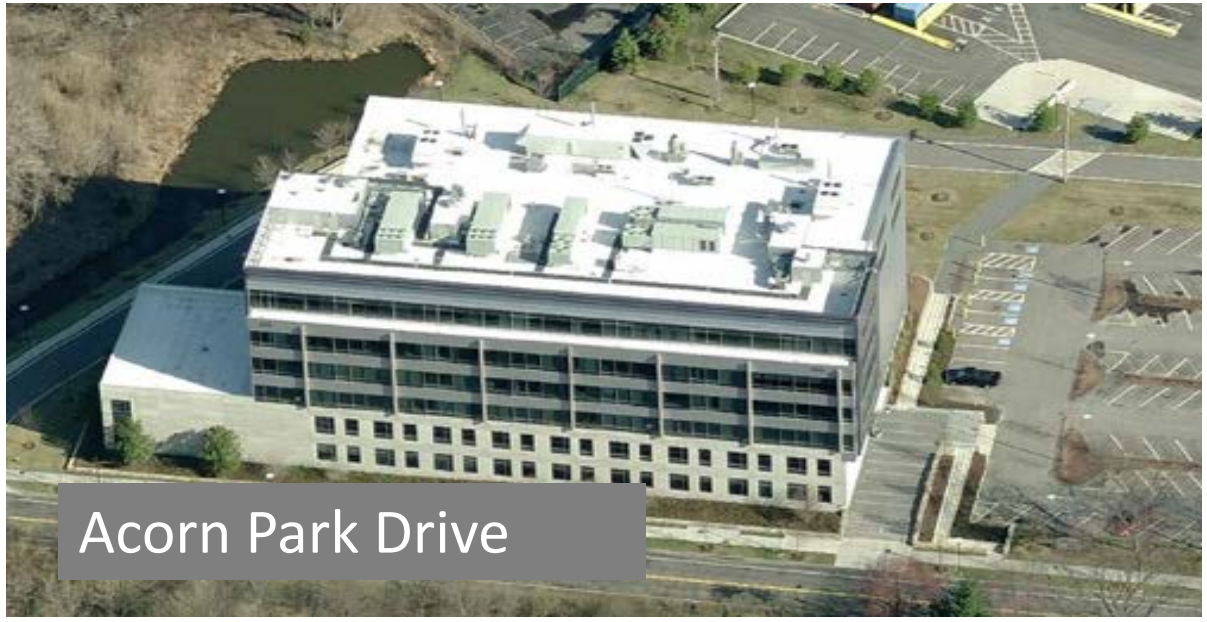
Locations:

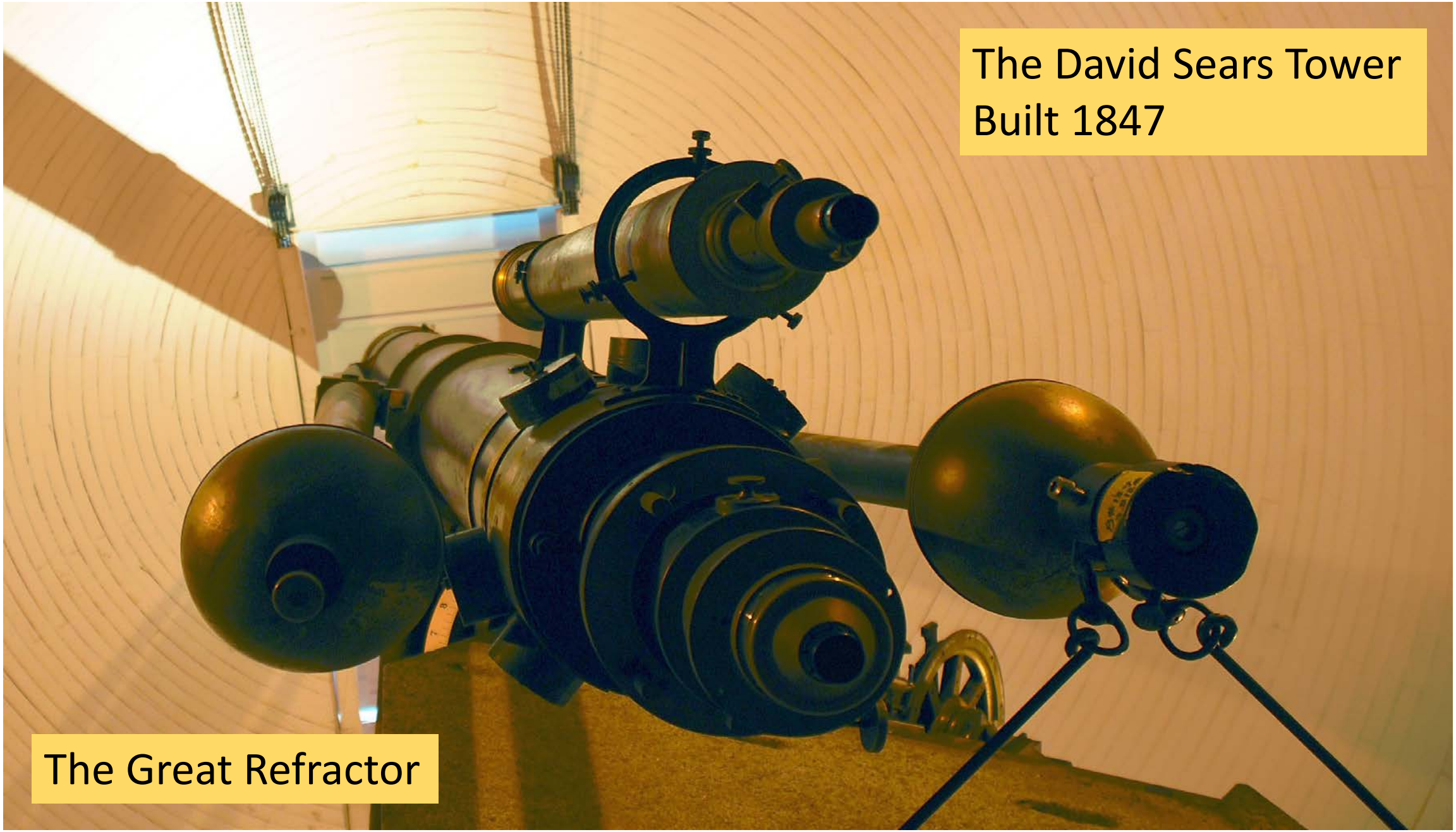
Cambridge
Arizona
Hawai’i

Chile
Greenland

Cambridge Locations






The David Sears Tower
Built 1847
The Great Refractor

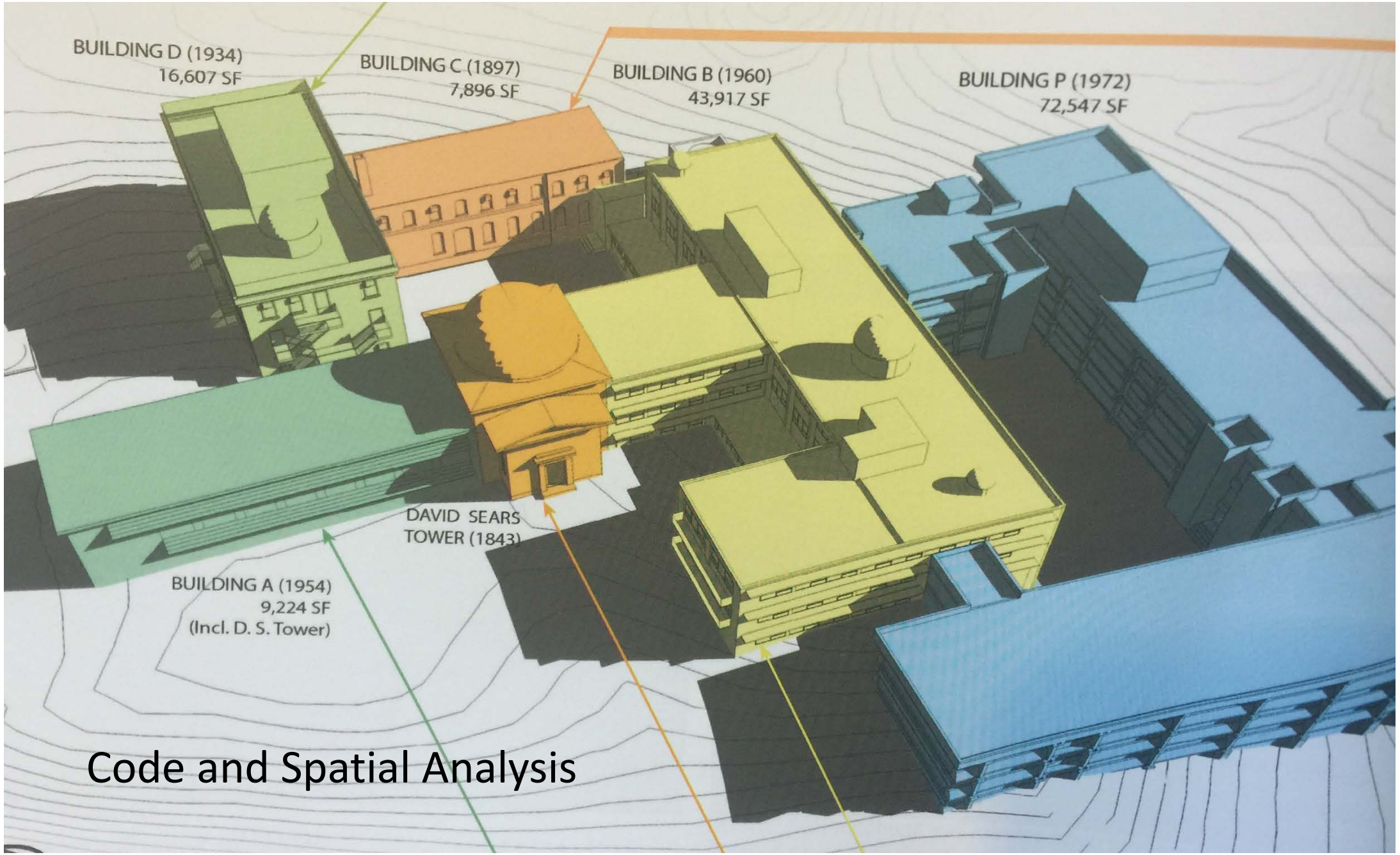
Garden Street Facility

Garden Street Challenges

- Phased Construction over many years
- Differing Construction Types
- Floor Level Changes
- Operating at Capacity
- Limited Potential for Expansion

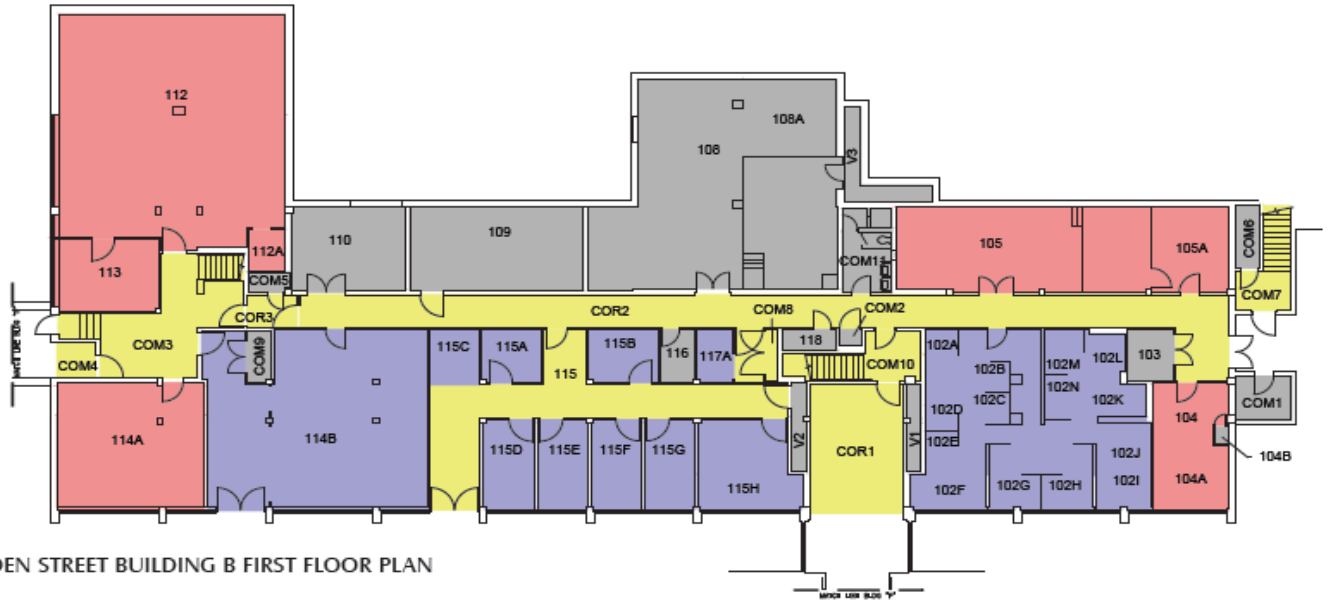
2013-
2014


Smithsonian Astrophysical Observatory
COMPREHENSIVE FACILITIES MASTER PLAN
FACILITIES DEVELOPMENT PLAN

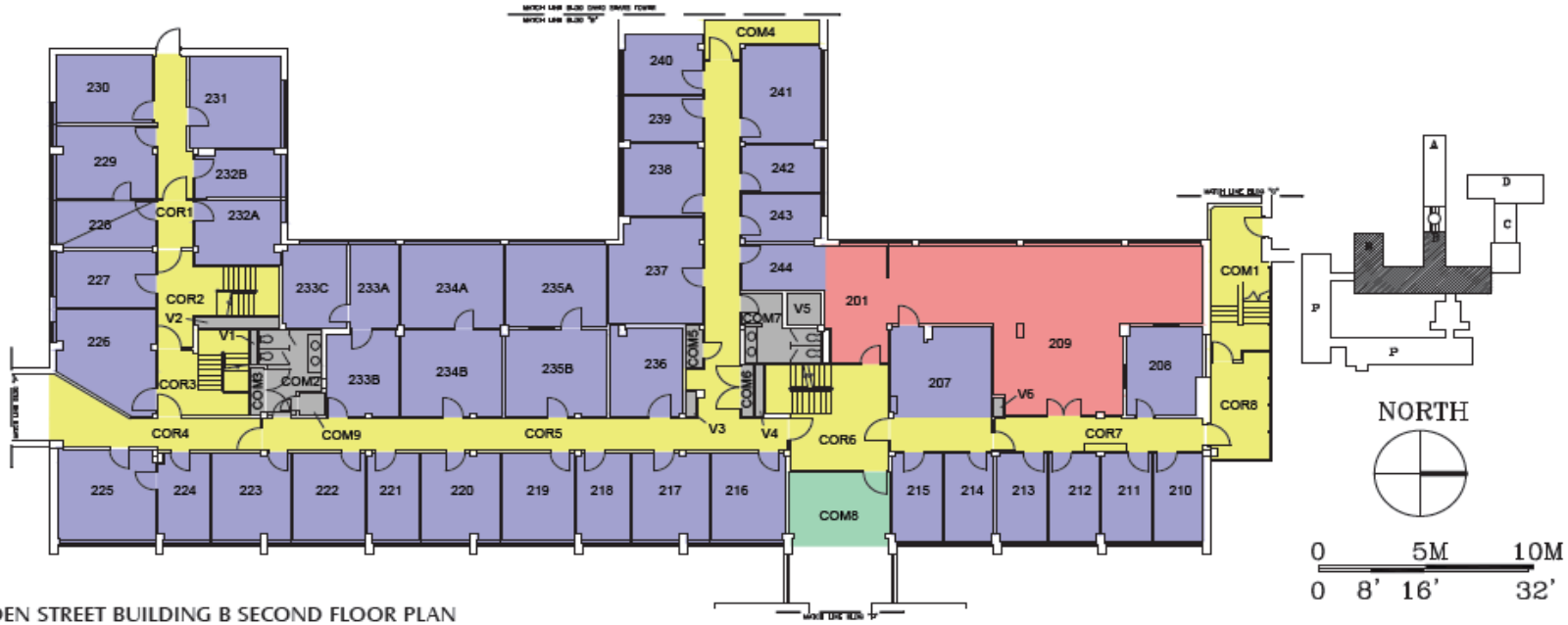


Code and Spatial Analysis

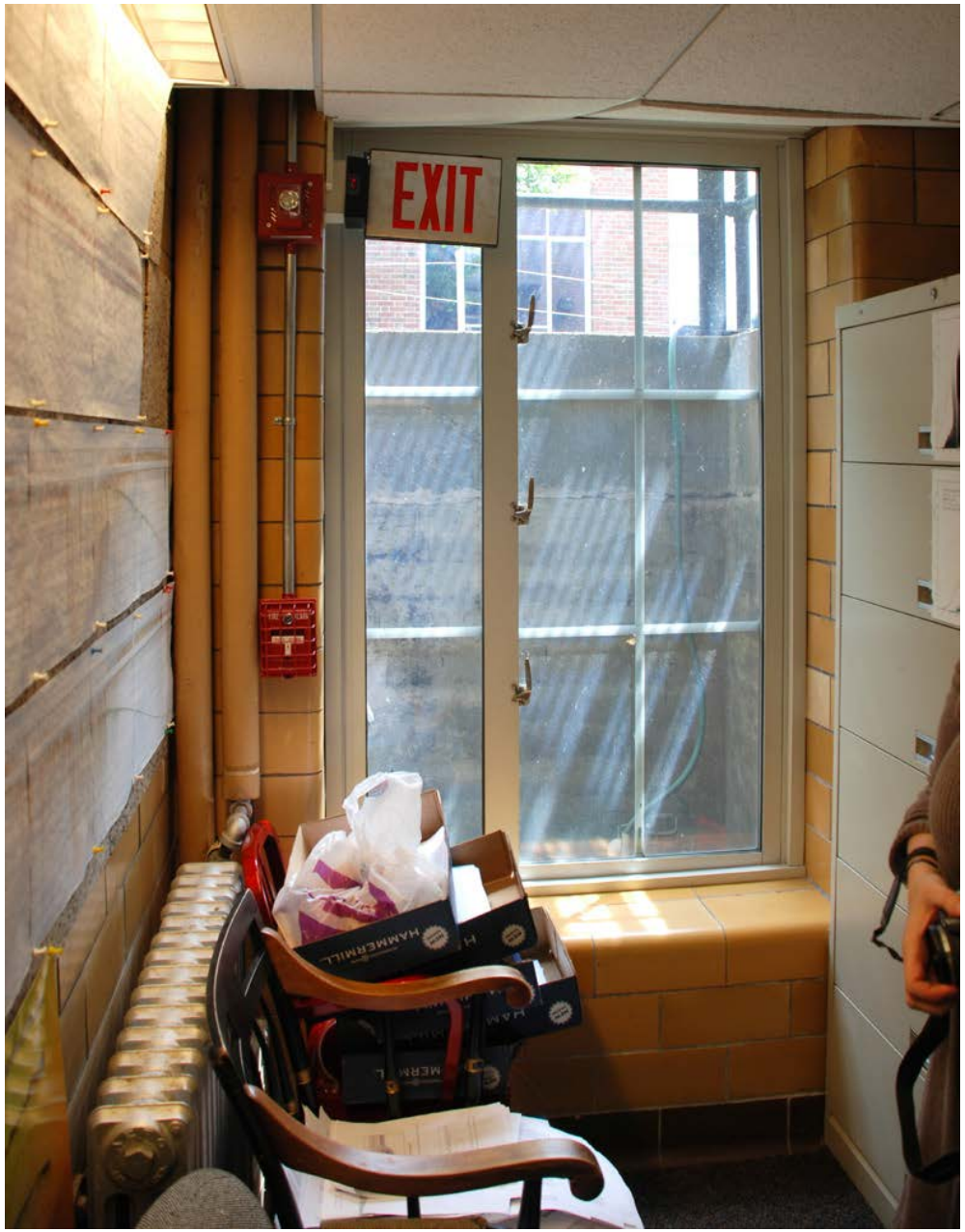
Egress and Accessibility Analysis



60 GARDEN STREET BUILDING B FIRST FLOOR PLAN

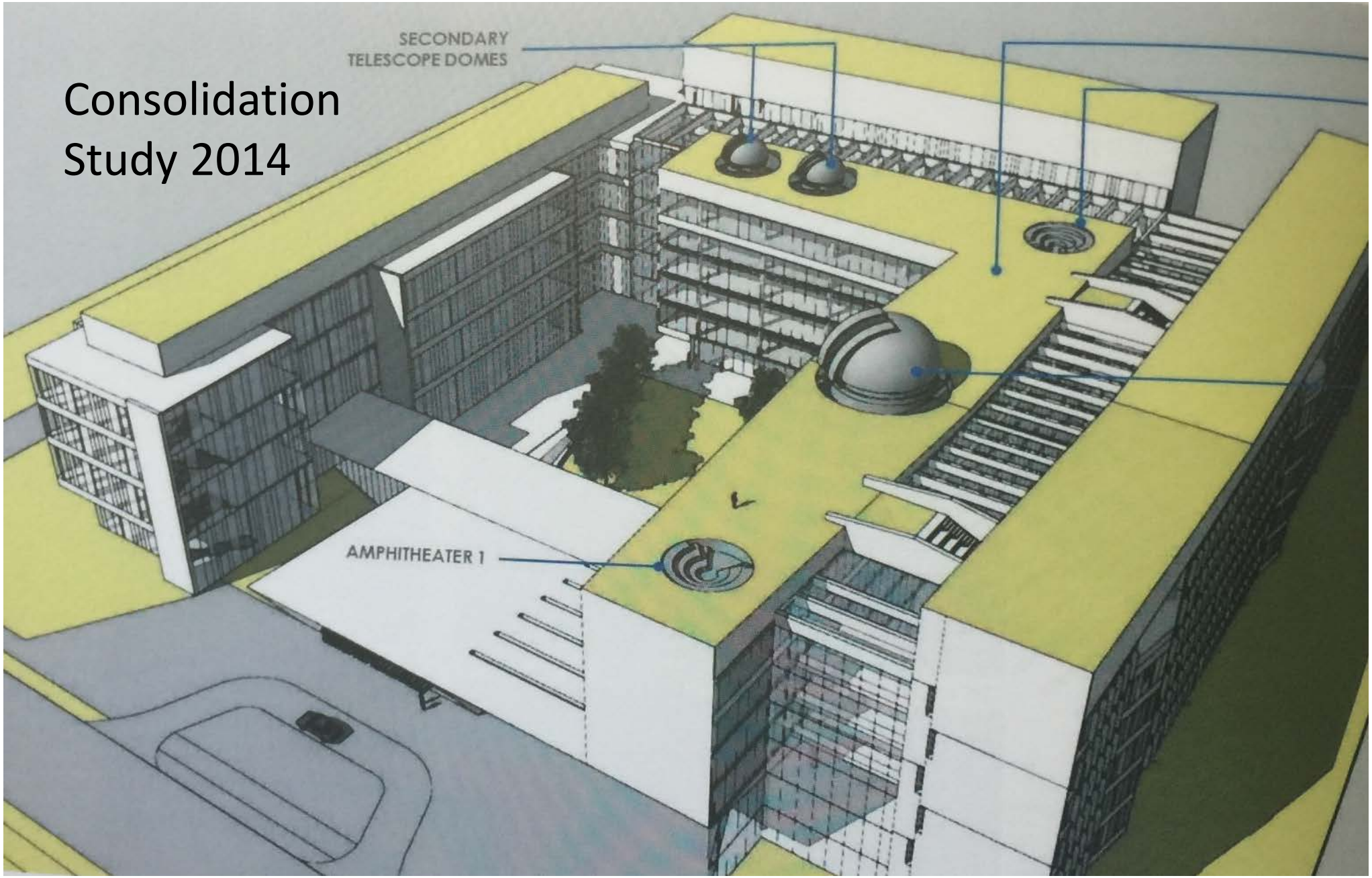


60 GARDEN STREET BUILDING B SECOND FLOOR PLAN


EXIT

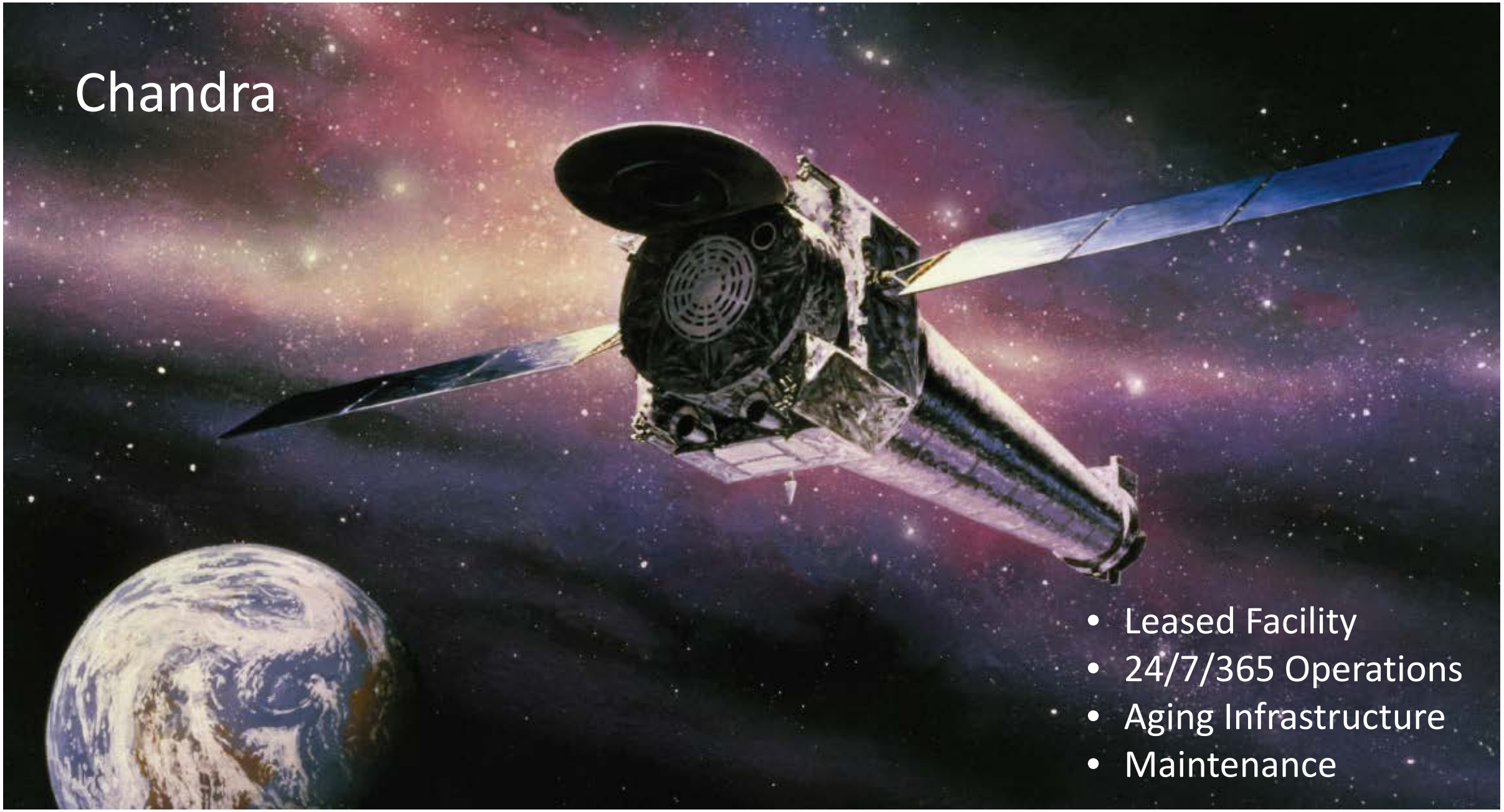

EXIT

Consolidation Study 2014



Hampshire Street Facility

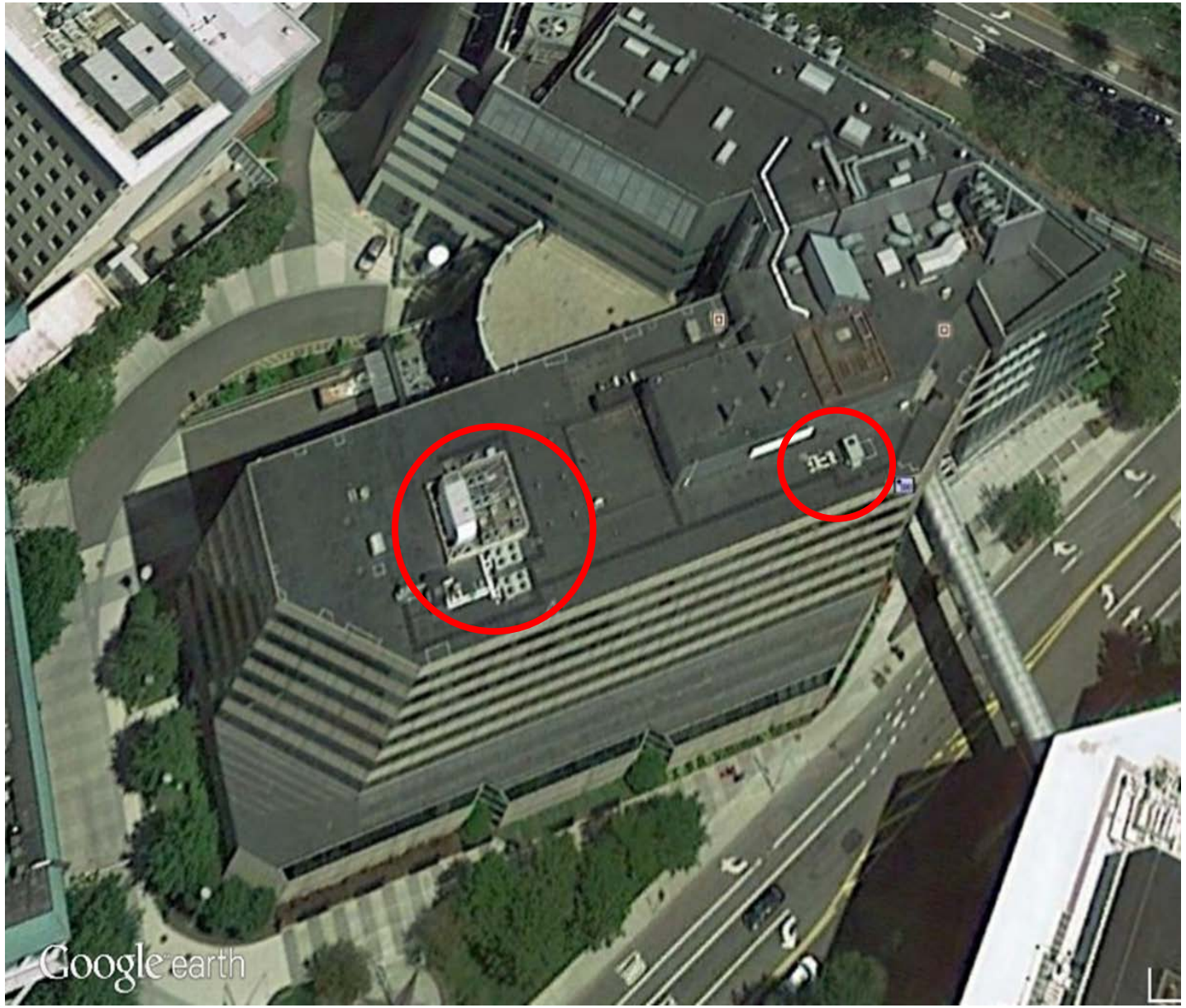
Chandra



- Leased Facility
- 24/7/365 Operations
- Aging Infrastructure
- Maintenance


Chandra Computer Room


Chandra Control Room



Replace failing HVAC equipment and increase cooling capacity

Challenge - Replace HVAC systems while maintaining operations

Arizona Location: Fred Lawrence Whipple Observatory (FLWO)

FLWO Base Camp

Located in Coronado National Forest

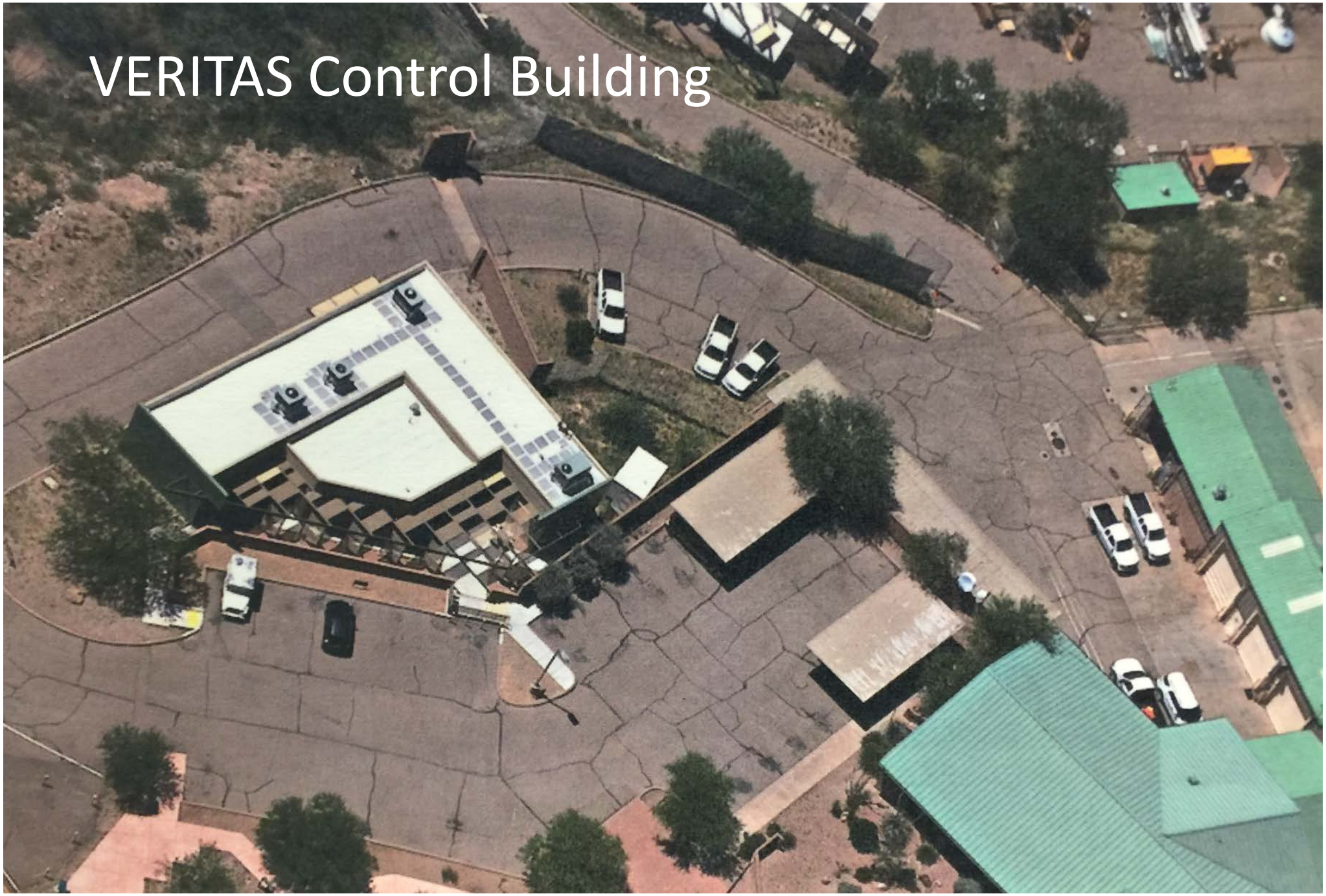
Built 1991

VERITAS

Very Energetic Radiation Imaging Telescope Array System
(2007)


New Construction
Future VERITAS
Control Building

VERITAS Control Building



VERITAS Control Building

Entrance


MMT
Ridge
Mt Hopkins Road
20 Km to Summit
Base Camp


FLWO Road Traffic

Risk Avoidance

Existing Guardrails

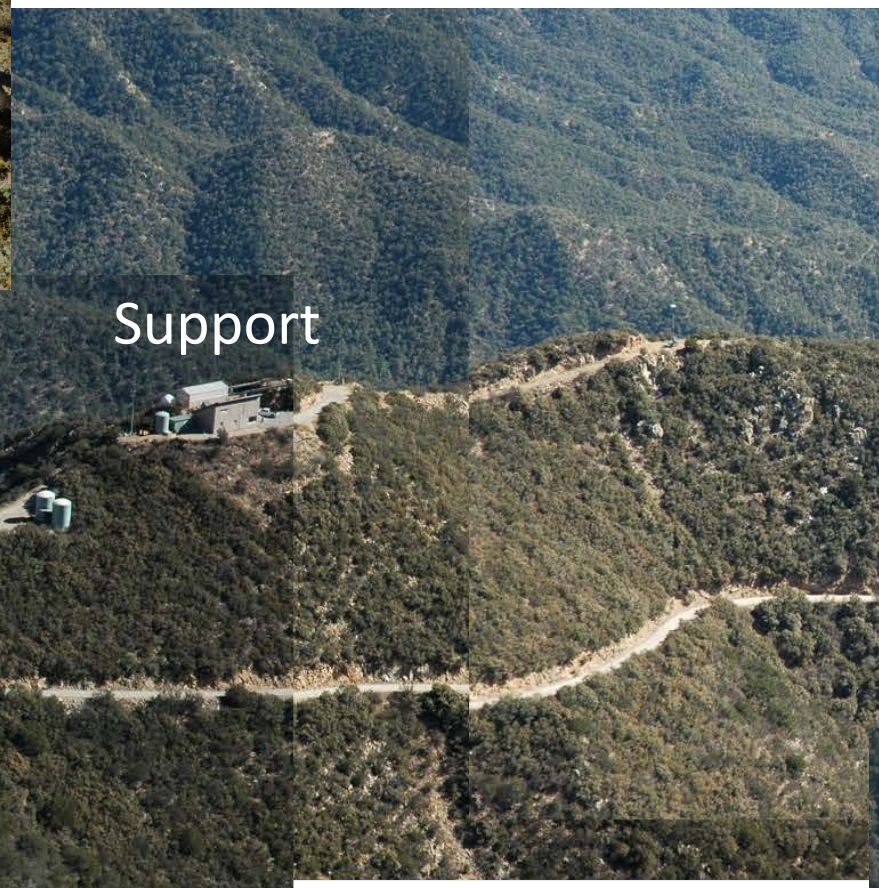

Existing Guardrails
SPEED
LIMIT
15

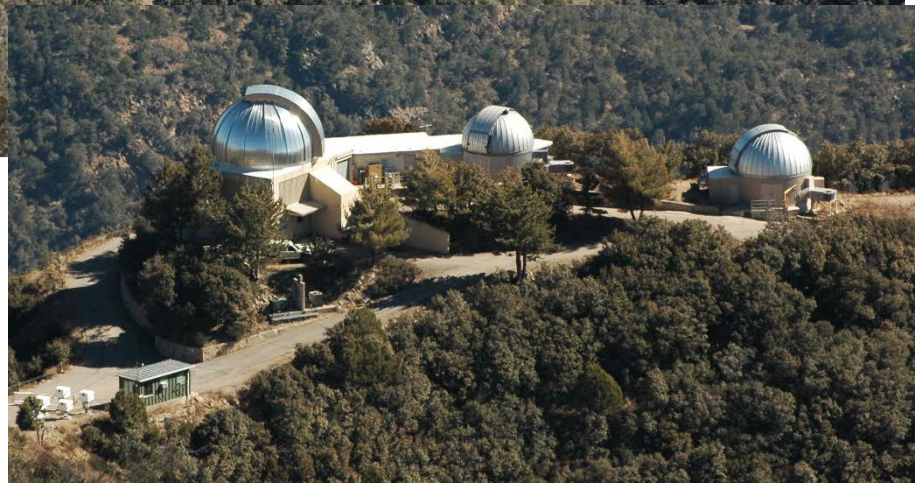

New Guardrails


Understanding Existing Conditions

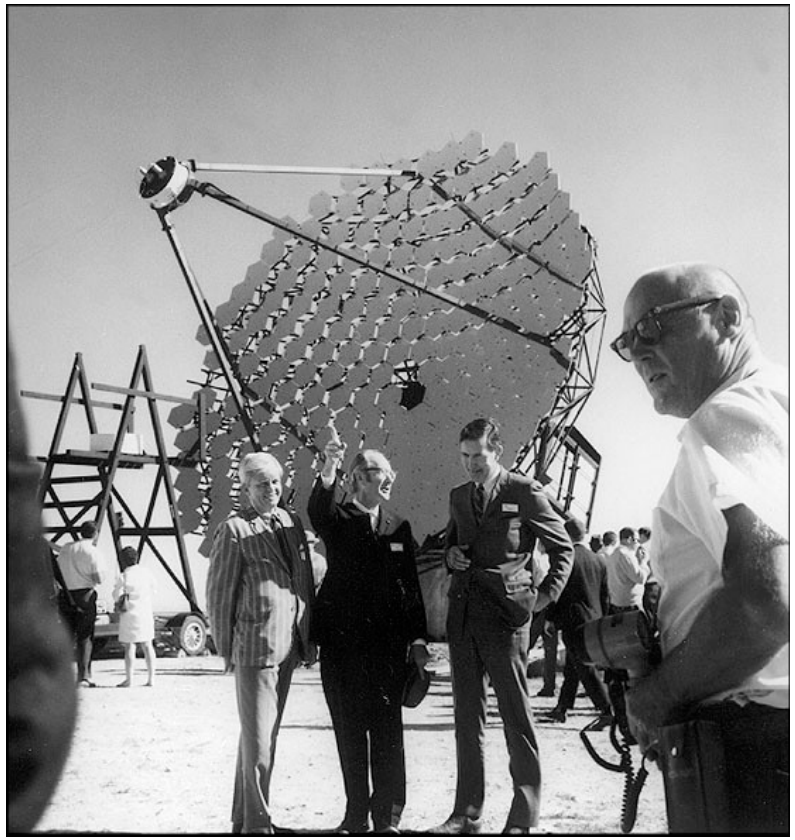
Road Stabilization

Culvert Replacement



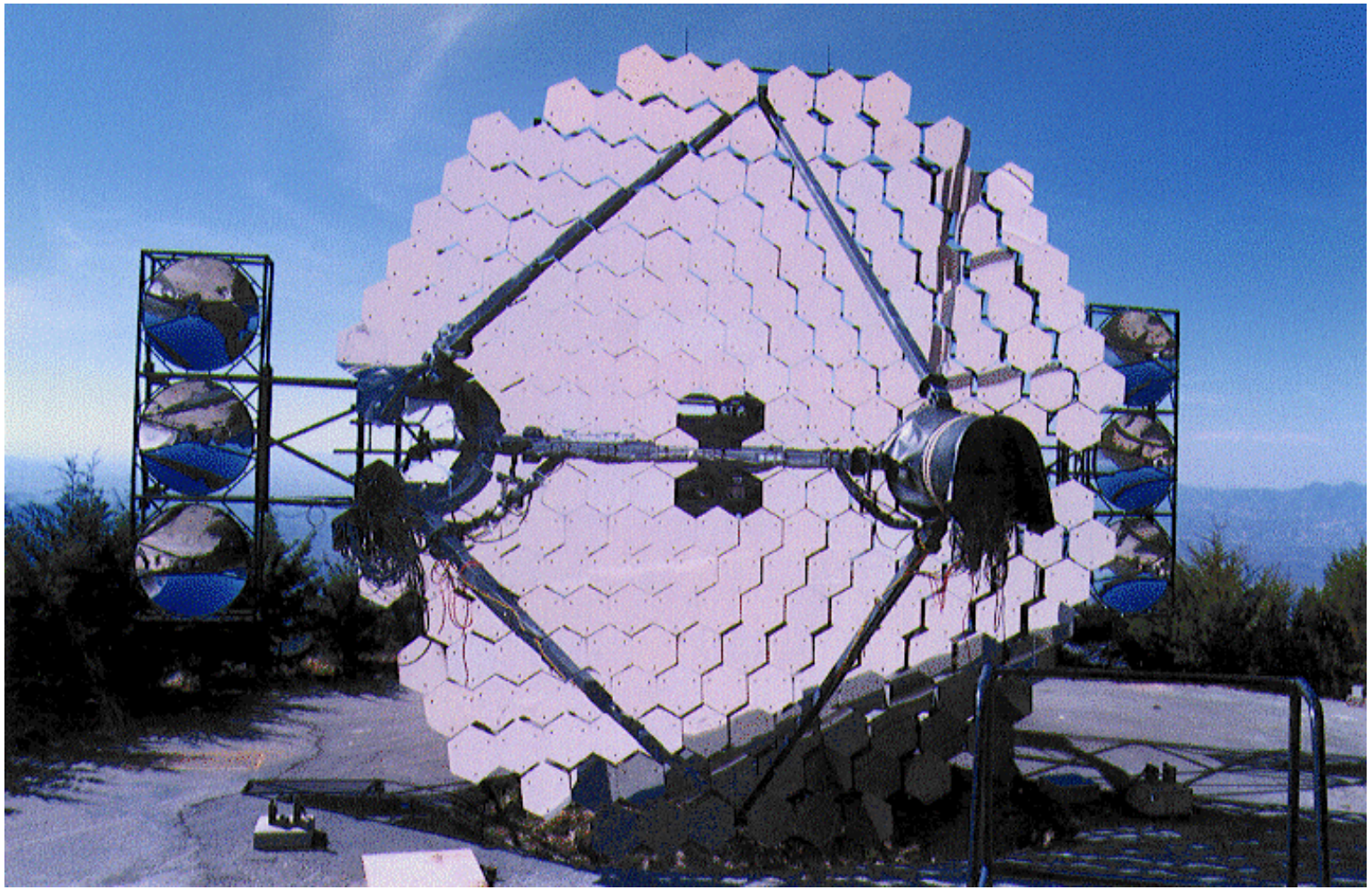


Ridge Facilities

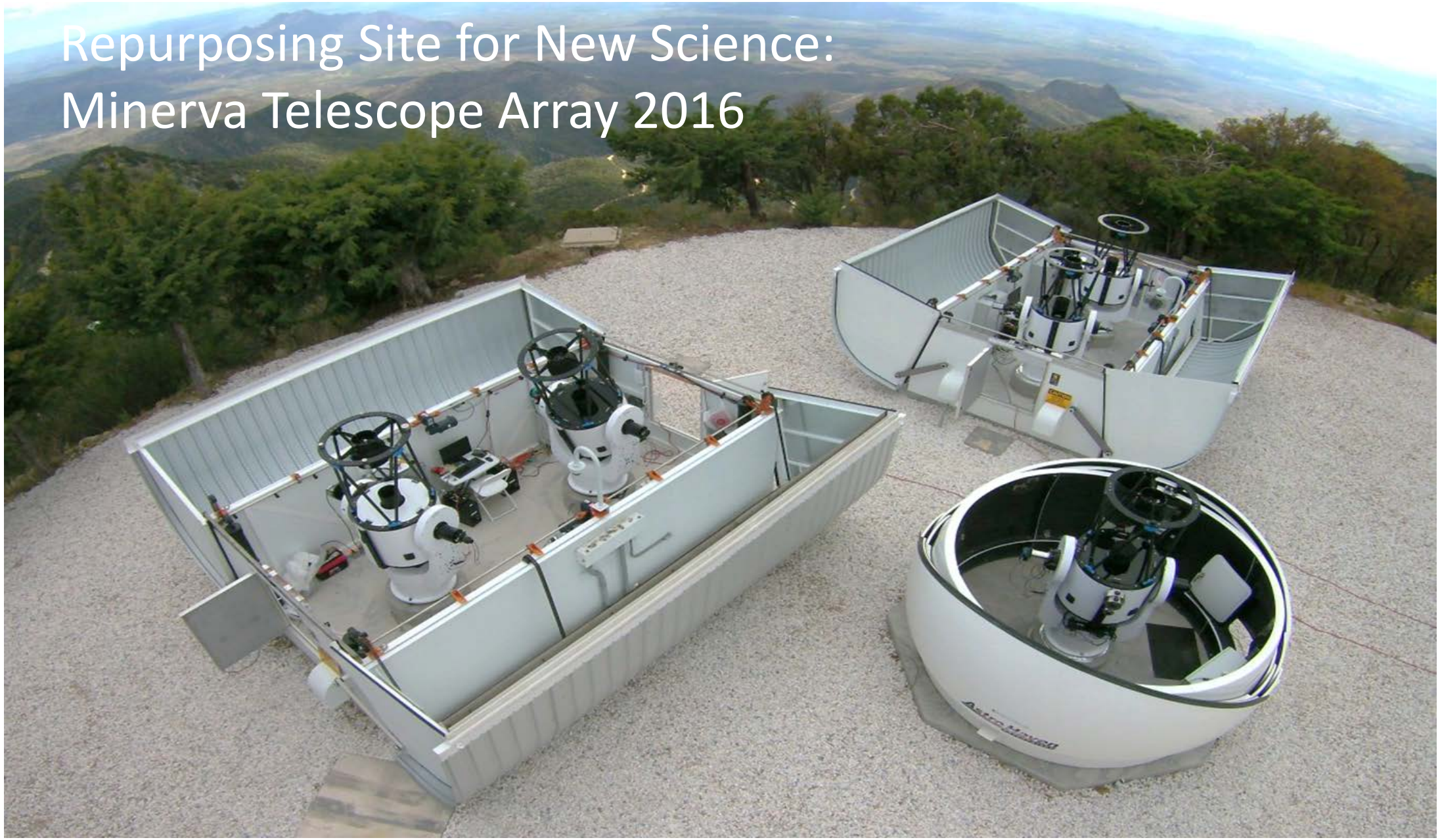


Dedication

Repurposing Site for New Science:
10 Meter Gamma Ray Telescope 1968-2011



Repurposing Site for New Science: Minerva Telescope Array 2016



Mountain Power

- Facility Complexity
- 24/7/365 Operations
- Aging Infrastructure
- Maintenance

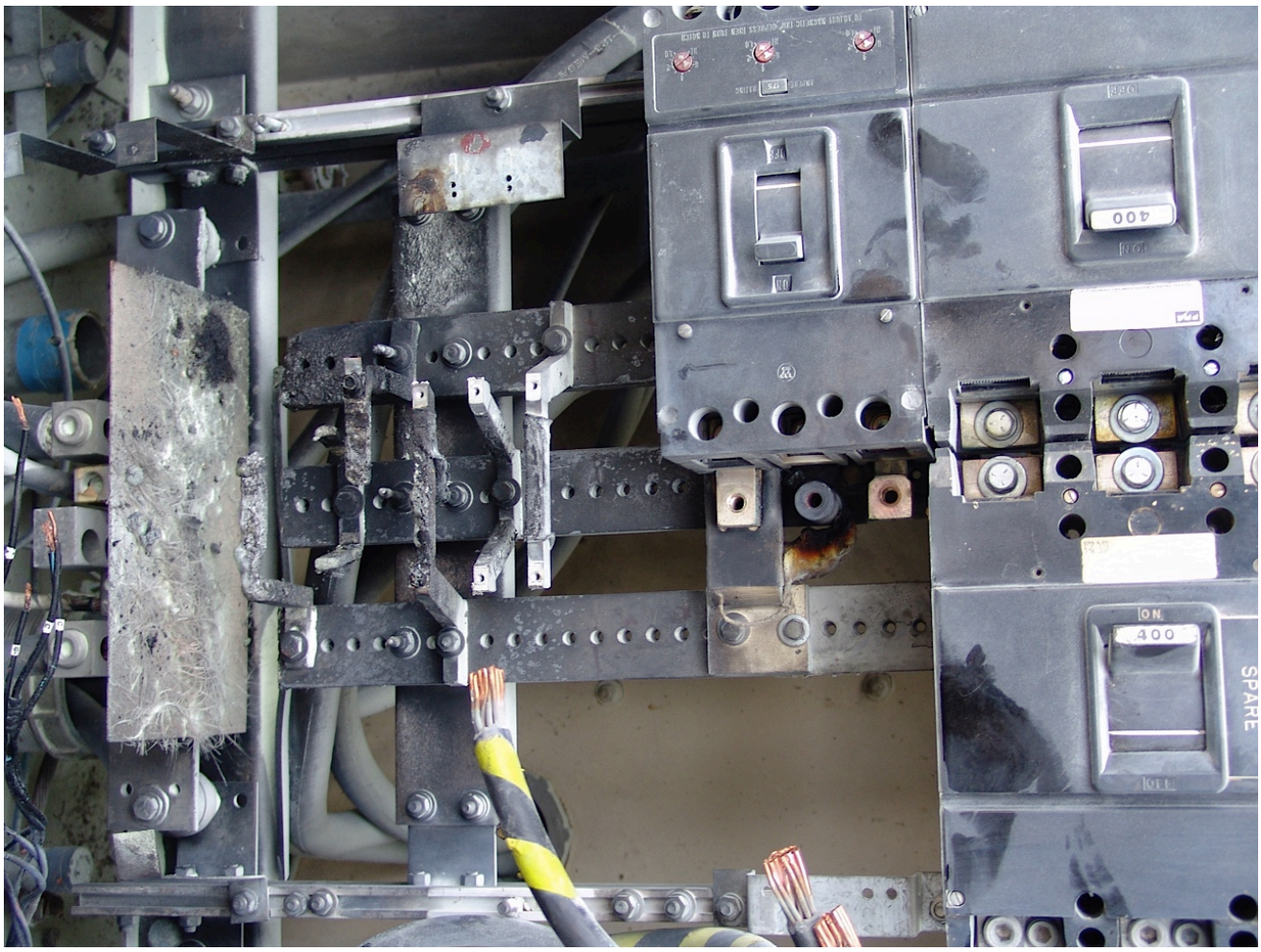
Existing Unisource Power 13800v Substation

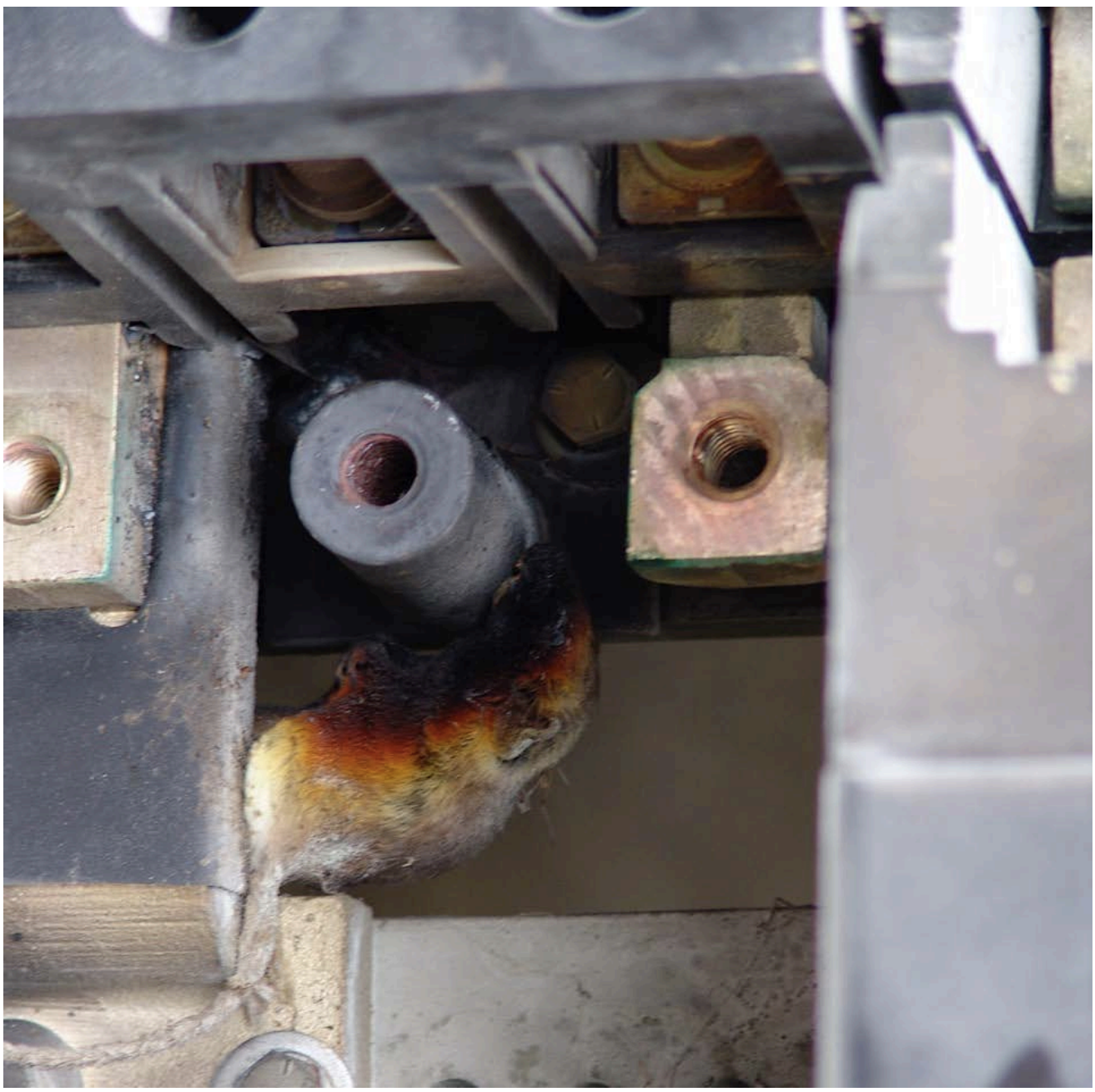
Existing SAO 4160v Distribution System

Existing SAO Generator

Challenging Neighbors

Spotted Owl Mating Season
March 1st to September 1st

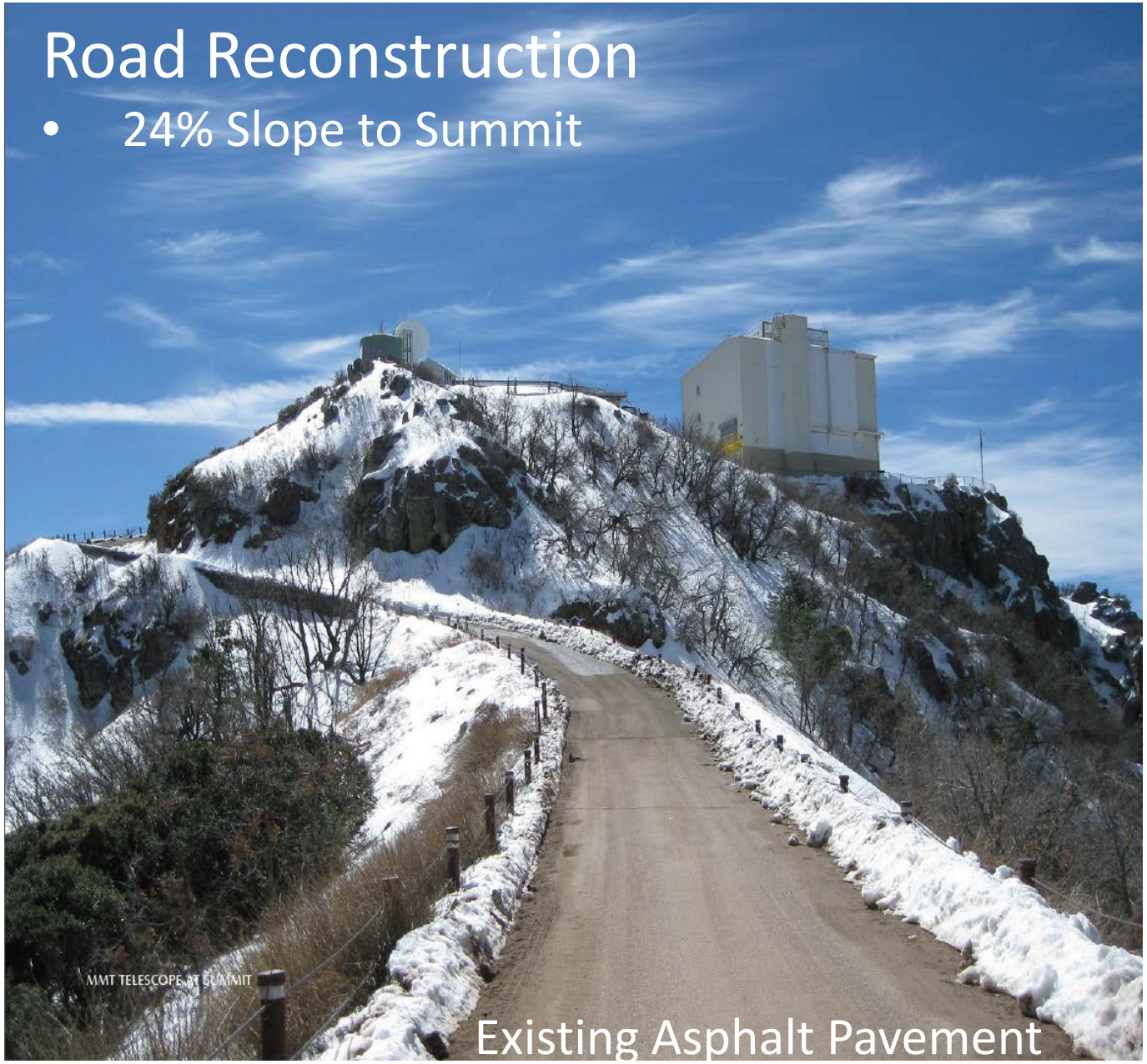

400
ON
400
SPARE



Creative Problem Solving

Road Reconstruction

- 24% Slope to Summit



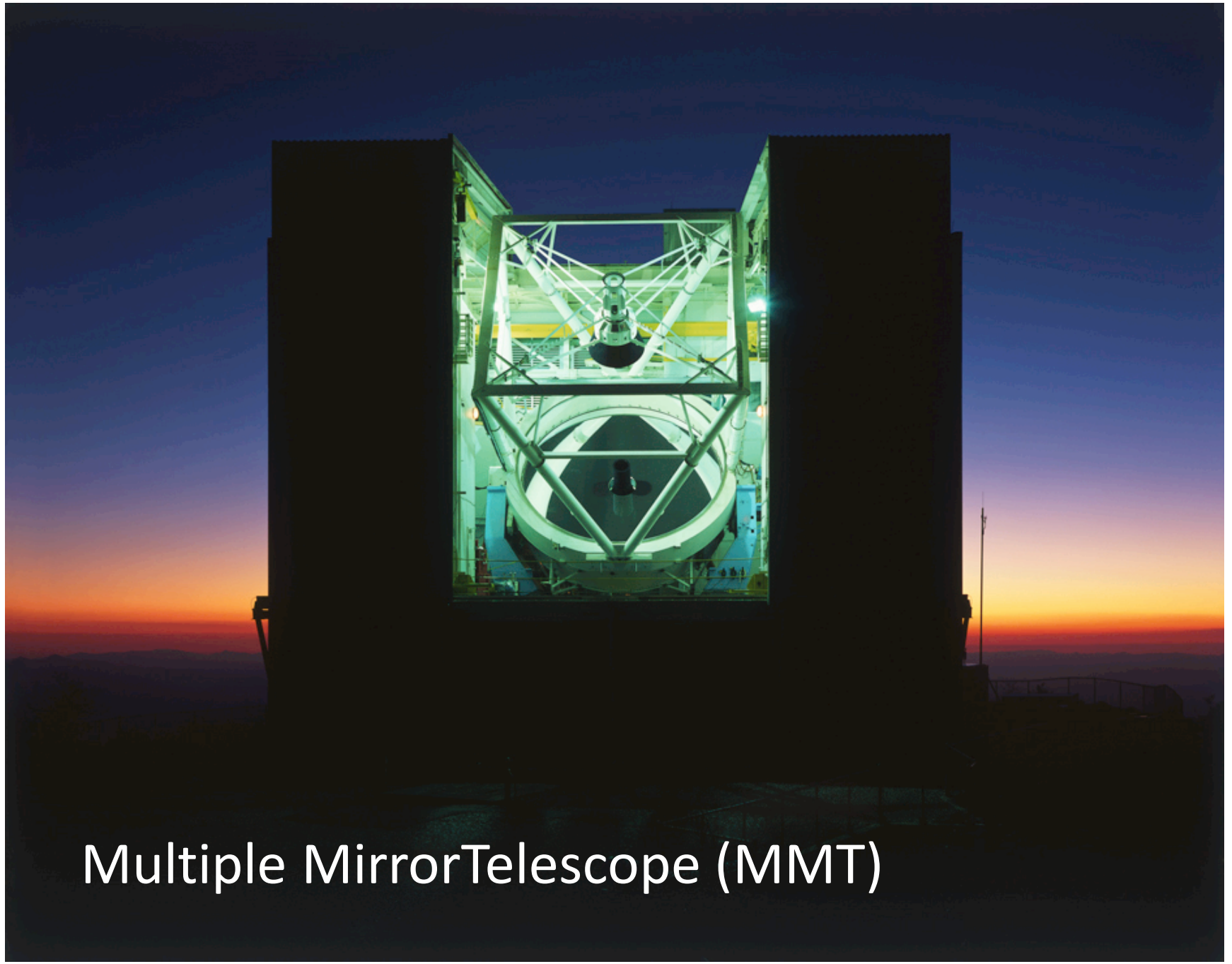
Existing Asphalt Pavement

New Concrete Pavement and Guardrail design to Summit

New Concrete Pavement

New Concrete Pavement and Guardrail design


MMT
Mount Hopkins
• Elevation 8,500 ft

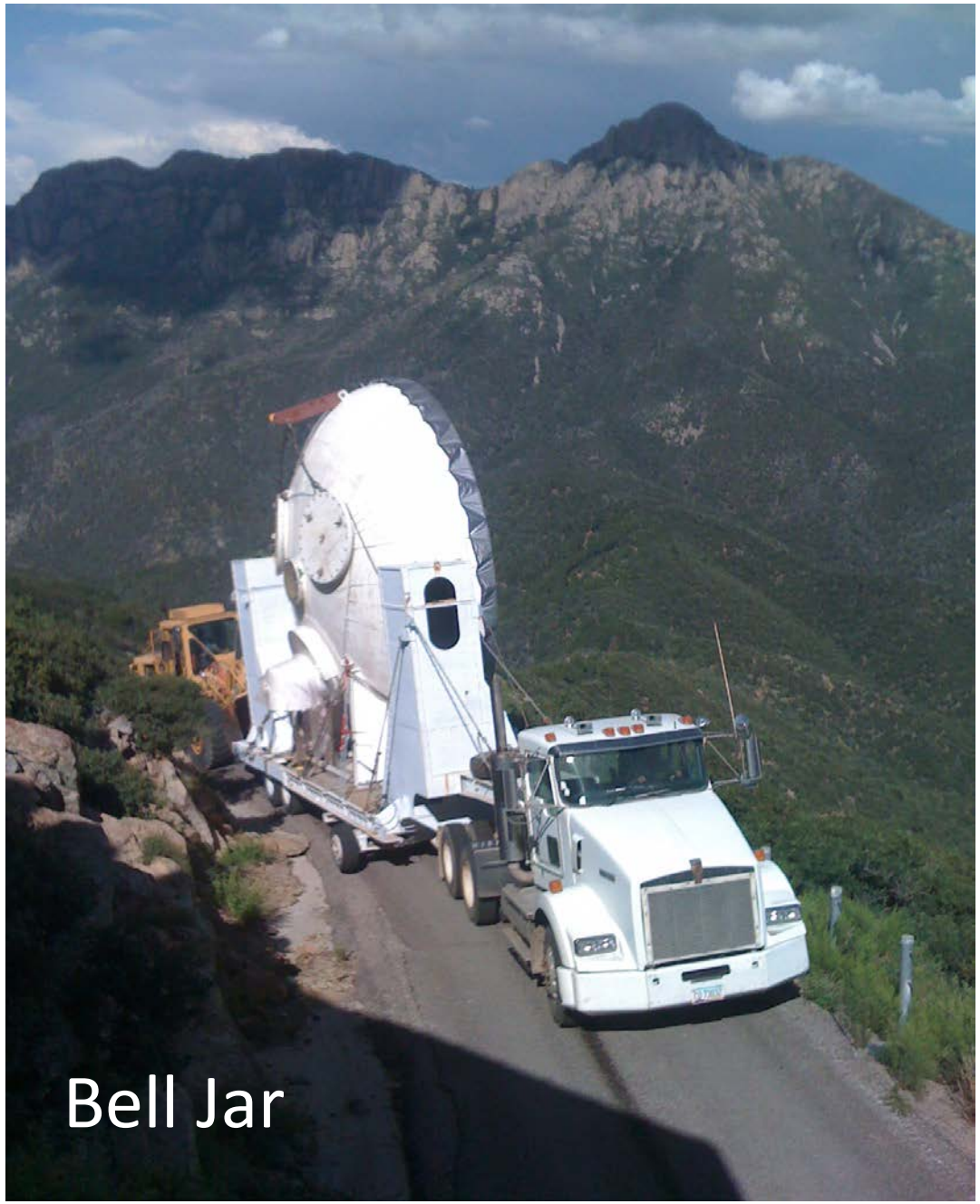


Multiple MirrorTelescope (MMT)

MMT at Summit


Constricted Sites


New Construction Instrument Repair Facility



Operations:

Bell Jar Placement for MMT Aluminizing

Repurposed AHU

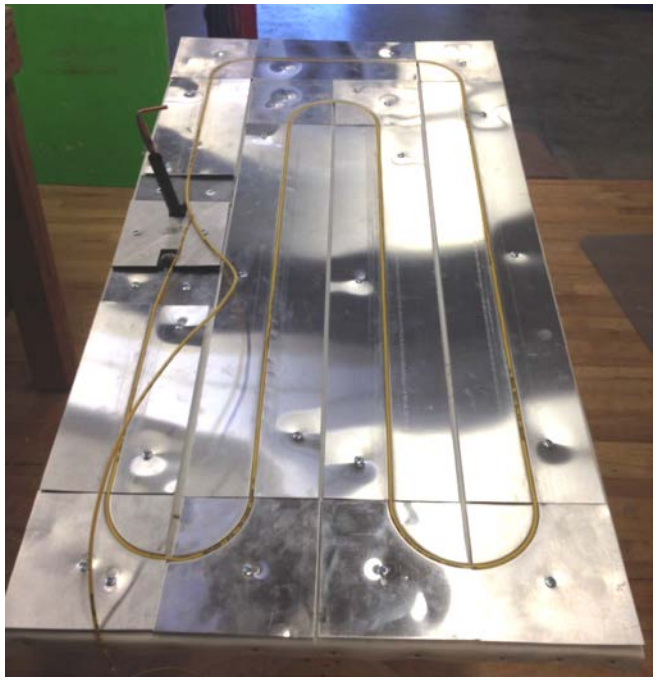
- New Platform and Piping

Extreme Climatic Conditions

MMT Roof

- Ineffective Snow Melt System

MMT Roof Testing Snow Melt System




Replacement of Heated Roof
• Installation of Heating Elements

Replacement of Heated Roof

Fall Protection System with
Snow Melt

Florida Fire (2005) Projects

- Enhanced Lightning Protection
- Site-Wide FA System
- 300K Gallon Water Tower

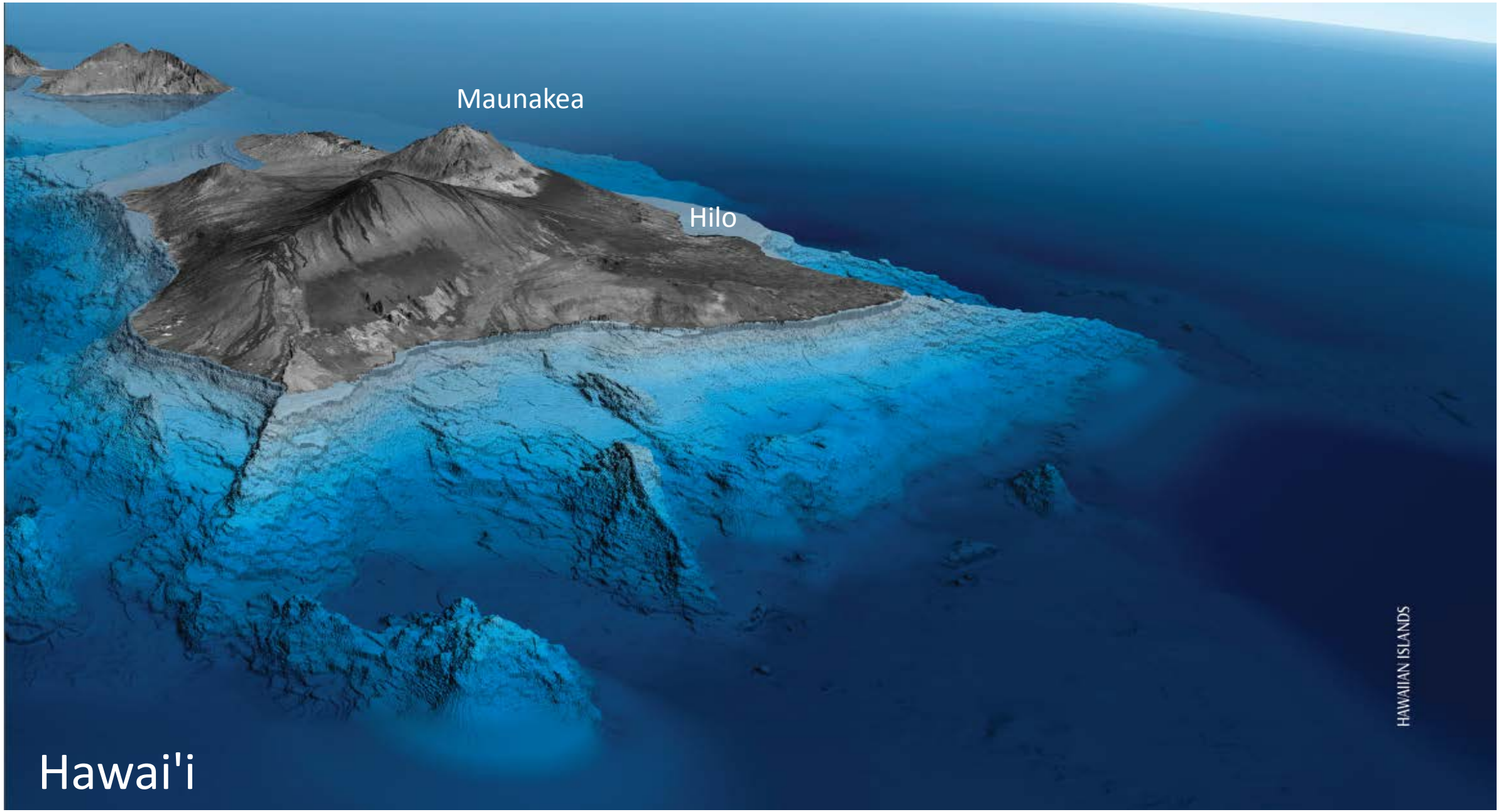

Mt. Wrightson
• 9,453’ Elevation
• 1.5 miles from Mt. Hopkins

Florida Fire 2005

- Approaches within 1 mile of Summit of FLWO

2005: New 300,000 Gallon Water Tank

Strategically Placed Additional Tanks

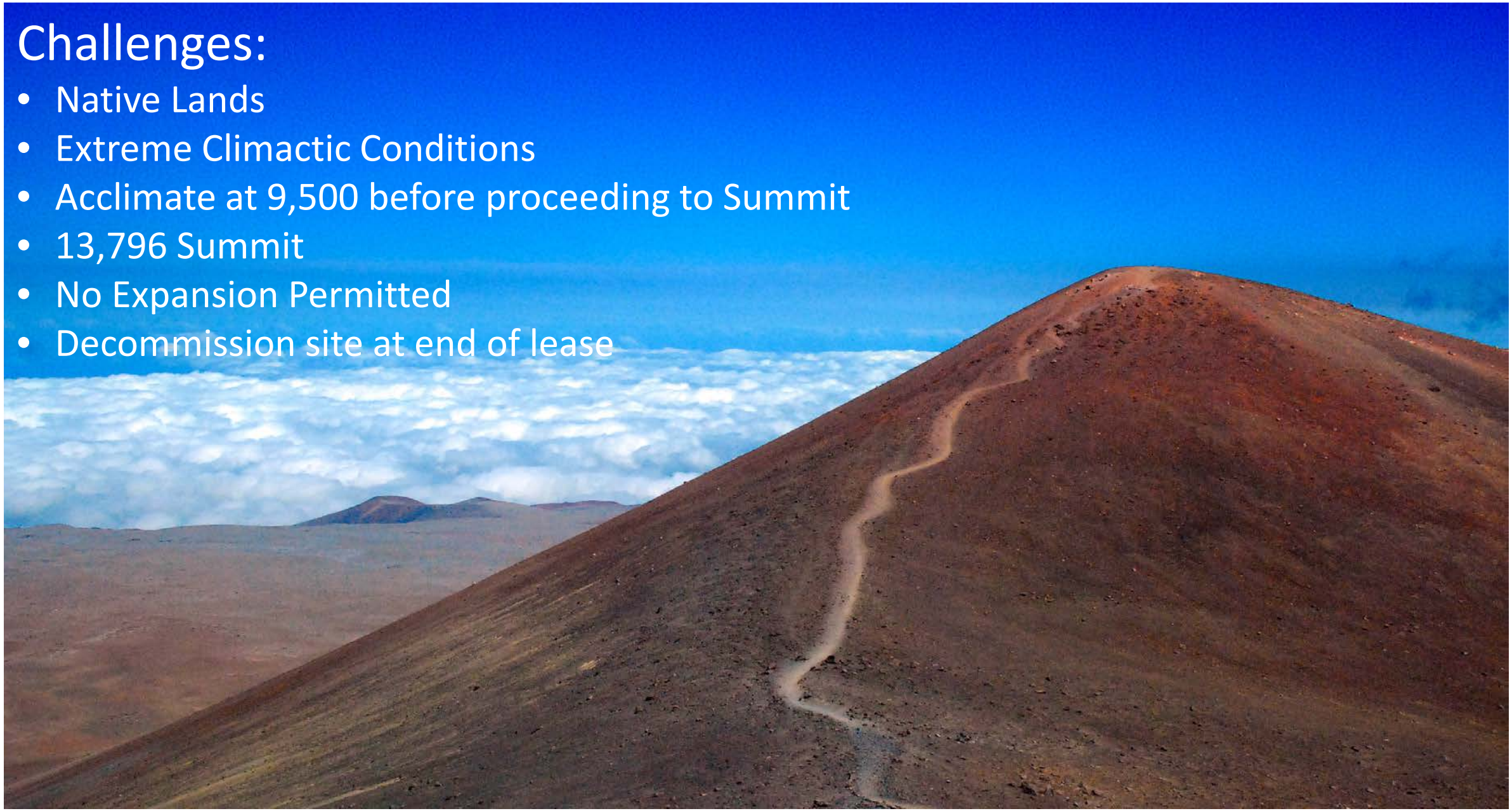


Hawai'i

Maunakea

Challenges:

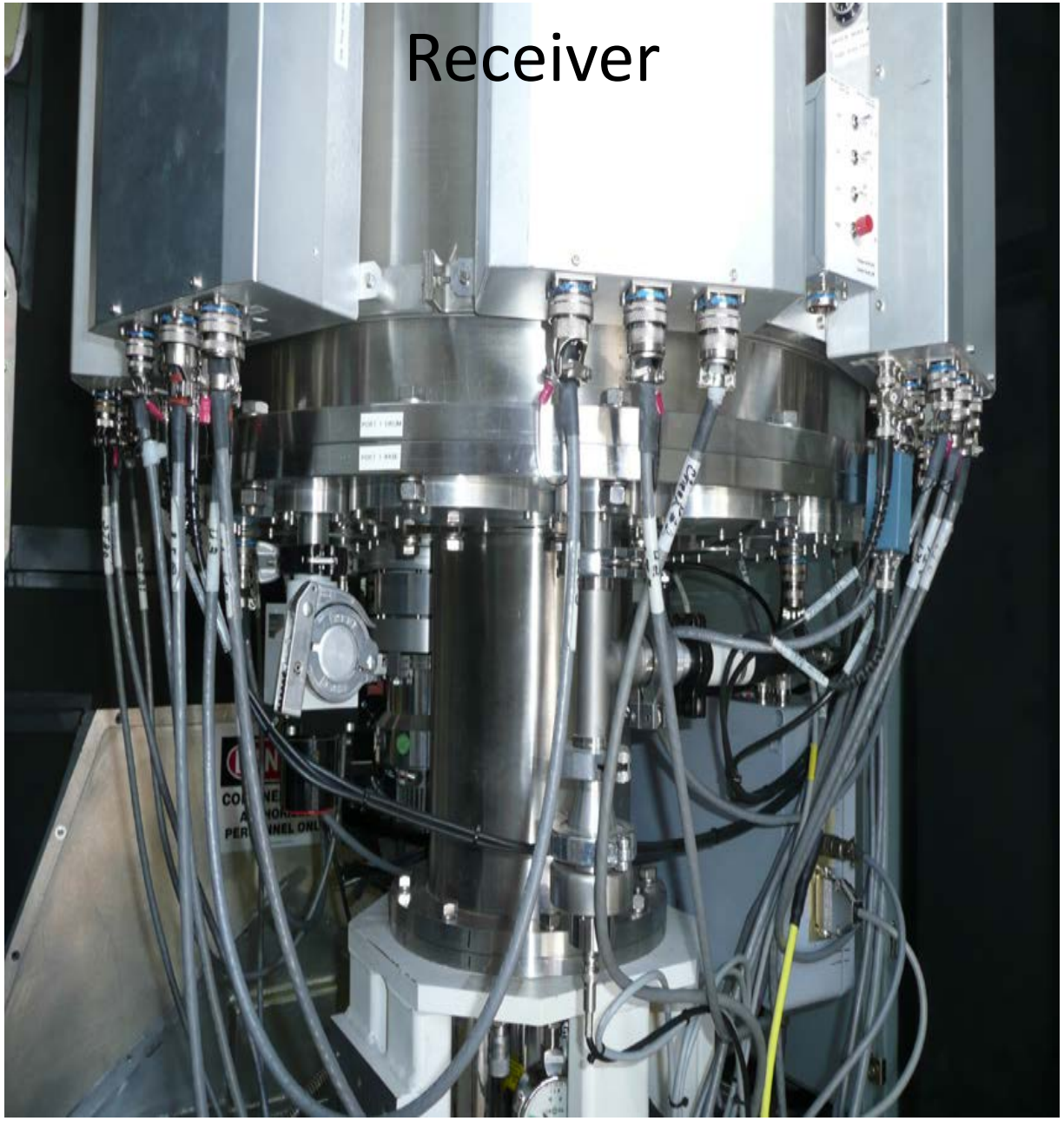
- Native Lands
- Extreme Climactic Conditions
- Acclimate at 9,500 before proceeding to Summit
- 13,796 Summit
- No Expansion Permitted
- Decommission site at end of lease




SMA Support Facility
SMA Antenna Array
Sub Millimeter Array

SMA Antenna

Receiver



SMA Support Facility

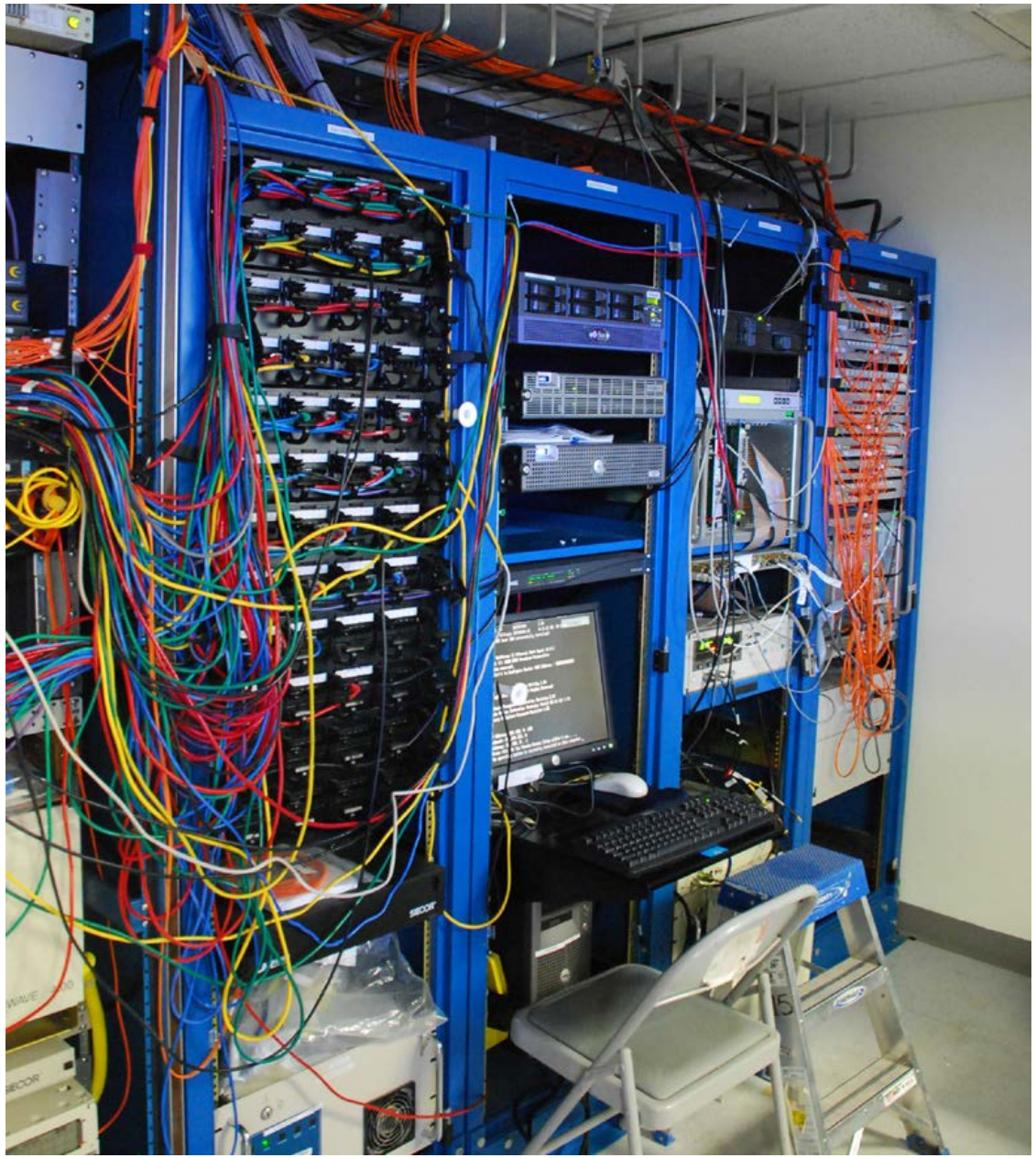
Main Hanger

SMA Support Facility

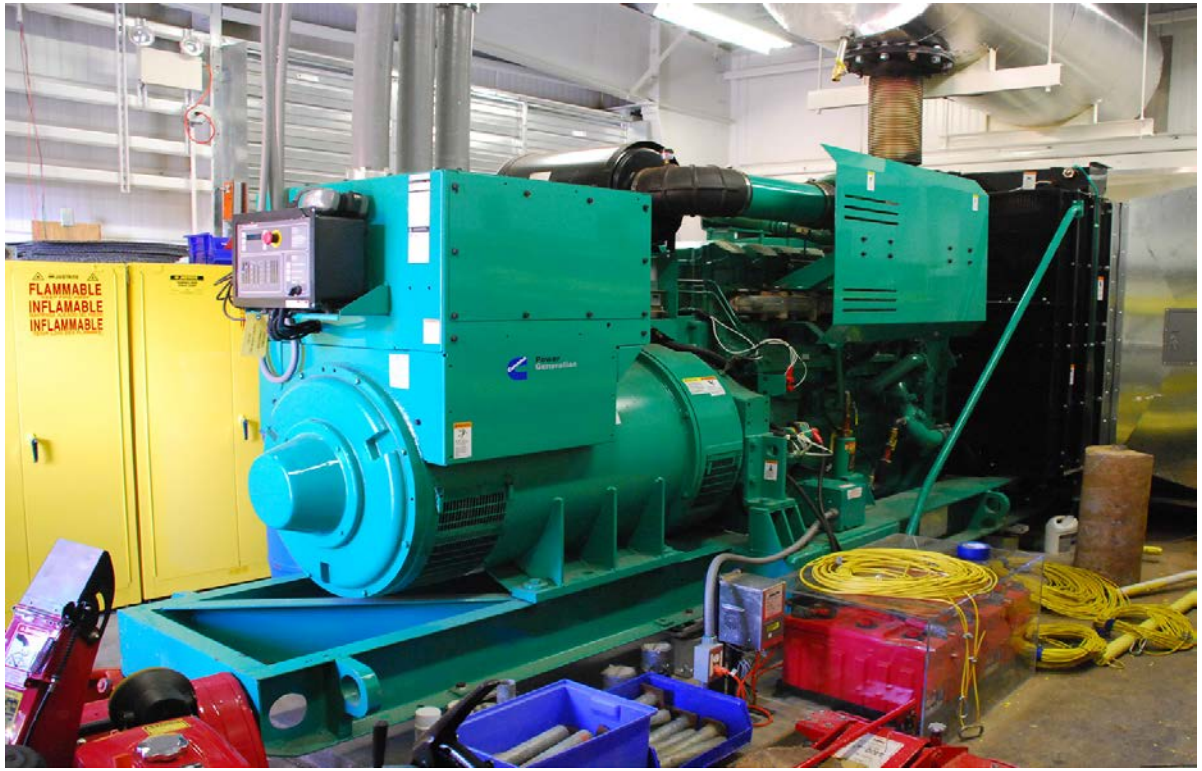
Main Hanger

SMA Antenna Transporter

Computer Room



Emergency Generator



Hawaiian Shaved Ice

SMA Base Facility, Hilo

Main Entrance

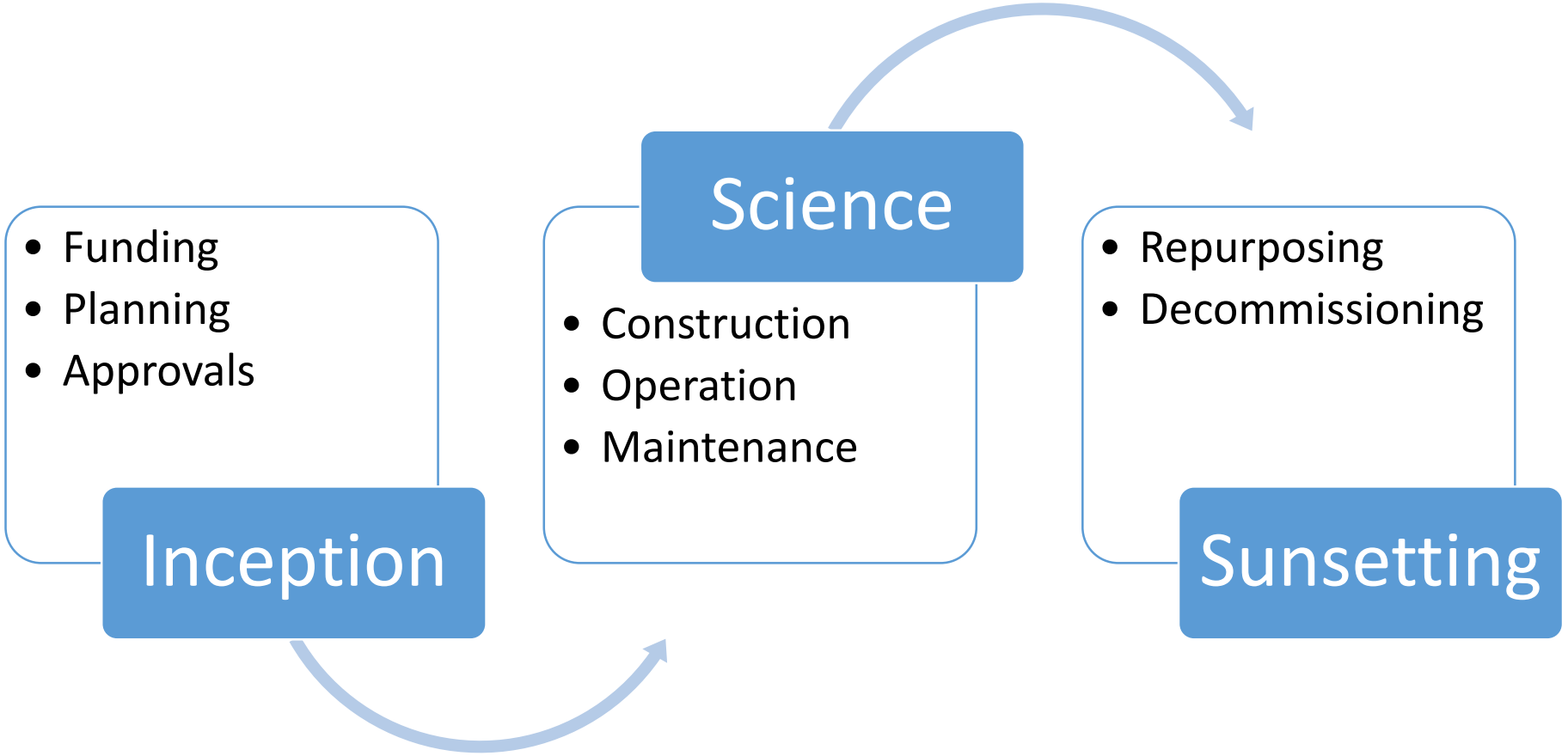
SMA Base Facility, Hilo

Lower Yard

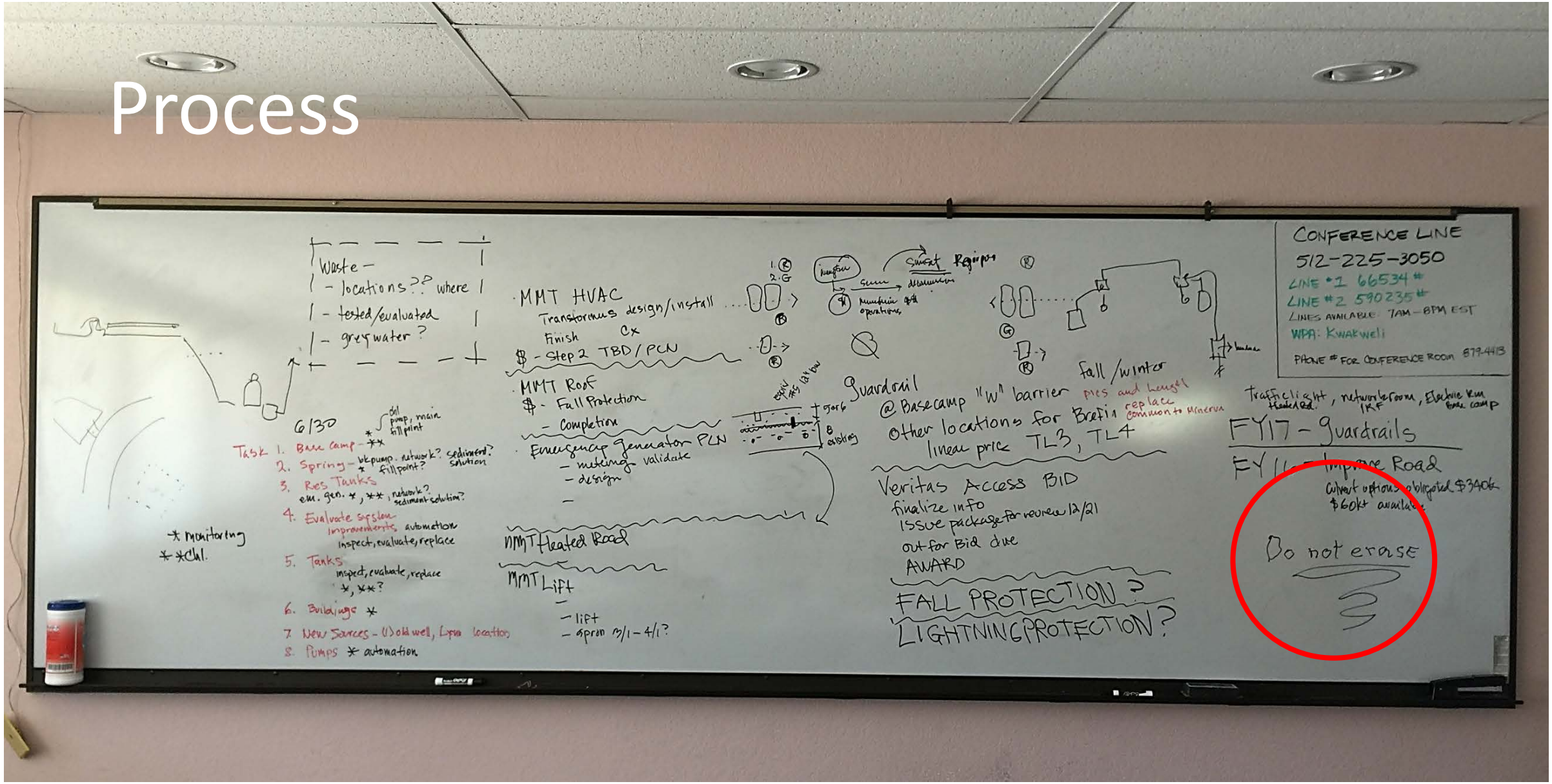
Electronics Lab

Main Conference Room

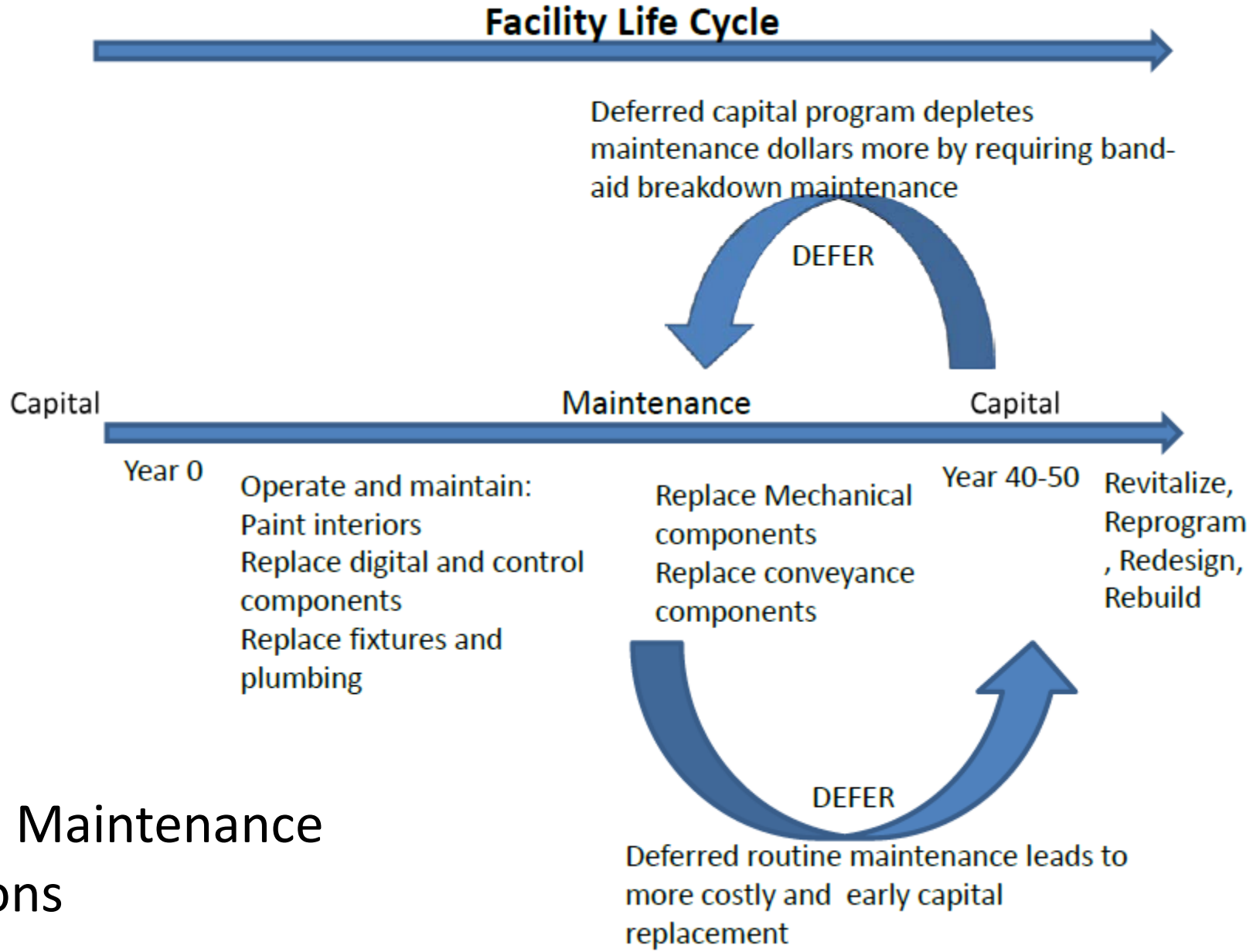
Process & Planning



Process


Waste –
- locations?? where
- tested/evaluated
- greywater ?
6/30
Task 1. Base camp – **
2. Spring – bkpump. network? sediment? * fillpoint? solution
3. Res Tanks
em. gen. *, **, network? sediment solution?
4. Evaluate system improvements, automation
inspect, evaluate, replace
5. Tanks
inspect, evaluate, replace
*, **?
6. Buildings *
7. New Sources – (1) old well, Lyon location
8. Pumps * automation
* monitoring
** Chl.
MMT HVAC
Transformers design/install
Finish Cx
$ - Step 2 TBD / PCN
MMT Roof
$ - Fall Protection
- Completion
Emergency Generator PCN
- metering validate
- design
MMT Heated Road
MMT Lift
- lift
- apron 3/1 – 4/1?
Guardrail
@ Basecamp "W" barrier
Other locations for Brefi
linear price TL3, TL4
fall / winter
pics and length
replace
Veritas Access BID
finalize info
issue package for review 12/21
out for Bid due
AWARD
FALL PROTECTION ?
LIGHTNING PROTECTION?
CONFERENCE LINE
512-225-3050
LINE #1 66534#
LINE #2 590235#
LINES AVAILABLE 7AM – 8PM EST
WPA: Kwakweli
PHONE # FOR CONFERENCE ROOM 879-4413
FY17 – Guardrails
Do not erase

Capital vs Maintenance Implications



Questions?