

# DUSEL Status

Deep Underground Science and Engineering Laboratory

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SNOLAB

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# Topics

- Science goals and DUSEL
- Summary of current and near-future activities at Sanford Laboratory
- Overview of DUSEL facility
- Plan and schedule
- Very much a high-level summary!

# Science Goals

- **Very broad program**
- Dark matter detection
- $0\nu\beta\beta$  decay
- Long baseline neutrino
- Proton decay
- Supernova and other neutrinos
- Nuclear astrophysics
- Enable low radioactivity studies and materials fab
- Facilitate R&D for the above
- Other physics perhaps (LIGO evolution?, ?)
- Biology, geology and engineering (not covered today)
- Education and public outreach critical (also not covered)

# Science Goals <-> Sanford Lab/DUSEL

- Dark matter program
  - Generation 1 (G1) by LUX at Sanford Lab
  - Potentially G2 at Sanford, started prior to DUSEL construction, finish in DUSEL era
  - One or more G3 at DUSEL
- $0\nu\beta\beta$  decay
  - MAJORANA Demonstrator at Sanford lab operates into DUSEL era
  - One or more large, next generation experiments at DUSEL
- Long baseline neutrinos, proton decay, other neutrinos
  - Combined function detectors (water Cherenkov and/or liquid argon)
  - (Anti)Neutrino beam from Fermilab (and near detector)
- Nuclear astrophysics
  - Potentially dedicated accelerator facility, decade(s) operation
- Low background and materials manufacturing
  - Basic capability (scope to be defined) proposed to be part of DUSEL capability
  - Large facility, unique capabilities evaluated as part of overall scientific program
- Enable R&D (dedicated space, although may evolve with time)
- Other physics – evaluated as part of overall scientific program



Waste Water Treatment

Open Cut

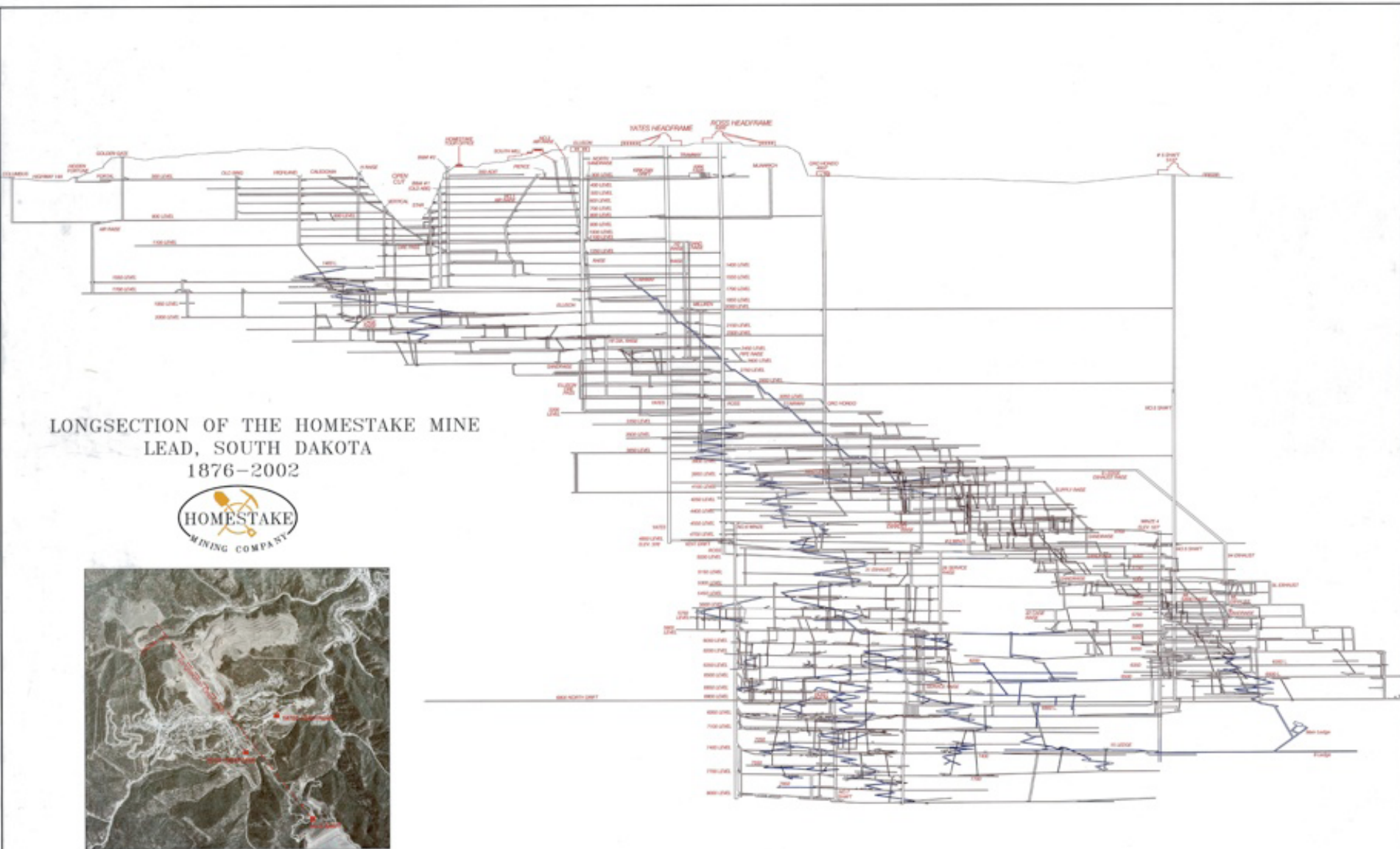
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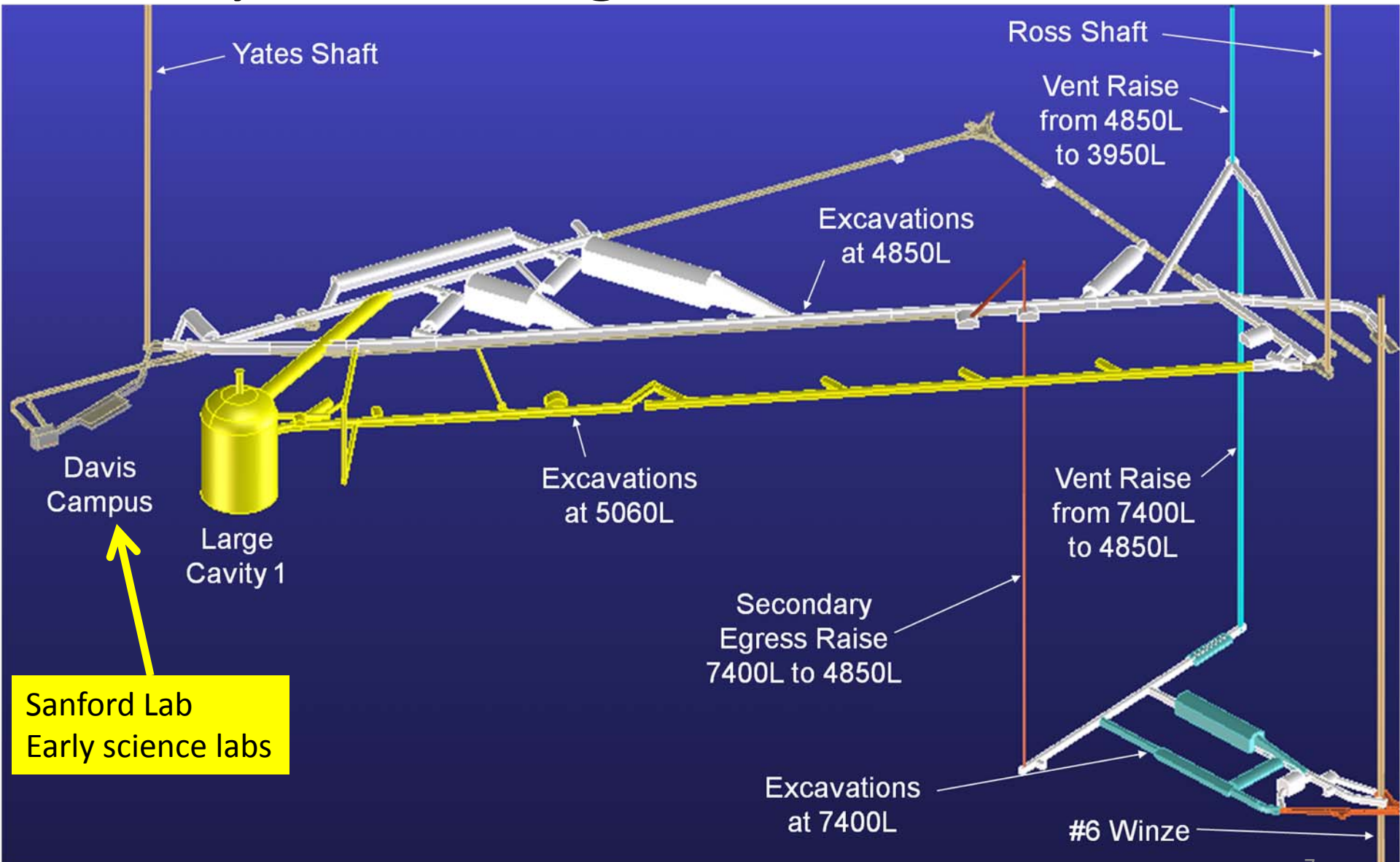


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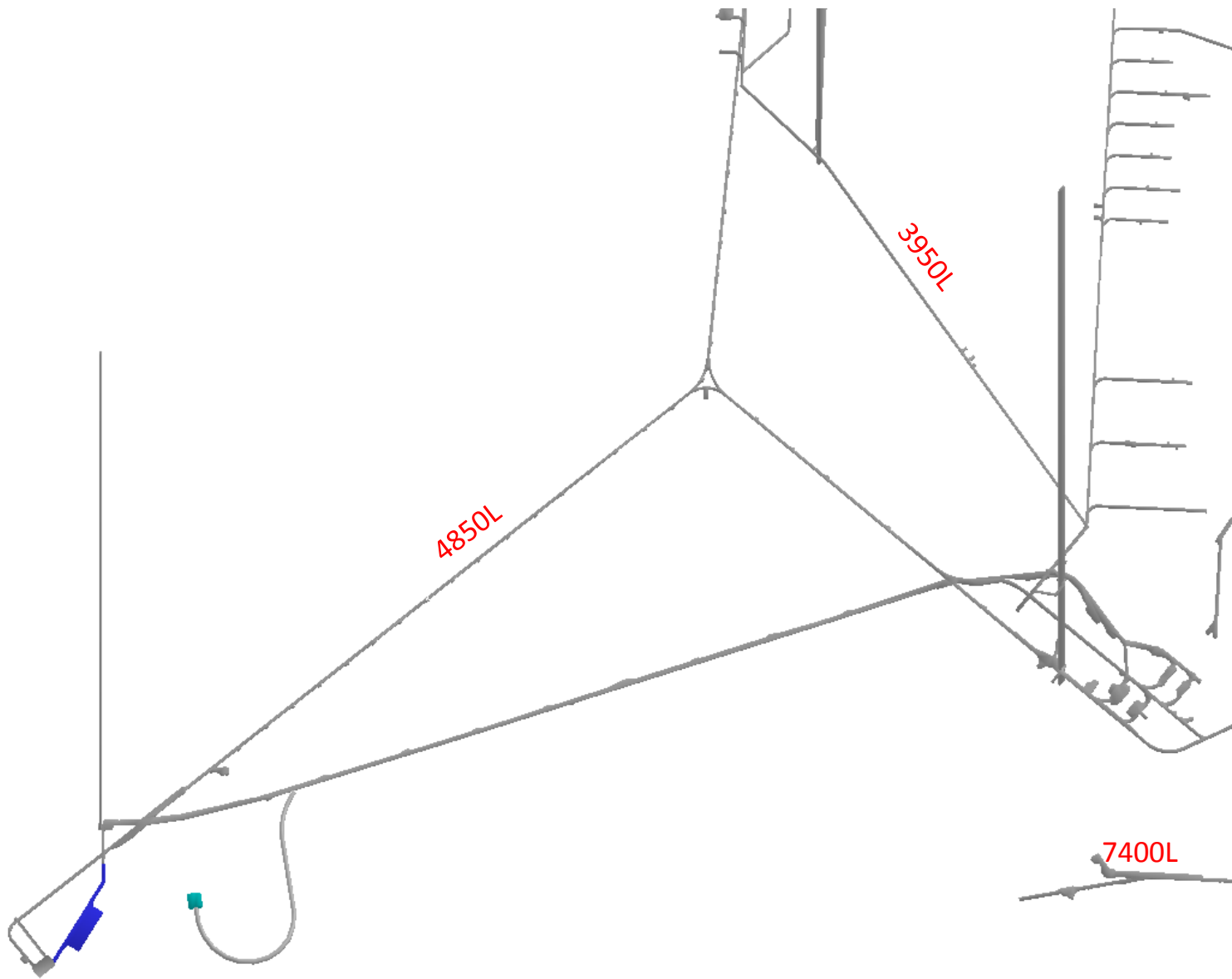
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# Physics Underground Lab Overview



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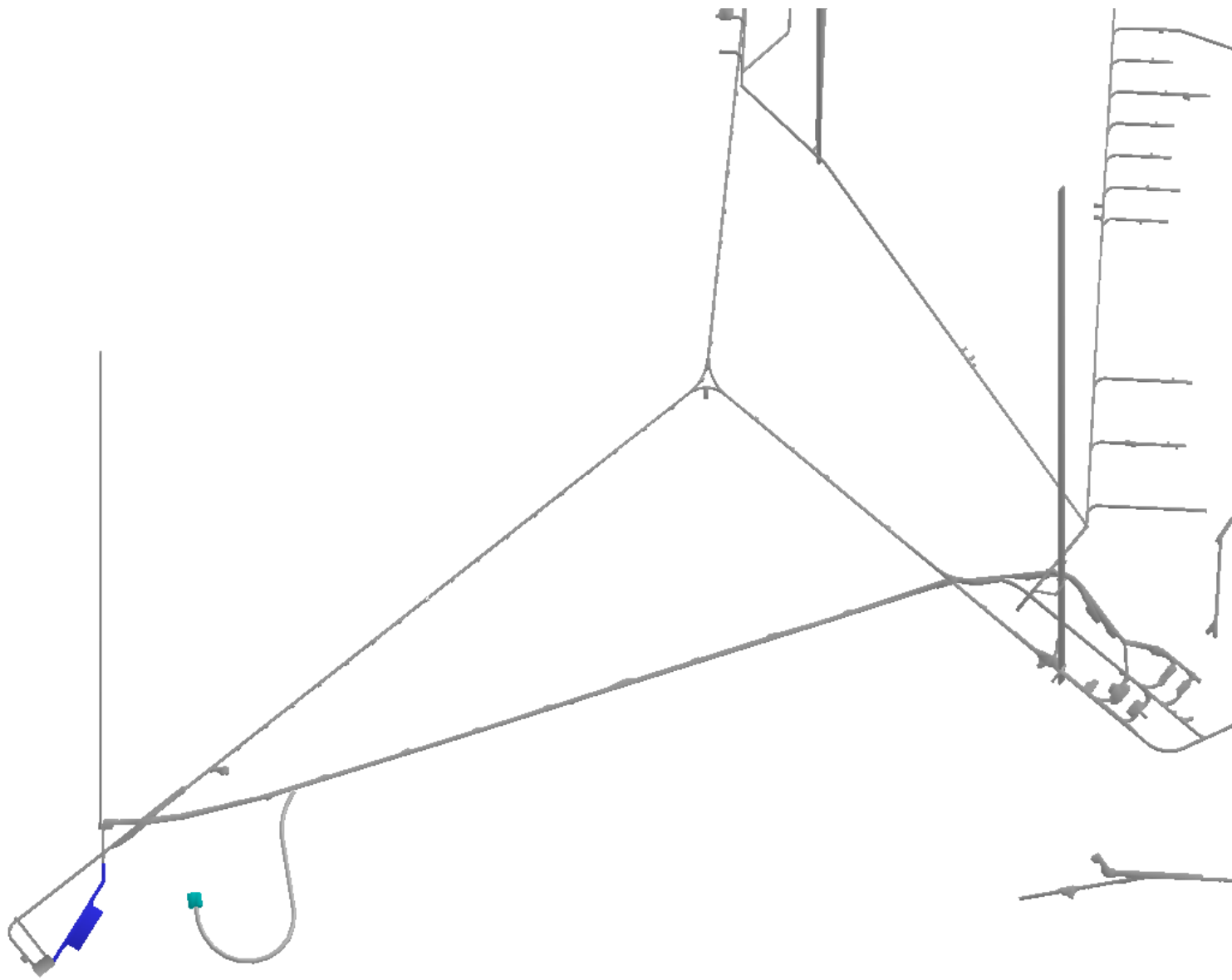
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- D10 (D10) ■
- YR (YR) ■





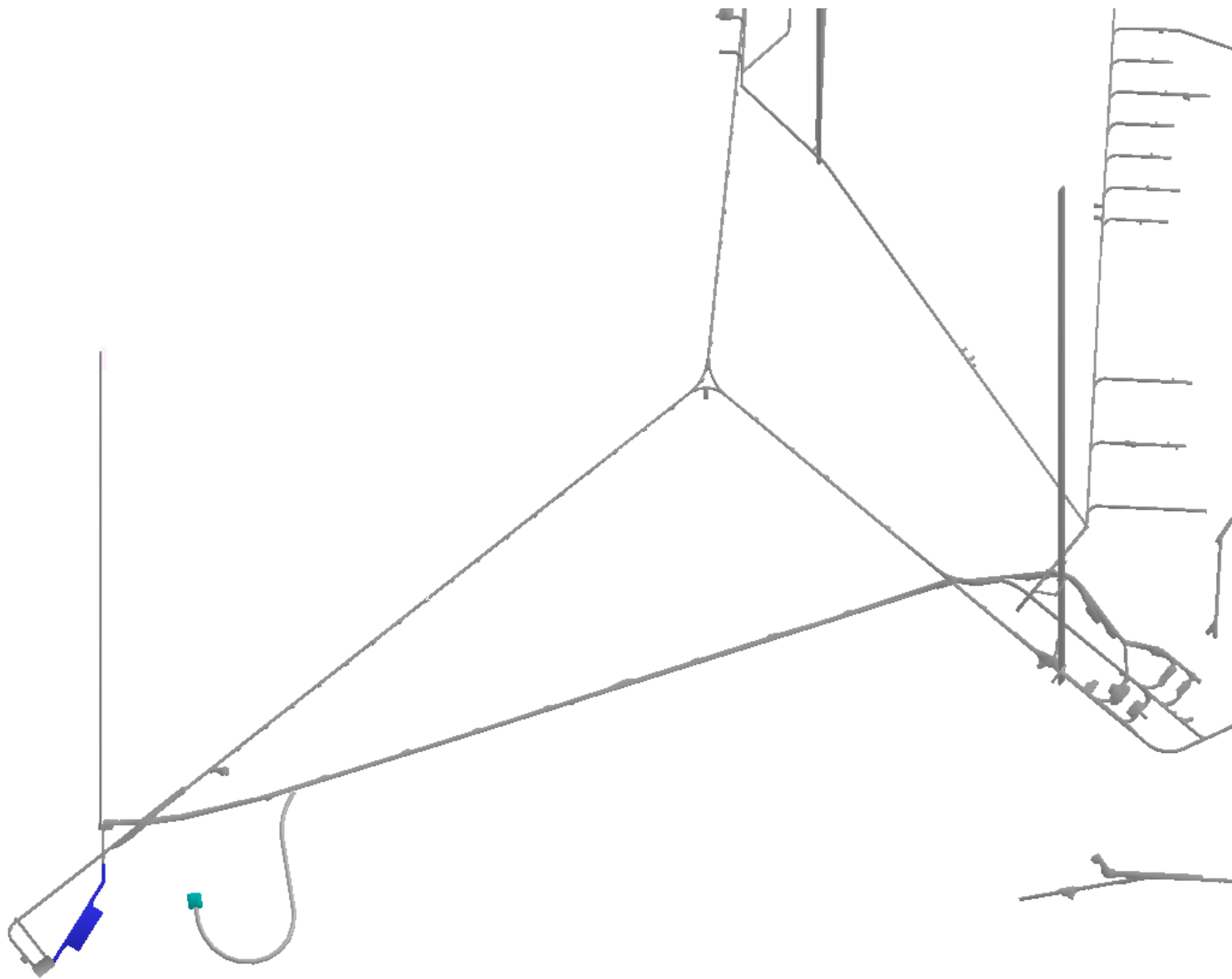
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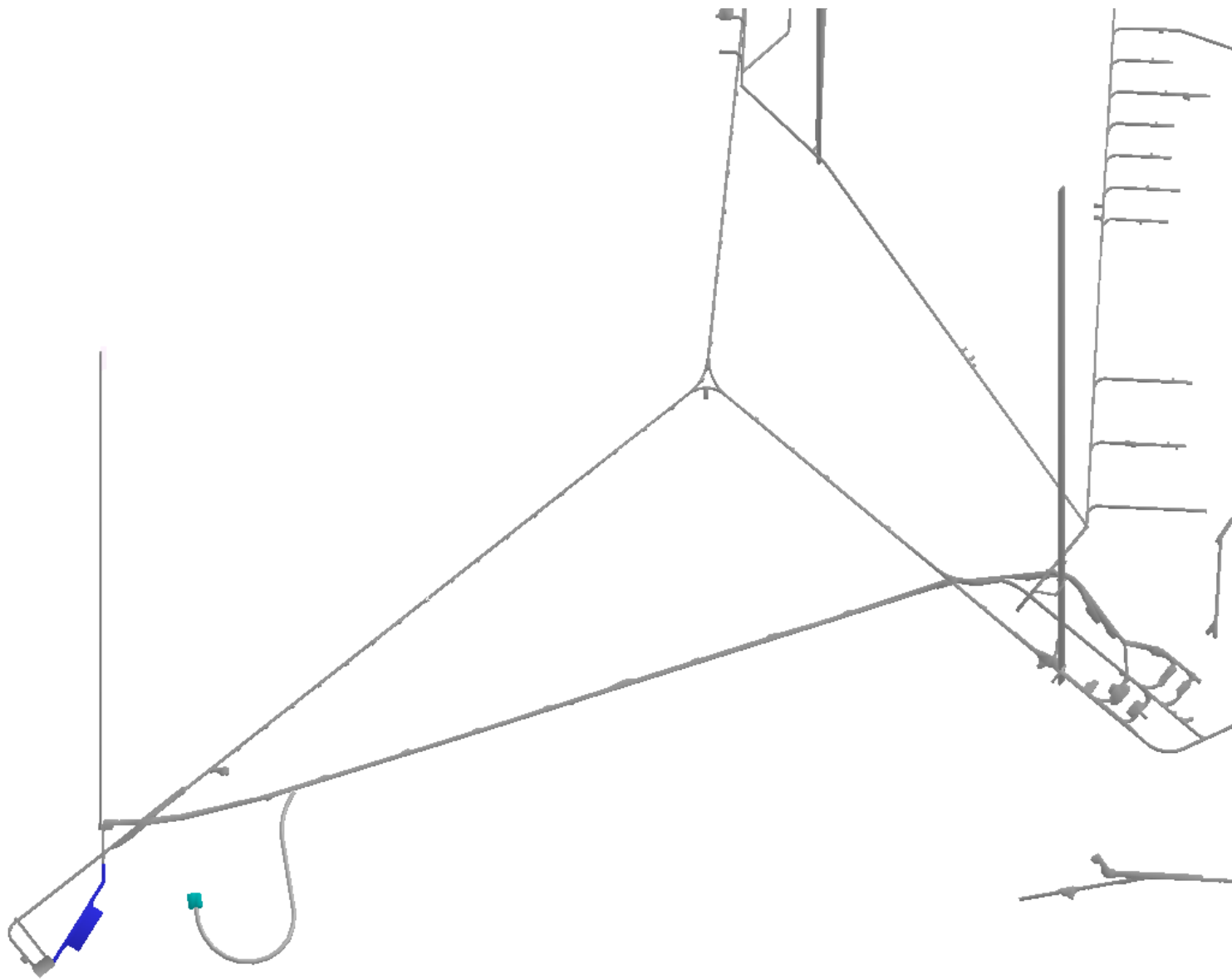
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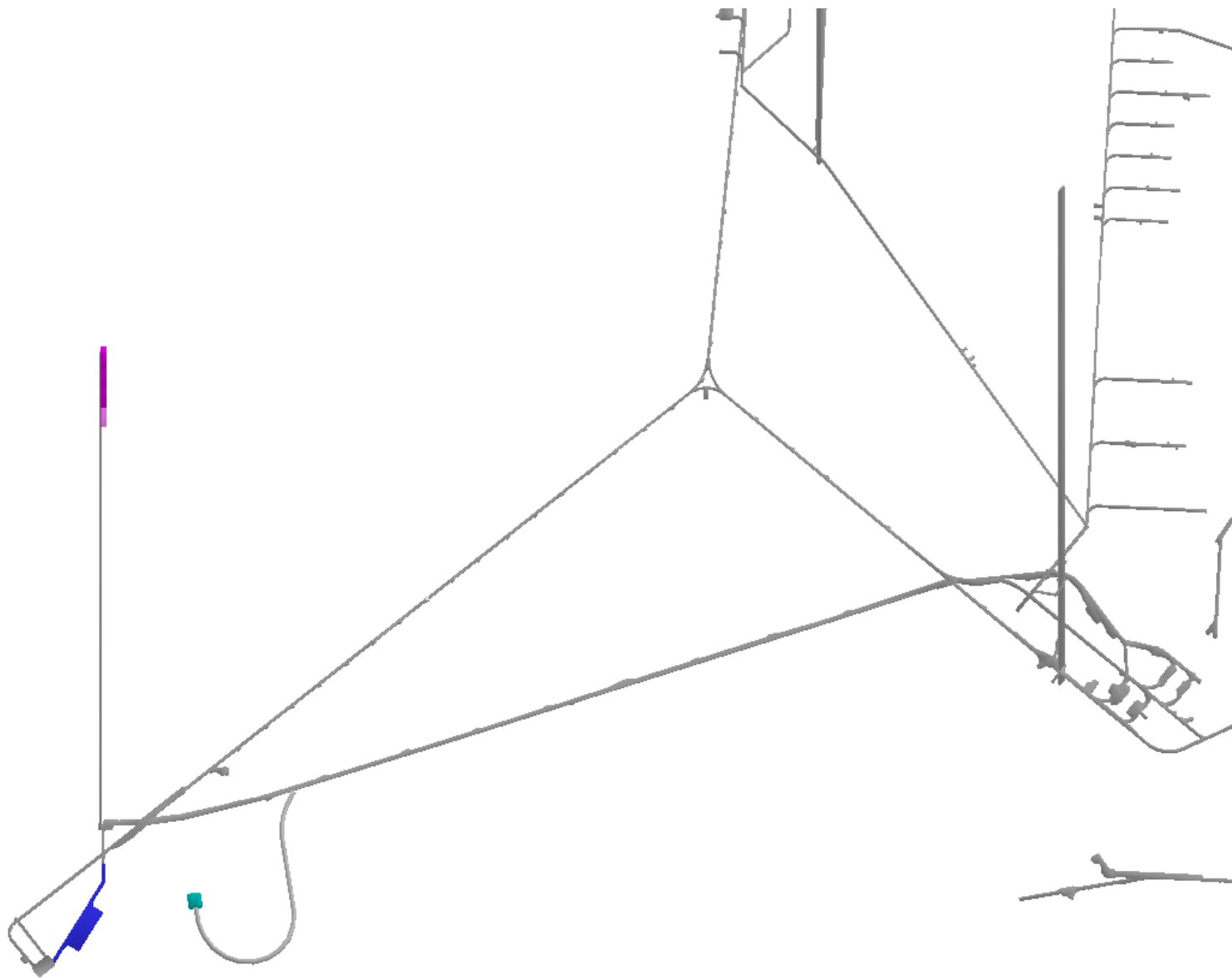
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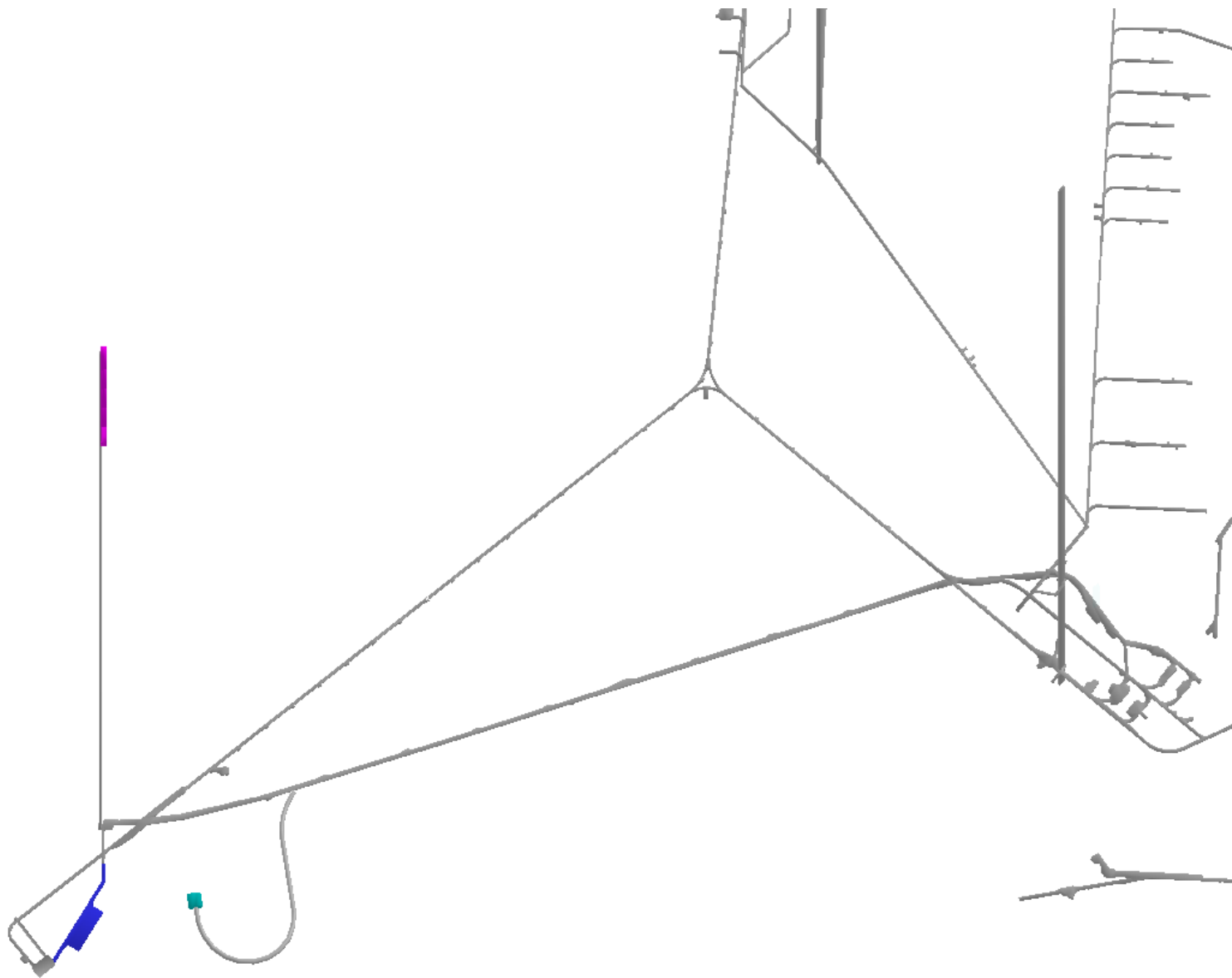
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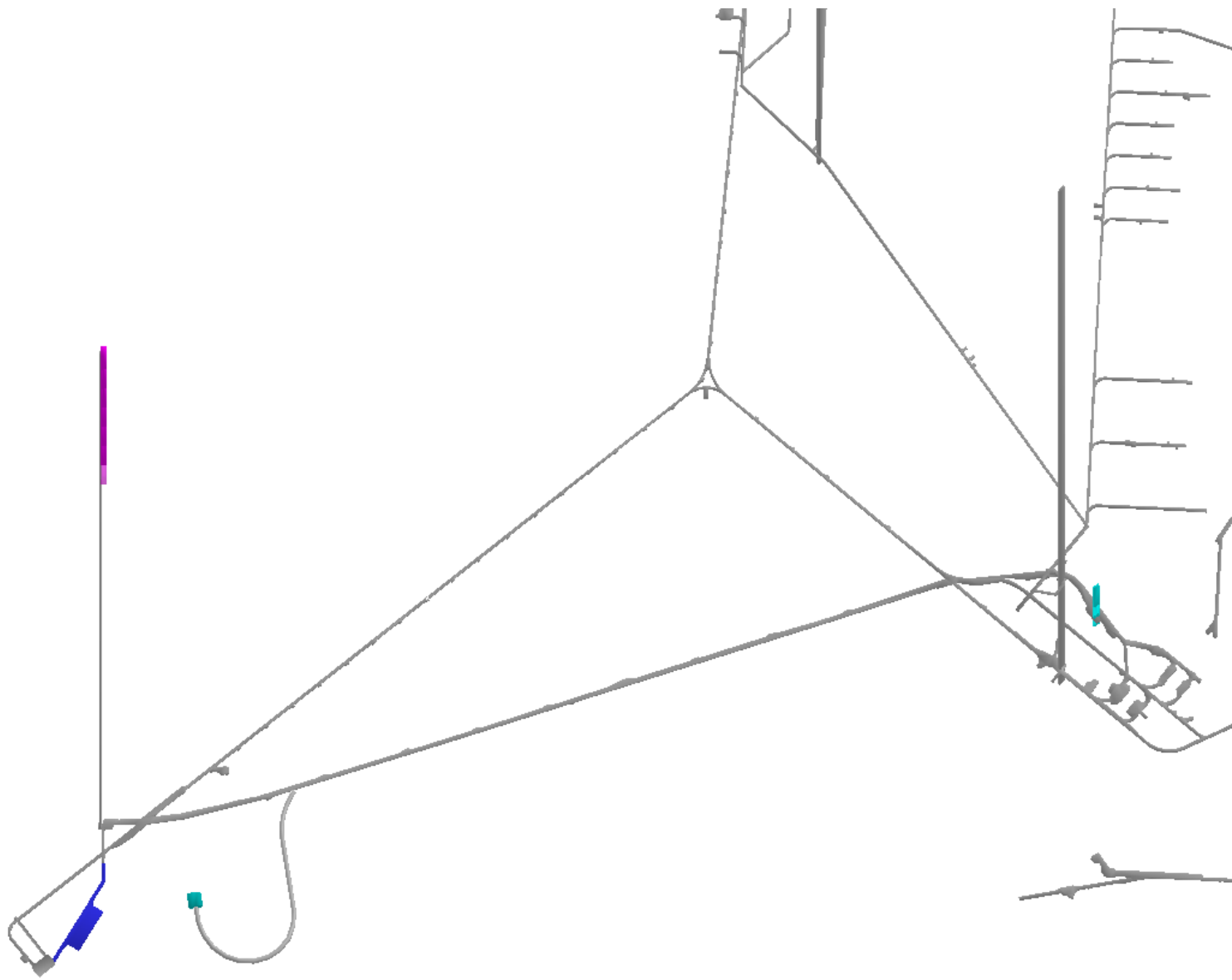
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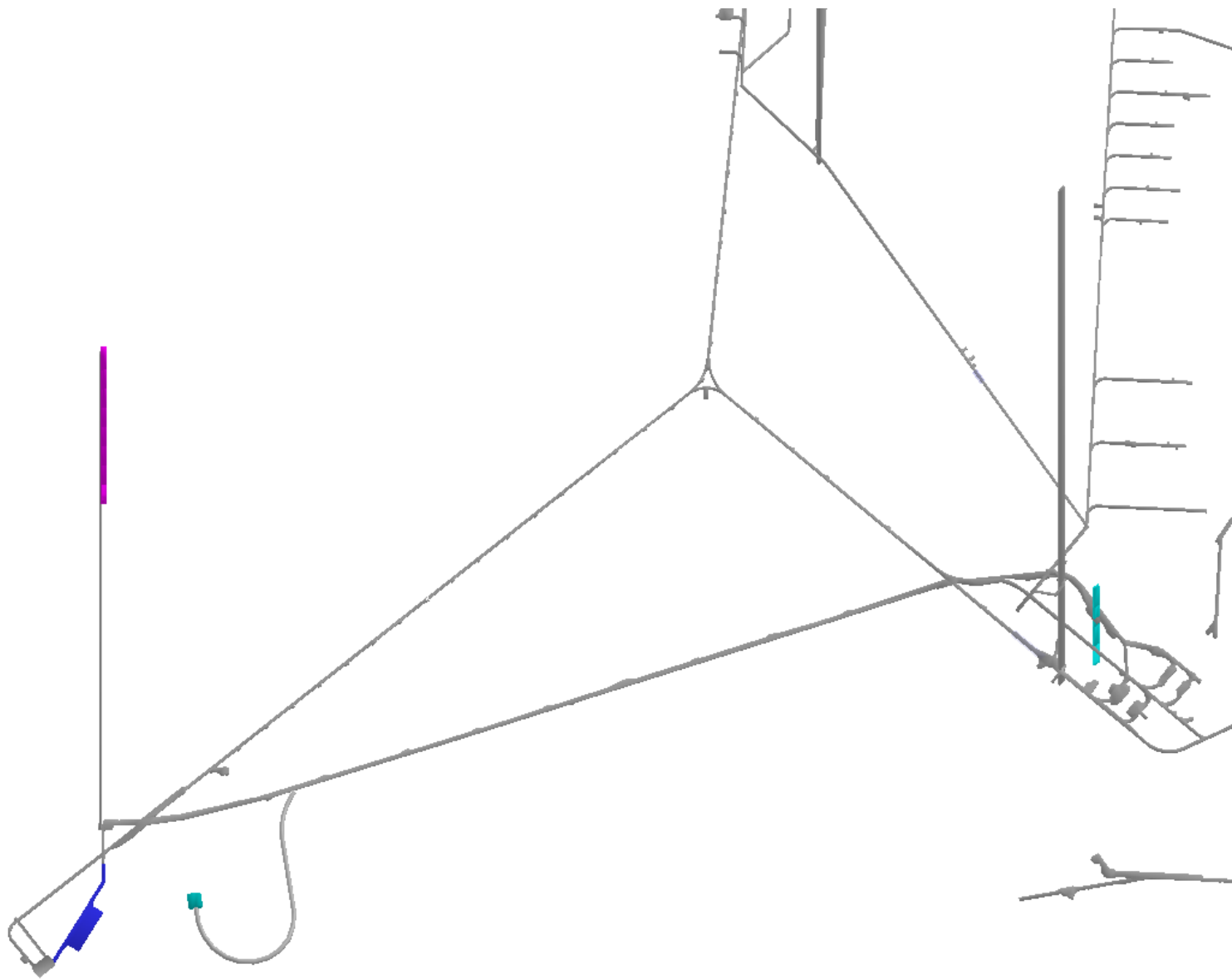
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D5 (D5)	Pink
D6 (D6)	Yellow
D7 (D7)	Red
D8 (D8)	Light Green
D9 (D9)	Light Blue
R1 (R1)	Light Green
R2 (R2)	Orange
Asbuilt (AS)	White
Asbuilt2 (AS2)	Light Green
D10 (D10)	Orange
YR (YR)	Pink



**Activity Type**

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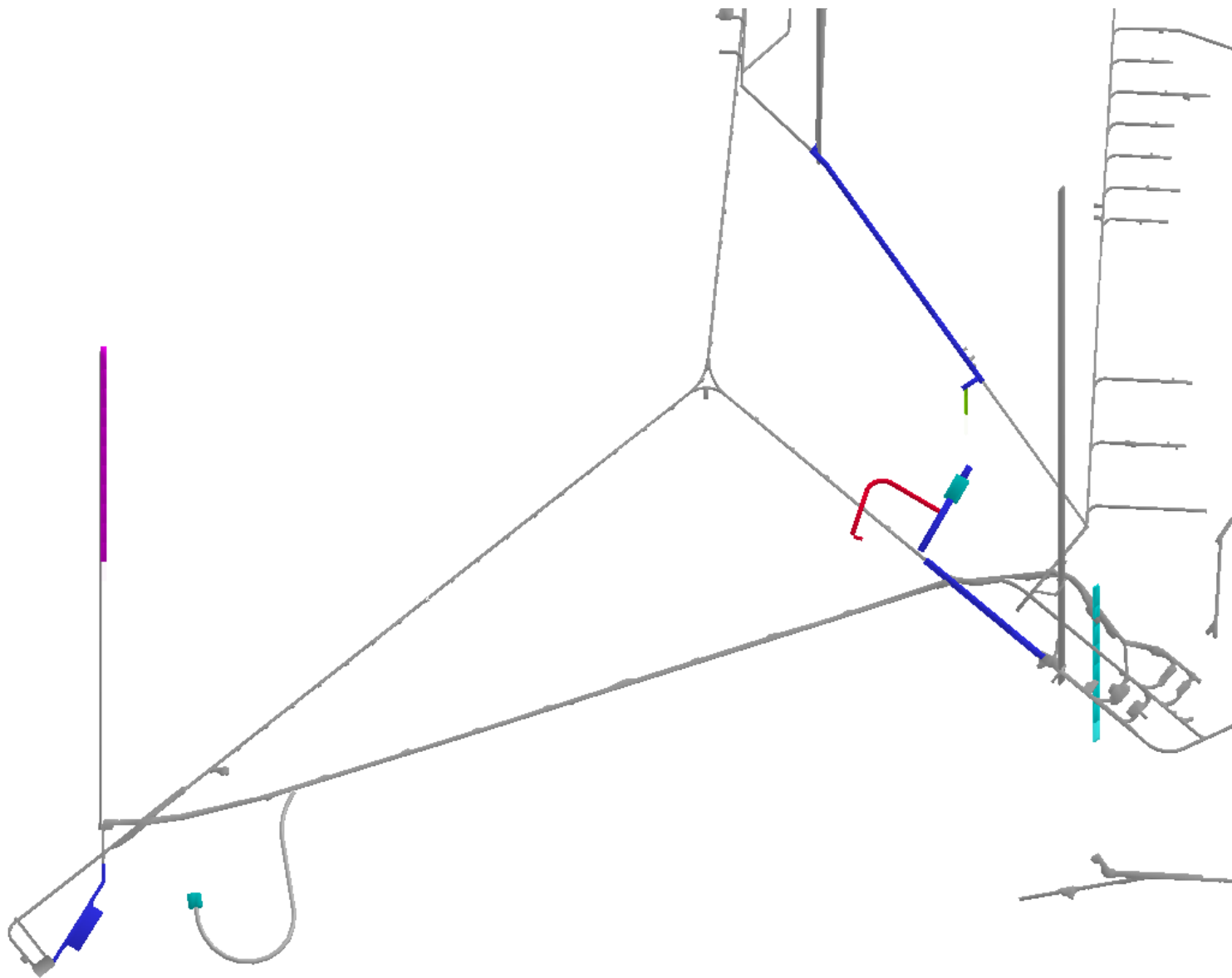






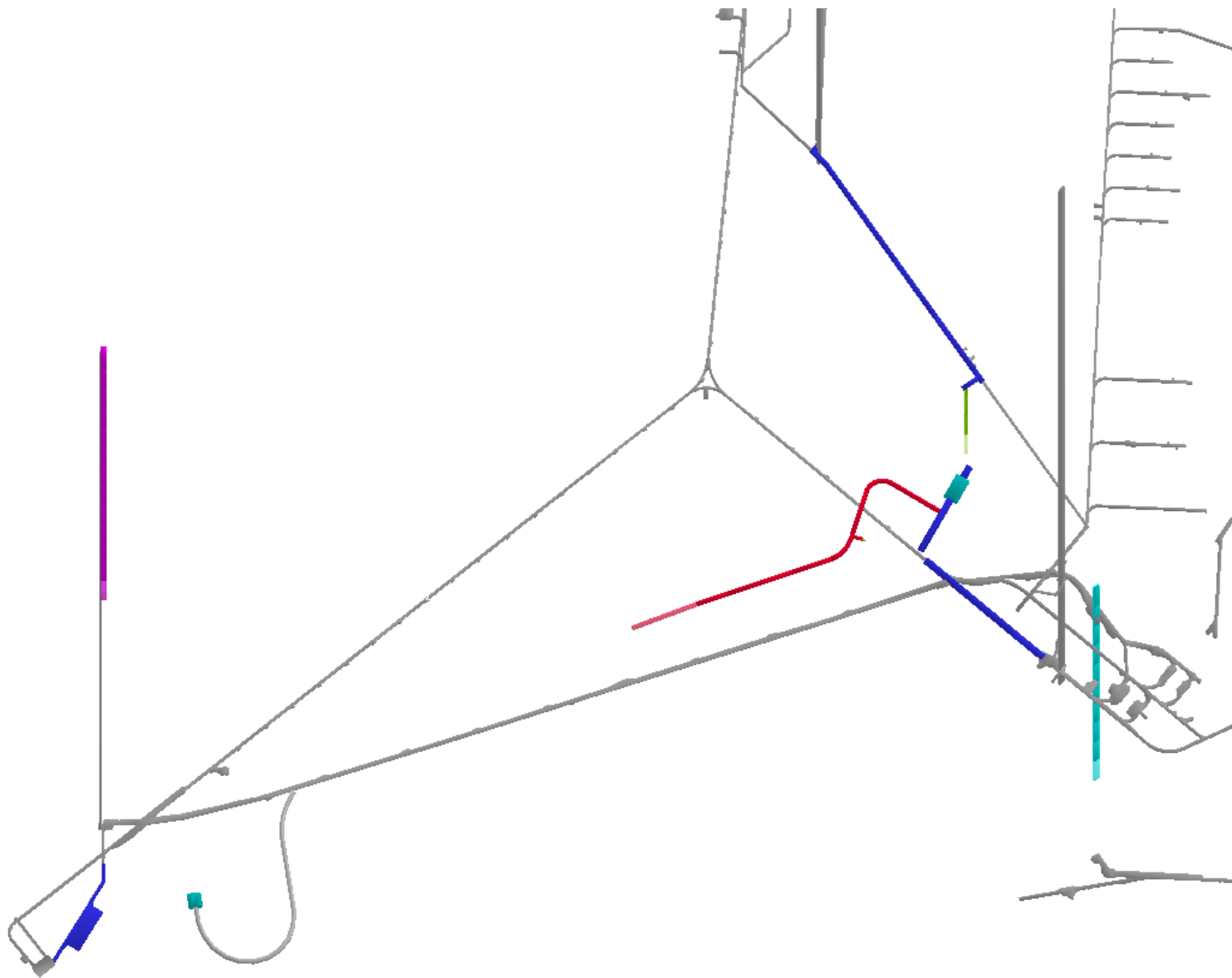
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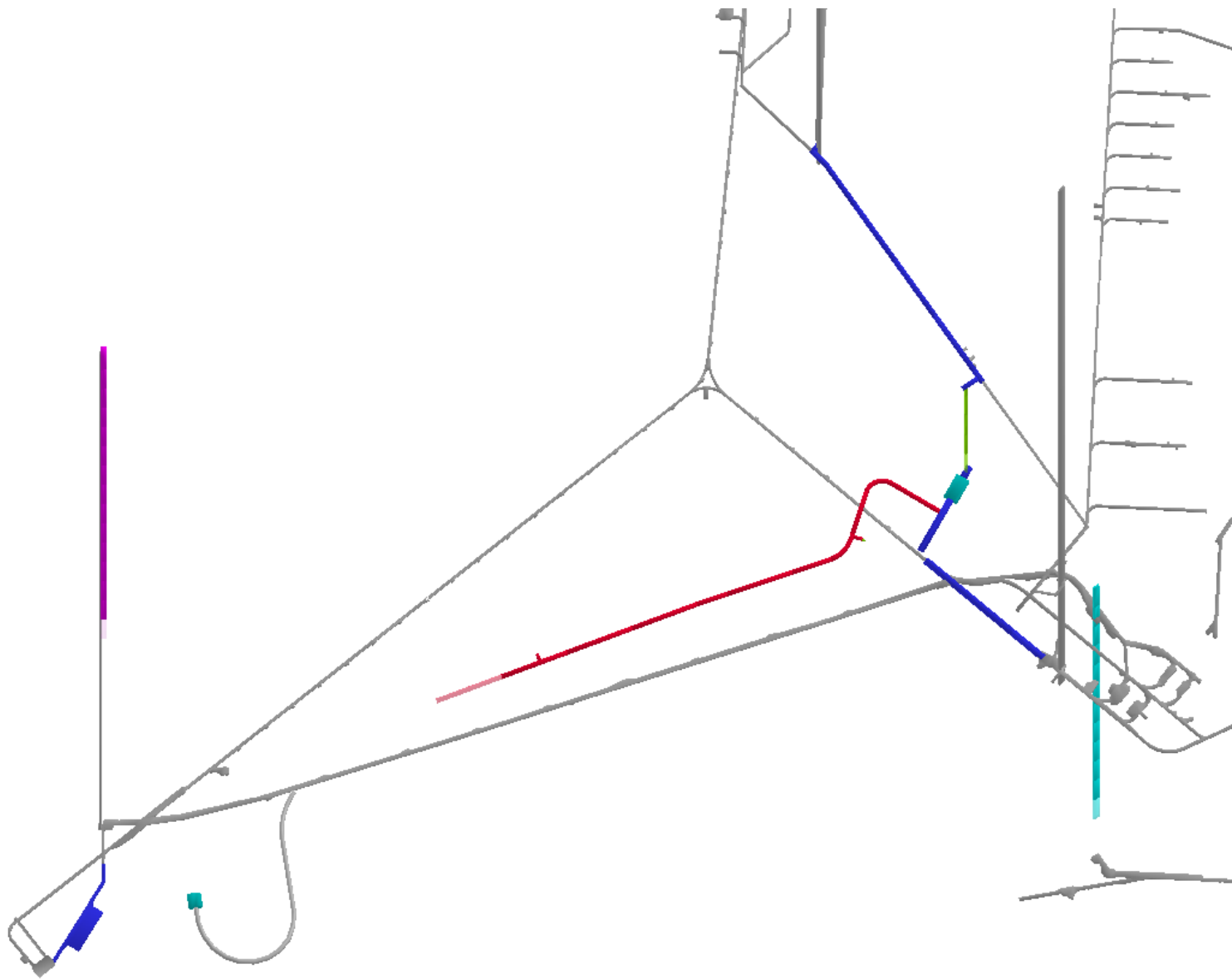
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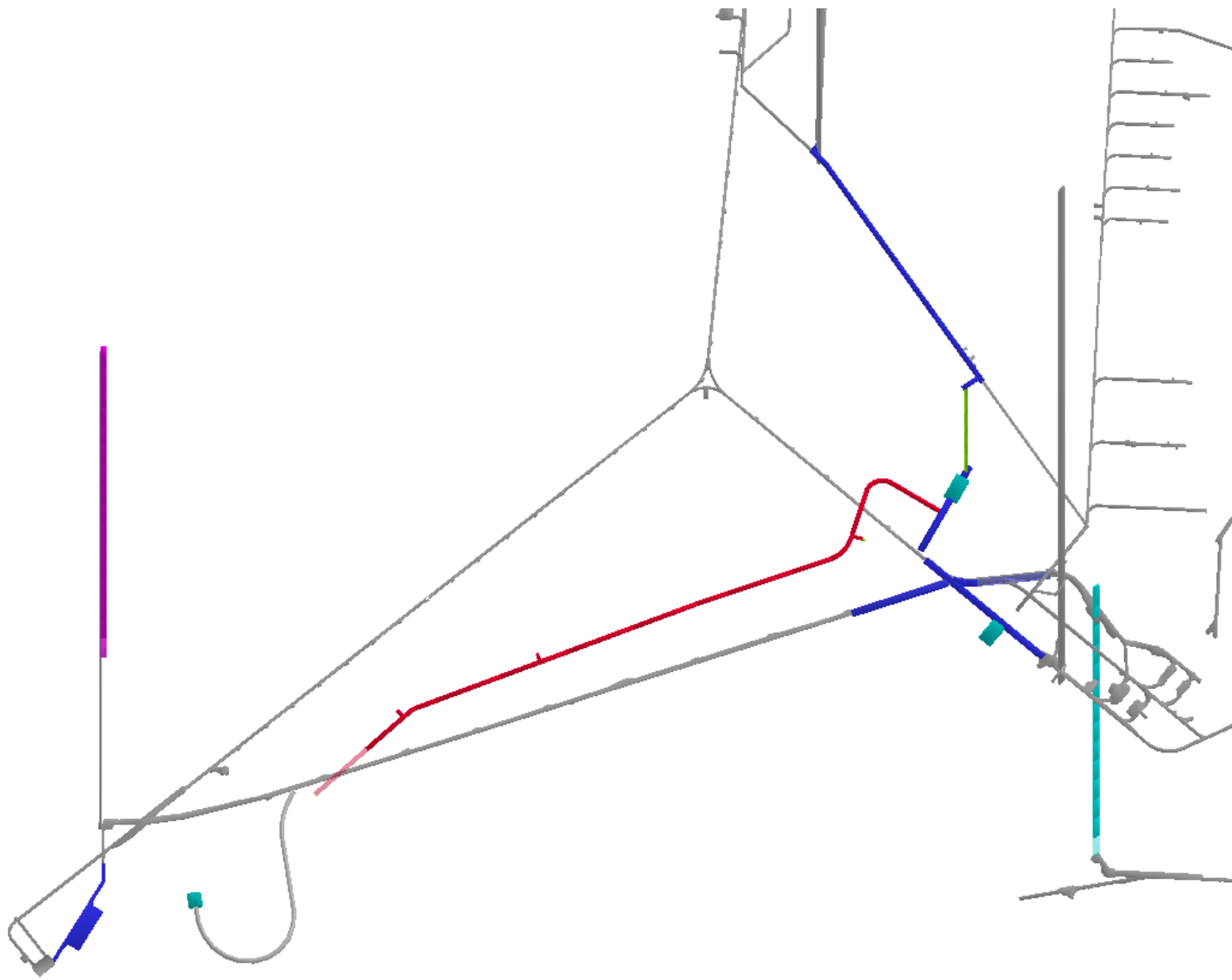
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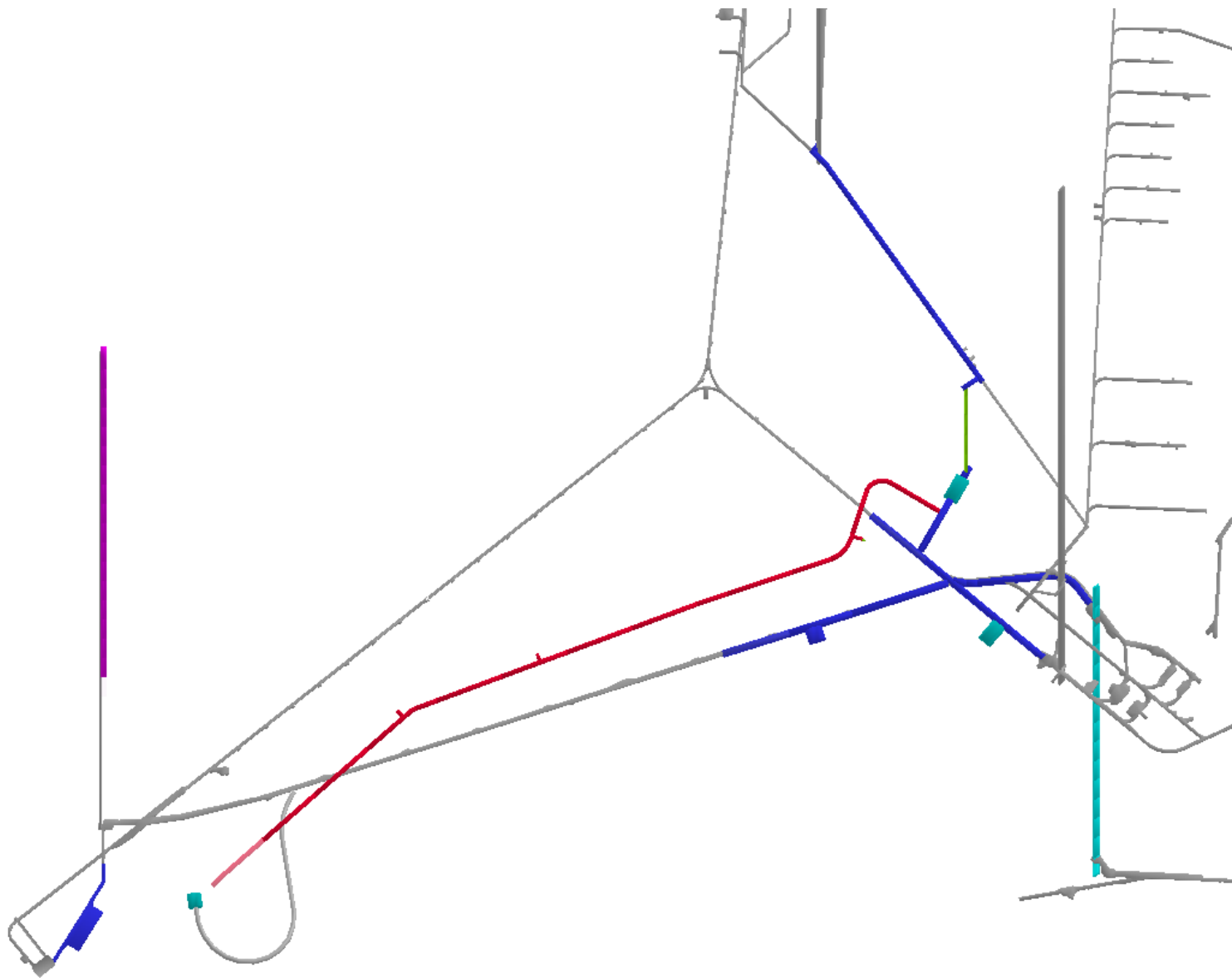
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D5 (D5)	Pink
D6 (D6)	Yellow
D7 (D7)	Red
D8 (D8)	Light Green
D9 (D9)	Cyan
R1 (R1)	Light Green
R2 (R2)	Orange
Asbuilt (AS)	Grey
Asbuilt2 (AS2)	Light Green
D10 (D10)	Orange
YR (YR)	Pink



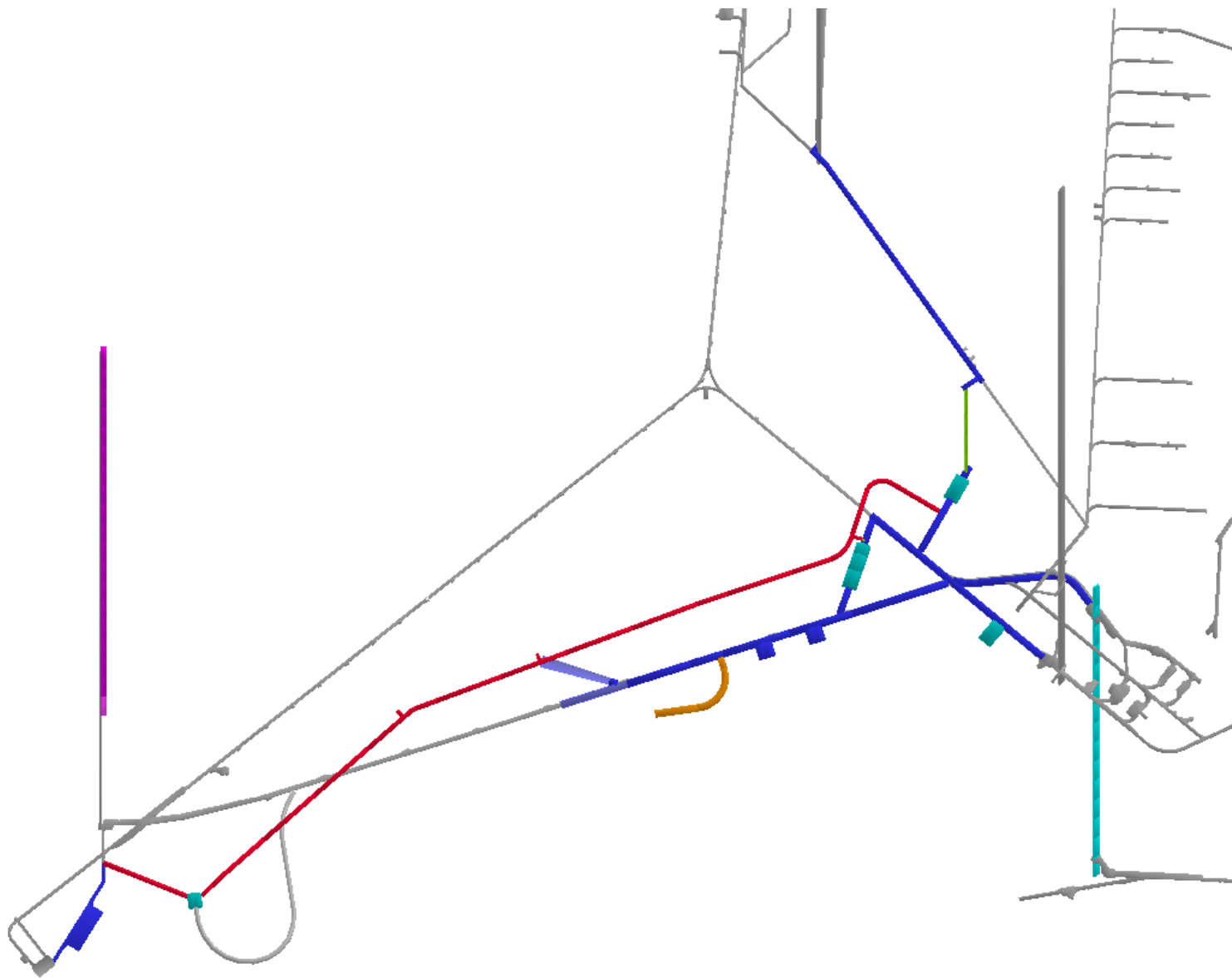
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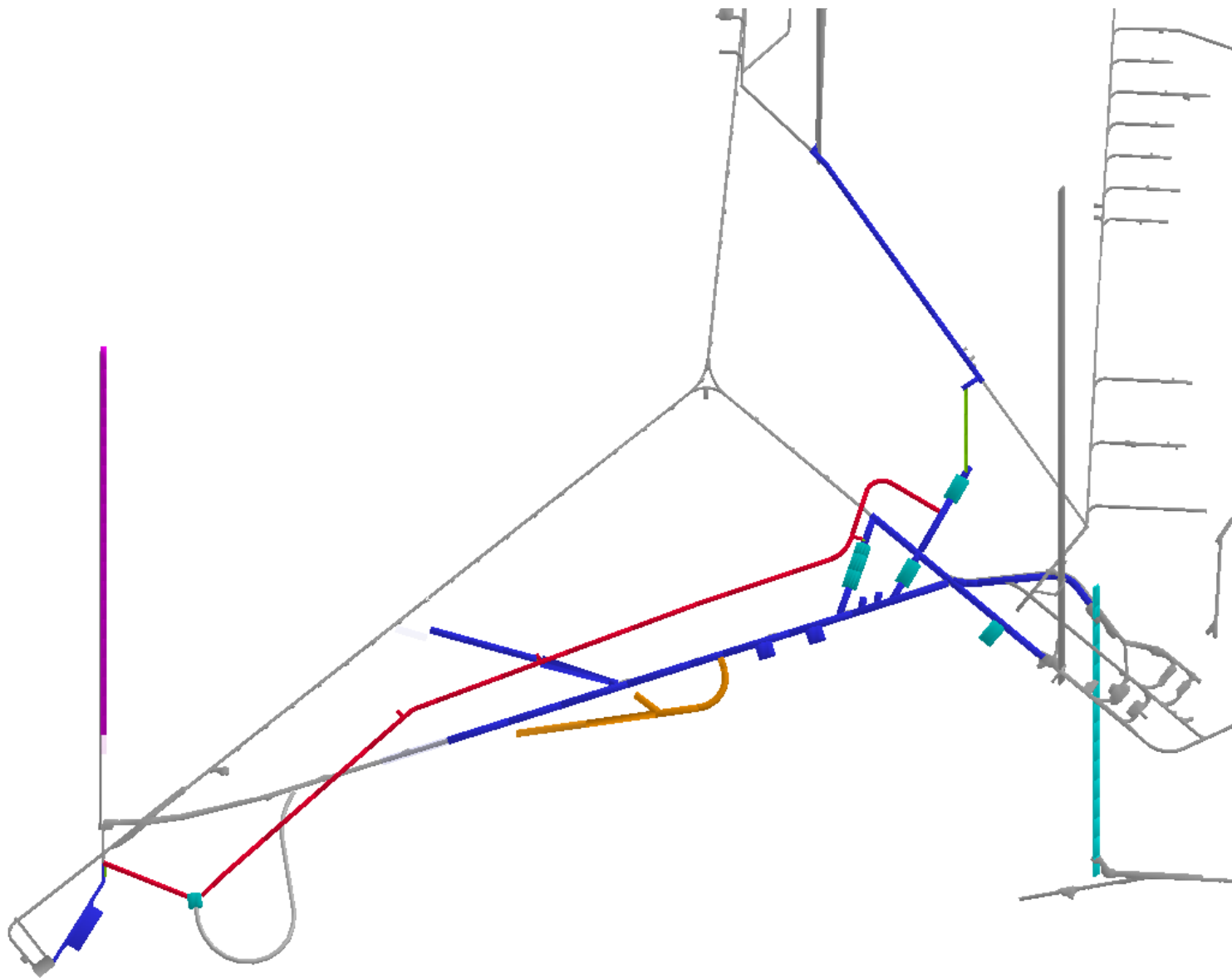
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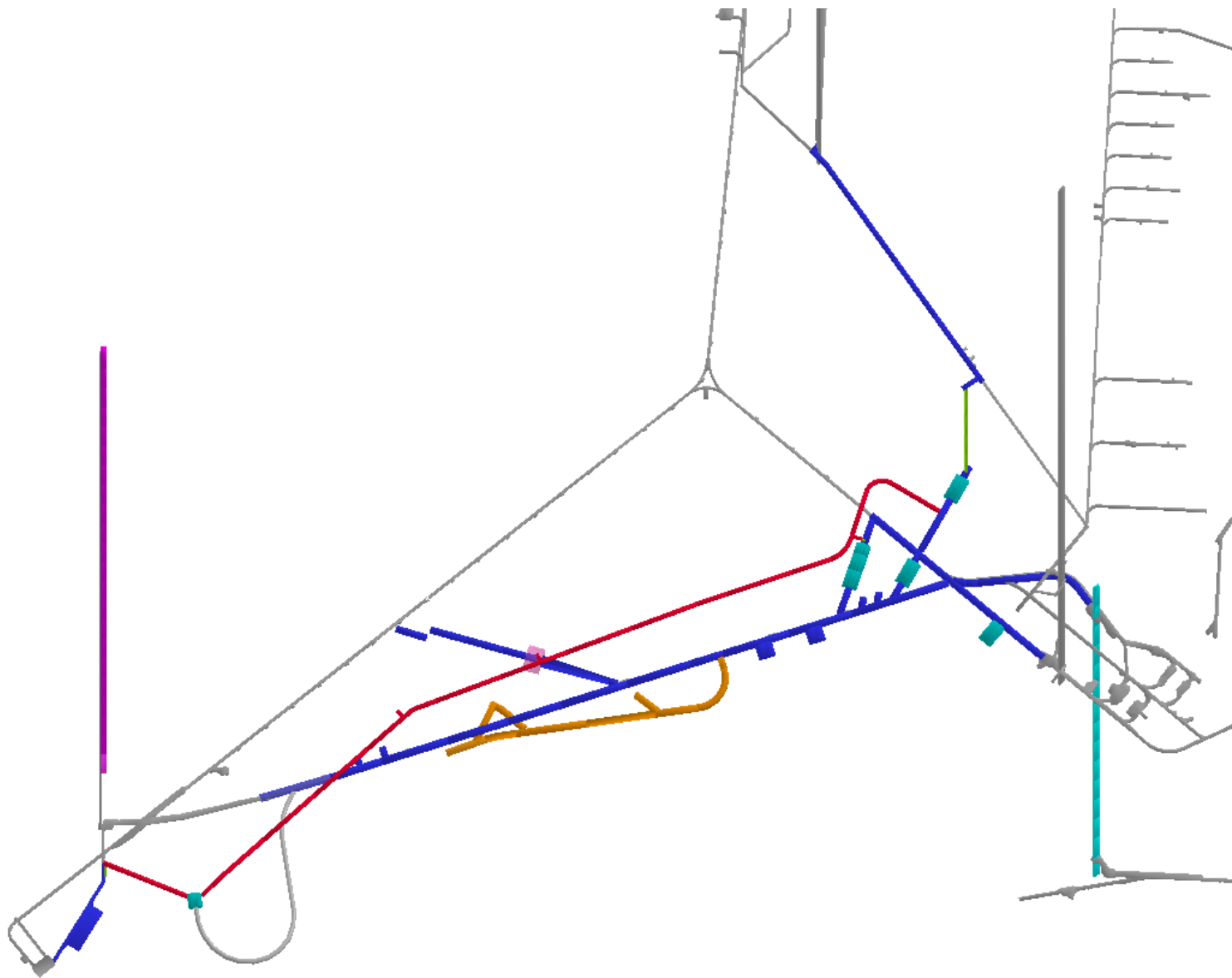
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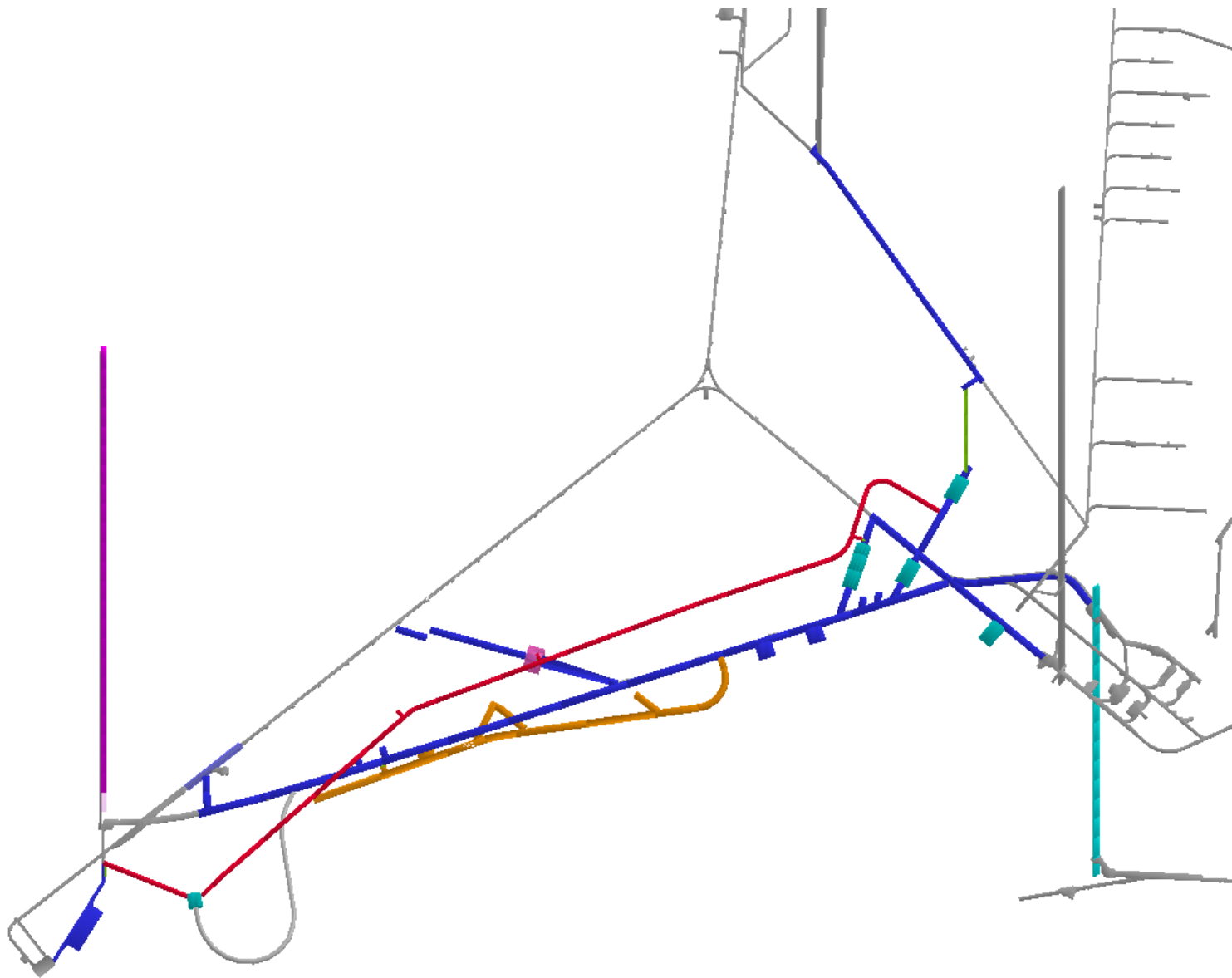
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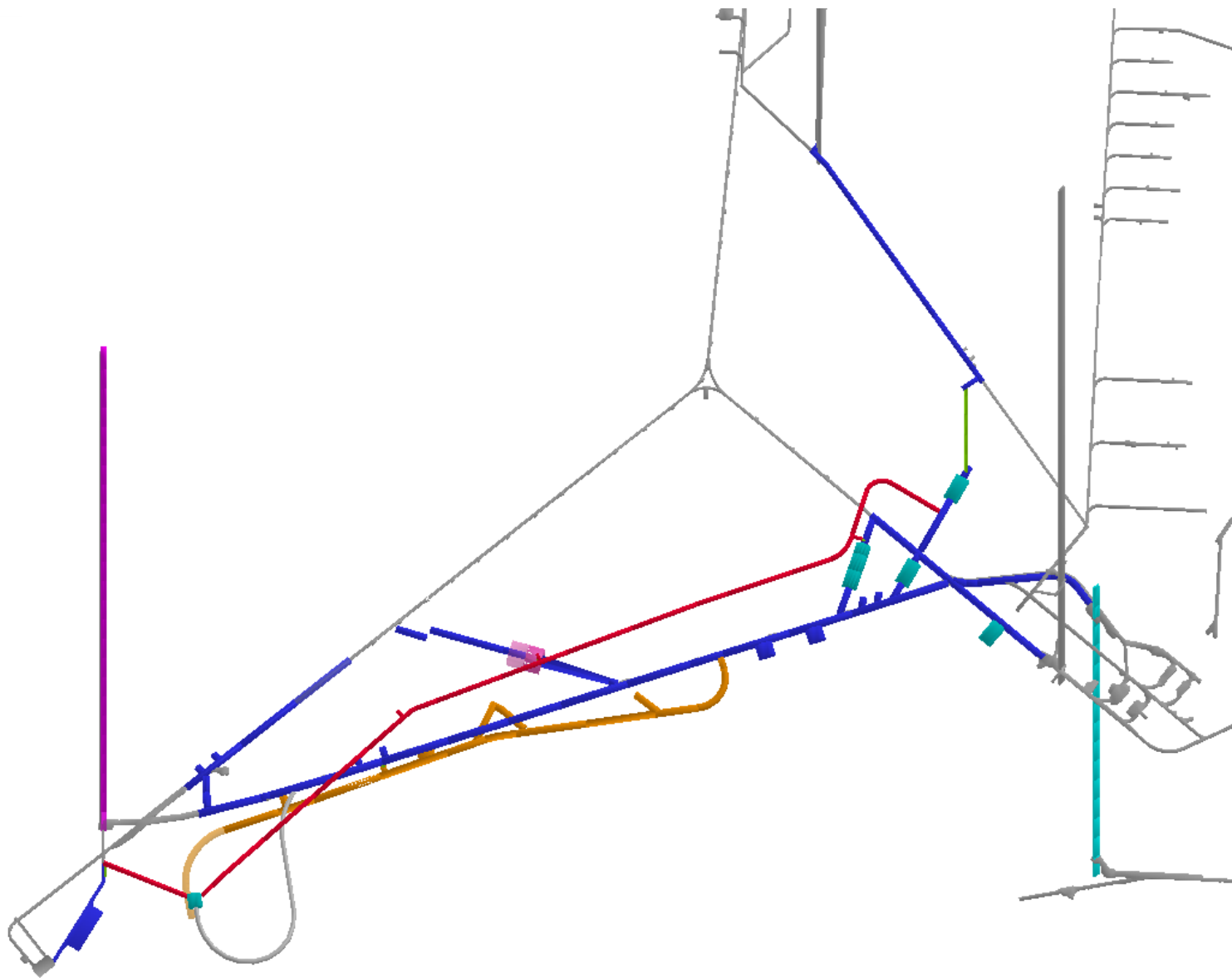
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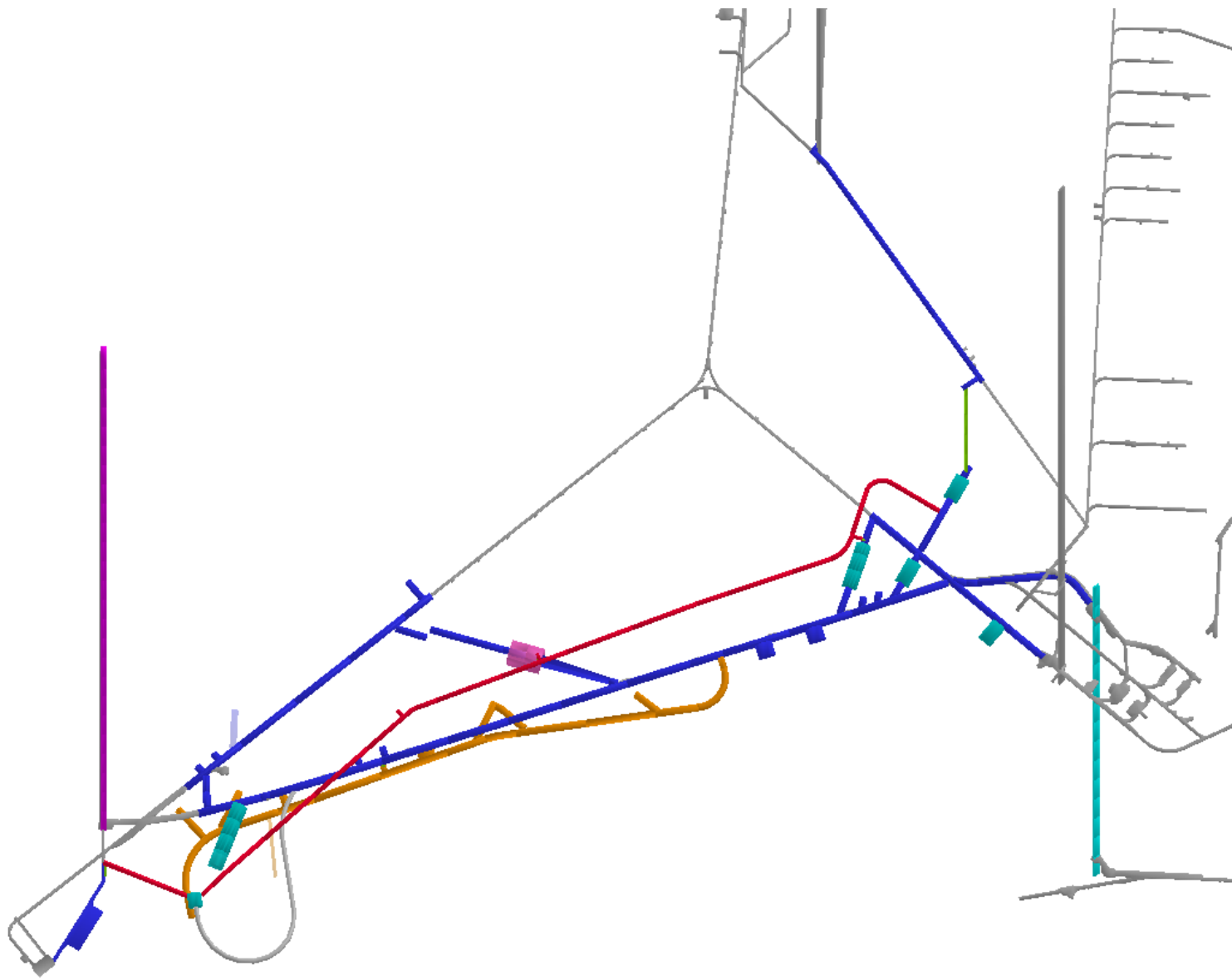


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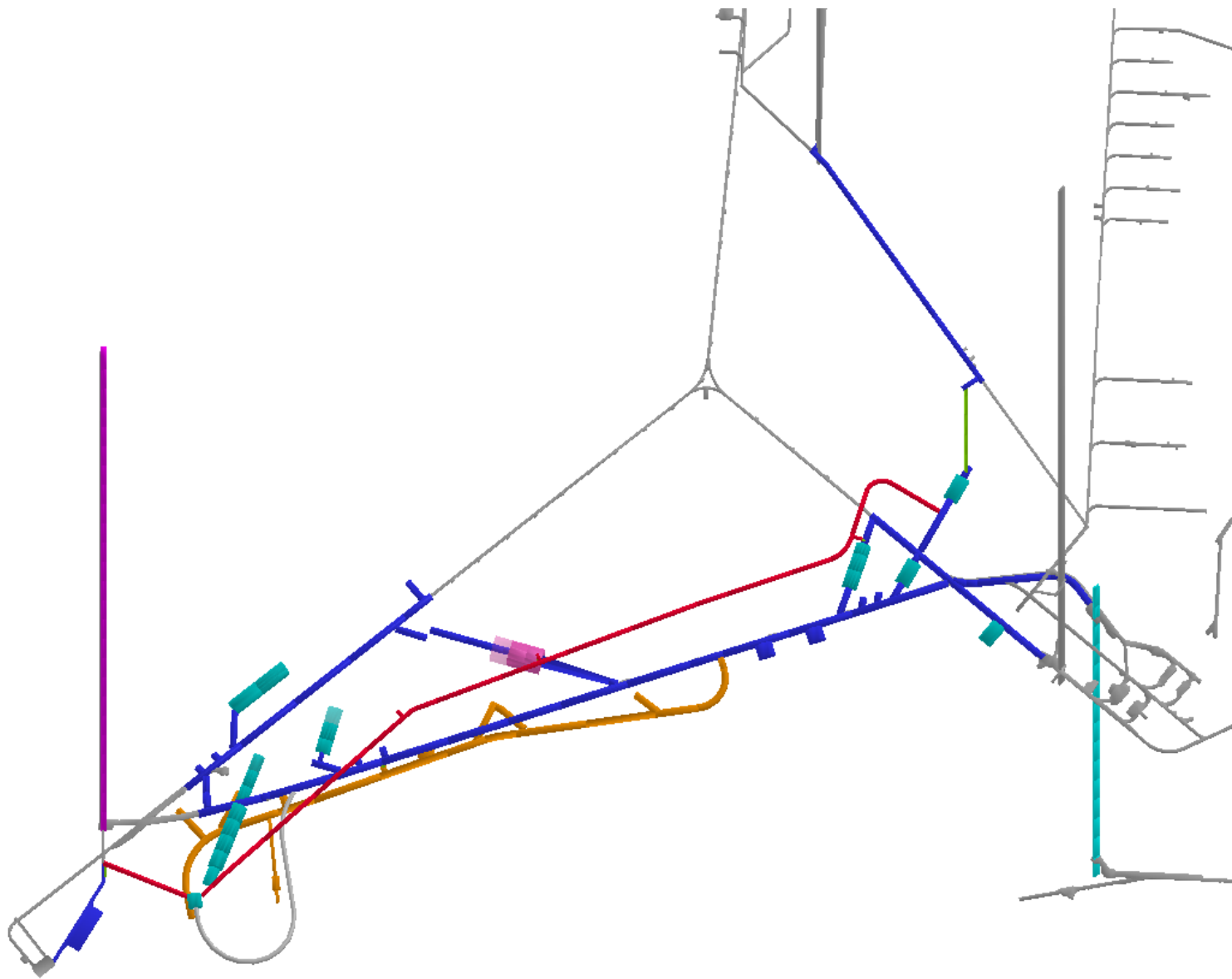


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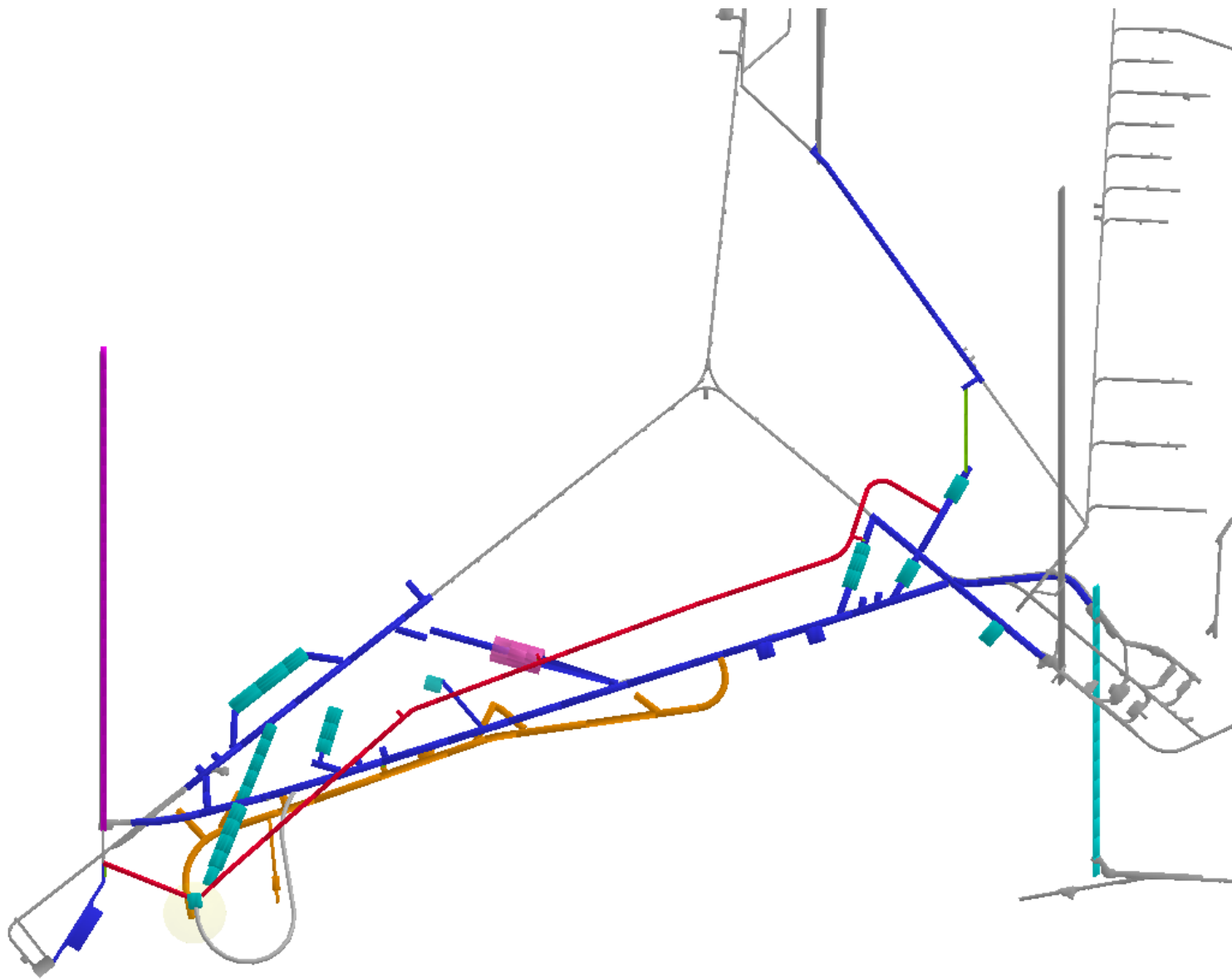
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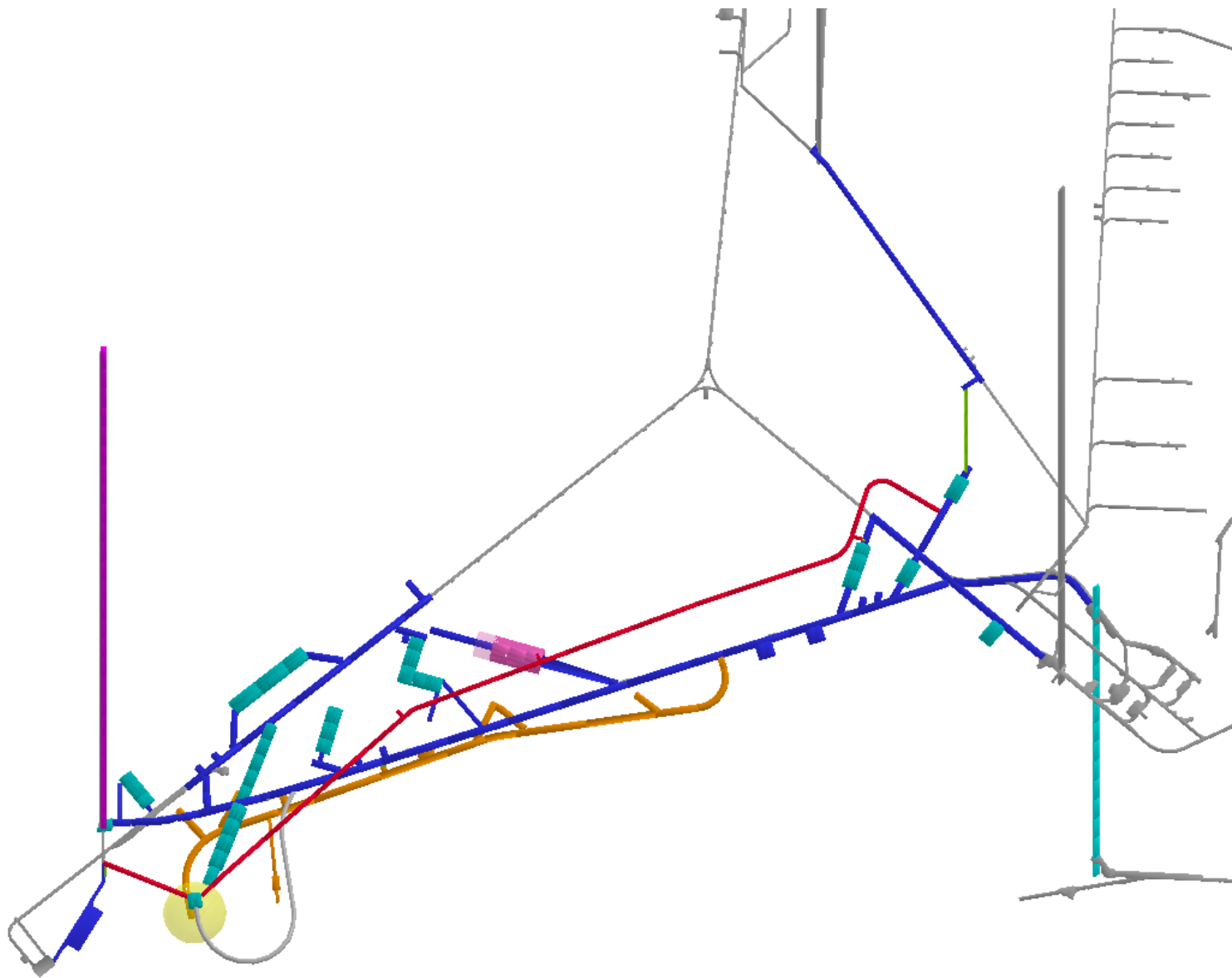
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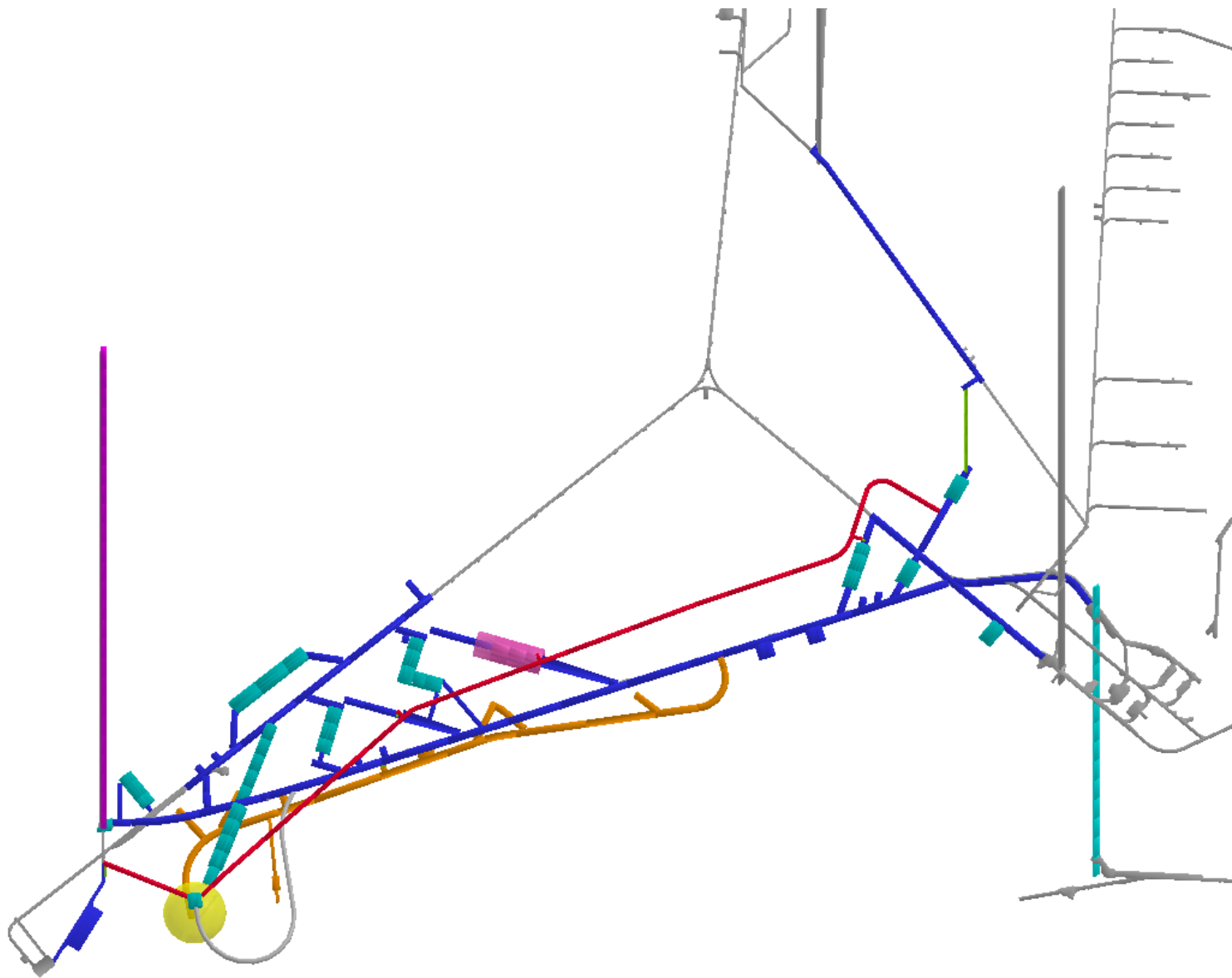
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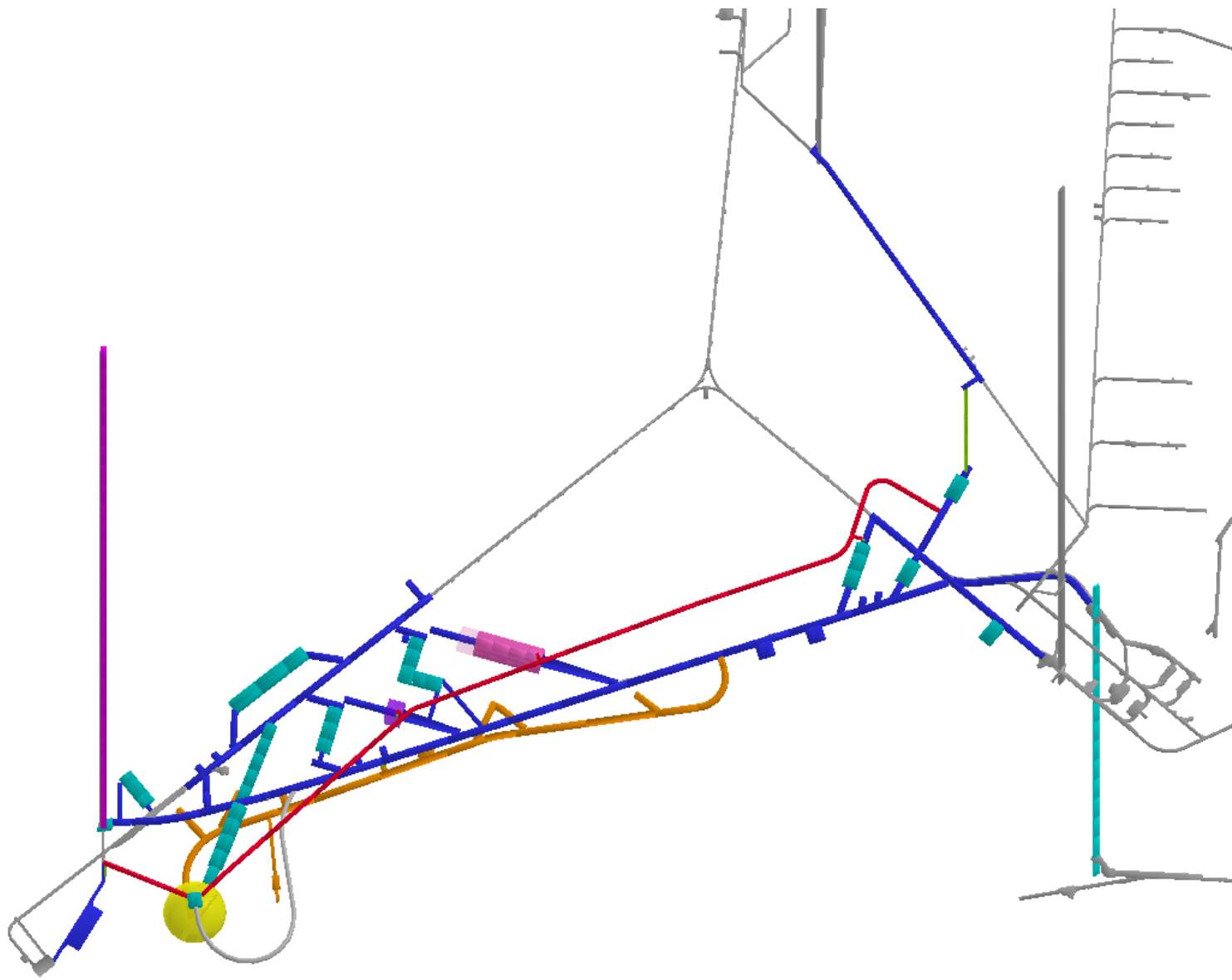
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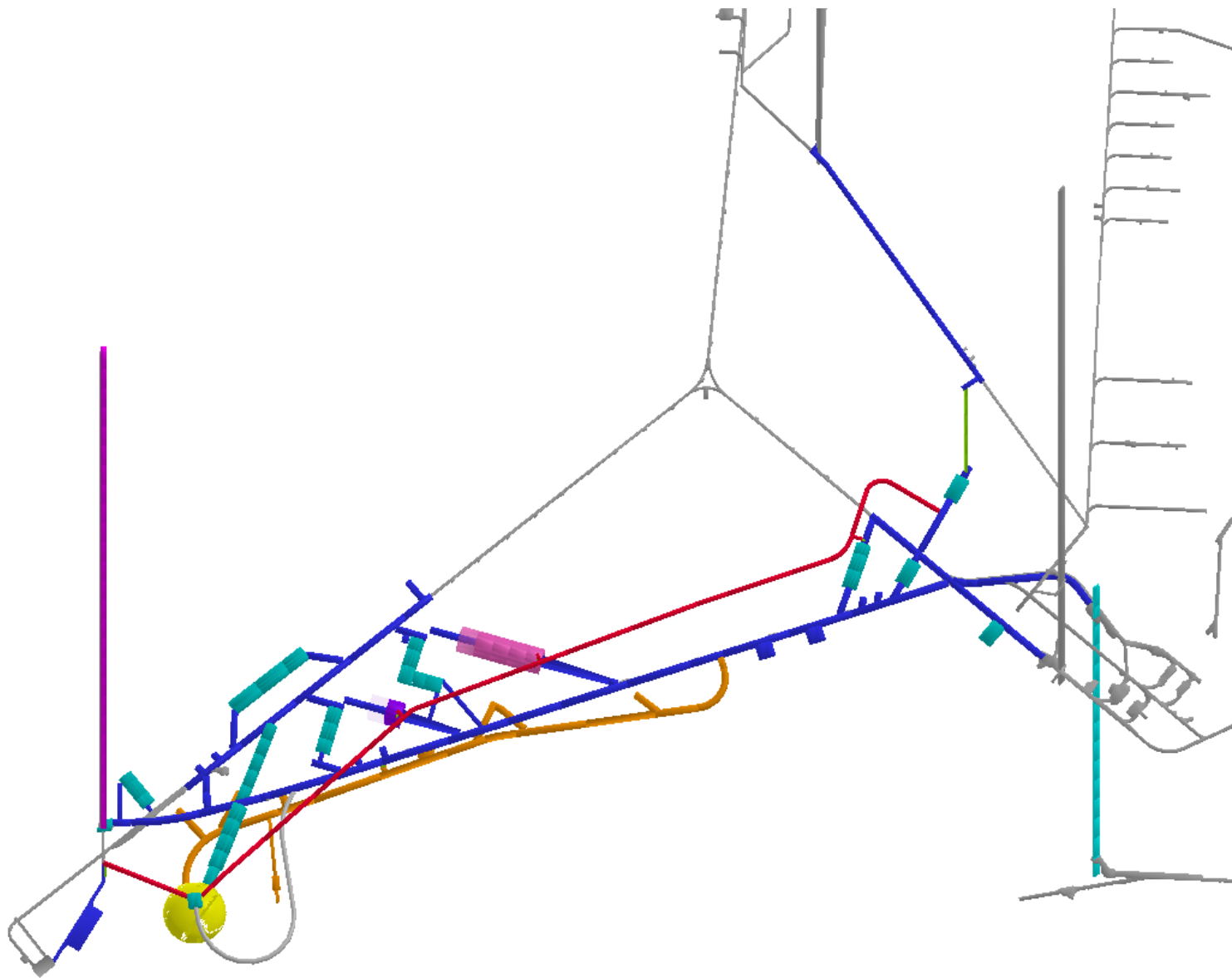
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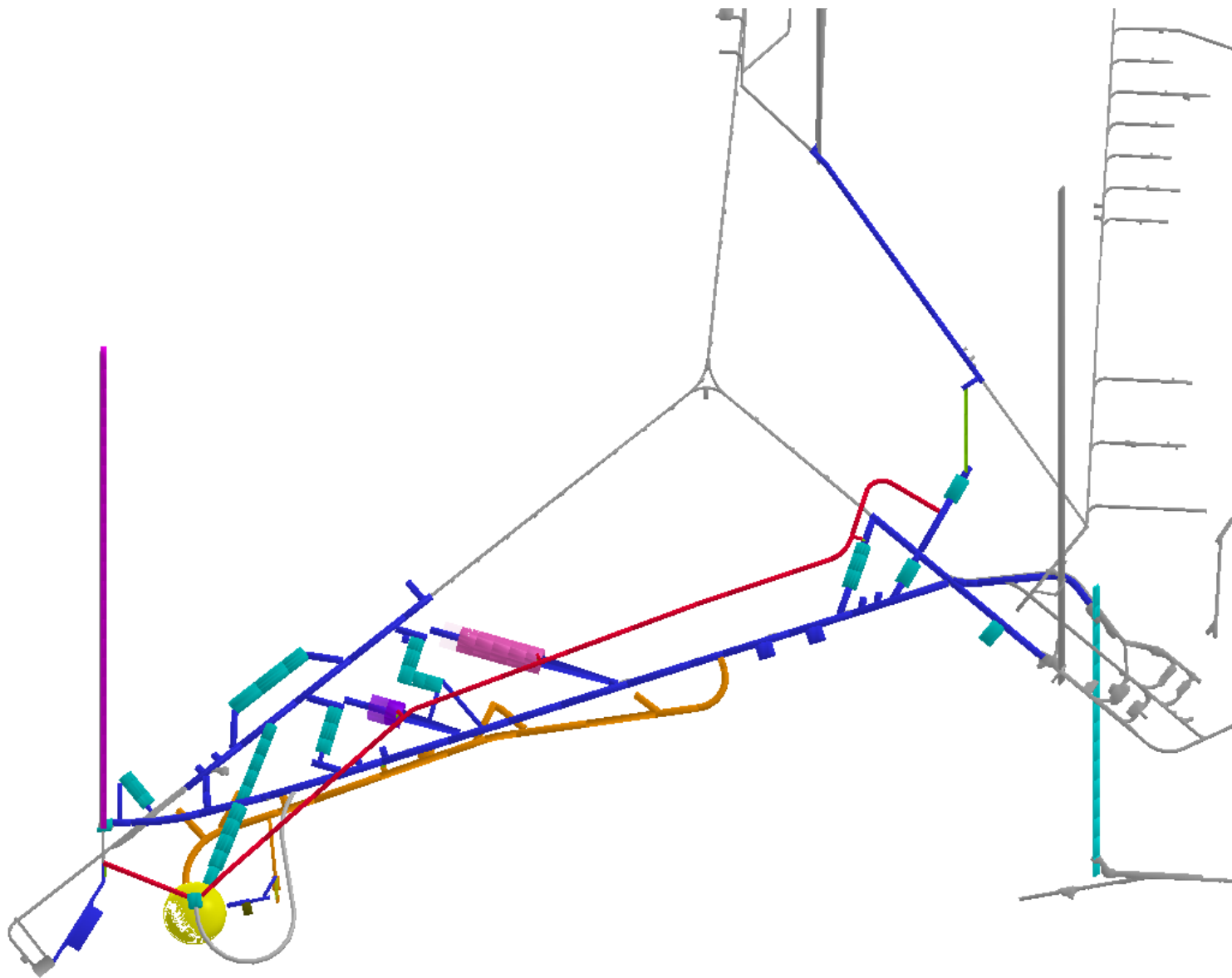
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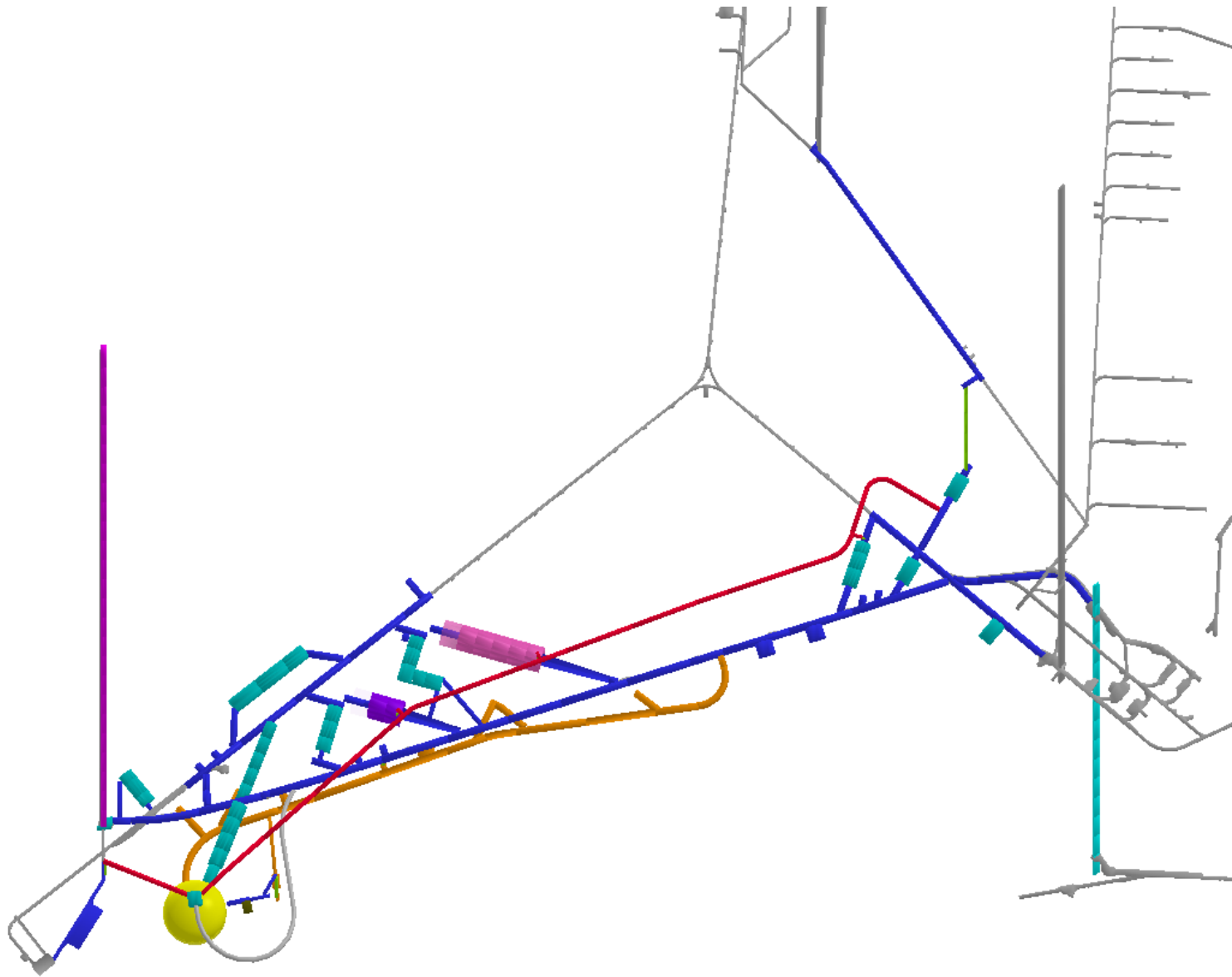
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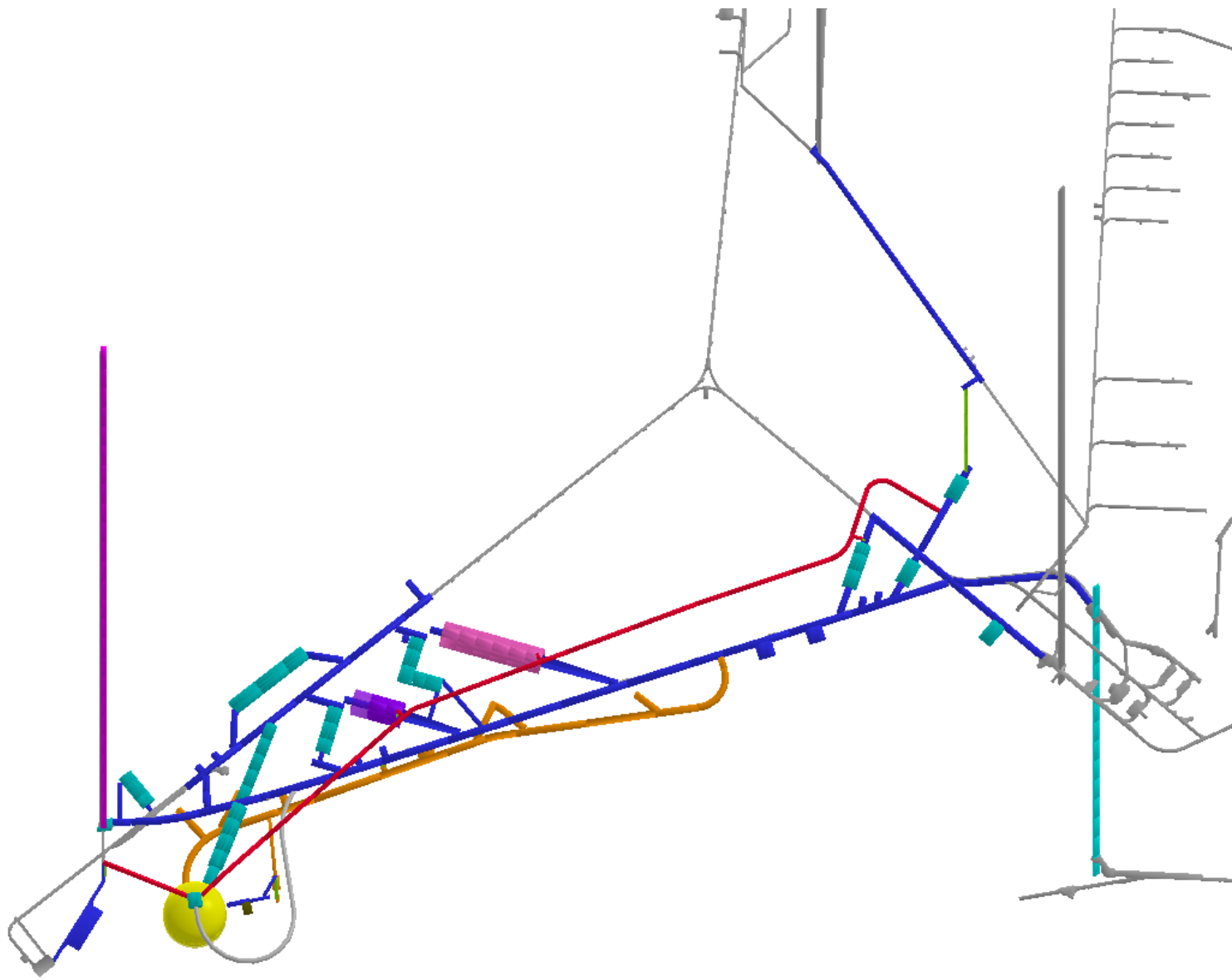


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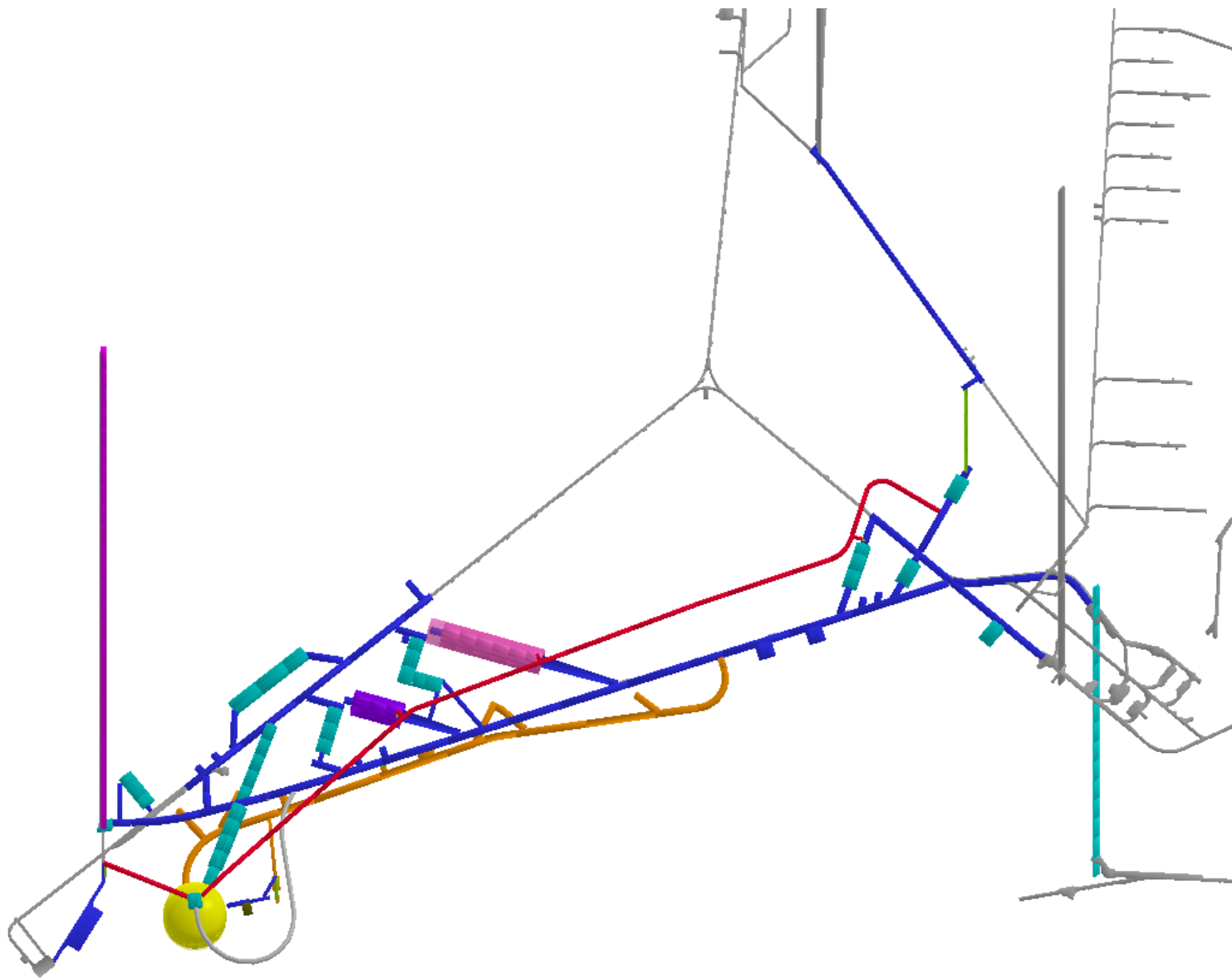


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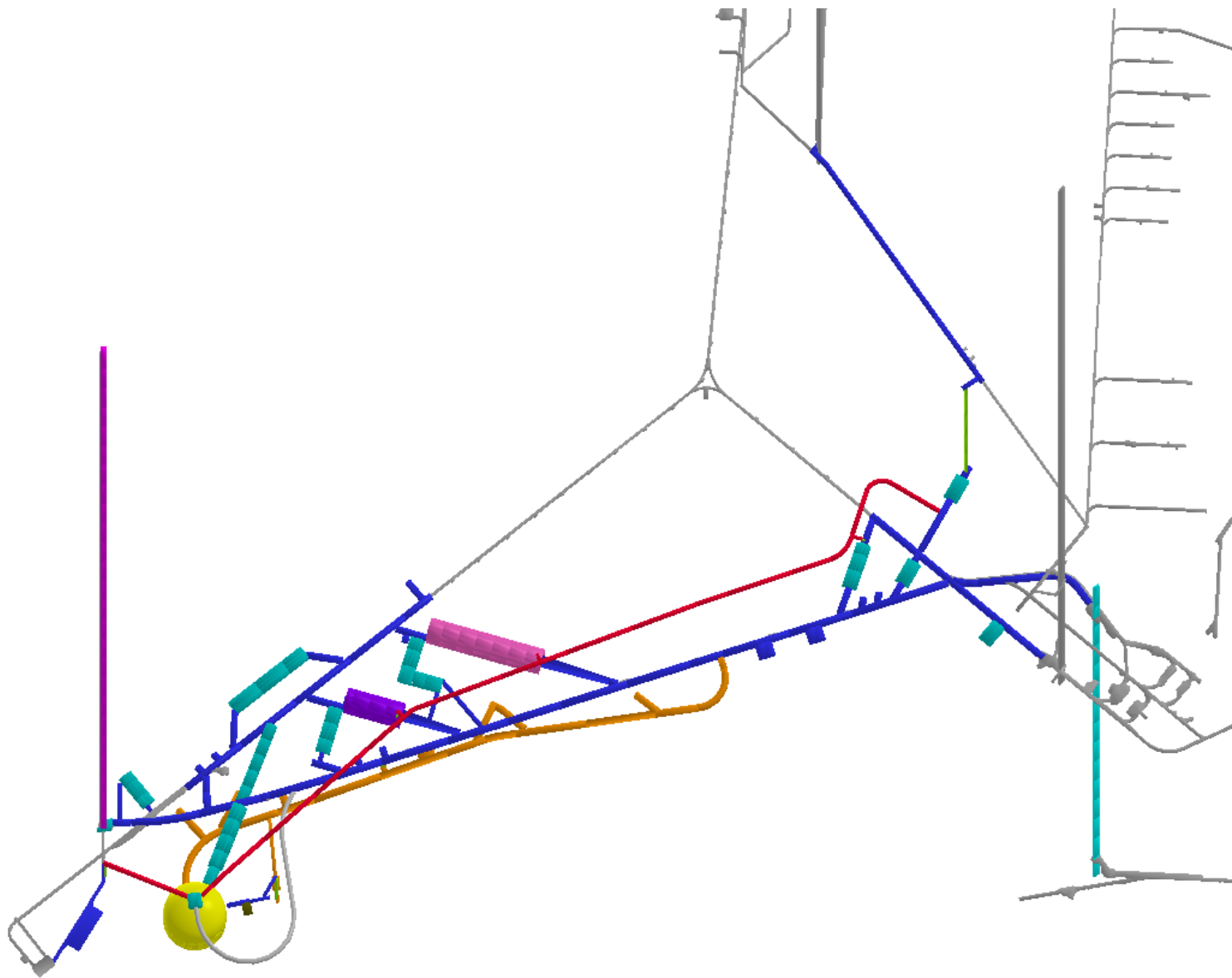
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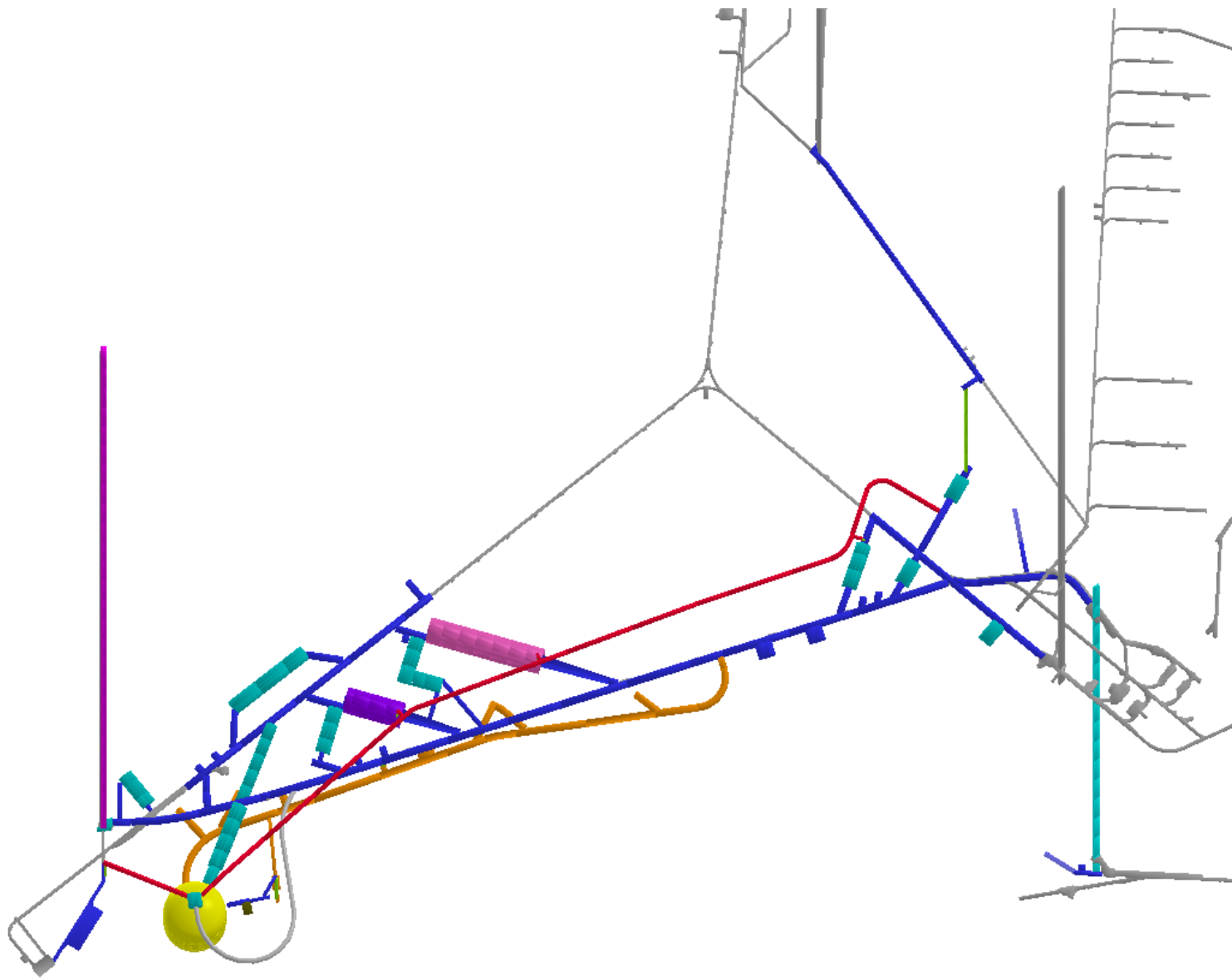
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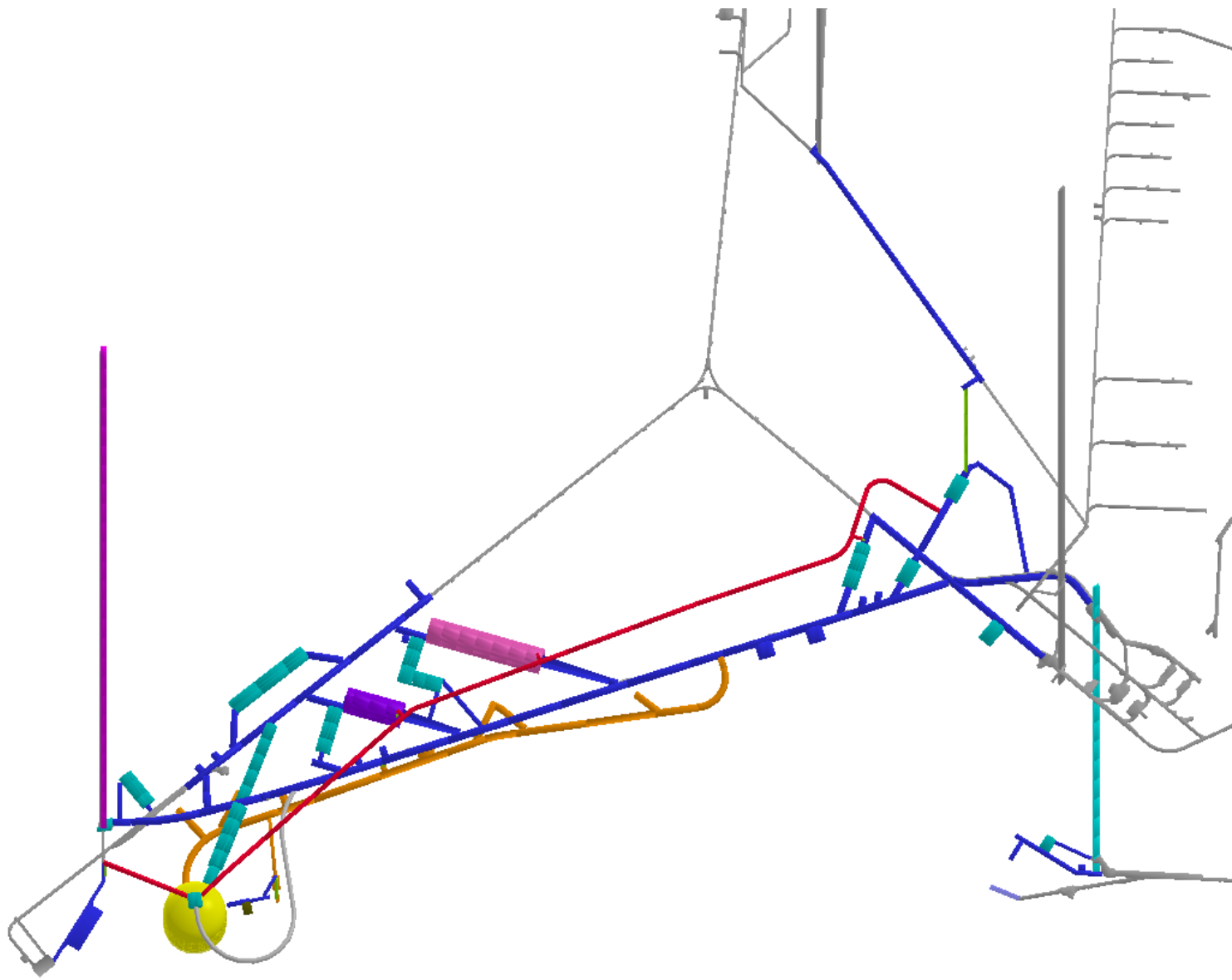
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- Asbuilt (AS) ■
- Asbuilt2 (AS2) ■
- D10 (D10) ■
- YR (YR) ■



**Activity Type**

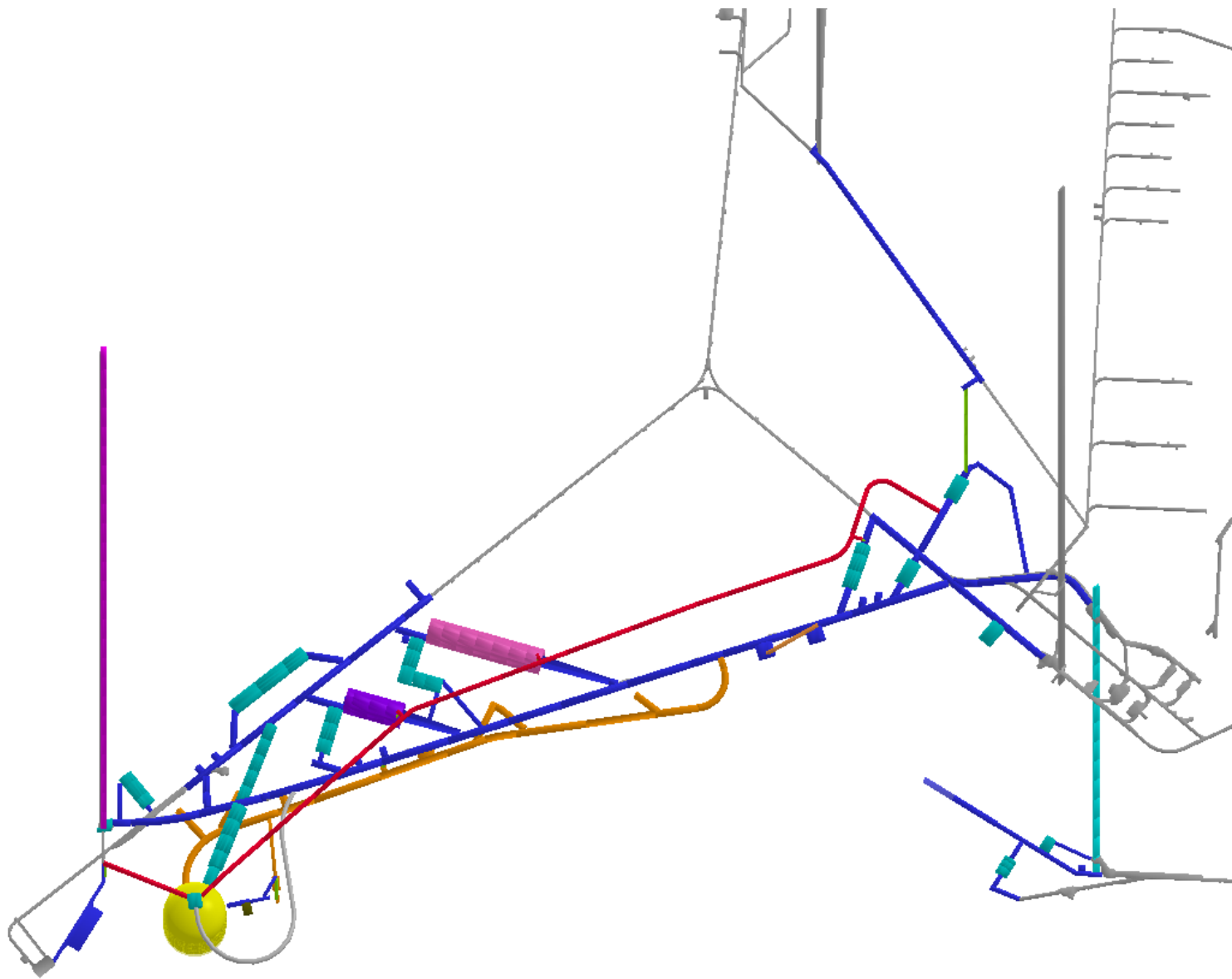
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- D9 (D9) ■
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- YR (YR) ■





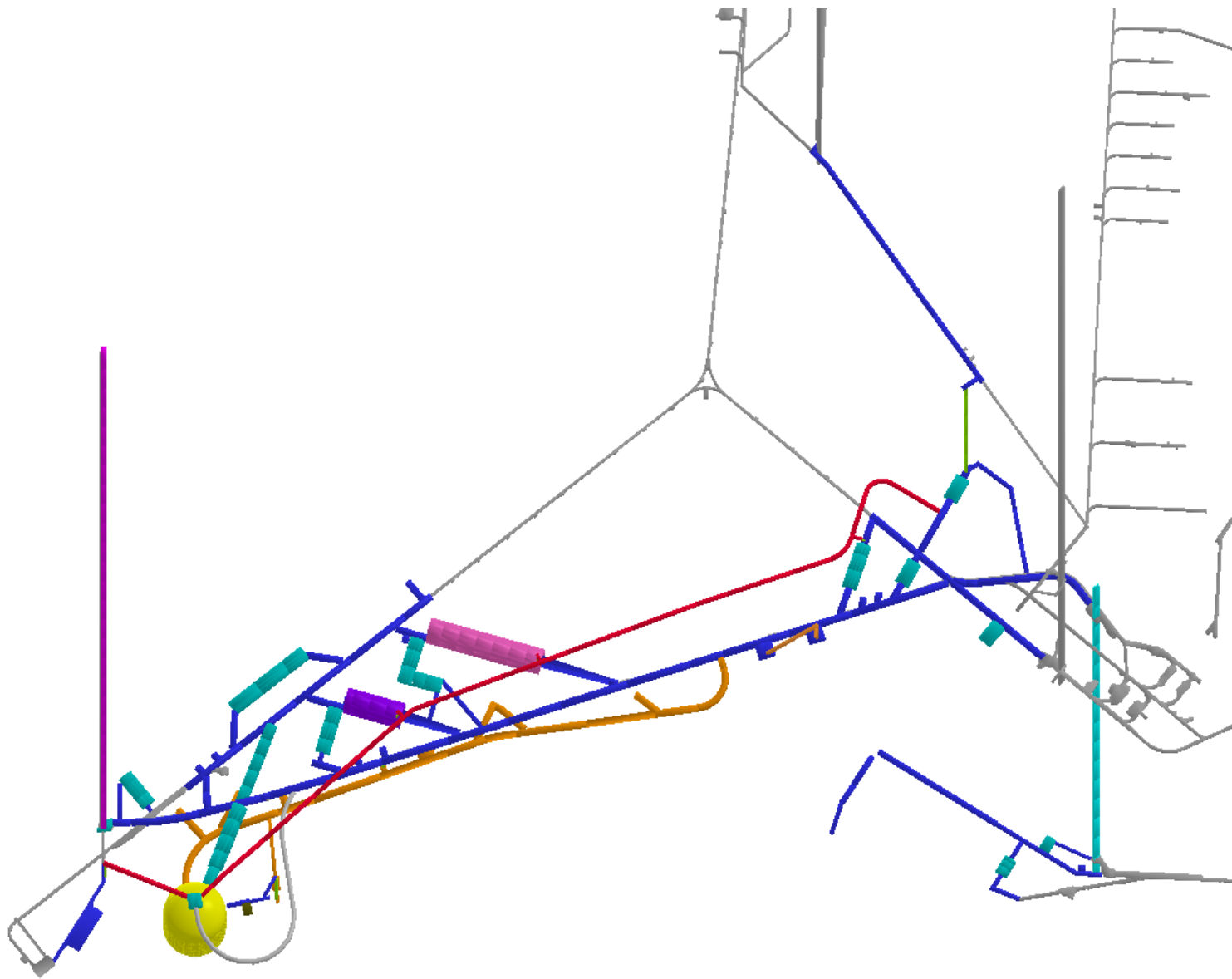
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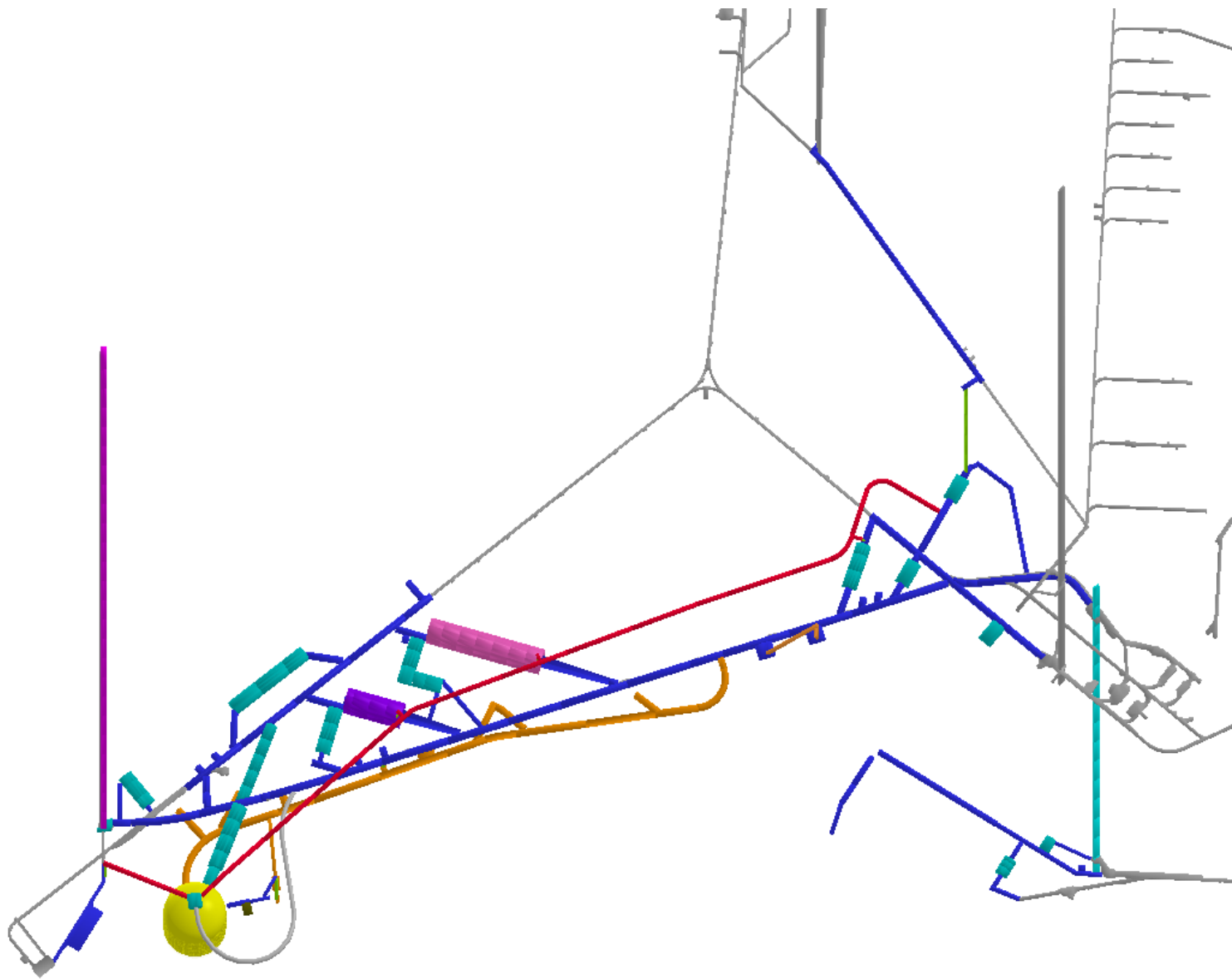
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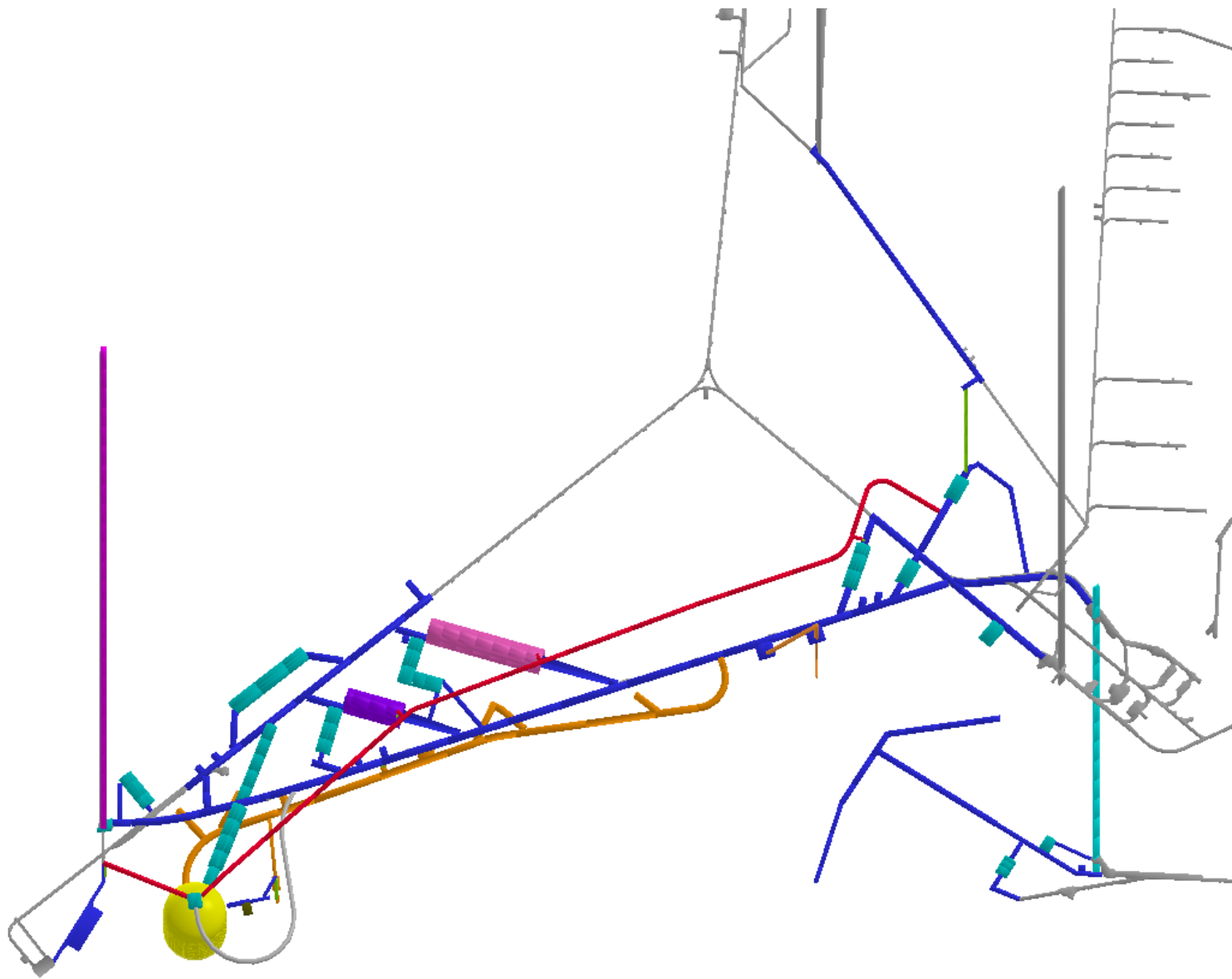
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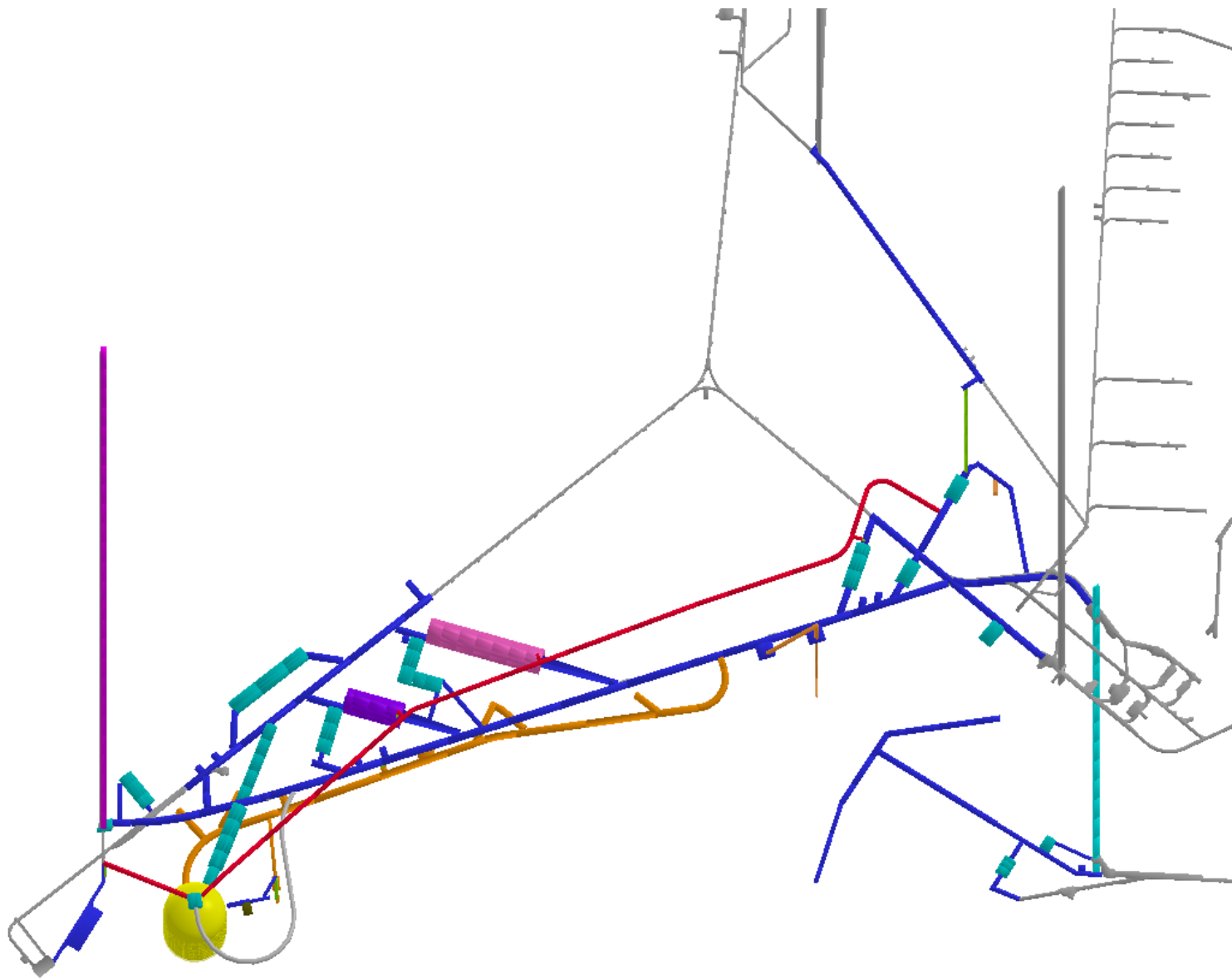
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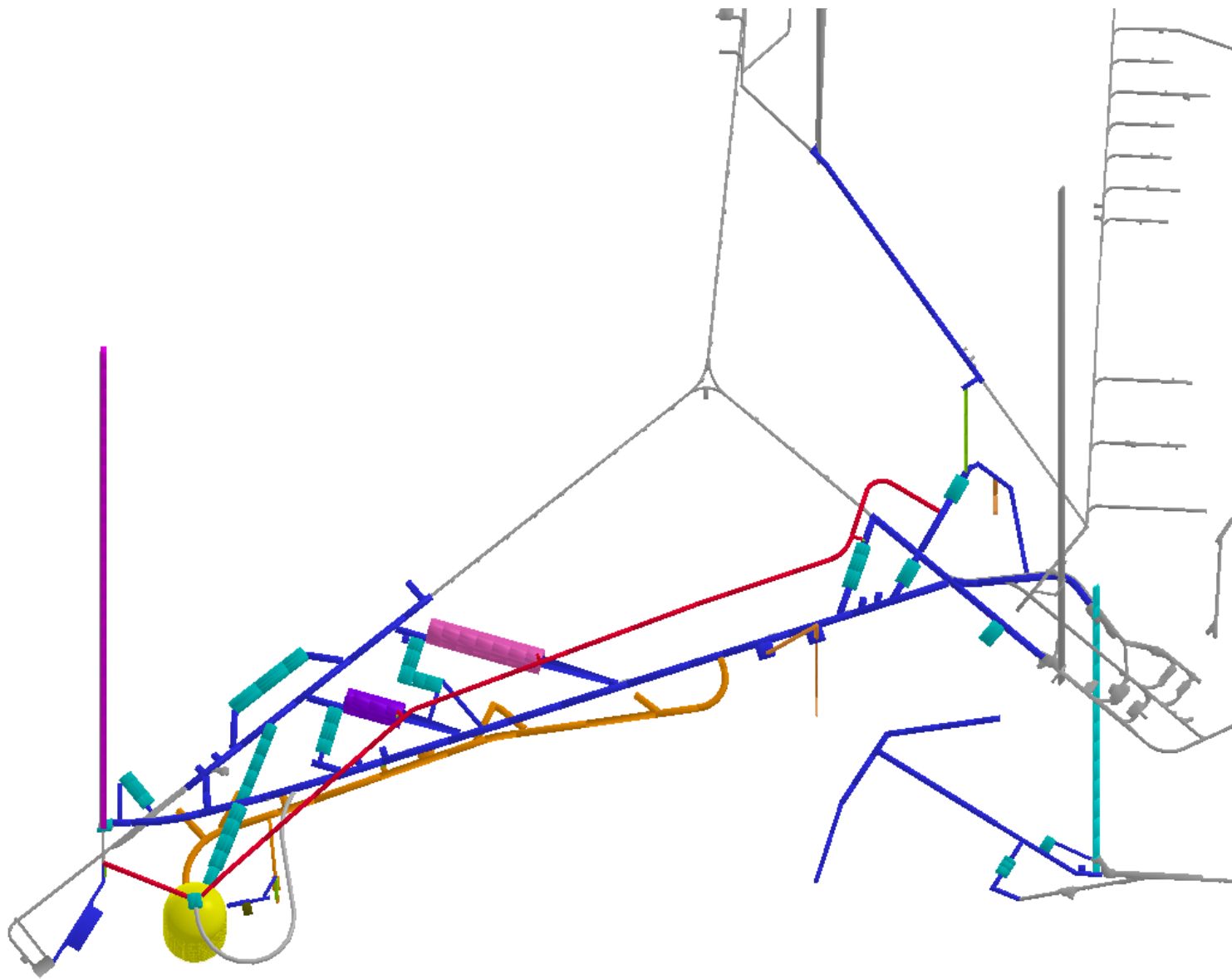
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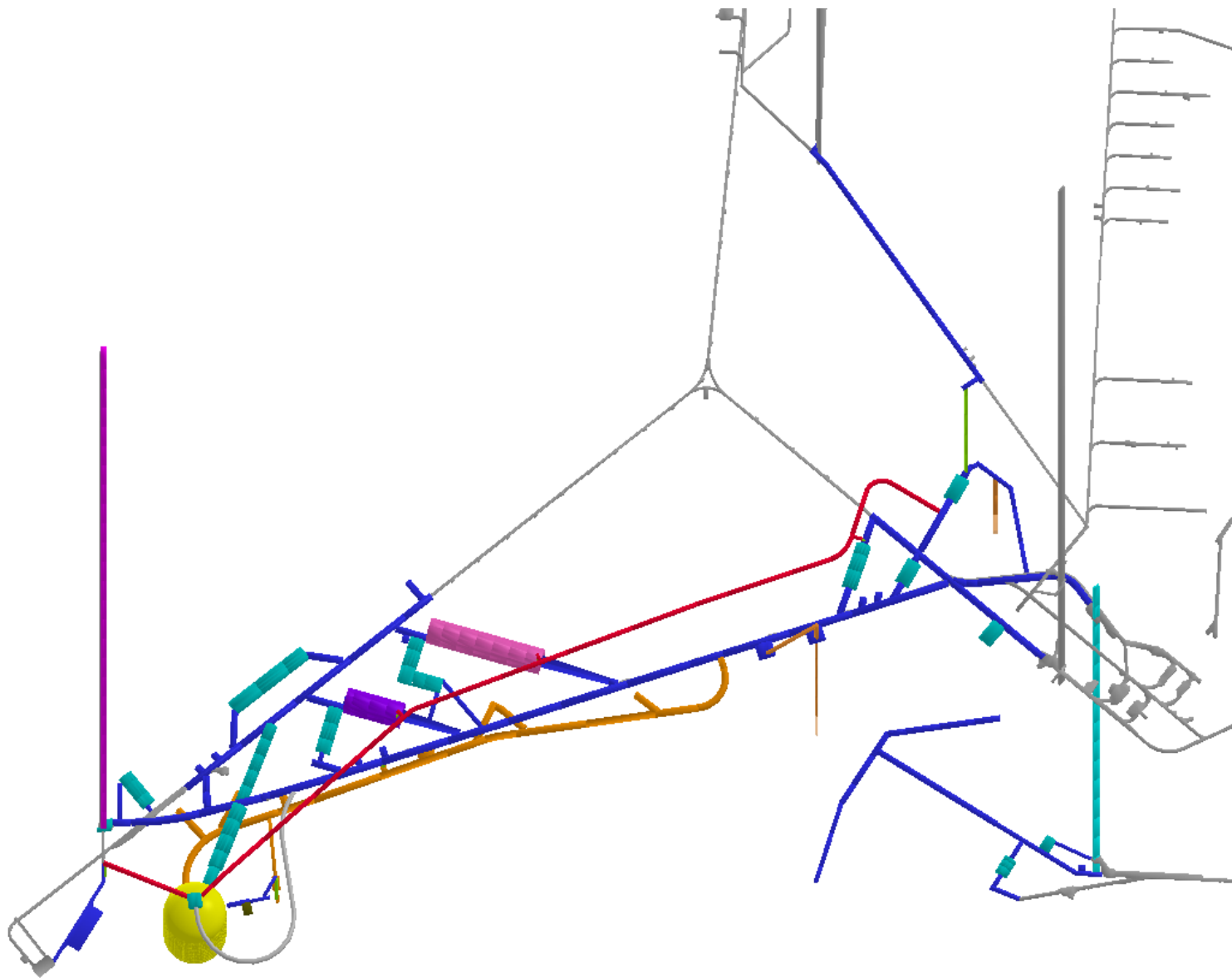
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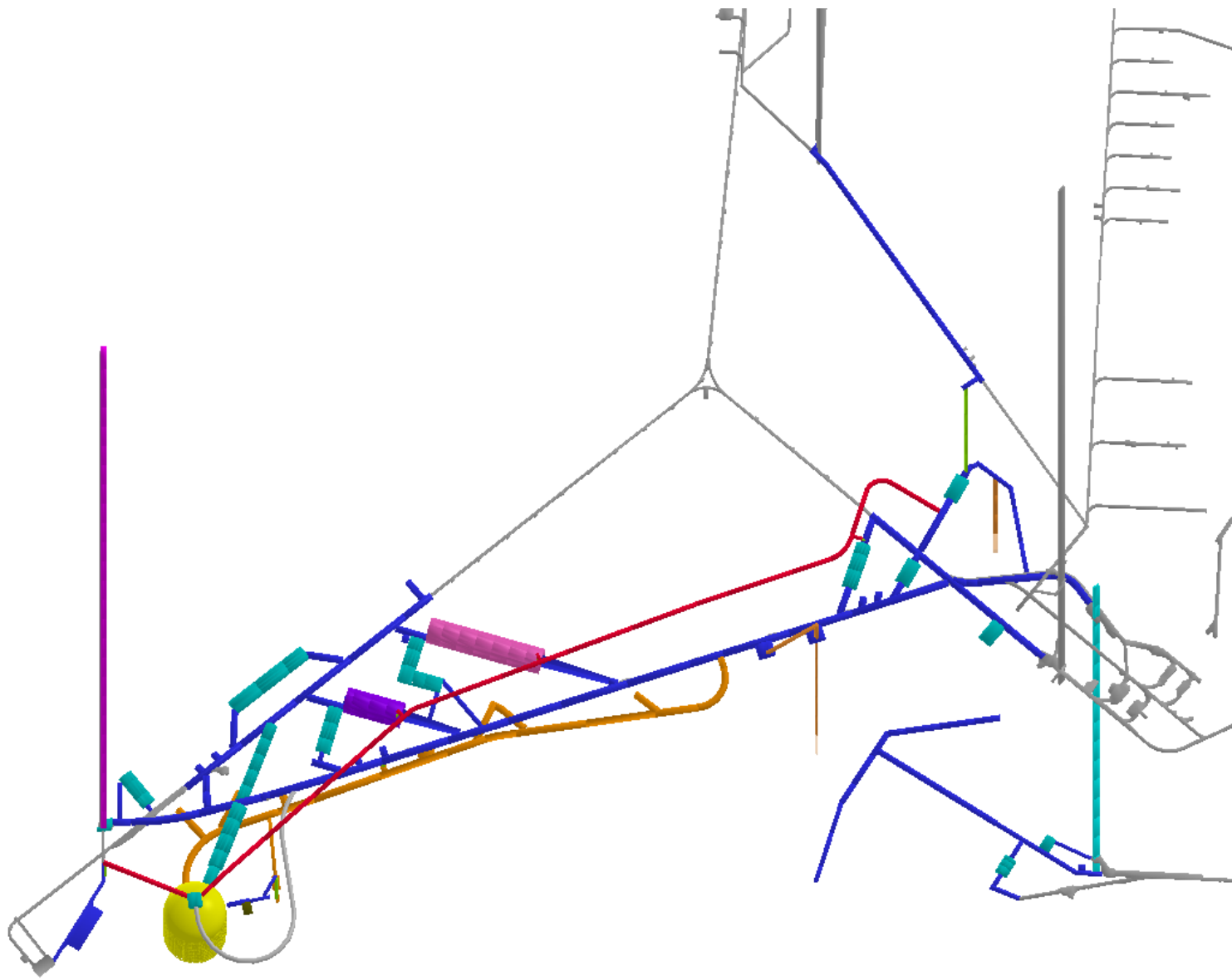
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**Activity Type**

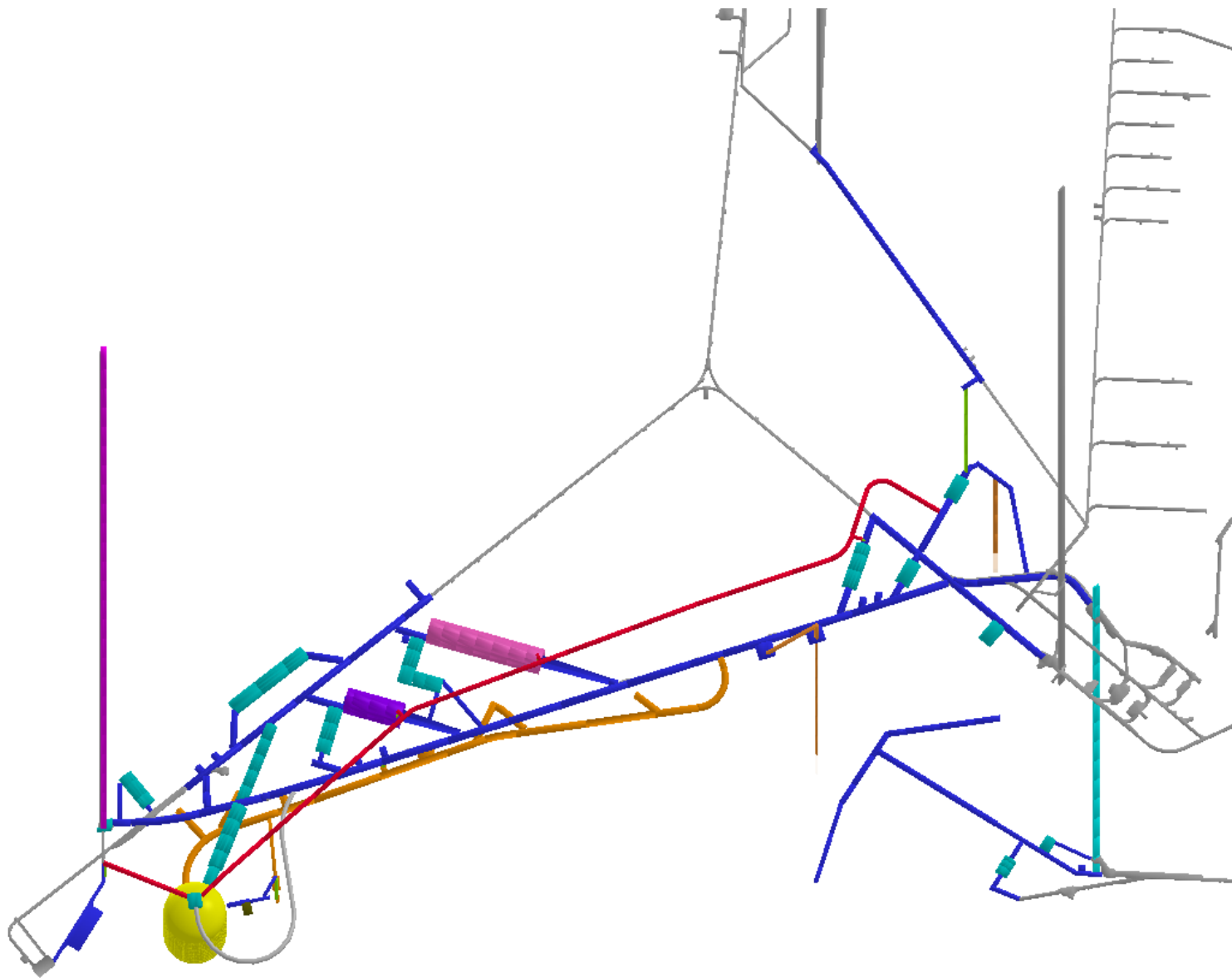
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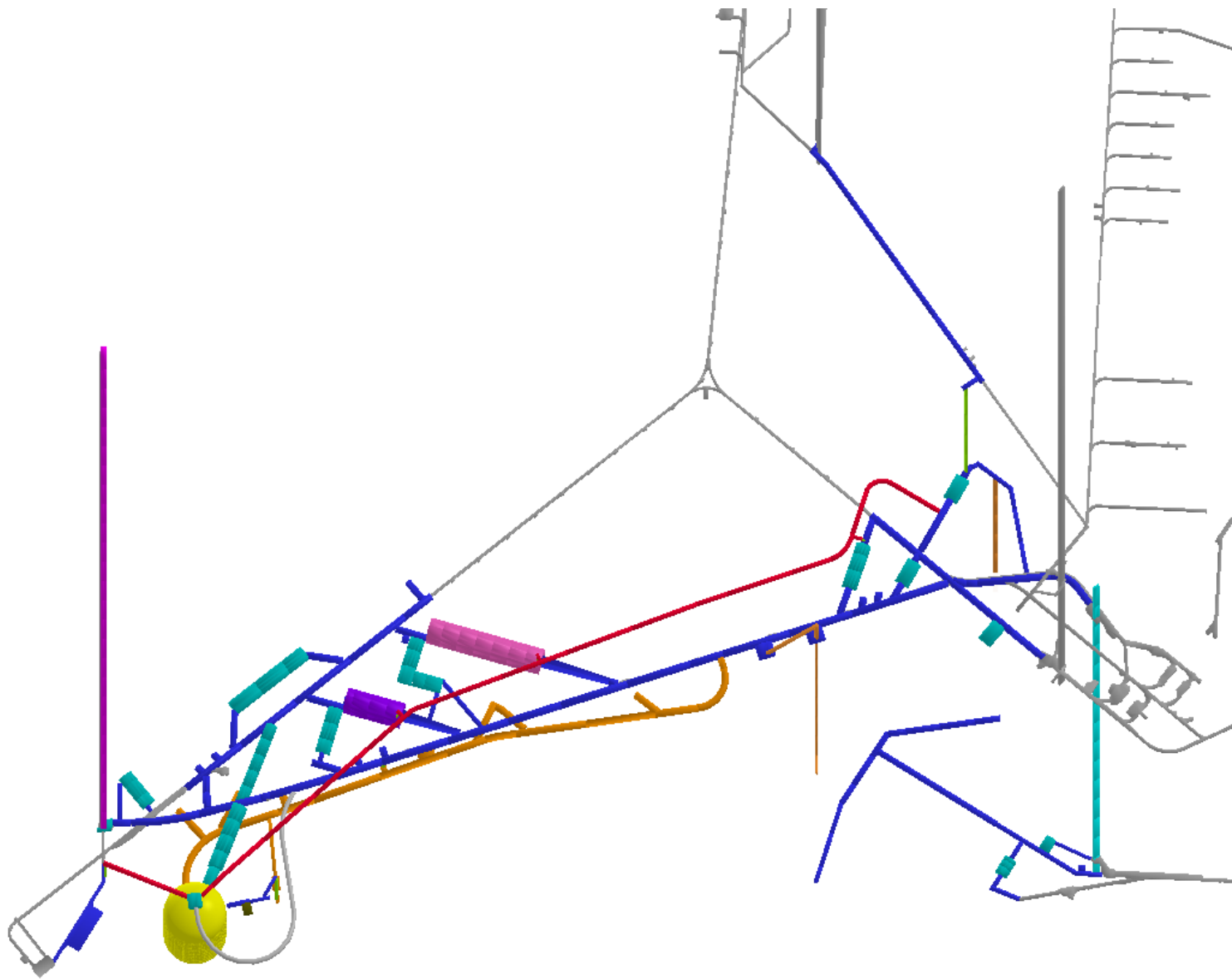
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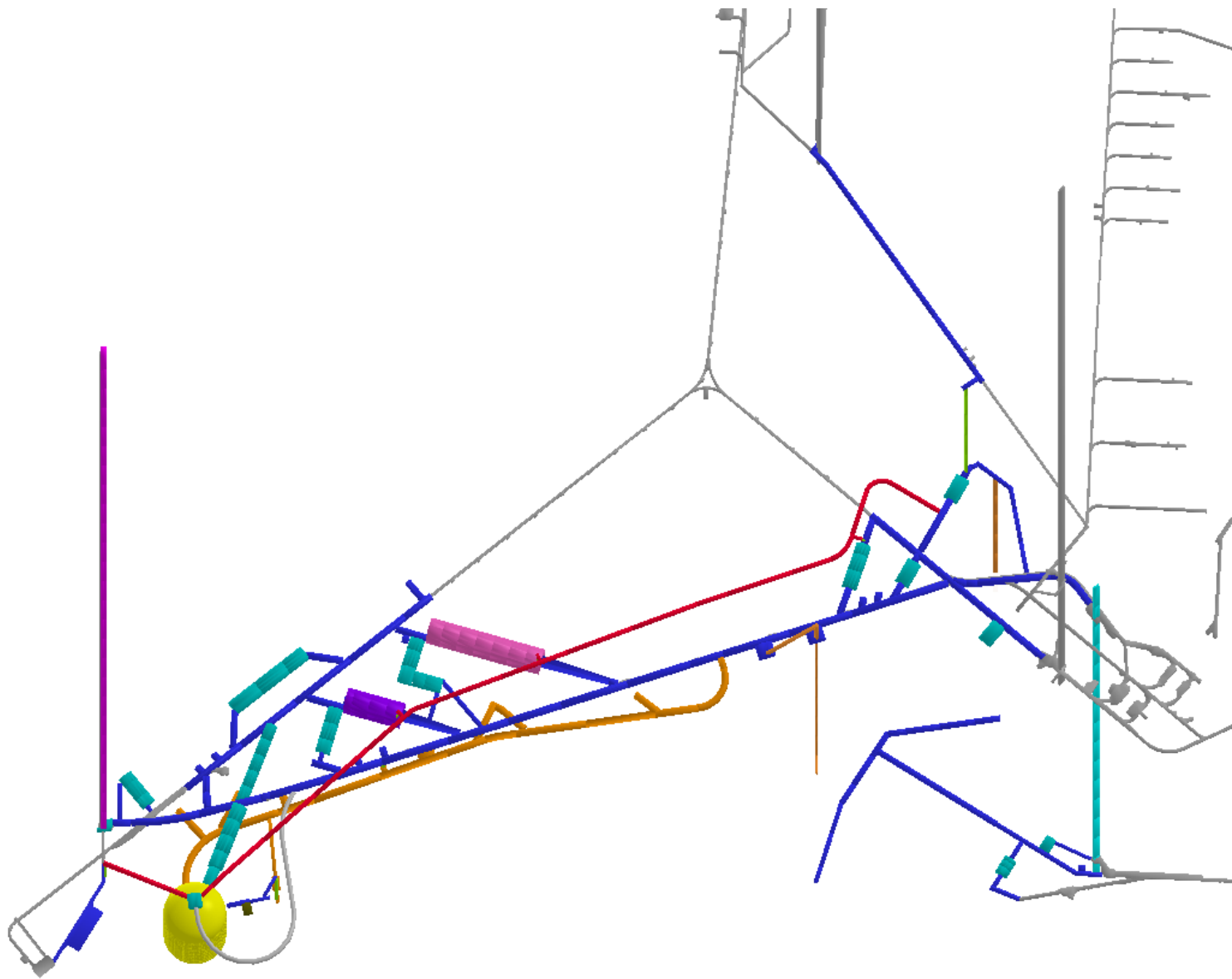
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- YR (YR) ■



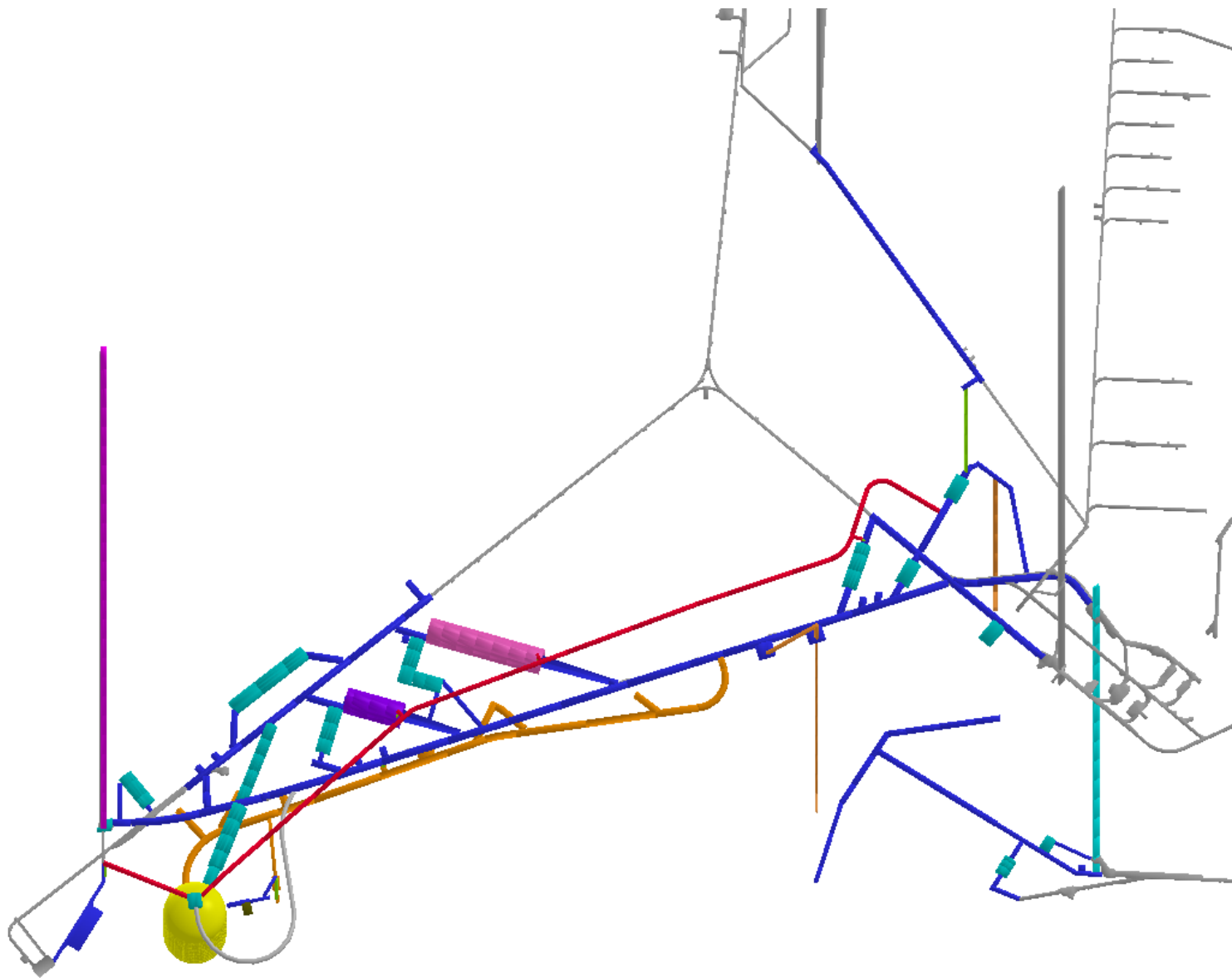
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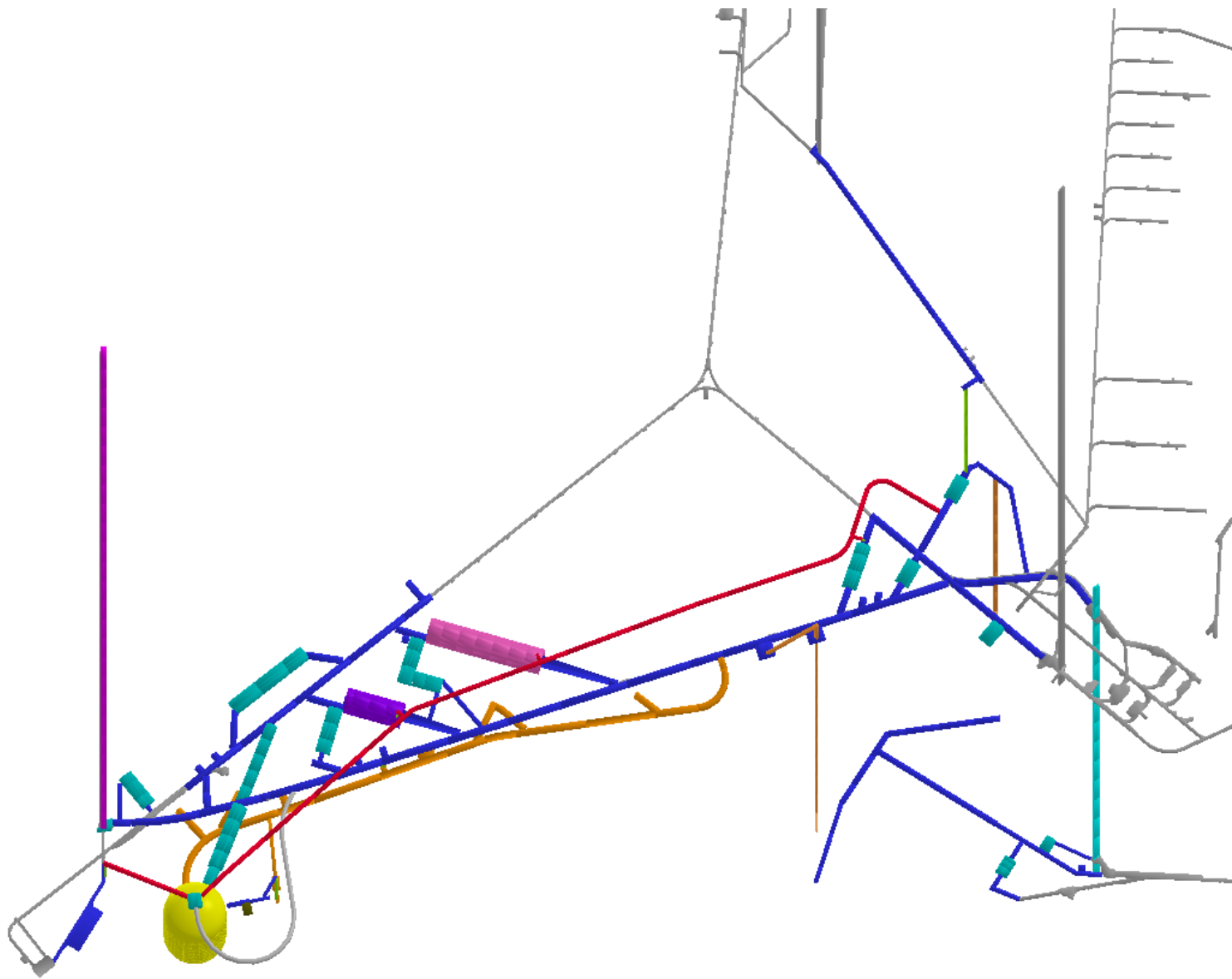
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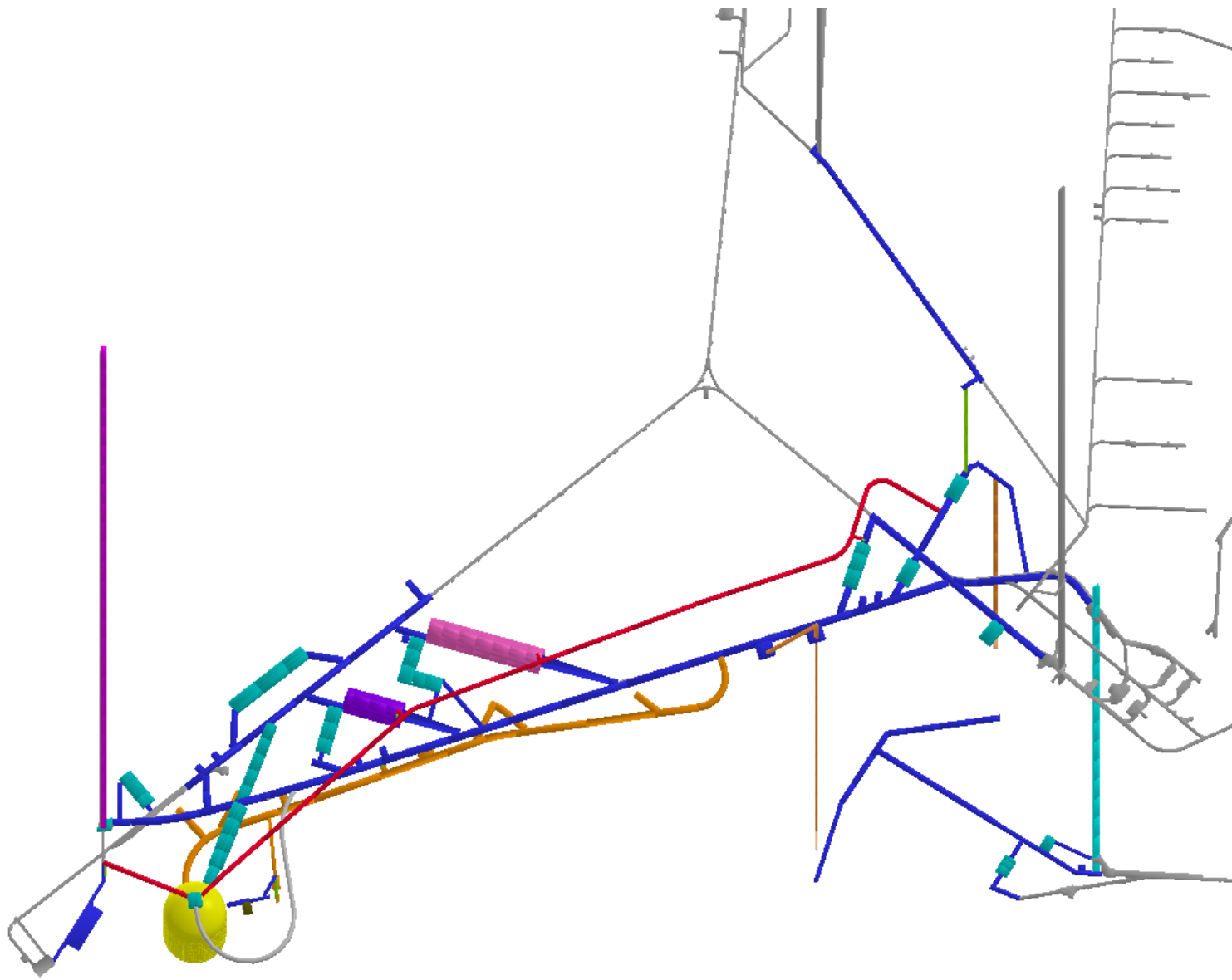
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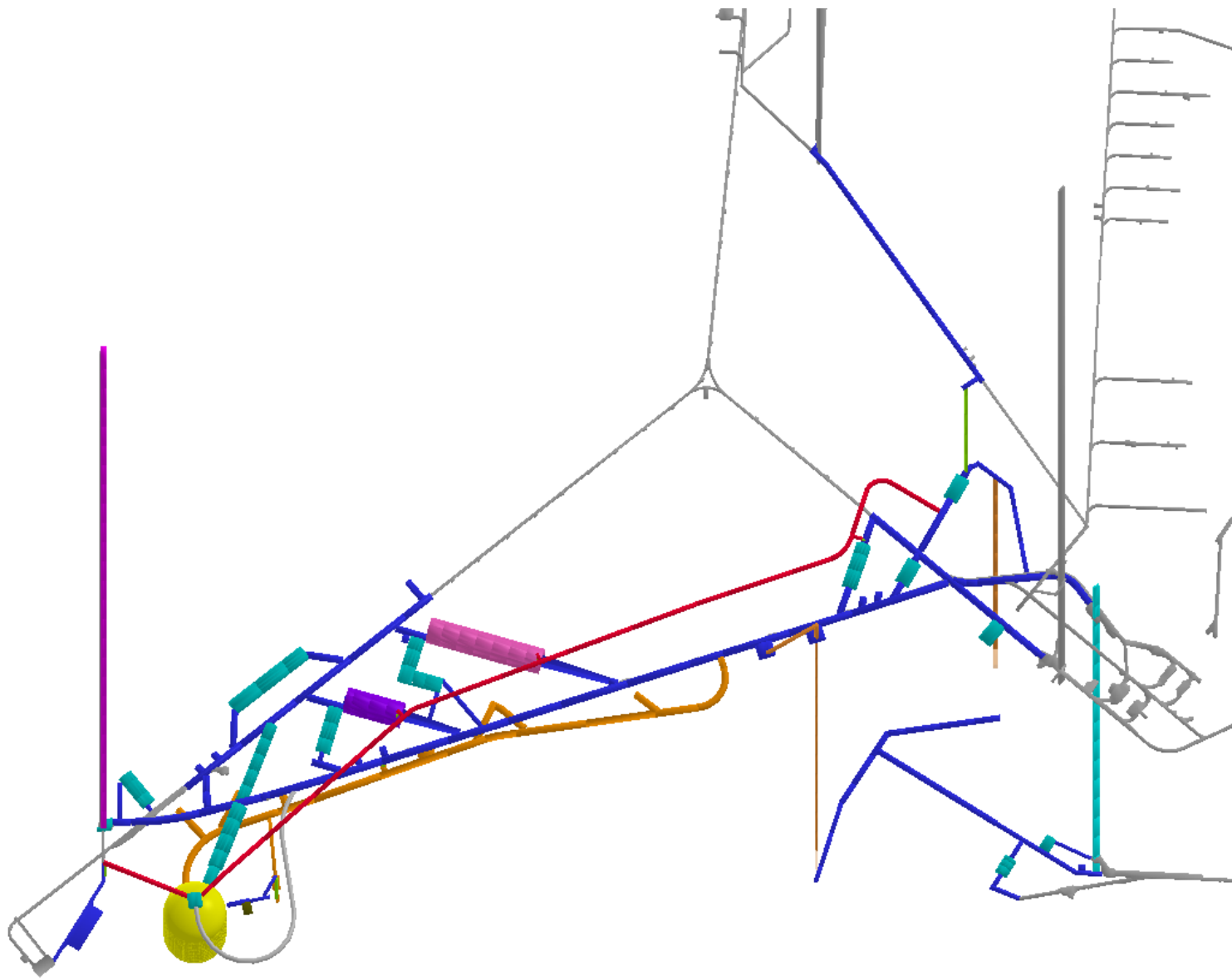
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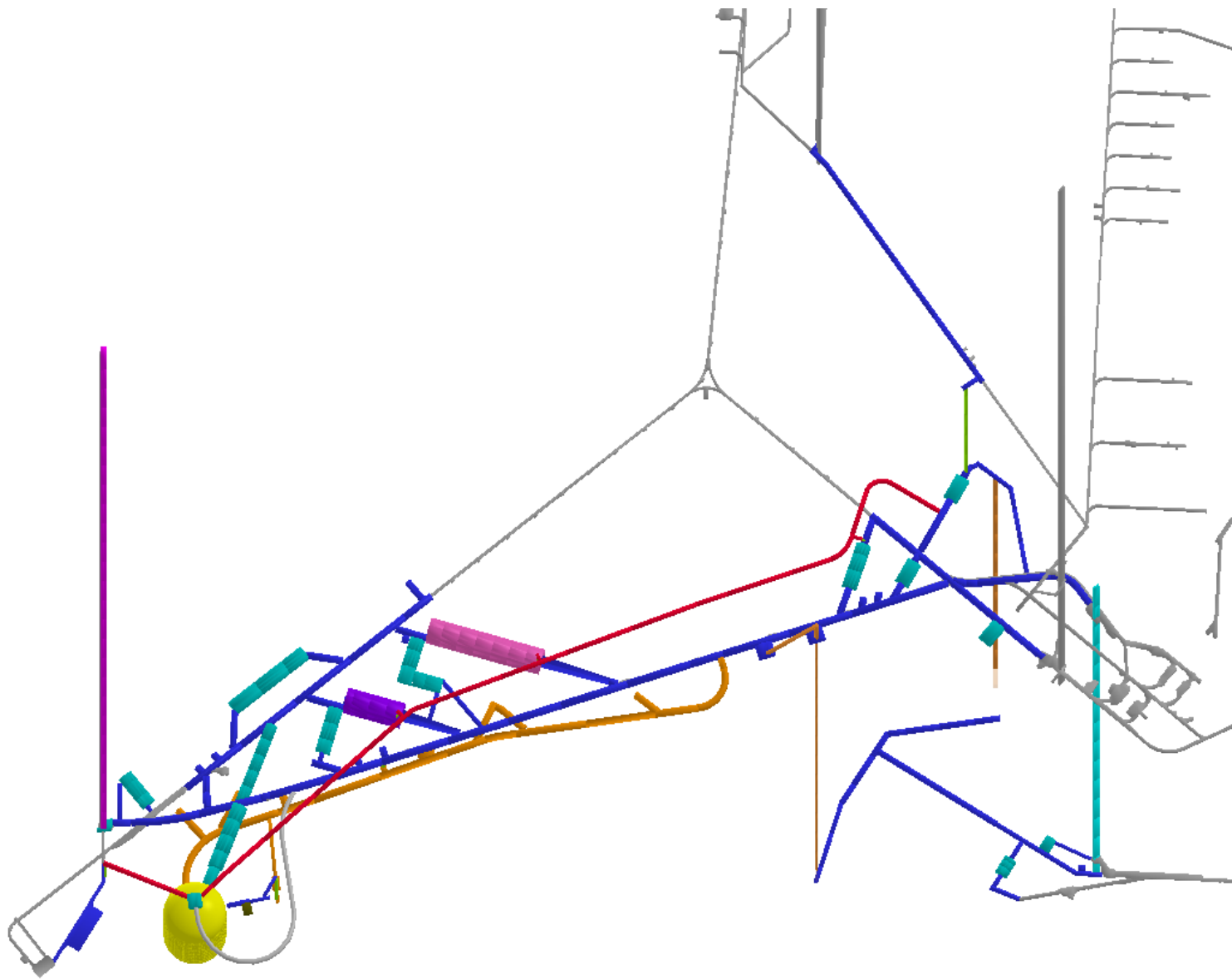
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Activity Type

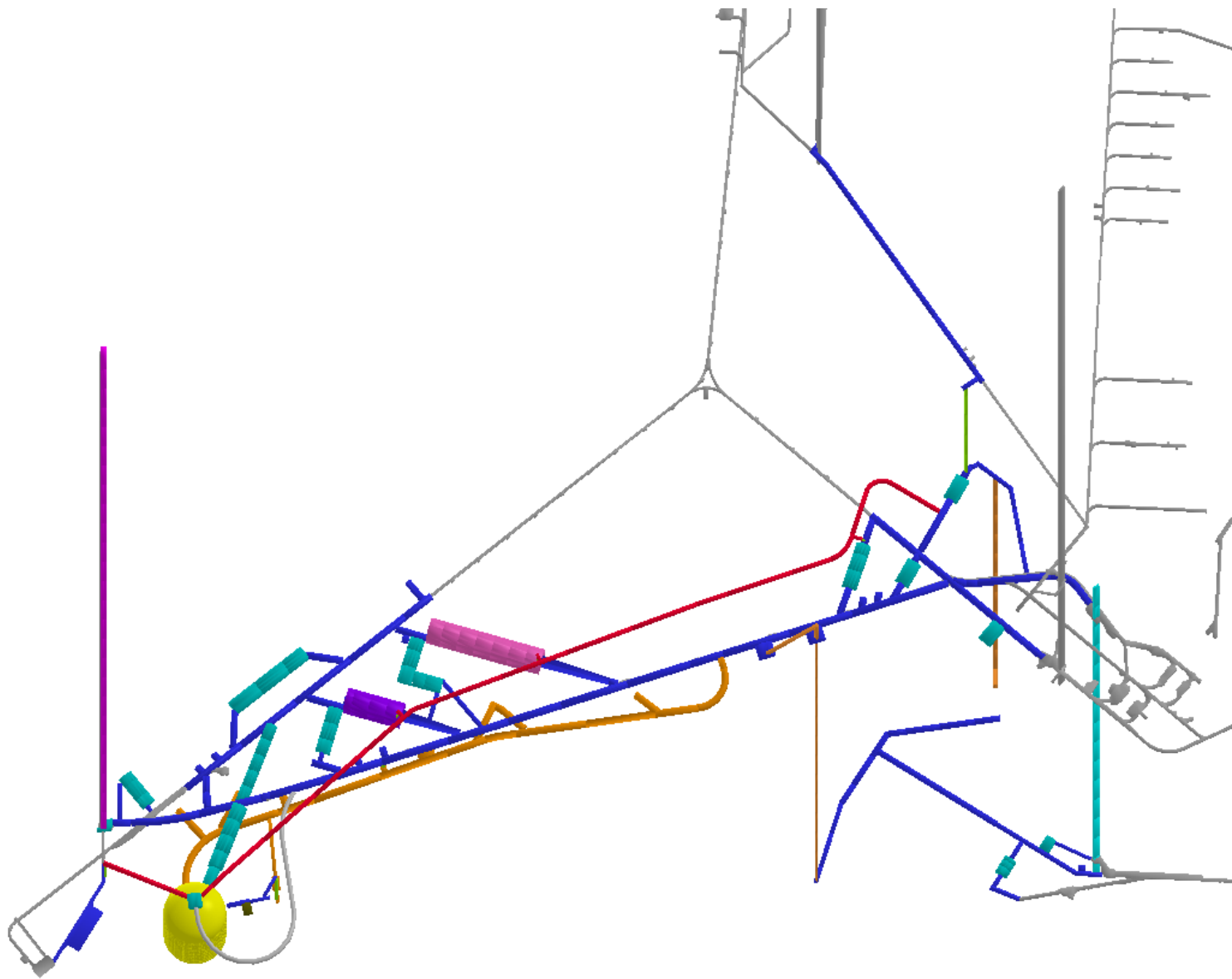
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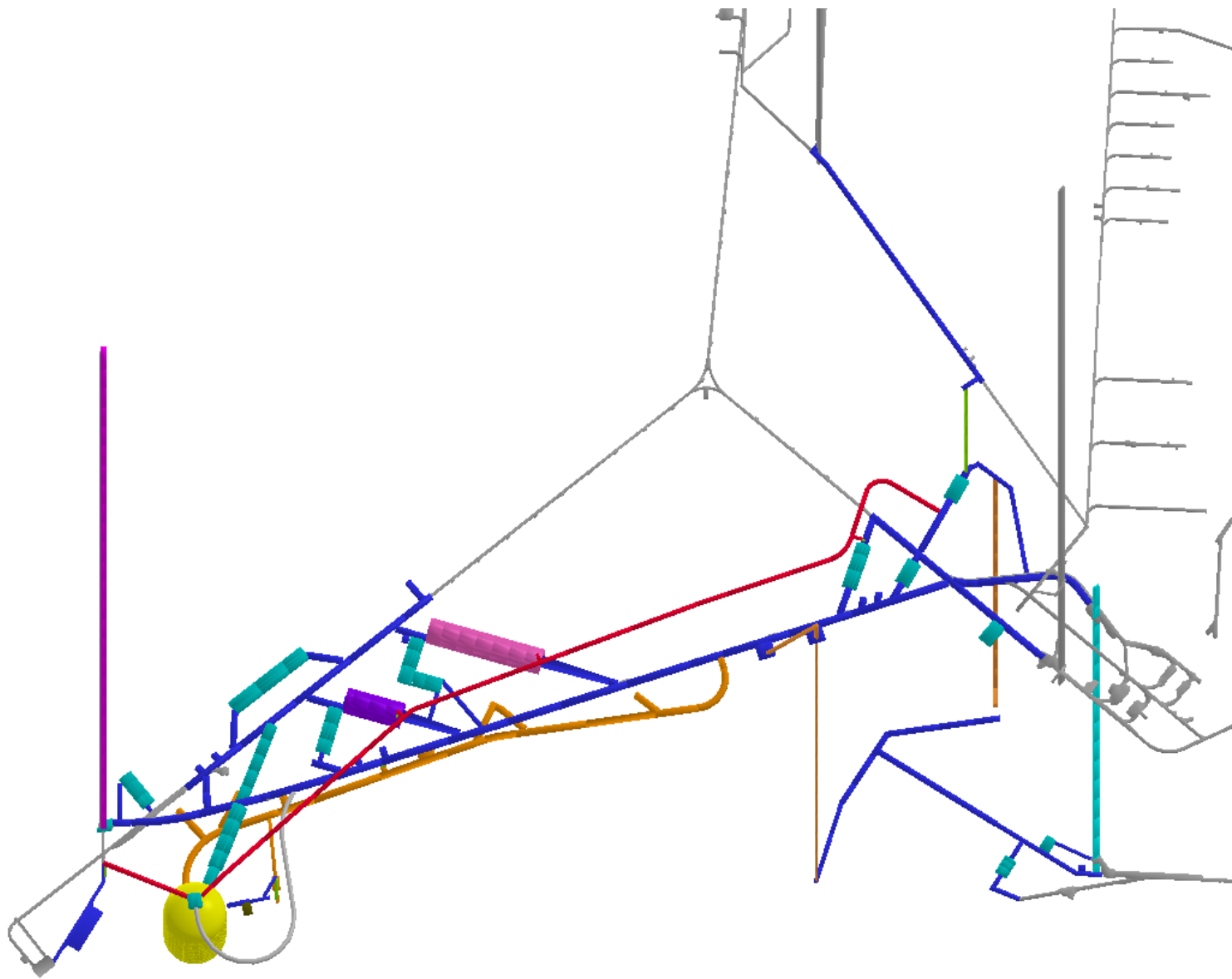
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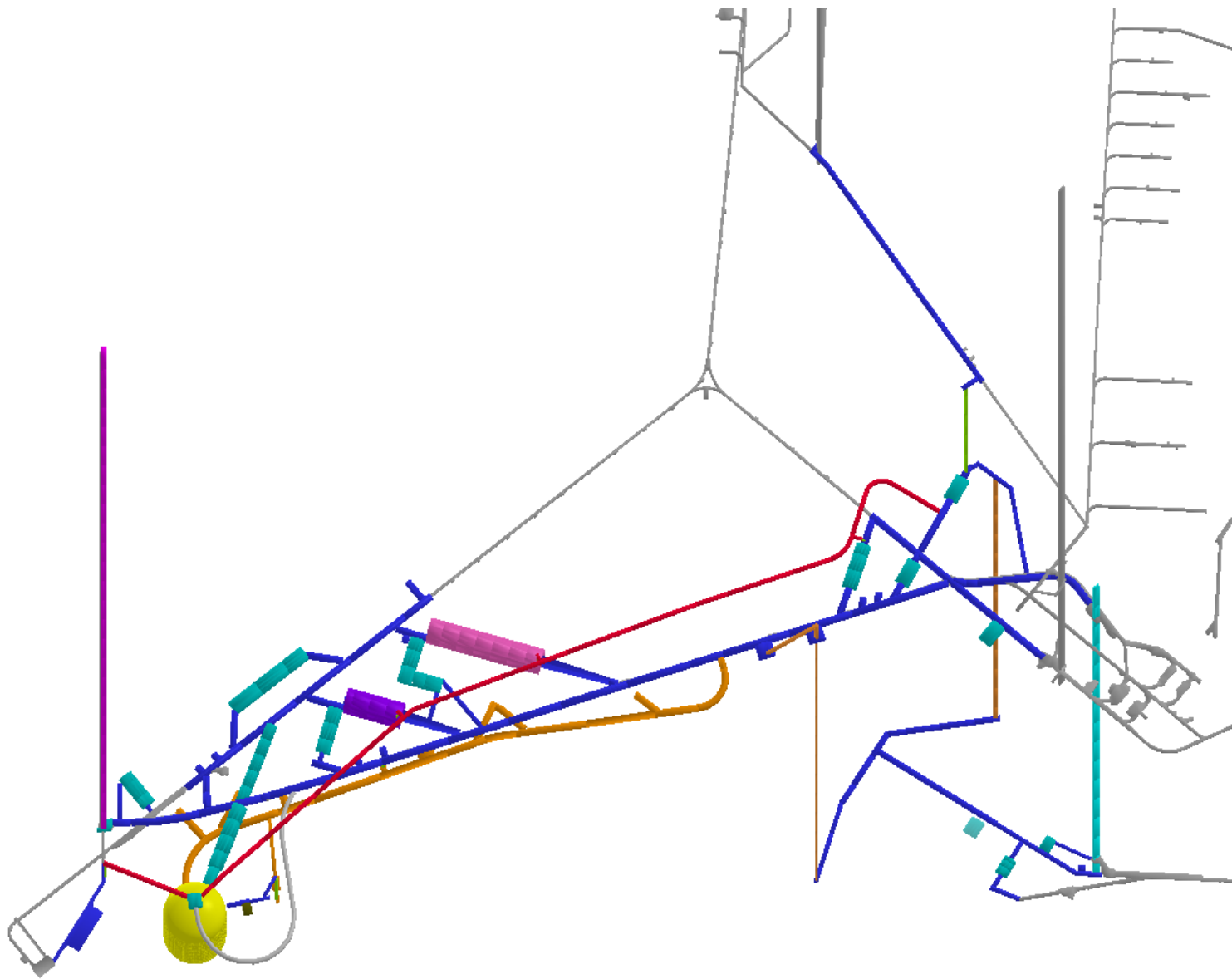
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- YR (YR) ■



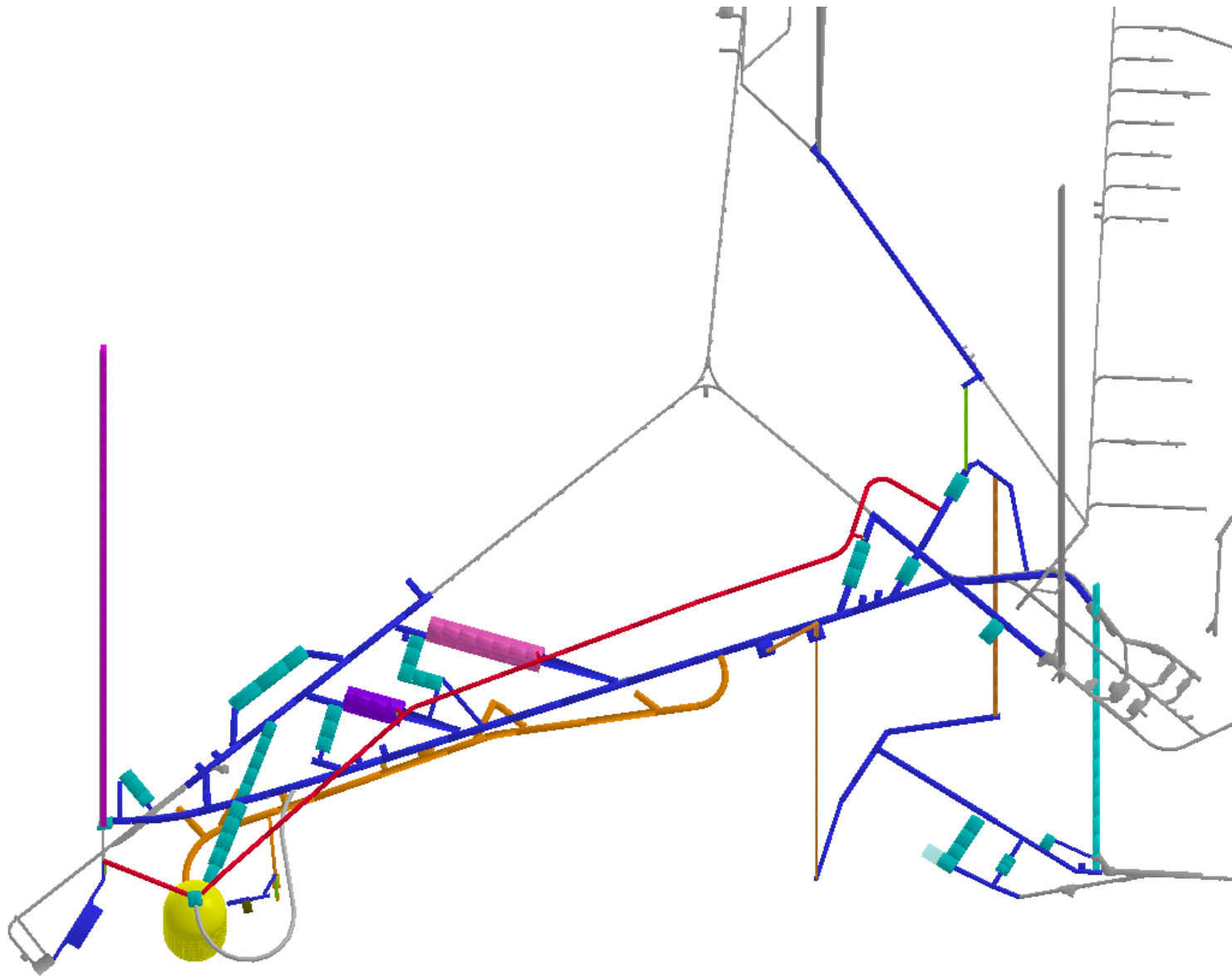
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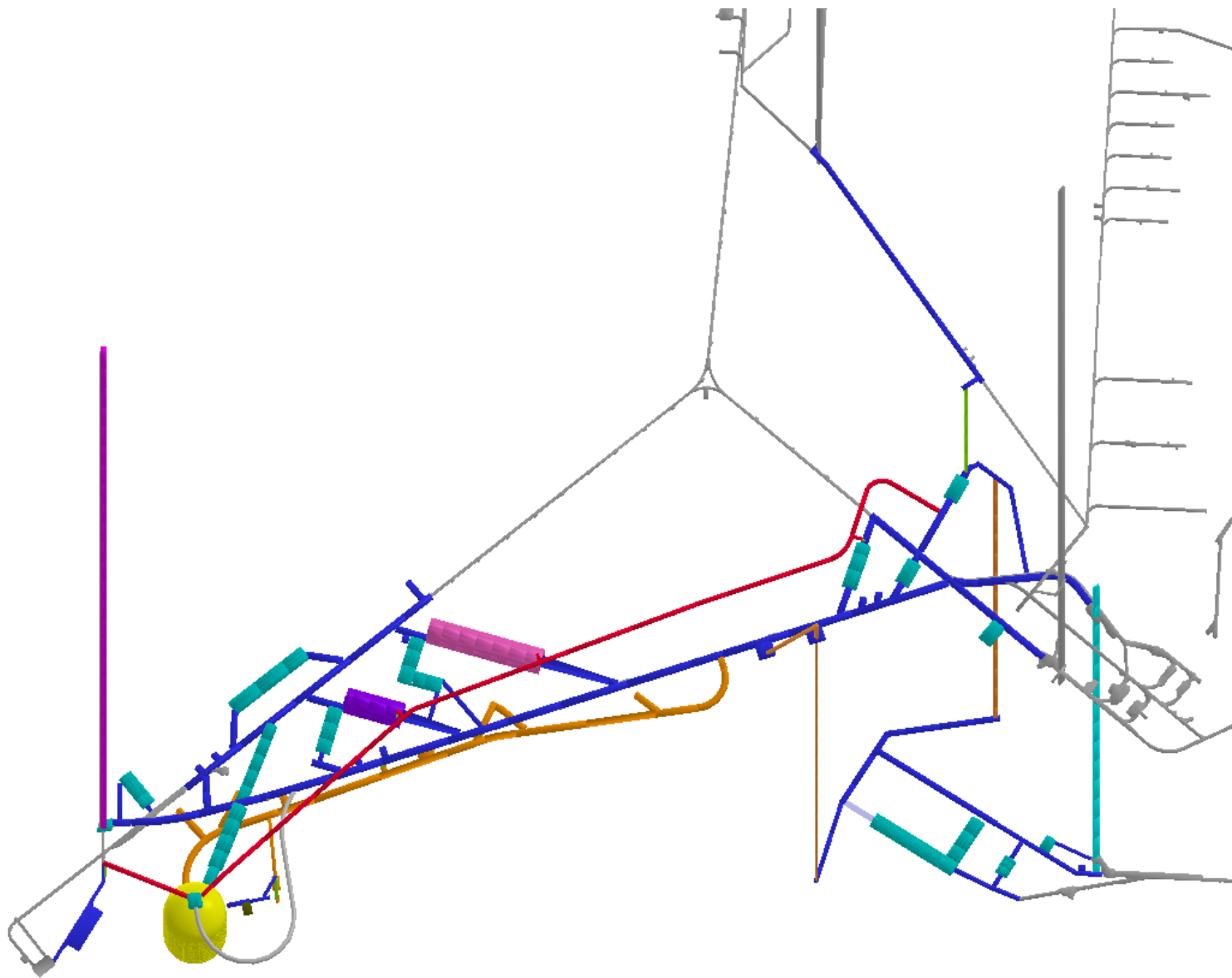
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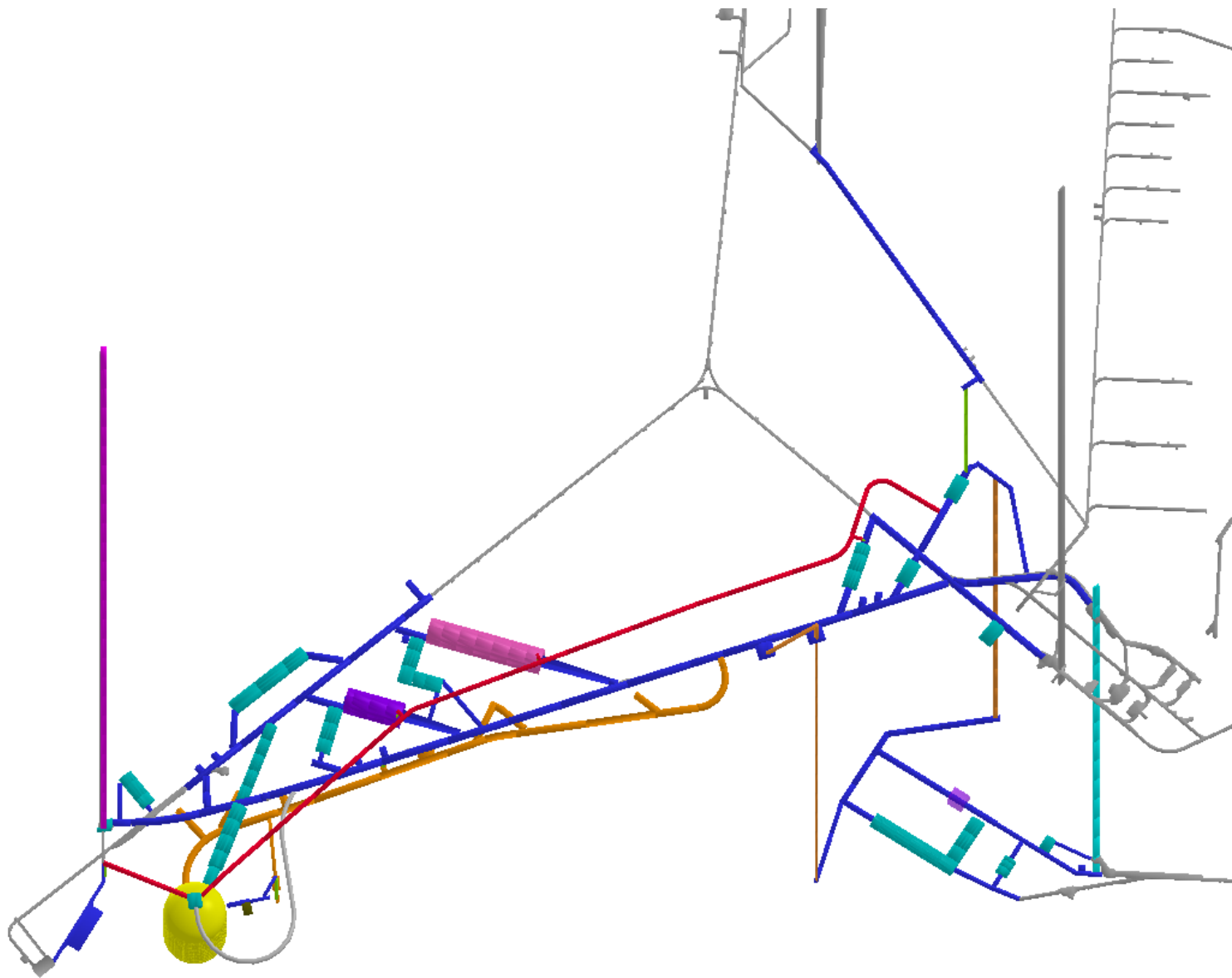
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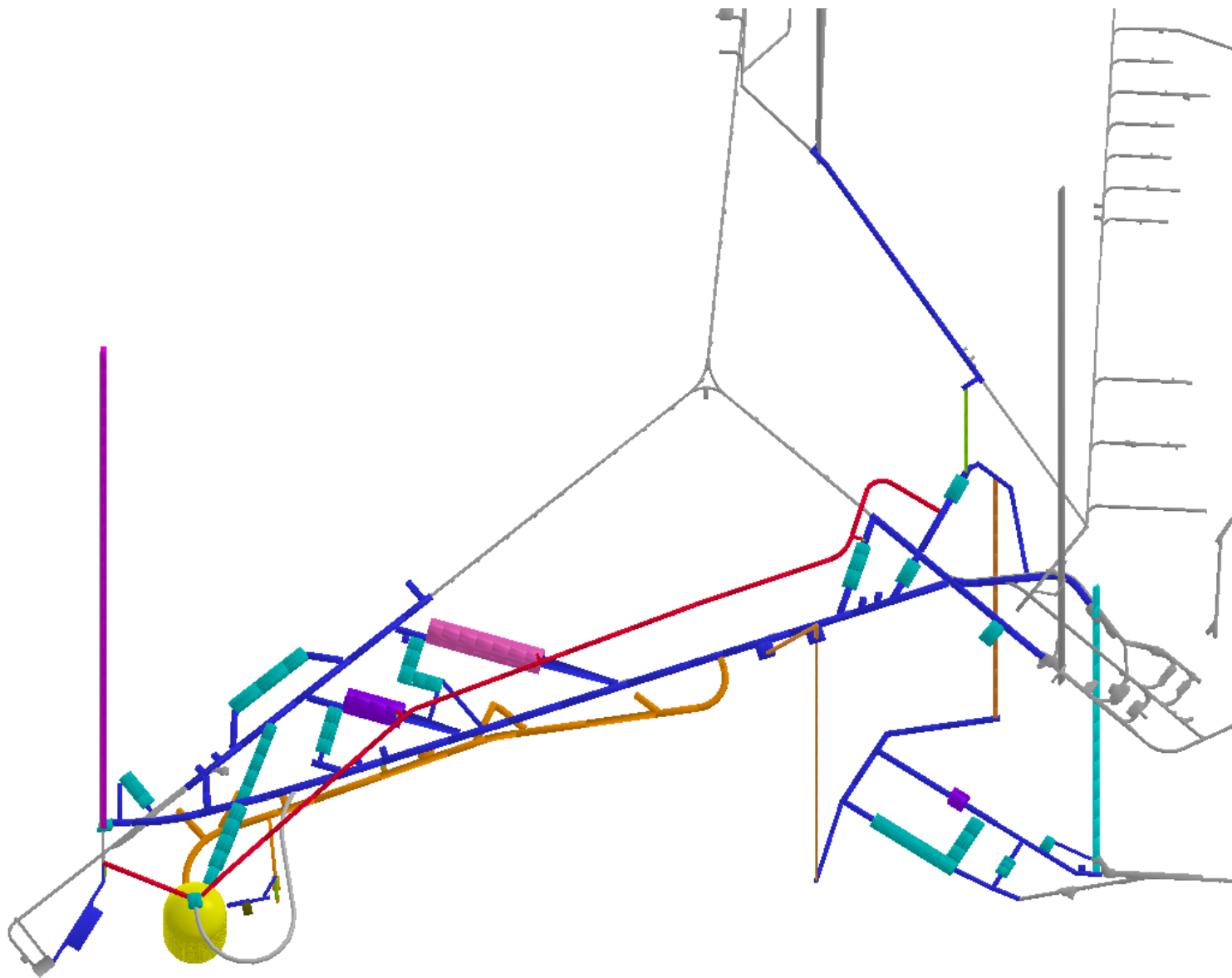
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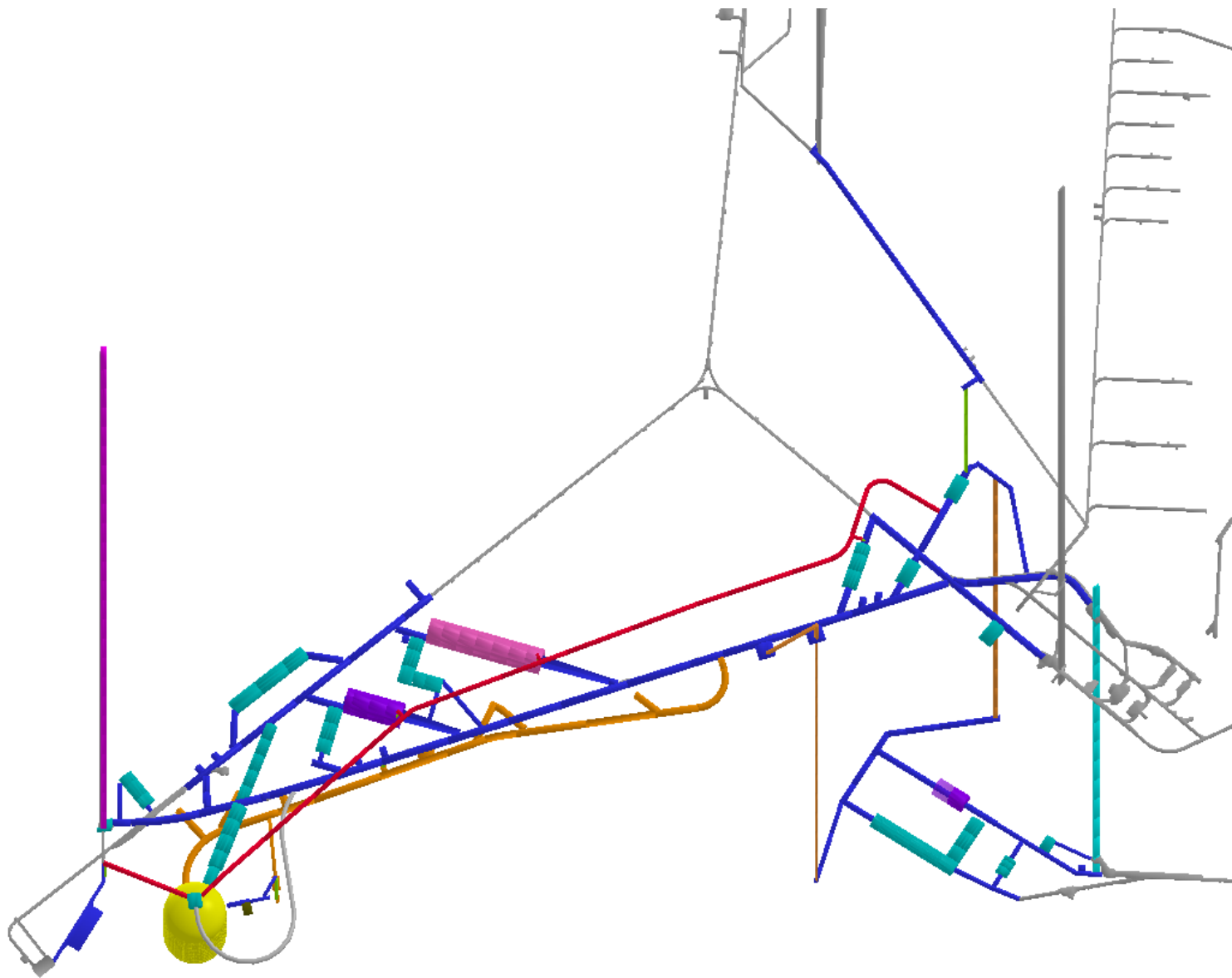
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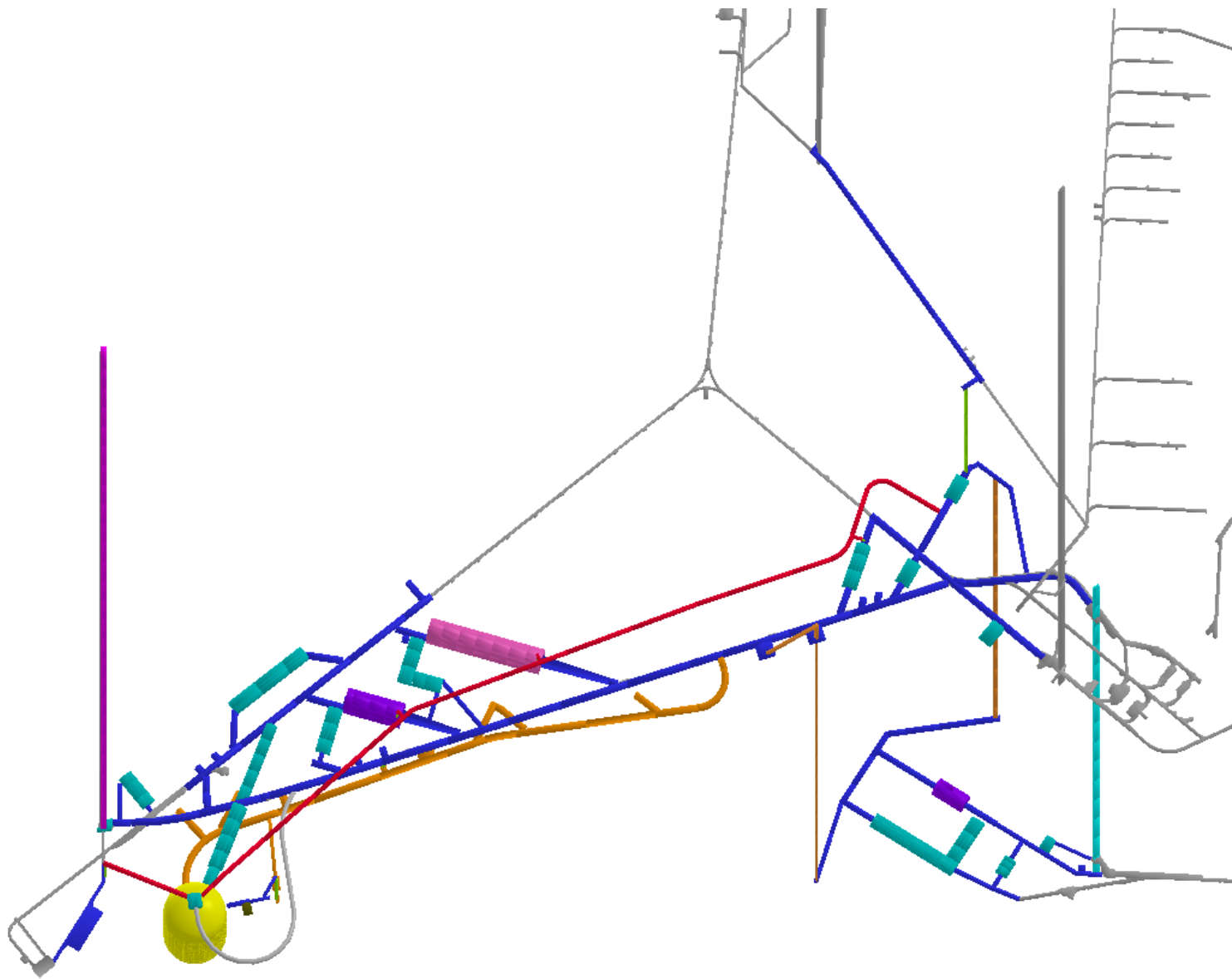
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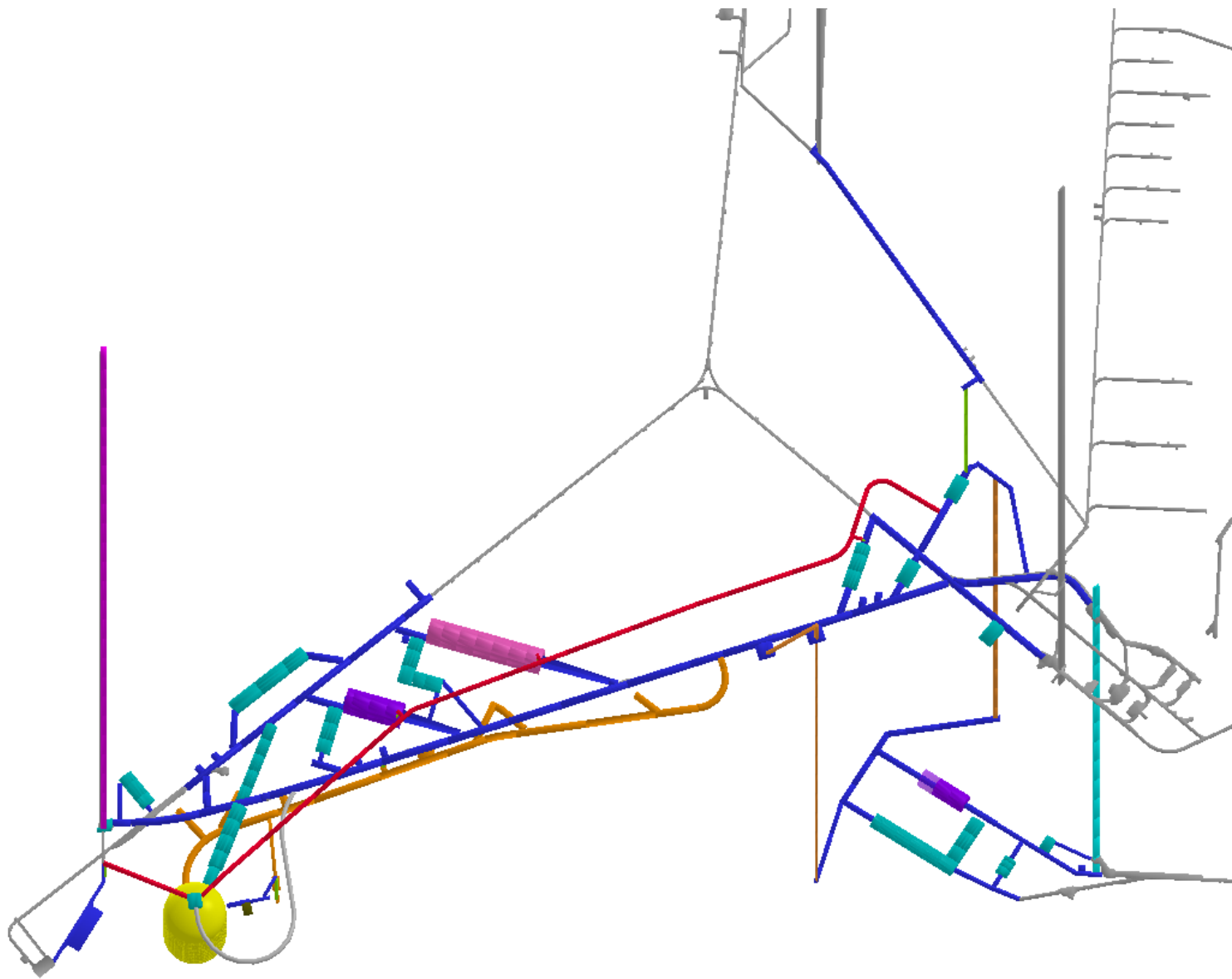
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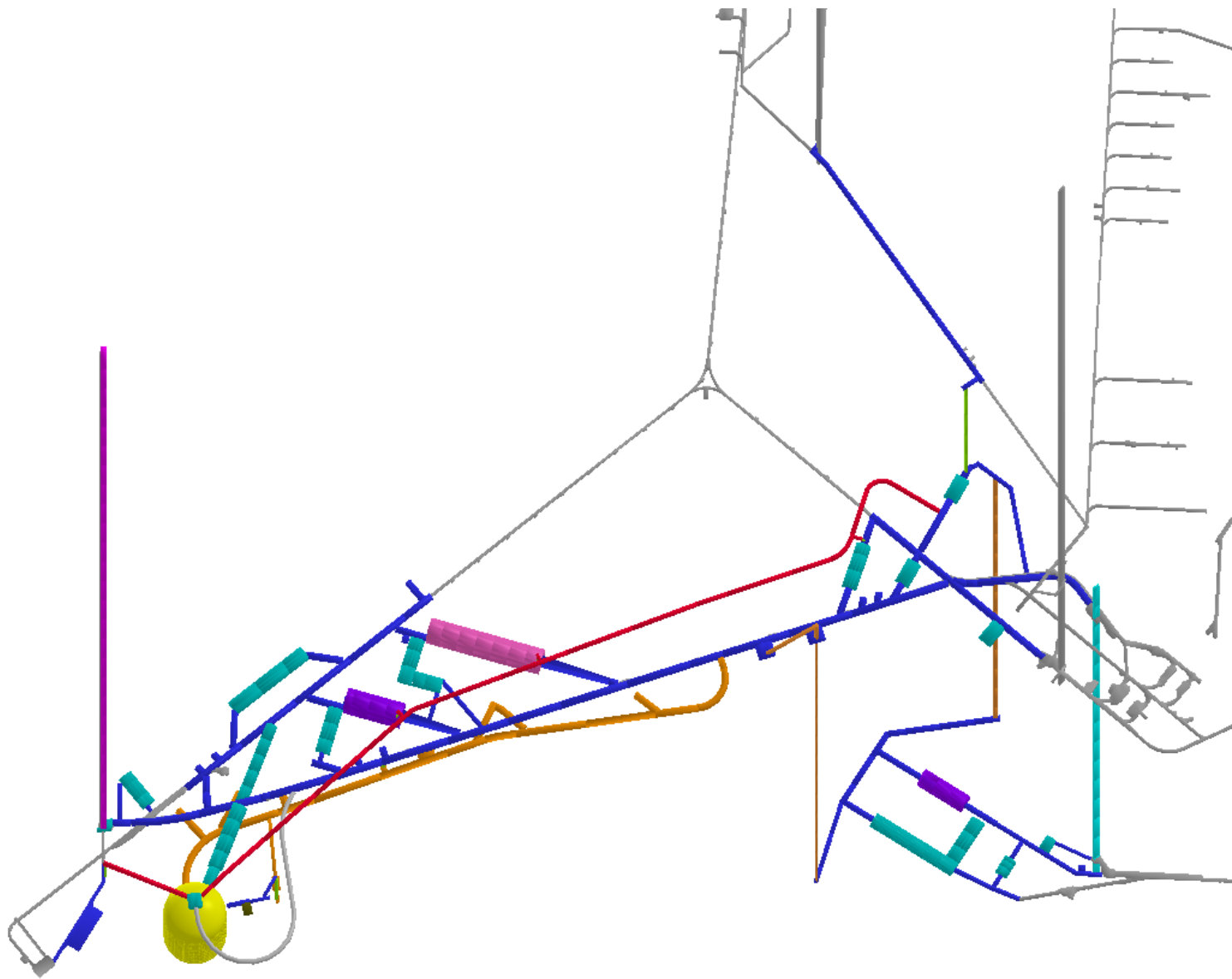
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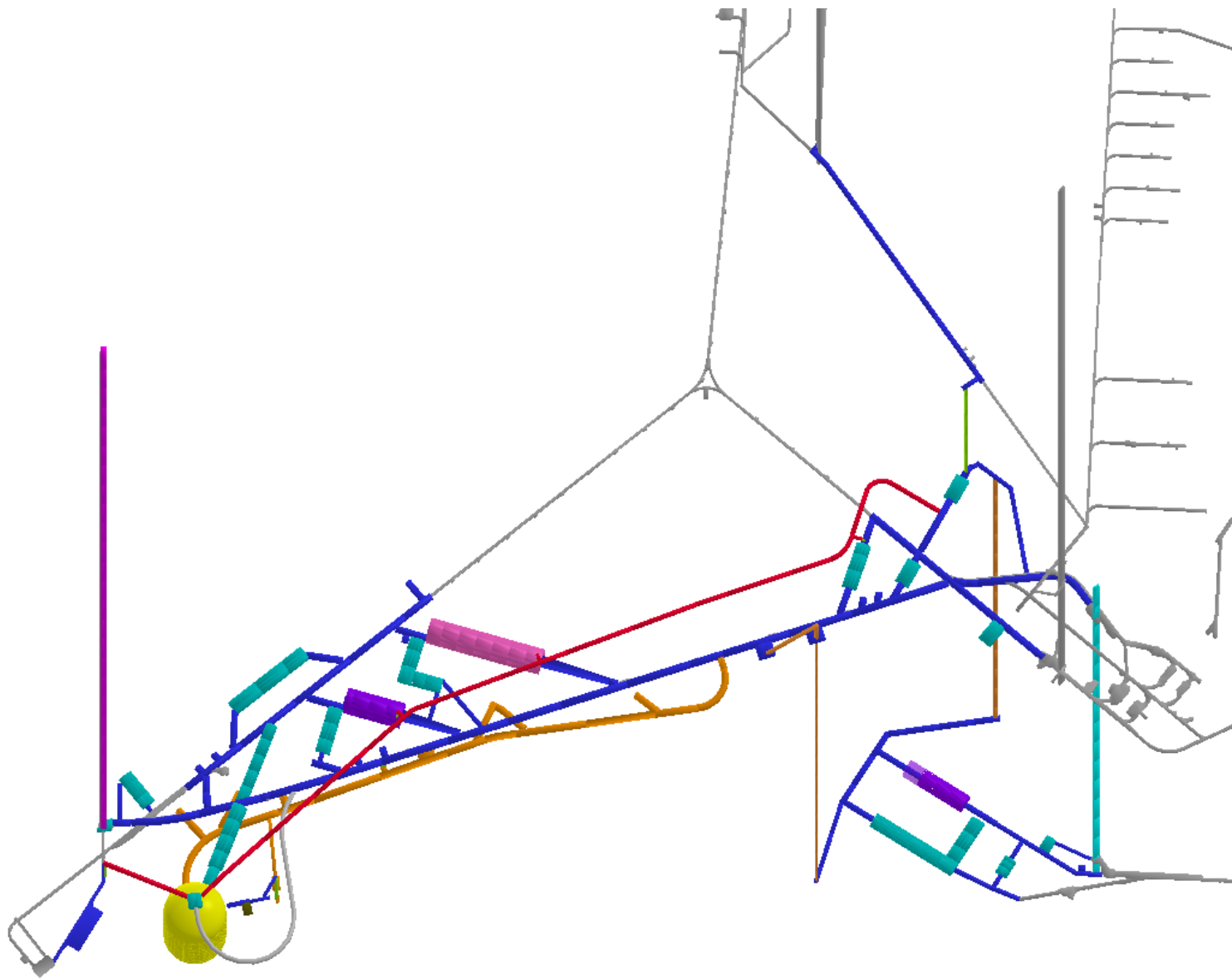
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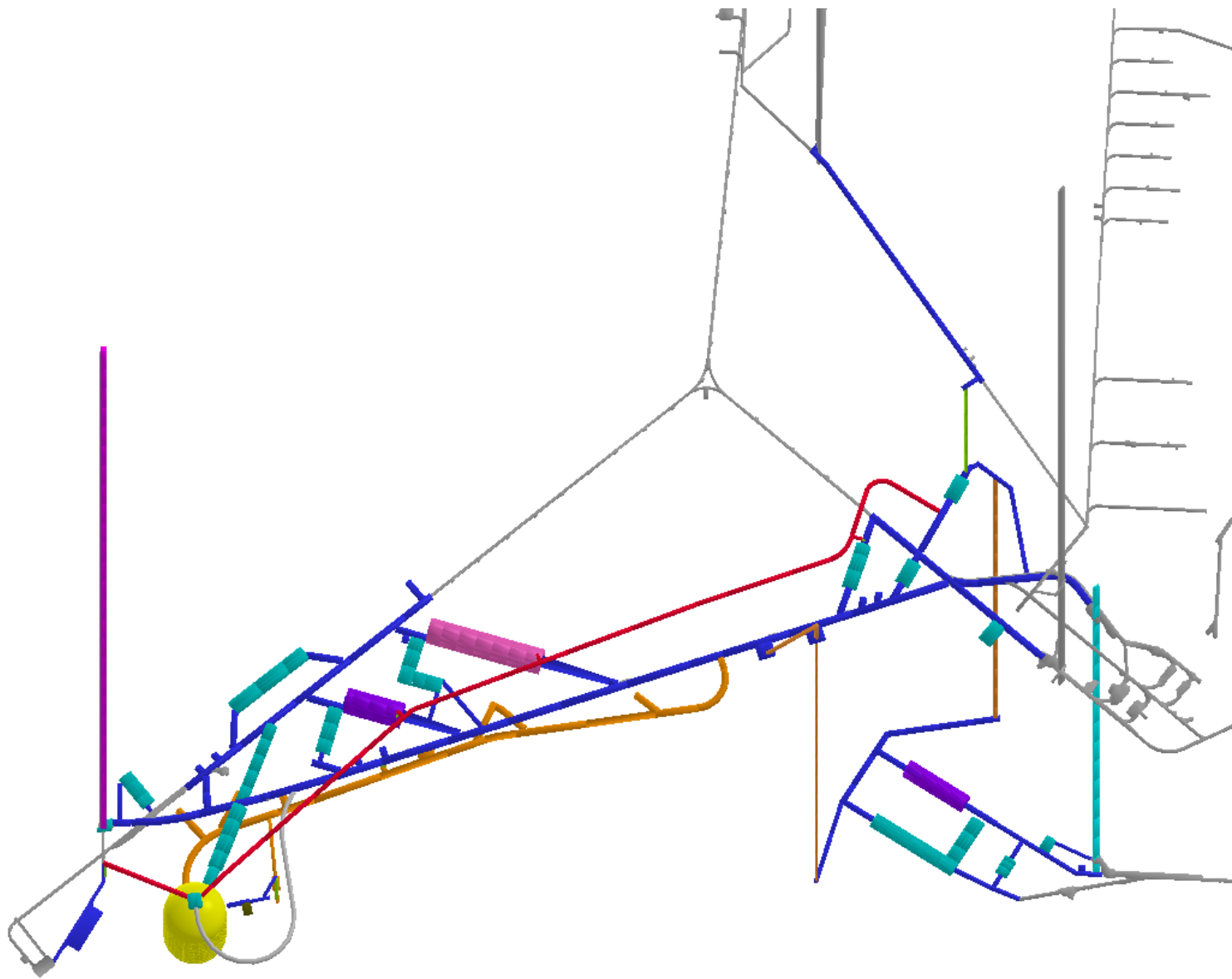
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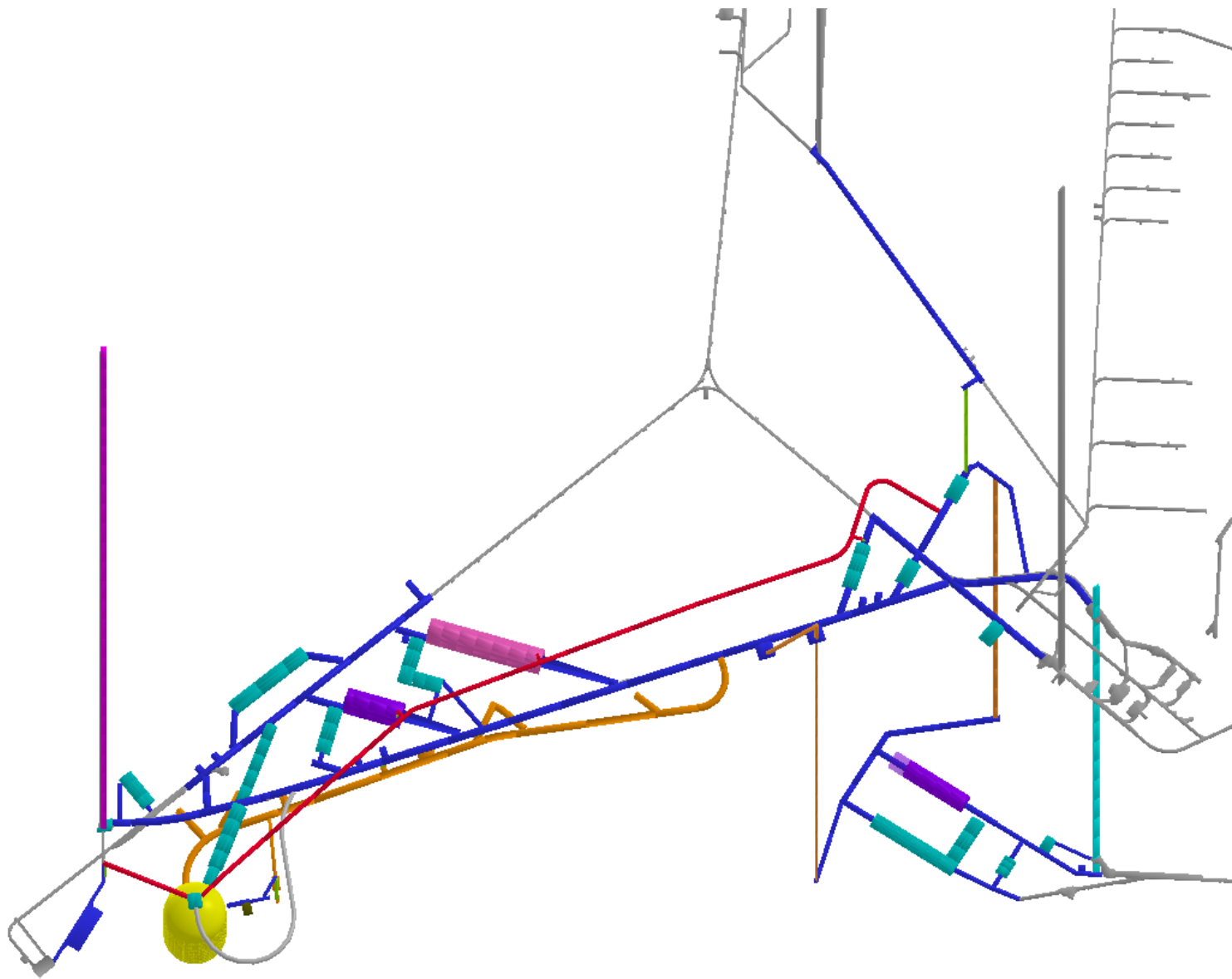
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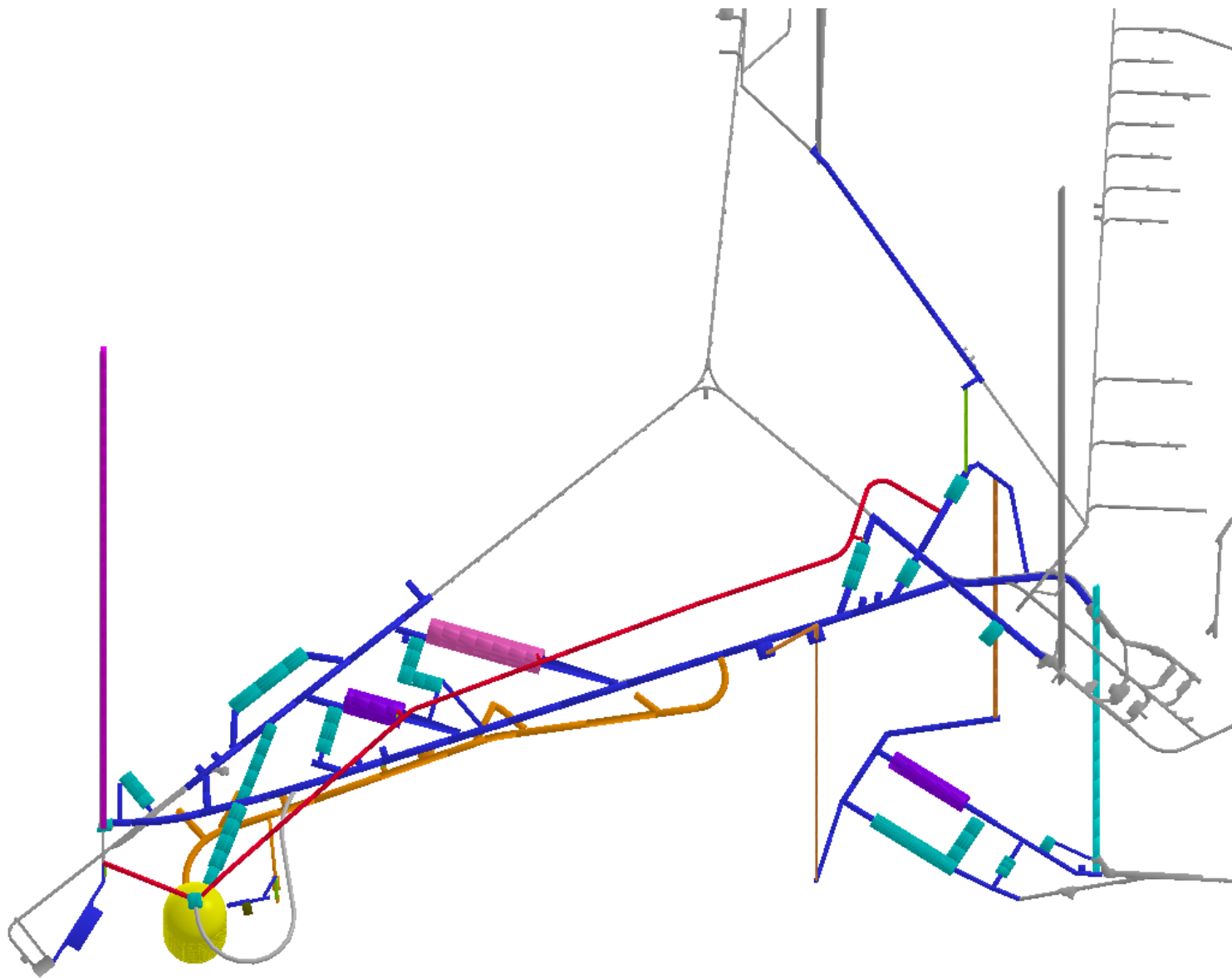
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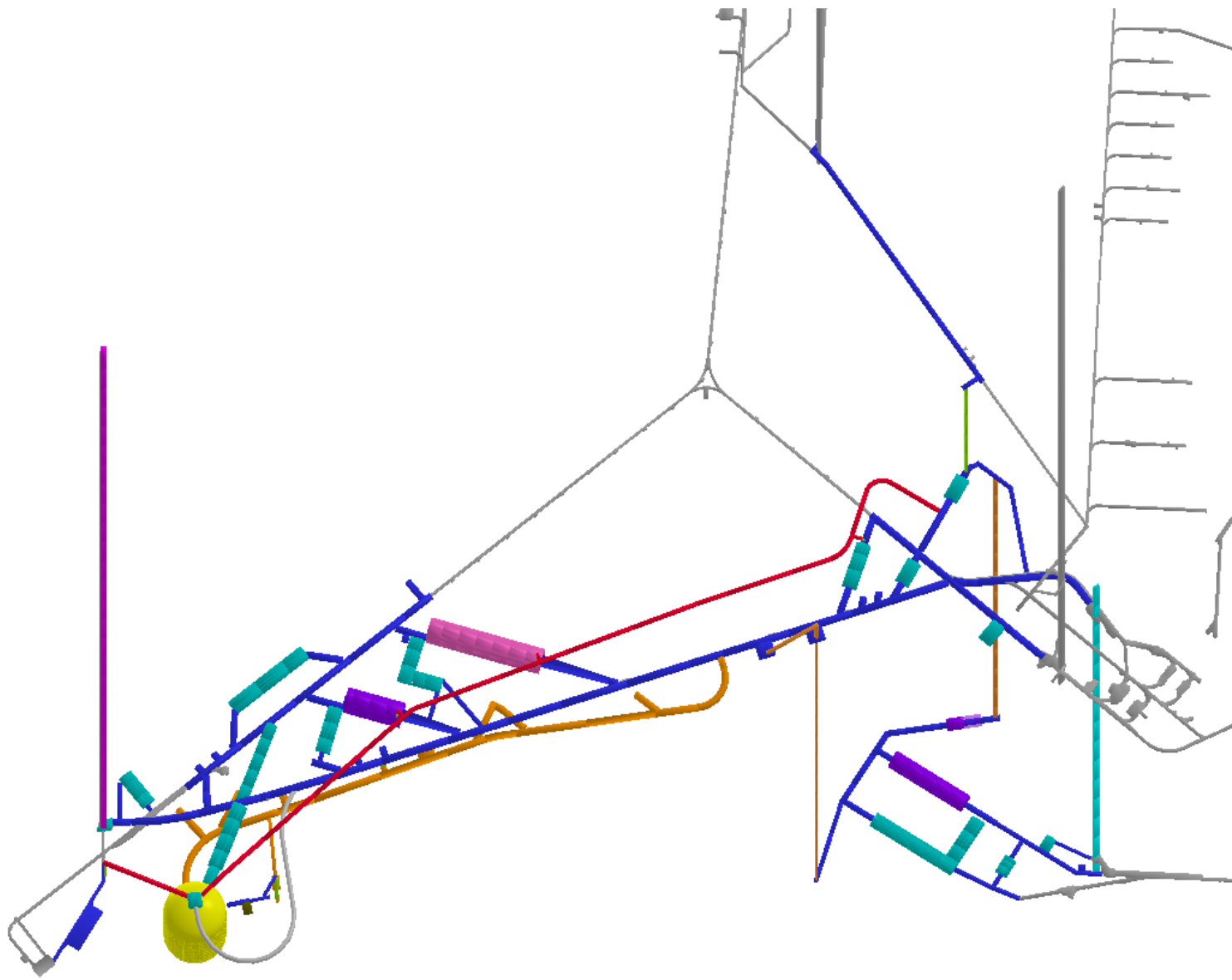
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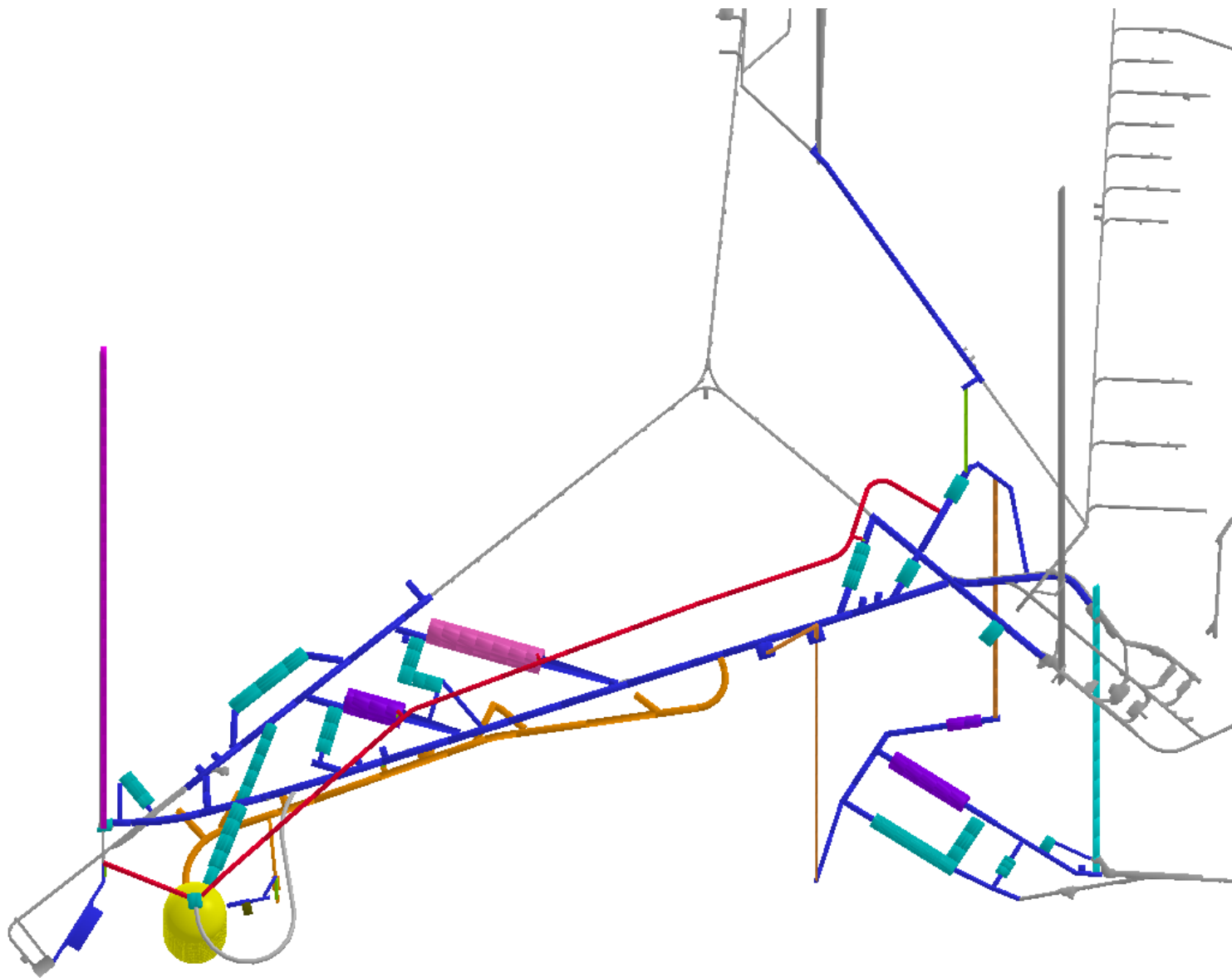
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**Activity Type**

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- Asbuilt2 (AS2) ■
- D10 (D10) ■
- YR (YR) ■



# Early Science at Sanford Lab

## Early Science Research Groups

### Physics

**LUX-350** – *Dark Matter*

**MAJORANA DEMONSTRATOR** –  *$0\nu\beta\beta$*

**CUBED** – *Crystal growth + other*

**Bkgd Characterization** –  *$\mu, n, \gamma, Rn$*

(also Screening Lab in future)

Vertical Facility – *N-Nbar, others*

(currently magnetic field bkgd)

**Geology** *CO<sub>2</sub> Sequestration – Environment*

*DUGL – Seismic characterization*

*Fiber Sensors – Extensometer, Temp*

*Hydrology – SDSMT/Sanford/DUSEL*

*Hydro-Gravity – USGS (SD,AZ)*

*PODS – Petrology, ore dep, structure*

*Tiltmeter – Rock deformation*

*Transparent Earth – Seismic*

**Biology** *Microbiology – Bang, Anderson*

*Lignocellulose – Bleakley*

*Manifold Sampling – Onstott, Pfiffner*

*Microbiology/Cellulose – Sani*

### Engineering

*Signal Propagation – Anagnostou*

*Submersible – McGough*

**Other** *Cumingtonite – Geology (Berman)*

(Site *Vertical Array – Geology (Dahlgren)*

Selection *THMCB – Geology (DUSEL S4)*

Only) *Fracture Group – Geology (DUSEL S4)*

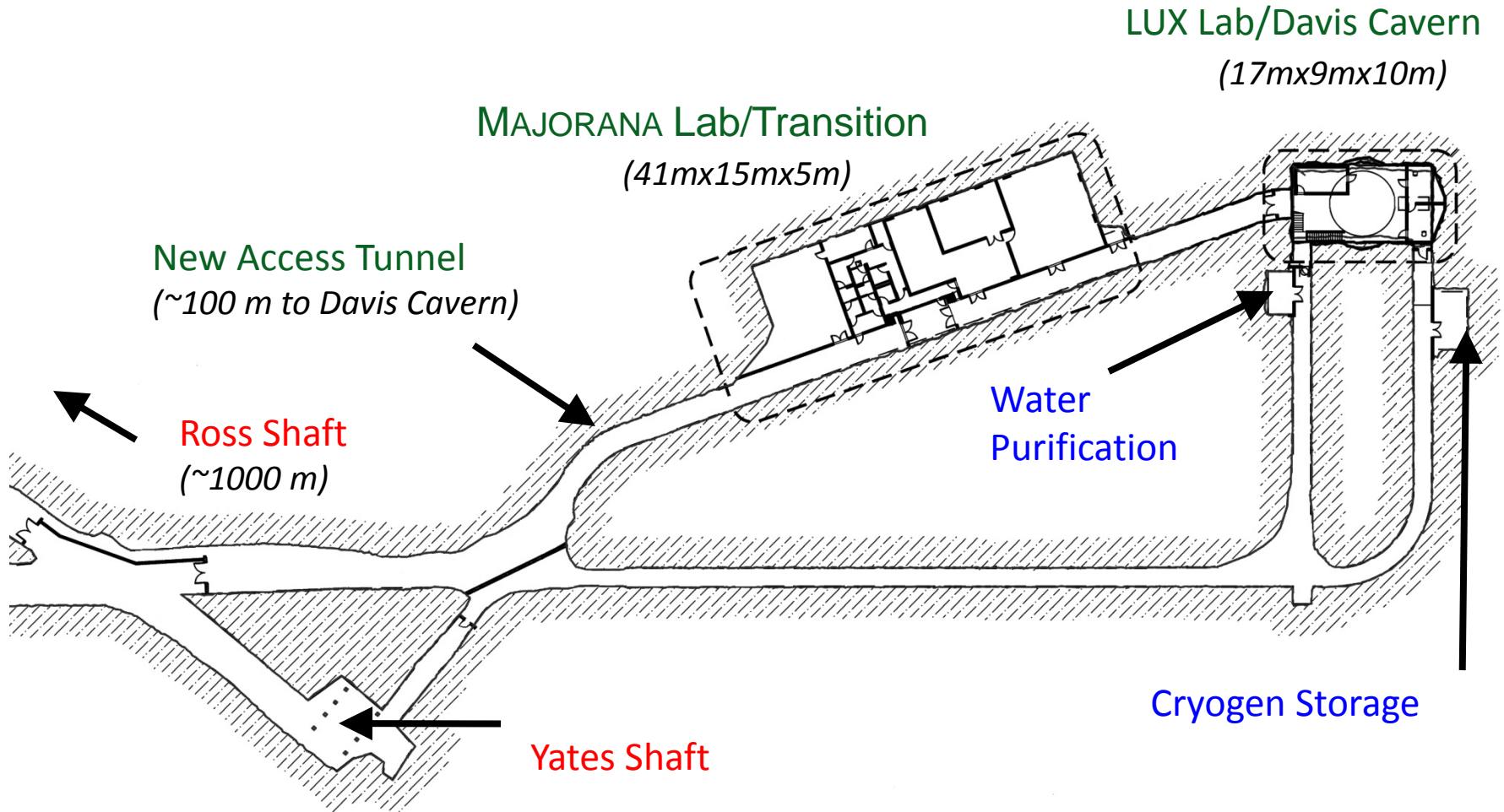
*EcoHydro Group – Geology (DUSEL S4)*

**Total Active = ~19 groups**

(Plus Others)

# New Sanford Laboratory Infrastructure

4850L Davis Campus: 745 m<sup>2</sup> (Total) / 455 m<sup>2</sup> (Science)



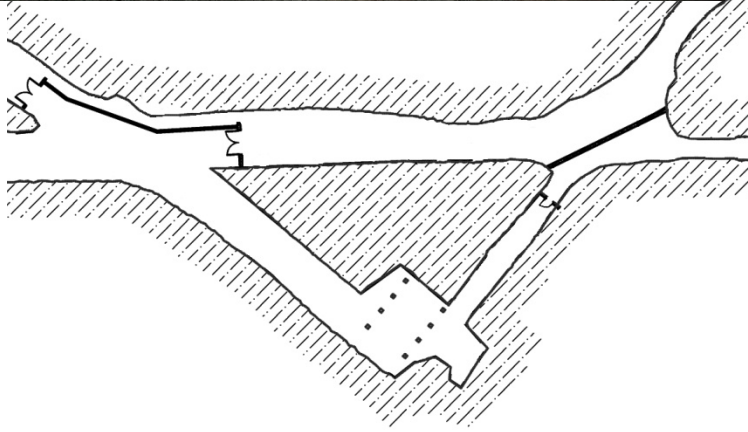
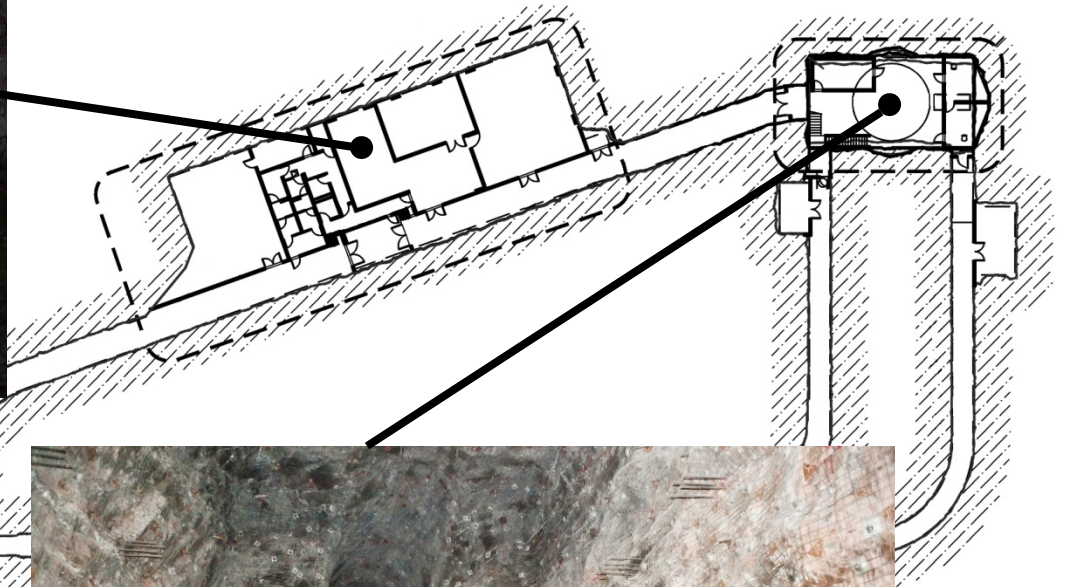
Excavation nearly complete. Outfitting, make into lab by ~ October 2011  
Electroforming for MAJORANA Demonstrator start near Ross Shaft this year

# New Sanford Laboratory Infrastructure

4850L Davis Campus: 745 m<sup>2</sup> (Total) / 455 m<sup>2</sup> (Science)



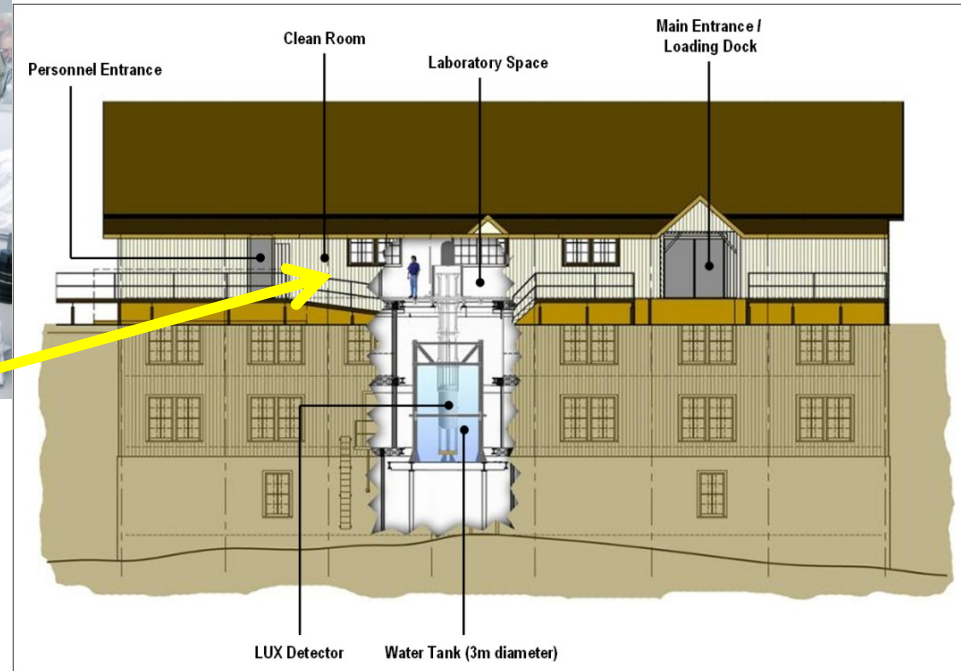
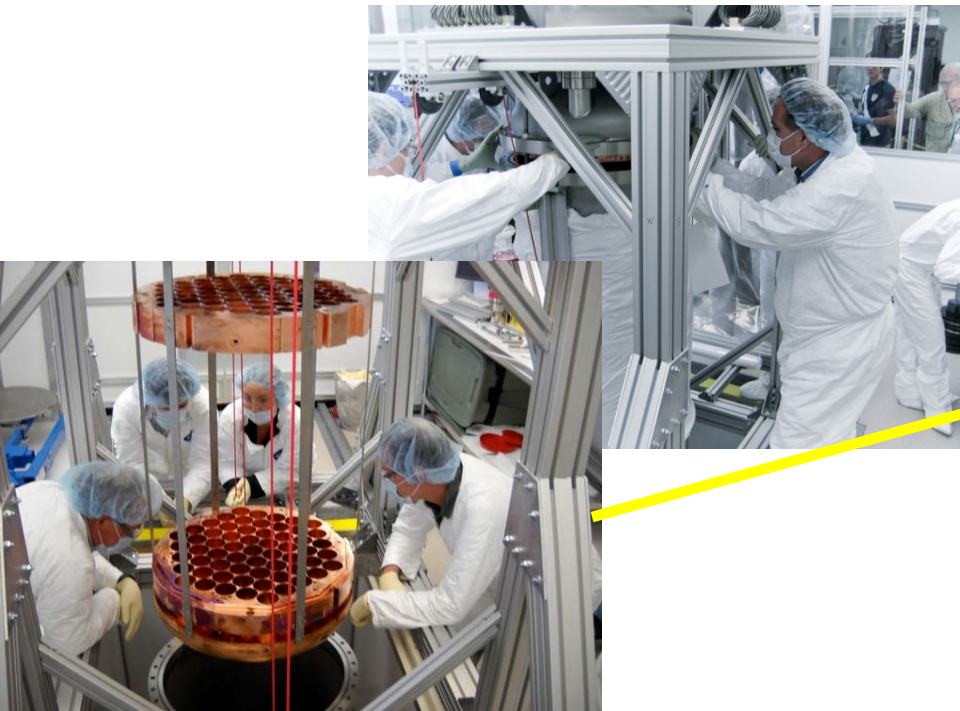
MAJORANA/Transition: Aug 2010



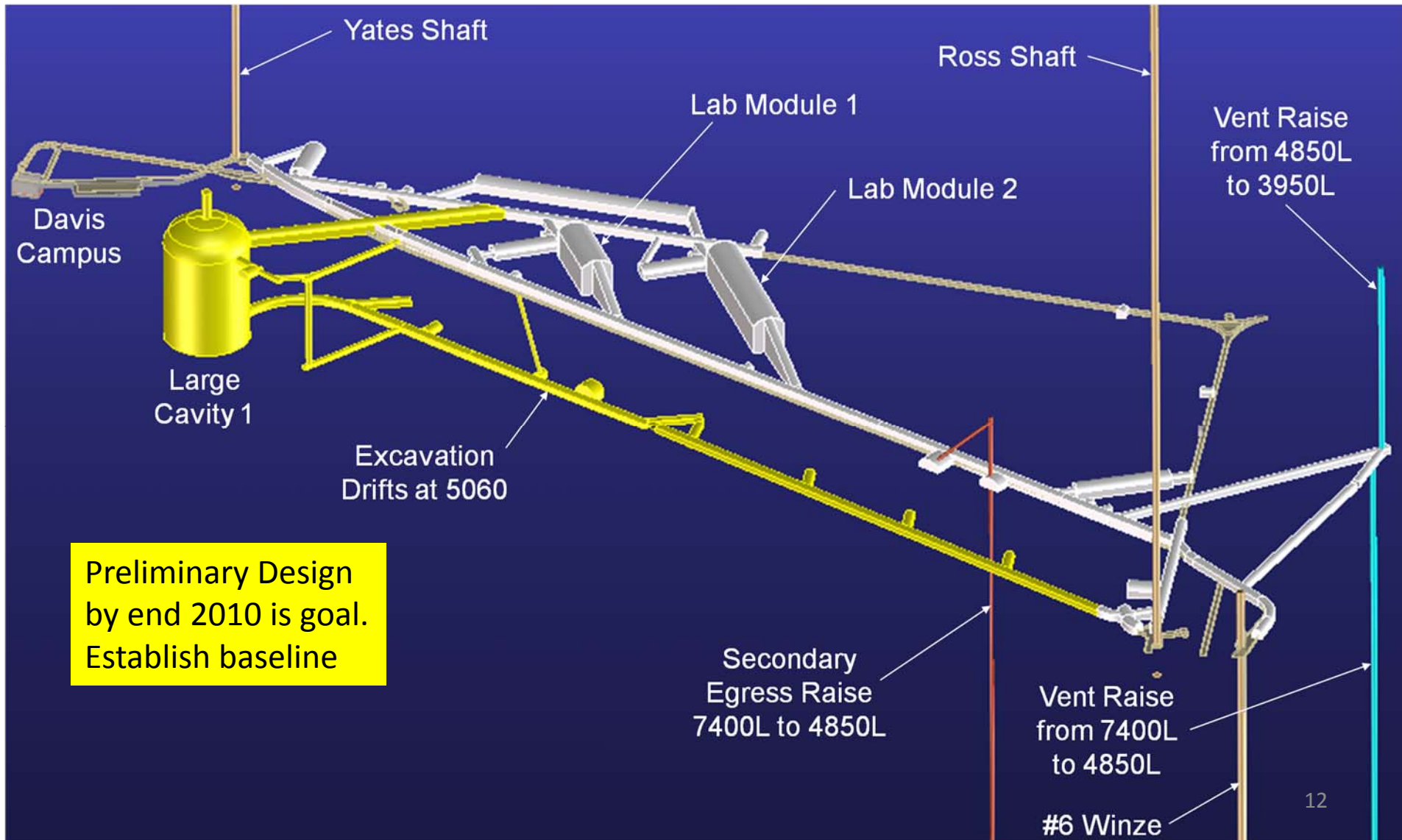
Davis Cavern: Aug 2010

# Sanford Lab Status and Plan

- LUX assembly underway in dedicated lab – see below. To be followed by operation on surface in water tank later this year.
- Preparations for MAJORANA Demonstrator underground space for electroforming continuing
- Davis campus ready ~ October 2011

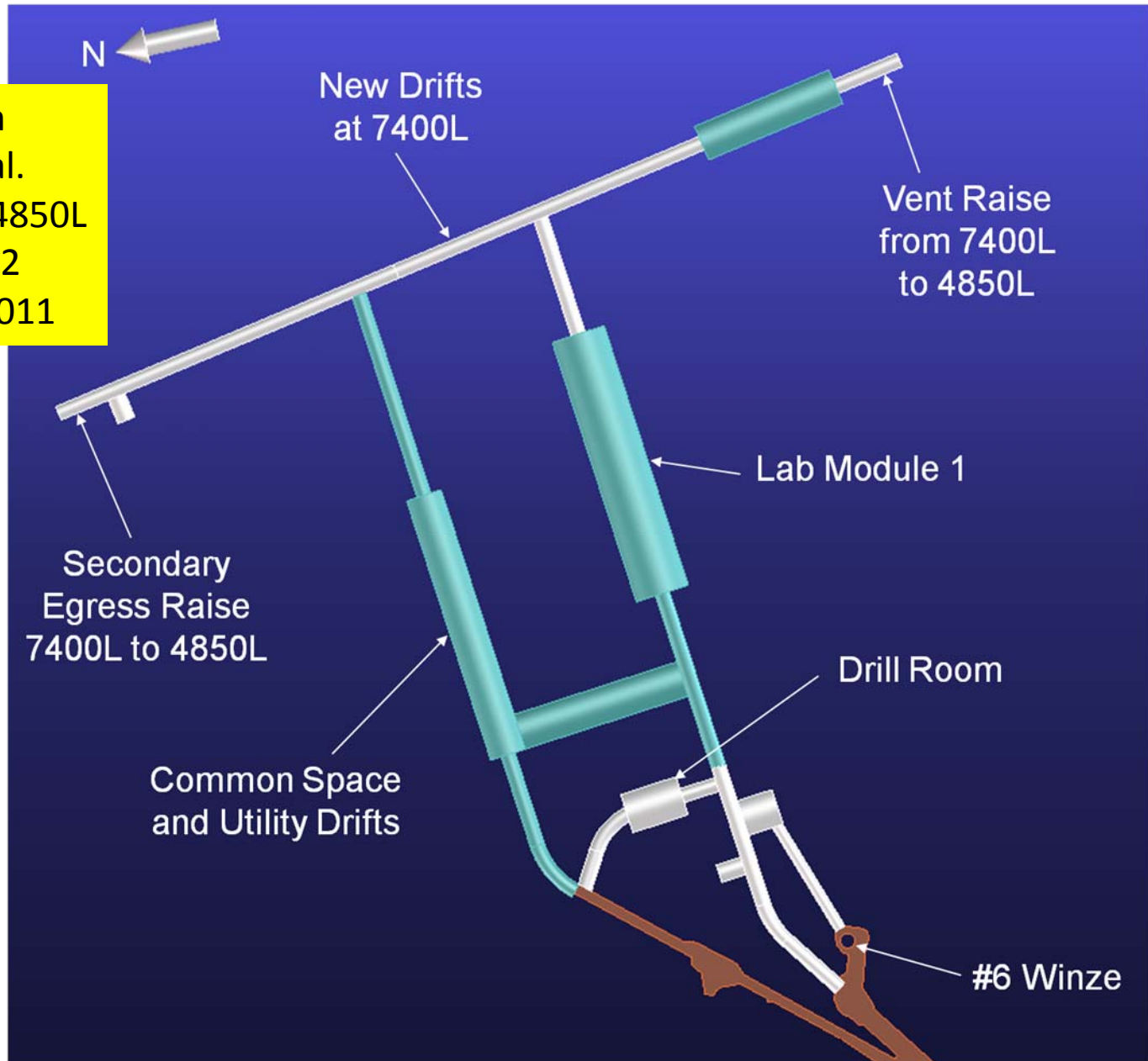


# 4850L Overview



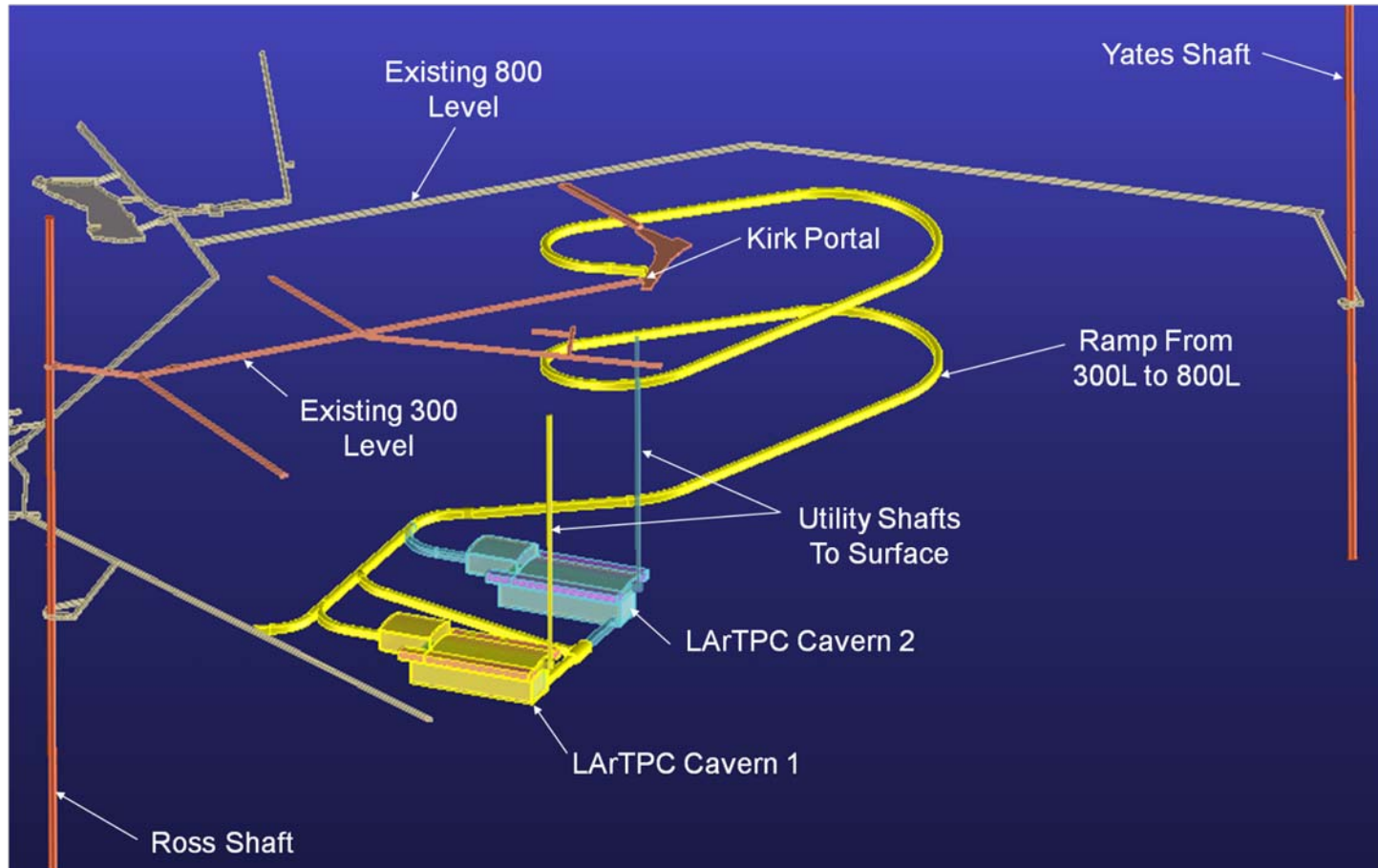
# 7400L Overview

Conceptual Design  
by end 2010 is goal.  
Not as mature as 4850L  
Dewatered by 2012  
Geotech studies 2011



# LBNE Liquid Argon Detector

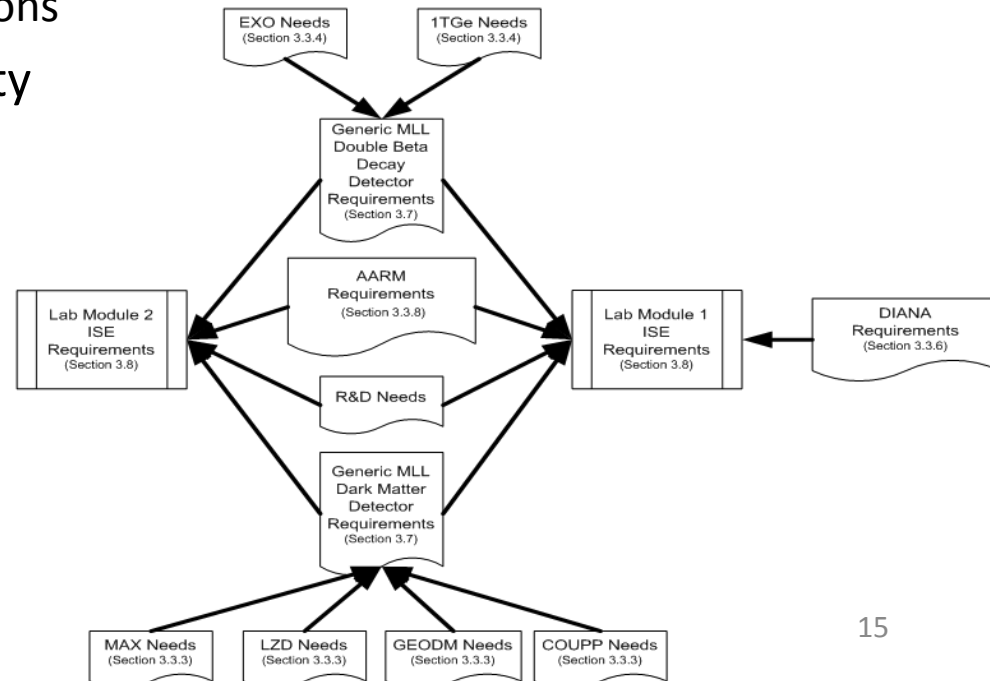
- LBNE considering options to realize equivalent of  $\sim 200$  ktonne of water equivalent: 2 water Cherenkov detectors or 1 WC + 1  $\sim 20$  ktonne liquid argon detector(different depth options) or 2 liquid argon
- Currently preferred liquid argon option is at 800L. Very early design phase





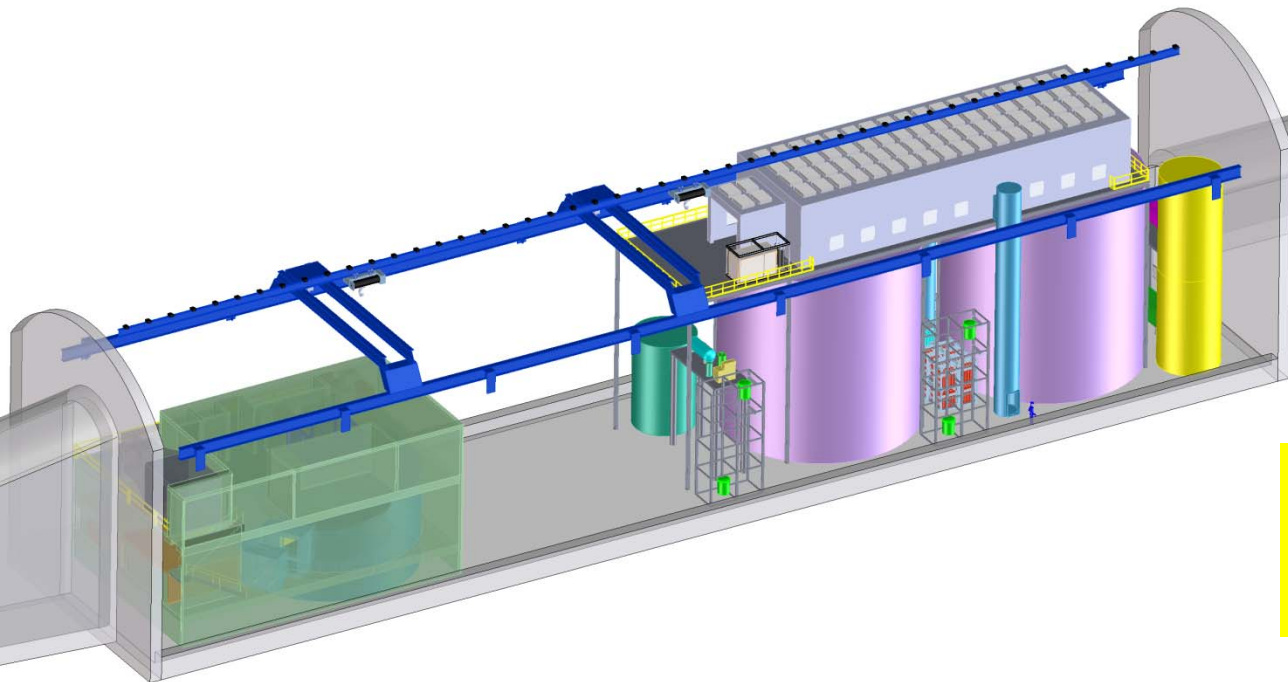
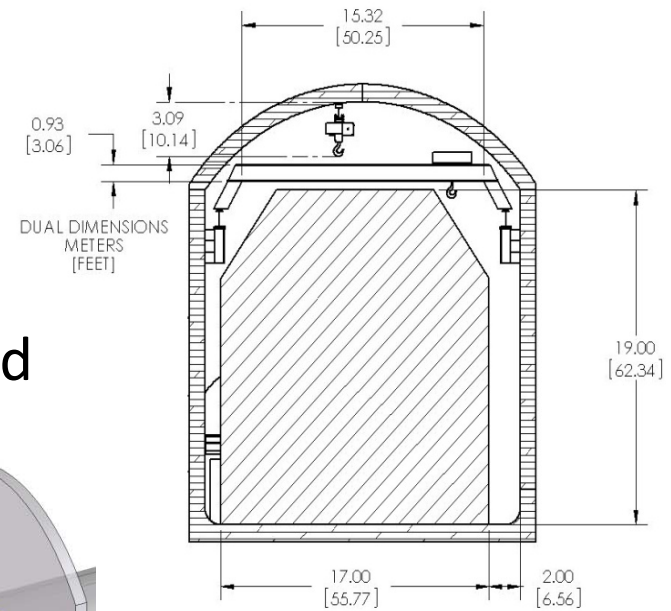
# Lab Module Planning

- Experiments to go into lab modules not selected but we have to provide requirements to design contractors now
- Detailed process using example experiments largely completed for creation of Preliminary Design Report and related funding proposal to be submitted this year.
- Space tight compared to desire of experiments
  - But overall will be limited by funds available for experiments in next 15 years
  - But also width/height, maybe length are tight for specific experiments
  - Have quantified costs, will work with community next year to resolve dimensional changes at ~ 20% level in key dimensions
- Nuclear astrophysics accelerator facility
  - Unique lab module needs
  - Partly understood
  - More study next year



# 4850L Lab Modules

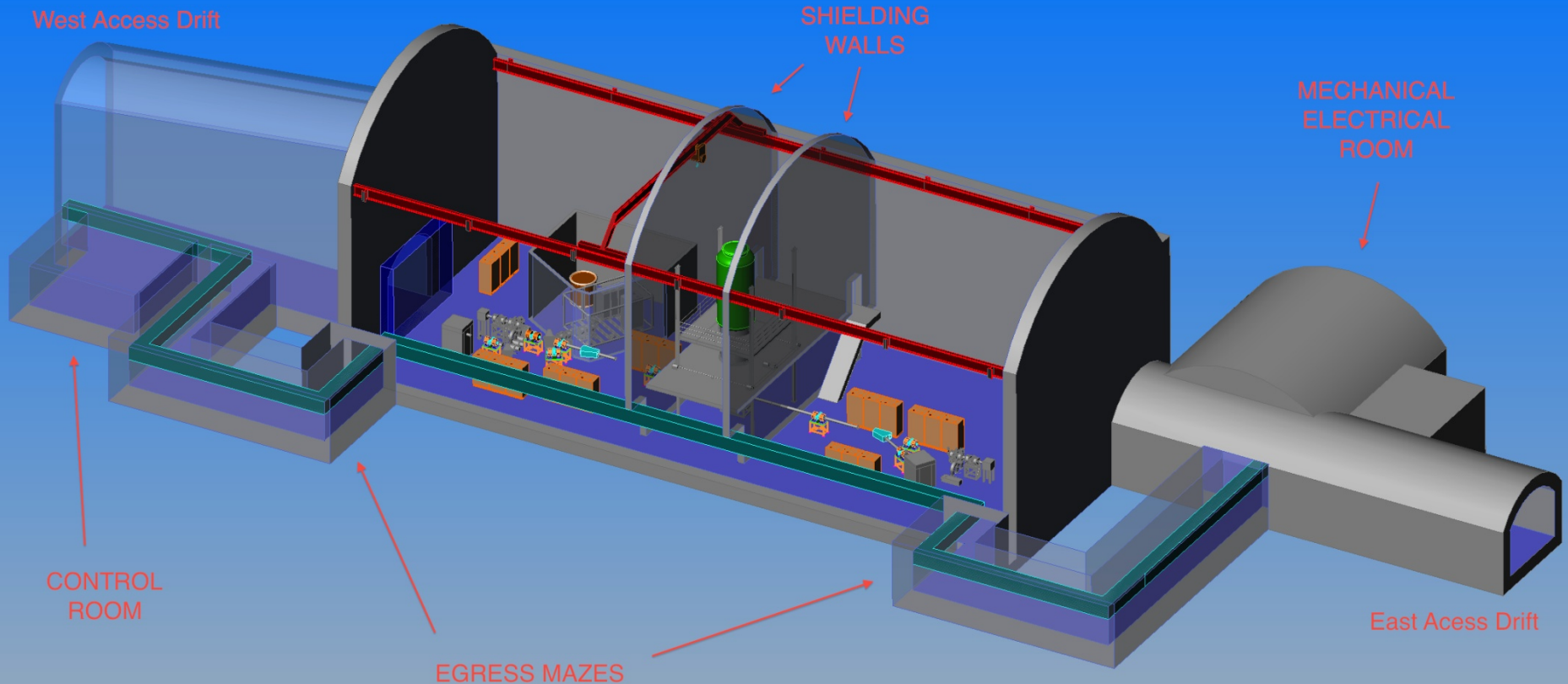
- LM1 and LM2 have same cross section.
- LM1 is 50m long and LM2 is 100m long
- 20m wide and 24m high to crown
- Some work on layouts done, more needed



Example of large  
Dark Matter experiments  
and FAARM in LM2

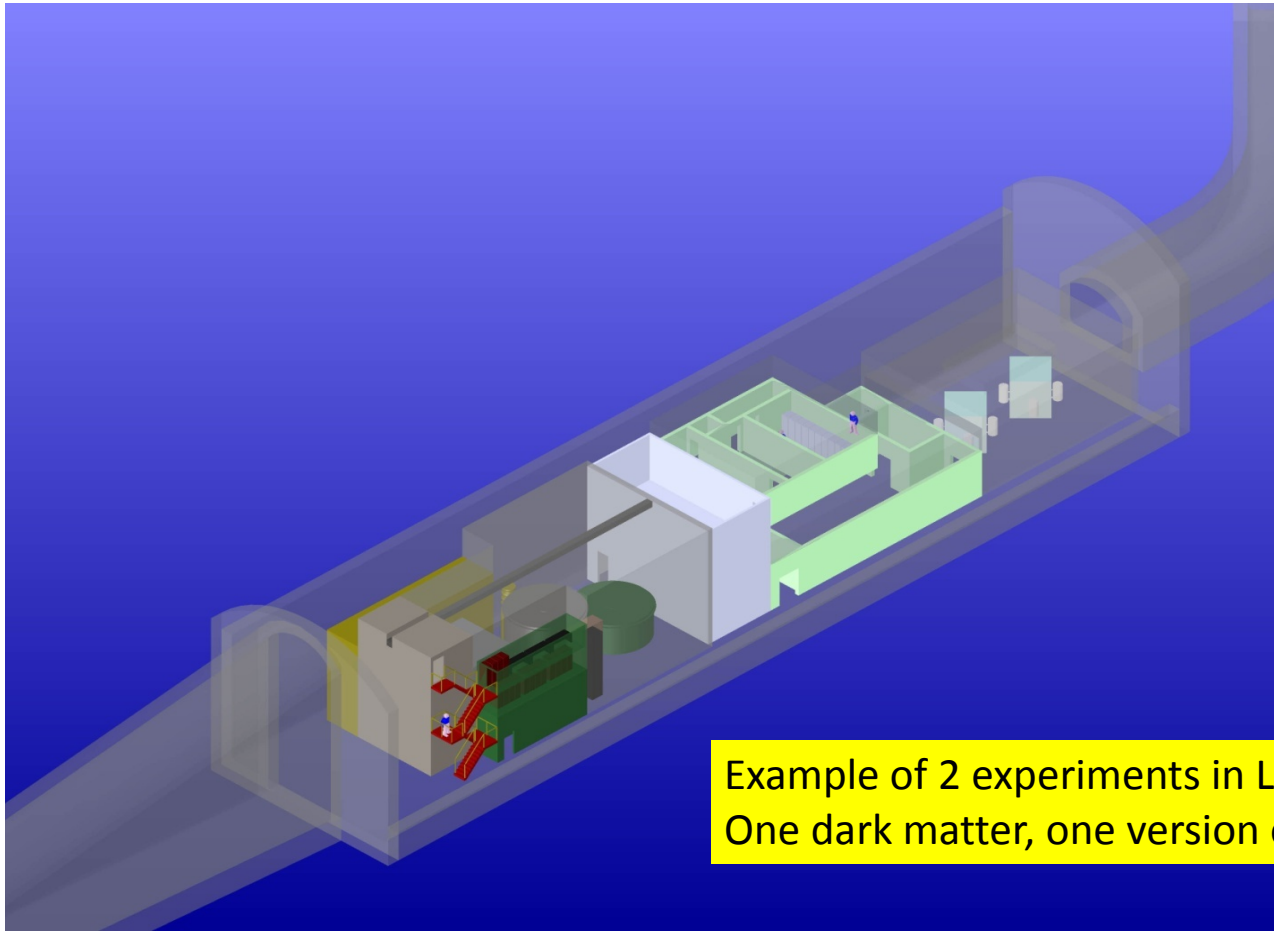
# Nuclear Astrophysics Accelerator

- DIANA proposal in LM1
- Would require some changes to generic LM1



# 7400L Lab Module

- Deep level lab module is 75m long, 15m wide and 15m high in present design
- Space very tight compared to request at 7400L
- Practically, major increases not likely in current plan (does not preclude future expansion post initial construction). Tradeoff of space at 4850L and 7400L?



Example of 2 experiments in LMD  
One dark matter, one version of  $0\nu\beta\beta$

# Planning

- DUSEL is a Major Research Equipment and Facilities Construction (MREFC) proposal to the U.S. National Science Foundation (NSF)
- Overall scope (\$) under discussion, come to the DuRA users meeting next week for latest news( <http://www.dusel.org/workshops/fallworkshop10/index.htm>)
- And unique partnership with the U.S. Department of Energy (DOE), including contributions to civil construction (LBNE). Office of Nuclear Physics (ONP) and Office of High Energy Physics (OHEP)
- Stewardship model for experiments and facility developed by U.S. agencies – see below
- International partnership is essential, needs more development

<b>U.S. Agency Roles and Stewardship</b>		
<b>Program Element</b>	<b>Steward Agency</b>	<b>Partner Agency</b>
DUSEL facility	NSF	DOE
Dark matter experiments	NSF	DOE OHEP
$0\nu\beta\beta$	DOE ONP	NSF
Long baseline neutrino & proton decay	DOE OHEP	NSF
Nuclear astrophysics	NSF	DOE ONP
Advanced low background and other physics	NSF	DOE
Biology, geology and engineering experiments	NSF	DOE

# DUSEL Schedule

- DUSEL (and LBNE) – big project, many steps
- DUSEL Preliminary Design Report and proposal to be submitted by end of this year
- LBNE project on roughly parallel timescale
- Reviews and more reviews through spring of 2011, including joint DUSEL/LBNE review
- DUSEL decision by NSF by Fall of 2011
- If yes, start Final Design in early 2012
- And start construction soonest in early 2014
- Maintain Sanford Lab science program and potentially expand early (G2 dark matter?, other physics?, BGE)
- DUSEL construction schedule under intense development, not settled, but earliest occupancy for experiments in 2017.