



APPENDIX 3.9

CALCULATION OF SURFACE ROUGHNESS HEIGHT FOR CALINE4

Appendix 3.9 - Calculation of Surface Roughness Height for CALINE4

The surface roughness height for each PATH grid was estimated by considering the percentage of areas of different land use types within the PATH grid:

$$\text{Weighted Surface Roughness} = \sum (\text{Surface Roughness}_{\text{landuse}} \times \text{Percentage of Area}_{\text{landuse}})$$

Study Area (1km x 1km PATH Grid from the Site)

Landuse	Surface Roughness (cm)	Percentage of Area in PATH Grid									
		18,40	19,40	19,41	19,42	20,39	20,40	20,41	21,39	21,40	21,41
Urban ^(a)	370	2.38%	60.45%	45.06%	49.18%	4.82%	67.06%	75.60%	32.85%	26.65%	11.27%
New Development Area ^(a)	100	0.00%	0.00%	27.62%	5.61%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Rural ^(b)	50	97.62%	27.53%	27.06%	45.21%	0.00%	1.60%	17.87%	2.12%	72.55%	88.73%
Open Water ^(c)	0.1	0.00%	12.02%	0.27%	0.00%	95.18%	31.33%	6.53%	65.03%	0.81%	0.00%
Area-Weighted Surface Roughness (cm)		58	237	208	210	18	249	289	123	135	86

Wind directional variability was calculated based on the following formula according to the stability class with reference to Irwin, J.S., 1980. (d)

$$S_o = S \times \left(\frac{z_0}{15\text{cm}}\right)^{0.2}$$

Where

Zo = surface roughness length (in cm) of the PATH grid;

So = standard deviation of the horizontal wind direction Fluctuations (in degrees); and

S = standard deviation of the horizontal wind direction fluctuations (in degrees) for an aerodynamic surface roughness length of 15cm with reference to Irwin, J.S., 1980. S is a function of Pasquill stability class.

Summary of The Standard Deviation of the Horizontal Wind Direction Fluctuations under Different Pasquill Stability Categories on Each PATH Grids

PATH Grid		18,40	19,40	19,41	19,42	20,39	20,40	20,41	21,39	21,40	21,41
Pasquill Stability Class	S	So									
A	22.5	29.4	39.1	38.1	38.1	23.3	39.5	40.6	34.3	34.9	31.9
B	22.5	29.4	39.1	38.1	38.1	23.3	39.5	40.6	34.3	34.9	31.9
C	17.5	22.9	30.4	29.6	29.7	18.1	30.7	31.6	26.6	27.2	24.8
D	12.5	16.4	21.7	21.1	21.2	13.0	21.9	22.6	19.0	19.4	17.7
E	7.5	9.8	13.0	12.7	12.7	7.8	13.2	13.5	11.4	11.6	10.6
F	3.8	5.0	6.6	6.4	6.4	3.9	6.7	6.9	5.8	5.9	5.4

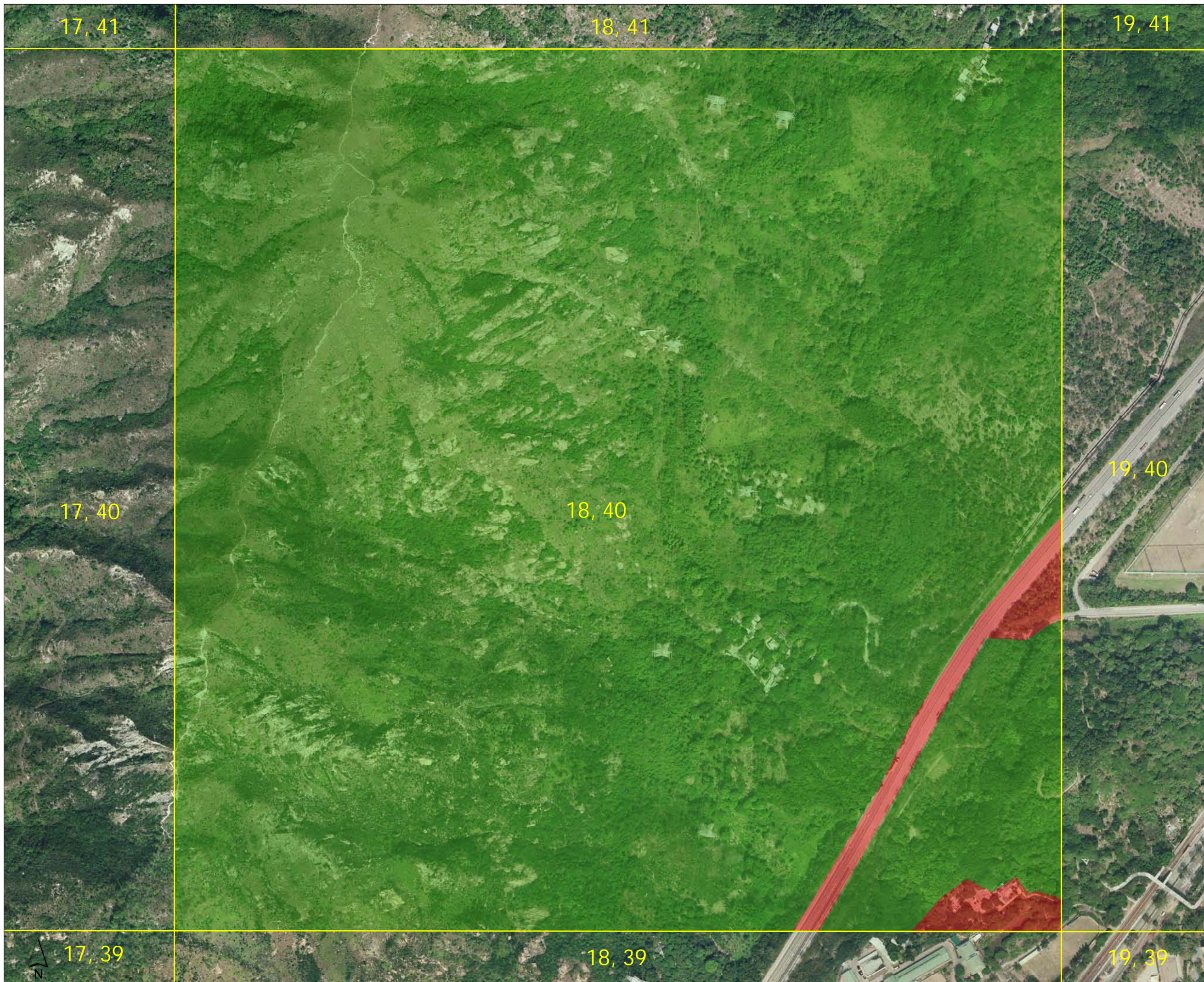
Notes:

(a) Surface roughness height for Urban and New Development Area was made reference to Section 2.2 of "Guidelines on Choice of Models and Model Parameters", (EPD, 2021).

(b) Surface roughness height for Rural was made reference to that adopted in the approved EIA Report for "Housing Sites in Yuen Long South" (AEIAR-215/2017) (see Section 4.5.3.16).

(c) Surface roughness height for Open Water was made reference to that adopted in the approved EIA Report "Tuen Mun - Chek Lap Kok Link" (AEIAR-146/2009) (see Appendix B8), and "Air Pollution Meteorology and Dispersion", (Arya S.P., 1999).

(d) Referenced from "Dispersion Estimate Suggestion #8: Estimation of Pasquill Stability Categories". U.S. Environmental Protection Agency, Research Triangle Park, NC. (Docket Reference No.II-B-10), Irwin, J.S., 1980.



Legend

- Path Grid
- Landuse**
- Urban
- Rural

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Project Title

TRAFFIC IMPROVEMENT SCHEME IN TUEN MUN
 - WIDENING AND ADDITION OF SLIP ROADS
 AT LUNG FU ROAD/ TUEN MUN ROAD/
 WONG CHU ROAD/ HOI WING ROAD

Title

Landuse for PATH Grid 18, 40 (CALINE4)

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Legend

- Air Sensitive Receiver
 - Path Grid
- Landuse**
- Urban
 - Rural
 - Water

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TRAFFIC IMPROVEMENT SCHEME IN TUEN MUN
 - WIDENING AND ADDITION OF SLIP ROADS
 AT LUNG FU ROAD/ TUEN MUN ROAD/
 WONG CHU ROAD/ HOI WING ROAD

Title

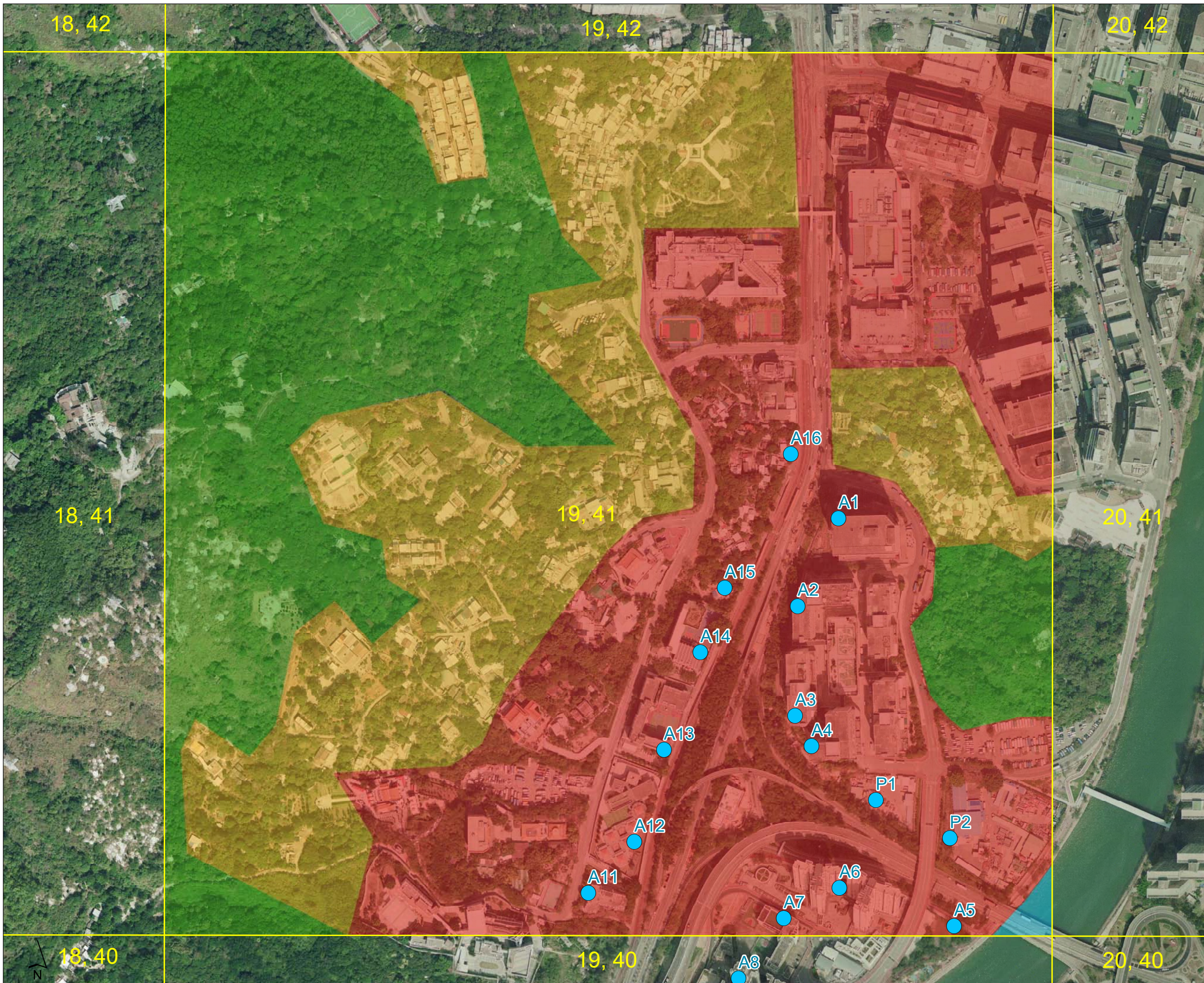
Landuse for PATH Grid 19, 40 (CALINE4)

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Legend

- Air Sensitive Receiver
- Path Grid
- Landuse**
- Urban
- New development area
- Rural
- Water

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Project Title
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 Landuse for PATH Grid 19, 41 (CALINE4)

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Legend

- Path Grid
- Landuse**
- Urban
- New development area
- Rural

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Landuse for PATH Grid 19, 42 (CALINE4)

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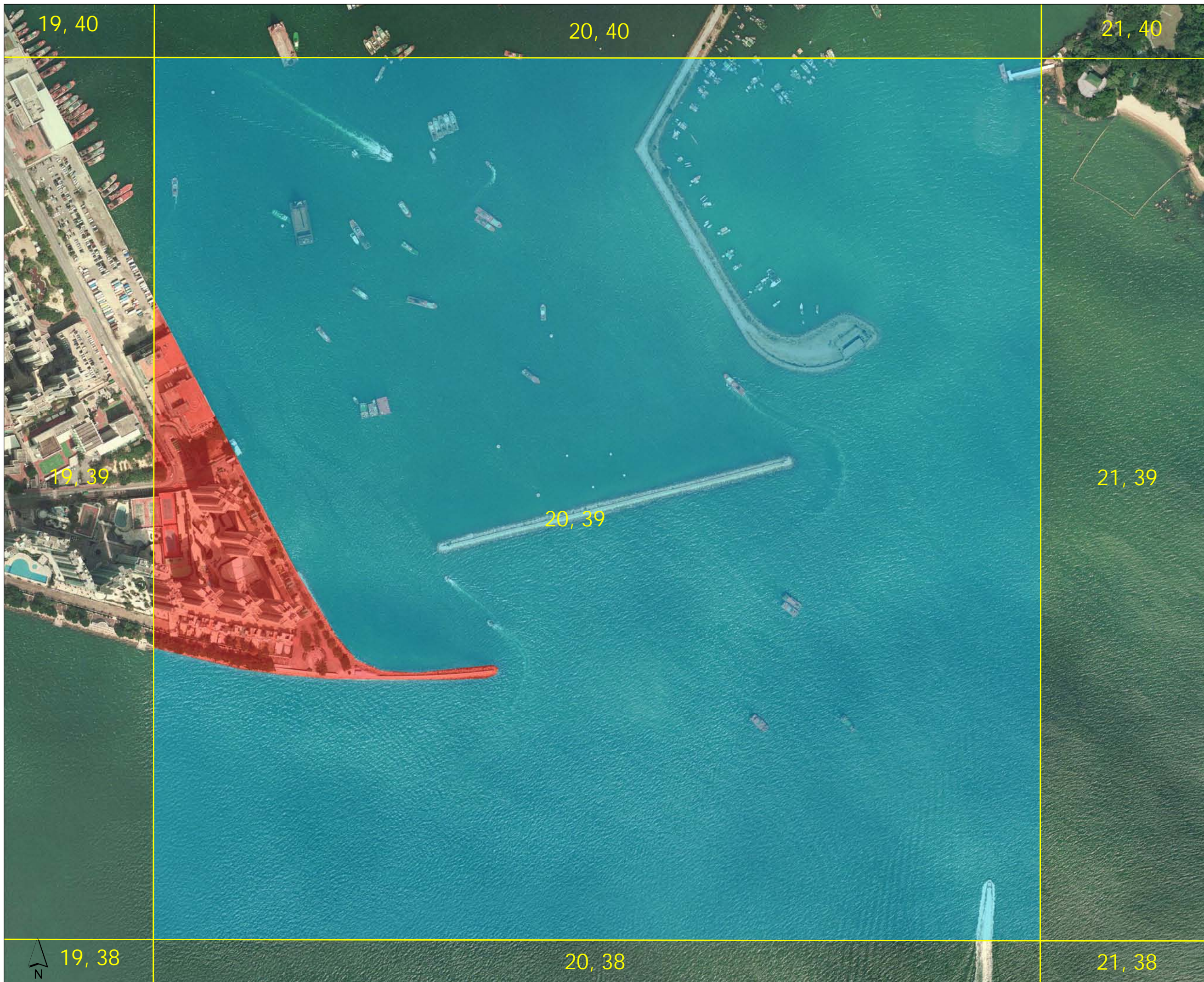
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Landuse for PATH Grid 20, 39 (CALINE4)

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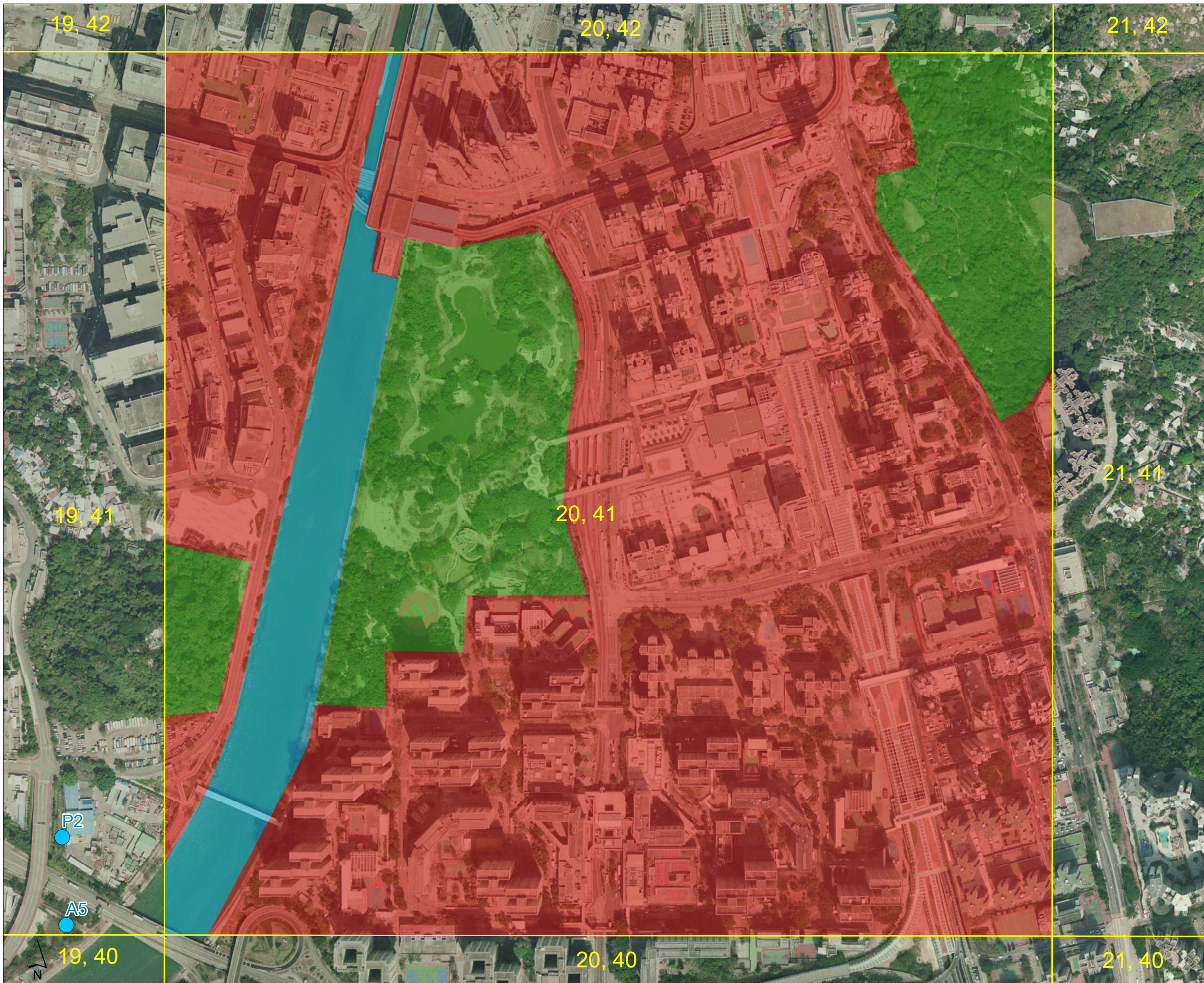
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Legend

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Legend

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Landuse for PATH Grid 21, 39 (CALINE4)

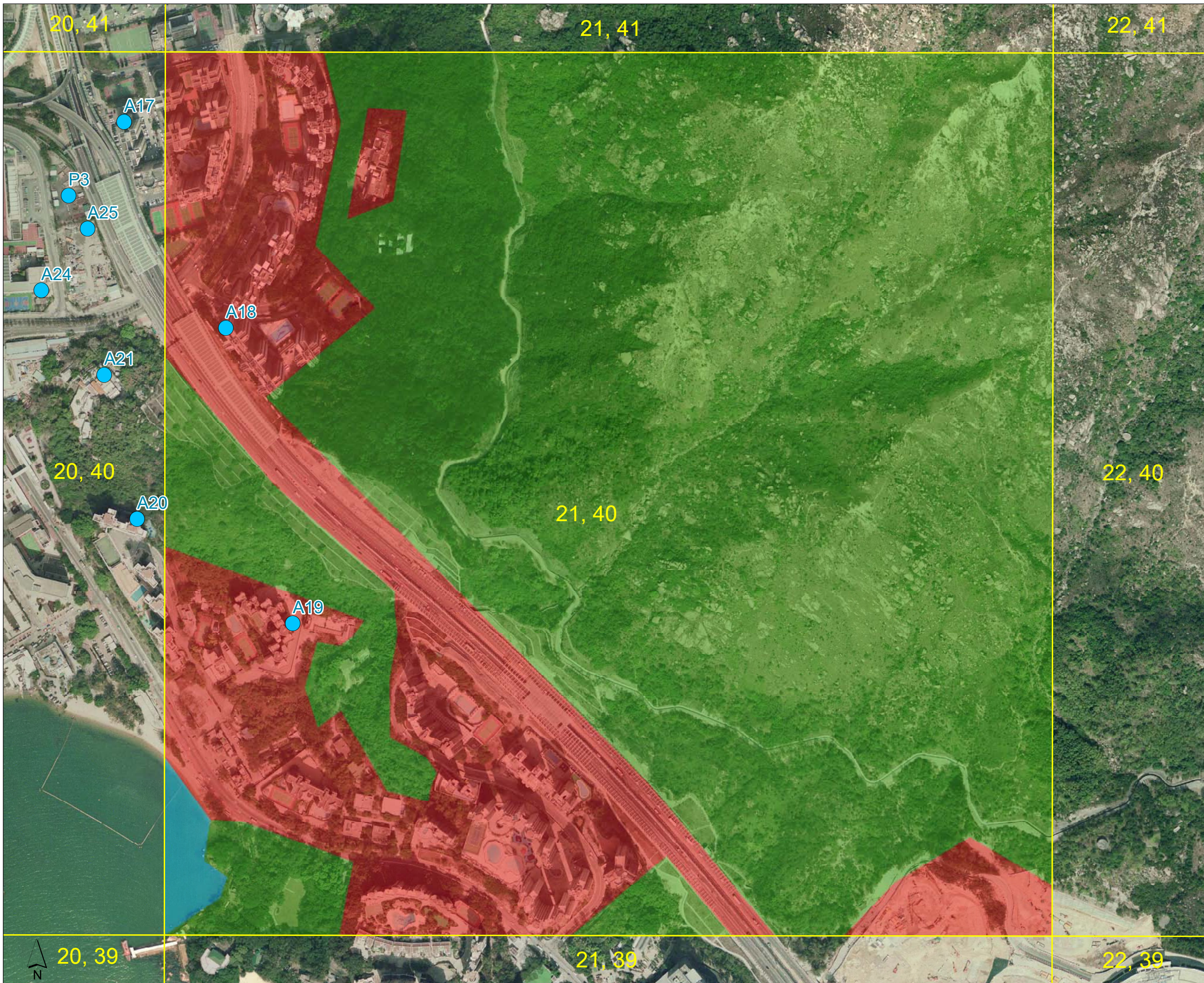
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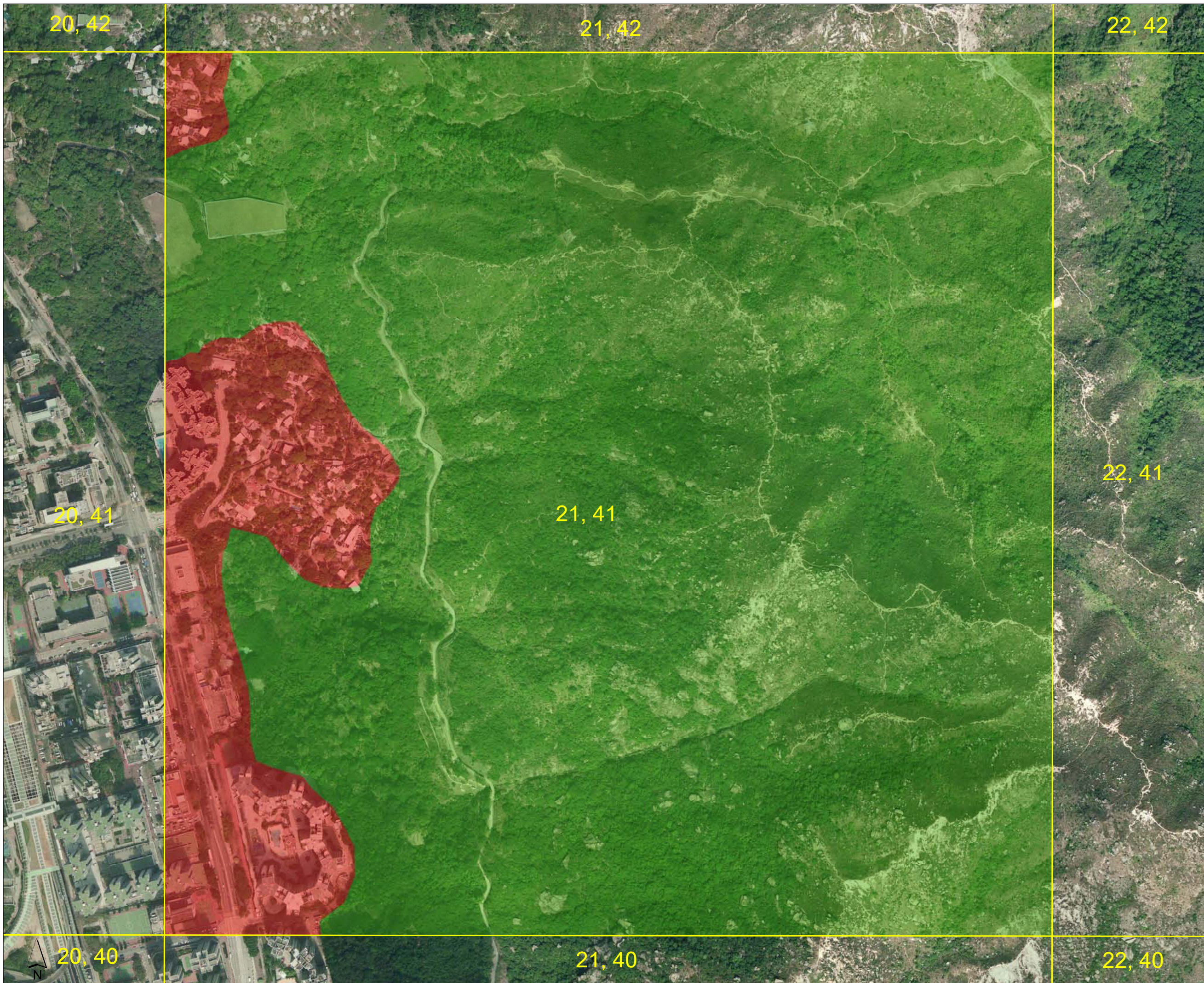
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