NEBORO

Stawell Underground Physics Laboratory (SUPL)

Design, Specifications and Excavation

Background

- The University of Melbourne is leading the planning and construction of SUPL in a partnership with the members that make up the newly formed company SUPL Ltd who will control and run the laboratory.
- SUPL Ltd members are: UoA, Swinburne, UoM, ANU and ANSTO.
- The ARC Centre of Excellence for Dark Matter Particle Physics will build and operate the first experiment (SABRE South) in the laboratory once completed in 2022.
- SUPL was proposed in 2014, commenced in 2016 but put on hold due to a temporary phase of mine care and maintenance. Construction commenced in 2019 with State and Federal funding committed.

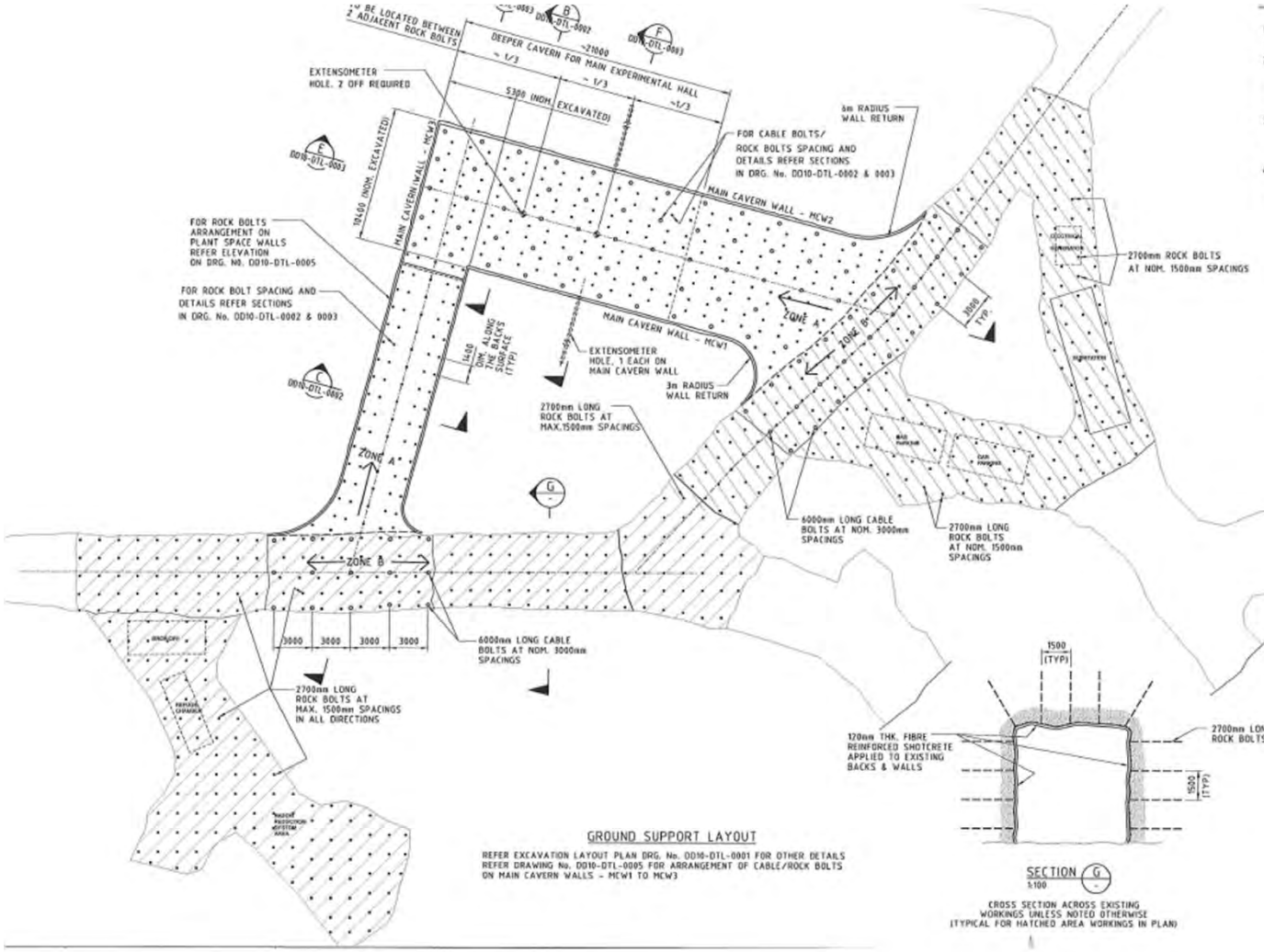
Site Selection – looking for a deep mine

- 1 km depth of cover requirement. ✓
- Stable background radiation environment. ✓
- Proximity to Melbourne an advantage. ✓
- Supportive mine owner and community. ✓
- In mine - services in place and distant from operational areas. ✓
- Decline allowing easy scientist access. ✓


Credit: University of Melbourne

SUPL Design

- Wood (formerly Amec Foster Wheeler) was appointed to design SUPL in 2016.
- An extensive consultation process was held to make the design work for the multiple stakeholders.
- Other deep underground low radiation laboratories served as design examples of what others have achieved – Gran Sasso (within the Traforo del Gran Sasso freeway tunnel), SNOLAB (within Creighton Mine).
- SUPL design is bespoke and considers experiment requirements, radiation, lab space, personnel facilities, delivery management etc.



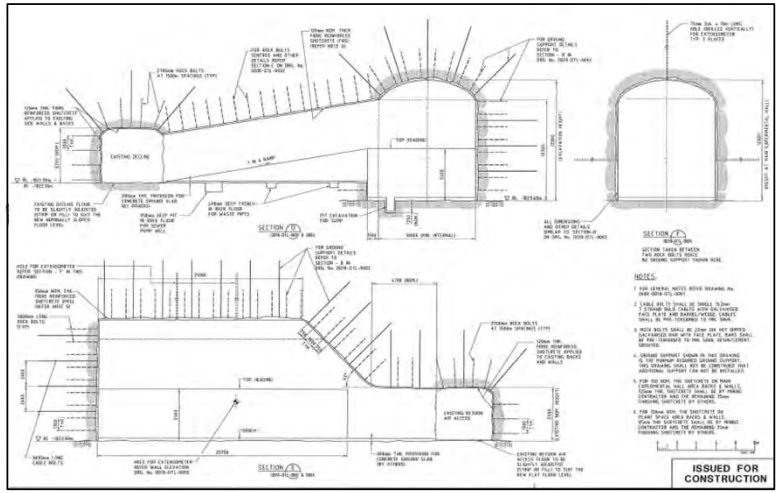
1. FOR GENERAL NOTES REFER DRAWING No. 0000-0010-DTL-0001
2. CABLE BOLTS SHALL BE SINGLE 15.2mm 7 STRAND BULB CABLES WITH GALVANISED FACE PLATE AND BARREL/WEDGE. CABLES PRE-TENSIONED TO MIN. 50kN. FULLY CEMENT GROUTED.
3. ROCK BOLTS SHALL BE 25mm DIA HOT DIPPED GALVANISED BAR WITH FACE PLATE. BARS SHALL BE PRE-TENSIONED TO MIN. 50kN. RESIN/CEMENT GROUTED.
4. GROUND SUPPORT SHOWN IN THIS DRAWING IS THE MINIMUM REQUIRED GROUND SUPPORT. THIS DRAWING SHALL NOT BE CONSTRUED THAT ADDITIONAL SUPPORT CAN NOT BE INSTALLED.

LEGEND:

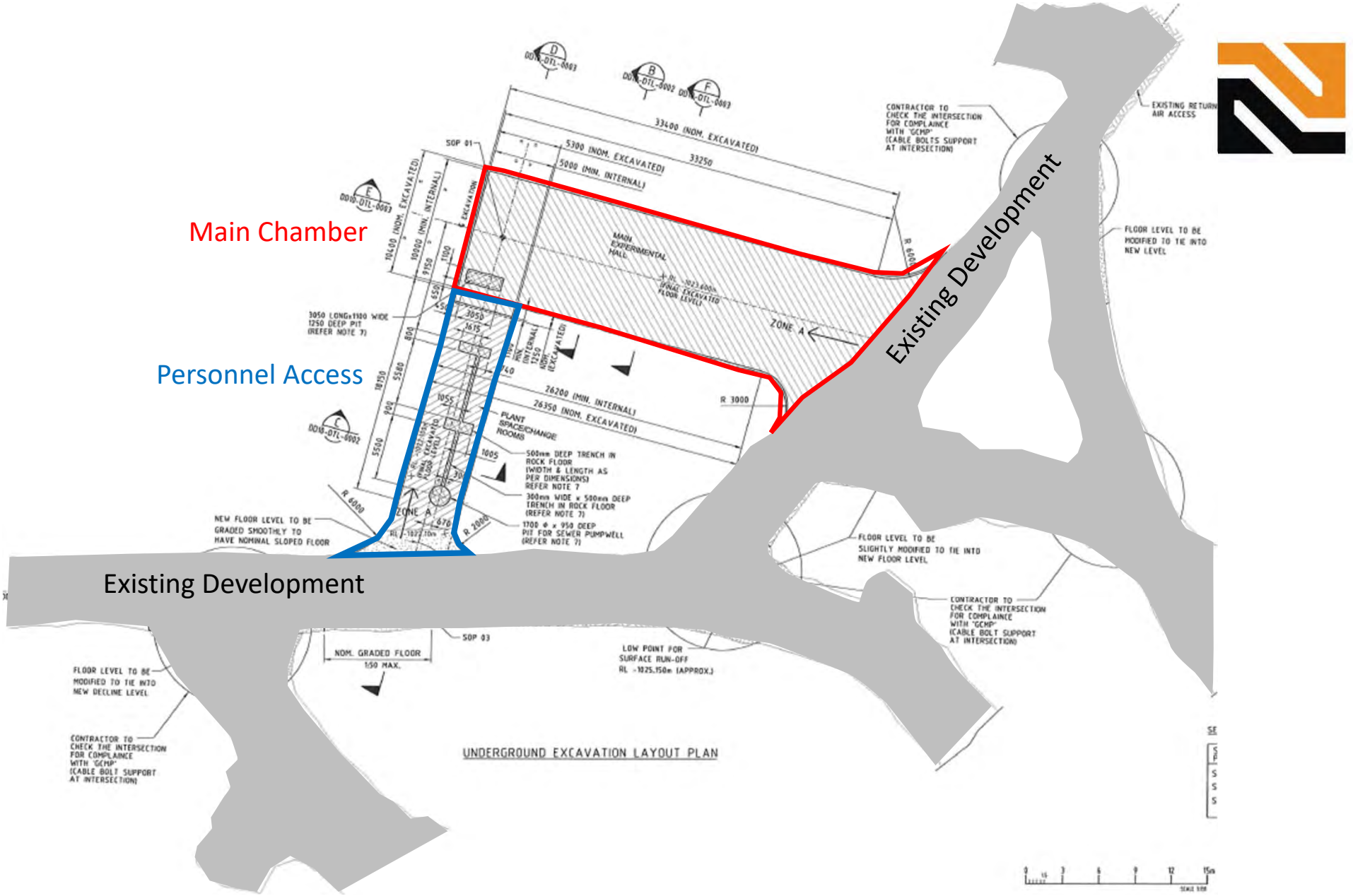
- ⊙ - CABLE BOLT
- • - ROCK BOLT
- ZONE A - 'ANSTO' APPROVED CONSTRUCTION MATERIALS ONLY
- ZONE B - NORMAL CONSTRUCTION MATERIALS
- ▨ - EXTENT OF 120mm THK. SHOTCRETE ON EXISTING WORKINGS WALL (BOTHSIDES) AND ON BACKS

GROUND SUPPORT LAYOUT

REFER EXCAVATION LAYOUT PLAN DRG. No. 0010-DTL-0001 FOR OTHER DETAILS
REFER DRAWING No. 0010-DTL-0005 FOR ARRANGEMENT OF CABLE/ROCK BOLTS ON MAIN CAVERN WALLS - MCW1 TO MCW3



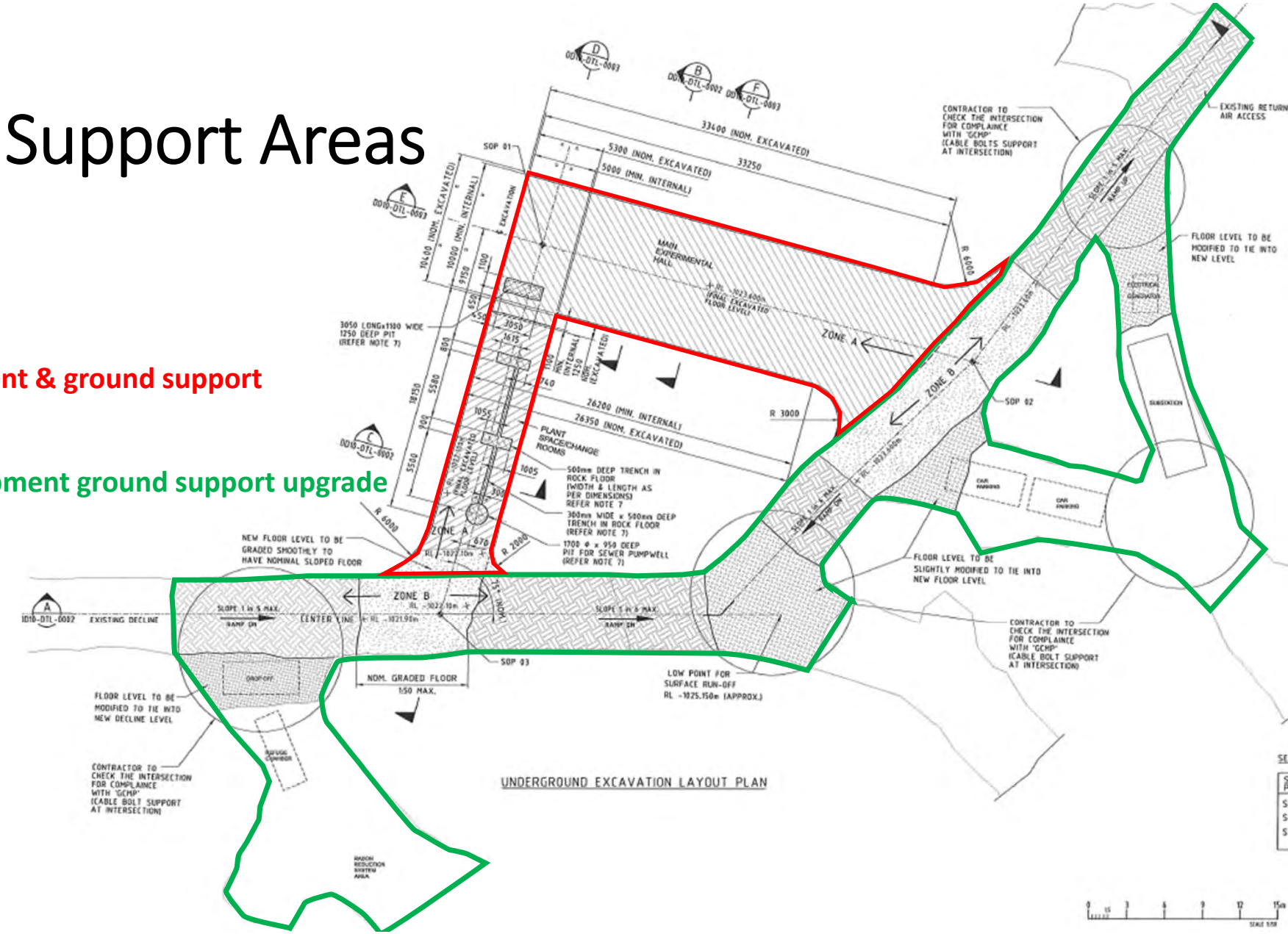
ISSUED FOR CONSTRUCTION


Main Chamber
Personnel Access
Existing Development
Existing Development
UNDERGROUND EXCAVATION LAYOUT PLAN
33400 (NOM. EXCAVATED)
33250
5300 (NOM. EXCAVATED)
5000 (MIN. INTERNAL)
MAIN EXPERIMENTAL HALL
ZONE A
26200 (MIN. INTERNAL)
26350 (NOM. EXCAVATED)
PLANT SPACE/CHANGE ROOMS
3050 LONG x 1100 WIDE 1250 DEEP PIT (REFER NOTE 7)
500mm DEEP TRENCH IN ROCK FLOOR (WIDTH & LENGTH AS PER DIMENSIONS) REFER NOTE 7
300mm WIDE x 500mm DEEP TRENCH IN ROCK FLOOR (REFER NOTE 7)
1700 Φ x 950 DEEP PIT FOR SEWER PUMPWELL (REFER NOTE 7)
NEW FLOOR LEVEL TO BE GRADED SMOOTHLY TO HAVE NOMINAL SLOPED FLOOR
NOM. GRADED FLOOR 1:50 MAX.
LOW POINT FOR SURFACE RUN-OFF RL -1025.150m (APPROX.)
CONTRACTOR TO CHECK THE INTERSECTION FOR COMPLAINCE WITH 'GCMP' (CABLE BOLTS SUPPORT AT INTERSECTION)
FLOOR LEVEL TO BE MODIFIED TO TIE INTO NEW LEVEL
FLOOR LEVEL TO BE SLIGHTLY MODIFIED TO TIE INTO NEW FLOOR LEVEL
CONTRACTOR TO CHECK THE INTERSECTION FOR COMPLAINCE WITH 'GCMP' (CABLE BOLT SUPPORT AT INTERSECTION)
FLOOR LEVEL TO BE MODIFIED TO TIE INTO NEW DECLINE LEVEL
CONTRACTOR TO CHECK THE INTERSECTION FOR COMPLAINCE WITH 'GCMP' (CABLE BOLT SUPPORT AT INTERSECTION)
EXISTING RETURN AIR ACCESS
SOP 01
SOP 03
R 6000
R 3000
R 2000

Ground Support Areas

Zone A – new development & ground support

Zone B – existing development ground support upgrade

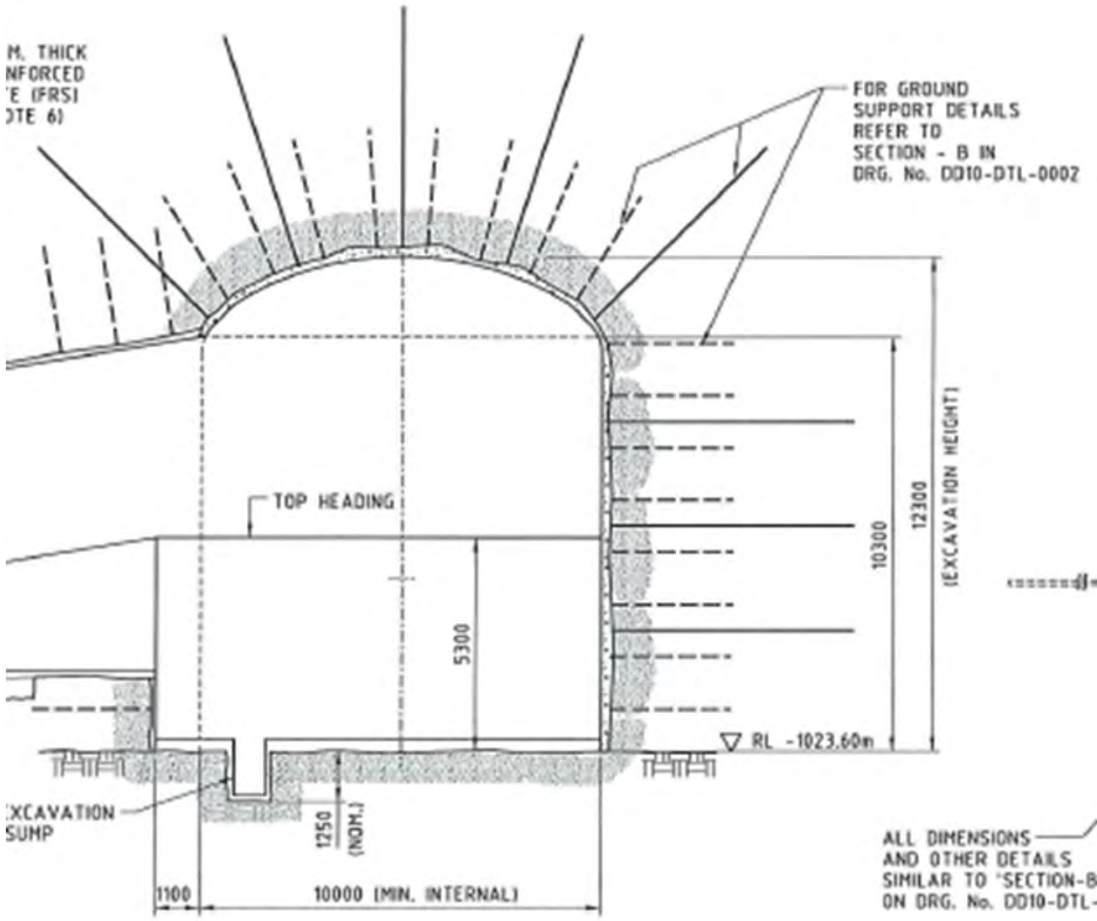


Stability Design

- Input data was sourced from existing excavation conditions, SGM databases, and two dedicated investigation drill holes.
- Entirely located within basalt. Three joint sets, structures lacking persistence, stress issues were not noted in the existing development.
- Kinematics, numerical models and empirical methods were used in combination to confirm the ground support requirements.
- Empirical assessment heavily influenced by the assigned SRF and ESR.

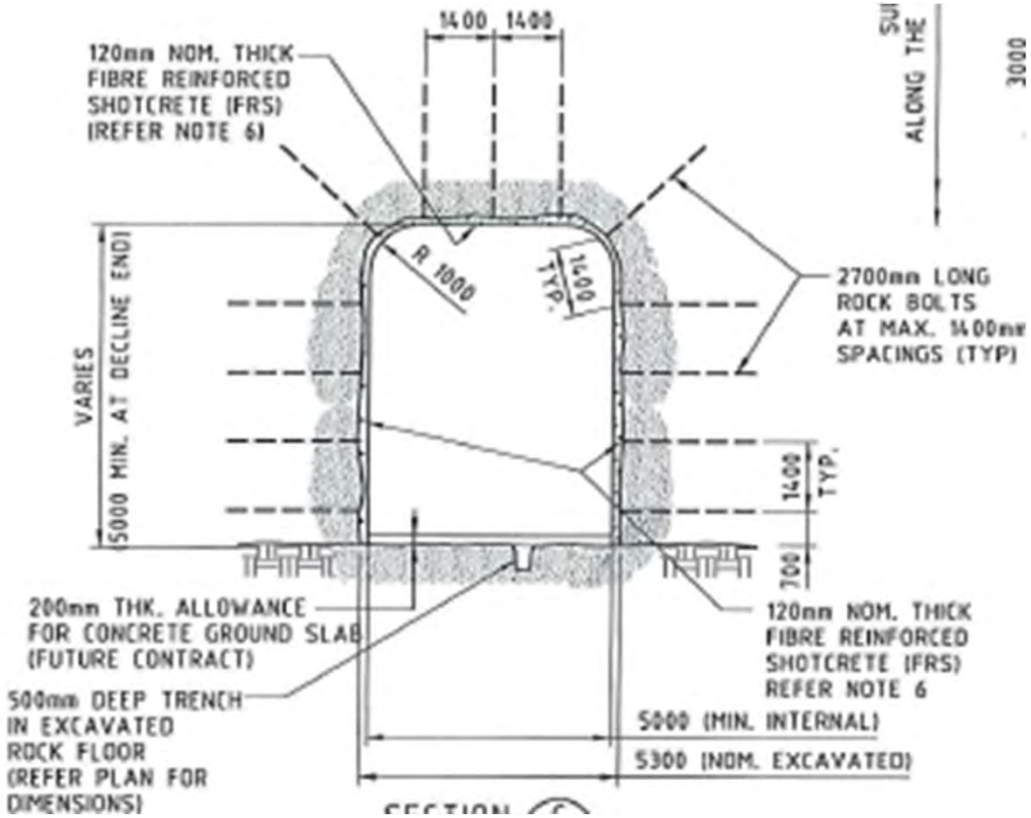
Main Chamber

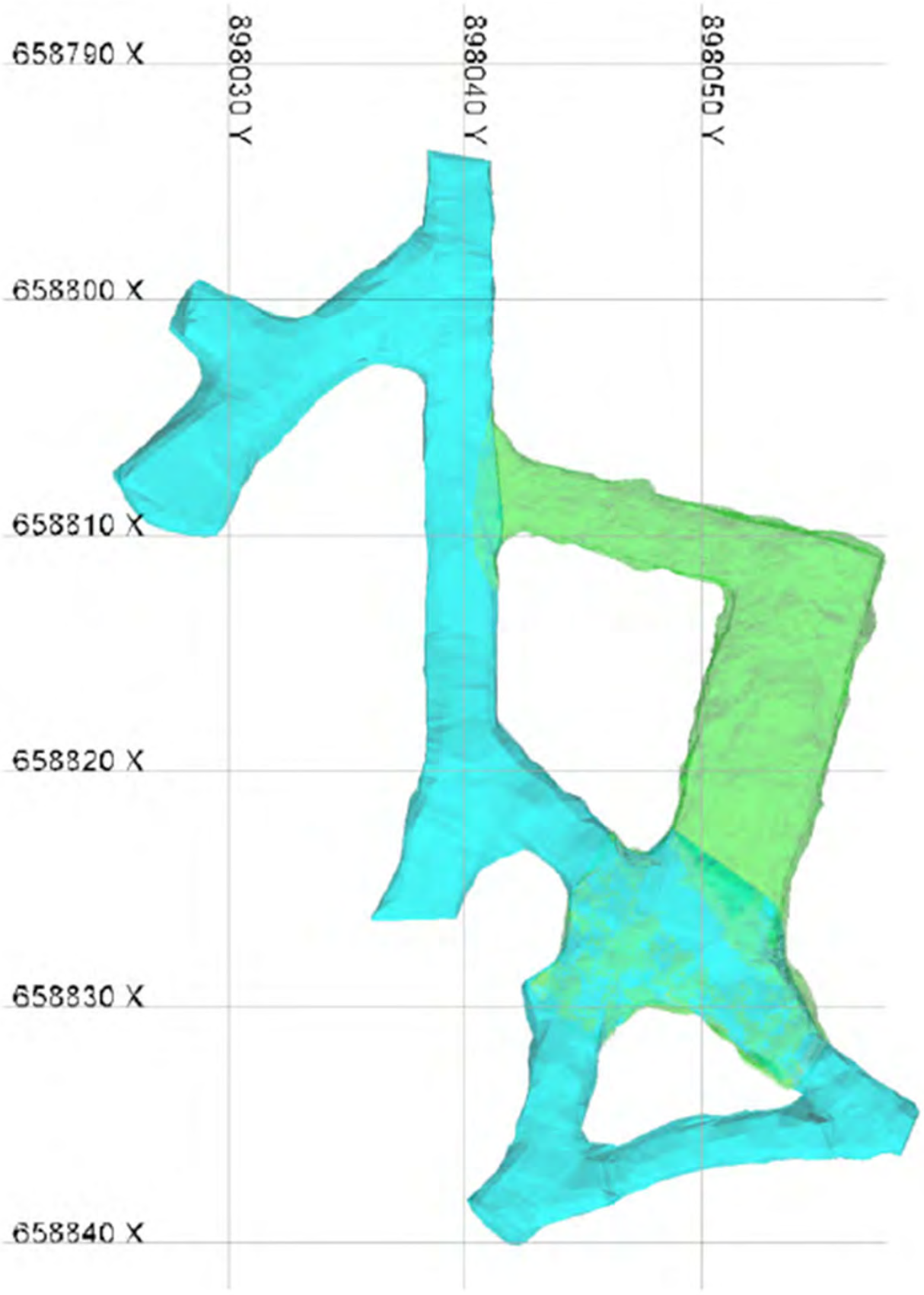
- 150mm fibrecrete floor to floor.
- 3m long fully resin encapsulated 25mm rock bolts, 1.5m x 1.3m spacing on all walls and backs.
- 6m long single strand cablebolts installed on 3m x 2.6m spacing, all walls and backs.

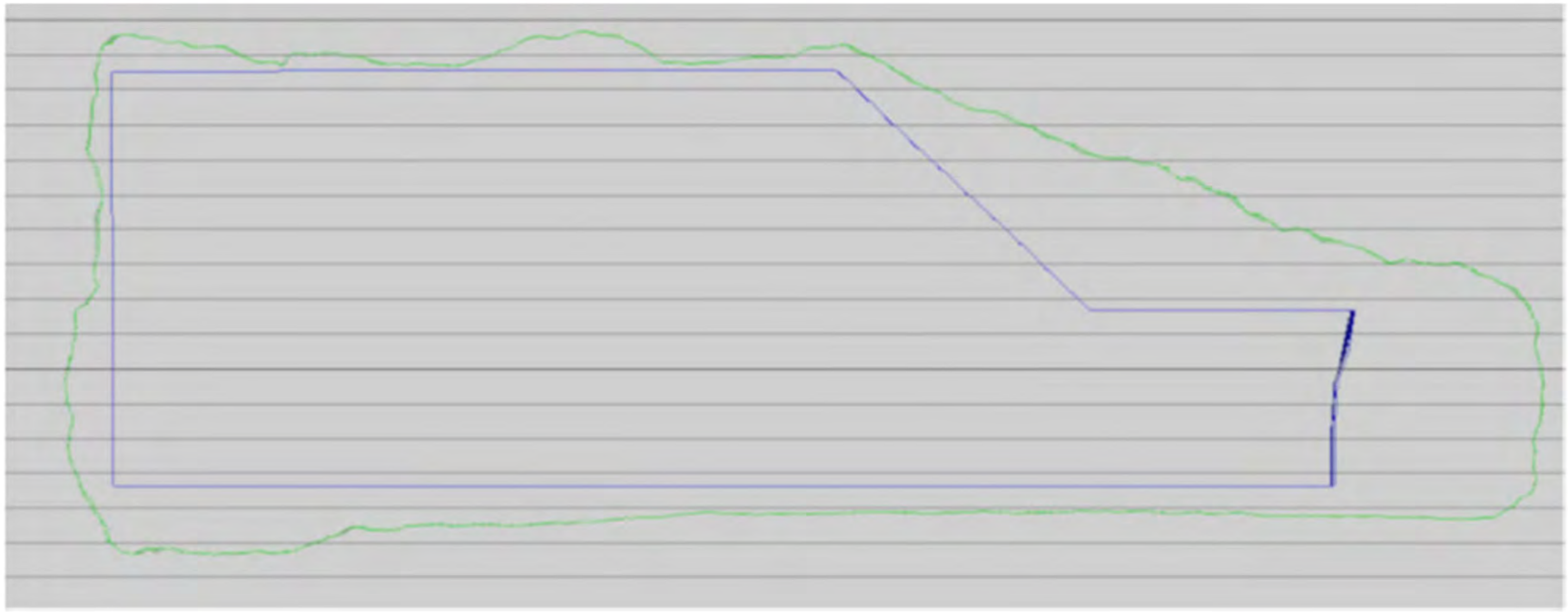


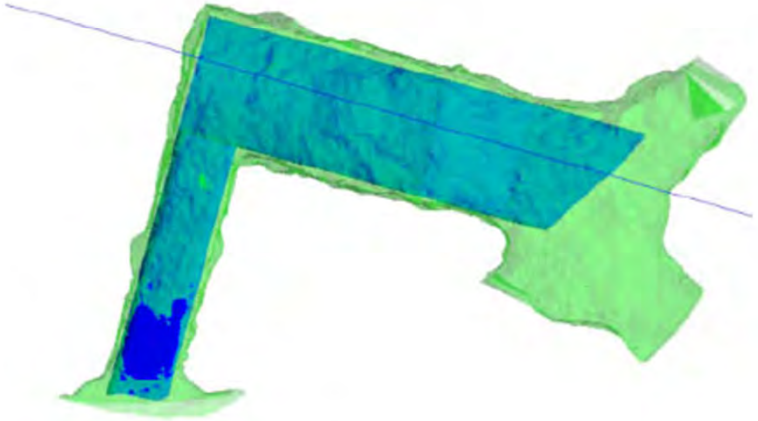
Personnel Access

- 120mm fibrecrete floor to floor.
- 2.7m long fully resin encapsulated 25mm rock bolts, 1.4m spacing on all walls and backs.




658790 X
658800 X
658810 X
658820 X
658830 X
658840 X
898030 Y
898040 Y
898050 Y



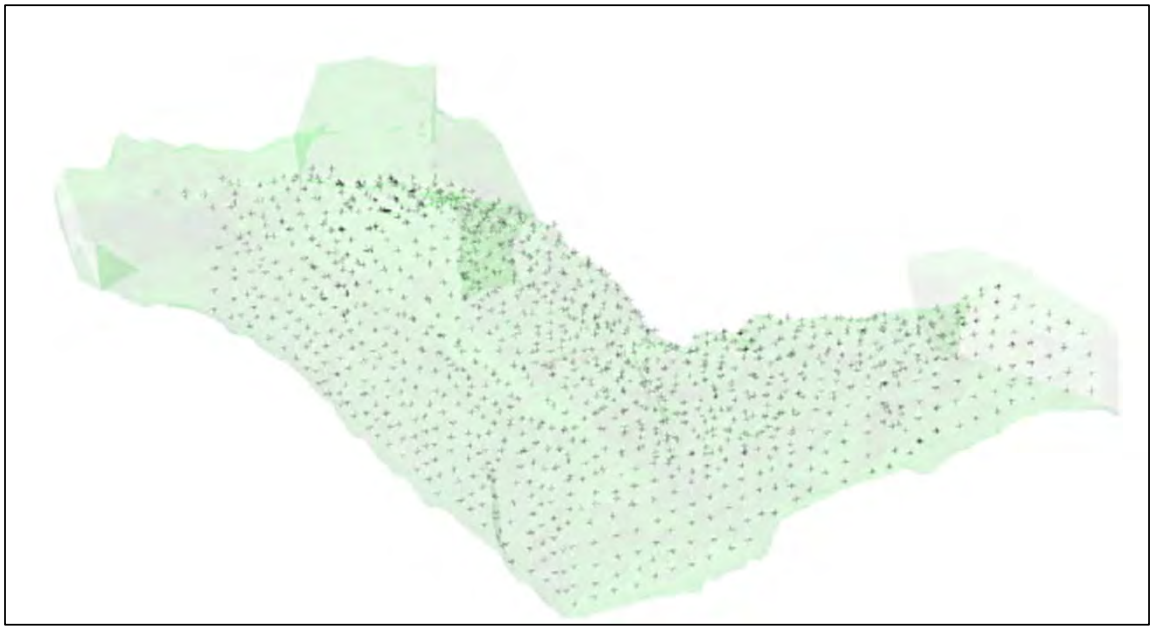


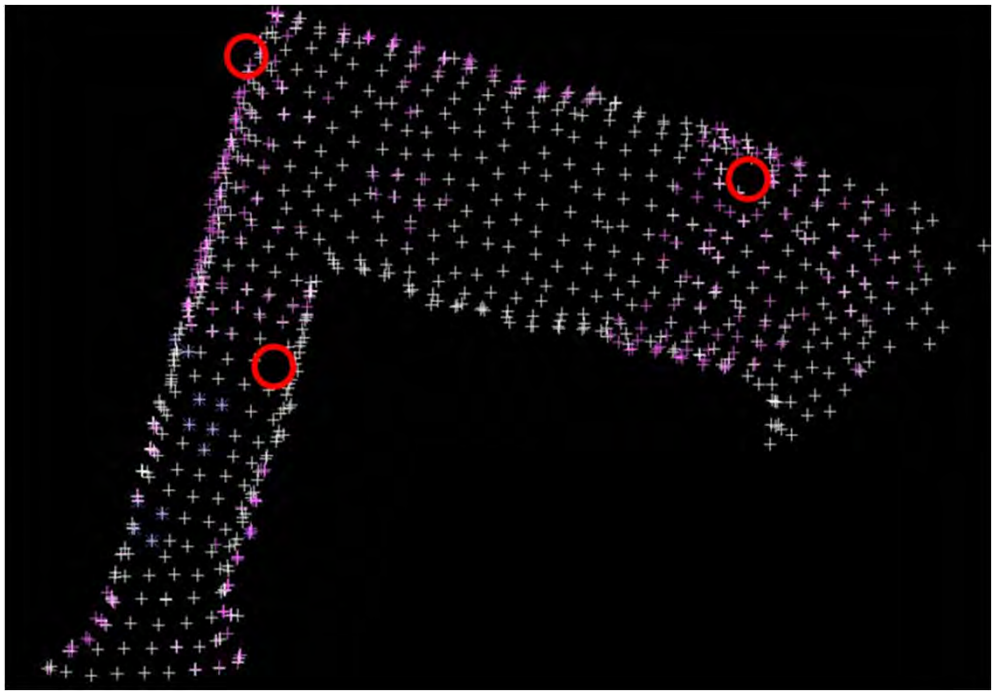
Existing Development Upgrade

- Existing ground support consisting of friction bolts and mesh.
- 120mm thick fibrecrete to walls and backs.
- 2.4m long fully resin encapsulated 25mm rock bolts, 1.5m spacing on all walls and backs.
- Cablebolts at all intersections.
- Floors graded to design levels.

Quality of Installation

- Detailed records of ground support specification compliance were maintained and reported.
- Extensive testing of fibrecrete and rockbolts.






ESTED

Fibrecrete

- A difficult specification of 40MPa and 400J.
- The Stawell Gold Mines mix was taken as the base case, and then altered:
  - Increased the amount of sand,
  - Increased the amount of fibre.
- More attention was given to sample preparation and early stage curing.


CAUTION

Rockbolt Encapsulation

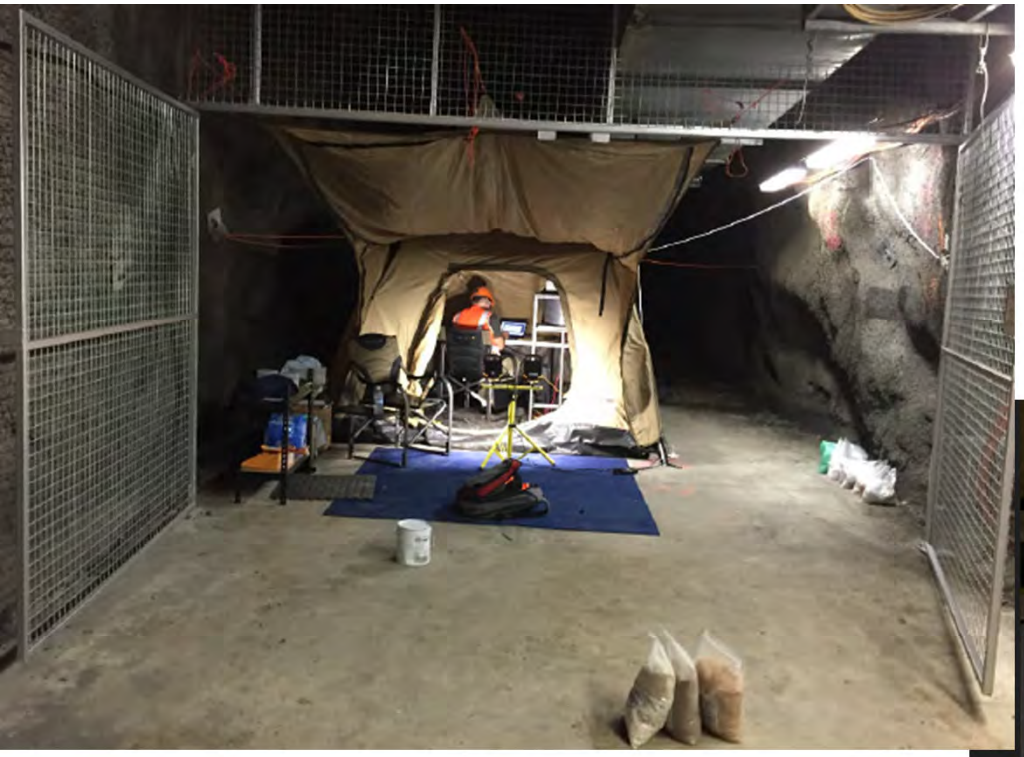
- Standard jumbo installation.
- Overdesign of resin volume. 35mm bit, 30mm diam resin, full hole length.
- Time spent with the operators to help them take ownership of the encapsulation specification.
- Simple steps followed, like mark up of the bolting steel.
- Result speak for themselves.

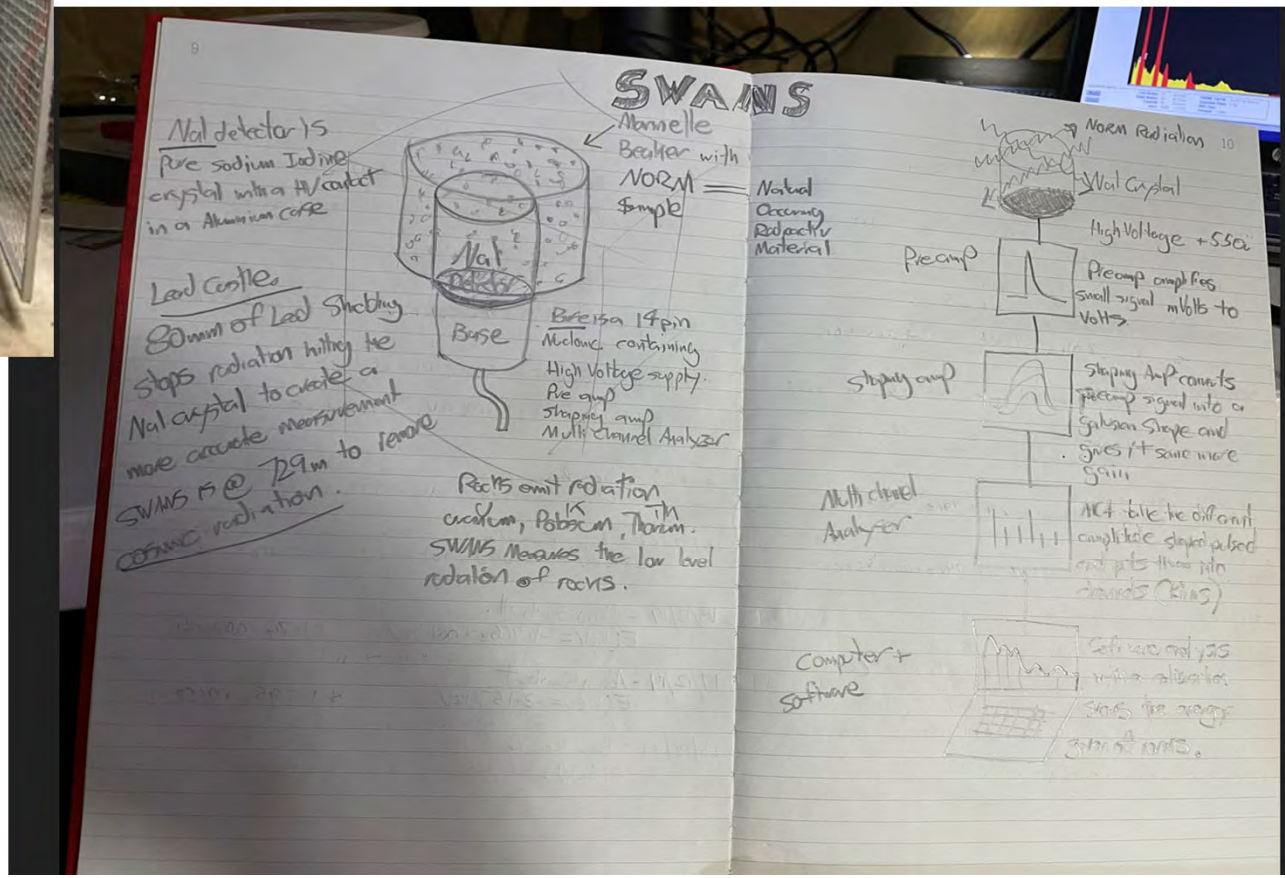
Radiation Considerations

- Radiation from radioactive isotopes, and also radon gas occurs naturally, but SUPL needed to be as “quiet” as possible.
- Ground support products were selected to reduce radiation from introduced ground support and building material.
- Inspections/audits were conducted at suppliers facilities/quarries, to ensure compliance with material source and tracking requirements.
- Radiation testing facilities set up at the SGM 729 workshop.


CAUTIO
SUPL- ZONE A
Ground Support
Materials Only


HEAT# 192H220000
JM
Jennmar Aust
PART NO:
CS1526001BM
Q.A.
PASSED
DATE
BY
OIL NO-MO: - 003429




SWANS
NaI detector is
Pure sodium Iodine
crystal with a HV contact
in a Aluminium case
Lead castle.
50mm of Lead Shielding
stops radiation hitting the
NaI crystal to create a
more accurate measurement
SWANS is @ 129m to remove
cosmic radiation.
Mannelle
Beaker with
NORM
Sample
NaI
Base
Base is a 14pin
Melonic containing
High Voltage supply
Pre amp
Shaping amp
Multi channel Analyser
Rocks emit radiation
caesium, Potassium, Thorium.
SWANS measures the low level
radation of rocks.
Natural
Occuring
Radioactive
Material
NORM Radiation
NaI Crystal
High Voltage +550v
Preamp
Preamp amplifies
small signal mVolts to
Volts
Shaping amp
Shaping Amp converts
preamp signal into a
Gaussian Shape and
gives it some more
gain
Multi channel
Analyser
MCA take the different
amplitude shaped pulses
and puts them into
channels (Bins)
Computer +
Software
Software analyses
with calibration
shows the energy
spectrum.


Tie Wire
- slab
240 Chair
PF1.3
PF1.1

Concrete Slab and Internal Build

- Lack of floor position control meant compacted crushed rock was needed to re-establish level.
- Compaction testing conducted.
- Further radiation testing during the concrete pour.
- Radiation testing of samples from build materials of interest.


AG02

Build Progress

- Nearing completion, in early 2022.