Annex G - Drainage Impact Assessment

JOINT-USER COMPLEX AND JOINT-USER GENERAL OFFICE BUILDING
AT AREA 29, KWU TUNG NORTH

JOINT-USER COMPLEX AND JOINT-USER GENERAL OFFICE BUILDING AT AREA 29, KWU TUNG NORTH

DRAINAGE IMPACT ASSESSMENT

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Project:	JOINT-USER COMPLEX AND JOINT-USER GENERAL OFFICE BUILDING AT AREA 29, KWU TUNG NORTH DRAINAGE IMPACT ASSESSMENT
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1 INTRODUCTION

1.1 PROJECT SCOPE AND DESCRIPTION

1.1.1. The proposed Joint-user Complex ("JUC") and Joint-user General Office Building ("JUB") project is one of the projects under the "single site, multiple use" ("SSMU") initiative as selected by Development Bureau (DEVB) to be taken forward expeditiously at Area 29, Kwu Tung North. The proposed JUC and JUB would provide postal facilities, a sports center, indoor heated swimming pools, a district library, a community hall, a 6-classroom kindergarten, welfare facilities, healthcare facilities and government offices.

1.1.2. The policy objectives of constructing a JUC are to provide more community and public services to residents of the nearby residential developments to be completed in phases starting from 2026 as well as to optimize the use of limited land resources under the SSMU initiative. Apart from that, a JUB is to provide suitable government accommodation to enable efficient delivery of public services. This involves, among others, "meeting Government's needs for general use accommodation through planning and construction of new government office buildings". The JUB would also accommodate government offices to be relocated from the Central Business Districts ("CBDs") and other areas in the territory, thus releasing floor space and land elsewhere for alternative use(s).

1.1.3. BeeXergy Consulting Limited was appointed by UDP International to conduct a Drainage Impact Assessment (DIA) in support of its planning application under Section 16 of the Town Planning Ordinance (TPO) for the Proposed Development. Latest architectural drawings and technical information of the Project Site were provided by the Project Architect.

1.2 PROJECT LOCATION

1.2.1. The Project Site is located in Kwu Tung North. The Site is close to the future Mass Transit Railway Kwu Tung Station which is under construction with target completion date of 2027. The Project site was mostly occupied by the Dills Corner Garden which has been handed over to CEDD to commence site clearance works since the fourth quarter of 2023, and bounded by the existing Castle Peak Road to the south and would be bounded by the future Road L1 to be constructed by CEDD to the north.

1.3 APPLICATION SITE AND PROPOSED DEVELOPMENT

1.3.1. The site area of the Project Site is about 2.1 hectares, comprised of department offices, ancillary facilities including a postal facilities, a sports center, indoor heated swimming pools, a district library, a community hall, a 6-classroom kindergarten, welfare facilities, healthcare facilities and government offices. The master layout plan provided by Project Architect is enclosed in **Appendix A.**

2 DRAINAGE IMPACT ASSESSMENT

2.1 SCOPE OF WORKS

2.1.1. The objectives of this DIA are to assess whether the Proposed Development may cause adverse impacts on drainage and flooding or not and to recommend appropriate mitigation measures to alleviate unacceptable drainage impact, if any.

2.2 PROPOSED SITE CONDITION AND DRAINAGE FACILITIES

2.2.1. The drainage record from the GeoInfo Map of the Lands Department (LandsD), CEDD and Drainage Service Department (DSD) are obtained for this DIA and attached in **Figure 2.1**. Proposed public drainage in a 900mm diameter pipe running along Heung Tsz Road from Pak Sau Road.

2.2.2. The Project Proponent would like to construct stormwater terminal manholes connecting JUB (STMH-JUB) to the public sewer at Heung Tsz Road via a 675mm diameter pipe. Another foul terminal manhole (FTMH-JUC) connecting JUC to the proposed public sewer at Castle Peak Road-Chau Tau via a 900mm diameter pipe. The location of terminal manhole, proposed drainage connection and catchments are shown in **Figure 2.2.**

2.3 DRAINAGE ANALYSIS

2.3.1. Peak instantaneous runoff before and after the Proposed Development is calculated based on the Rational Method. The recommended physical parameters, including runoff coefficient (C) and storm constants (a, b, c) for different return periods, are referred to the Drainage Services Department (DSD)'s *Stormwater Drainage Manual Fifth Edition, January 2018* and *Stormwater Drainage Manual - Corrigendum No. 1/2022* (SDM).

2.3.2. The Rational Method (Equation 1) has been adopted for hydraulic analysis and the peak runoff is given by the following expression:

$$Q_p = 0.278CiA \qquad \text{(Equation 1)}$$

Where:

Q_p = peak runoff in m^3/s

C = runoff coefficient

i = rainfall intensity in mm/hr

A = catchment area in km^2

2.3.3. Rainfall intensity is calculated using the following expression (Equation 2):

$$i = \frac{a}{(t_d+b)^c} \qquad \text{(Equation 2)}$$

Where:

i = rainfall intensity in mm/hr

t_d = duration in minutes ($t_d \leq 240$)

a, b, c = storm constants given in Table 3a and Figure 3 of the SDM with return period of 50 years of the HKO Headquarters

2.3.4. For a single catchment, duration (t_d) can be assumed to be the time of concentration (t_c) which is calculated as follows (Equation 3):

$$t_c = t_0 + t_f \qquad \text{(Equation 3)}$$

Where:

t_c = time of concentration (time needed for water to flow overland from the most remote point in a catchment to its outlet)

t_0 = inlet time

t_f = flow time

2.3.5. Generally, t_0 is much smaller than t_f. As shown in Equation 2 above, t_d is the divisor. Therefore, the larger t_d will result in the smaller rain intensity (i) as well as a smaller Q_p. For the worst-case scenario (Equation 4 and Equation 5), t_0 is assumed to be negligible and so:

$$t_d = t_c = t_0 \qquad \text{(Equation 4)}$$

$$t_c = \frac{0.14465L}{H^{0.2}A^{0.1}} \qquad \text{(Equation 5)}$$

Where:

A = catchment area (m^2)

H = average slope (m per 100m), measured along the line of natural flow, from the summit of the catchment to the point under consideration

L = distance (on plan) measured on the line of natural flow between the summit and the point under consideration (m)

2.3.6. The capacities of the drainage pipes have been calculated using the Colebrook-White Equation (Equation 6), assuming full bore flow with no surcharge, as follows,

incorporate 10% sedimentation in the calculation of drainage flow capacity in accordance with the SDM:

$$V = -\sqrt{32gRs} \times \log\left(\frac{k_s}{14.8R} + \frac{1.25v}{R\sqrt{32gRs}}\right) \qquad \text{(Equation 6)}$$

Where:

V = mean velocity (m/s)

g = gravitation acceleration (m/s^2)

R = hydraulic radius (m)

k_s = hydraulic pipeline roughness (m)

V = kinematic viscosity of fluid (m^2/s)

S = hydraulic gradient (energy loss per unit length due to friction)

2.4 CHANGES IN SURFACE CHARACTERISTICS

2.4.1. Although greenery will be provided in the Proposed Development, the Project Site is assumed to be fully paved in a conservative approach. No change in surface characteristics of the Project Site is expected as shown in **Table 2.1.**

Table 2.1 Changes in Surface Characteristics of the Project Site

Scenario of Project	Surface Characteristics (Paved)	Surface Characteristics (Unpaved)
Before Development	100%	0%
After Development	100%	0%

2.5 CUMULATIVE RUNOFF

2.5.1. As the proposed drainage system by CEDD collects runoff from the Site and the surrounding catchments, runoff from surrounding catchments shall be taken into account. catchments that contributed to the cumulative runoff have been identified as catchments A as shown in **Figure 2.2.** The stormwater manhole PSMH-02 will collect the runoff from the top of Project Site (S1) and its associated upstream and downstream catchments. As the Proposed Development is within the Project Site with no utilization on the surrounding catchments A, the condition of these catchments remains unchanged. Meanwhile, PSMH-03 will collect the stormwater from the bottom

of the Project Site (S2). The changes in cumulative runoff at the PSMH-02 and PSMH-03 are summarized in **Table 2.2.**

Table 2.2 Changes of Cumulative Runoff at SMH4045416

Catchment	Before Development		After Development	
	Unpaved Area	Paved Area	Unpaved Area	Paved Area
Catchment S1	0m^2	10407m^2	0m^2	10407m^2
Catchment S2	0m^2	10572m^2	0m^2	10572m^2
Catchment A	0m^2	32395m^2	0m^2	32395m^2

2.6 ESTIMATED FUTURE RUNOFF

Peak Runoff to PSMH-02 & PSMH-03

2.6.1. Based on the cumulative runoff shown in **Table 2.2**, the runoff at the PSMH-02 & PSMH-03 before and after the development was estimated based on the return periods of 50 years.

2.6.2. The estimated peak runoff discharged to PSMH-02 & PSMH-03 before and after Development will be 4.111m^3/s and 1.045m^3/s. The detailed calculations of runoff discharge to PSMH-02 & PSMH-03 under the assessed return periods of 50 years are provided in **Appendix B**.

Assessment of Drainage Capacity

2.6.3. Calculation of drainage capacity of the runoff from the Project Site (Catchment S1 & S2) is provided in **Appendix C**. Calculation of drainage capacity of all runoff from the Project Site (Catchment S), its associated upstream (Catchment A) is provided in **Appendix D**.

2.6.4. The results presented in **Appendices C** and **D**, suggested that the estimated peak runoff will not be higher than 89% capacity of the drainage systems, and it is anticipated that the proposed drainage system will have sufficient capacity to cater to the surface runoff from the Proposed Development. Given the surface characteristics of the Project Site and surrounding catchments remain unchanged before and after the Proposed

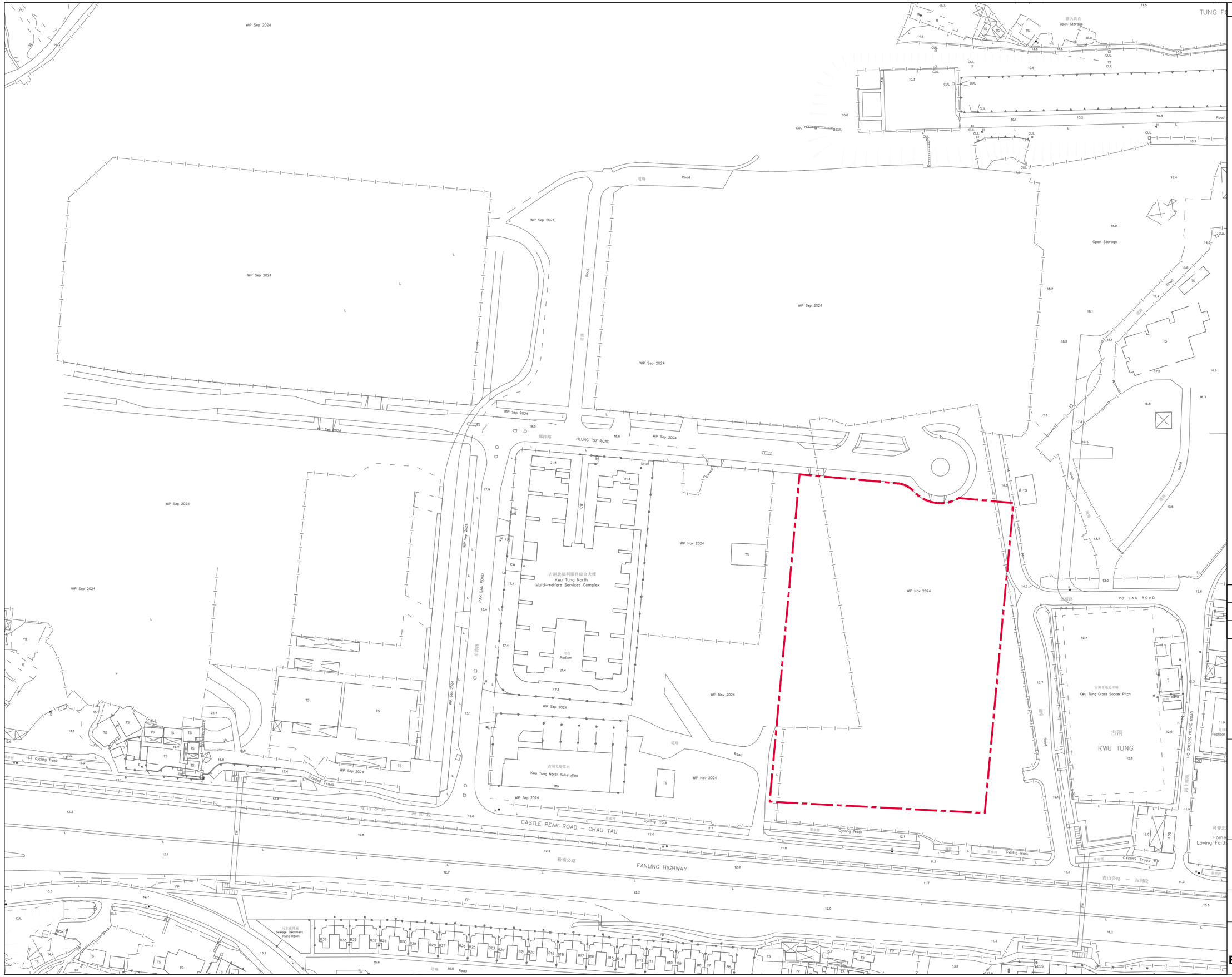
Development, no additional runoff or hydraulic capacity will be inducted due to the Proposed Development and no adverse drainage impact is anticipated.

3 CONCLUSION

3.1.1. A Joint-User Complex and Joint-User General Office Building is proposed to develop at Area 29, Kwu Tung North. The surface characteristics remain unchanged for the Project Site, and surrounding catchments A.

3.1.2. Based on this DIA results, it is found that the proposed drainage system by CEDD and project proponent serving the area has sufficient capacity to cater for the drainage generation from the Proposed Development and the surrounding catchment areas. Adverse drainage impact is not anticipated, and thus no upgrading or improvement works for the proposed drainage system by CEDD are required.

FIGURE 1.1
LOCATION OF PROJECT SITE AND ITS ENVIRONS



Project Site

	Prepared	Checked	Approved
Initial	TL	YS	HM
Date	20250303	20250303	20250303

Project Title
JOINT-USER COMPLEX AND JOINT-USER GENERAL OFFICE BUILDING AT AREA 29, KWU TUNG NORTH

Drawing Title
Site Environs

Drawing No.	Rev.
1.1	0

Scale: A3

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FIGURE 2.1
PROPOSED DRAINAGE CONNECTION BY CEDD

Project Site

Drainage connection information retrieved from CEDD

	Prepared	Checked	Approved
Initial	TL	YS	HM
Date	20250303	20250303	20250303

Project Title
JOINT-USER COMPLEX AND JOINT-USER GENERAL OFFICE BUILDING AT AREA 29, KWU TUNG NORTH

Drawing Title
Drainage Connection

Drawing No.	Rev.
2.1	0

Scale: A3

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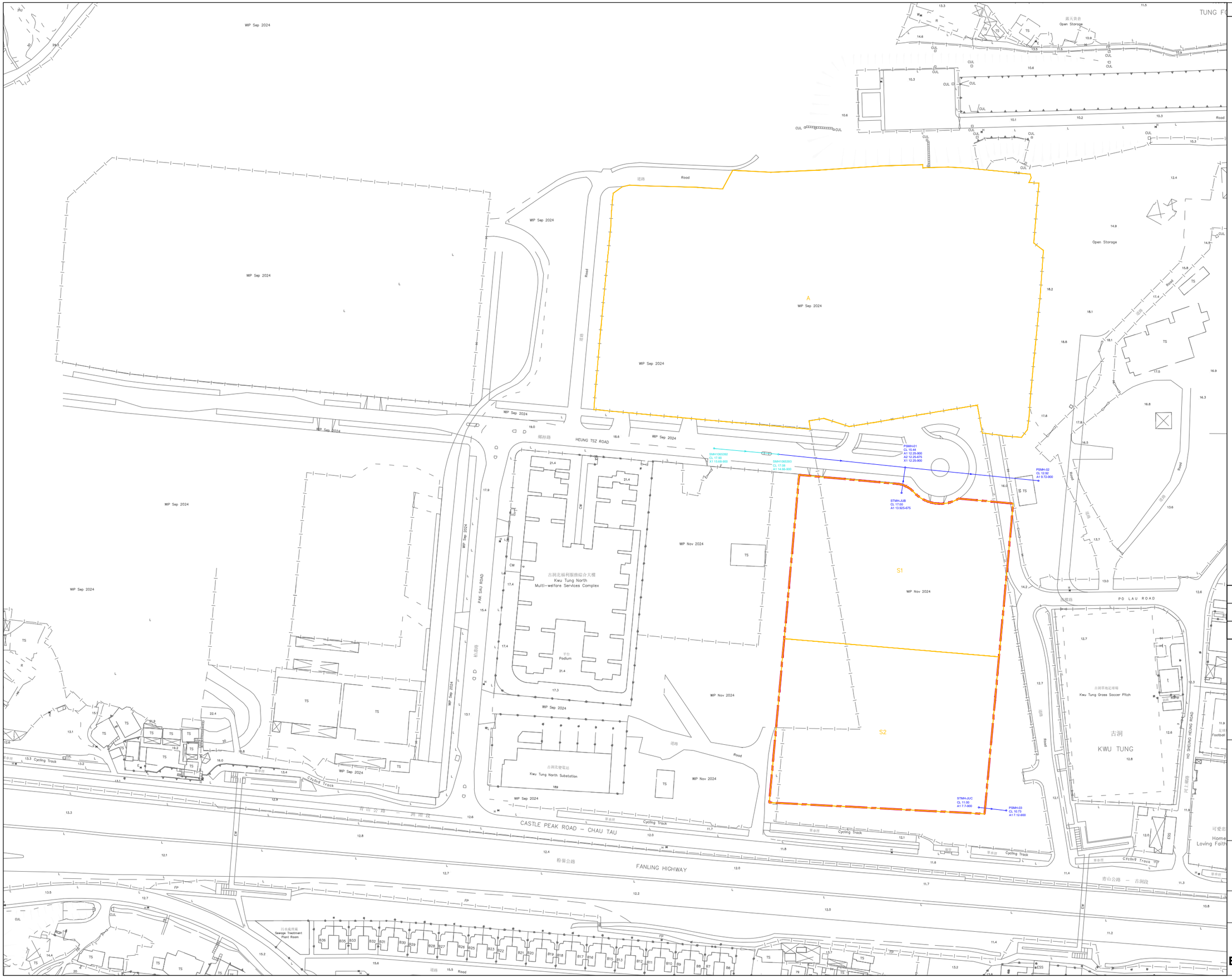
FIGURE 2.2
PROPOSED DRAINAGE ARRANGEMENT & CATCHMENT AREA



Project Site

Drainage connection information retrieved from CEDD

Proposed drainage connection

Catchment

	Prepared	Checked	Approved
Initial	TL	YS	HM
Date	20250303	20250303	20250303

Project Title
JOINT-USER COMPLEX AND JOINT-USER GENERAL OFFICE BUILDING AT AREA 29, KWU TUNG NORTH

Drawing Title
Proposed Drainage Connection & Catchment

Drawing No. 2.2

Rev. 0

Scale: A3

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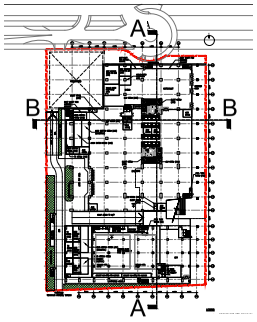
APPENDIX A
MASTER LAYOUT PLAN

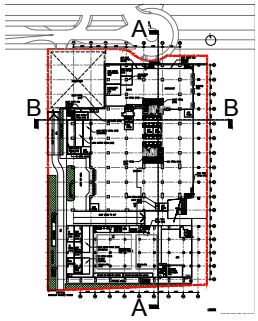
SECTION A-A

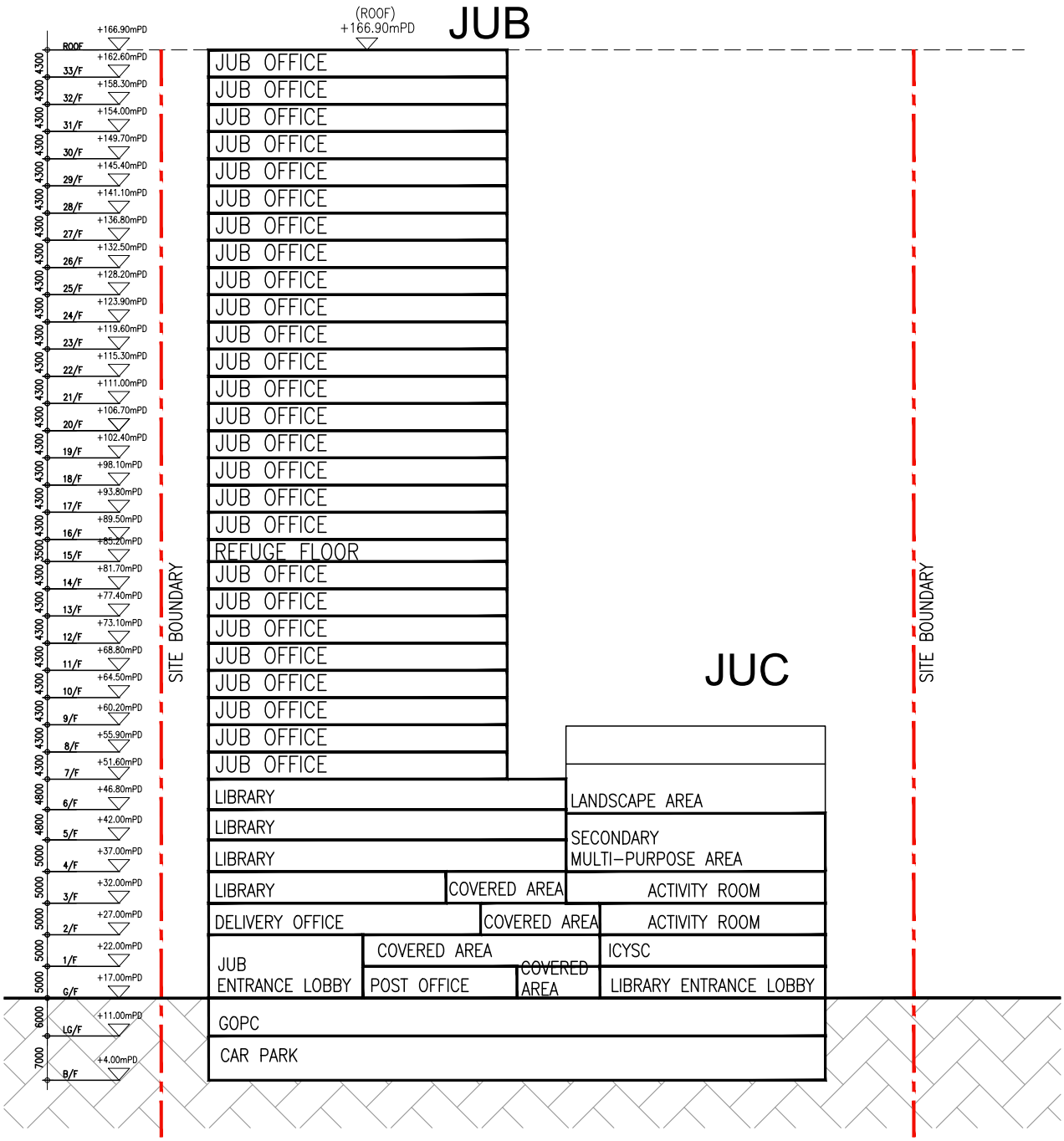
1:1000 @ A4

DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



SECTION A-A

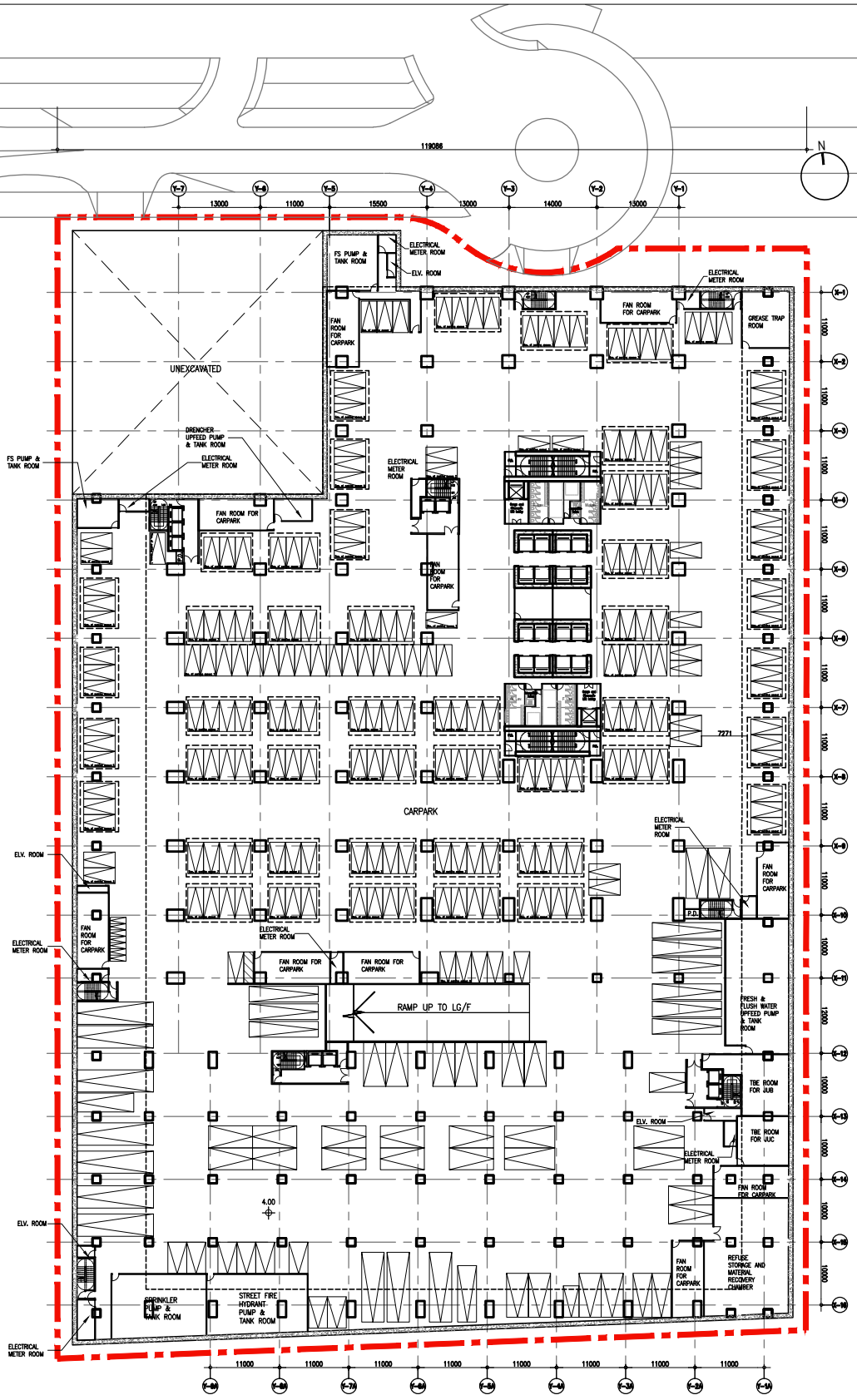




SECTION B–B

10m 0 20m

SECTION B-B 1:1000 @ A4	DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL	



LEGEND

DEVELOPMENT SITE BOUNDARY

青山公路 — 洲頭段 CASTLE PEAK ROAD — CHAU TAU

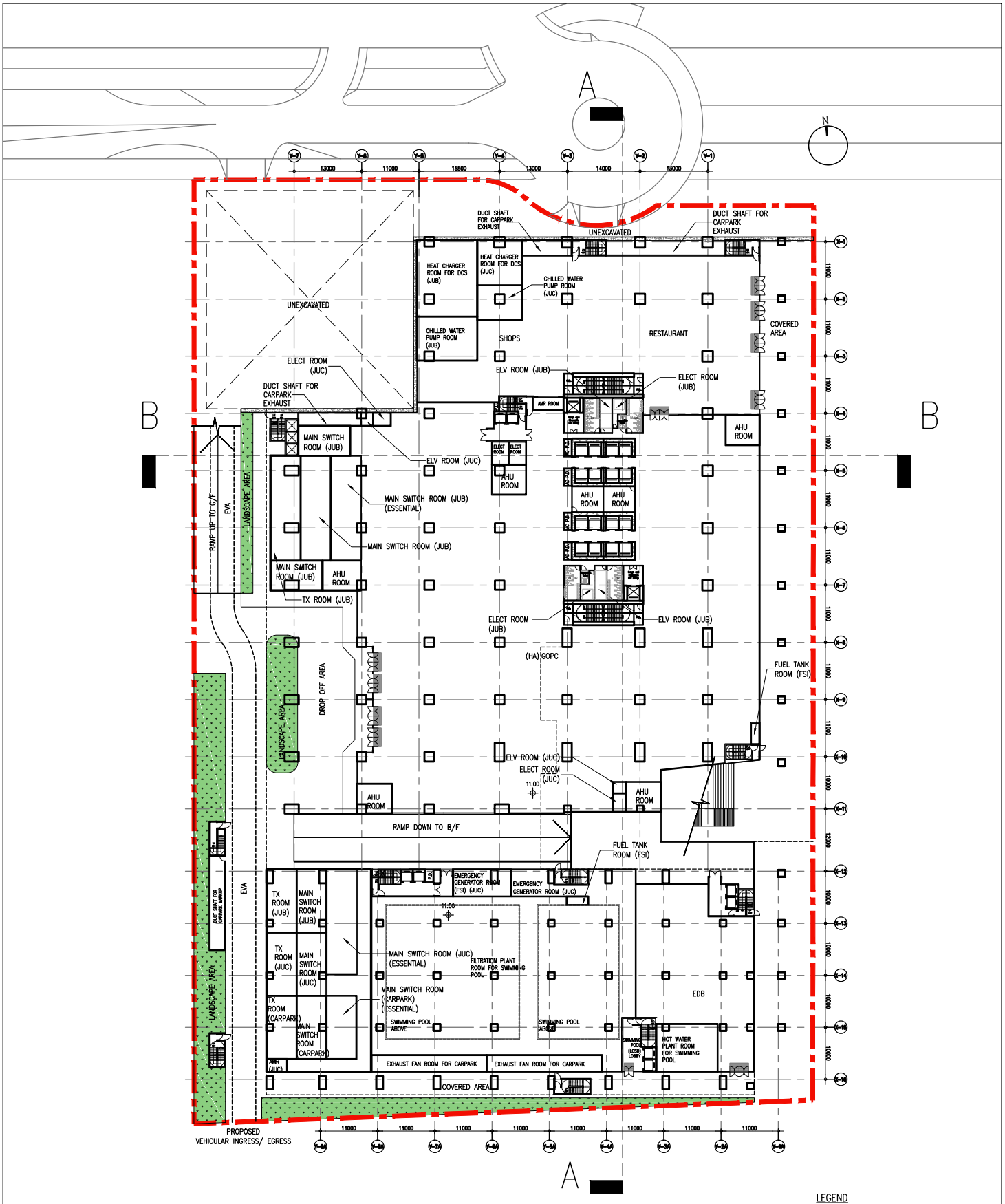
粉嶺公路 FANLING HIGHWAY

10m 0 20m

B/F PLAN

1:1000 @ A4

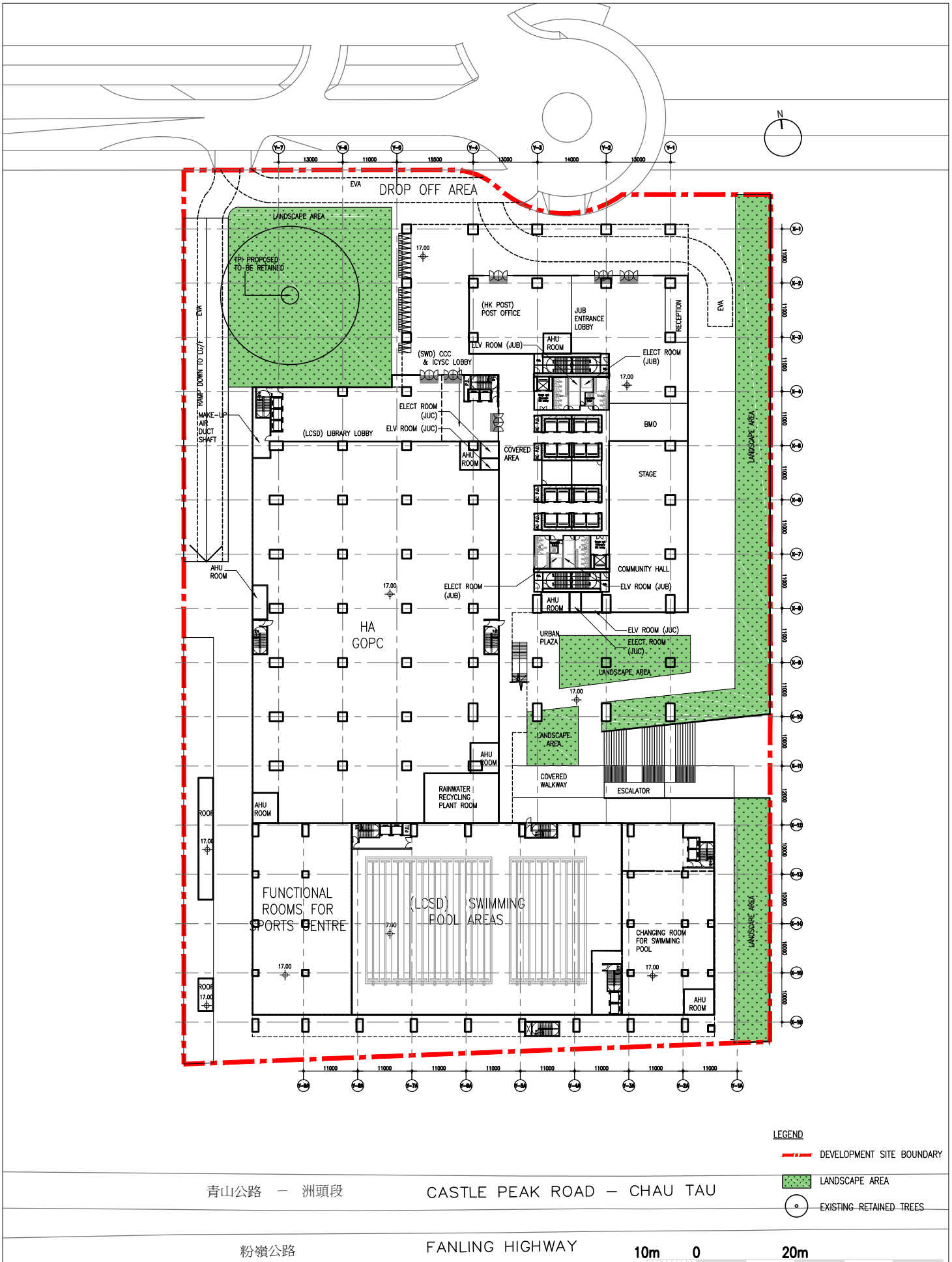
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



LG/F PLAN

1:1000@A4

DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



G/F PLAN

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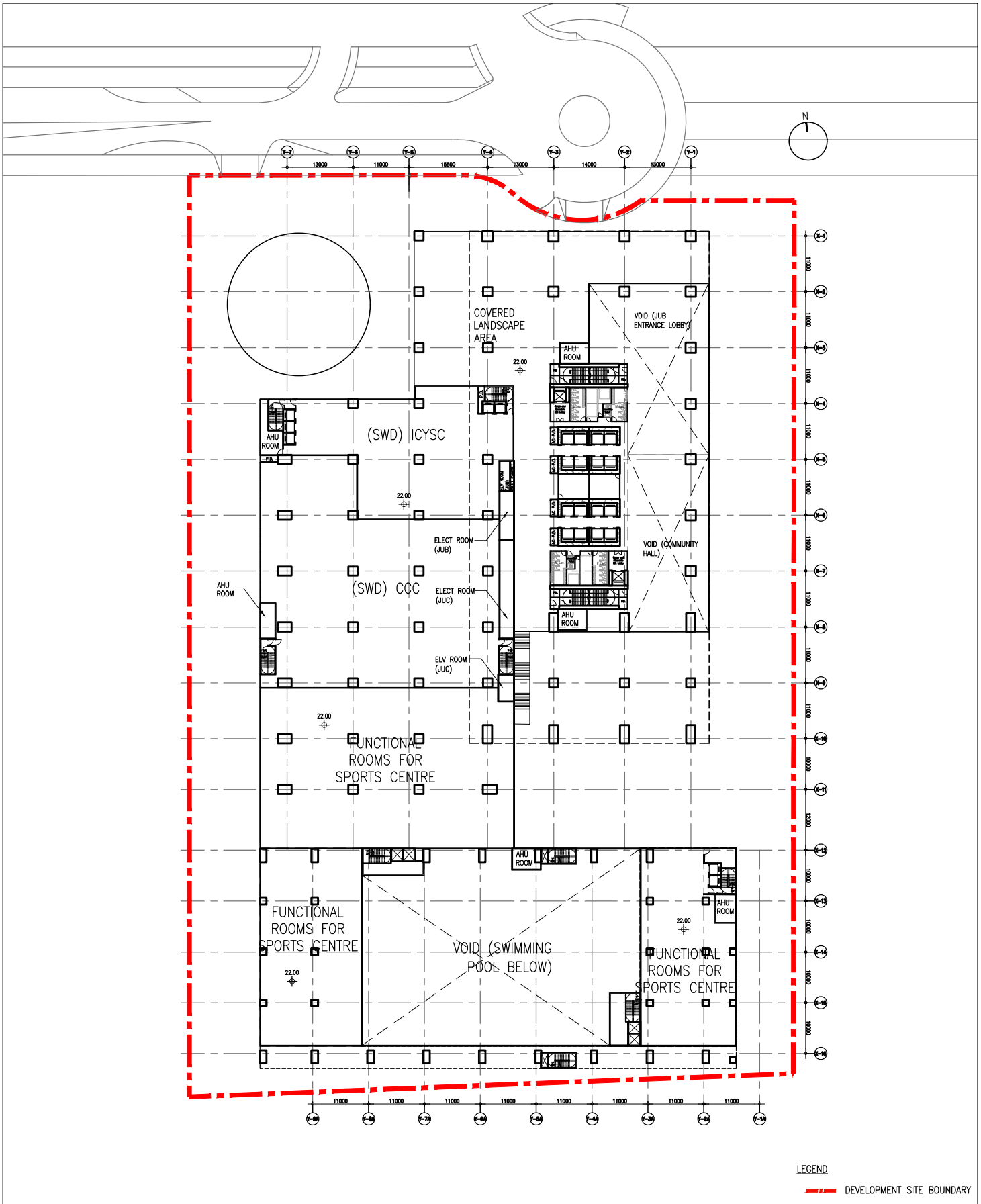
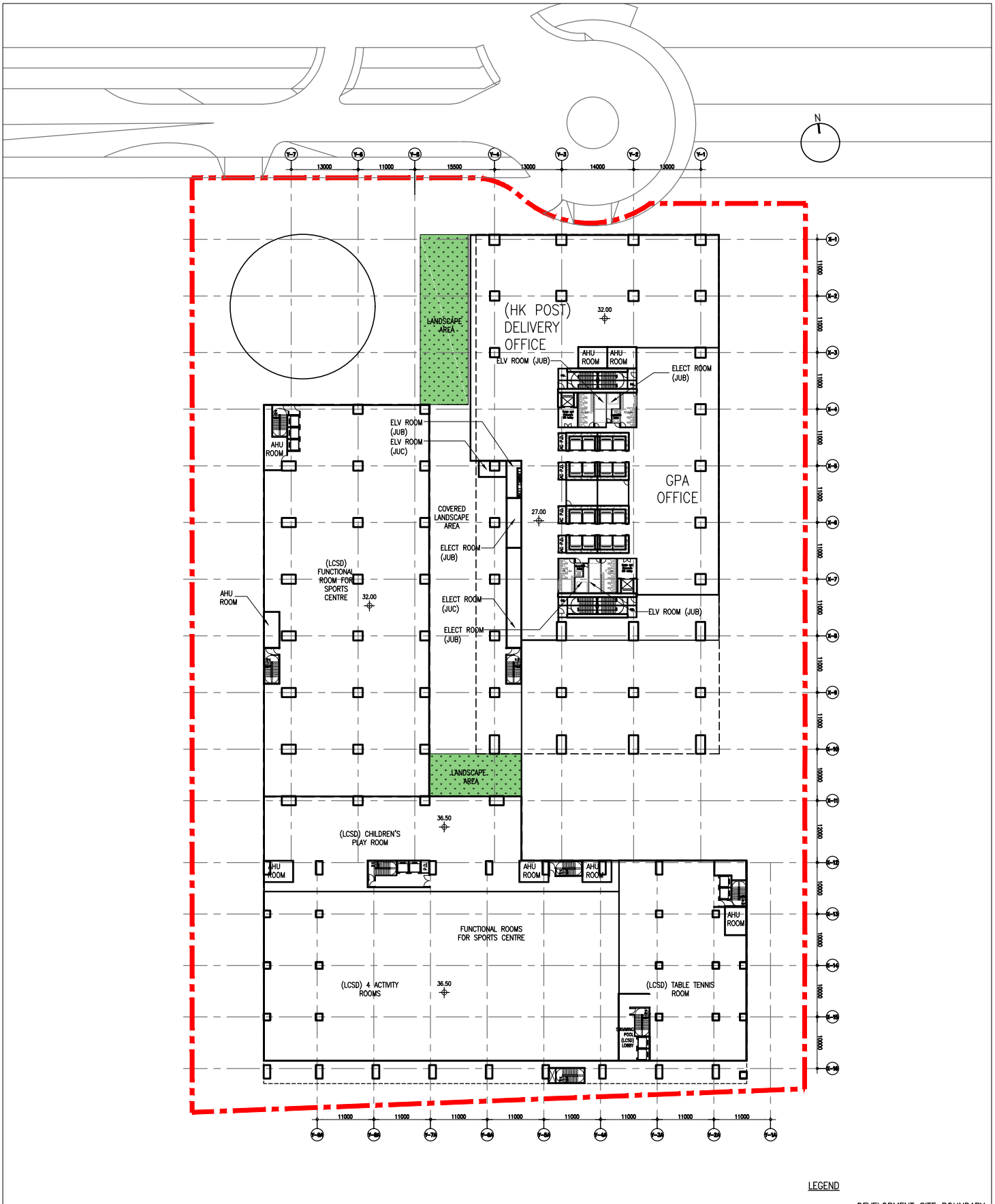
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



1/F PLAN 1:1000 @ A4	DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL	



2/F PLAN

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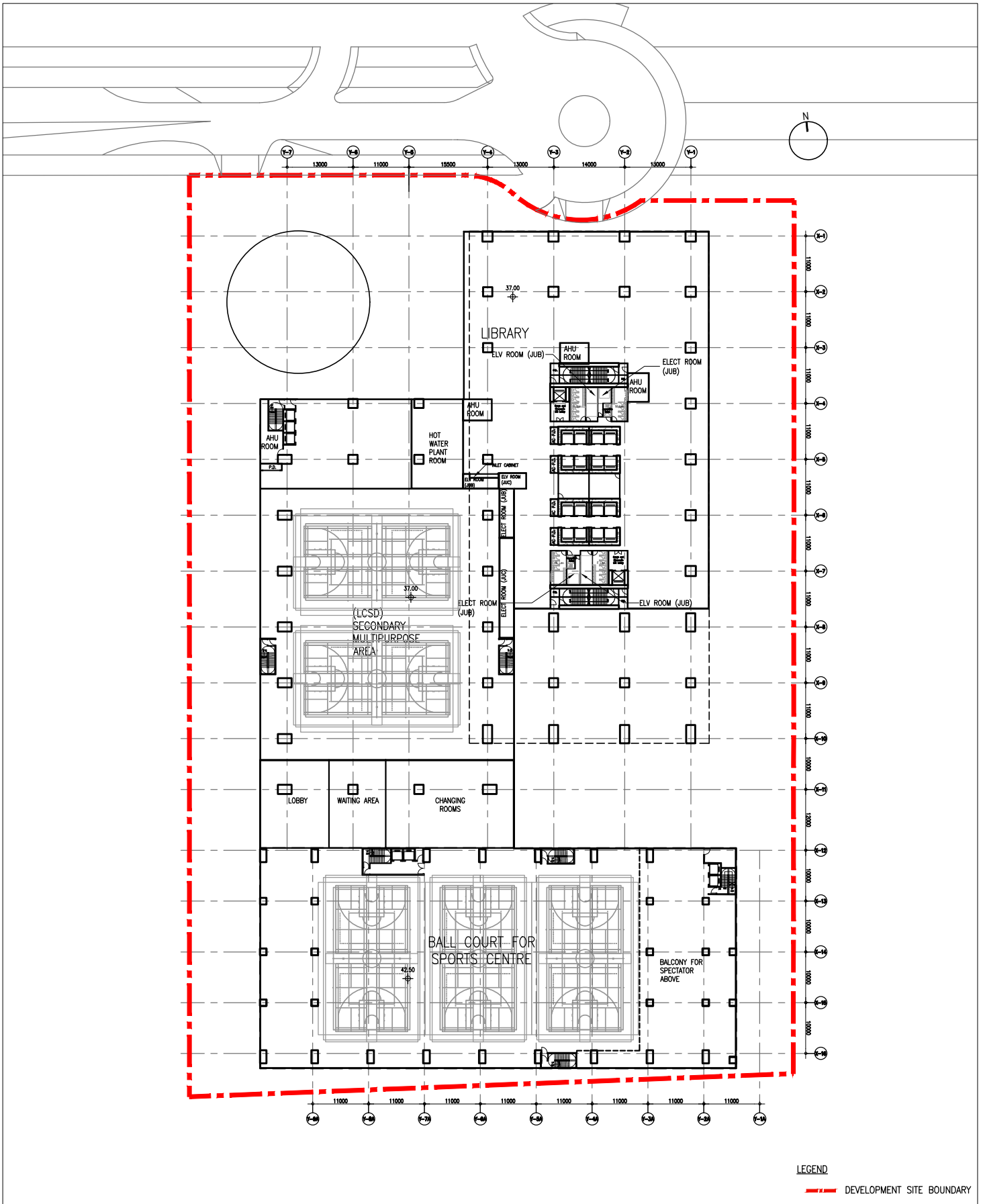
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



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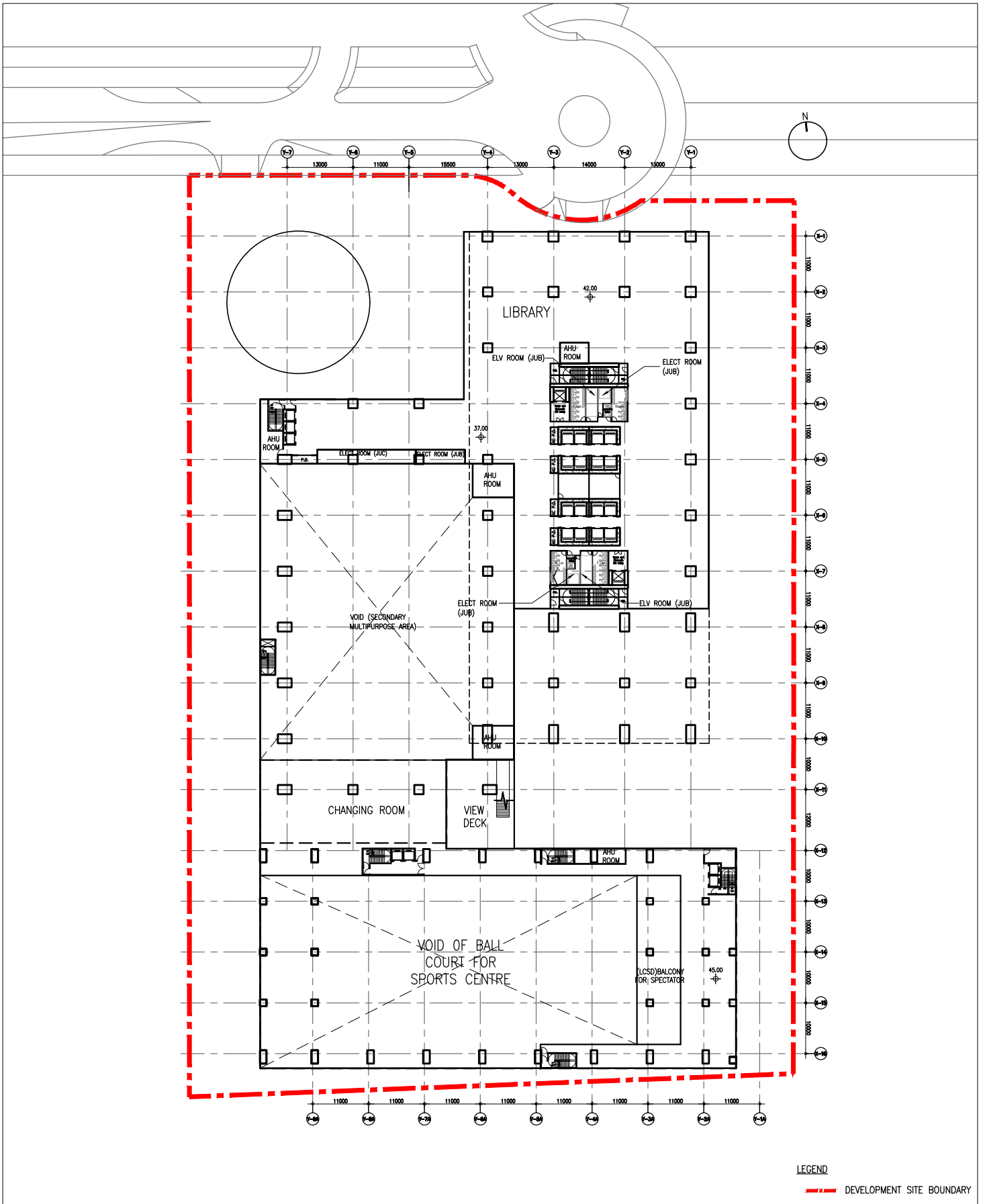

4/F PLAN

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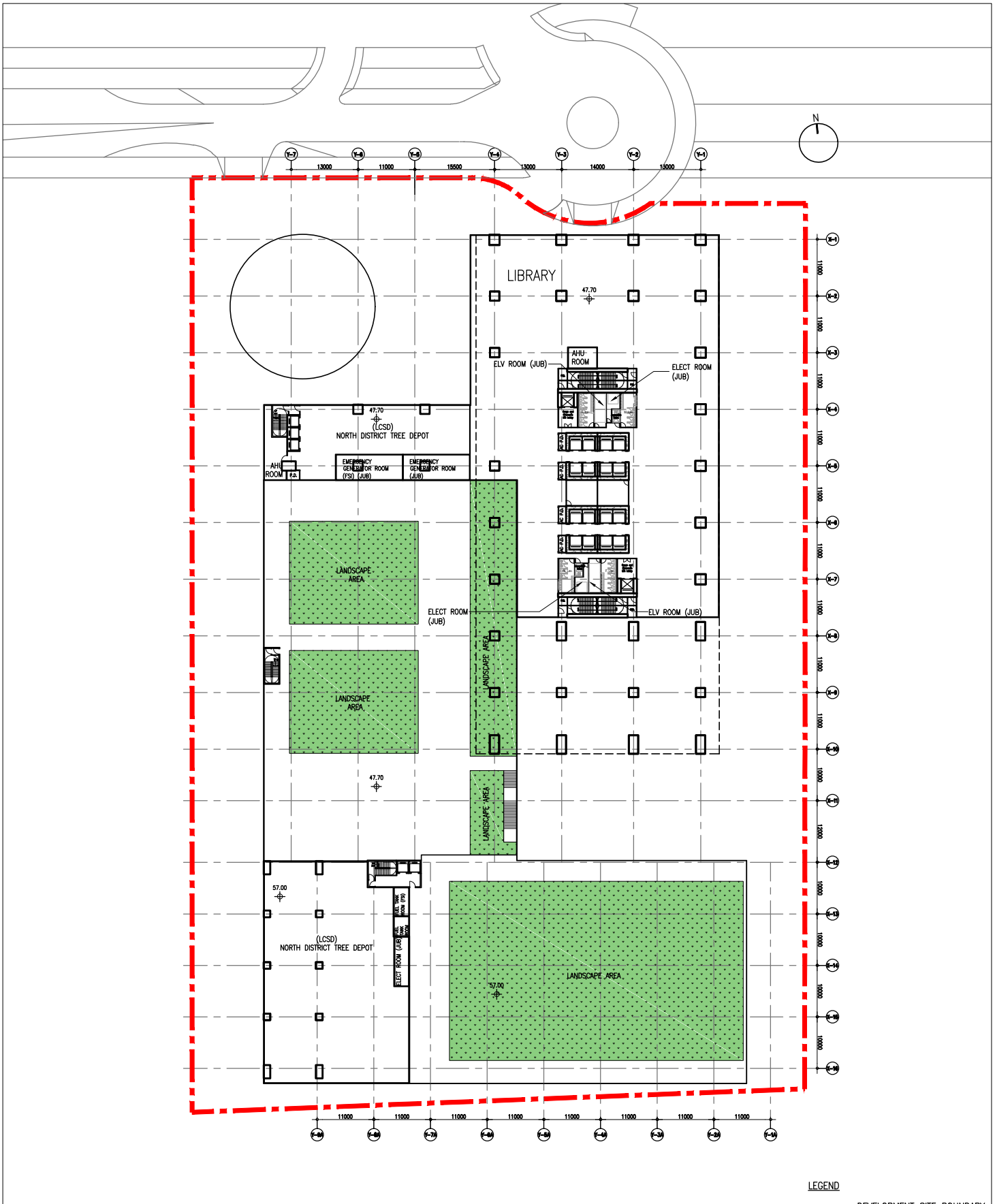
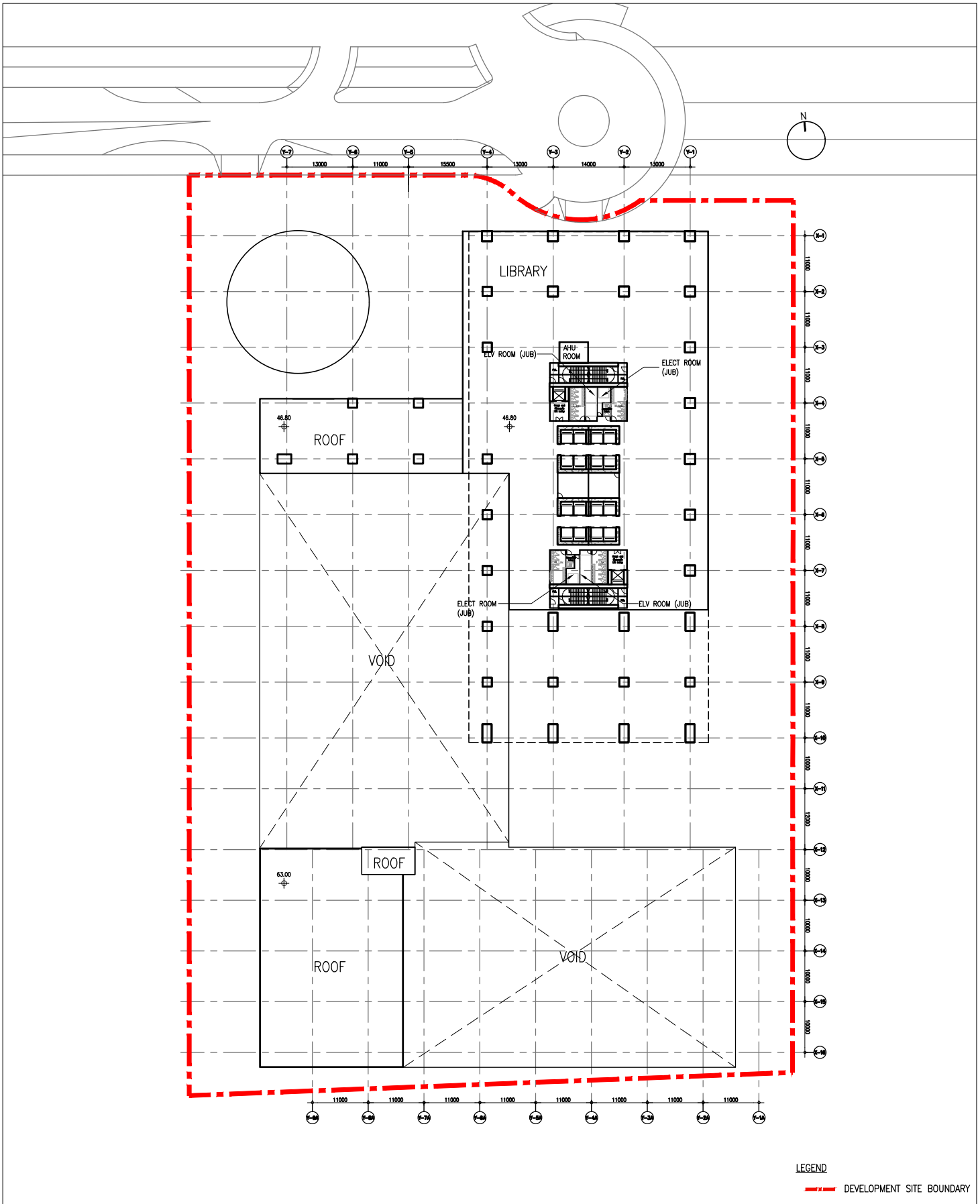
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



5/F PLAN

1:1000 @ A4

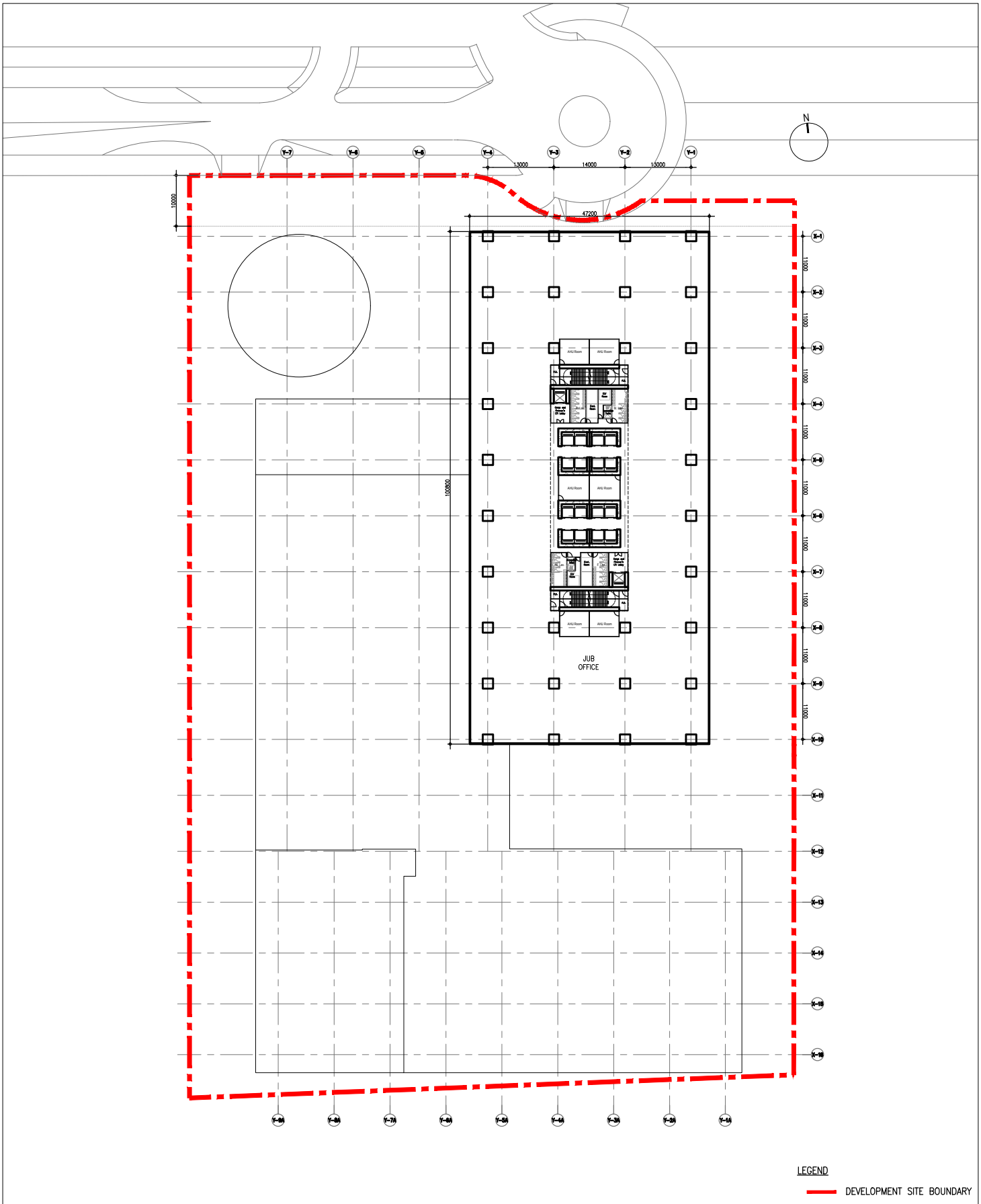
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



6/F PLAN

1:1000 @ A4

DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



7-14/F PLAN

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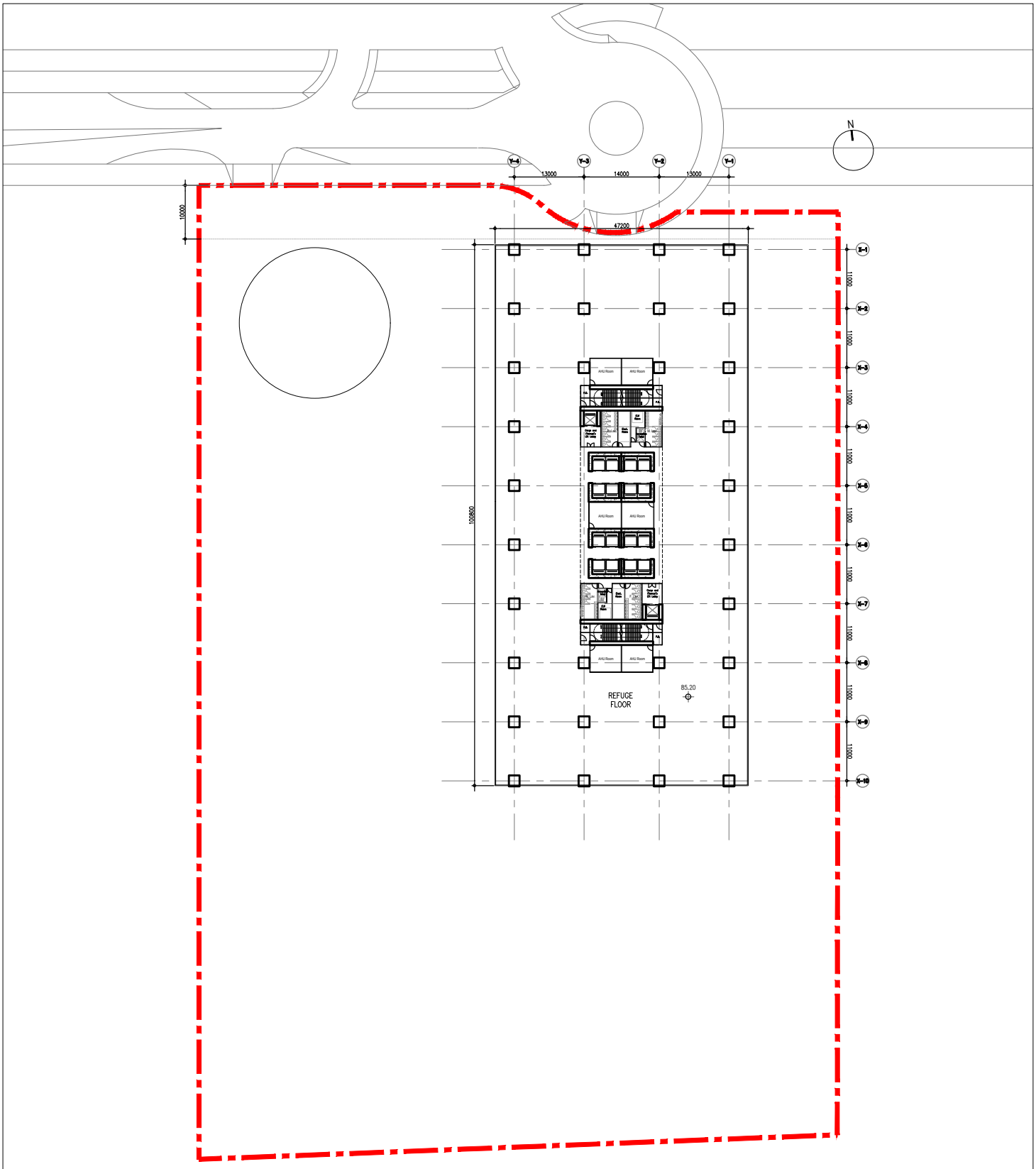
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



15/F PLAN

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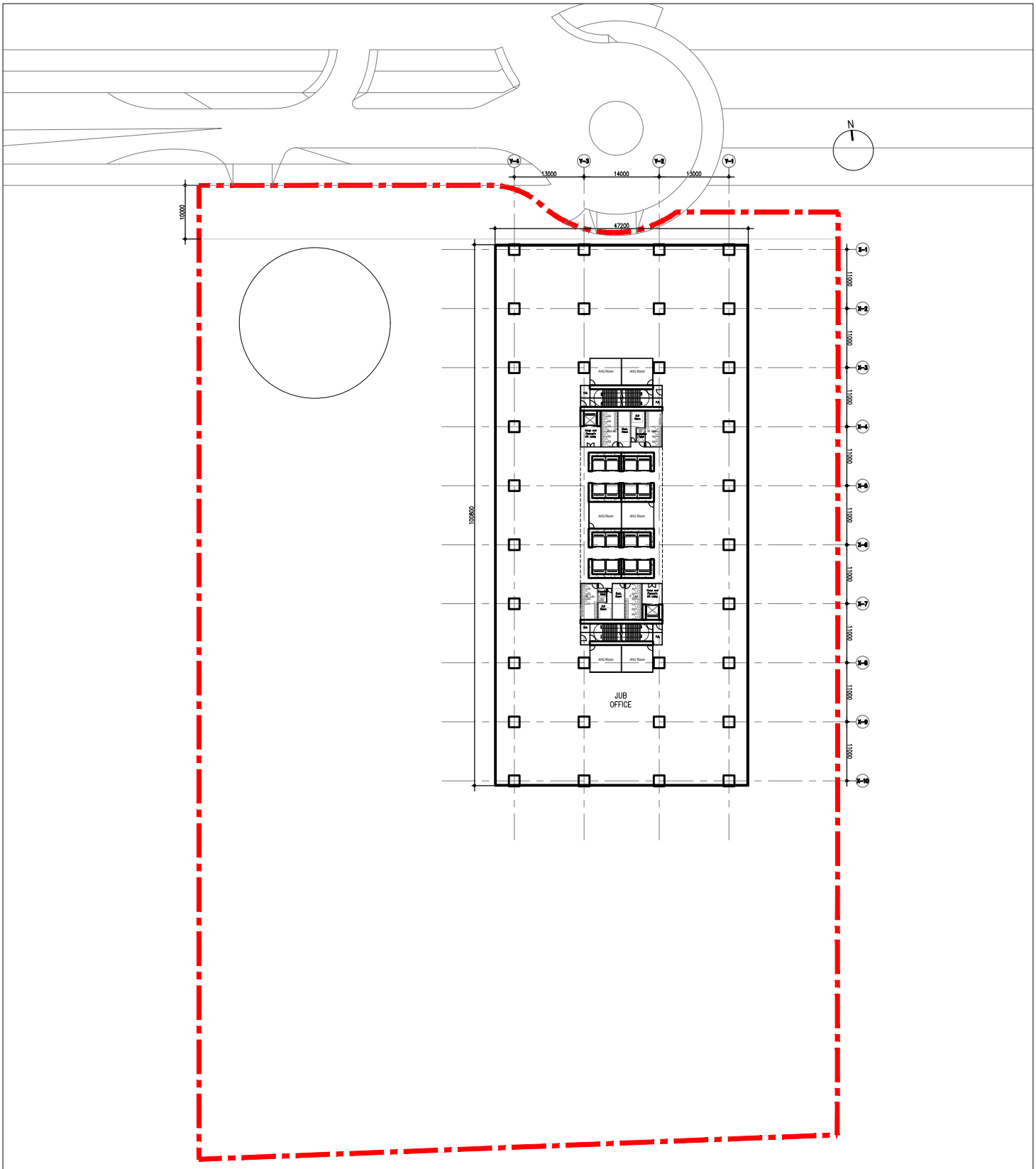
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



16-33/F PLAN

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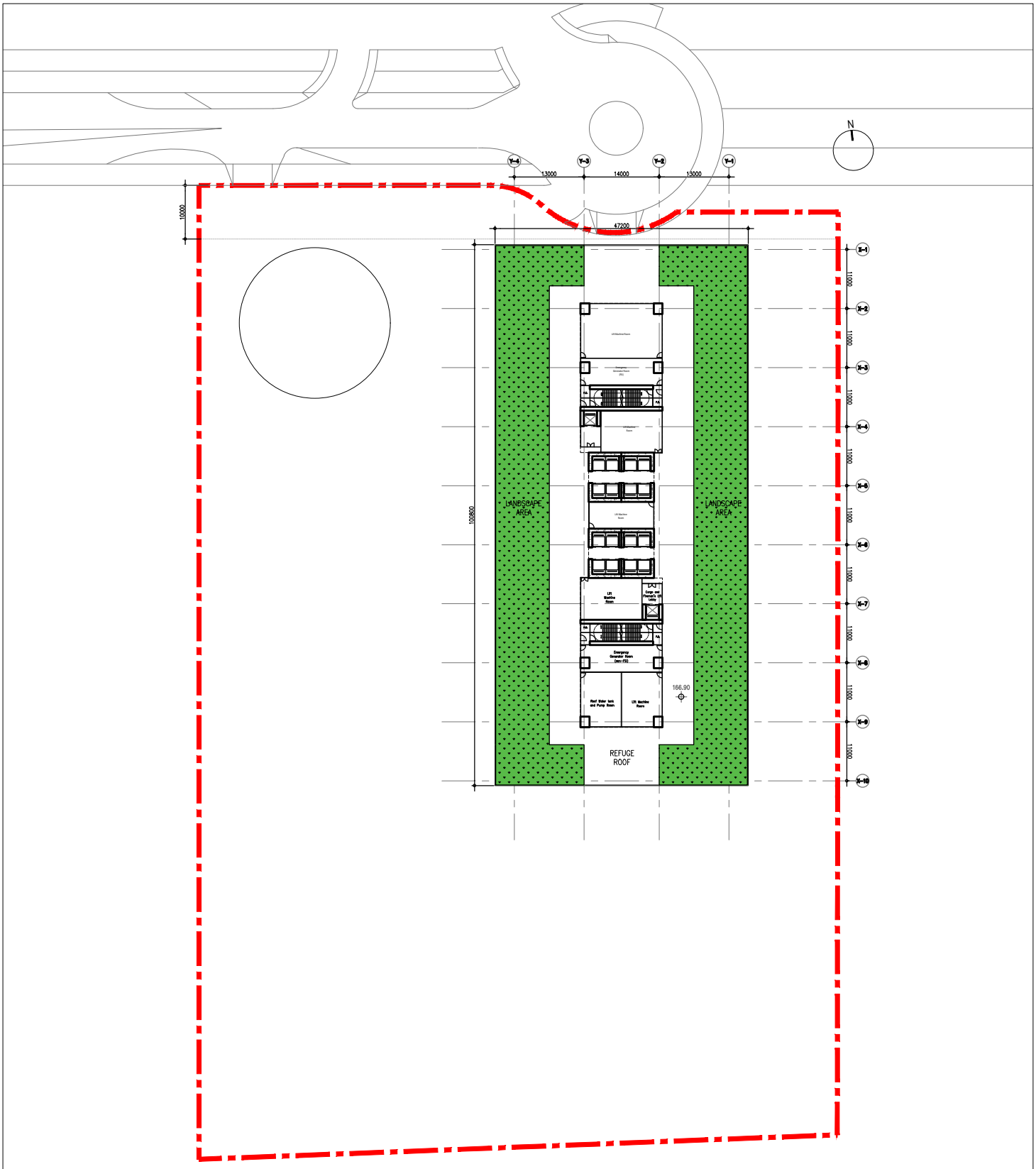
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



R/F PLAN

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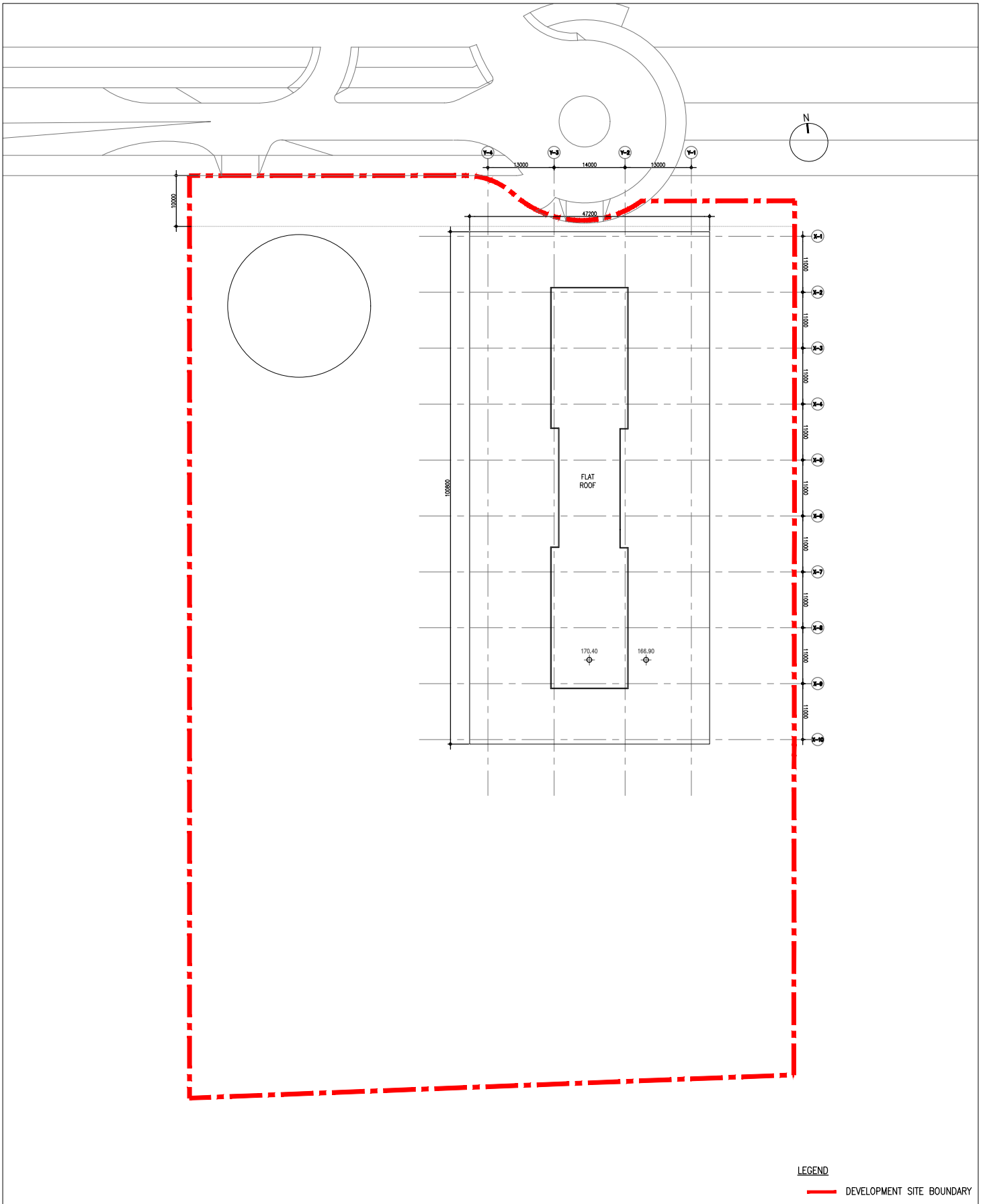
DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL



UR/F PLAN

1:1000 @ A4

DEVELOPMENT OF KWU TUNG NORTH AREA 29, GIC SITE PLANNING PROPOSAL

APPENDIX B

CALCULATION OF RUNOFF FOR RETURN PERIOD OF 50 YEARS

Appendix B

Calculation of Runoff for the Return Period of 50 Years

Catchment ID	Unpaved Catchment Area (km^2)	Paved Catchment Area (km^2)	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_o), min	Duration (t_d), min	(50 years) Storm Constants*			Runoff intensity (i) with climate change factor & design allowance, mm/hr*	Runoff coefficient for unpaved area (C_{up})	Runoff coefficient for paved area (C_p)	C x A	Peak runoff (Q_p) m^3/s
								a	b	c					
Catchment S1	0.000000	0.010407	0.010407	0.38	21	1.46	1.46	505.5	3.29	0.355	372.40	0.25	0.95	0.00989	1.024
Catchment S2	0.000000	0.010572	0.010572	0.63	22	1.39	1.39	505.5	3.29	0.355	374.32	0.25	0.95	0.01004	1.045
Catchment A	0.000000	0.032395	0.032395	0.36	30	1.90	1.90	505.5	3.29	0.355	360.85	0.25	0.95	0.03077	3.087
														Total	**5.156**

Remark:

1. According to Stormwater Drainage Manual CORRIGENDUM No. 1/2022 - Table 28, the rainfall increases due to Climate Change will be 16.0% for end of 21st Century.
2. According to Stormwater Drainage Manual CORRIGENDUM No. 1/2022 - Table 31, the design allowance in the rainfall increases will be 12.1% for end of 21st Century.
3. 50 years storm constants according to SDM - Corrigendum No. 1/2024.
4. No change of surface characteristic before the after the Proposed Development for the Project Site (Catchment S) its associated upstream catchment A.

APPENDIX C

CALCULATION OF DRAINAGE CAPACITY OF THE RUNOFF FROM THE PROJECT SITE (CATCHMENT S)

Appendix C

Calculation of drainage capacity of the runoff from the Project Site (Catchment S)

SECTION		Pipe	Catchment	Length	Upstream Invert Level	Downstream Invert Level	d	r	A_w	P_w	R	s	k_s	V	Q_c	Total Runoff in 50 Years	% of capacity	Remark
From	To			m	mPD	mPD	m	m	m^2	m	m	-	mm	m/s	m^3/s	m^3/s	%	
STMH-JUB	PSMH-01	1 x 675mm circular pipe	S1	13.4	+13.93	+12.25	0.675	0.34	0.358	2.121	0.17	0.125	0.06	11.7498	4.205	1.024	24%	OK
STMH-JUC	PSMH-03	1 x 900mm circular pipe	S2	14.5	+7.70	+7.12	0.9	0.45	0.636	2.827	0.23	0.040	0.06	7.8397	4.987	1.045	21%	OK

Legend

d = pipe diameter, m

r = pipe radius (m) = 0.5d

A_w = wetted area (m^2) = πr^2 (circular) ; $\pi r^2/2$ (U-channel) ; WH (Box Culvert)

P_w = wetted perimeter (m) = $2\pi r$ (circular) ; πr (U-channel) ; 2W+2H (Box Culvert)

R = Hydraulic radius (m) = A_w / P_w

s = Slope of the total energy line

k_s = equivalent sand roughness, mm

V = Velocity of flow calculated based on Colebrook White Equation, m/s

Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s

Q_p = Estimated total peak flow from the Site during peak season, m^3/s

APPENDIX D

CALCULATION OF DRAINAGE CAPACITY OF ALL RUNOFF FROM THE PROJECT SITE (CATCHMENT S) AND ITS ASSOCIATED UPSTREAM AND DOWNSTREAM CATCHMENTS (CATCHMENTS A)

Appendix D

Calculation of drainage capacity of all runoff from the Application Site (Catchment S) and its associated upstream and downstream catchments (Catchments A)

SECTION		Pipe	Catchment	Length	Upstream Invert Level	Downstream Invert Level	d	r	A_w	P_w	R	s	k_s	V	Q_c	Total Runoff in 50 Years	% of capacity	Remark
From	To			m	mPD	mPD	m	m	m^2	m	m	-	mm	m/s	m^3/s	m^3/s	%	
SMH1065393[1]	PSMH-01[2]	1 x 900mm circular pipe	A	69.6	+14.66	+12.25	0.9	0.45	0.636	2.827	0.23	0.035	0.06	7.2973	4.642	3.087	67%	OK
PSMH-01[2]	PSMH-02[2]	1 x 900mm circular pipe	A, S1	73.2	+12.25	+9.72	0.9	0.45	0.636	2.827	0.23	0.035	0.06	7.2973	4.642	4.111	89%	OK

Legend

d = pipe diameter, m

r = pipe radius (m) = 0.5d

A_w = wetted area (m^2) = πr^2 (circular) ; $\pi r^2/2$ (U-channel) ; WH (Box Culvert)

P_w = wetted perimeter (m) = $2\pi r$ (circular) ; πr (U-channel) ; 2W+2H (Box Culvert)

R = Hydraulic radius (m) = A_w / P_w

s = Slope of the total energy line

k_s = equivalent sand roughness, mm

V = Velocity of flow calculated based on Colebrook White Equation, m/s

Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s

Q_o = Estimated total peak flow from the Site during peak season, m^3/s

Remarks

(1) Information retrieved from CEDD.

(2) The information is based on assumption, actual value shall be confirmed by CEDD in later stage.