

Annex 4D

PATH - Land Use

Annex 4D - Detailed Calculations of Land Use Parameters

1. BPPS Study Area

Land Cover	Area (km2)	Fraction of Total Area	Bowen Ratio (Bo)	Albedo (r)
Tree	29.1	0.29	0.6	0.12
Urban	1.5	0.02	1.7	0.16
Water	67.7	0.68	0.1	0.12
Landfill	1.1	0.01	1.5	0.20
Bare Land	0.6	0.01	1.5	0.20
Average:			0.18	0.12

2. LPS Study Area

Land Cover	Area (km2)	Fraction of Total Area	Bowen Ratio (Bo)	Albedo (r)
Tree	14.1	0.14	0.6	0.12
Urban	2.1	0.02	1.7	0.16
Water	83.8	0.84	0.1	0.12
Average:			0.14	0.12

Notes:

(a) Bowen ratio was calculated based on the area-weighted geometric mean within 10km x 10km area from the Project Site. Considering the climate in Hong Kong covers dry and wet season throughout the year, bowen ratios for average moisture conditions have been adopted. With reference to Table 4-5 of the User's Guide for the AERMOD Meteorological Preprocessor (AERMET) (AERMET User Guide), the bowen ratio for tree, urban and water areas were assumed to be 0.6, 1.7 and 0.1, respectively. Landfill and bare land areas are regarded as Class 31-Bare Rock/Sand/Clay and bowen ratio for landfill and bare land areas was assumed to be 1.5 with reference to Table A-2 of the AERSURFACE User's Guide.

(b) Albedo was calculated based on the area-weighted arithmetic mean within 10km x 10km area from the Project Site. With reference to Table 4-2 of the AERMET User Guide, the albedo for tree, urban and water areas were assumed to be 0.12, 0.16 and 0.12, respectively. Landfill and bare land areas are regarded as Class 31-Bare Rock/Sand/Clay and albedo for landfill and bare land areas was assumed to be 0.2 with reference to Table A-1 of the AERSURFACE User's Guide.

(c) The average of the albedo and bowen ratio values in spring, summer and autumn for each land use was used.

Annex 4D - Detailed Calculations of Land Use Parameters

1. BPPS Study Area

PATH Grid 15, 44

Sector (degree)	Land Cover	Area (km2)	Fraction of Total Area	Distance (km)	Weighting	Zo (m)	Resultant Zo (m) for each sector
60 - 145	Landfill	0.74				0.05	0.05
145 - 240	Tree	0.83				0.6	0.60
240 - 275	Bare land	0.31				0.05	0.05
275 - 310	Bare land	0.11	0.35	0.39	0.88	0.05	0.0025
	Water	0.20	0.65	0.79	0.83	0.0001	
310 - 60	Urban	0.07	0.07	0.13	0.52	1	0.0012
	Water	0.89	0.93	0.66	1.42	0.0001	

PATH Grid 14, 42

Sector (degree)	Land Cover	Area (km2)	Fraction of Total Area	Distance (km)	Weighting	Zo (m)	Resultant Zo (m) for each sector
20 - 130	Urban	0.20	0.21	0.20	1.07	1	0.76
	Tree	0.76	0.79	0.66	1.20	0.6	
130 - 175	Tree	0.39				0.6	0.60
175 - 305	Water	1.13				0.0001	0.0001
305 - 20	Urban	0.15	0.22	0.13	1.70	1	0.81
	Tree	0.51	0.78	0.66	1.18	0.6	

2. LPS Study Area

PATH Grid 34, 23

Sector (degree)	Land Cover	Area (km2)	Fraction of Total Area	Distance (km)	Weighting	Zo (m)	Resultant Zo (m) for each sector
25 - 120	Urban	0.09	0.11	0.20	0.53	1	0.70
	Tree	0.74	0.89	0.72	1.24	0.6	
120 - 175	Tree	0.04	0.07	0.13	0.57	0.6	0.001
	Water	0.44	0.93	0.66	1.41	0.0001	
175 - 265	Urban	0.79				1	1.00
265 - 295	Tree	0.10	0.40	0.39	1.00	0.6	0.014
	Water	0.16	0.60	0.79	0.76	0.0001	
295 - 335	Urban	0.06	0.19	0.26	0.71	1	0.003
	Water	0.28	0.81	0.72	1.13	0.0001	
335 - 25	Urban	0.44				1	1.00

PATH Grid 35, 22

Sector (degree)	Land Cover	Area (km2)	Fraction of Total Area	Distance (km)	Weighting	Zo (m)	Resultant Zo (m) for each sector
45 - 90	Tree	0.26	0.65	0.53	1.24	0.6	0.07
	Water	0.14	0.35	0.86	0.41	0.0001	
90 - 165	Tree	0.65				0.6	0.60
165 - 230	Water	0.57				0.0001	0.0001
230 - 290	Water	0.22	0.42	0.39	1.05	0.0001	0.004
	Urban	0.31	0.58	0.79	0.74	1	
290 - 330	Tree	0.09	0.27	0.33	0.83	0.6	0.79
	Urban	0.25	0.73	0.79	0.92	1	
330 - 45	Tree	0.65				0.6	0.60

PATH Grid 34, 22

Sector (degree)	Land Cover	Area (km2)	Fraction of Total Area	Distance (km)	Weighting	Zo (m)	Resultant Zo (m) for each sector
20 - 75	Water	0.12	0.25	0.33	0.76	0.0001	0.01
	Tree	0.36	0.75	0.72	1.03	0.6	
75 - 120	Water	0.20	0.51	0.46	1.11	0.0001	0.002
	Tree	0.19	0.49	0.79	0.62	0.6	
120 - 230	Water	0.96				0.0001	0.0001
230 - 265	Water	0.18	0.59	0.46	1.28	0.0001	0.001
	Urban	0.12	0.41	0.86	0.48	1	
265 - 315	Urban	0.44				1	1.00
315 - 345	Urban	0.10	0.40	0.39	1.01	1	0.80
	Tree	0.16	0.60	0.79	0.76	0.6	
345 - 20	Water	0.05	0.16	0.20	0.79	0.0001	0.03
	Tree	0.10	0.34	0.53	0.65	0.6	
	Urban	0.15	0.50	0.79	0.64	1	

Annex 4D - Detailed Calculations of Land Use Parameters

PATH Grid	Sector	Land Use Type	Albedo (r) (a)	Bowen Ratio (Bo) (a)	Surface Roughness (Zo) (b)	Remark/Justifications
15, 44	60 - 145	Landfill	0.12	0.18	0.05	This sector is comprised of landfill area.
	145 - 240	Tree	0.12	0.18	0.60	This sector is comprised of tree area.
	240 - 275	Bare Land	0.12	0.18	0.05	This sector is comprised of bare land area.
	275 - 310	Bare Land / Water	0.12	0.18	0.0025	This sector is comprised of both bare land and water areas. Bare land area covers 35% and the distance from the centre is about 0.39km. Water area covers 65% and the distance from the centre is about 0.66km.
	310 - 60	Urban / Water	0.12	0.18	0.0012	This sector is comprised of both urban and water areas. Urban area covers 7% and the distance from the centre is about 0.13km. Water area covers 93% and the distance from the centre is about 0.66km.
14, 42	20 - 130	Urban / Tree	0.12	0.18	0.76	This sector is comprised of both urban and tree areas. Urban area covers 21% and the distance from the centre is about 0.20km. Tree area covers 79% and the distance from the centre is about 0.66km.
	130 - 175	Tree	0.12	0.18	0.60	This sector is comprised of tree area.
	175 - 305	Water	0.12	0.18	0.0001	This sector is comprised of water area.
	305 - 20	Urban / Tree	0.12	0.18	0.81	This sector is comprised of both urban and tree areas. Urban area covers 22% and the distance from the centre is about 0.13km. Tree area covers 78% and the distance from the centre is about 0.66km.
34, 23	25 - 120	Urban / Tree	0.12	0.14	0.70	This sector is comprised of both urban and tree areas. Urban area covers 11% and the distance from the centre is about 0.20km. Tree area covers 89% and the distance from the centre is about 0.72km.
	120 - 175	Tree / Water	0.12	0.14	0.0012	This sector is comprised of both tree and water areas. Tree area covers 7% and the distance from the centre is about 0.13km. Water area covers 93% and the distance from the centre is about 0.66km.
	175 - 265	Urban	0.12	0.14	1.00	This sector is comprised of urban area.
	265 - 295	Tree / Water	0.12	0.14	0.014	This sector is comprised of both tree and water areas. Tree area covers 40% and the distance from the centre is about 0.39km. Water area covers 60% and the distance from the centre is about 0.79km.
	295 - 335	Urban / Water	0.12	0.14	0.003	This sector is comprised of both urban and water areas. Urban area covers 19% and the distance from the centre is about 0.26km. Water area covers 81% and the distance from the centre is about 0.72km.
	335 - 25	Urban	0.12	0.14	1.00	This sector is comprised of urban area.
35, 22	45 - 90	Tree / Water	0.12	0.14	0.07	This sector is comprised of both tree and water areas. Tree area covers 65% and the distance from the centre is about 0.53km. Water area covers 35% and the distance from the centre is about 0.86km.
	90 - 165	Tree	0.12	0.14	0.60	This sector is comprised of tree area.
	165 - 230	Water	0.12	0.14	0.0001	This sector is comprised of water area.
	230 - 290	Water / Urban	0.12	0.14	0.004	This sector is comprised of both water and urban areas. Water area covers 42% and the distance from the centre is about 0.39km. Urban area covers 58% and the distance from the centre is about 0.79km.
	290 - 330	Tree / Urban	0.12	0.14	0.79	This sector is comprised of both tree and urban areas. Tree area covers 27% and the distance from the centre is about 0.33km. Urban area covers 73% and the distance from the centre is about 0.79km.
	330 - 45	Tree	0.12	0.14	0.60	This sector is comprised of tree area.
34, 22	20 - 75	Water / Tree	0.12	0.14	0.01	This sector is comprised of both water and tree areas. Water area covers 25% and the distance from the centre is about 0.33km. Tree area covers 75% and the distance from the centre is about 0.72km.
	75 - 120	Water / Tree	0.12	0.14	0.002	This sector is comprised of both water and tree areas. Water area covers 51% and the distance from the centre is about 0.46km. Tree area covers 49% and the distance from the centre is about 0.79km.
	120 - 230	Water	0.12	0.14	0.0001	This sector is comprised of water area.
	230 - 265	Water / Urban	0.12	0.14	0.001	This sector is comprised of both water and urban areas. Water area covers 59% and the distance from the centre is about 0.46km. Urban area covers 41% and the distance from the centre is about 0.86km.
	265 - 315	Urban	0.12	0.14	1.00	This sector is comprised of urban area.
	315 - 345	Urban / Tree	0.12	0.14	0.80	This sector is comprised of both urban and tree areas. Urban area covers 40% and the distance from the centre is about 0.39km. Tree area covers 60% and the distance from the centre is about 0.79km.
	345 - 20	Water / Tree / Urban	0.12	0.14	0.03	This sector is comprised of water, tree and urban areas. Water area covers 16% and the distance from the centre is about 0.20km. Tree area covers 34% and the distance from the centre is about 0.53km. Urban area covers 50% and the distance from the centre is about 0.79km.

Notes:

(a) With reference to Table 4-6 of the AERMET User's Guide, the surface roughness value for urban area and water area is assumed to be 1m and 0.0001m, respectively. With reference to Table A-3 of the AERSURFACE User's Guide, the surface roughness value for landfill area and bare land area is assumed to be 0.05m. The height of trees within 1 km from the identified ASRs near BPPS and LPS is about 6m on average. The surface roughness can be estimated as about 10% of the average height of physical structures. Therefore, the surface roughness of 0.6m has been adopted for trees. For sector consisting of 2 or more different land use types, the surface roughness length for the sector is calculated based on the inverse-distance weighted geometric mean.

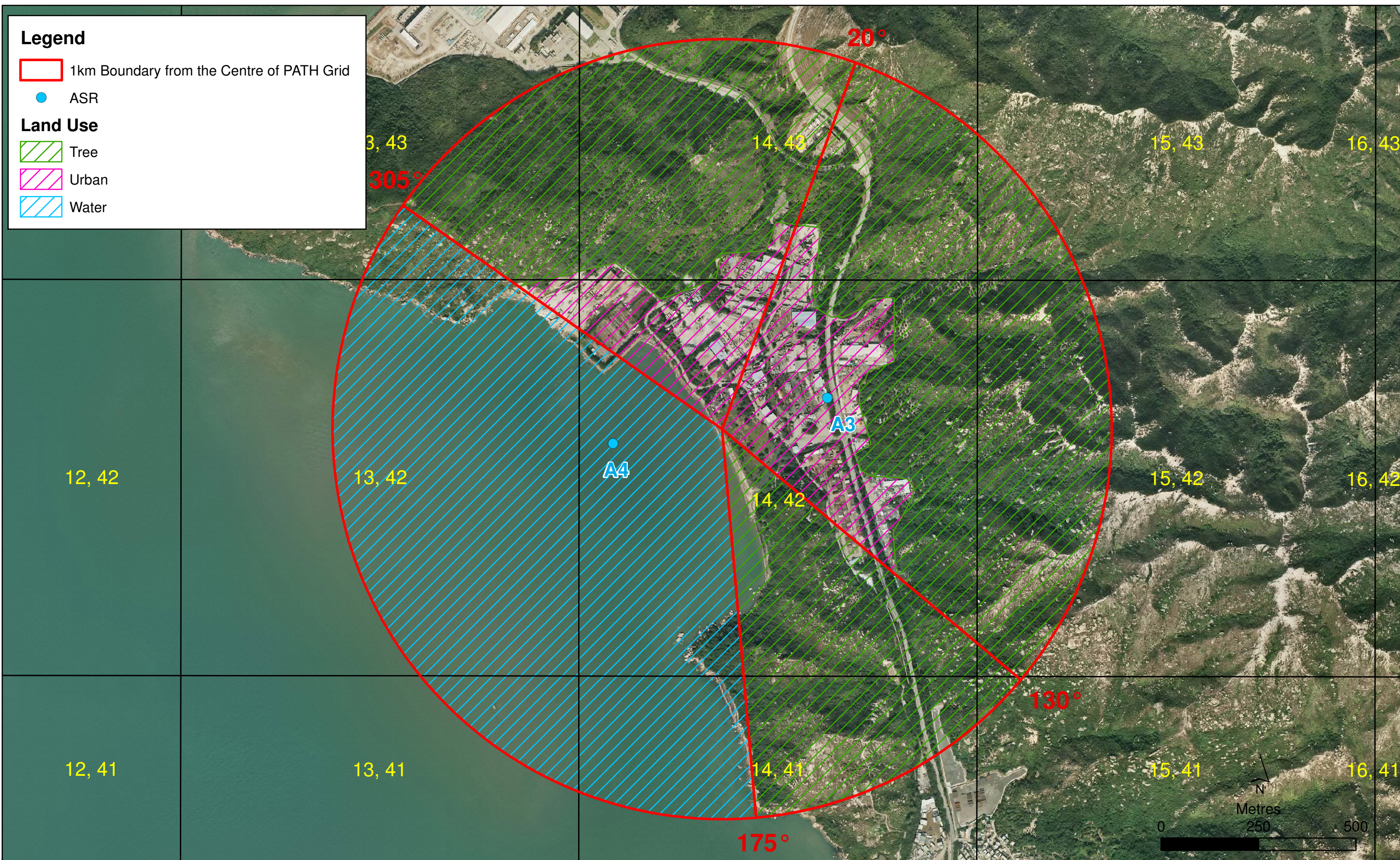
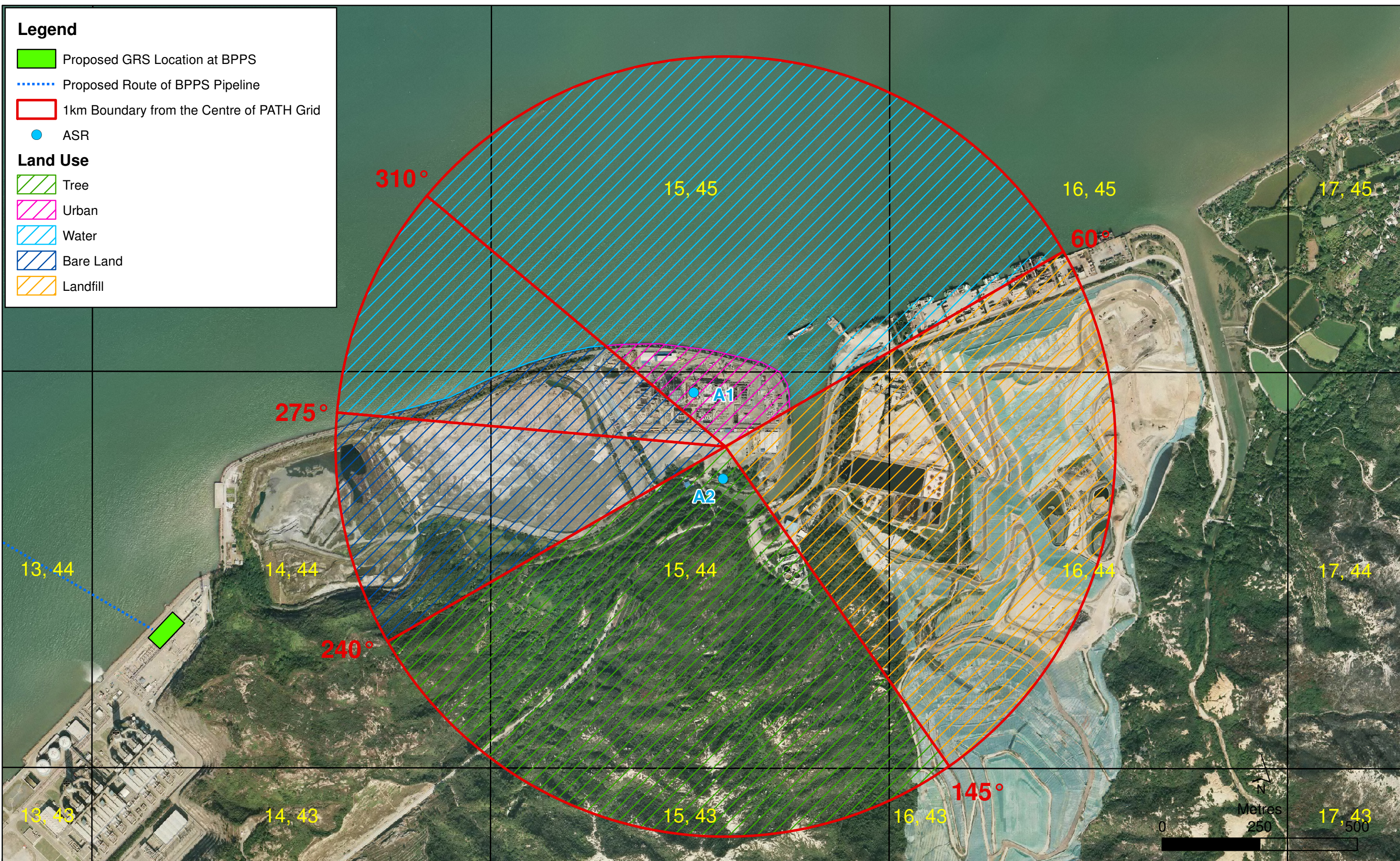


Figure 4D.1

Sectors of Land Use for PATH Grid 14,42



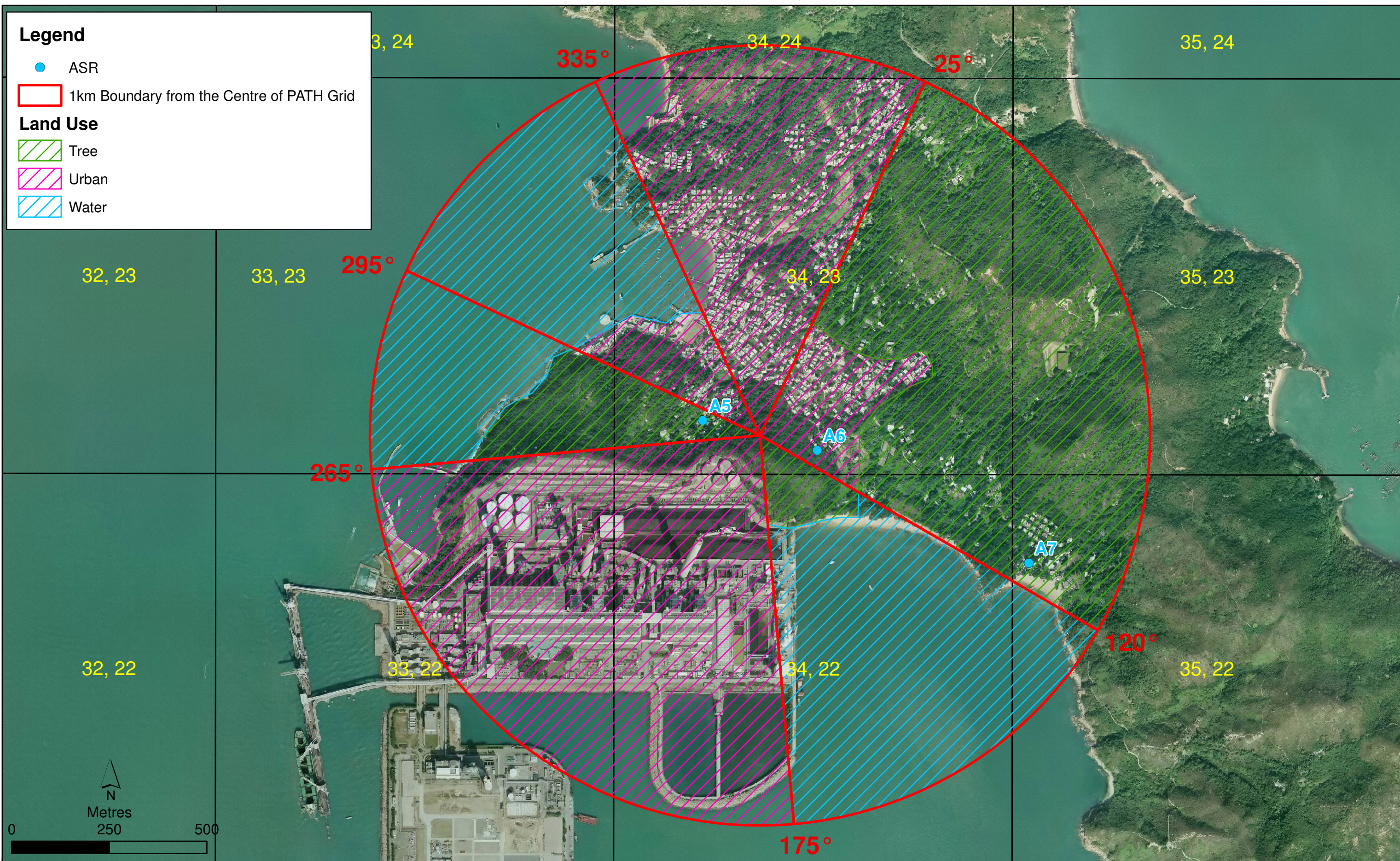


Figure 4D.3

Sectors of Land Use for PATH Grid 34, 23

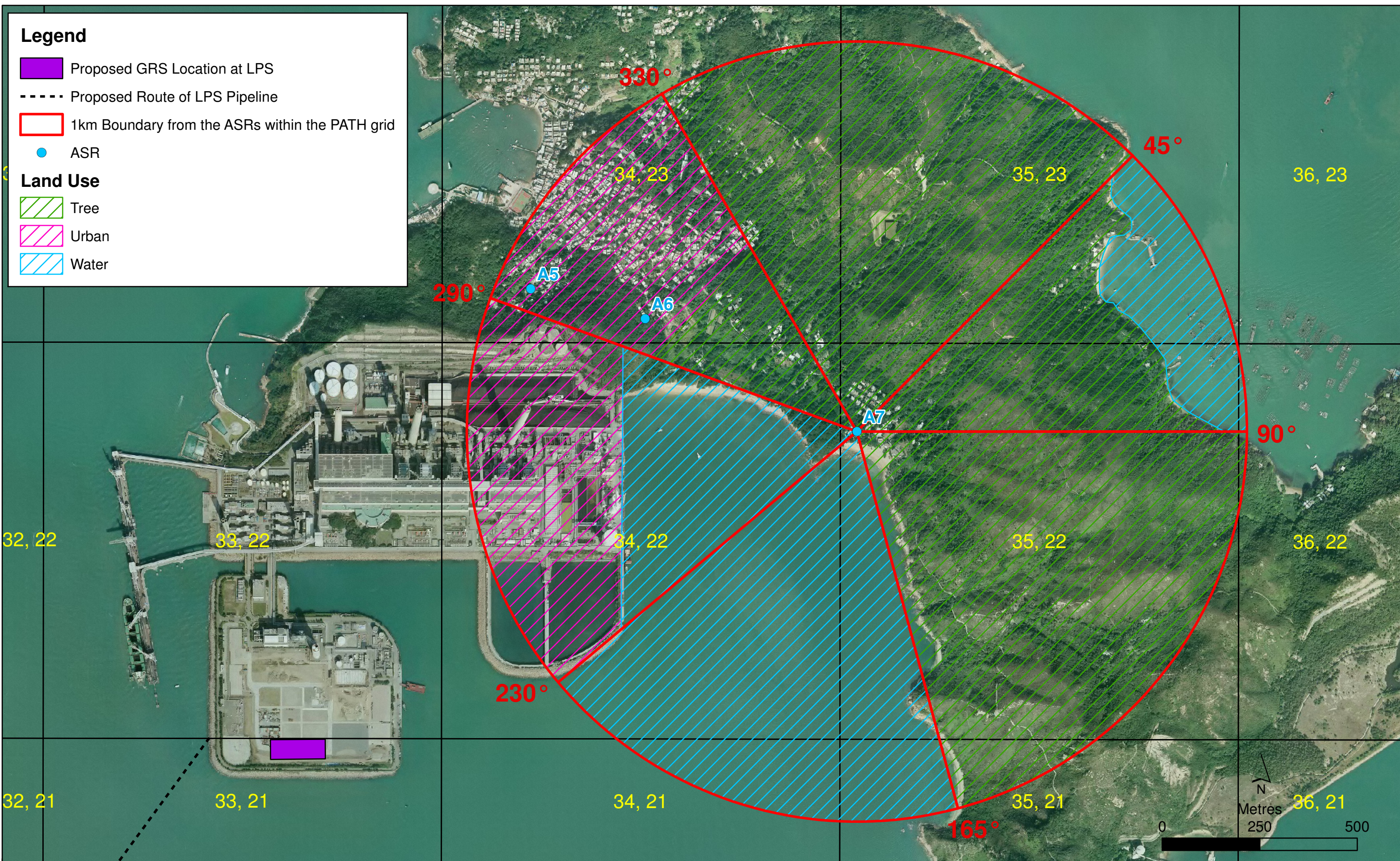
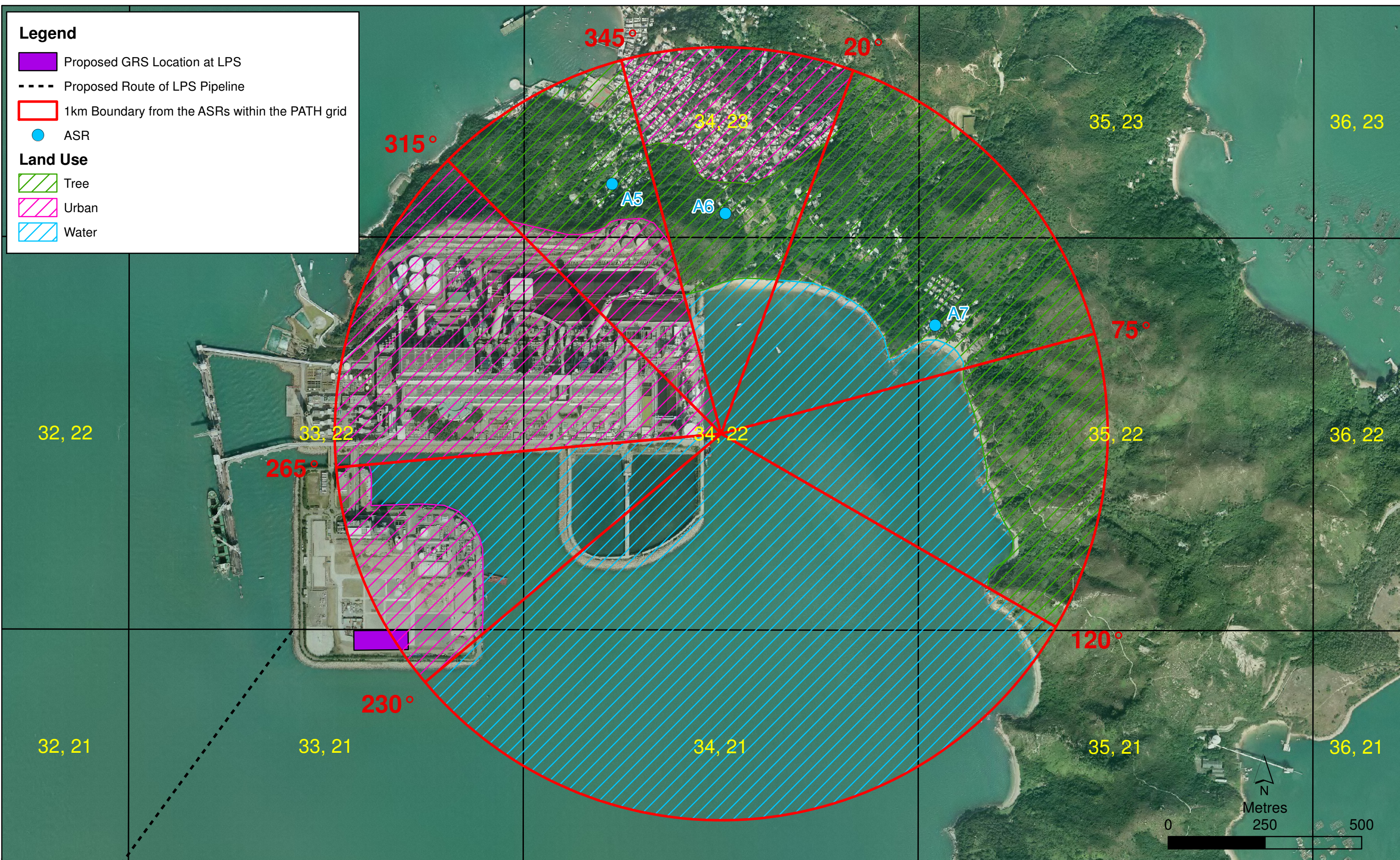


Figure 4D.4

Sectors of Land Use for PATH Grid 35, 22



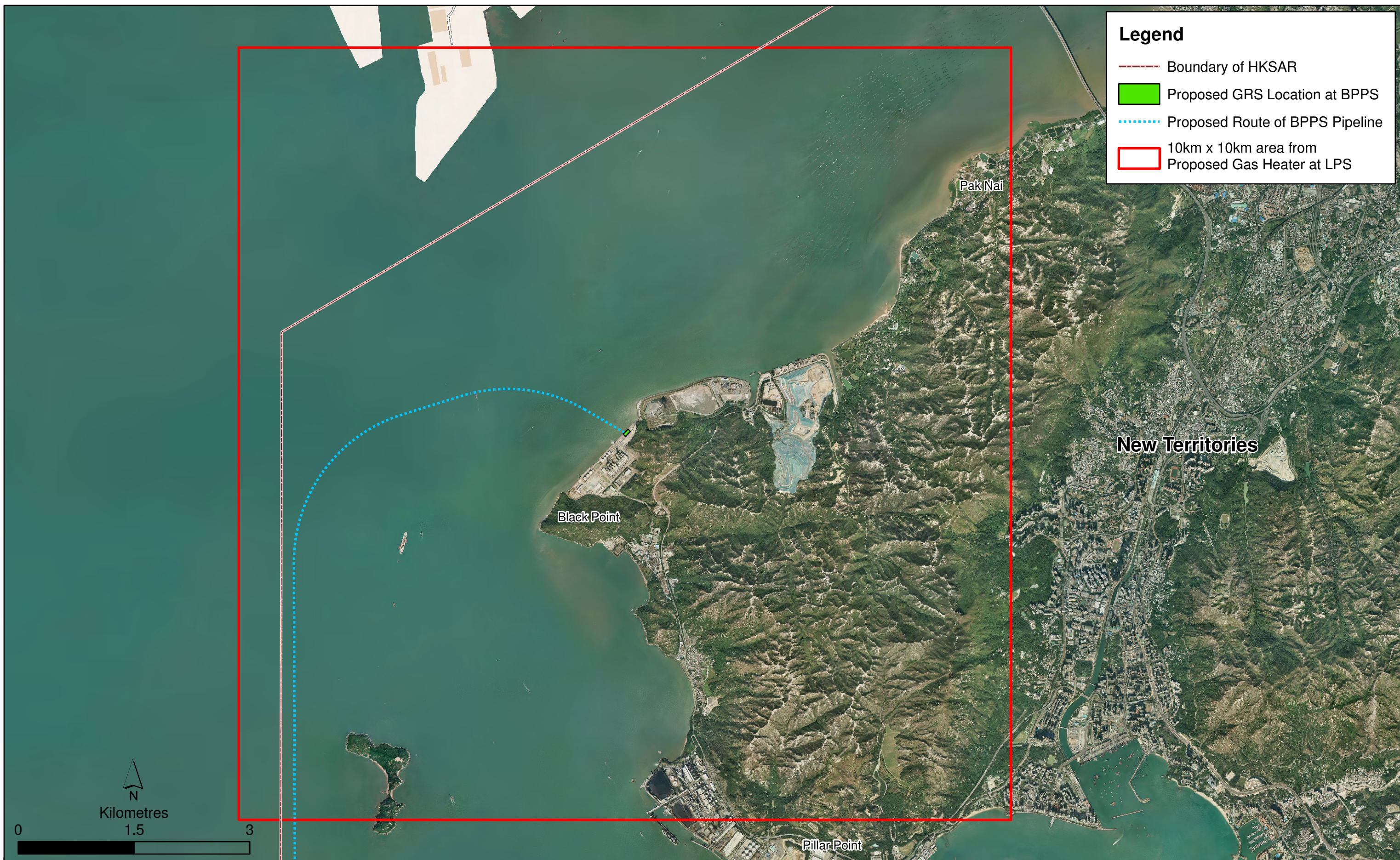


Figure 4D.6

10km x 10km area from Proposed Gas Heater at Black Point Power Station

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Date: 6/12/2017

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Figure 4D.7

10km x 10km area from Proposed Gas Heater at Lamma Power Station