2017 MINED Open Innovation Competition

Problem Statement:

Throughout the life of a mine the ore that is extracted and depleted must continually be replaced with new resources, found through exploration drilling both beside and below the known resource, to allow companies to continue their operations and remain economic . Over time as the mine ages, it is common for exploration targets to define new resources at increasingly deeper horizons as well as further away from the existing infrastructure. At the same time that the mine must expand deeper the existing infrastructure has often been maximized. A unique condition for Canadian mines is extreme cold and hot seasonal fluctuations of surface temperatures. Ventilation practices are advancing with the introduction of process control to manage ventilation systems and battery powered mobile equipment. Consider the step changing ideas that can safely and economically take mining deeper.

The question to be answered is:

"*How can the mine as described increase efficiencies within existing ventilation infrastructure and designs in order to enable deeper mining while minimizing the costs of additional large scale investments*"?

The solution is seeking a concept plan which addresses the above question and considers the listed "Outcomes of Analysis" and "Boundary Limits" as per below.

Outcomes of analysis:

- Improved safety
- Improved productivity
- Decrease capital intensity and operating costs

With considerations such as:

- Technology enablers that can be used to achieve the increased productivity and safety
- Solutions to incorporate new technologies into existing mines with low impact
- Enablers for regulators to accept new technologies
- Opportunities to improve the work environment
- Opportunities for improved mining methods

Boundary Limits:

- Safety of the workforce must be ensured
- Geo-mechanics at depth must be considered
- Adhere to applicable regulations

Case Study

Lakeview Mine is located in a pristine area of northern Canada 10 km from a community of 50,000 people as well as nearby cottages. The mine site is bordered by a deep fresh water lake and shares an all-weather road with the cottagers. The mine has been operating for 15 years with 5 years of mining

remaining from the current resources. Two new orebodies, #5 and #6, have recently been discovered at depth; which would extend the mine life an additional 10 years.

The production shaft is currently used to supply fresh conditioned air into the mine and was driven to a depth of 2060 m. A production rate of 3000 tpd was established from orebodies #3 and #4. With the cost of expanding the #3 and #4 orebodies, the development to reach the new #5 and #6 orebodies, and the current economic conditions, production must be increased from 3000 to 3500 tpd. The current mining plan at the increased production rate has maximized the output of the ventilation system.

The first orebody, #5, is between 2060m and 2250m depth, which is a continuation of #4 orebody below shaft bottom. The second orebody, #6, is an independent resource between 2450 m and 2654 m elevation, with potential for expansion to depth.

A study is required to develop a plan for ventilating the new ore zones so that production can remain constant as the upper mining is completed and the lower mining begins.

Physical Data

Dimensions:

Description	Length	Size	Comments
Fresh Air Raise	Shaft bottom at 2,134m below collar	7.3 m Φ (24.0')	The FAR is the production shaft. k factor, measured, = 273
Return Air Raise	Shaft bottom at 2,058m below collar	5.5 m Φ (18.0')	The RAR contains the secondary escape system. K factor, measured, = 52
Ramps		5.5 m x 5.2 m (18.0' x 17.0')	Maximum 15% grade
Drifts		4.9 m x 4.9 m (16.0' x 16.0')	

Rock Properties:

Density	2545 kg/m³	159 lb/ft^3
Thermal conductivity	3.4 W/m°C	2.0 Btu/h.ft°F
Specific heat	820 J/kg°C	0.2 Btu/lb°F
Thermal diffusivity	1.6 x 10^{-6} m^2/s	0.15 x 10^{-6} ft^2/s

Geothermal step = 62 m/°C
VRT (°C) at 10 m = 4.3°C

Surface Ambient Conditions:

Summer design wet bulb (wb)	18.0°C	64.4°F
Summer design dry bulb (db)	23.0°C	73.4°F
Barometric pressure	99.5 kPa	29.38" Hg
Surface density	1.15 kg/m³	0.072 lb/ft^3

Mine Conditions:

153 m^3/s (325,000 cfm) of fresh air is currently supplied to both # 3 and #4 orebodies to ventilate for the mining activities and repair facility.

Mine cooling was designed for ambient summer temperatures of 23°C DB/18°C WB. Under these conditions, temperatures at the fresh air raise are as follows:

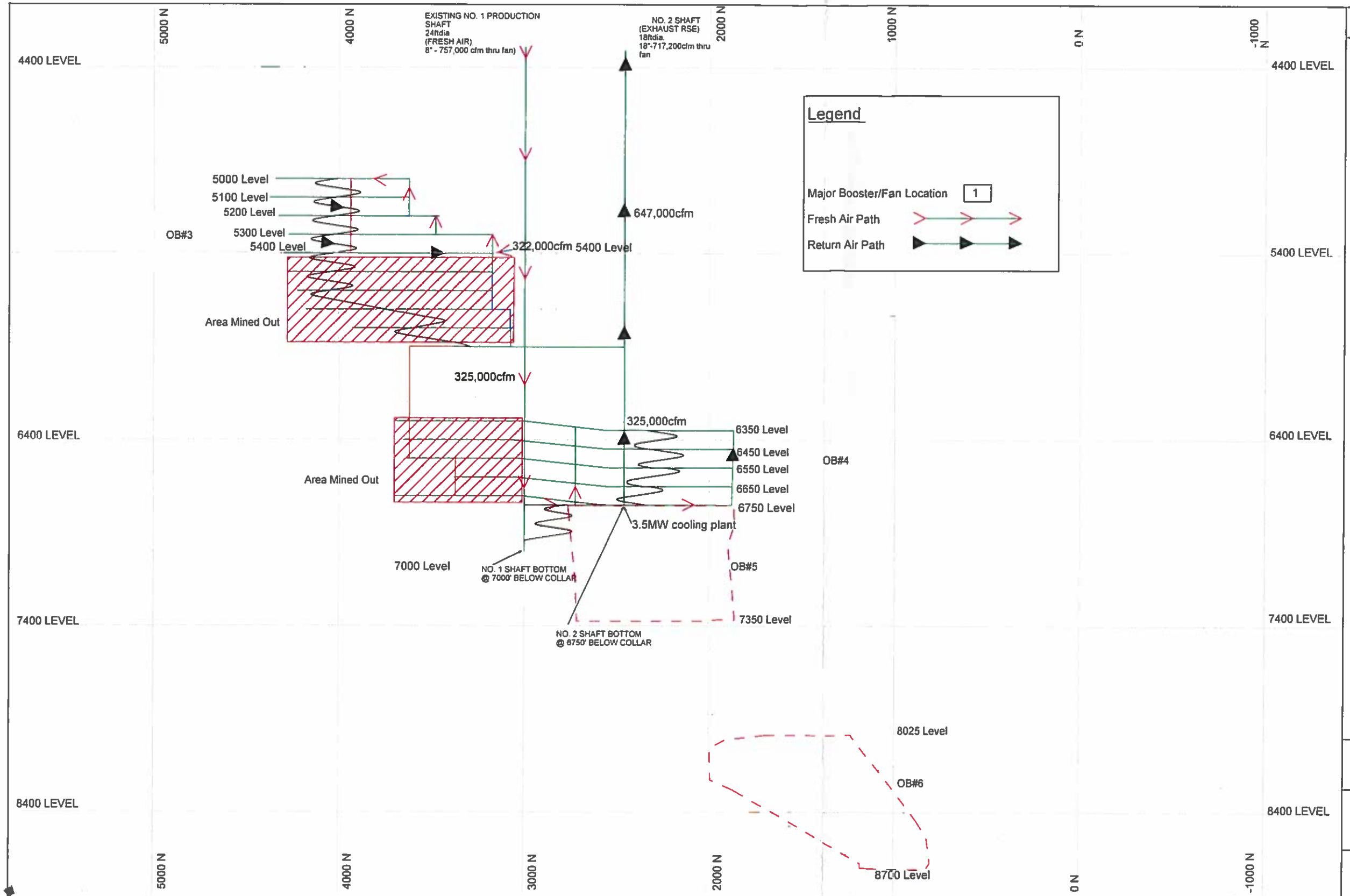
- 5400 Level = 34.5°C DB/24.8°C WB
- 6750 Level = 37.1°C DB/26.4°C WB

Mining activities will raise temperatures across the level 6 to 8 °C DB and 4 to 6 °C WB. Underground zone cooling is required for #4 orebody during the warmer surface ambient conditions. The plant produces 3.5 MW of cooling power to keep temperatures in the workplace below thermal work limits.

Mobile Equipment:

Diesel equipment used throughout the mine (typical for equipment purchased prior to 2011):

Equipment	Engine Size (kW)	Engine Size (hp)
Scoop Trams	239	335
Haulage Trucks (30 T)	305	400
ITH Drills	76	105
Scissor Lifts	105	145
Anfo Loaders	110	147
Bolters	119	160
Boom Trucks	172	235
Jumbos	119	160
Graders	108	146
Kubotas	37	50
Toyotas	95	128



SECTION LOOKING EAST

Lakeview Mine

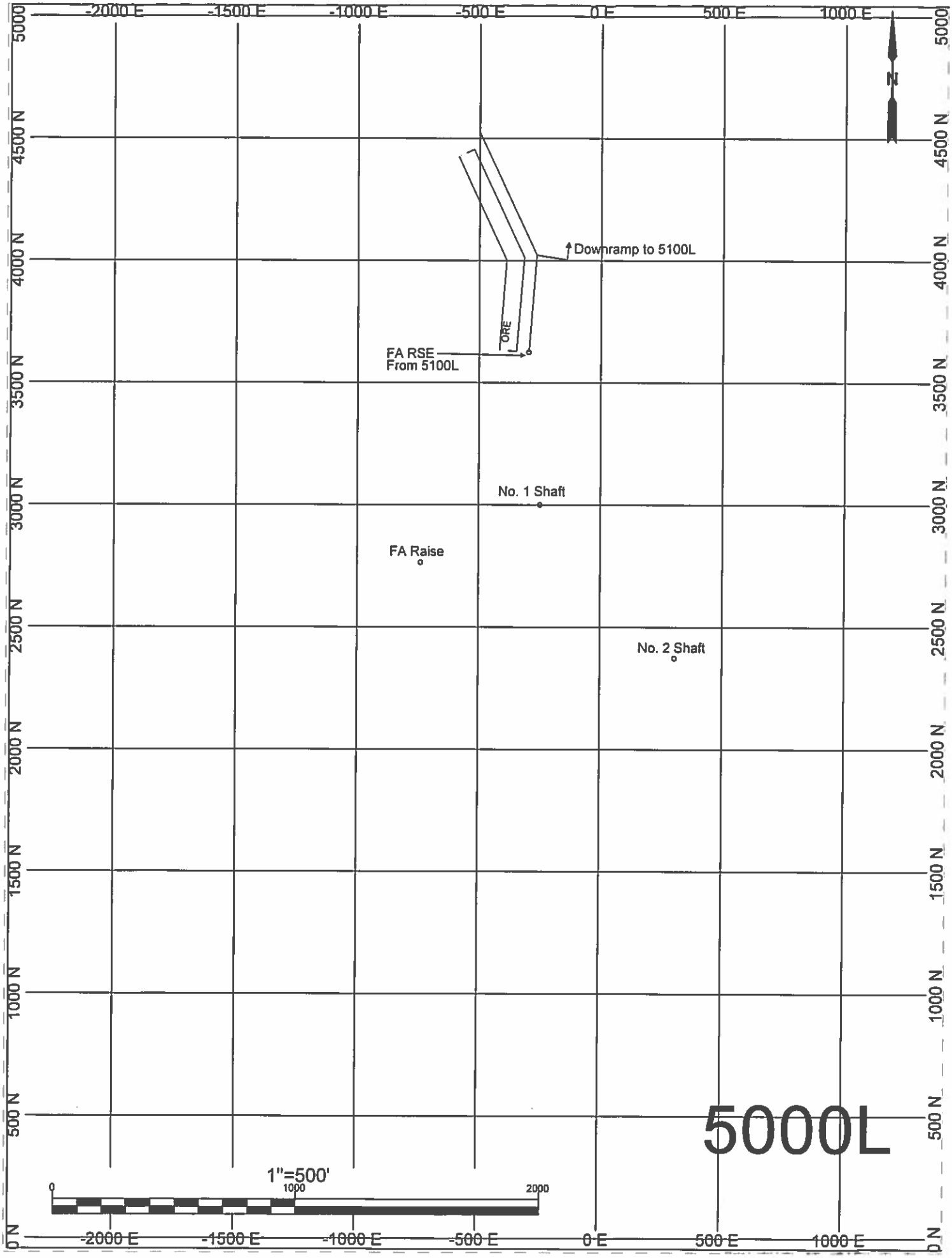
DRAWING NO.	DRAWING TITLE	REG. PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

ROLE	NAME	SIGNATURE	DATE

SCALE OR AS NOTED | DWG. No. | REV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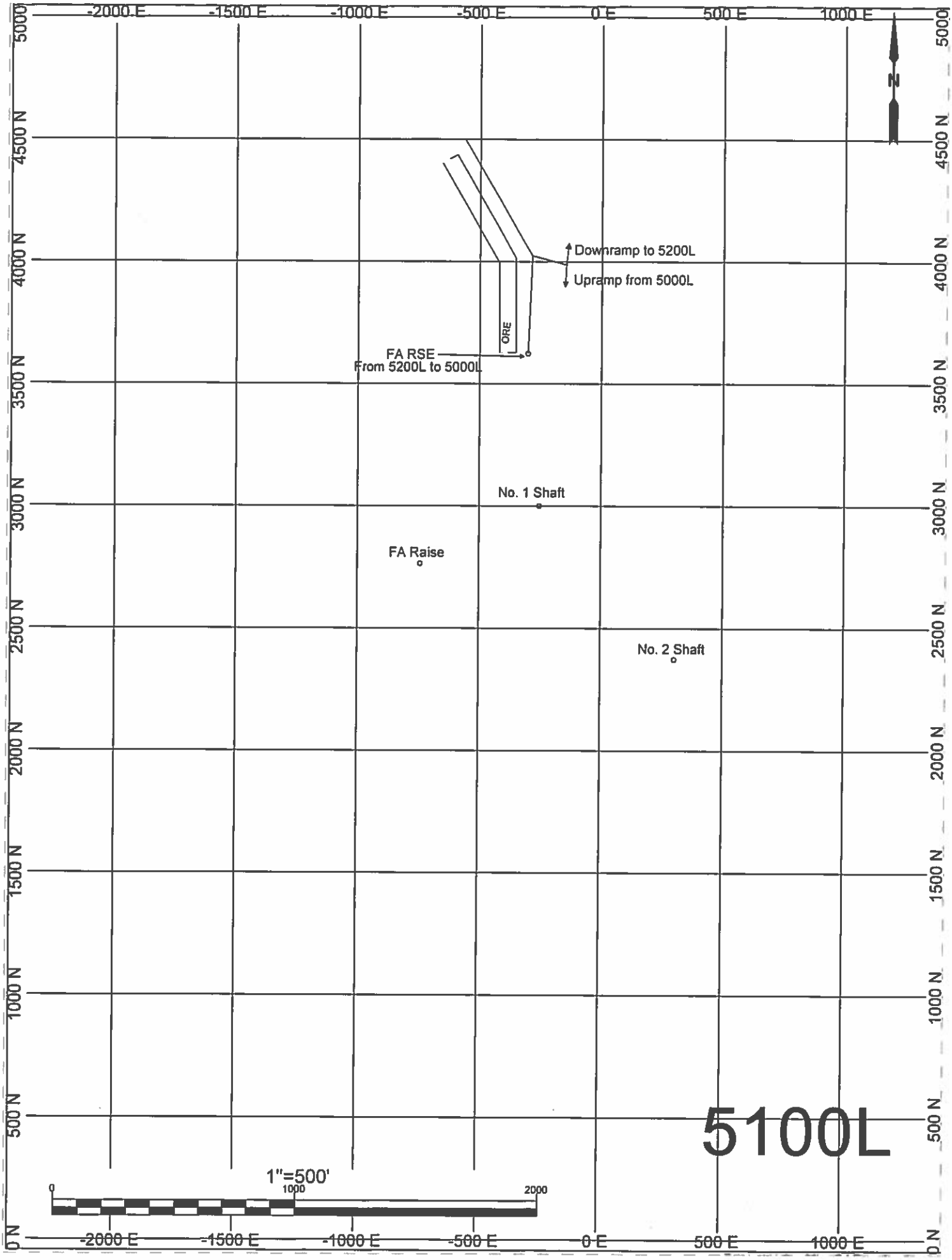
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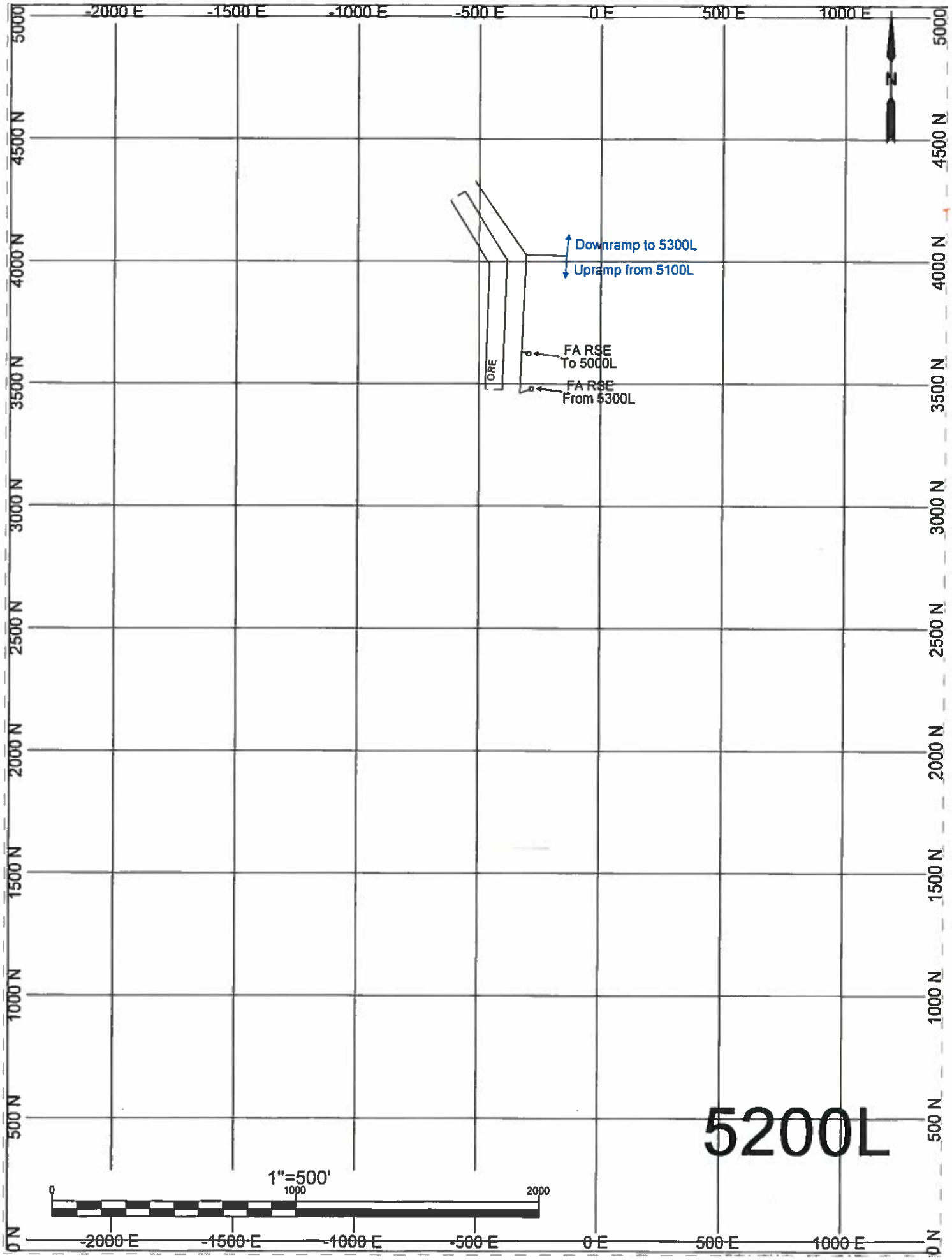
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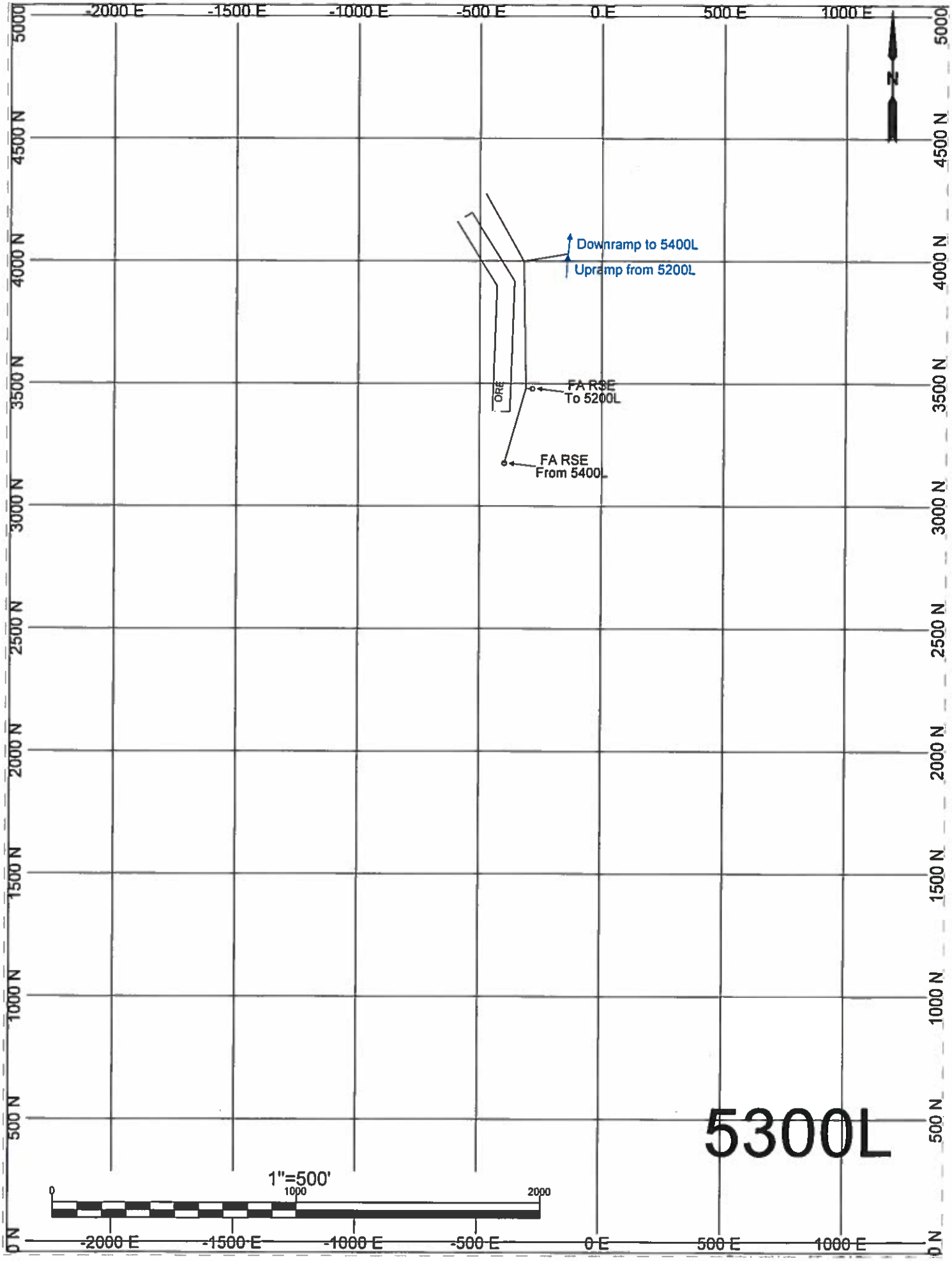
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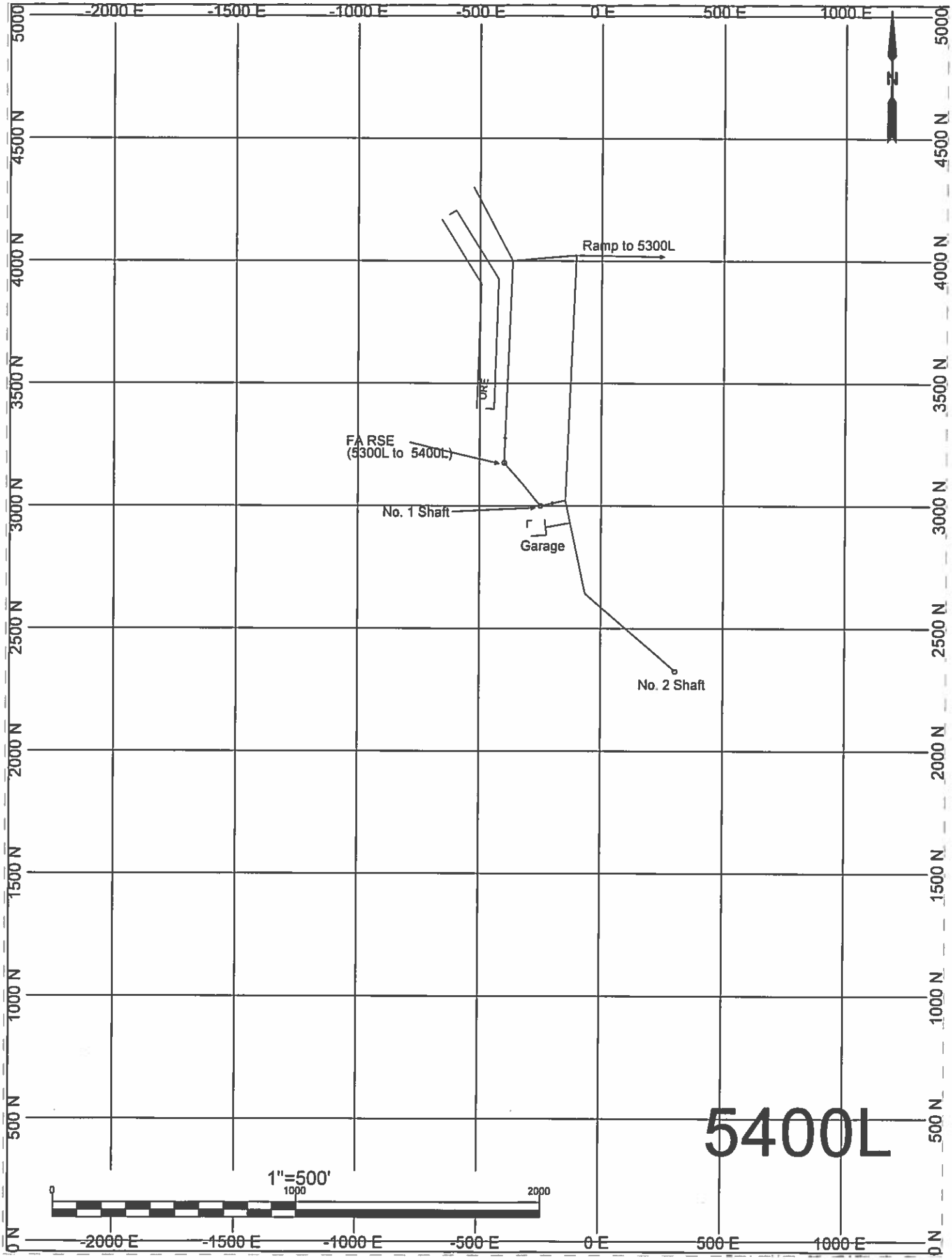
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Ramp to 5300L
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(5300L to 5400L)
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Garage
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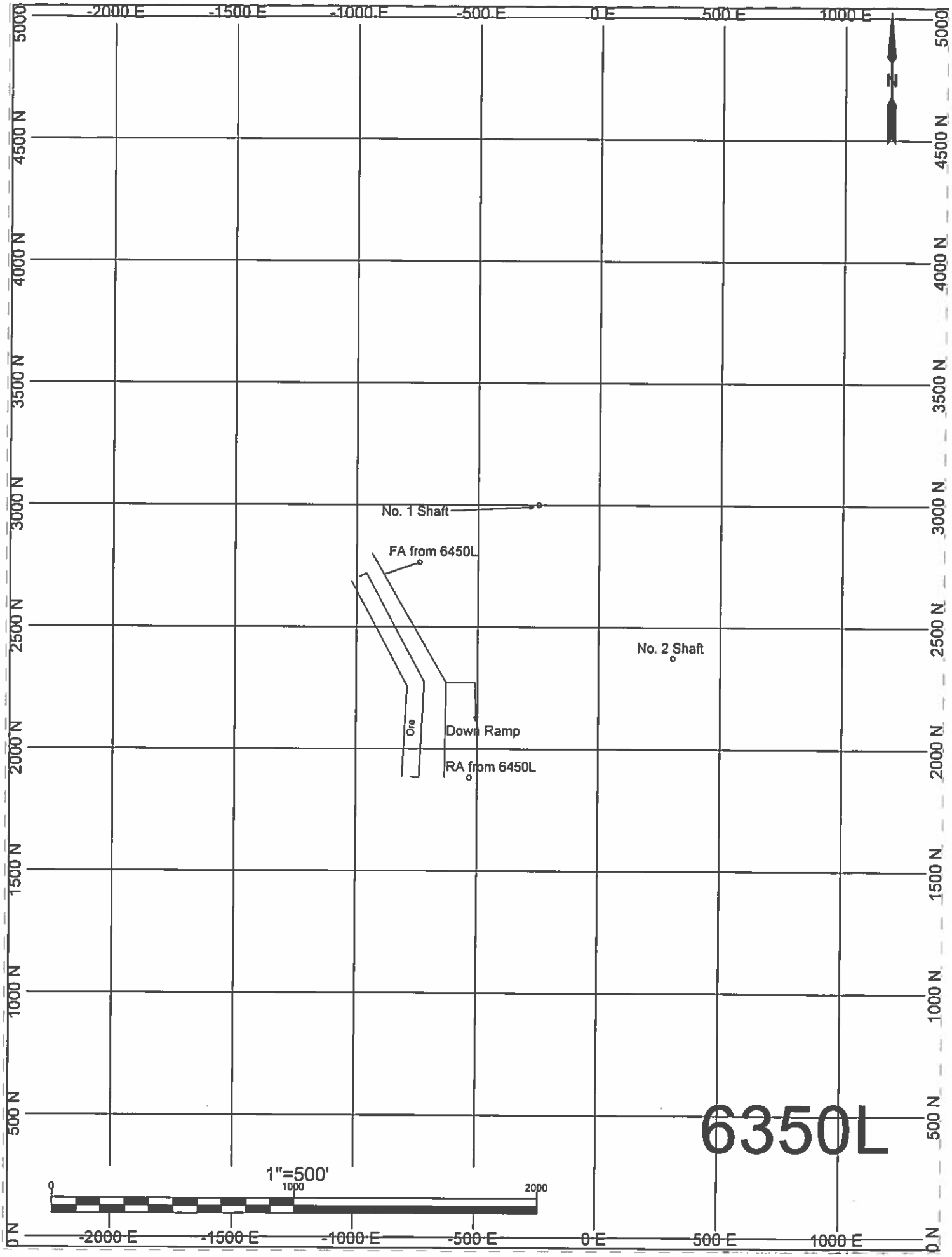
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Ore
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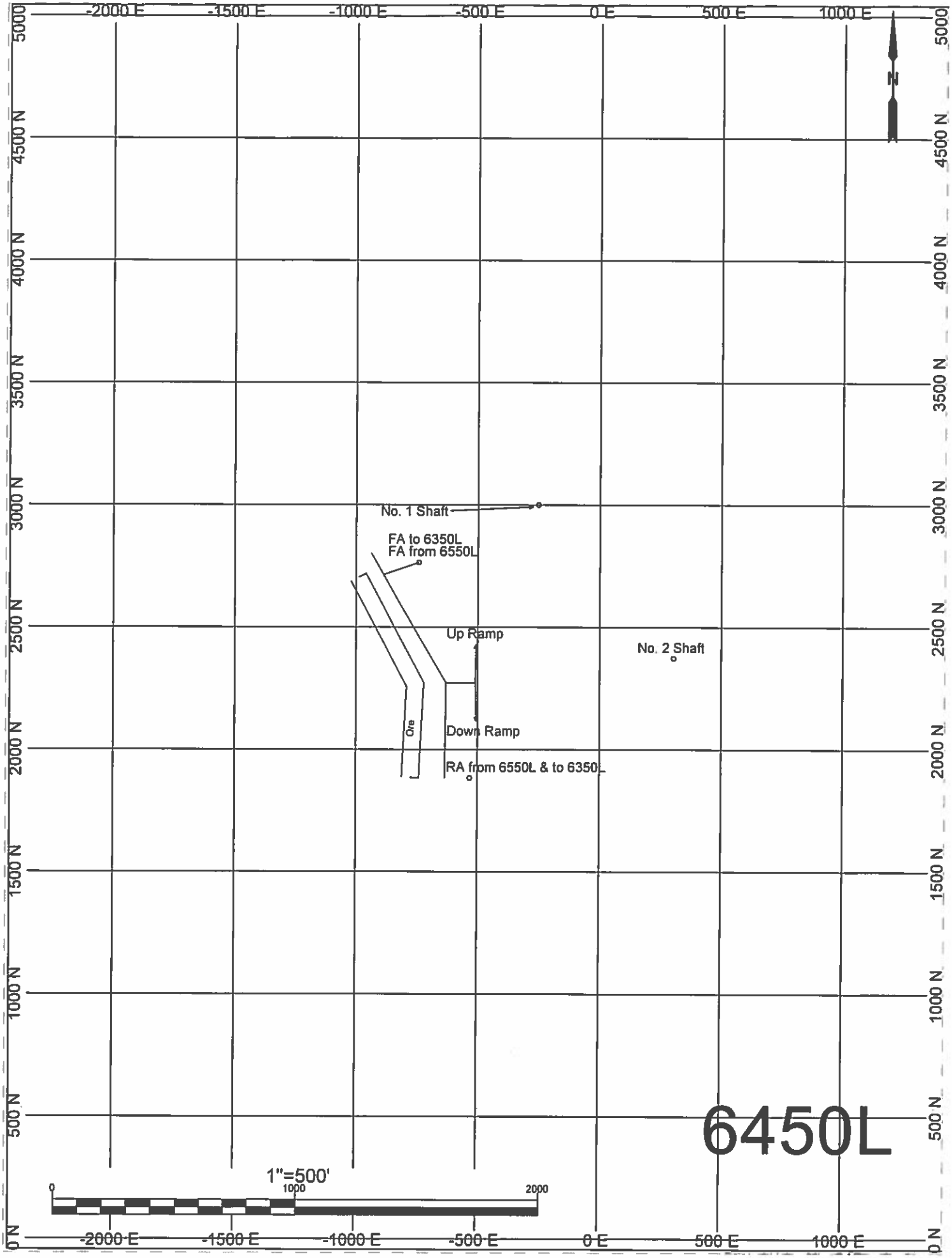
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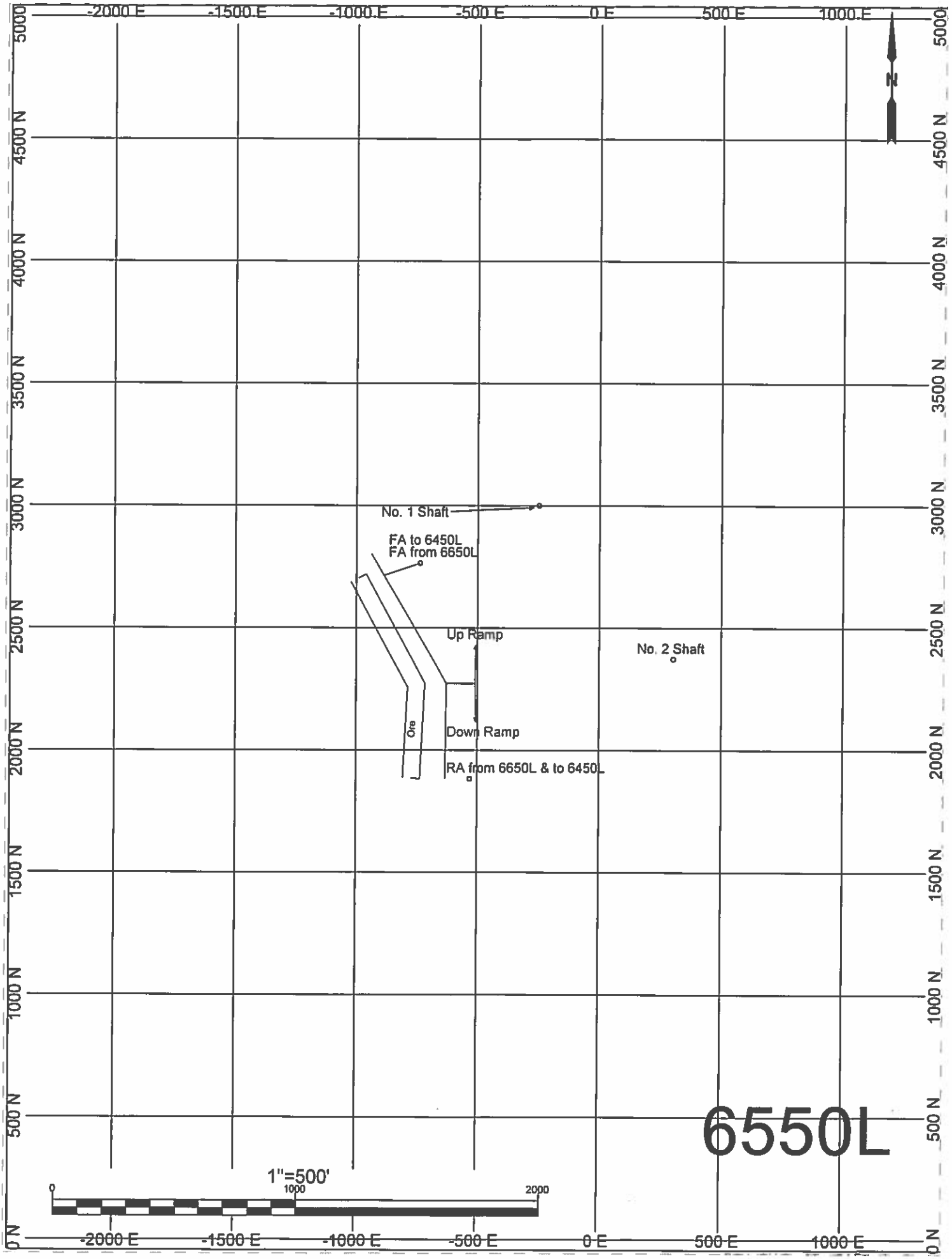
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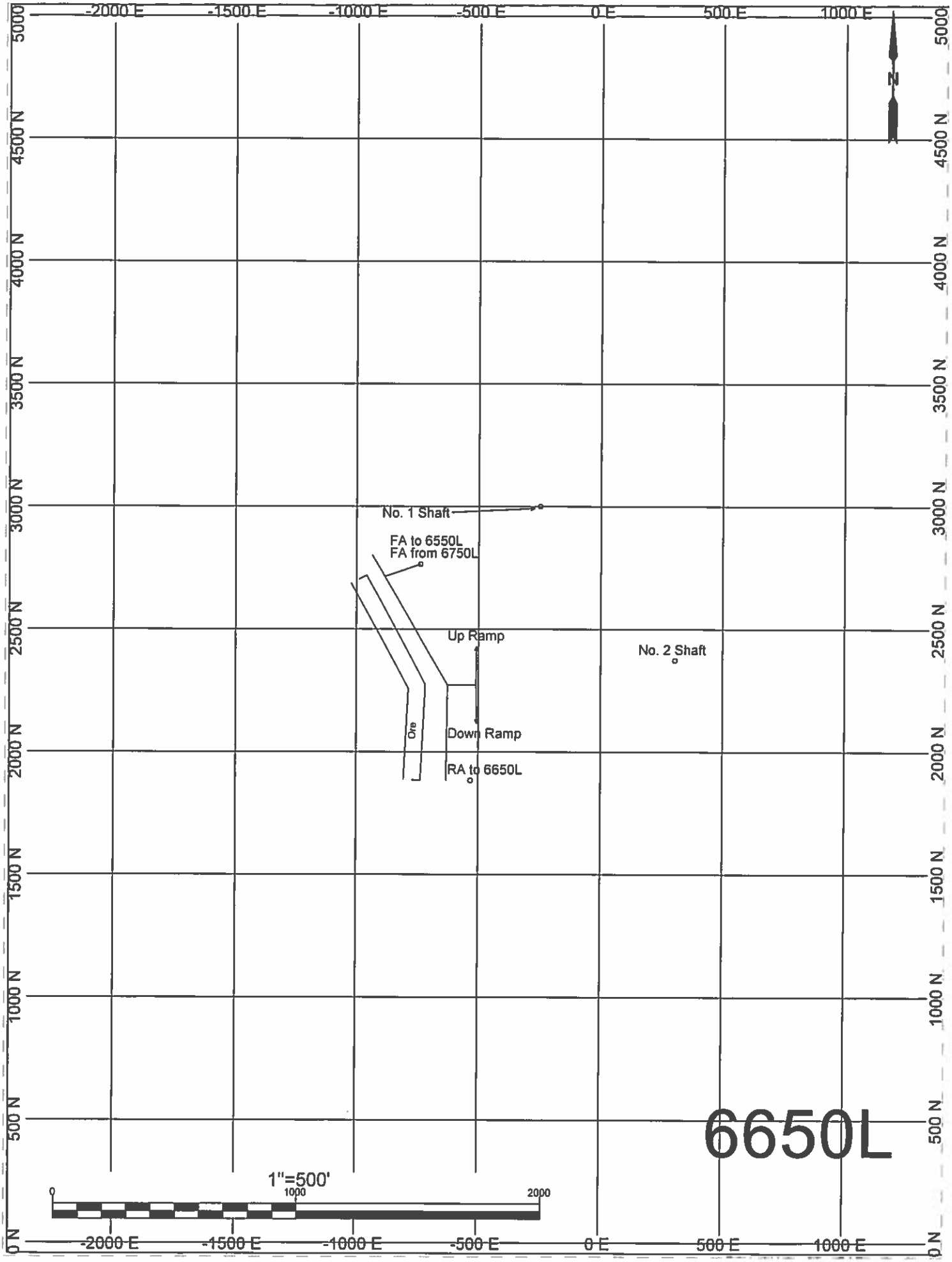
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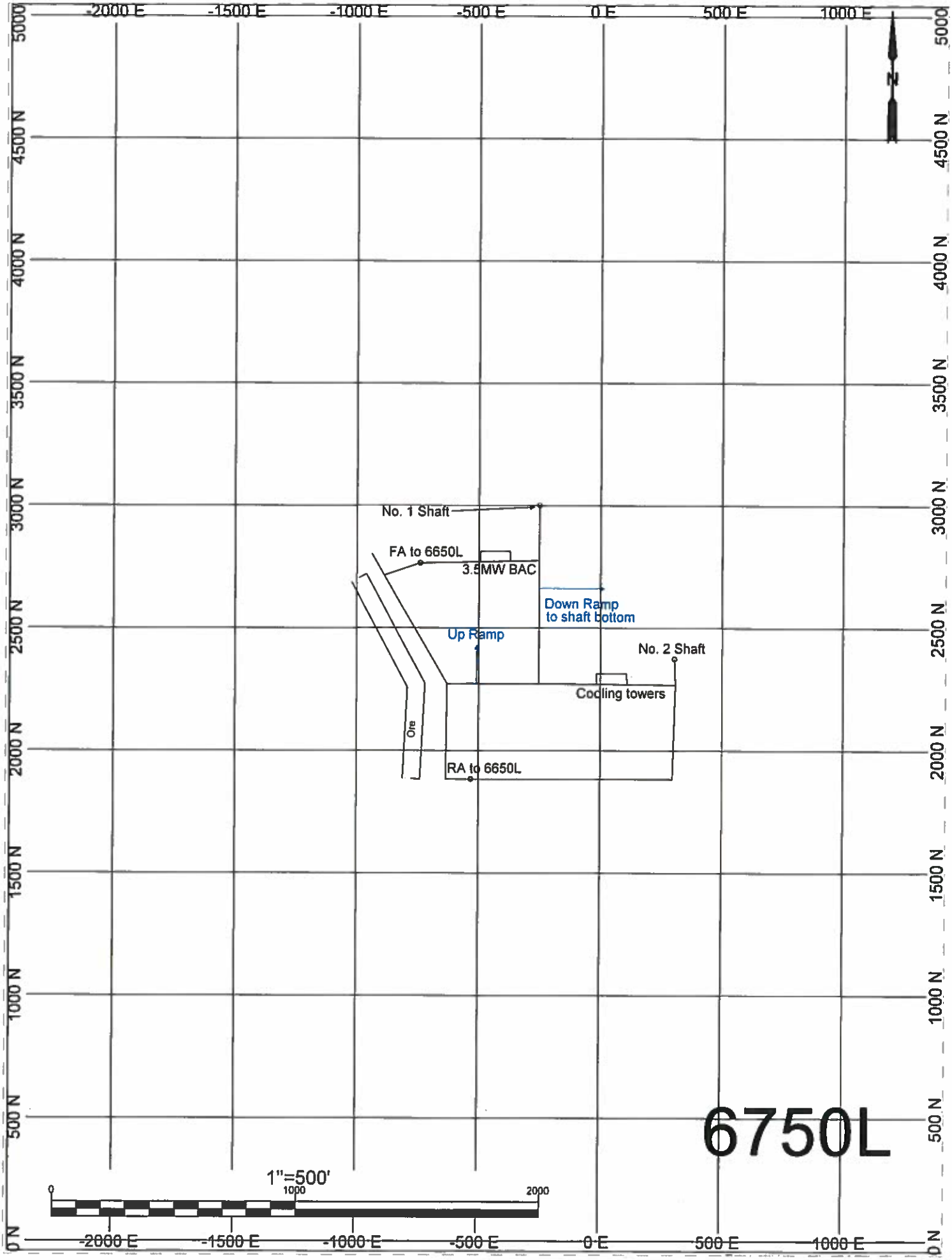
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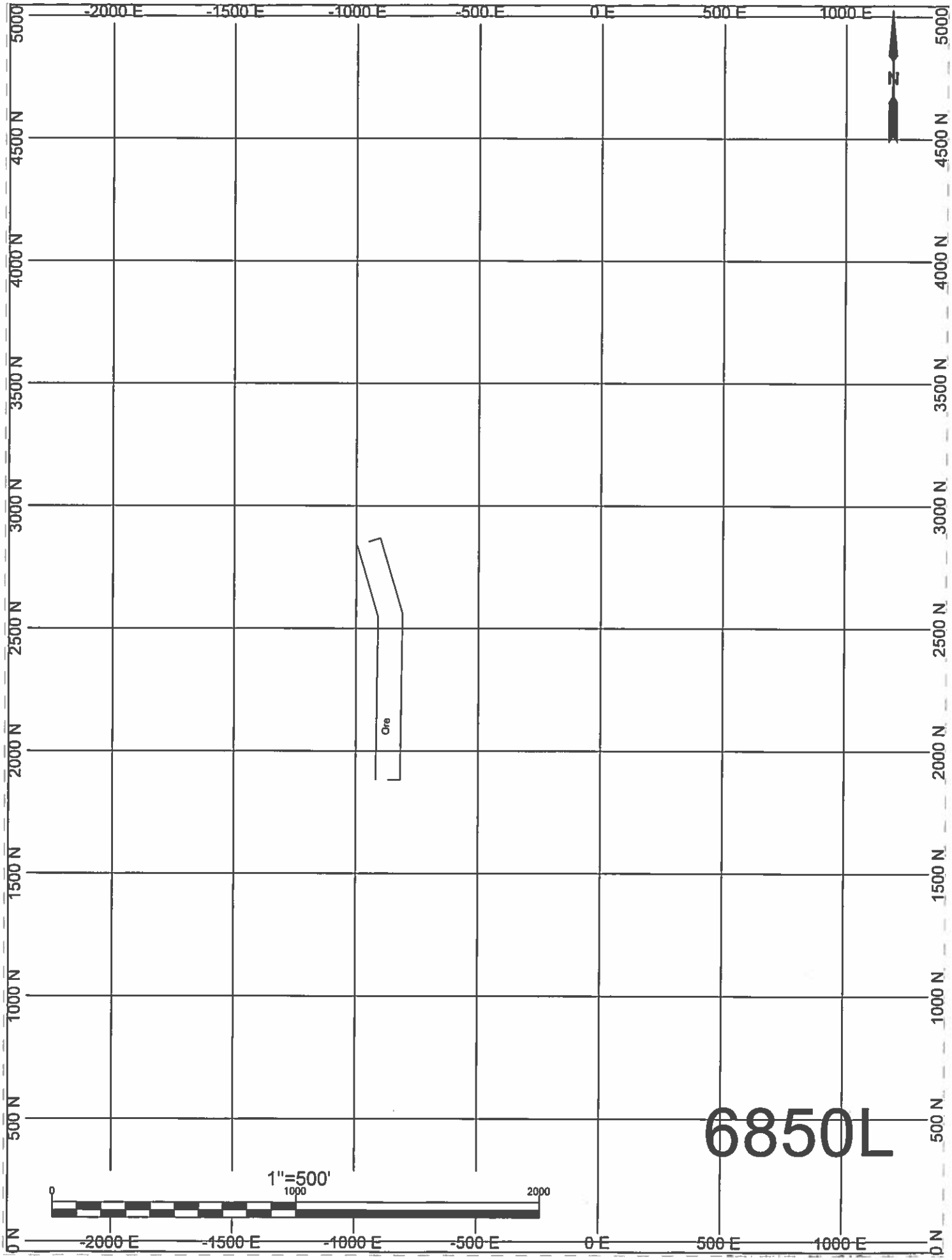
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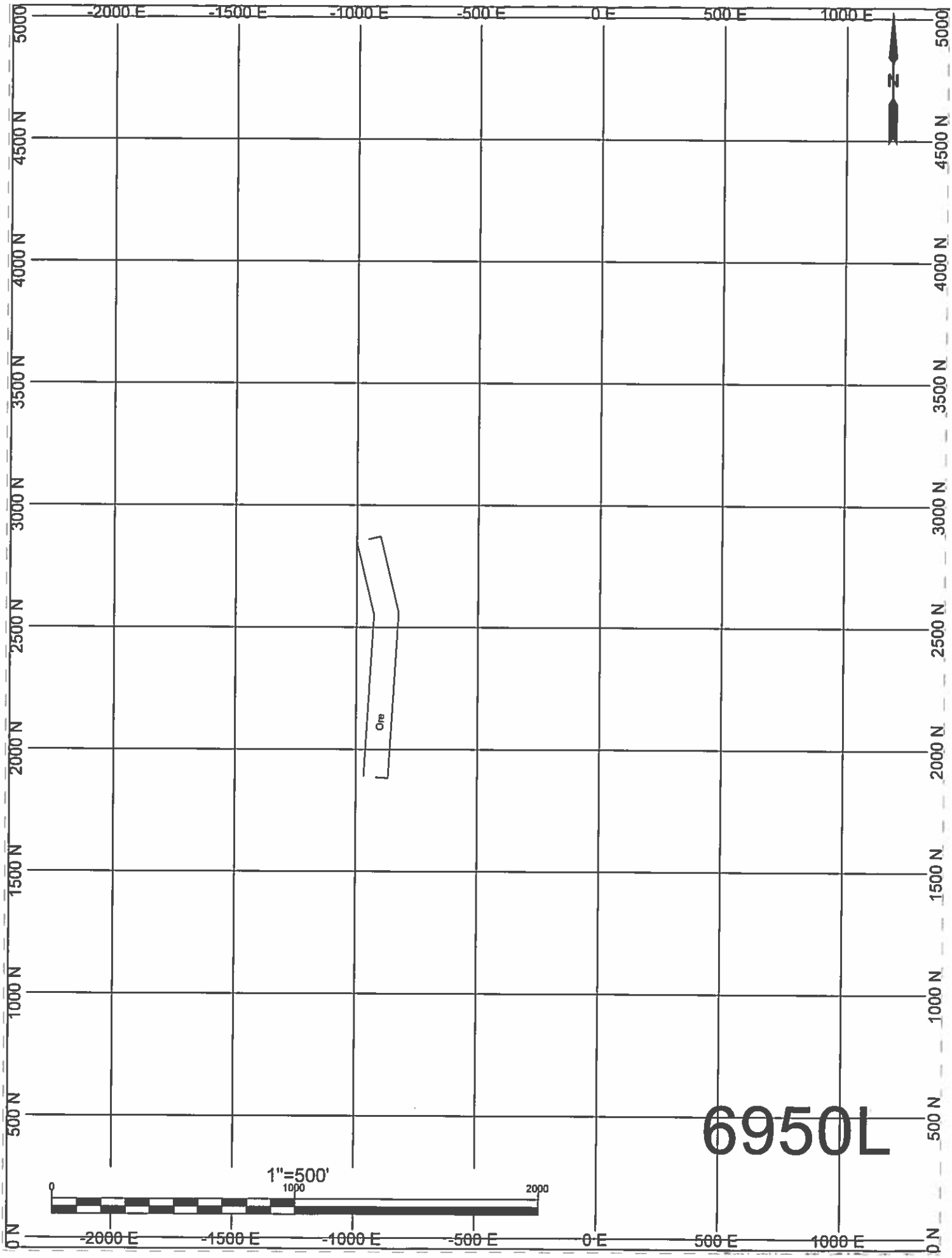
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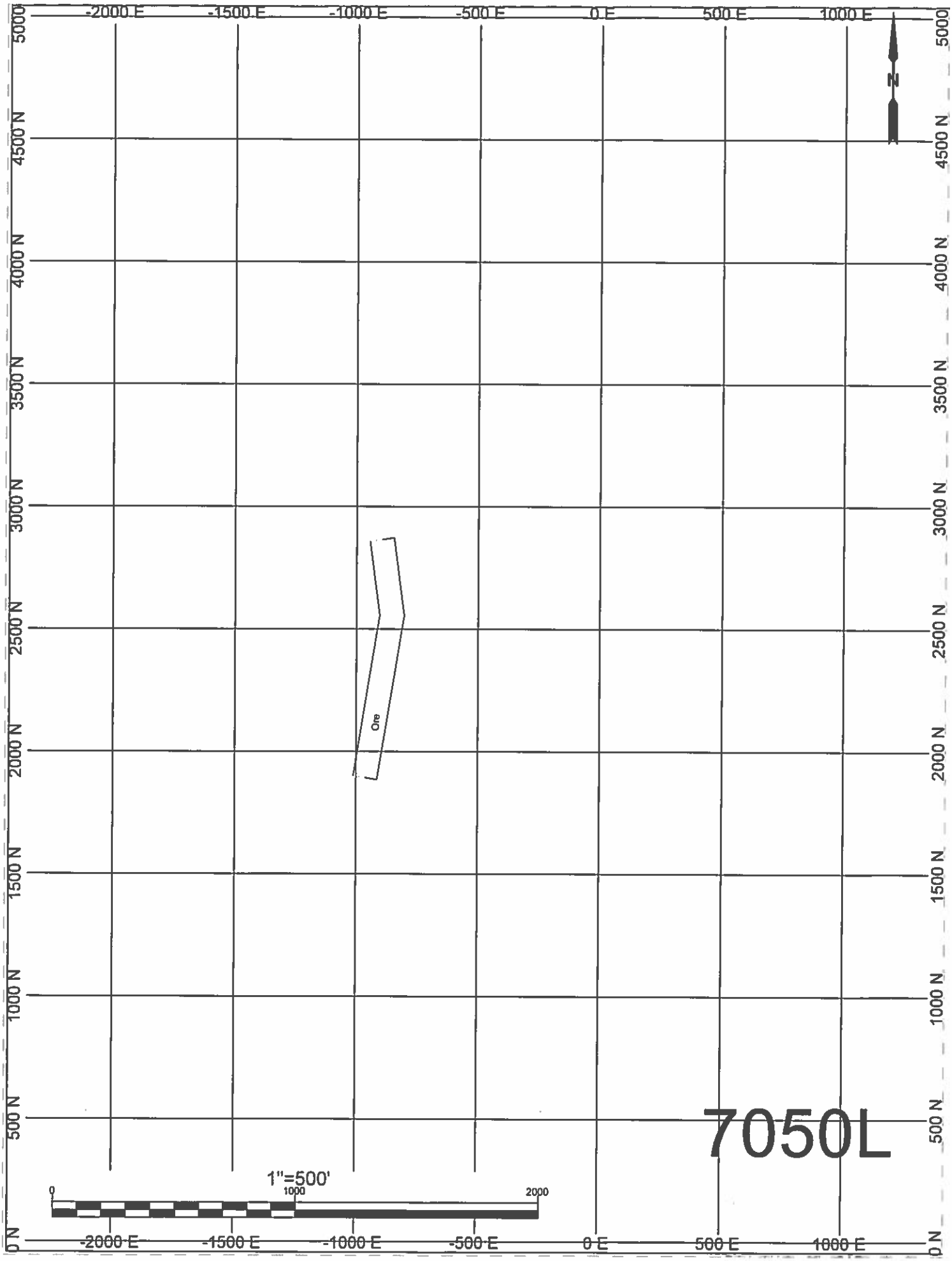
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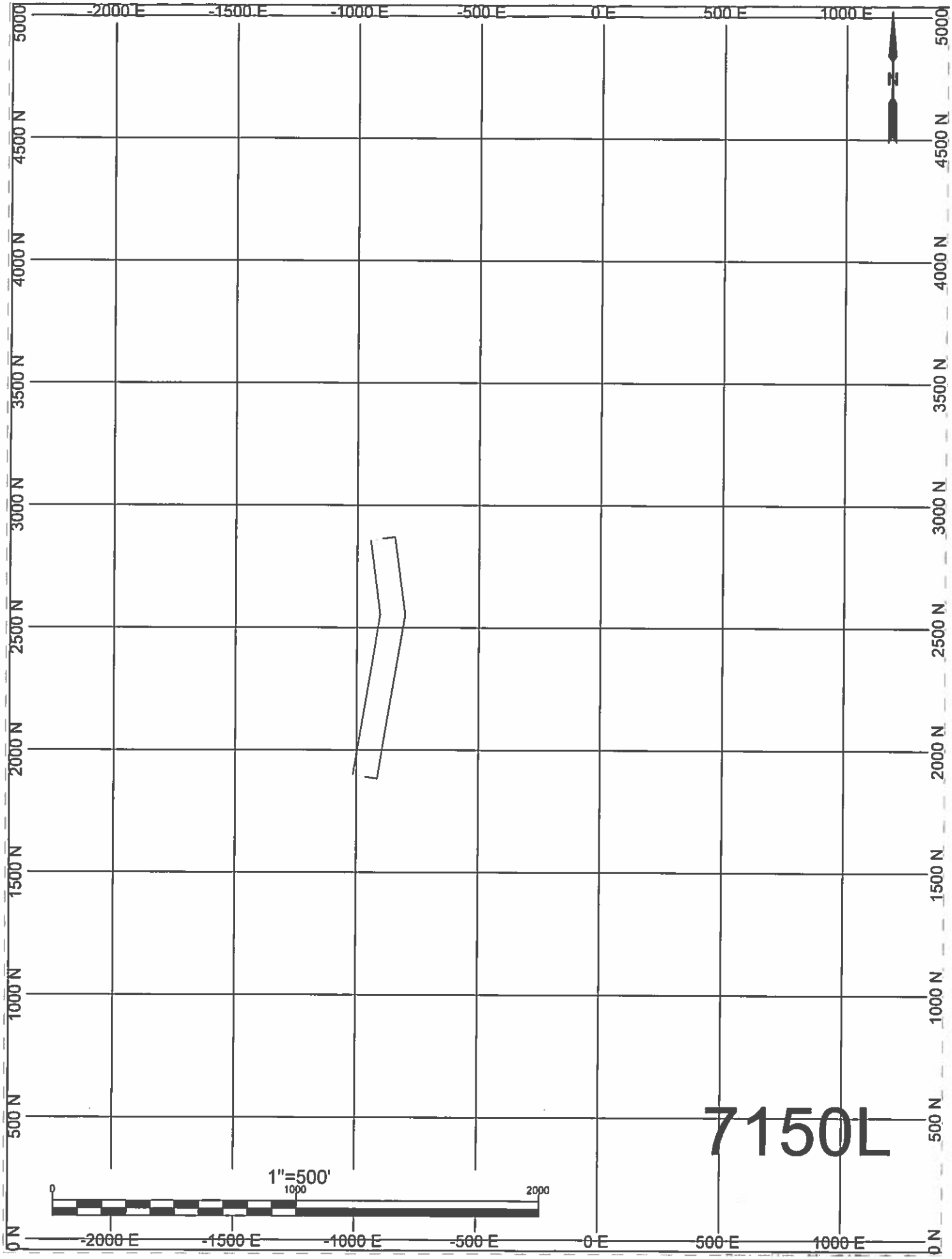
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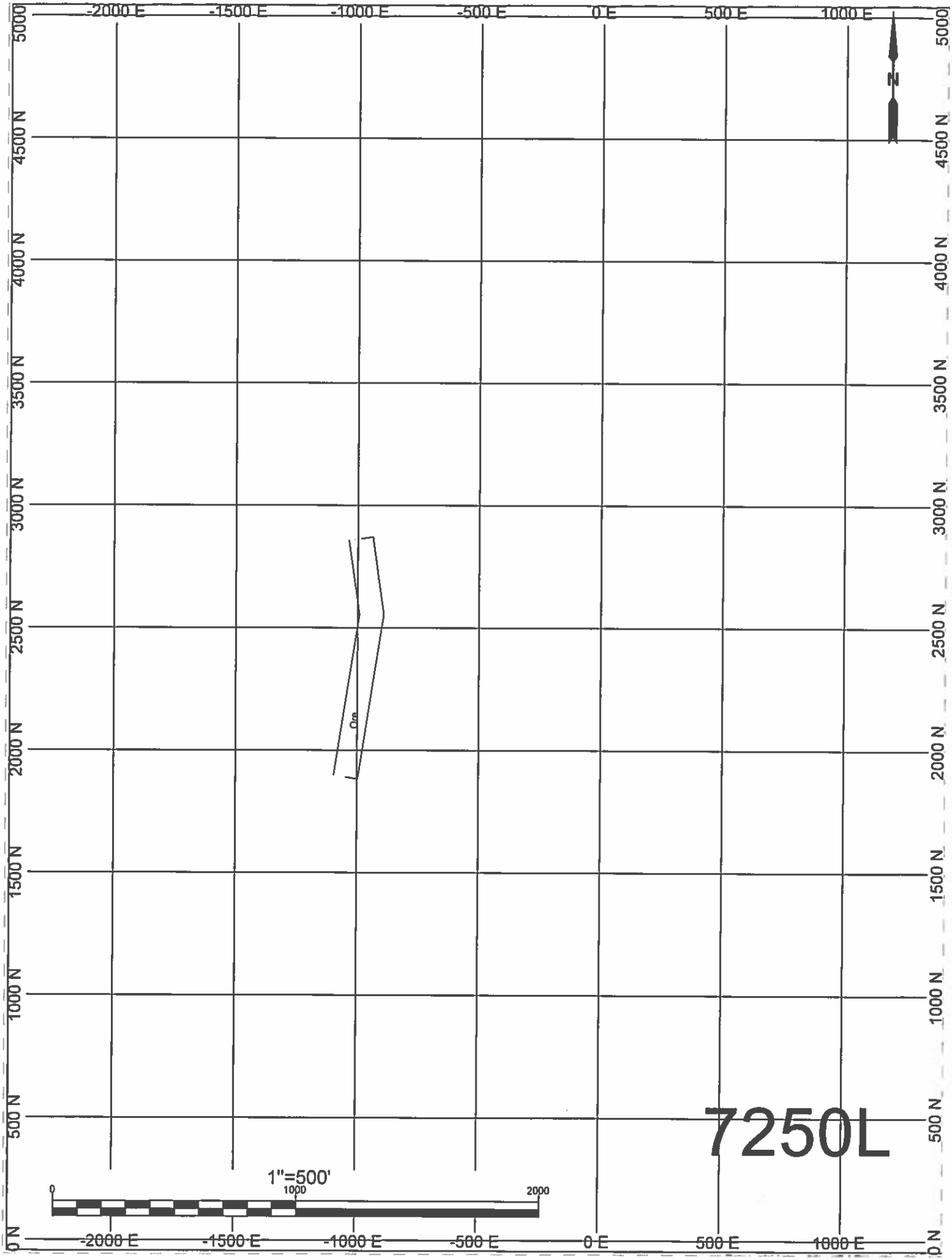
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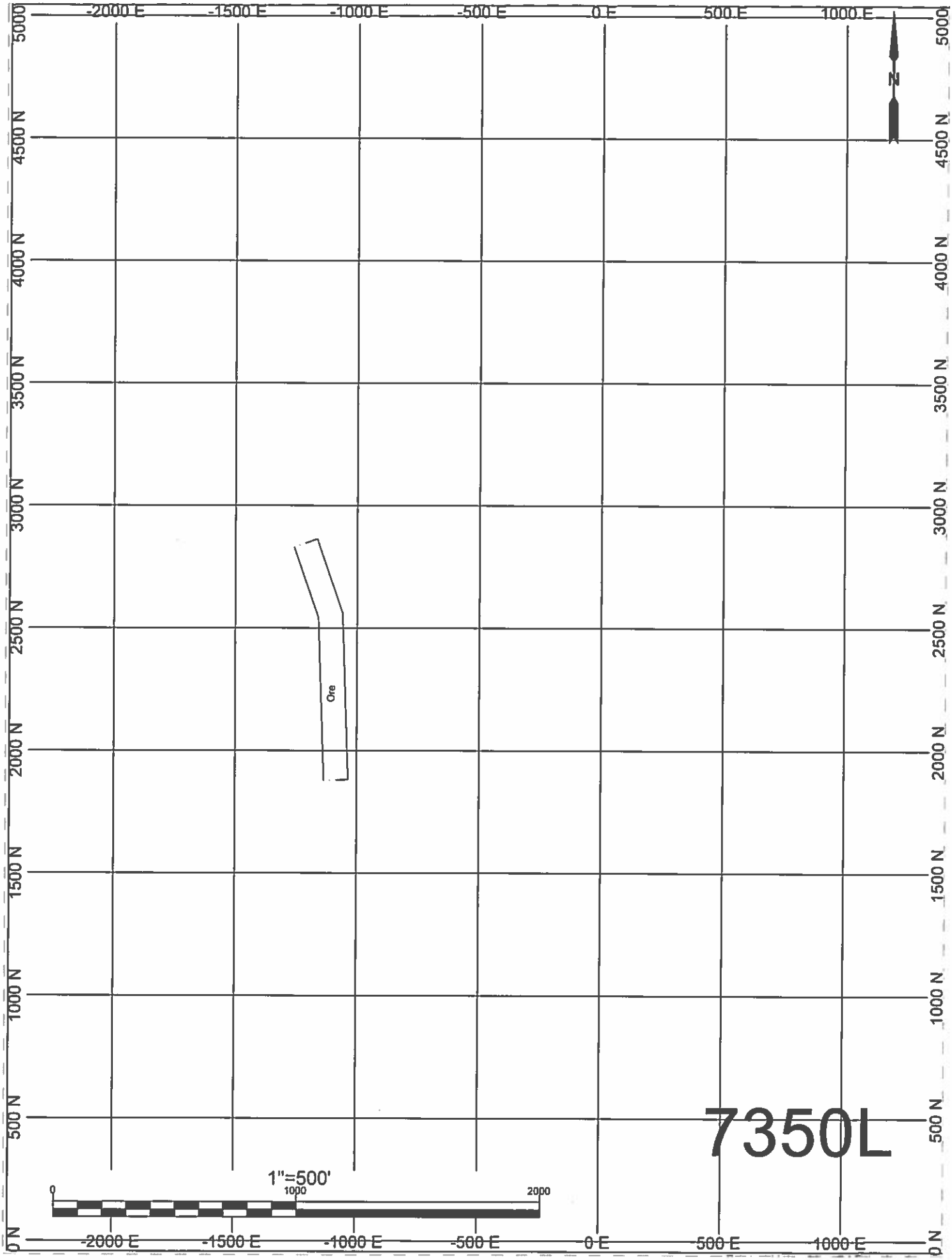
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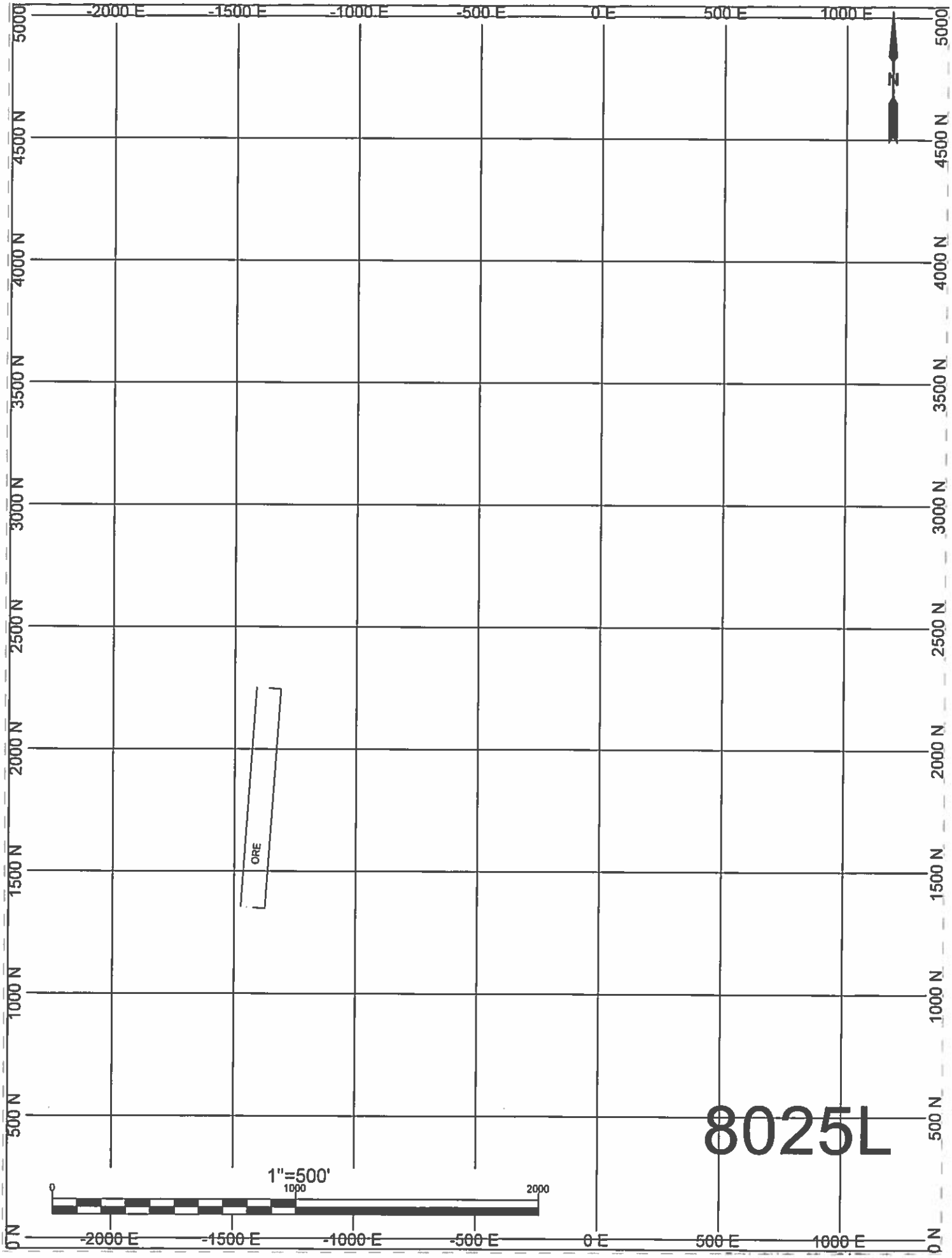
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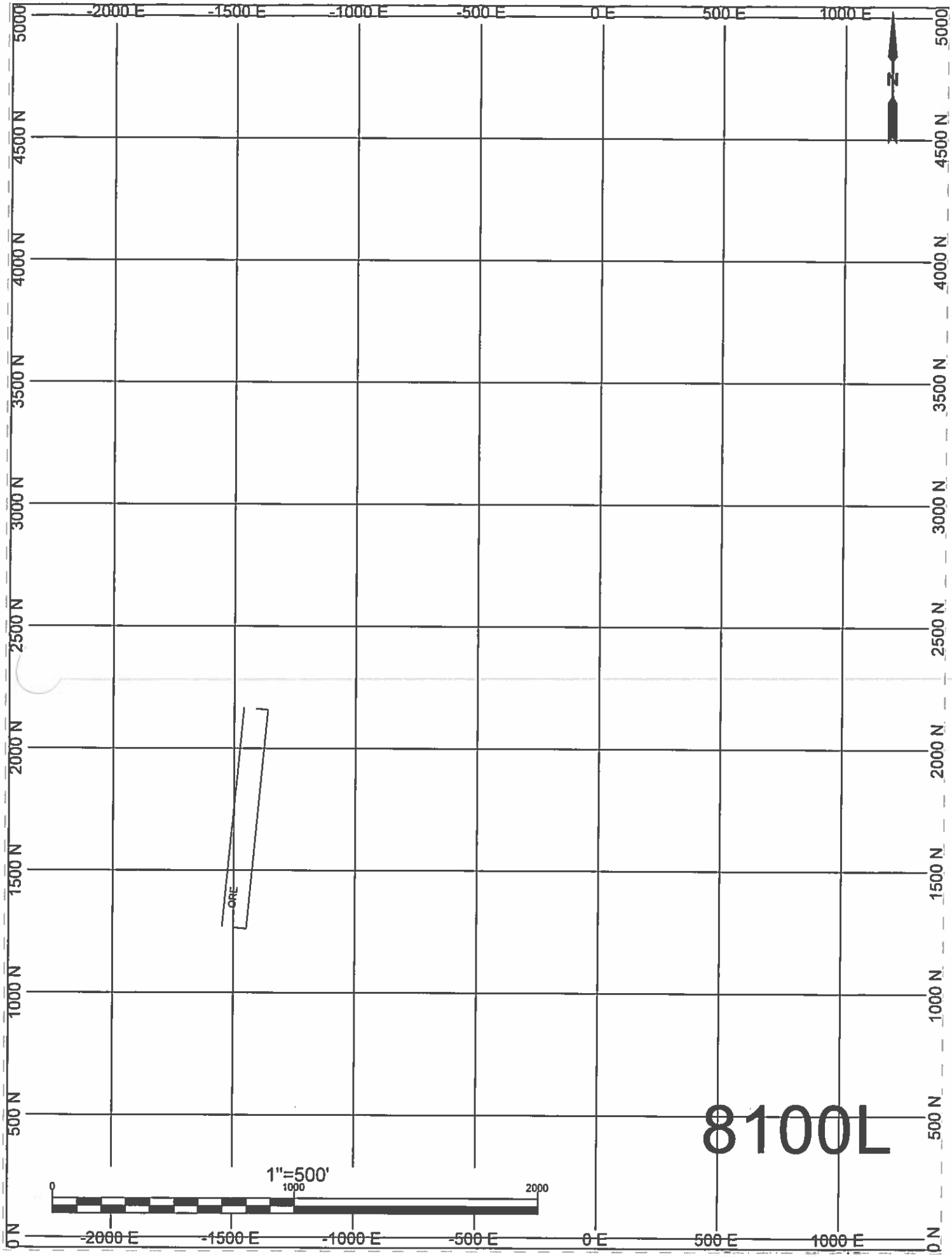
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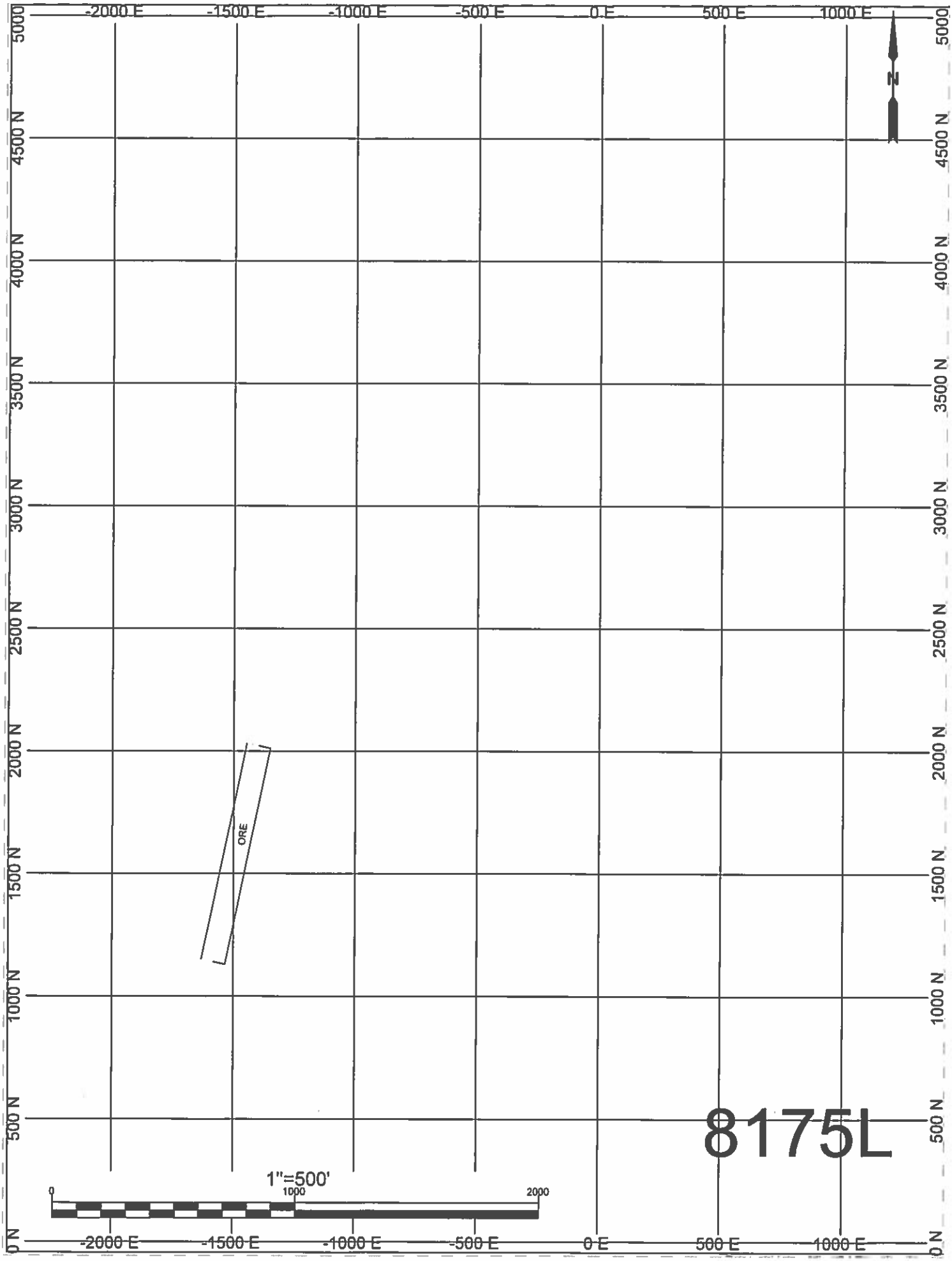
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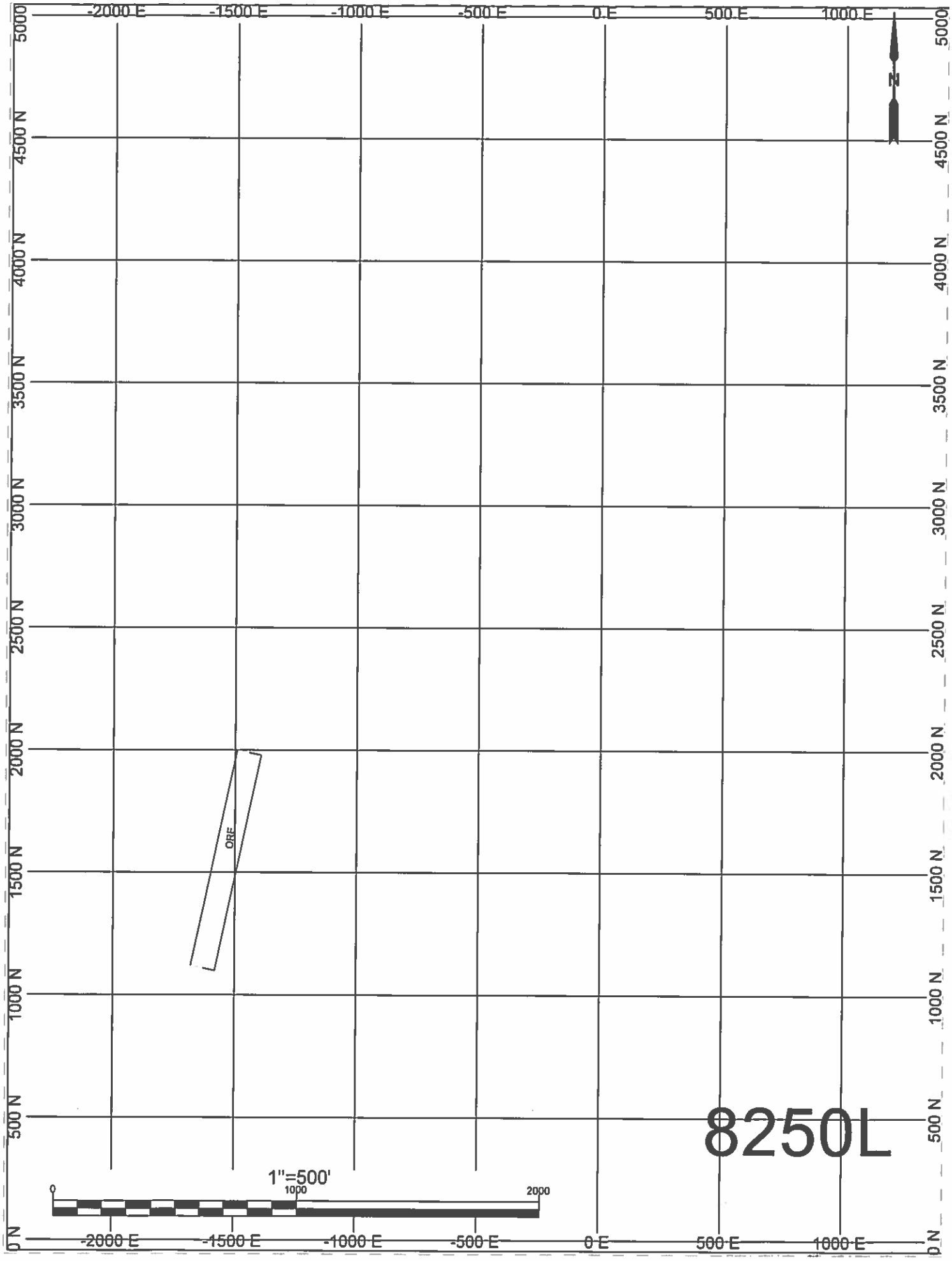
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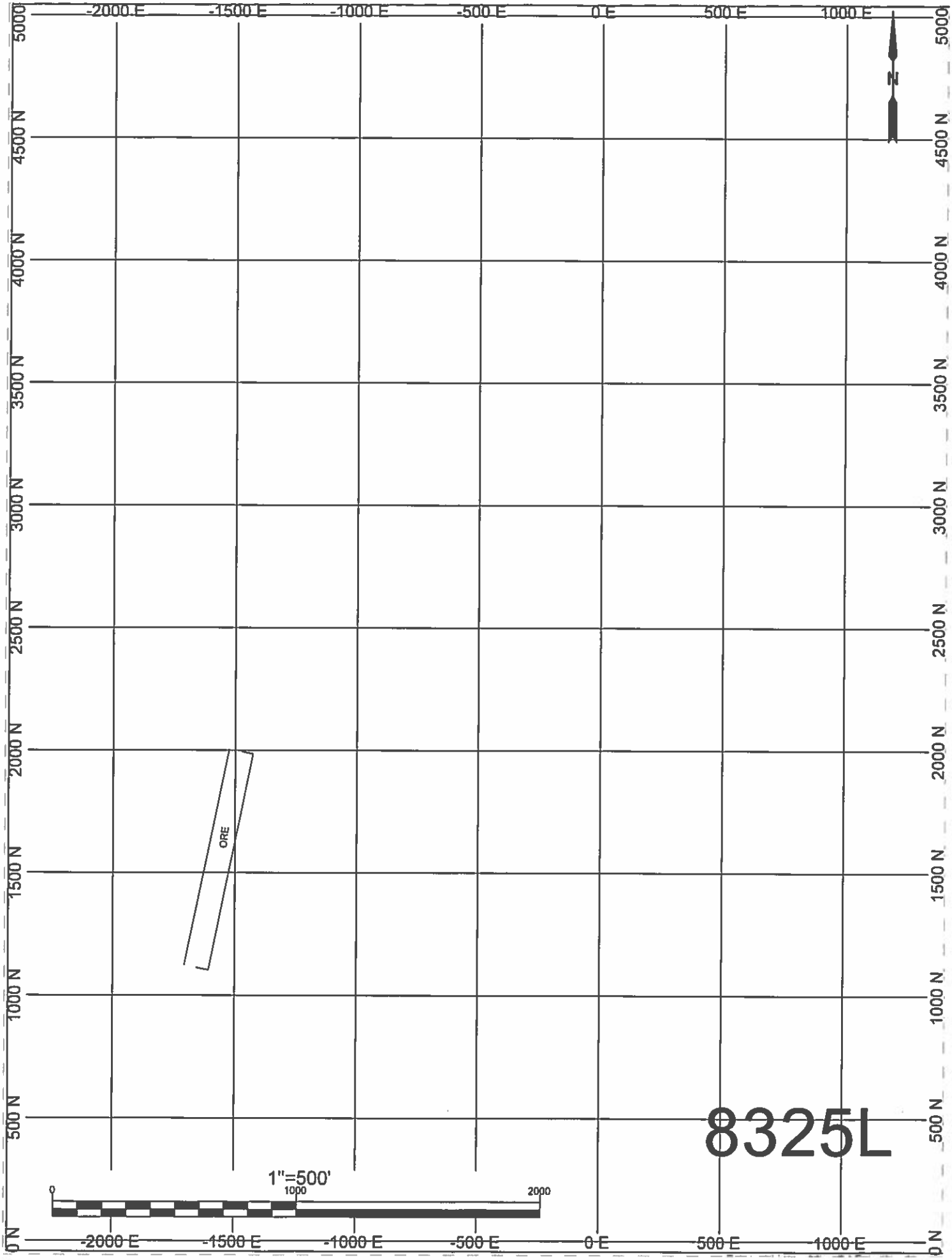
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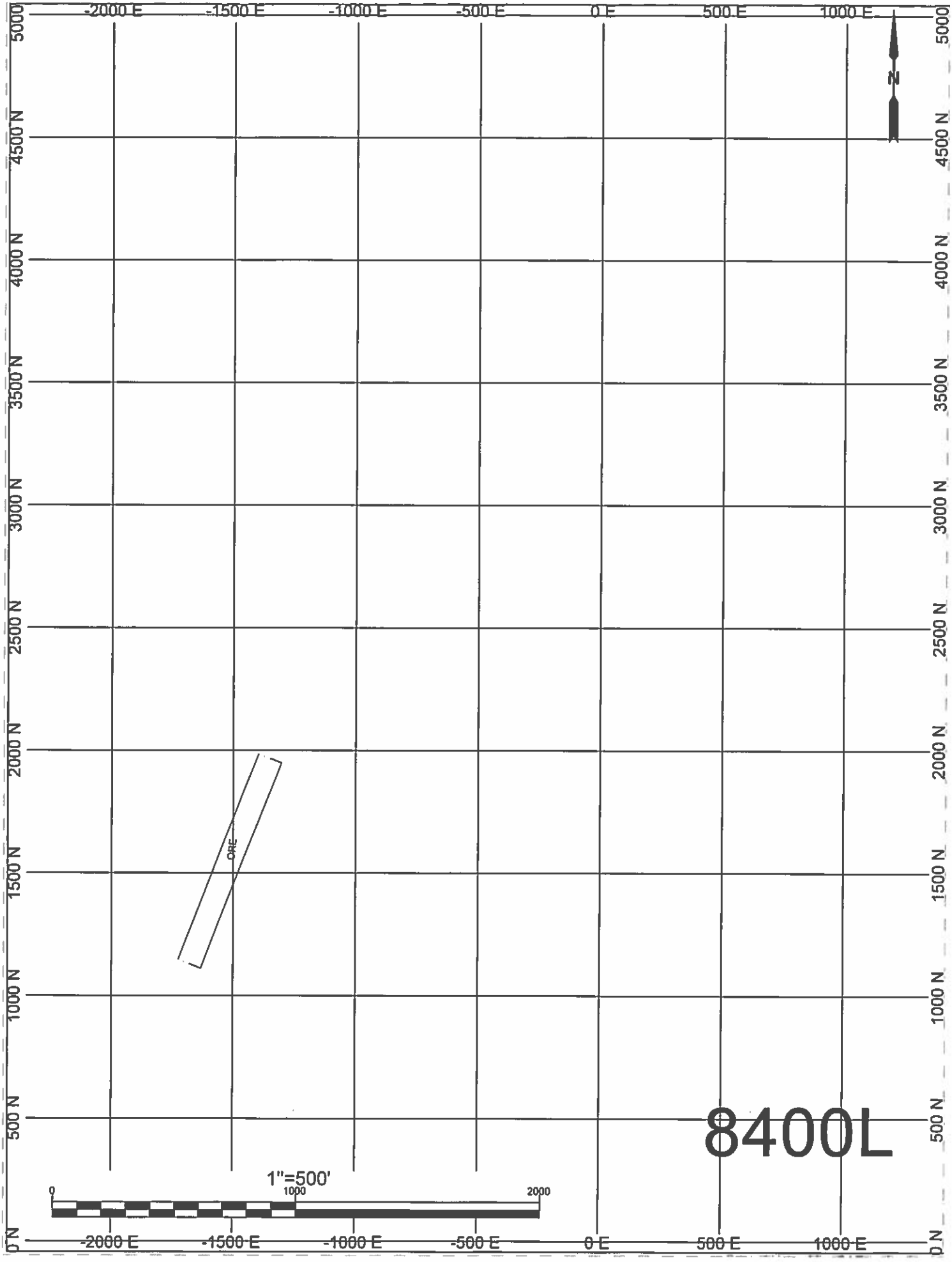
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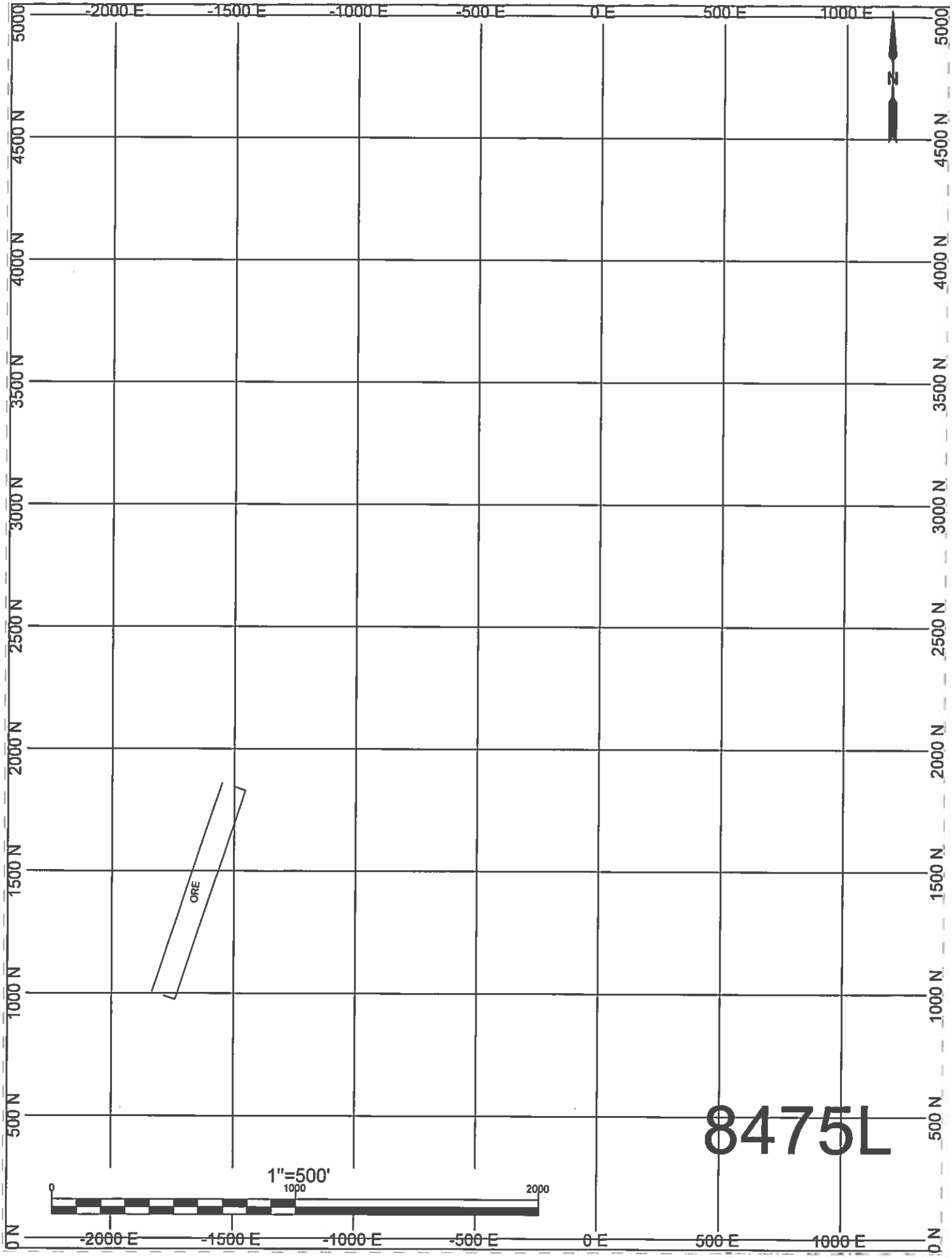
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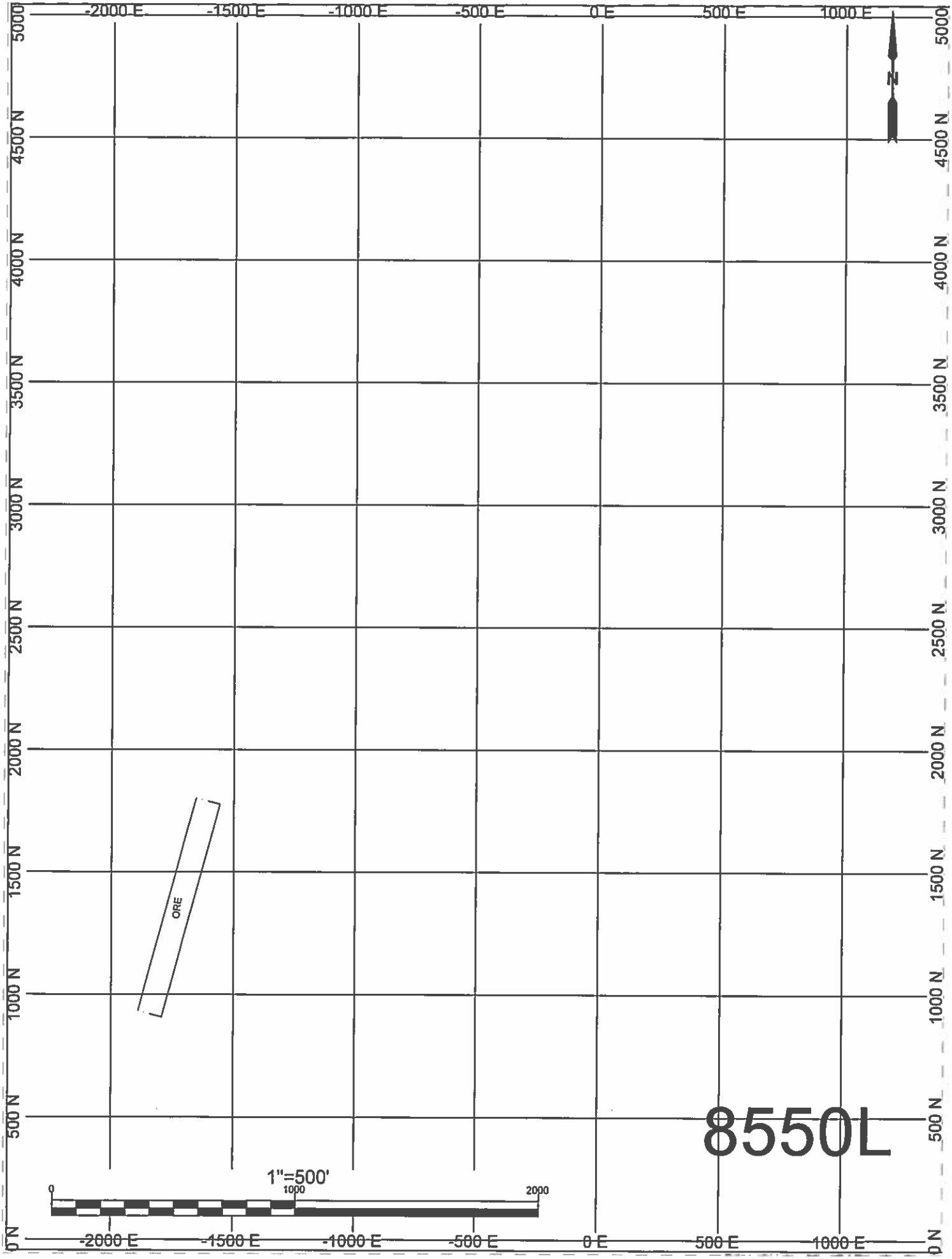
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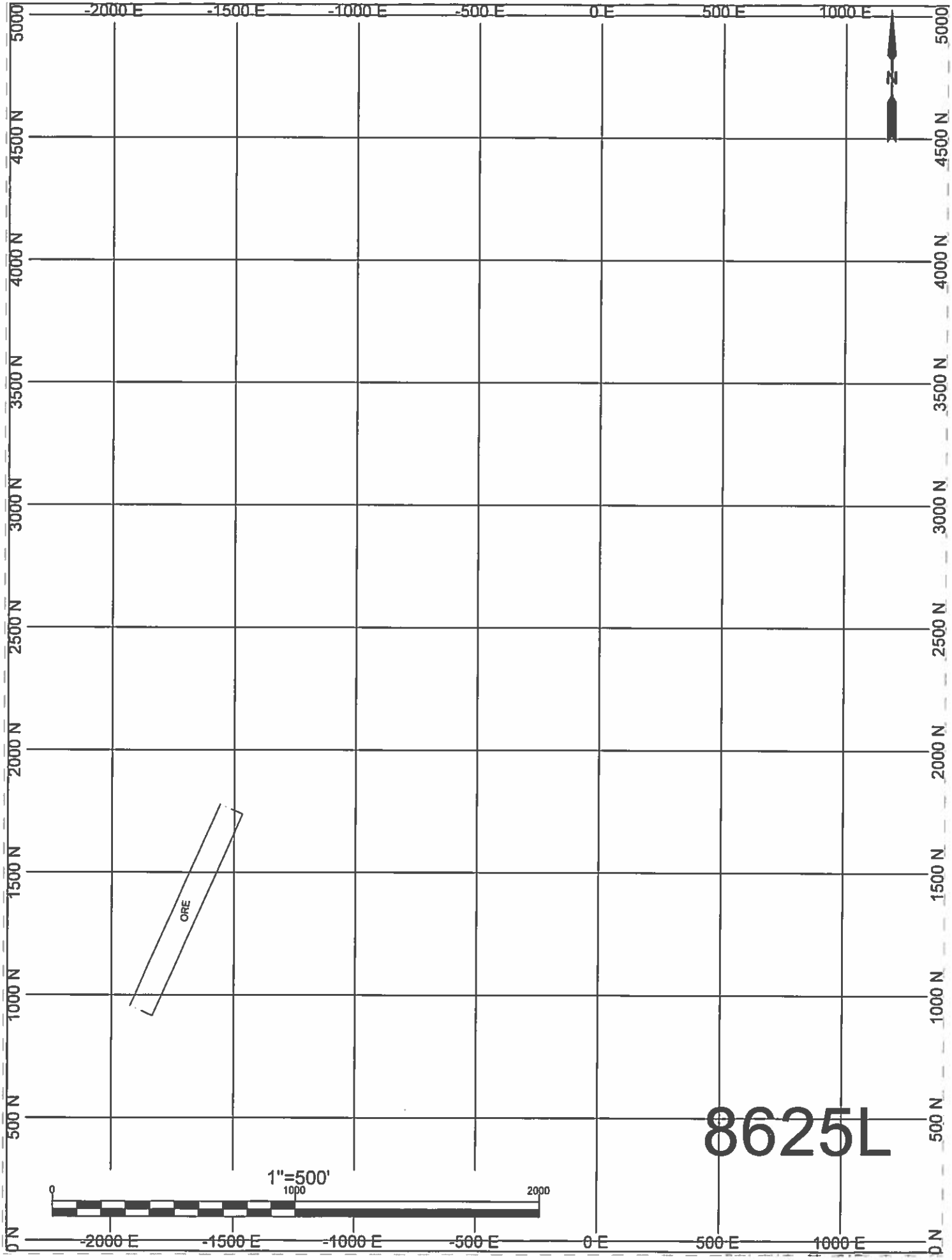
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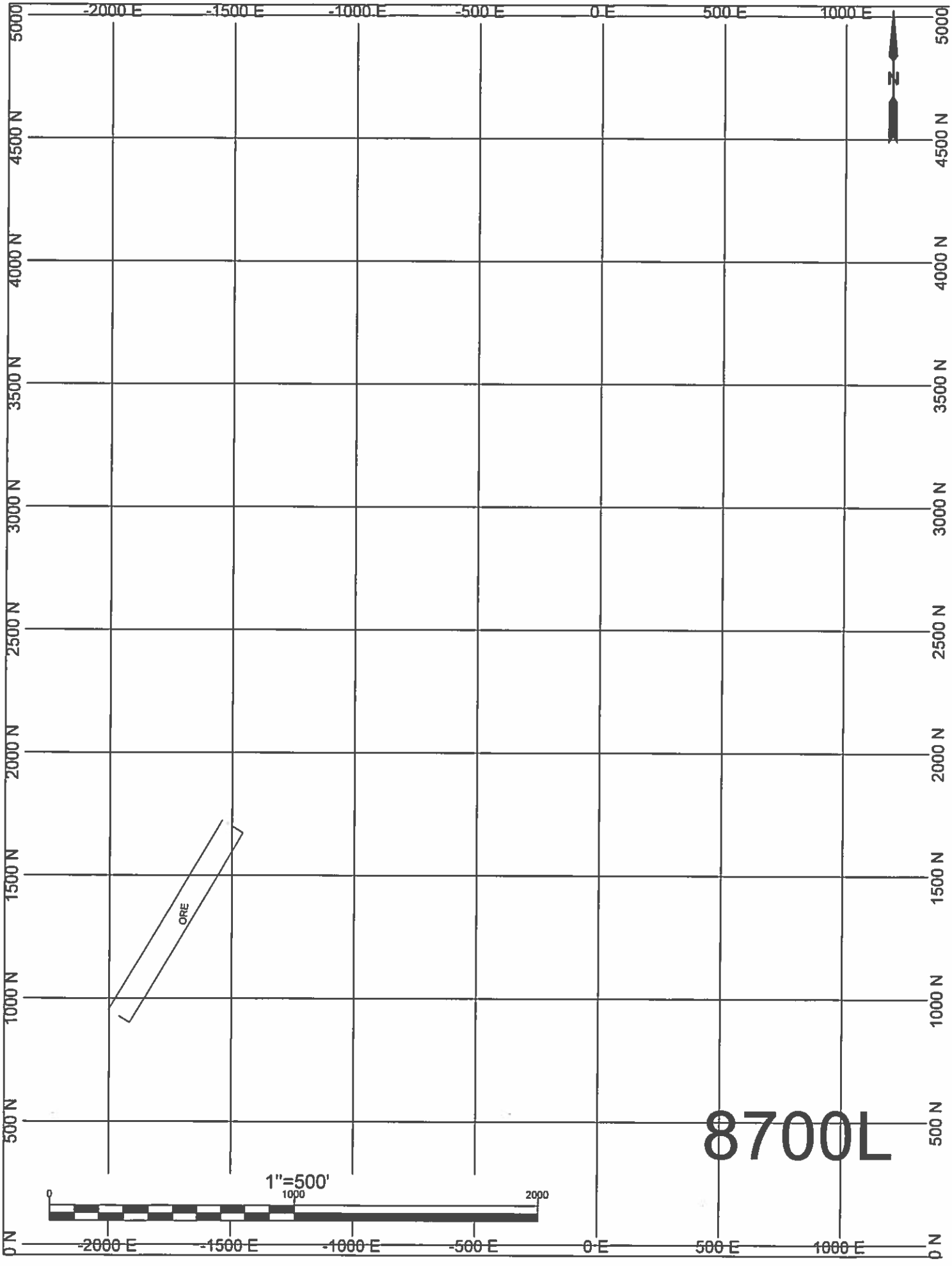
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ORE
8700L
1"=500'
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