Sanford Laboratory Update

Jaret Heise
Science Liaison Director, Sanford Lab

DUSEL S4 Workshops
Lead, SD

September 30, 2009

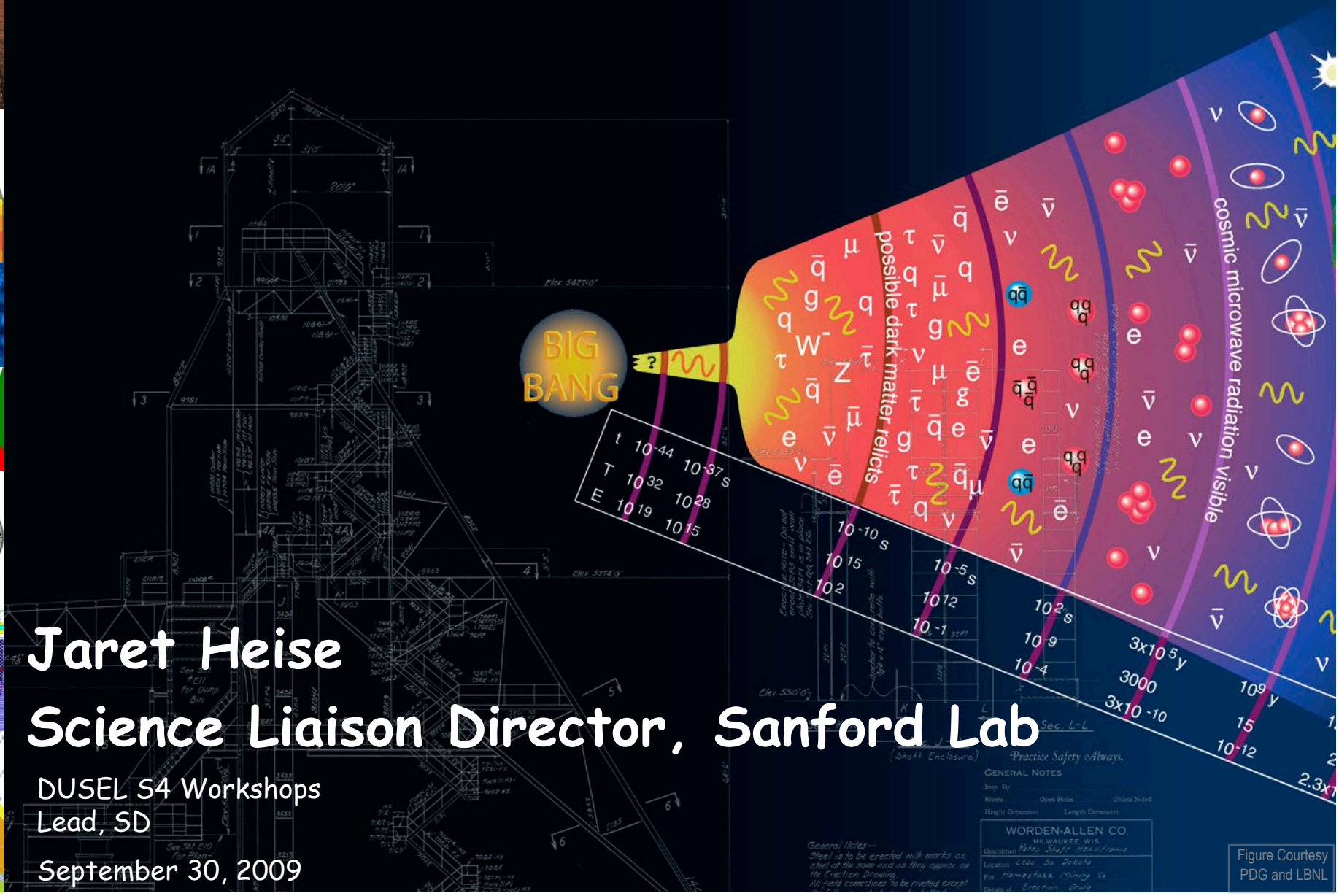
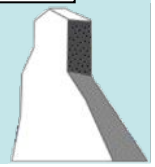


Figure Courtesy PDG and LBNL

The Road to Homestake

Overview

- Gold Mining 1876-2001:
  - → *~41 million troy ounces of gold (~1275 metric tonnes)*
  - → *Decommissioned and sealed 2001-2003 (pumping ceased 2003)*
- World's First Solar Neutrino Detector 1965-2001:
  - → *Ray Davis et al. established neutrino deficit using 100,000 gallons of perchloroethylene*
  - → *"Solar Neutrino Problem" lasted ~30 years (resolved by SNO)*
  - → *Nobel Prize awarded to Davis/Koshiba in 2002*
- Site Selection Process:
  - → *2000/2001: Homestake proposed as NUSEL site*
  - → *2004: NSF re-defines selection process*
    Cascades/WA, Henderson/CO, Kimbalton/VA, San Jacinto/CA, Soudan/MN, WIPP/NM, SNOLAB/Canada
  - → *2006: Barrick Gold donates Homestake Mine to South Dakota*
  - → *2006: T. Denny Sanford donates $70M*
  - → *2007: Homestake selected as DUSEL by NSF*



The Road to Homestake

Homestake's Legacy

Davis solar neutrino experiment at the 4850L in Homestake Mine

$$\nu_e + {}^{37}Cl \rightarrow {}^{37}Ar + e^-$$

Sanford Lab at Homestake

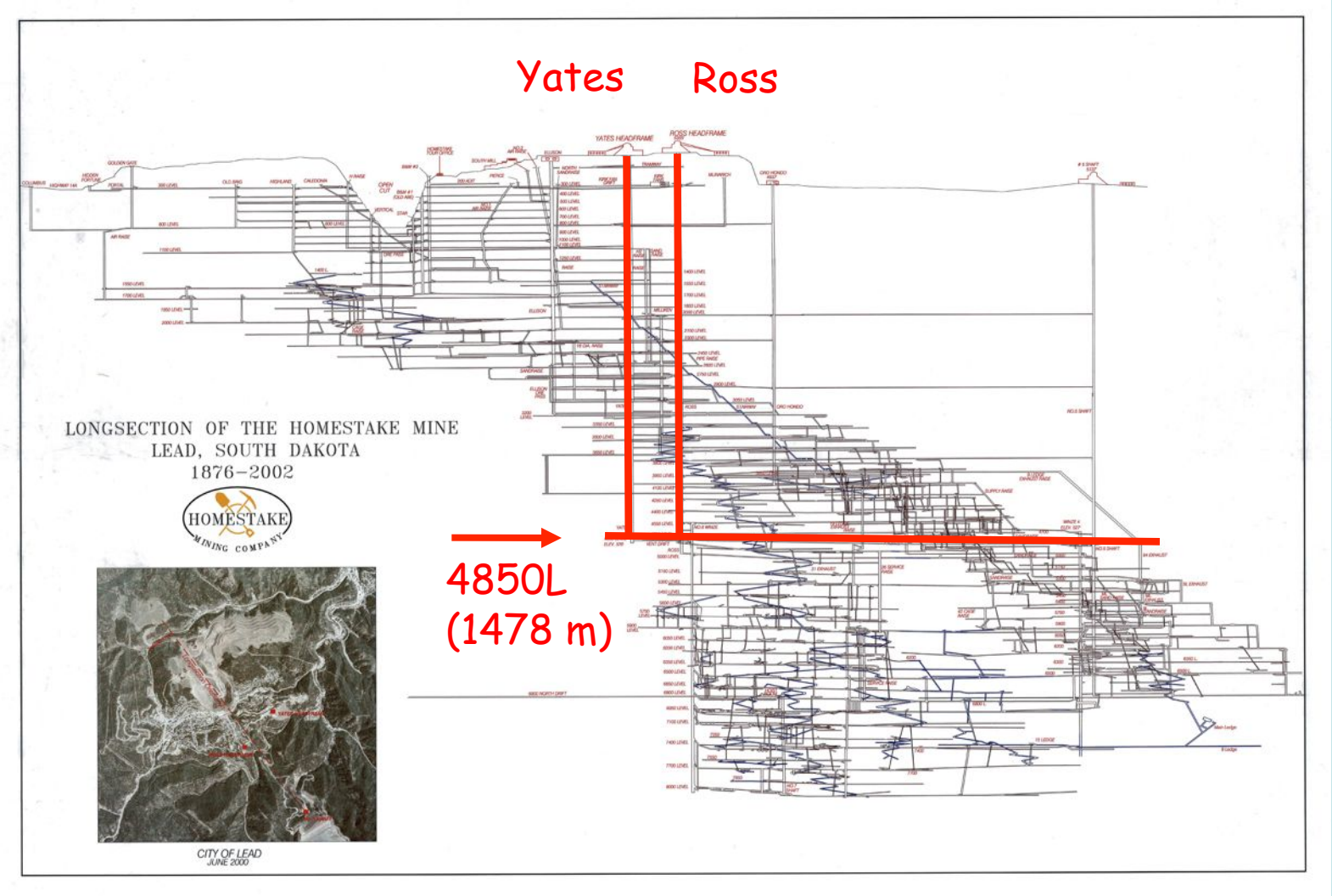
Sanford Laboratory Footprint

Property: 186 acres (surface), 7700 acres (UG)

Jaret Heise

Sanford Laboratory Footprint

Property: 370 miles (595 km) Underground Tunnels

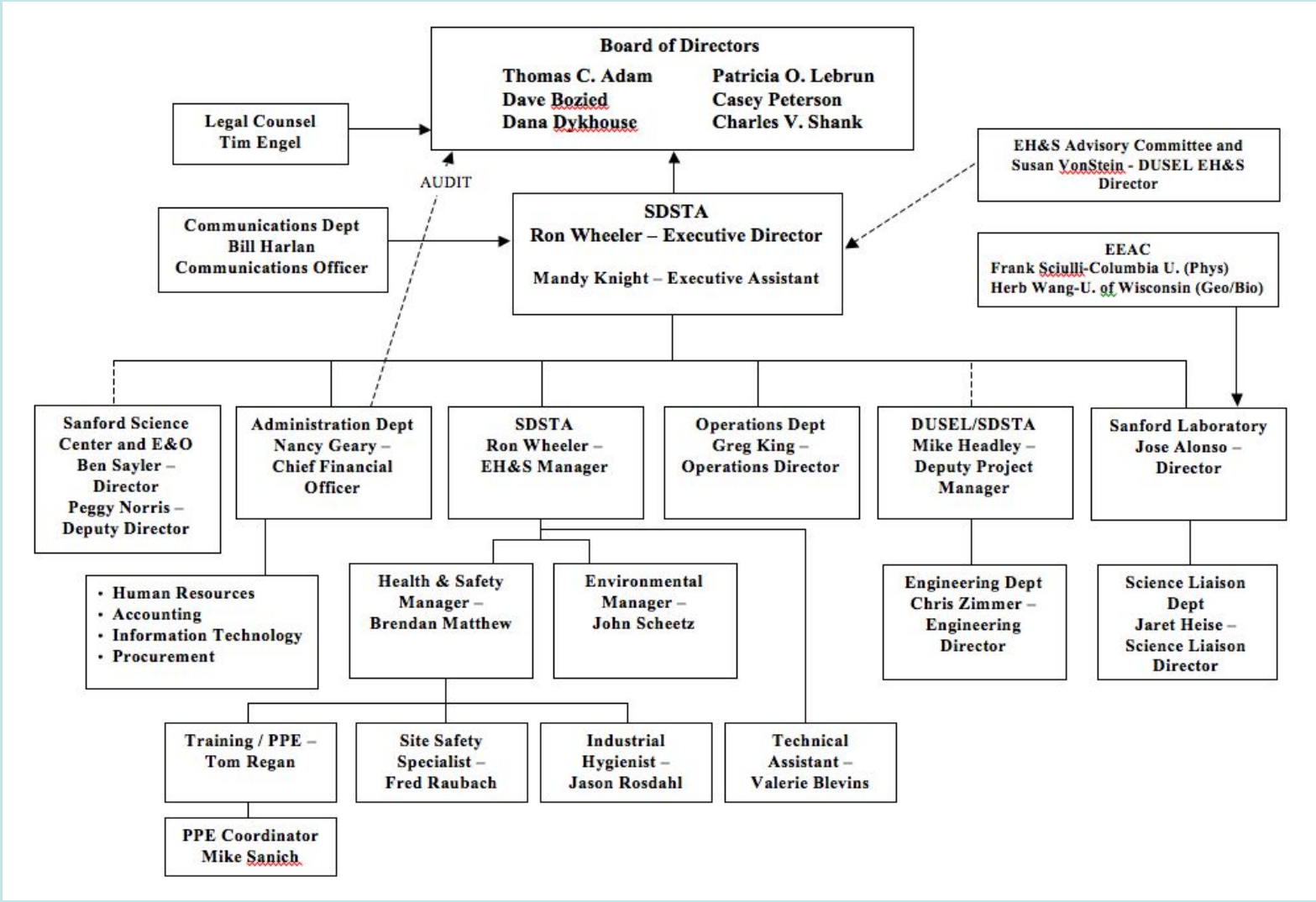


Sanford Lab at Homestake

Jaret Heise

Sanford Laboratory Organization

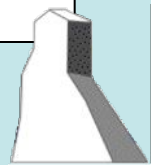
Personnel: 80 full-time, 26 part-time employees



Current Laboratory Status

General Synopsis

- Dewatering:
  - → *Reached 4850L May 13! Inauguration ceremony June 22*
  - → *Water level currently ~4996 feet below surface*
- Refurbishment:
  - → *Ross Shaft: Jun 2007 - Oct 2008*
  - → *Yates Shaft: Nov 2008 – Present (access to 4300L now, 4850L by Nov)*
  - → *Surface: Administration Bldg (presentation room, Science offices)*
  - → *Re-establish additional power sub-stations, extend to 4850L, etc*
- Early Science:
  - → *Summer 2009 was very busy! (~20 groups + outreach + DUSEL, etc)*
  - → *Surface Laboratory (Warehouse) renovation Jul-Nov 2009*
    (LUX to occupy starting mid-Oct while 4850L Davis Campus developed)
  - → *Temporary Laboratory on 4850L preparations to begin ~Oct 2009*
    (Majorana electroforming lab + clean machine shop)
  - → *Excavation for 4850L Davis Campus:*
    - Core drilling began August 2009 (geotechnical info for Sanford/DUSEL)
    - First excavation blast September 23!



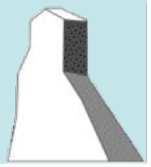
Current Laboratory Status

IT Synopsis

- Core network hardware, servers purchased and onsite:
  - → *Robust wireless network (Admin)*
  - → *Firewall and VPN installed and operational (Admin)*
  - → *Core switches/routers installed and operational (Admin, Ross, Yates)*
  - → *New fibre installed, incl 300L, 800L, 2000L, 4100L, 4550L (Ross)*
  - → *7 servers, recently cutover to new IT systems,* ***sanfordlab.org*** *(All)*
- Bandwidth:
  - → *Inter-campus communication = 1 Gbps*
  - → *"Internet 1" (commodity) = 1 Gbps*
  - → *"Internet 2" (research) = 10 Gbps [expandable to 50 Gbps for DUSEL]*

Nearterm IT Plans

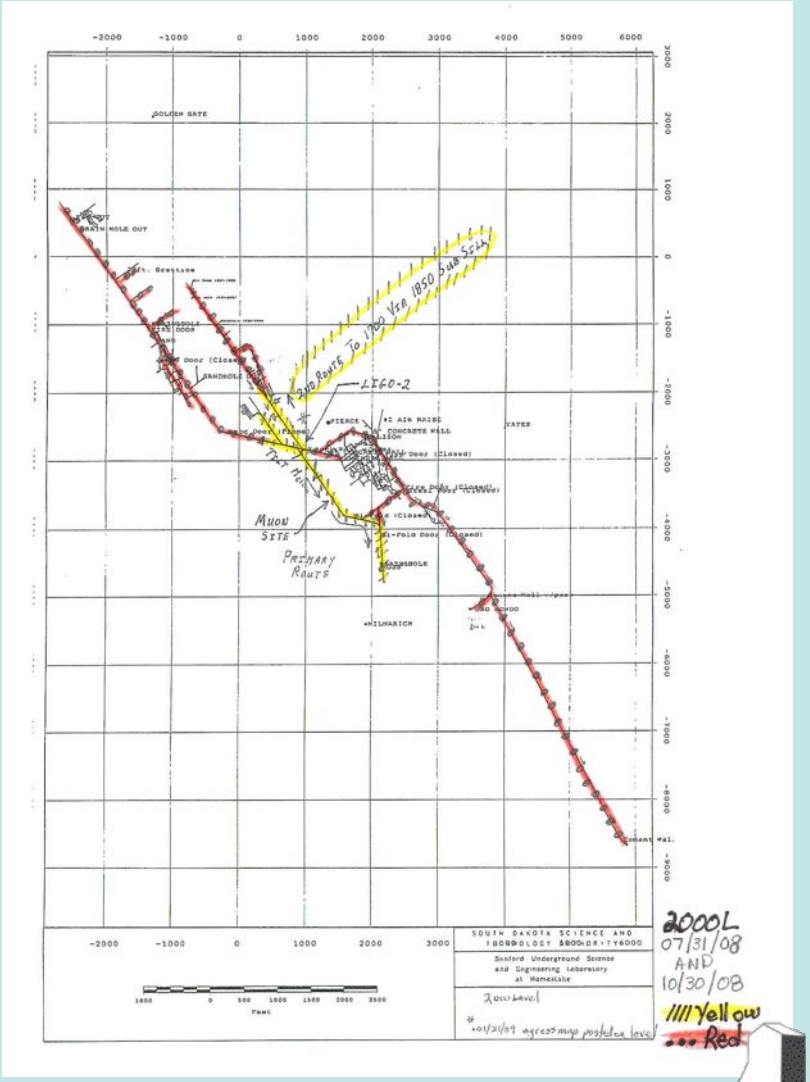
- Fibre deployment:
  - → *Underground: 4850L (Ross) + Science Levels (Yates)*
  - → *Surface: extend site network to Surface Lab (Warehouse)*



Current Laboratory Status

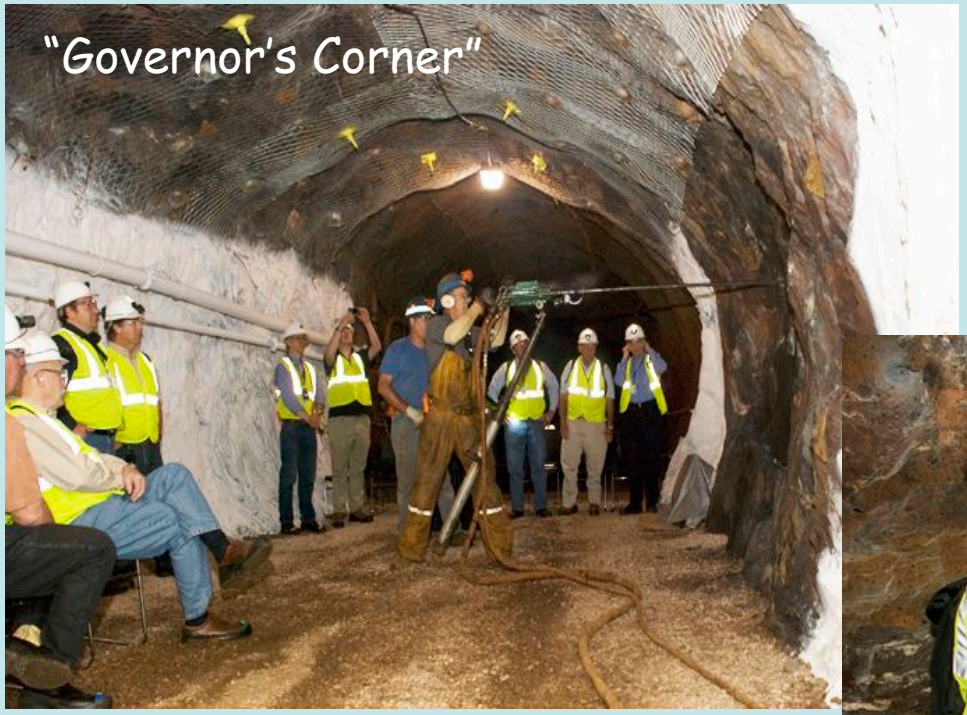
Level Risk Assessment:

- Assessment Process
  - → *Expert team visits level (lots of notes, lots of pictures)*
  - → *Expert teams meets to discuss conditions and evaluate risks*
  - → *Assign colour coding to areas:*
    - Red = Staff-Only Access
    - Yellow = Access with Staff Guide
    - Green = Access with Training
- Hazard Mitigation
  - → *Sanford Lab has allocated $1.3M to improve ground conditions, ventilation/fire doors, cordon areas*
  - → *Levels = 1700L, 2000L, 3950L, 4100L, 4850L*
- Not all areas are accessible
  - → *DUSEL funding will help*



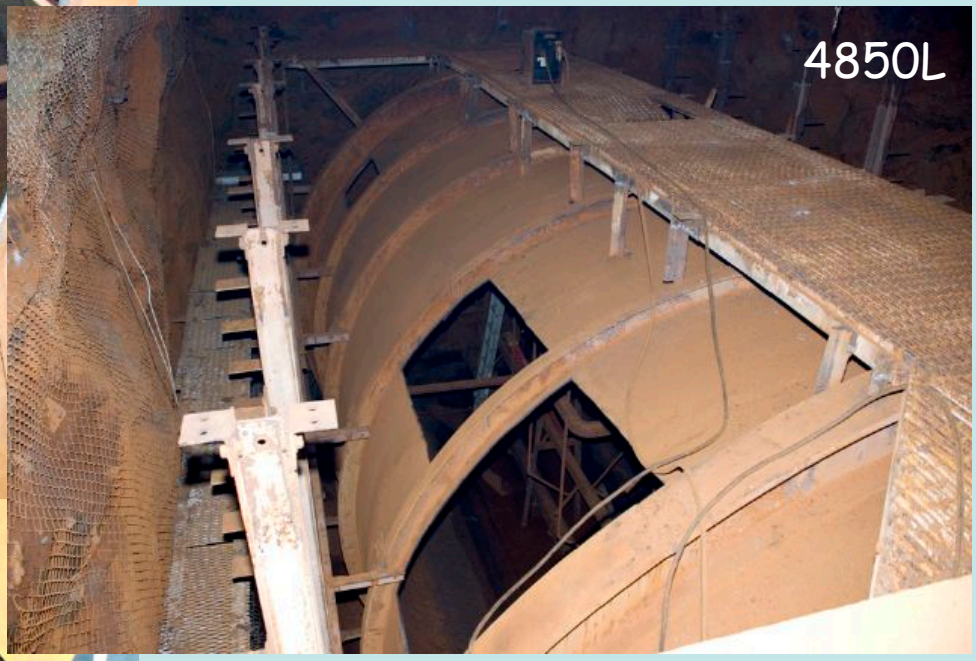
Current Laboratory Status

4850L Inauguration Ceremony (June 22, 2009)



Current Laboratory Status

Davis Tank (August 2009)



Current Laboratory Status

Davis Tank (September 2009)

Sanford Lab Dewatering

Pumping/Treatment System

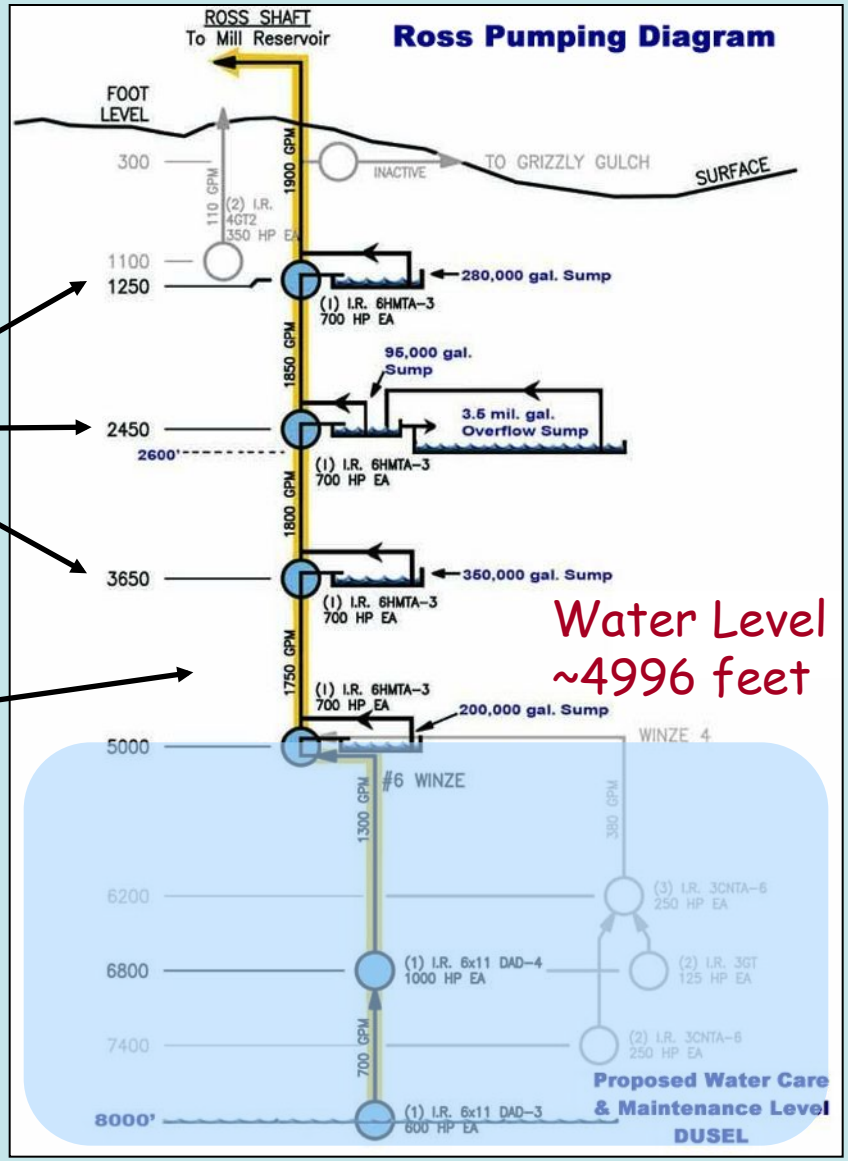
Water Treatment Plant
- surface
- 32 sand filters installed
- ~2000 gpm capacity

Stationary Pump System
- 1250L, 2450L, 3650L
- 2-700 HP pumps/station
- ~2200 gpm capacity

Cascade Pump System
- 3950L, 4250L, 4550L, pool
- 4 submersible pumps/station
- ~1800 gpm capacity

System Capacity = ~1800 gpm

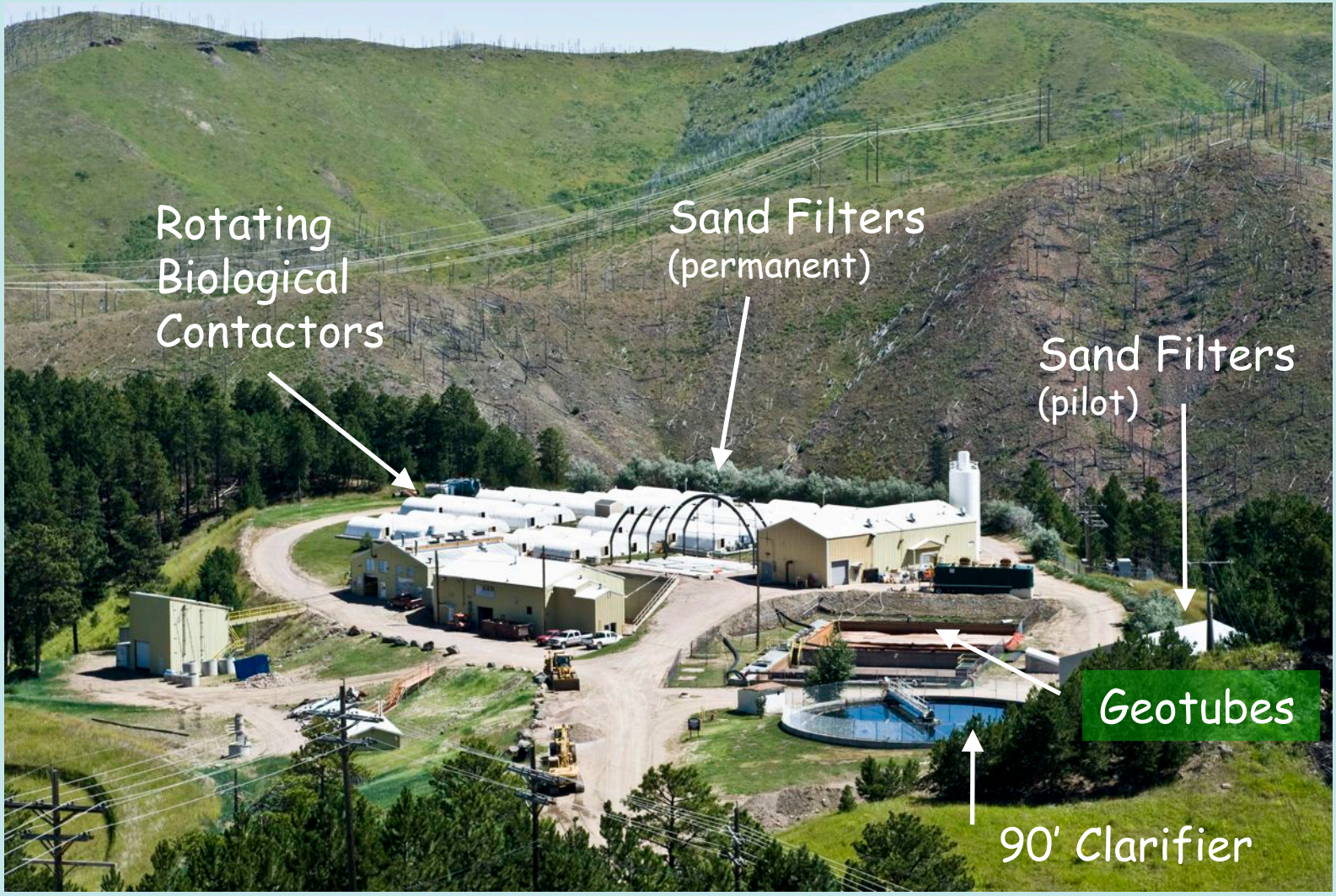
Reduced blend water ➔ ~1500 gpm



Jaret Heise

Sanford Lab Dewatering

Water Treatment: Mine Water + Barrick Water



Jaret Heise

Sanford Lab Dewatering

Water Treatment

Before (Mill Reservoir)

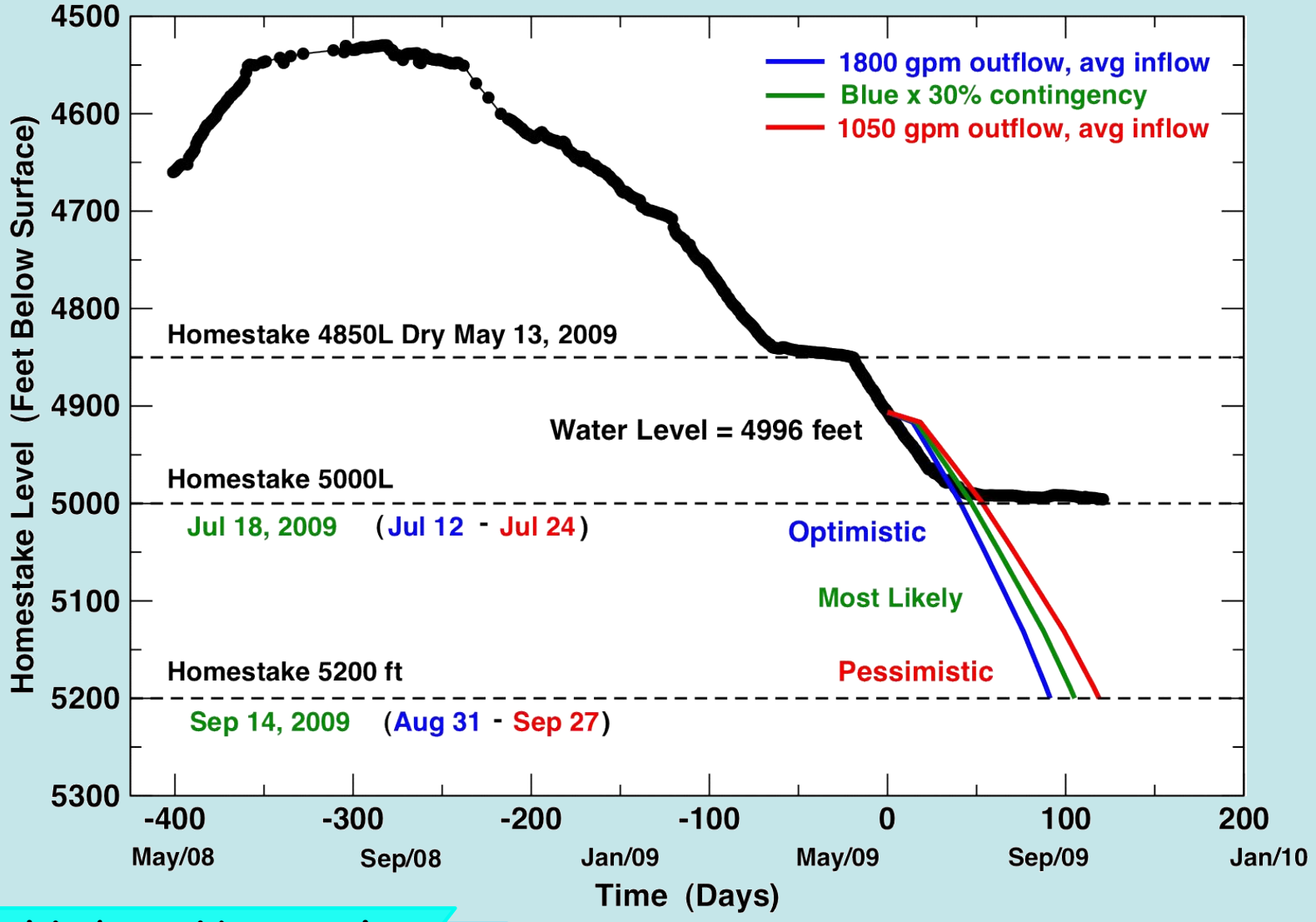
After (Gold Run Creek)

Sanford Lab at Homestake

Jaret Heise

Sanford Lab Dewatering

Projection for 4850L Using Barrick Mine Model

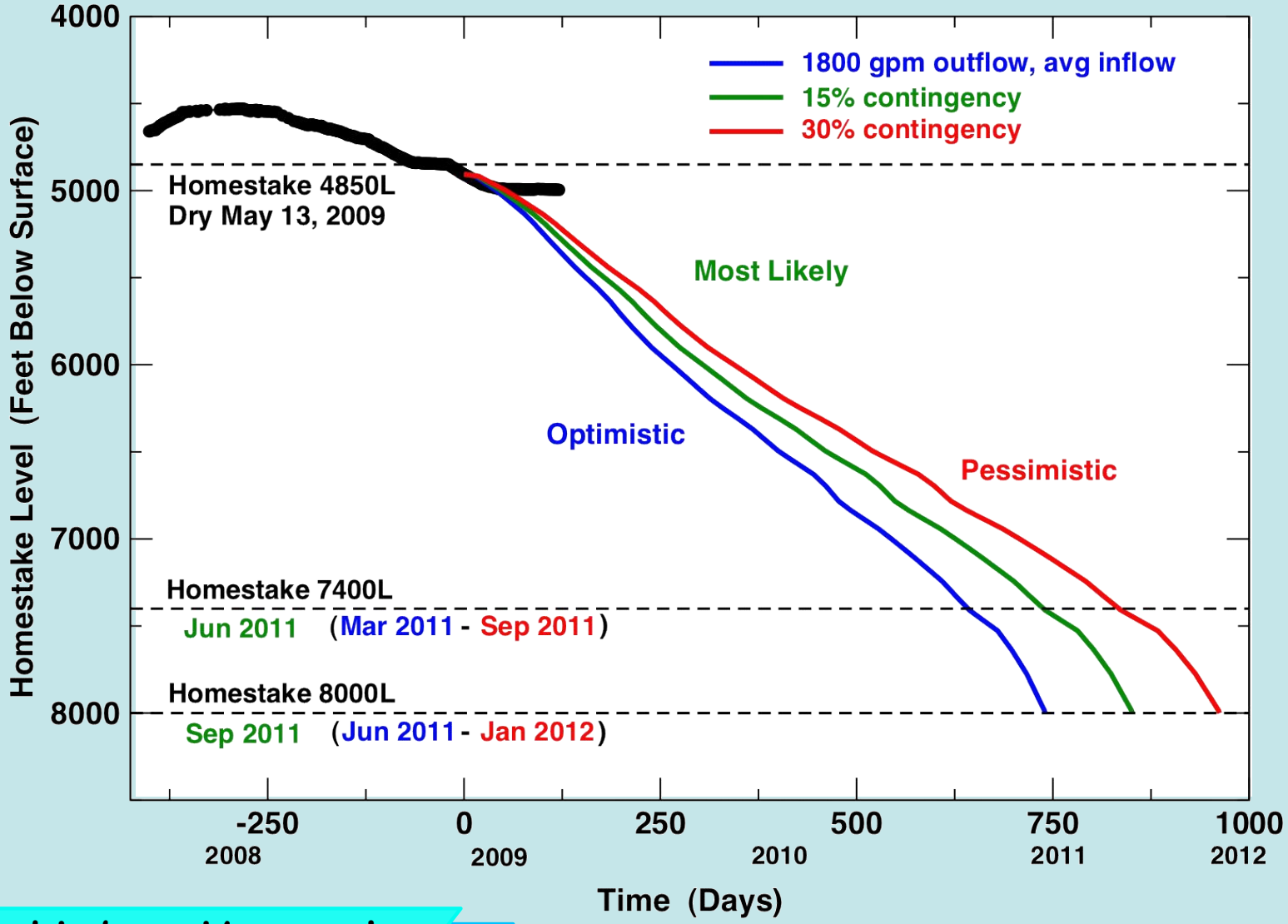


Sanford Lab at Homestake

Jaret Heise

DUSEL Dewatering

Projection for 8000L Using Barrick Mine Model



Sanford Lab at Homestake

Jaret Heise

Sanford Lab Pioneers

Early Laboratory Footprint:

Surface
USD/BHSU —*Gamma, Rn*
Regis —*Muon*
SDSMT – *Climate station*
UT/BHSU – *Mag field, Ross/Yates*

Tramway
USD/BHSU —*Rn*

300L
DUGL —*Low-freq seismometer*
USD/BHSU —*Rn*
SDSMT —*Signal propagation*

800L
DUGL —*Low-freq seismometer*
USD/BHSU —*Gamma, Rn*
Regis – *Muon/neutron*
LBNL —*CO_2 sequestration*
Majorana —*Pb, Cu storage*
PODS —*Geology (pet,ore dep,struct)*

1250L
SDSMT —*Climate station*
USD/BHSU —*Rn*

1700L
SDSU —*Bio samples*

2000L
SDSMT/FNAL —*Water-level tiltmeters (x2), climate*

2000L (cont)
SDSMT/UCB —*Seismometers/ tiltmeters (x2)*
DUGL —*Low-freq seismometer (x3)*
USD/Regis —*Gamma, Rn and muon/neutron*
BHSU —*Seeps, fungus samples (x2)*
LBNL —*CO_2 sequestration*

2600L
SDSMT —*Climate station (x2)*

3350L
Utah —*Extensometers*

4100L
DUGL —*Low-freq seismometer (x3)*
UW/MT —*Optical extensometers*
BHSU, Many —*Bio seeps*

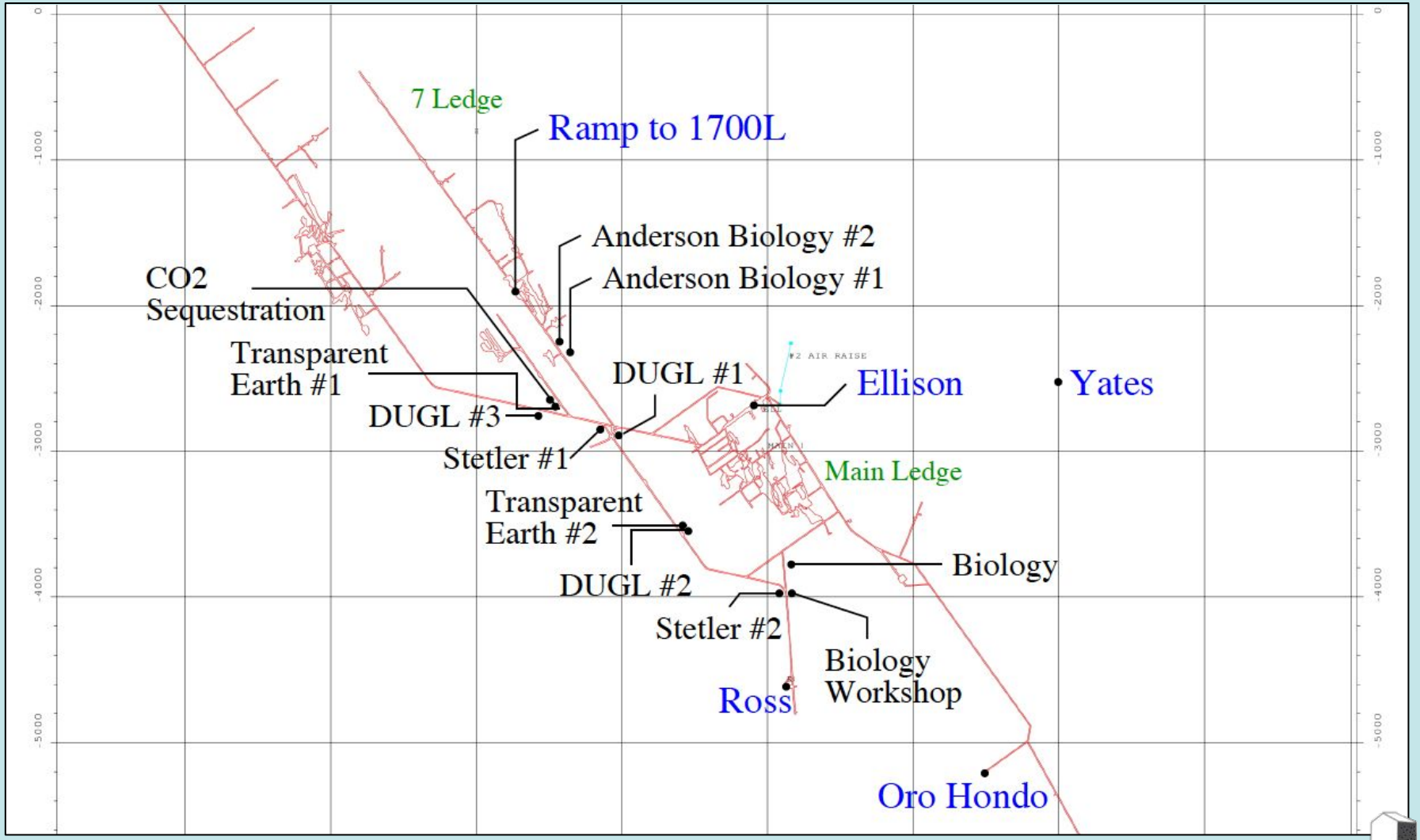
4550L
USD —*Gamma, Rn*
Many —*Bio samples pump water*

4850L
SDSMT —*Hydrometry probes*
LBNL —*CO_2 sequestration (removed)*
BHSU, Many —*Bio samples*
USD/BHSU —*Rn*
Many —*Core holes (hydrology, bio)*

Jaret Heise

Sanford Lab Pioneers

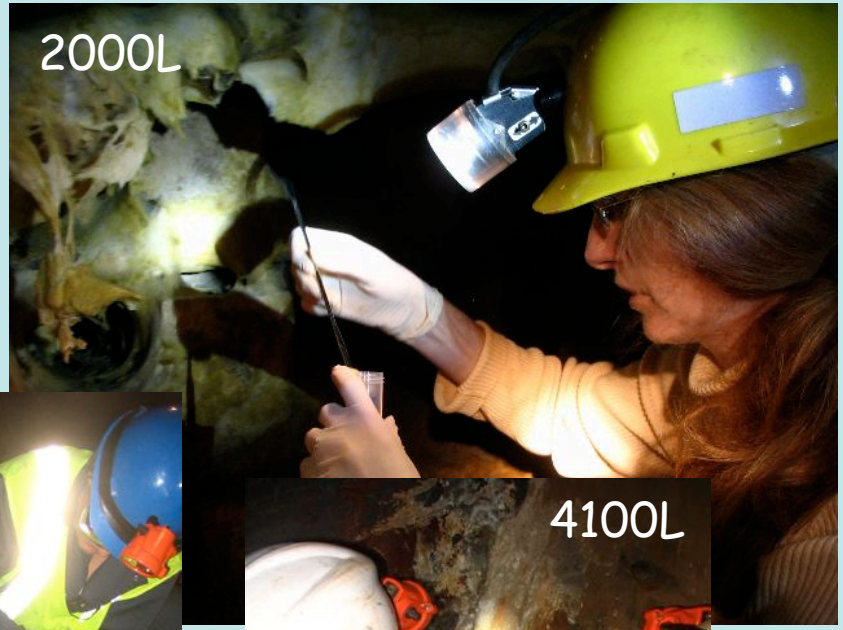
Early Science: 2000L



Jaret Heise

Sanford Lab Pioneers

Biology (BHSU, SDSMT, SDSU, Princeton, UTK, ORNL)

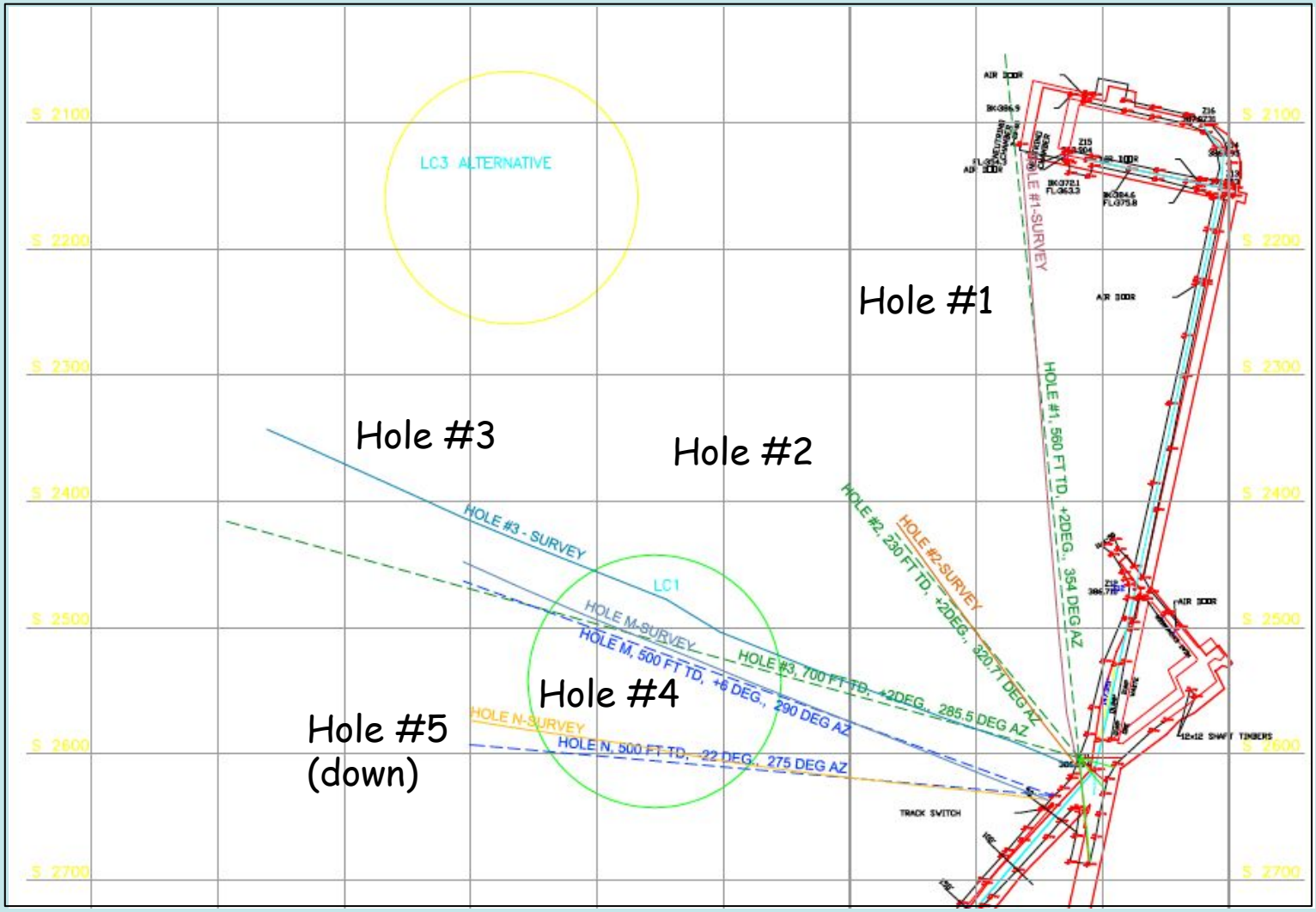


Sanford Lab at Homestake

Jaret Heise

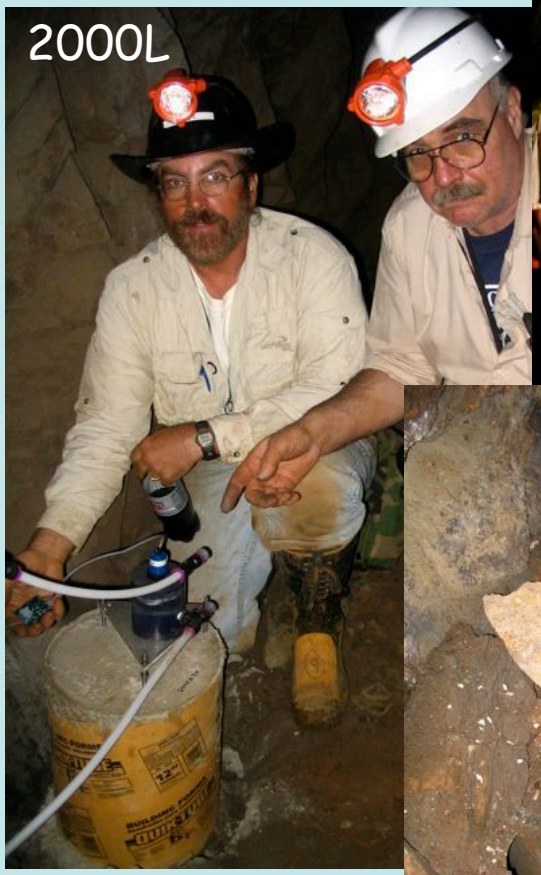
Sanford Lab Pioneers

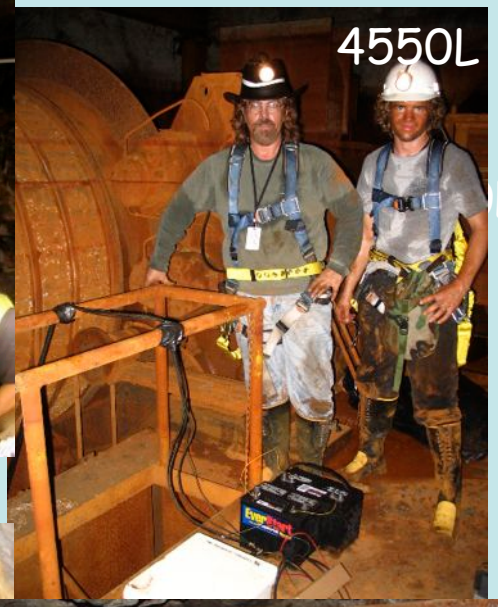
Opportunities: 4850L Core Holes



Sanford Lab Pioneers

Geology (SDSMT, FNAL, UCB, LBNL, Montana, Wisconsin)





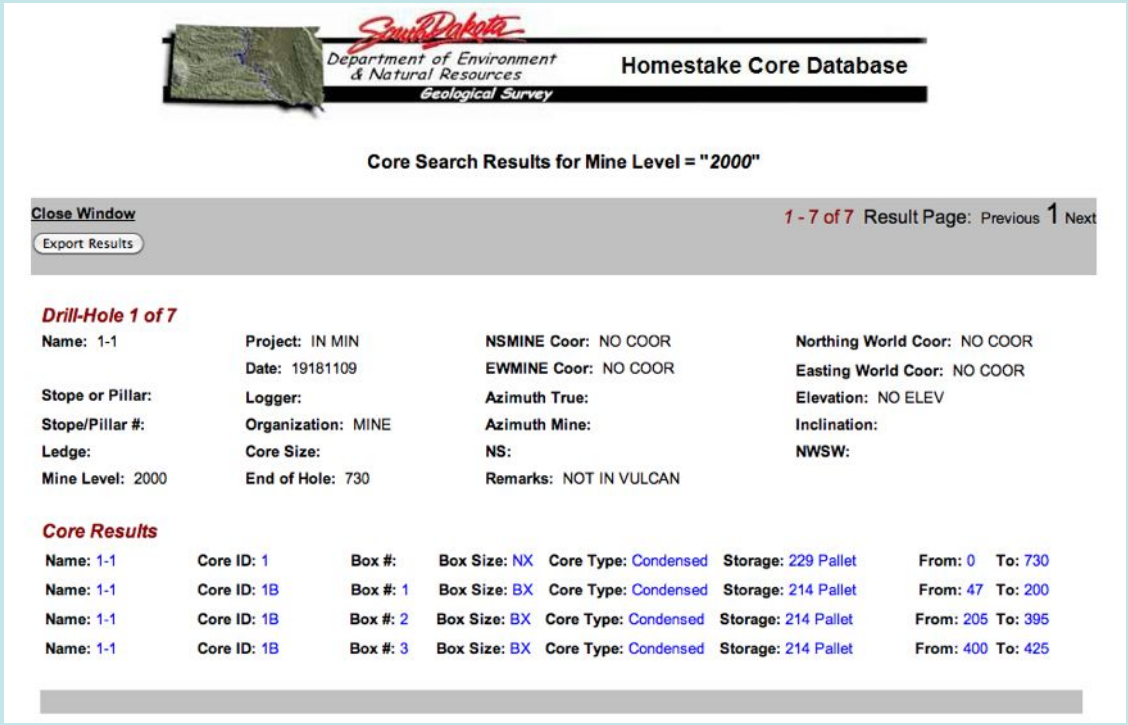
Sanford Lab at Homestake

Jaret Heise

Sanford Lab Pioneers

Opportunities: Homestake Core Repository

- Core donated to SDSTA, SD Geological Society "stewards"
  - → *39,760 boxes of core (91 km!)*
- Database being developed
  - → *58,000+ entries so far represent 1,740 drill holes*



South Dakota Department of Environment & Natural Resources — Geological Survey

Homestake Core Database

Core Search Results for Mine Level = "*2000*"

Close Window | Export Results | 1 - 7 of 7 Result Page: Previous 1 Next

Drill-Hole 1 of 7

Name: 1-1	**Project:** IN MIN	**NSMINE Coor:** NO COOR	**Northing World Coor:** NO COOR
	Date: 19181109	**EWMINE Coor:** NO COOR	**Easting World Coor:** NO COOR
Stope or Pillar:	**Logger:**	**Azimuth True:**	**Elevation:** NO ELEV
Stope/Pillar #:	**Organization:** MINE	**Azimuth Mine:**	**Inclination:**
Ledge:	**Core Size:**	**NS:**	**NWSW:**
Mine Level: 2000	**End of Hole:** 730	**Remarks:** NOT IN VULCAN	

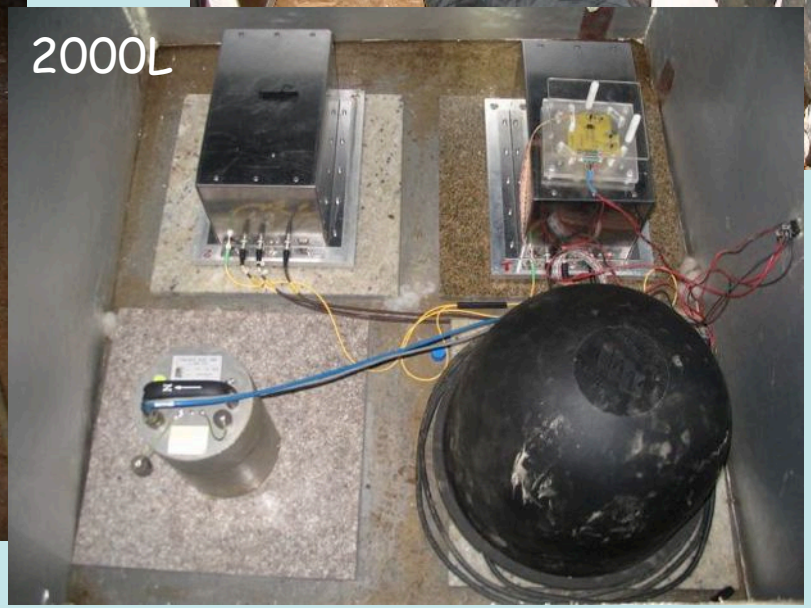
Core Results

Name: 1-1	**Core ID:** 1	**Box #:**	**Box Size:** NX	**Core Type:** Condensed	**Storage:** 229 Pallet	**From:** 0 **To:** 730
Name: 1-1	**Core ID:** 1B	**Box #:** 1	**Box Size:** BX	**Core Type:** Condensed	**Storage:** 214 Pallet	**From:** 47 **To:** 200
Name: 1-1	**Core ID:** 1B	**Box #:** 2	**Box Size:** BX	**Core Type:** Condensed	**Storage:** 214 Pallet	**From:** 205 **To:** 395
Name: 1-1	**Core ID:** 1B	**Box #:** 3	**Box Size:** BX	**Core Type:** Condensed	**Storage:** 214 Pallet	**From:** 400 **To:** 425

Jaret Heise

Sanford Lab Pioneers

Gravity Waves (UMN, Caltech, NIKHEF, Florida)

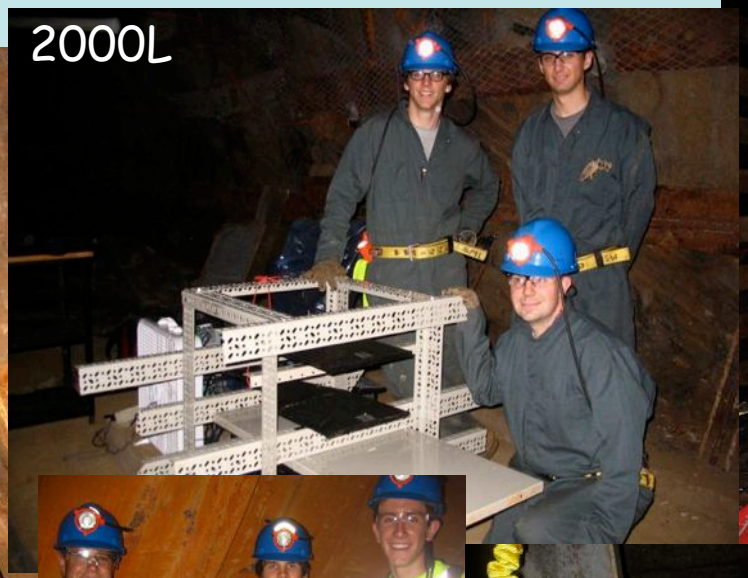


Sanford Lab at Homestake

Jaret Heise

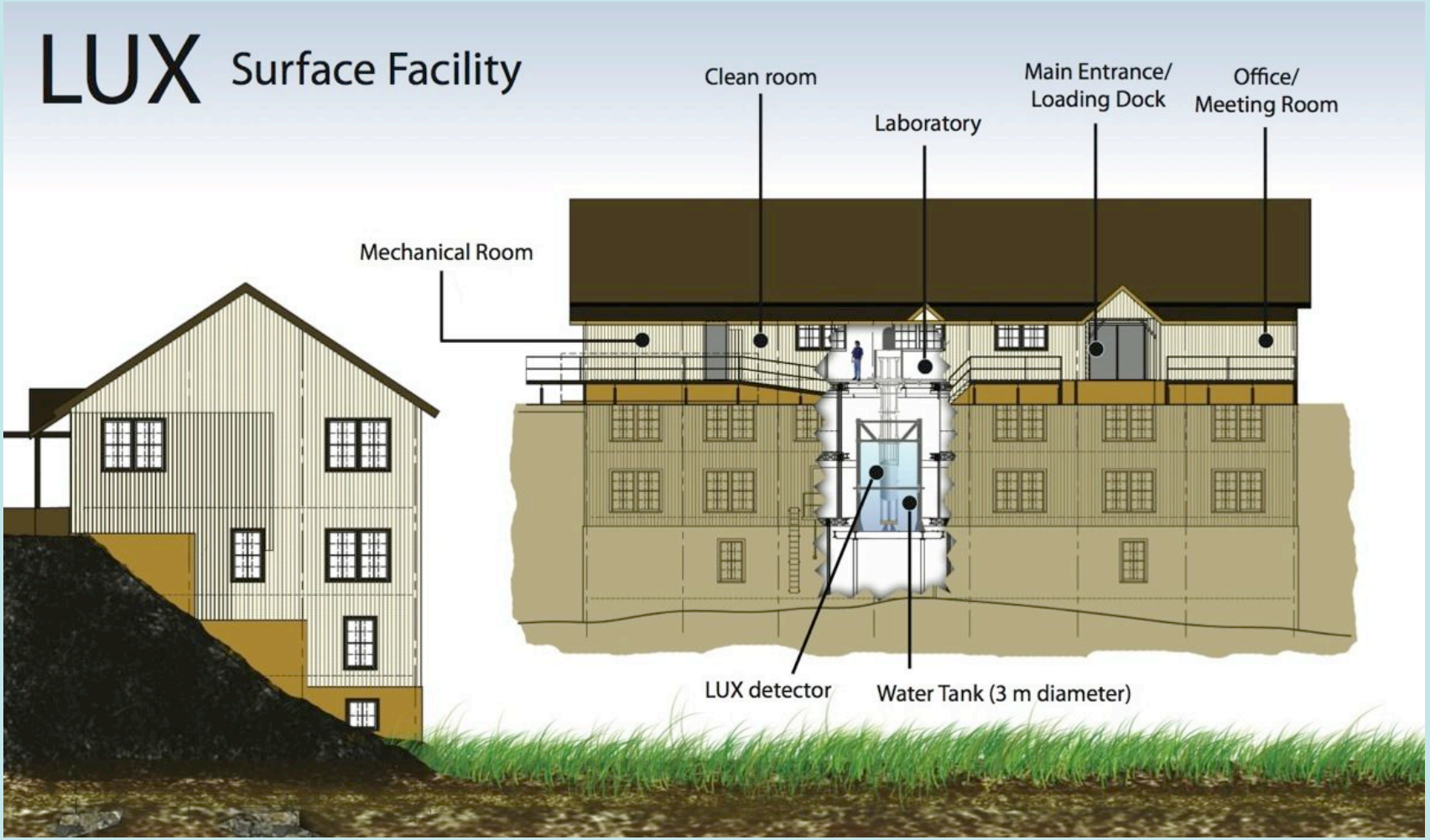
Sanford Lab Pioneers

Physics Backgrounds (USD, Regis, BHSU, UTK)



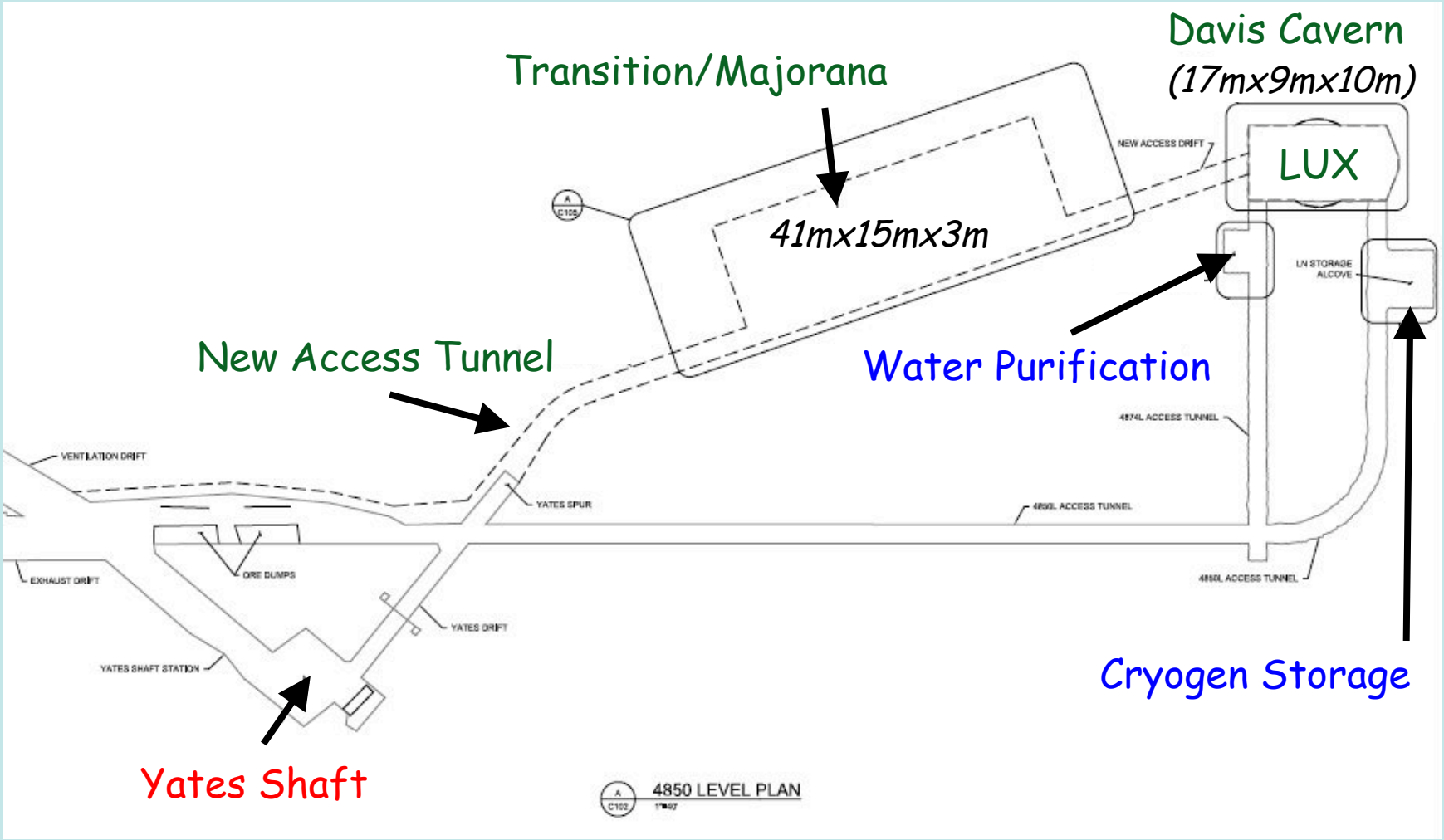
New Sanford Lab Infrastructure

Surface Laboratory (aka Warehouse)



New Sanford Lab Infrastructure

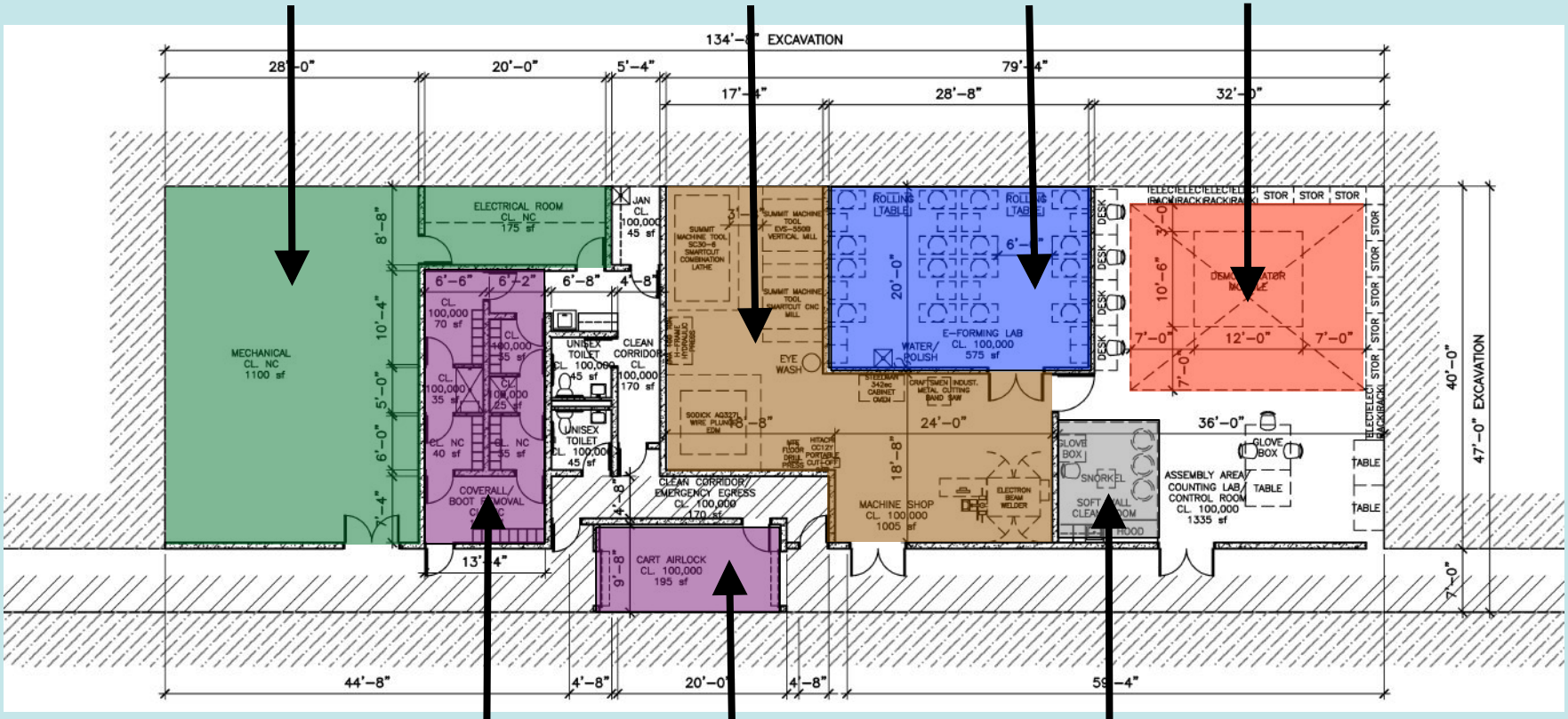
4850L Davis Campus



New Sanford Lab Infrastructure

4850L Davis Campus: LUX/Majorana Transition + Majorana

Mechanical/Electrical/Air Machine Shop Electroforming Detector



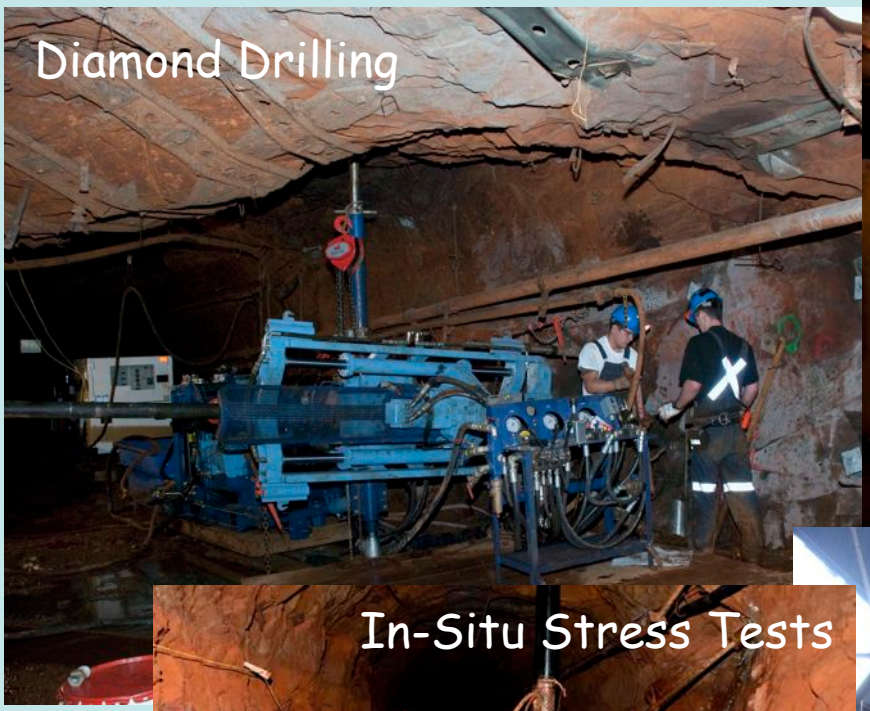
Yates Transition Airlock Cleanroom Davis Cavern

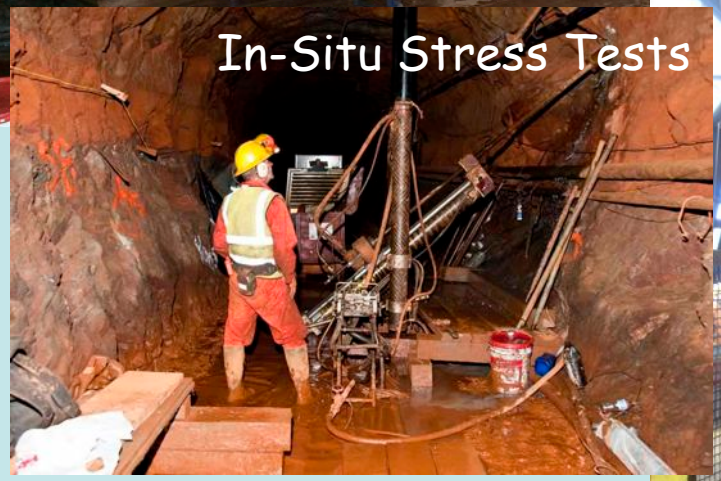
Sanford Lab at Homestake

Jaret Heise

New Sanford Lab Infrastructure

Excavation Preparations

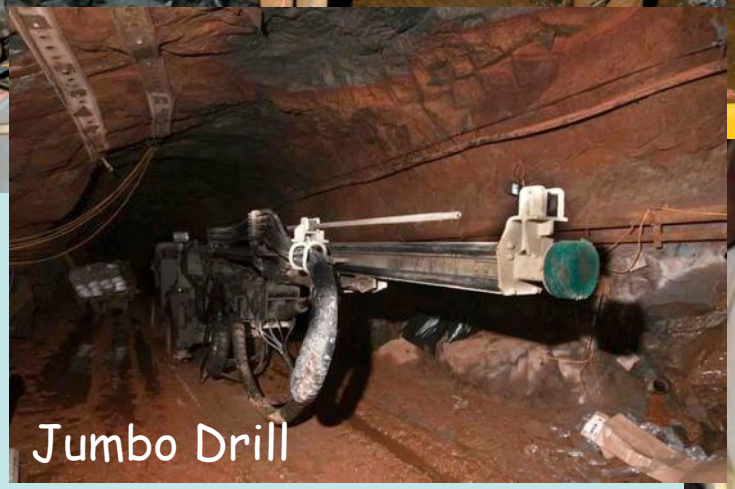




Jaret Heise

New Sanford Lab Infrastructure

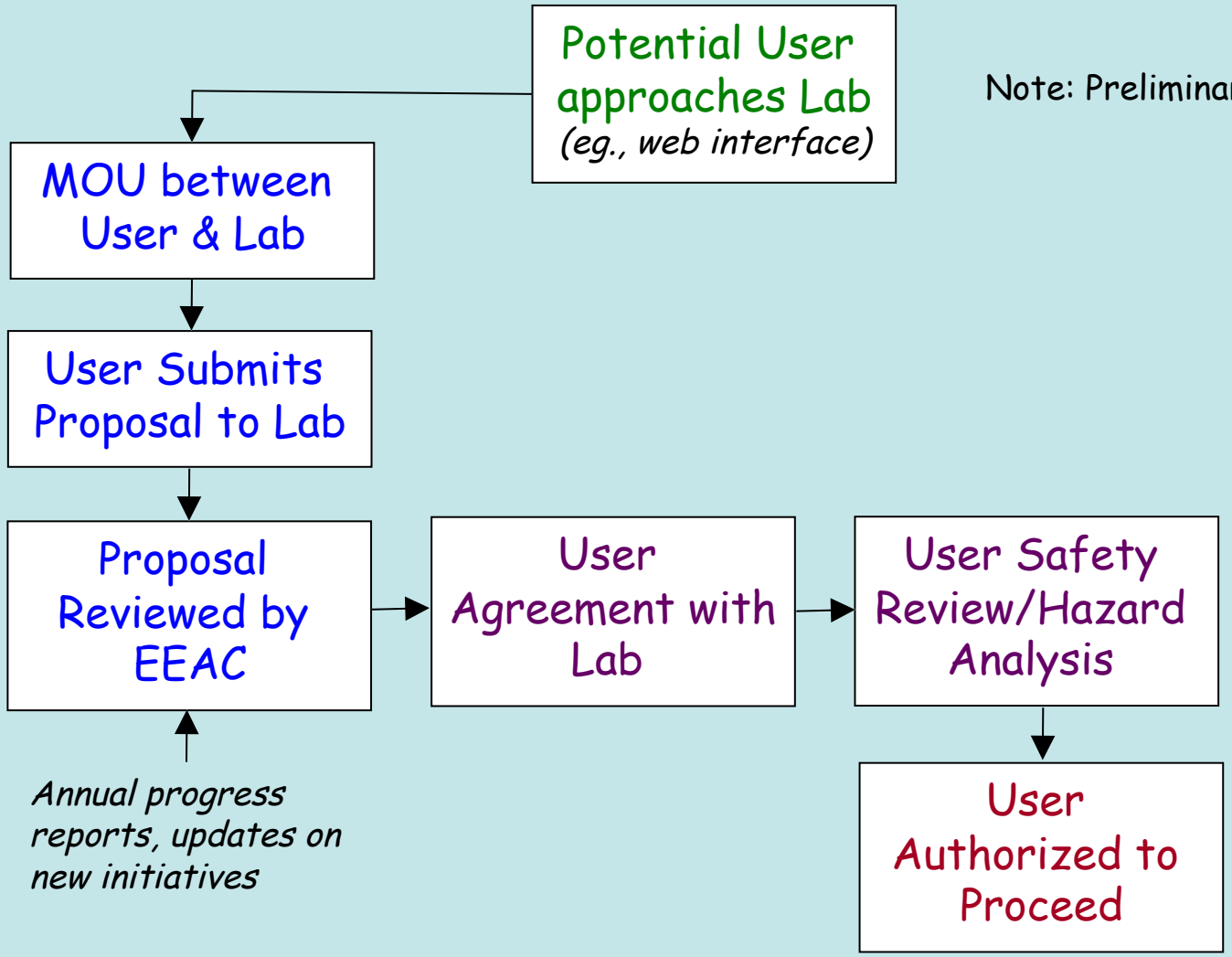
Excavation! First Blast September 23, 2009



Jaret Heise

Laboratory/Experiment Interactions

Relationship Flow Chart

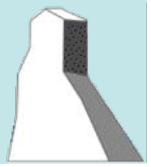


Note: Preliminary, work in progress

Sanford Laboratory Summary

Highlights

- Good progress with dewatering and infrastructure improvements:
  - → *Water level currently ~4996 feet below surface*
  - → *Expect to reach 5000L shortly, continue pumping to the 8000L*
  - → *Re-commission Yates Shaft, extend power and IT to 4850L*
- Good Science progress:
  - → *Geology, biology, physics on several levels (and expanding!)*
    - Over a dozen projects on a dozen levels
  - → *Two large physics experiments onsite in 2009*
    - LUX: Surface Lab renovation started July 2009, occupancy Oct 2009
    - 4850L Temporary Lab preparations to begin ~October 2009, occupancy Winter 2009
    - Majorana/LUX: 4850L Davis Campus preparations started August 2009, occupancy Summer/Fall 2010
  - → *Working to develop a robust User Liaison program*



Thank You, Jose!