SANFORD UNDERGROUND RESEARCH FACILITY

SURF Overview

Deb Wolf – Dir. of Strategic Partnerships

Higher Education Connections Workshop
Pre-Record

Deb Wolf – Director of Strategic Partnerships

Experience includes over 30 years serving K-12 education:

- **K-12 classroom teacher & instructional coach**
- **State level – SD Dept of Education – Education Innovationist**
- **Professional development facilitator**

2018 – Director for Education & Outreach at SURF

2021 – Director of Outreach and Culture, Strategic Partnerships

Sanford Underground Research Facility

SURF Mission:

We advance world-class science and inspire learning across generations.

SURF Vision:

The world's preferred location for underground science and education.

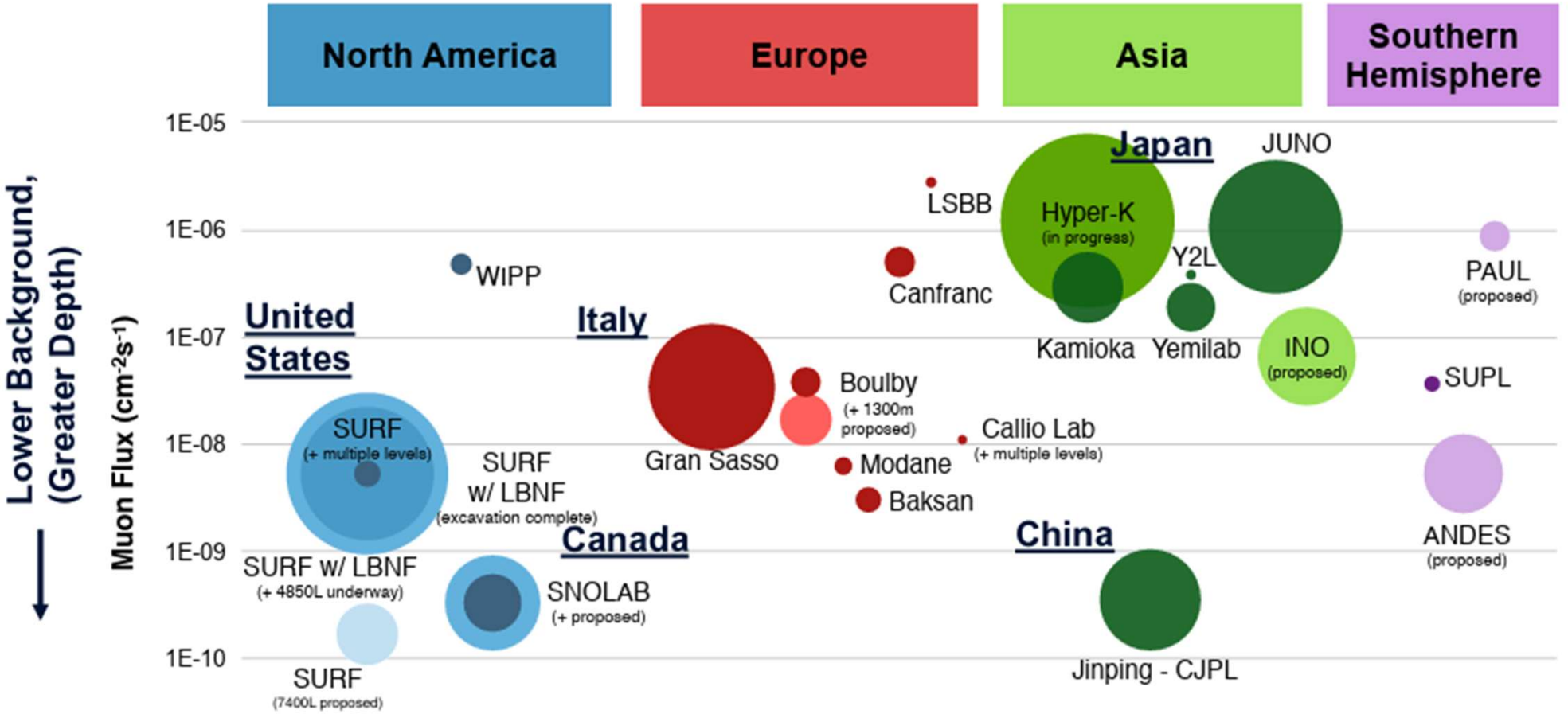
SURF serves the entire underground science community

SURF welcomes and encourages research from all disciplines that are able to take advantage of the unique attributes of our laboratory

Sanford Underground Research Facility

Where in the world is SURF?

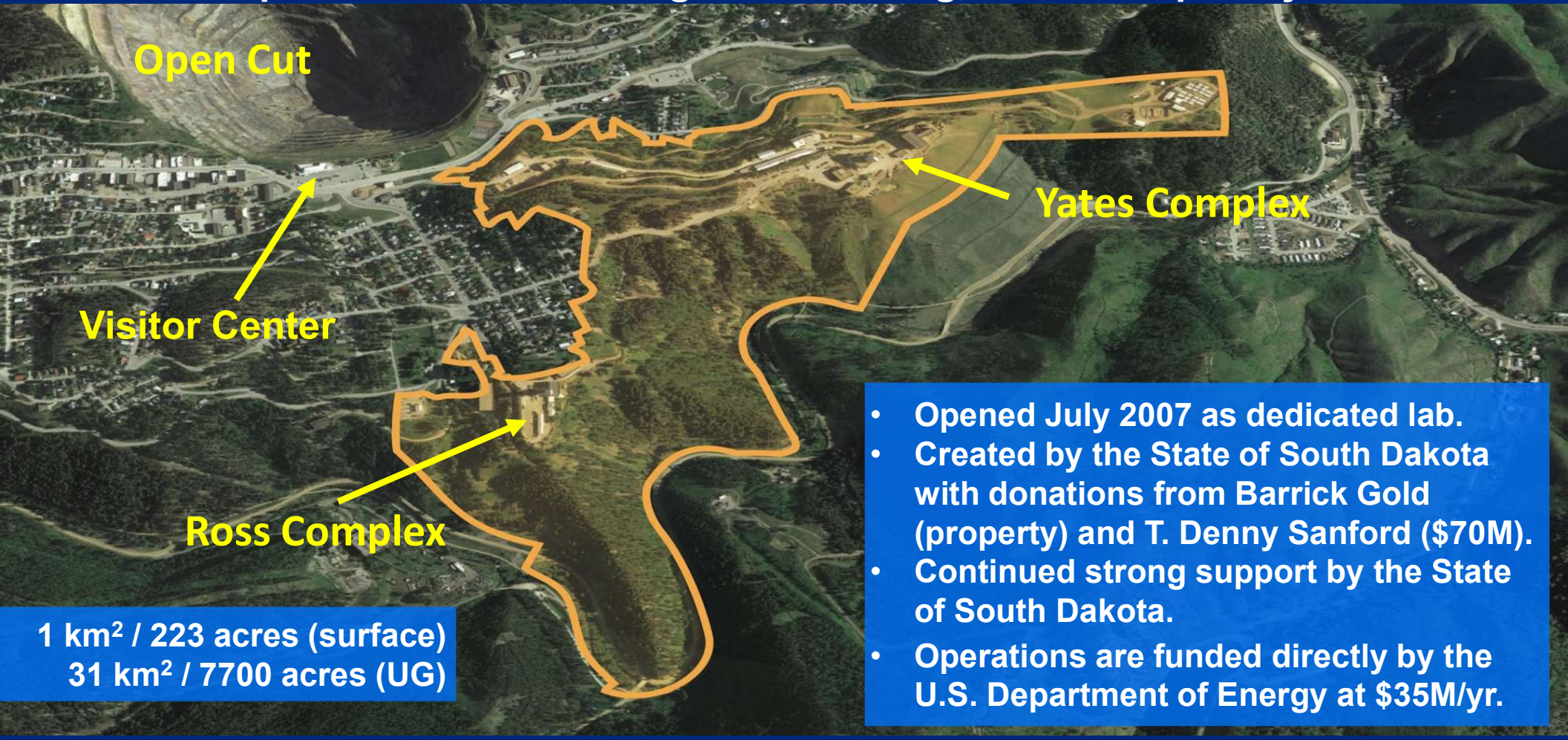
SURF in the Global Context



Note: Circles represent volume of science space

Sanford Underground Research Facility

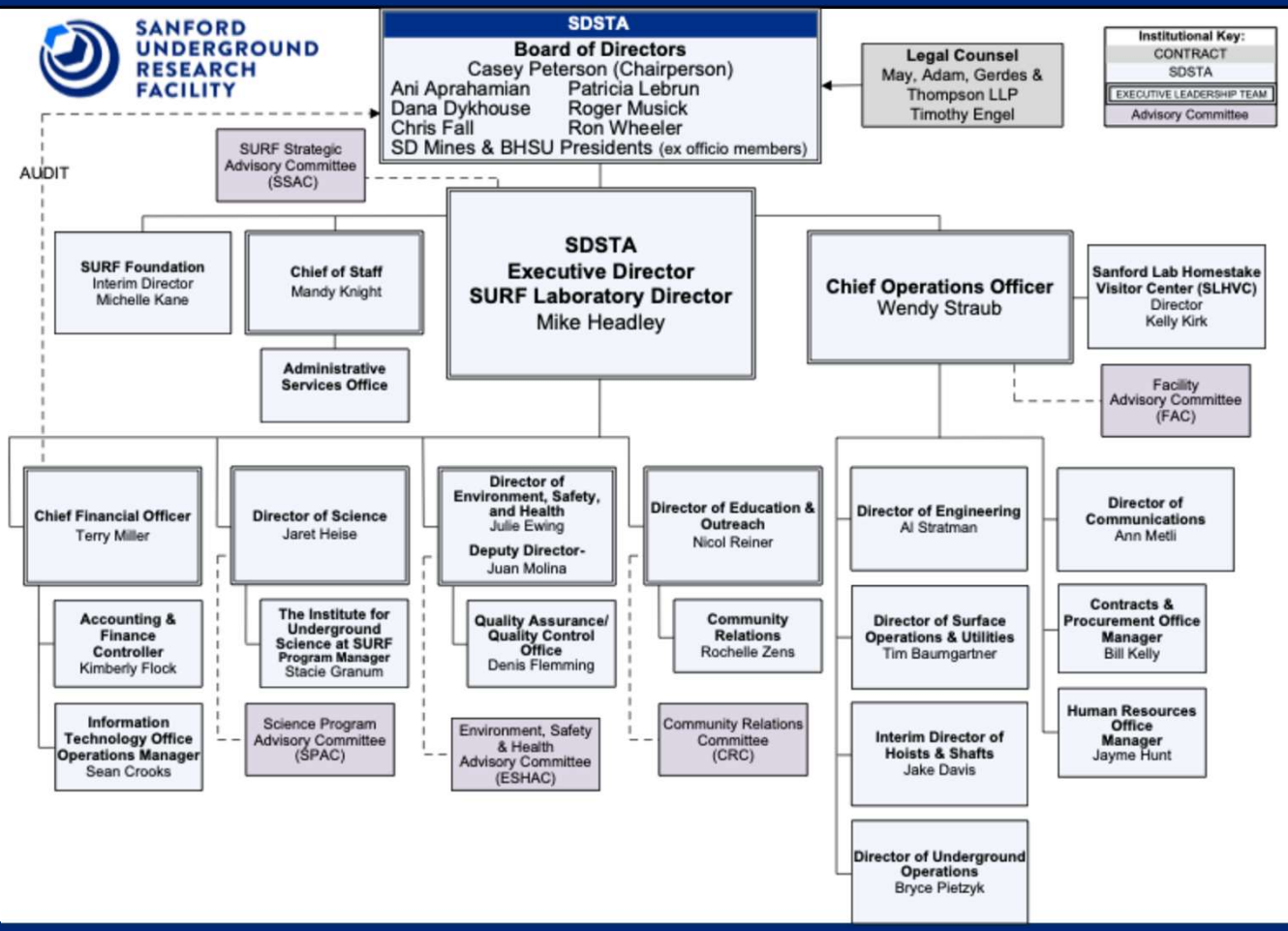
Nation's deepest UG lab, advancing world-leading, multi-disciplinary research



- Opened July 2007 as dedicated lab.
- Created by the State of South Dakota with donations from Barrick Gold (property) and T. Denny Sanford ($70M).
- Continued strong support by the State of South Dakota.
- Operations are funded directly by the U.S. Department of Energy at $35M/yr.

1 km^2 / 223 acres (surface)
31 km^2 / 7700 acres (UG)

Organizational Chart



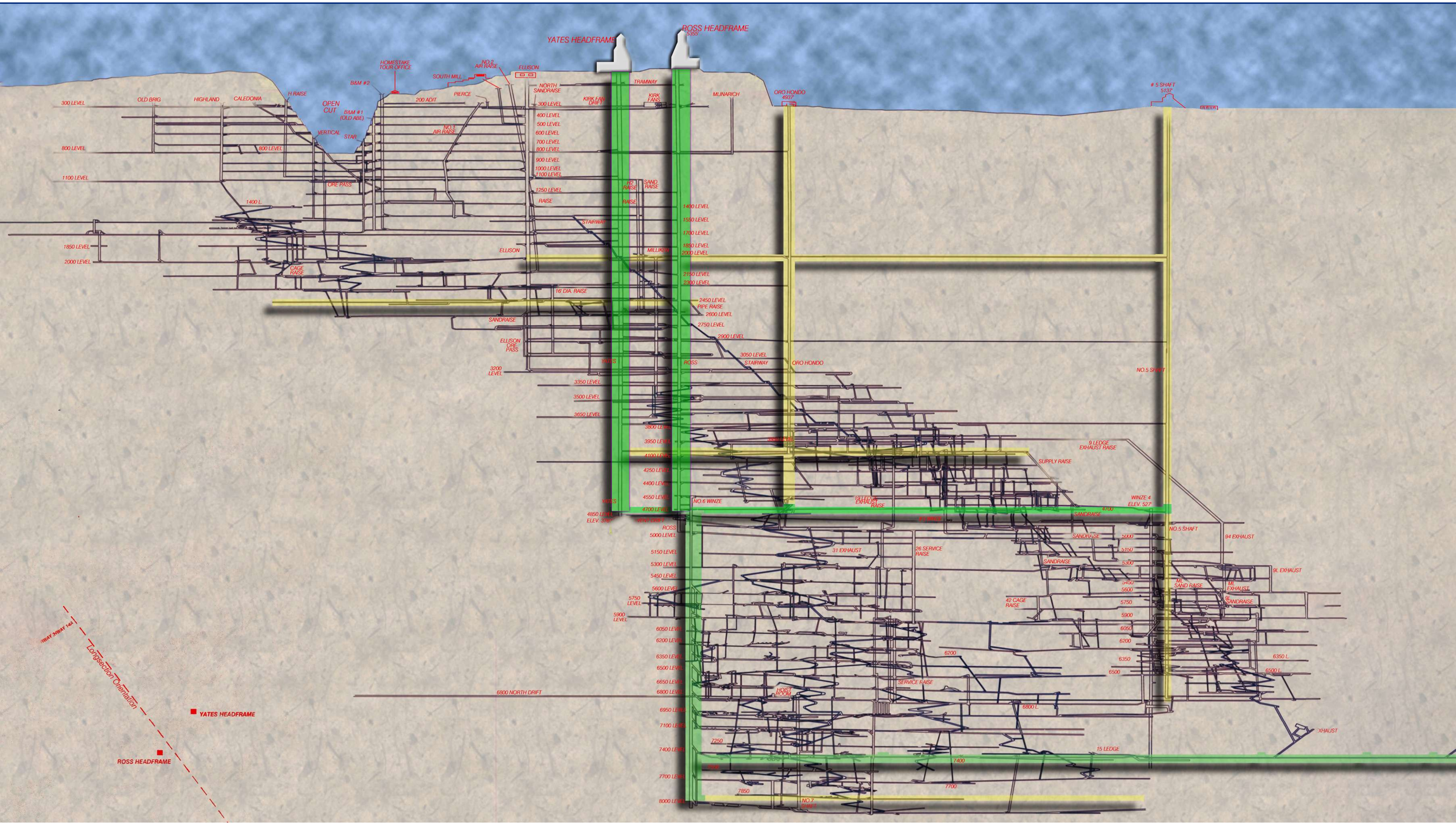
SURF Operations Cooperative Agreement (CA)

- CA established a direct relationship between DOE and SDSTA
- Original agreement included 5 years of SURF ops at $125M total (Federal FY20-24).
- CA “renewal” for an additional five years awarded in Sept 2024. Added $208M.
- Under the CA, the SDSTA operates and maintains SURF in support of the science mission. Provides all personnel, facilities, equipment, supplies, and services. Manages the overall effort.
- CA scope includes “Basic Support” to approved Non-Proprietary users without charge. The user will pay for costs incurred for services over and above basic support.
- Costs to support Proprietary users must be fully recovered per DOE direction.
- DOE funds SURF Infrastructure Improvement Projects through the CA to ensure safe and reliable operations.

SURF Long-Term Goals

By 9/30/2035, SURF will have world-leading multi-disciplinary experiments in operations with proposed experiments actively competing for newly developed underground laboratory space including:

1. The Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE) have been constructed and are fully operational.
2. Yates Shaft and Hoists have been fully reconstructed and modernized.
3. Maximize science with existing space to include a cryogenic user facility and potential LUX-ZEPLIN (LZ) upgrade.
4. Additional lab space on the 4850L has been constructed and is fully operational to support next generation science, including at least one Generation 3 Dark Matter experiment.
5. The Institute for Underground Science at SURF has been constructed and is fully operational with compelling, vibrant science, and education programs.
6. Foster commercial partnerships to advance technology development in the region, increase facility operations efficiency and safety, and expand workforce development opportunities.

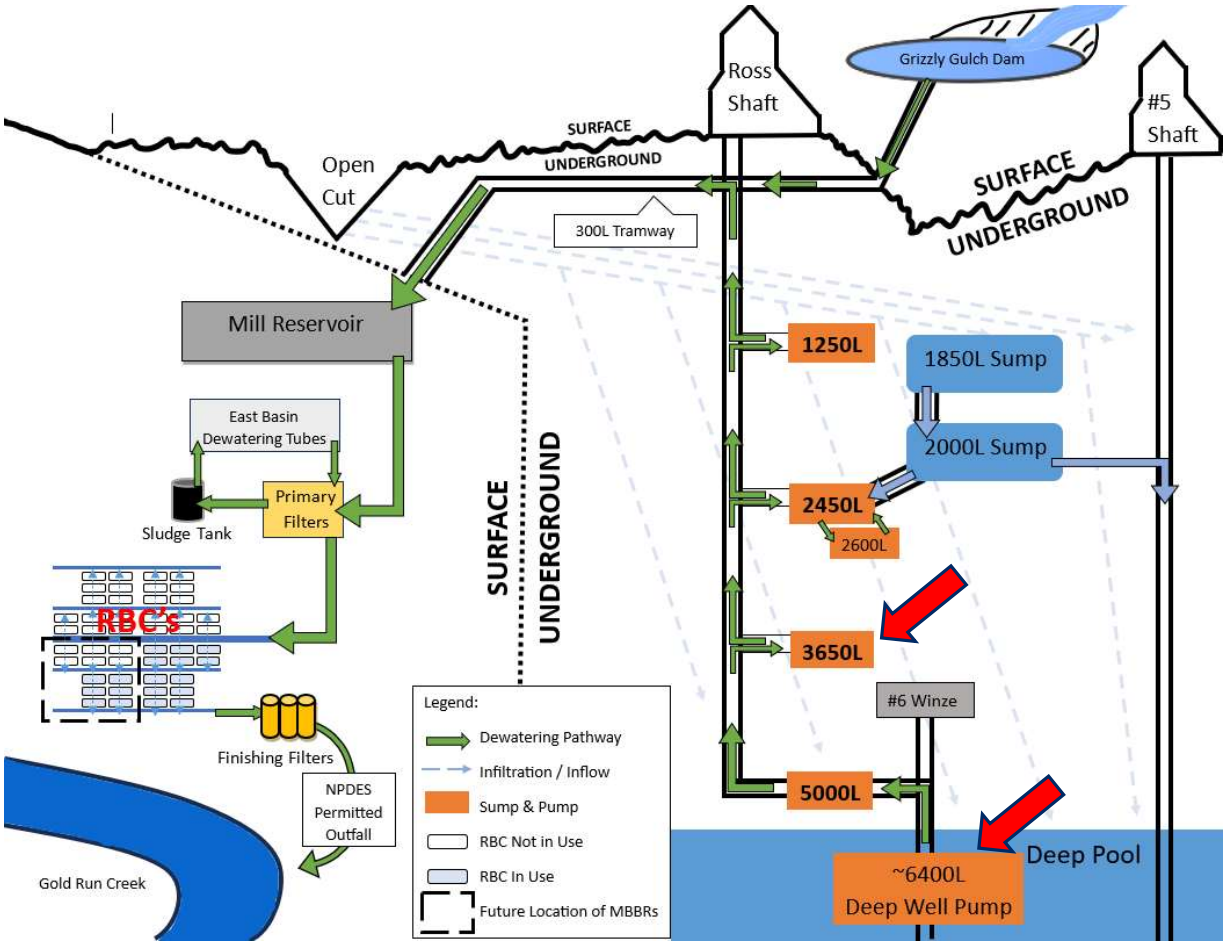


YATES HEADFRAME
ROSS HEADFRAME
HOMESTAKE TOUR OFFICE
NO.2 AIR RAISE
ELLISON
SOUTH MILL
B&M #2
OPEN CUT
B&M #1 (OLD ABE)
H RAISE
VERTICAL
STAR
300 LEVEL
OLD BRIG
HIGHLAND
CALEDONIA
200 ADIT
PIERCE
NORTH SANDRAISE
TRAMWAY
KIRK FANS
MUNARICH
ORO HONDO
5 SHAFT
NO.1 AIR RAISE
800 LEVEL
1100 LEVEL
ORE PASS
1400 L.
400 LEVEL
500 LEVEL
600 LEVEL
700 LEVEL
900 LEVEL
1000 LEVEL
1250 LEVEL
RAISE
STAIRWAY
SAND RAISE
1400 LEVEL
1550 LEVEL
1700 LEVEL
1850 LEVEL
2000 LEVEL
1850 LEVEL
2000 LEVEL
ELLISON
CAGE RAISE
16' DIA. RAISE
2150 LEVEL
2300 LEVEL
2450 LEVEL
PIPE RAISE
2600 LEVEL
2750 LEVEL
2900 LEVEL
SANDRAISE
ELLISON ORE PASS
3050 LEVEL
STAIRWAY
ORO HONDO
3200 LEVEL
YATES
ROSS
NO.5 SHAFT
3350 LEVEL
3500 LEVEL
3650 LEVEL
3800 LEVEL
3950 LEVEL
4100 LEVEL
4250 LEVEL
4400 LEVEL
4550 LEVEL
4700 LEVEL
4850 LEVEL
9 LEDGE EXHAUST RAISE
SUPPLY RAISE
NO.6 WINZE
WINZE 4
SANDRAISE
5000 LEVEL
5150 LEVEL
5300 LEVEL
5450 LEVEL
5600 LEVEL
5750 LEVEL
5900 LEVEL
31 EXHAUST
26 SERVICE RAISE
NO.5 SHAFT
94 EXHAUST
42 CAGE RAISE
6050 LEVEL
6200 LEVEL
6350 LEVEL
6500 LEVEL
6650 LEVEL
6800 LEVEL
6950 LEVEL
7100 LEVEL
7400 LEVEL
7700 LEVEL
8000 LEVEL
6800 NORTH DRIFT
SERVICE RAISE
HOIST ROOM
15 LEDGE
7400
7700
7850
NO.7 SHAFT
Longsection Orientation
YATES HEADFRAME
ROSS HEADFRAME

SDSTA Dewatering System

- The Dewatering System at SDSTA is responsible for removing and treating all the natural water inflows that accumulate underground
- Without this system natural water accumulation underground would continue to rise eventually overtaking the lab spaces and levels

Dewatering Statistics	Gallons Pumped
Pumped Yearly Average	348 Million
Treated Yearly Average	601 Million
Total Discharge (since 2008)	10.2 Billion



SD Discharge Permit Compliance

17 Years → 10,000,000,000+ Gallons Discharged → 50,000+ Analytes Sampled → **0 Violations**

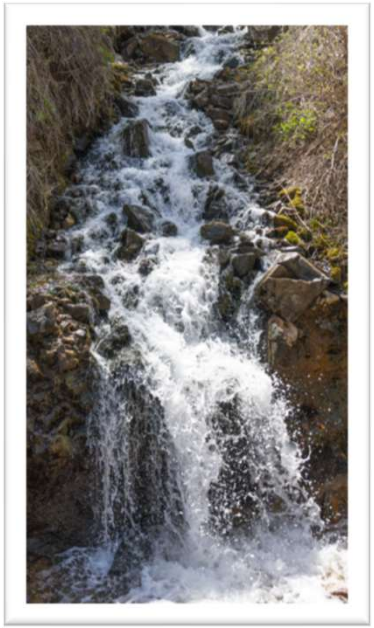
Discharging under Homestake Mine's administratively continued 2004 NPDES Permit

Discharged Water

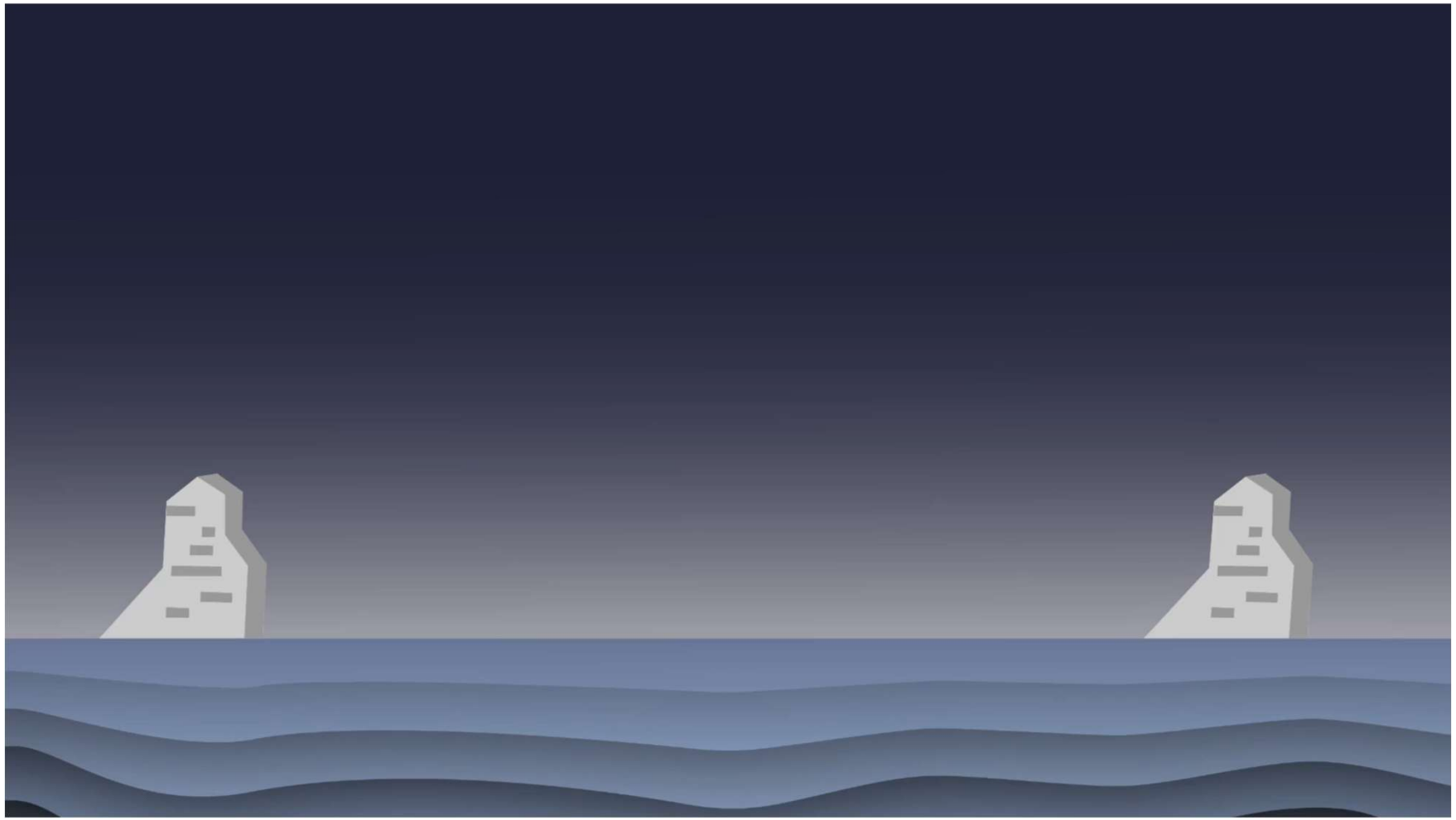
Daily: TSS, Ammonia, pH, Flow, Temperature (effluent and receiving water)
Weekly: Cyanide, As, Cu, Pb, Hg, Ag, Se, Nitrates, Hardness, TPH
Monthly: BOD_5, Cd, Cr, Ni, Zn
Semiannually: Whole Effluent Toxicity

Receiving Water Above and Below Discharge

Monthly: As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Zn, pH, TSS, TPH, Cyanide, Hardness
Annually: Aquatic Biomonitoring

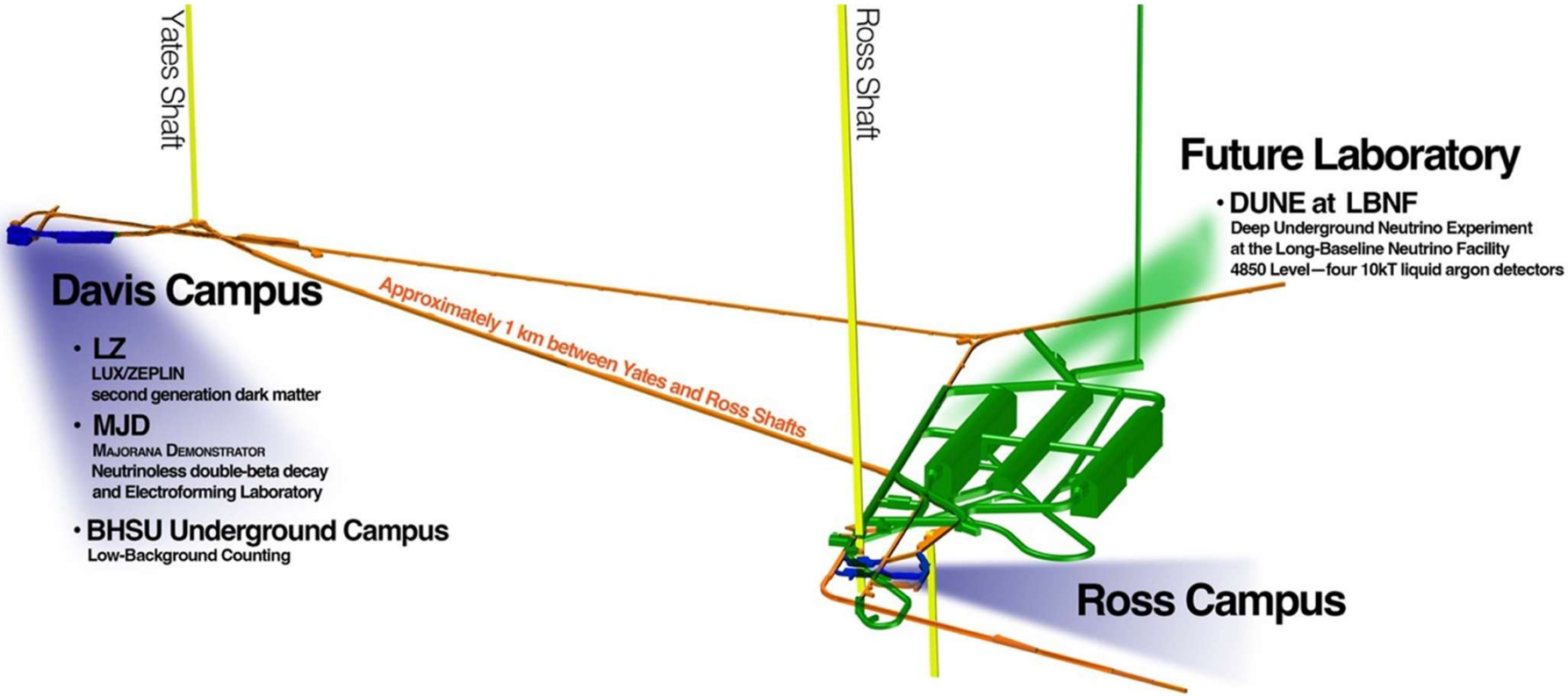


Why Do Science Underground?



Historic physics site – Homestake Experiment

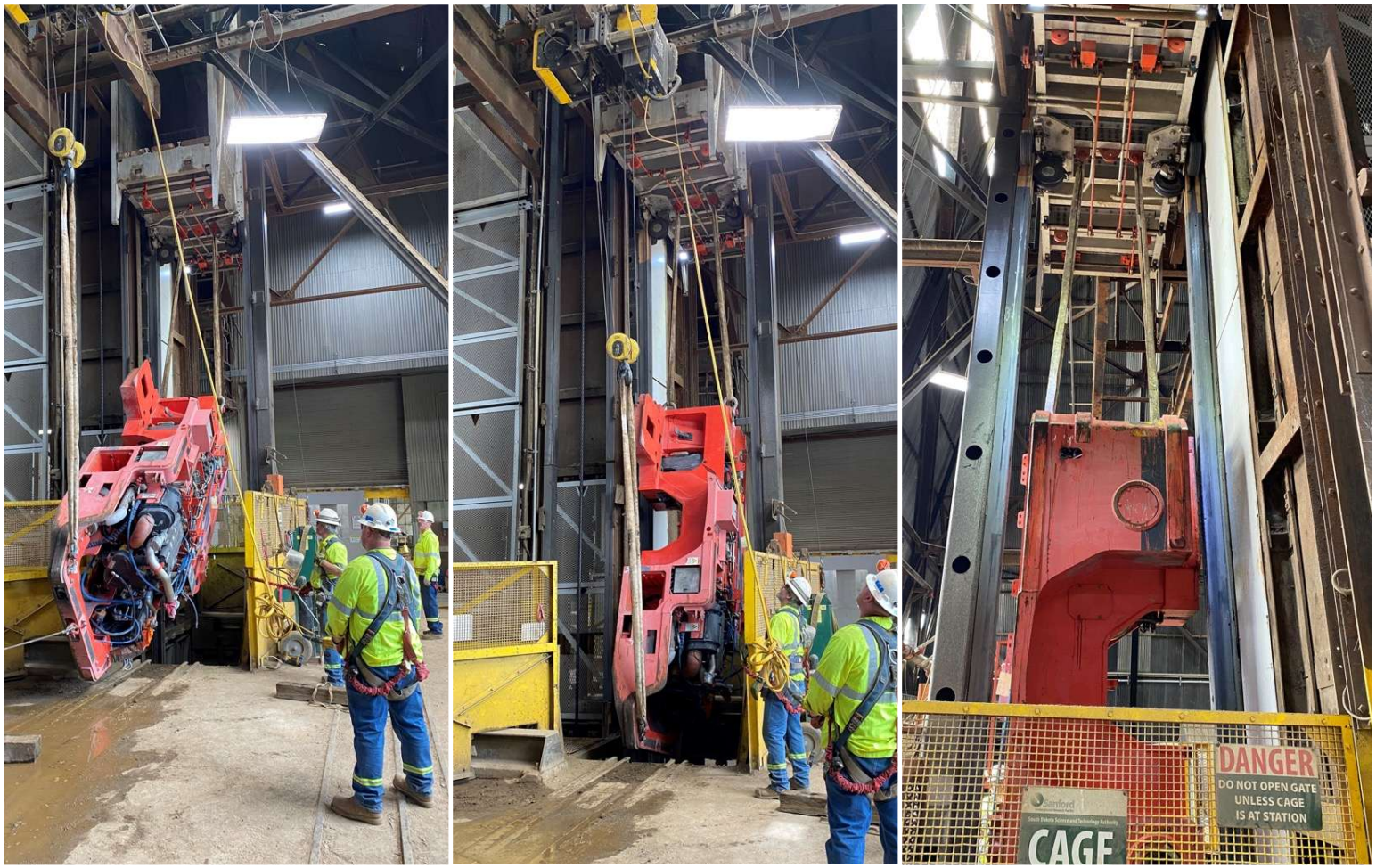
4850’ Level at SURF



What do you notice?

What do you wonder?

Mucker “Slinging” at the Shaft Collar




Dark Matter
LUX-ZEPLIN
Neutrinos
MAJORANA DEMONSTRATOR
LBNF /DUNE
Science Program
Biology
Extreme Life
Astrobiology
Geology
Geothermal Energy
Seismic Studies

Areas of Impact

Across South Dakota

SANFORD UNDERGROUND RESEARCH FACILITY

30 ONGOING RESEARCH POJECTS*

*24 include members from South Dakota universities

$2B NET ECONOMIC IMPACT by 2029

1,200 JOBS CREATED by 2029

16,000 - 22,000

Students and reached annually

K-12 Education & Outreach – By the Numbers

School Year	2019-2020 (covid begins)	2020-2021 (during covid)	2021-2022	2022-2023	2023-2024	2024-2025
Field Trips	254	58	485	972	966	1,437
Classroom Presentations	3,704	2,005	14,038	12,799	10,281	14,712
Curriculum Units	3,236	3,384	3,718	2,554	3,965	4,171
Other	918	298	1,468	1,596	1,368	1,793
Total Student Contacts	8,112	5,745	19,709	17,921	16,580	22,113

Provide professional development and support to **more than 400** educators during the school year.

Powerful Partnerships: Magnifying Outreach Impact

- Black Hills State University
  - NSF EPSCoR/SD E-CORE
  - CIRCLES Alliance
  - QuarkNet
- Jackson State University
- University of Wyoming & WY Space Grant Consortium
- SD Space Grant Consortium
- SD Army National Guard
- STEM Researchers: CETUP, PPC, DUNE
- International Outreach Collaboration: Fermilab, SNOLAB, Perimeter Institute, CERN, University of Zurich (UZH), University of Bern, ARC Centre for Dark Matter Research in Australia
- Internal

Sanford Lab Homestake Visitor Center (SLHVC)

Building Meaningful Relationships with Diverse Audiences

Diverse Audiences

- Intergenerational year-round programming
- Venue space for SURF and its affiliates
- Local community
- Tourists

Engaging Content

- Docent tours
- Ask-a-Scientist events
- *Deep Talks* lecture series
- *Deep Roots* cultural events
- Tours to hoistroom and Čhaŋgléška Wakȟáŋ

Accessible Opportunities

- Accessibility strategic plan in process
- Serves as SURF's public "front door"
- Multi-use space
- Community partner:
  - Voter polling site
  - Visitor center for tourists
  - Exploring public EV charging station

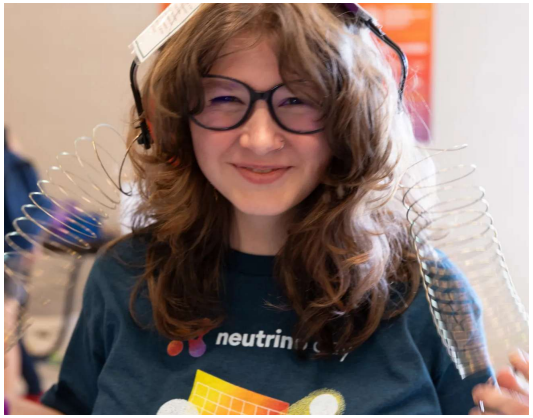
By the Numbers

	2023	2024
Visitors	57,317	58,136
States	*50*	*50*
Countries	*33*	*42*
Buses	139	137
Events	121	124

Undergraduate Impacts

Davis-Bahcall Scholars, Summer Interns, REU

Neutrino Day 2025 Record Turnout




Cangleska Wakan, the Ethnobotanical Garden at SURF

World-leading Center for Underground Science

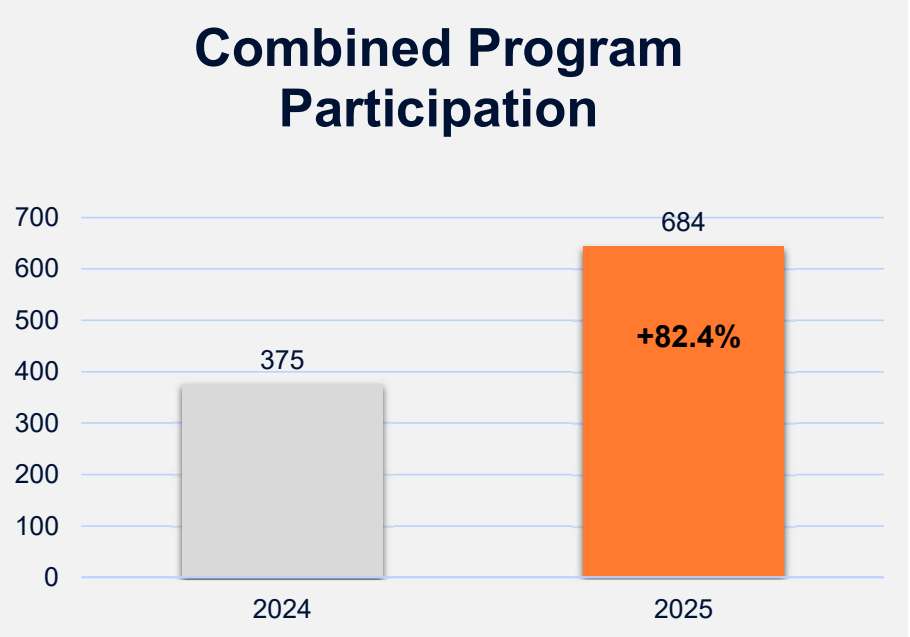
THE INSTITUTE
FOR UNDERGROUND SCIENCE
AT SURF

- Build Intellectual Community
- Expand Educational Opportunities
- Foster Interdisciplinary Collaboration
- Establish Passionate Partnerships
- Construct a Path for Future Generations

2025 Programming Highlights

By The Numbers	2024	2025
Programs	5	6
Participants	*375*	*684+*
States/Territories	*31*	*29*
Countries	*10*	*24*

States/territories, countries of Institutions.



Be a part of SURF's future!

- Sign up for our newsletter – Deep Talks
- Watch our online science lectures
- Follow @sanfordlab on social media
- Support STEM education through donations online on our website: sanfordlab.org
- Tell your family and friends about SURF!

SANFORD UNDERGROUND RESEARCH FACILITY

The Institute at SURF | Neutrino Day | SURF Visitor Center