

Long Baseline Neutrino Facility (LBNF) Update

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Community Informational Meeting

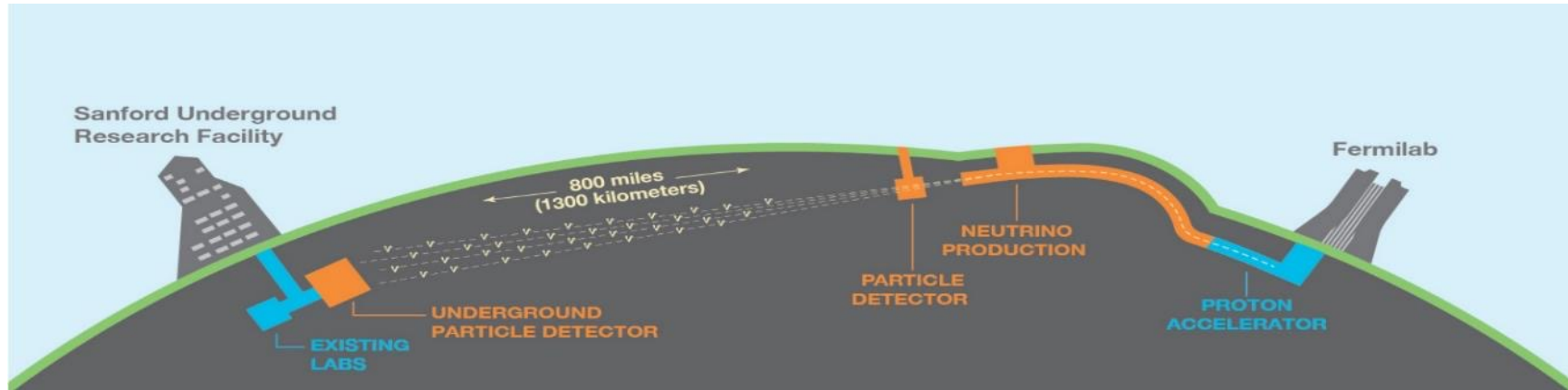
25 January 2022



U.S. DEPARTMENT OF
ENERGY

Office of
Science

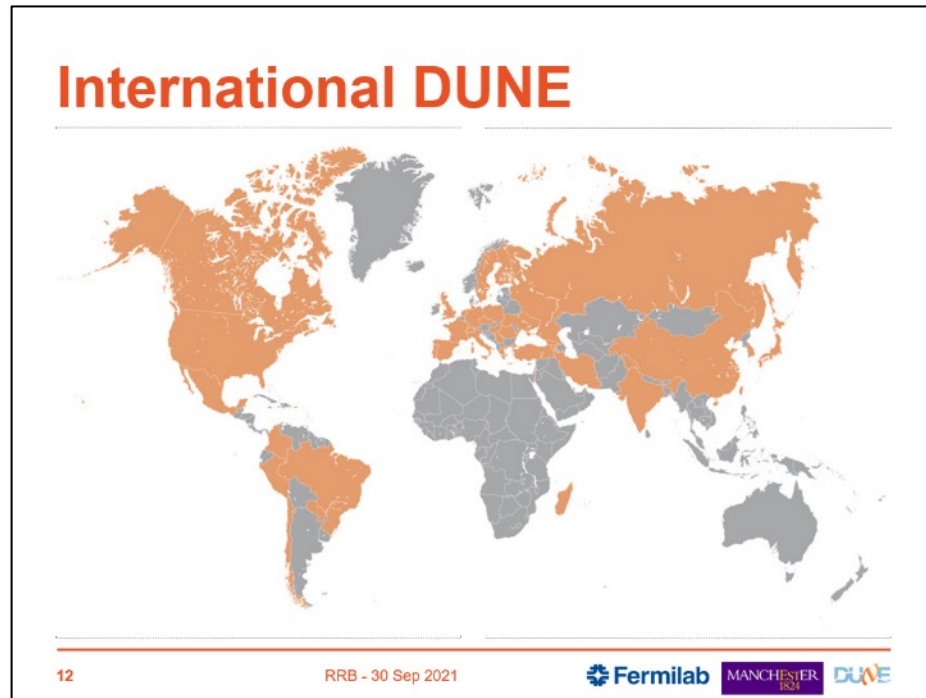
World-Class Facility supporting World-Class Experiment



- The **Deep Underground Neutrino Experiment** will be a game-changing experiment for neutrino science, potentially transforming our understanding of why the universe exists as it does.
- The **Long-Baseline Neutrino Facility** is the infrastructure necessary to send a powerful beam of neutrinos 800 miles through the earth, and measure them deep underground at South Dakota's Sanford Underground Research Facility.
- The DUNE/LBNF project will be the **first internationally conceived, constructed, and operated mega-science project** hosted by the Department of Energy in the United States.

LBNF will drive neutrino science forward the way CERN's Large Hadron Collider drove Nobel Prize-winning Higgs discovery

The DUNE experiment is managed by the international DUNE Collaboration



Collaboration statistics (as of Oct 2021)

- 1,432 collaborators, 48% U.S./52% non-US
- 217 institutions from 37 countries including CERN



Demographics (not including computing)

- Facility/Senior staff: 676
- Grad Students: 319
- Post Docs: 240
- Engineers: 158

DUNE will be the first internationally conceived and operated mega-science experiment hosted by the Department of Energy in the United States

DUNE Science Objectives

Neutrinos – most ubiquitous matter particle in the universe, yet the least understood.
Opportunities for game changing physics discoveries:



- **Origin of matter**

Discover what happened after the big bang: Are neutrinos the reason the universe is made of matter?



- **Neutron Star and Black hole formation**

Ability to observe supernovae events

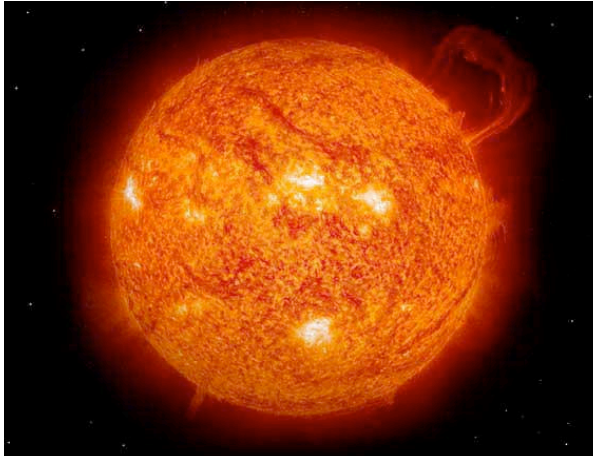
- Use neutrinos to look into the cosmos and watch the formation of neutron stars and black holes in real time



- **Unification of forces**

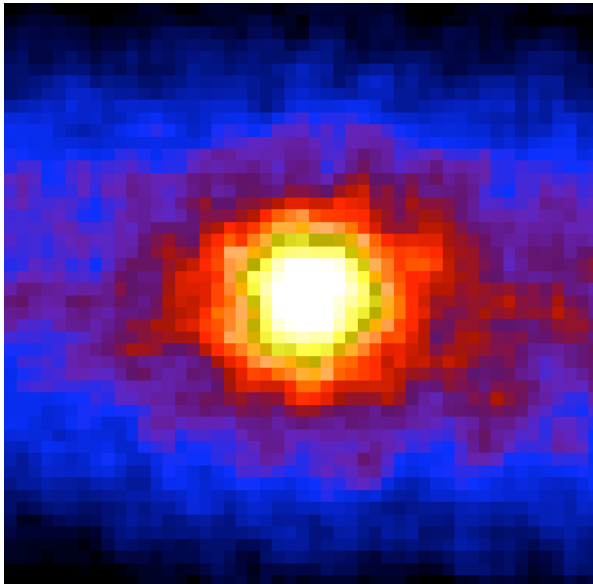
Move closer to realizing Einstein's dream of a unified theory of matter and energy

Where do neutrinos come from?



The Sun:

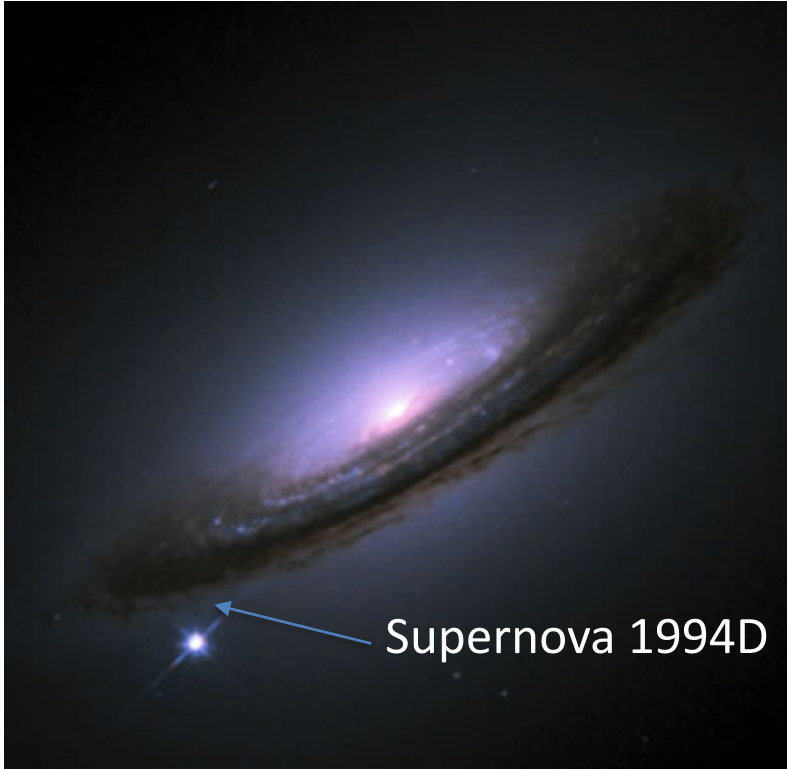
The nuclear fusion reactions that power the sun produce neutrinos



The sun shines almost as brightly in neutrinos as it does in light

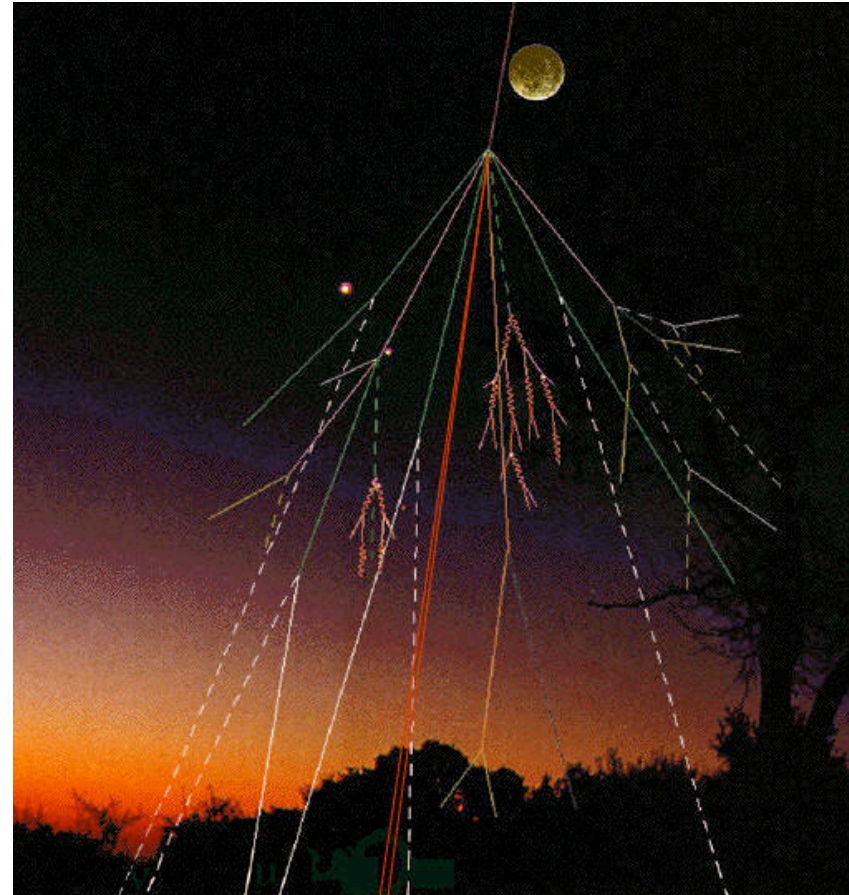
(Courtesy of Dr. Joe Lykken, Deputy Director of Fermilab for Research)

Where do neutrinos come from?



Supernovae

Cosmic rays



(Courtesy of Dr. Joe Lykken, Deputy Director of Fermilab for Research)

Where do neutrinos come from?



Nuclear reactors



The Earth's crust

(Courtesy of Dr. Joe Lykken, Deputy Director of Fermilab for Research)

Where do neutrinos come from?

Bananas



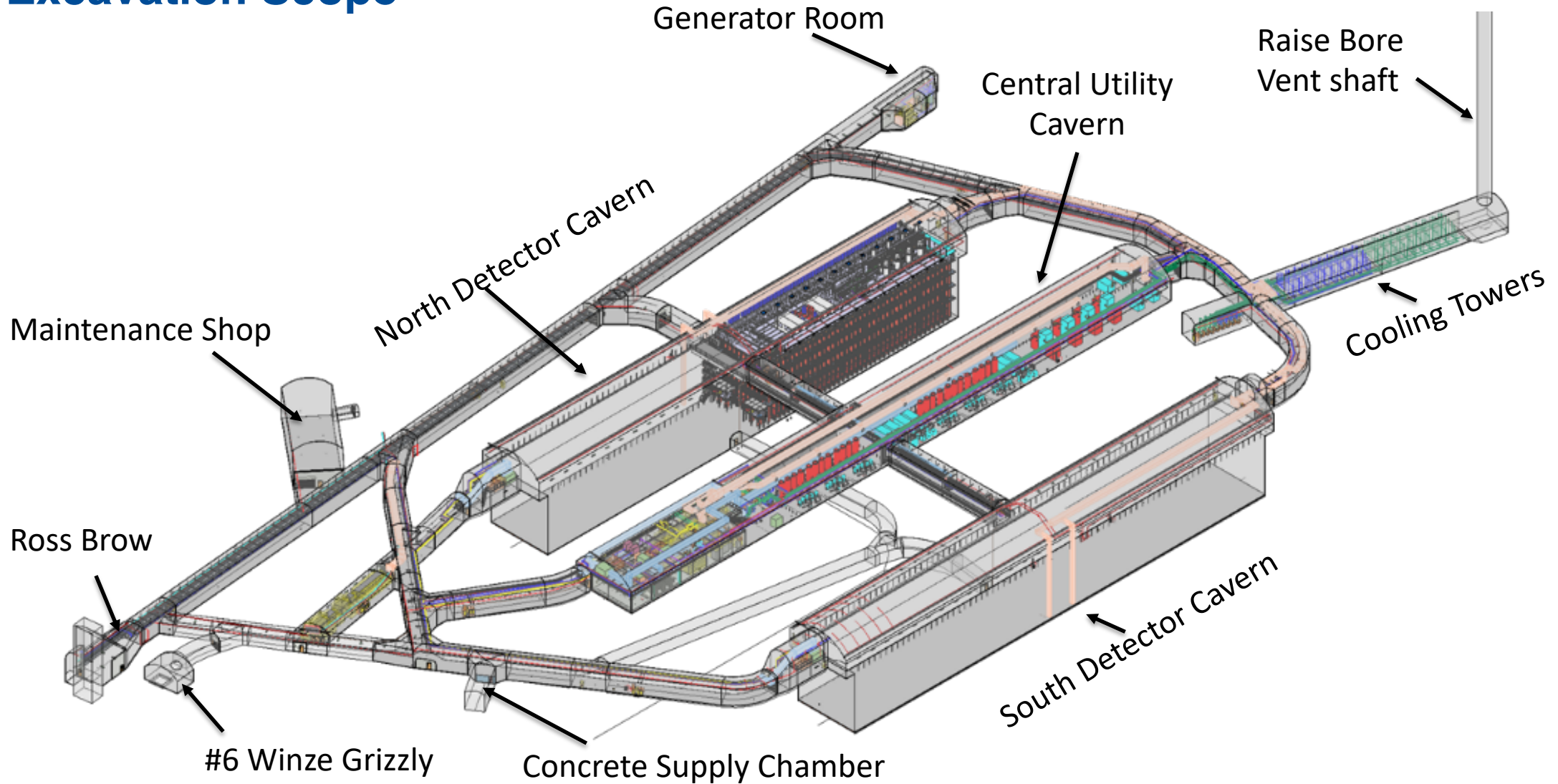
A banana emits about one million neutrinos per day from the radioactive decay of potassium 40

(Courtesy of Dr. Joe Lykken, Deputy Director of Fermilab for Research)

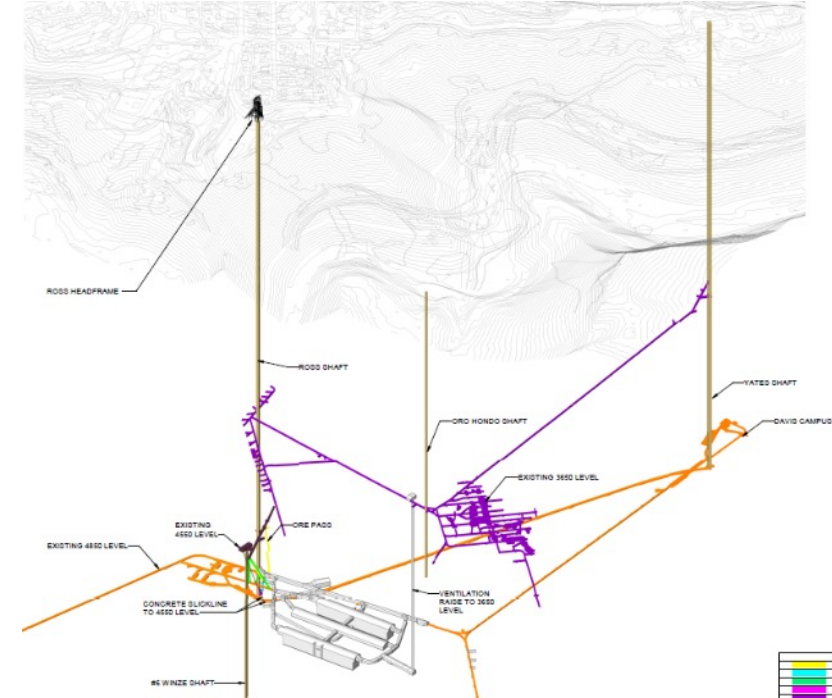
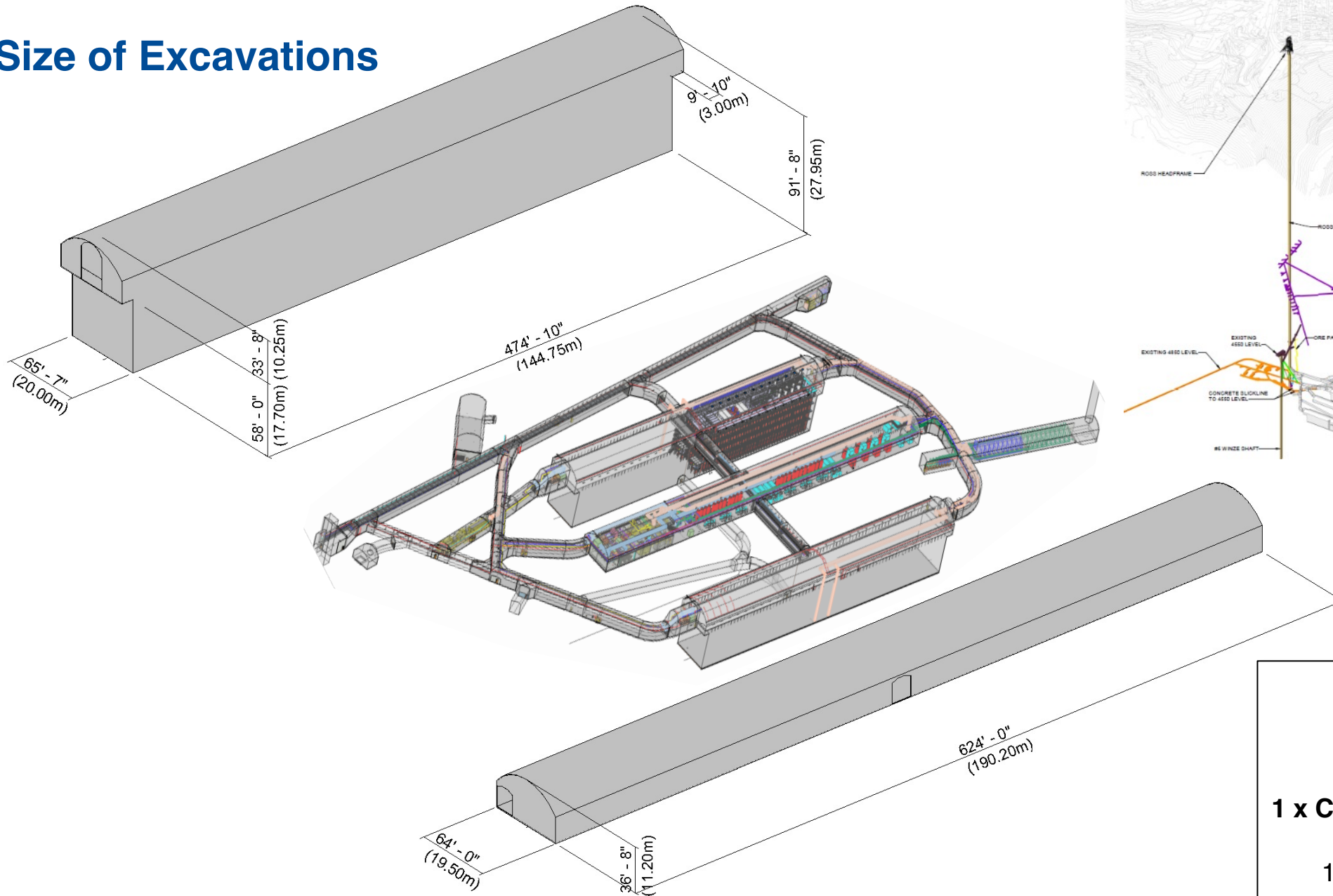
Economic Impact



Excavation Scope



Size of Excavations

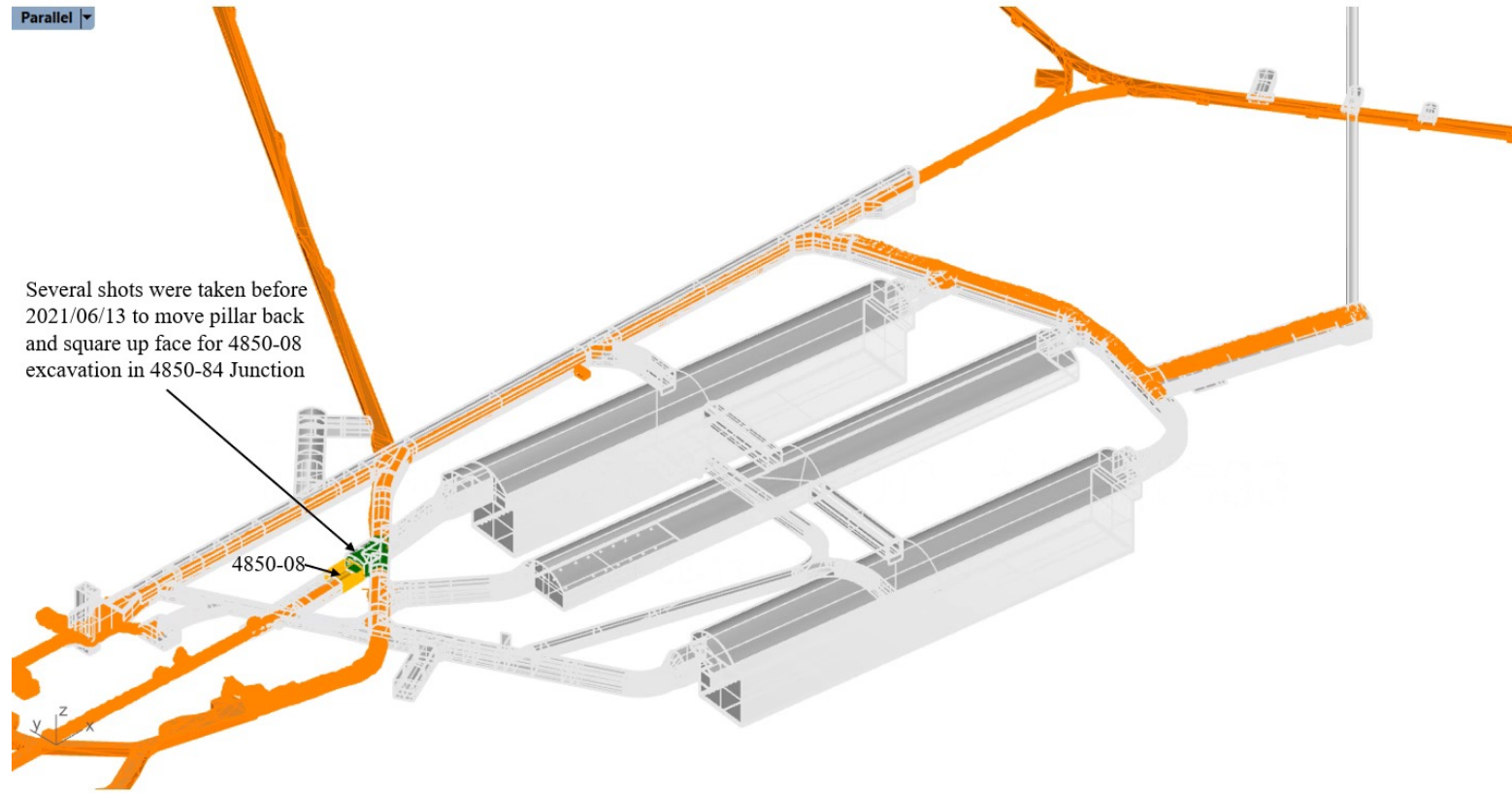


2 x Detector Caverns:
 475' L x 65' W x 92' H
 145m L x 20m x 28m

1 x Central Utility Cavern (CUC):
 624' L x 64' W x 37' H
 190m L x 20m W x 11m H

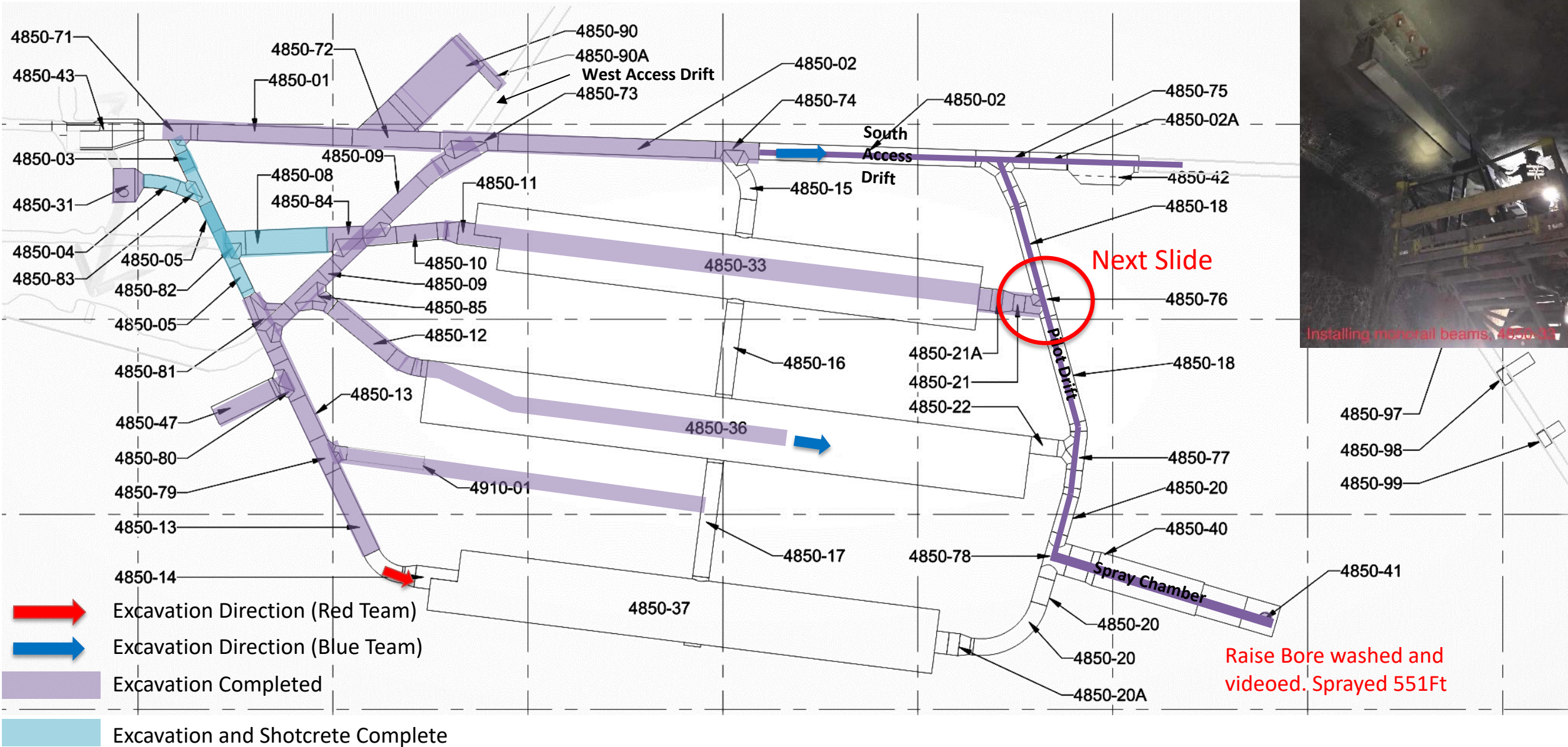
Progress through 1/9/22

Week 2021-06-13 to 2021-06-19



Total Excavation Complete 16%

January 21st 2022





North Cavern Pilot Hole Breakthrough!!!!
January 11, 2022



North Cavern Pilot Hold Looking East

Statistics as of 1/20/22

- 99,500 tons excavated (by TMI)
- 284,837 lb of explosives used
- 25,973 rock bolts installed ranging from 6' to 12' long
- 226,440 sq ft welded wire fabric (over 5 acres!)
 - 3,380 6'x11' panels
 - 105 4'x8' panels
- 1,209 cubic yards of shotcrete applied
- 83 cubic yards of concrete placed
- 36 pieces of mobile equipment mobilized to the 4850L
- Project Employees: TMI: 130, KAJV: 35, FRA: 12



Progress Photos

- U/G Construction began April 5, 2021 with Mobilization of U/G Mining Equipment



First Underground Equipment (Crete Rod) to Arrive on the 4850L



Underground Equipment Ready for Disassembling



Drill & Blast Equipment (Jumbo) Arrive on the 4850L

Progress Photos - LHD



4 CY Mucker to be disassembled and mobilized to 4850L

Raise Bore Machine



Raise Bore Machine (3650L)



12' Diameter Raise Bore Reamer Head (4850L)



Shotcrete Robot in Raise

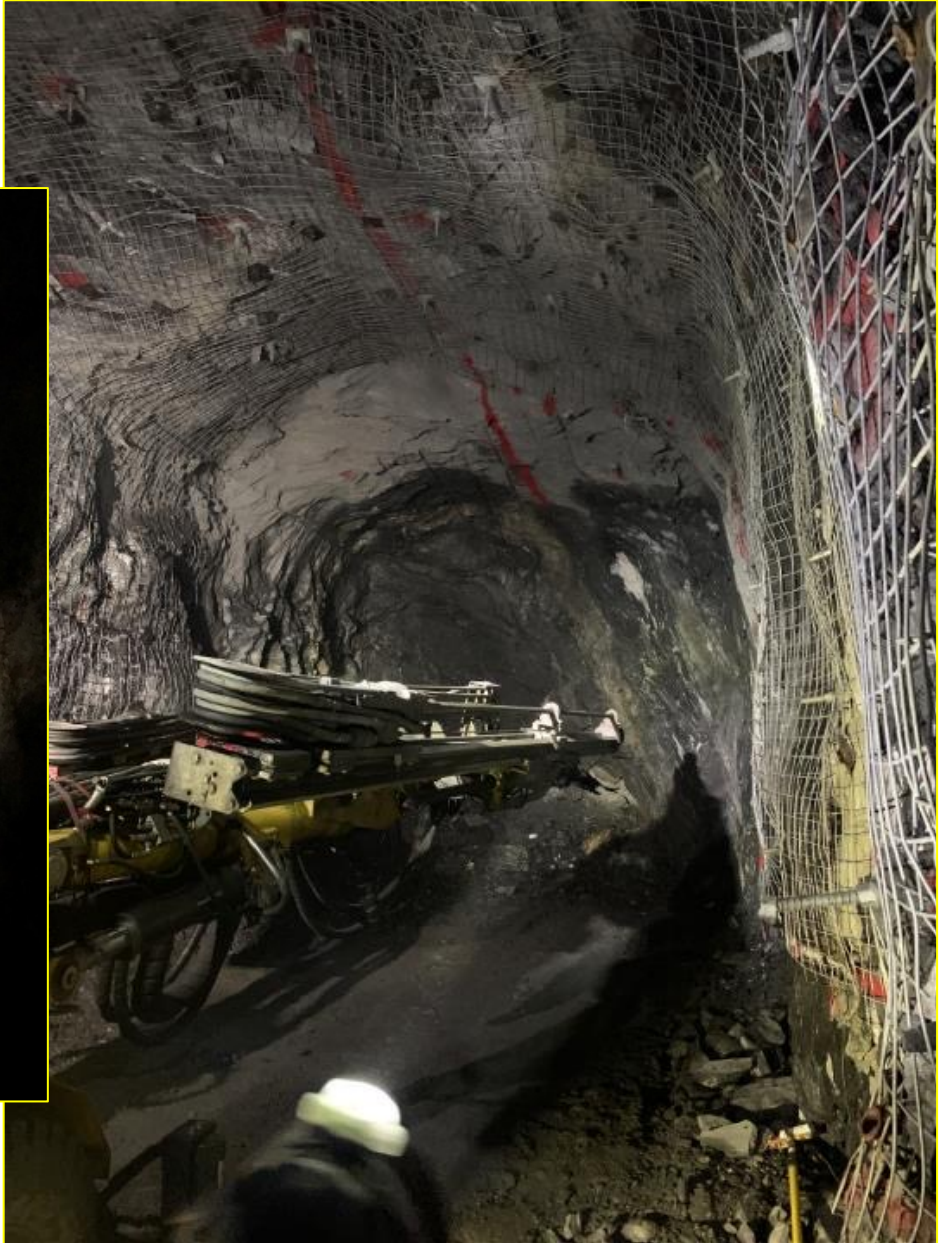
Progress Photos



Setting out the Blast Pattern

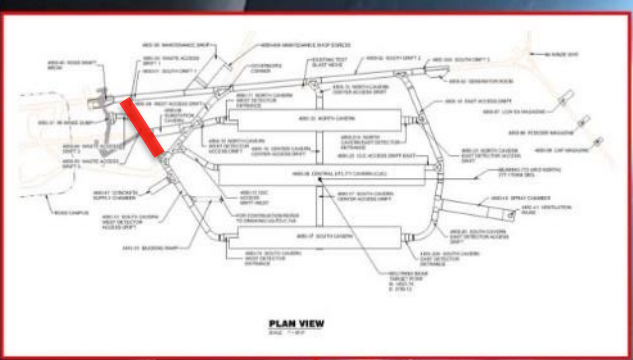


Robotic Shotcrete Machine

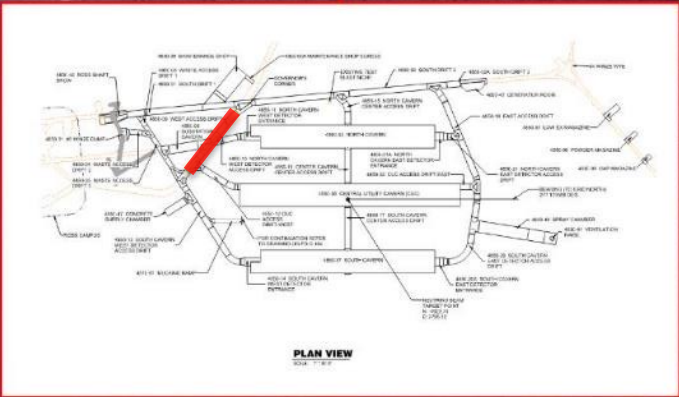
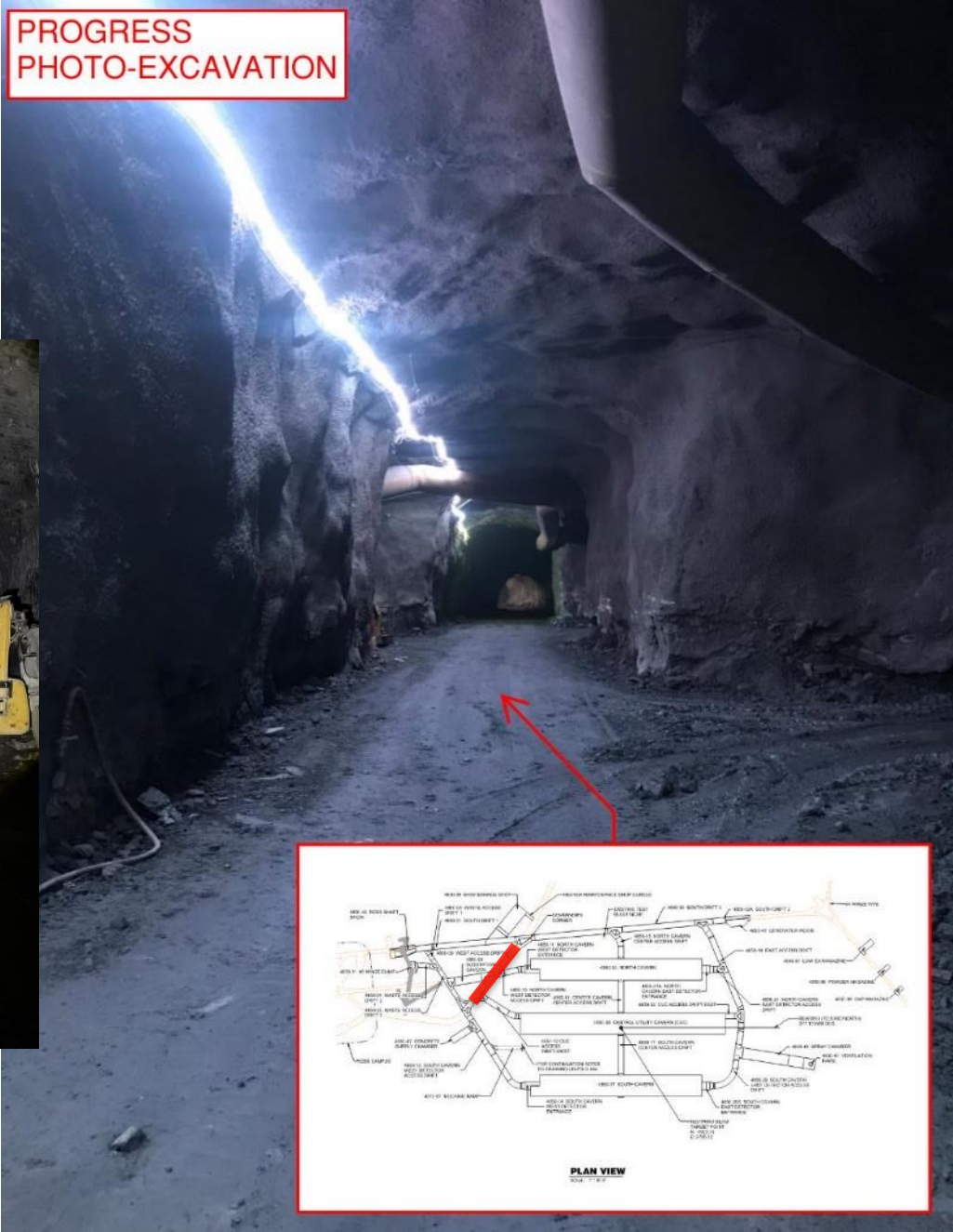


Scaling a Drift with a drill Jumbo

**PROGRESS
PHOTO-EXCAVATION**



**PROGRESS
PHOTO-EXCAVATION**



Progress Photo – Crane Beams



Thyssen Safety and Quality Performance and Community Involvement

- November marked 1 year without a recordable injury or incident by TMI!
- TMI's excavation quality is excellent.
- Thyssen is committed to being a good community partner including:
 - City of Lead Summer Beautification Sponsor
 - Organizer and Sponsor of Lead Police Department Bicycle Rodeo for Kids Safety Training Program
 - Boy Scouts of America Mining-In-Society Local Representative
 - 4th of July BBQ Co-Sponsor for the SURF Visitor Center
 - Gold Camp Jubilee Equipment Display
 - Sponsor and booth participant in SURF's Neutrino Day
 - Heroic effort in apartment fire in July
 - Sponsored Lead Youth Football League Team
 - Sponsored Lawrence County Golf Tournament to Raise Funds to Rehabilitate Juvenile Misdemeanor Offenders
 - Joint sponsor of visitor center flagpole
 - Donated \$2,400 towards the Twin City Animal Shelter in Lead, SD
 - Sponsored "Honoring Our Local Heroes" Annual Initiative in the Black Hills Pioneer Newspaper
 - Participated in Lead's Adopt-A-Highway sponsorship of the Kirk Road 2021-2024.
 - Annual Thanksgiving Food Drive for City of Lead
 - Participated in community Christmas toy drive
 - Provided appetizers and refreshments for Mining Museum Community Meeting
 - TMI has been recognized by the City of Lead, SD as a premier contractor for their actions in the community.

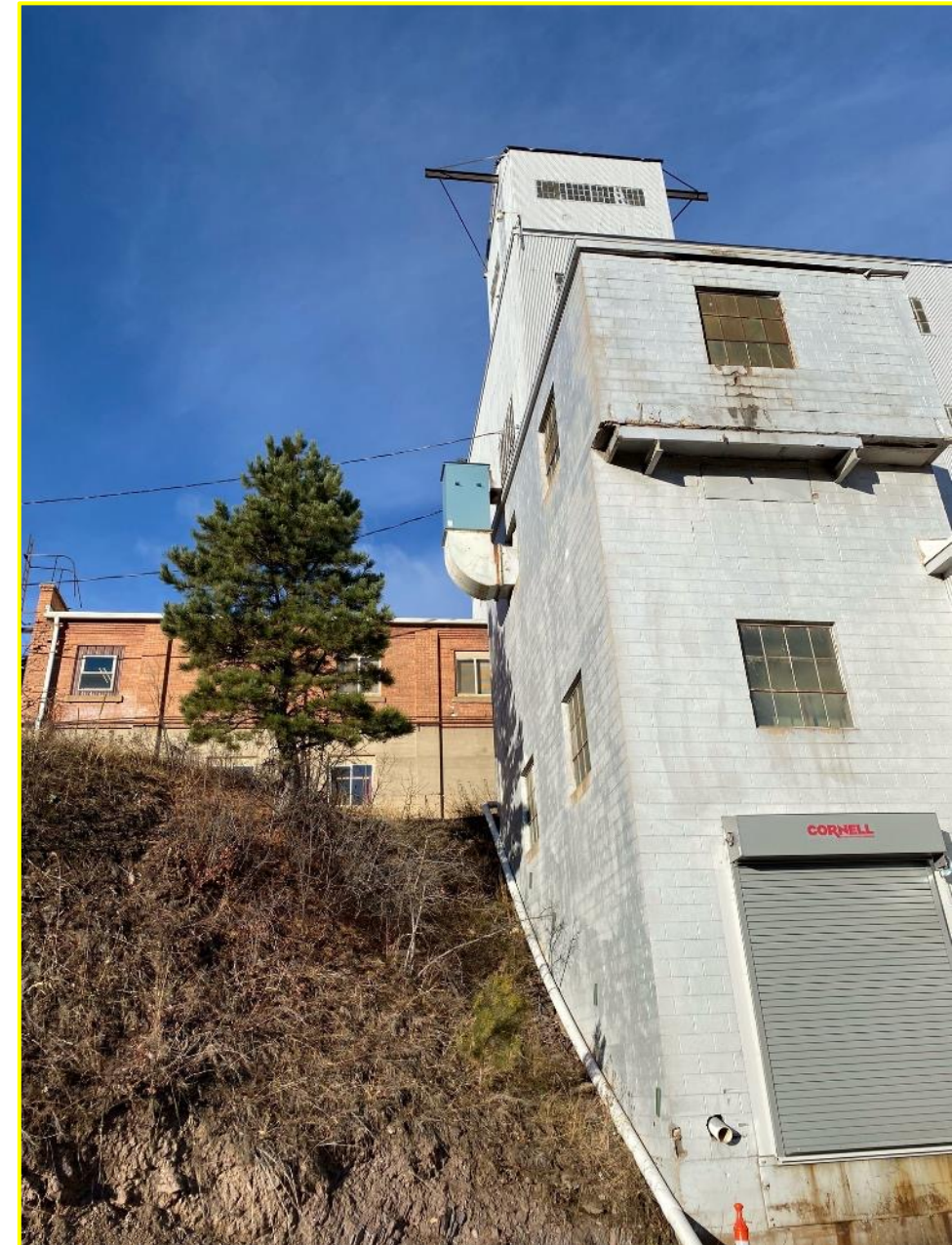
Shaft heaters

- Temporary supplemental heaters added at both shafts for ventilation increases
- Permanent heaters will be installed this spring.



Community Concerns - Noise

- Noise
 - Special backup alarms installed on equipment to minimize community impact while still ensuring construction safety
 - Education and training of personnel to minimize noise at night
 - Installed muffler on dust collector fan, reduced noise by 12 dBA



Community Concerns - Dust

- Since December 16 meeting
 - Continue applying tackifier to new material to bind dust particles
 - Continual visual observation and shut down for visible dust, and do not operate when wind is more than 15 mph
 - New chute installed 12/30
- Pending
 - Applying binder via drone create a top “crust” that will not dry out
 - Working on plans to safely remove material “above” the discharge
 - Additional sampling and testing in process





Thank You

