Drainage Impact Assessment for Proposed Residential Care Home for the Elderly (RCHE) Development at Tung Tsz, Tai Po

C241003W-02-C

PREPARED FOR

R LEE Architects Ltd

PREPARED BY

Eddy Ng
BSc(Hons), MHKIOA, MIOA, MMOIA, MIET,
MAES, MASHRAE, MHKIEIA, REnv, BEAM Pro

APPROVED BY

Wong Kam San
MSc, CEng, MIOA,
MHKIOA, AFCHKRI, MHKIEIA, MHKIQEP

15 August 2025

Contents

1. Background

The applicant, R Lee Architect, intends to develop one 10-storey building block situated at Tung Tsz, Tai Po, New Territories for the Proposed Residential Care Home for the Elderly (RCHE) Development.

The purpose of this report is to conduct a Drainage Impact Assessment (DIA) to assess the potential drainage impact arising from the proposed development.

2. Objective

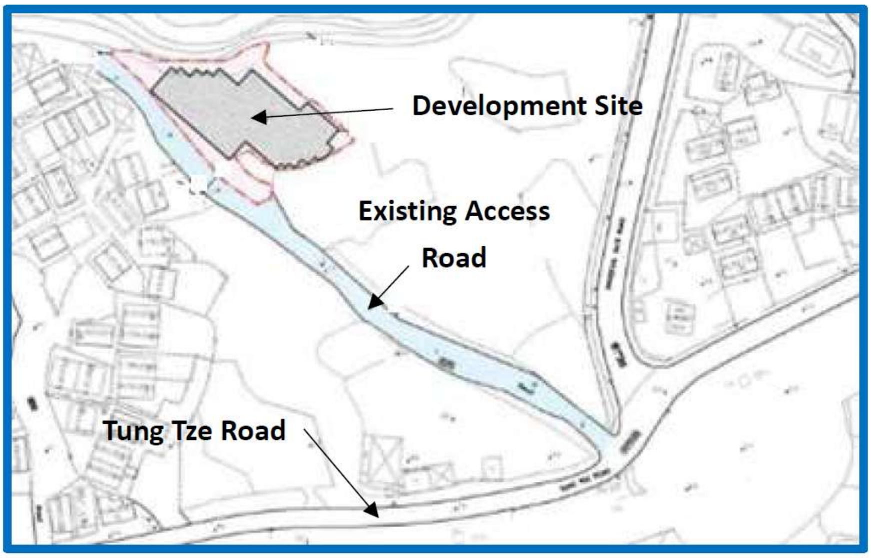
These DIA objectives are to assess the potential drainage impact arising from the proposed development and recommend mitigation measures, if necessary, to alleviate the impacts.

3. Site Information

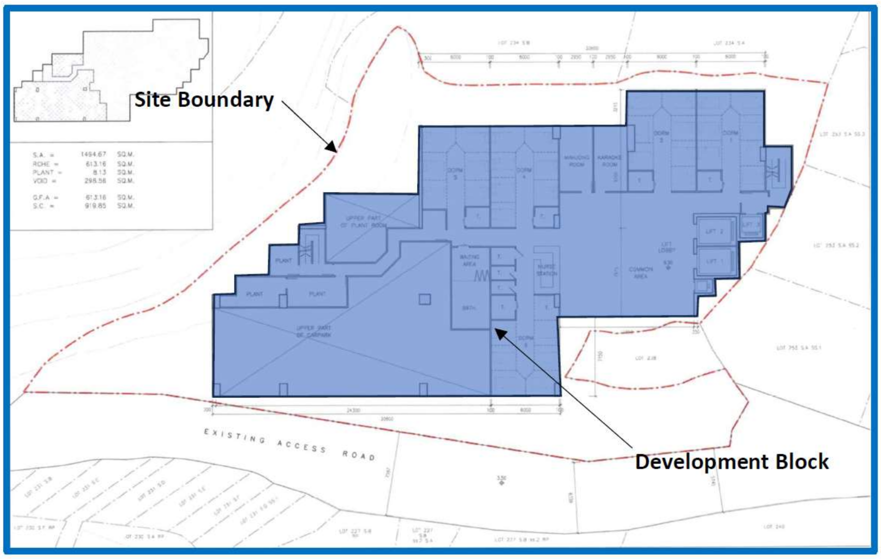
The Premise: D.D.23, Lot 232RP, 232 S.A. RP, 232 S.A.ss. 1 to 14, 232 S.B. RP, 232 S.B. ss 1 to 2, 232 S.C. to 232 S.E., 233 RP, 233 S.A to 233 S.M., 237 S.R. 238, 239 RP, 239 SG.

Address: Tung Tsz, Tai Po

Location Plan:



Development Plan:



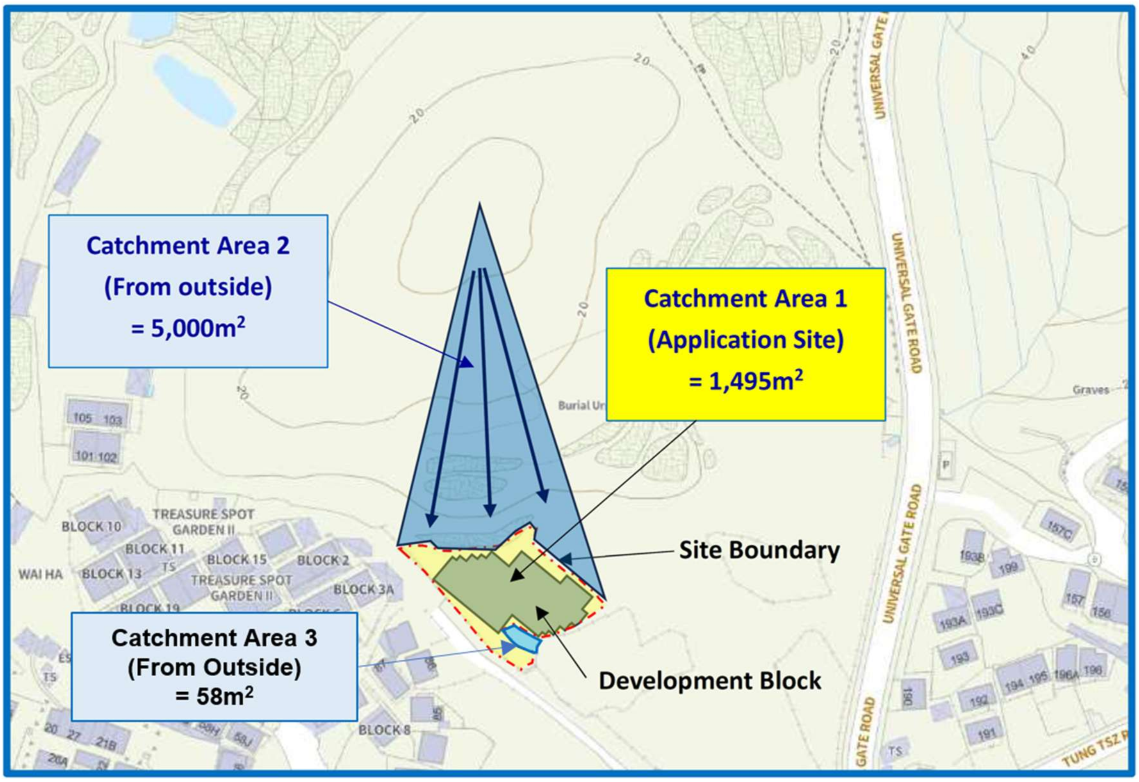
Development Schedule: Proposed Residential Care Home for the Elderly (RCHE) Development

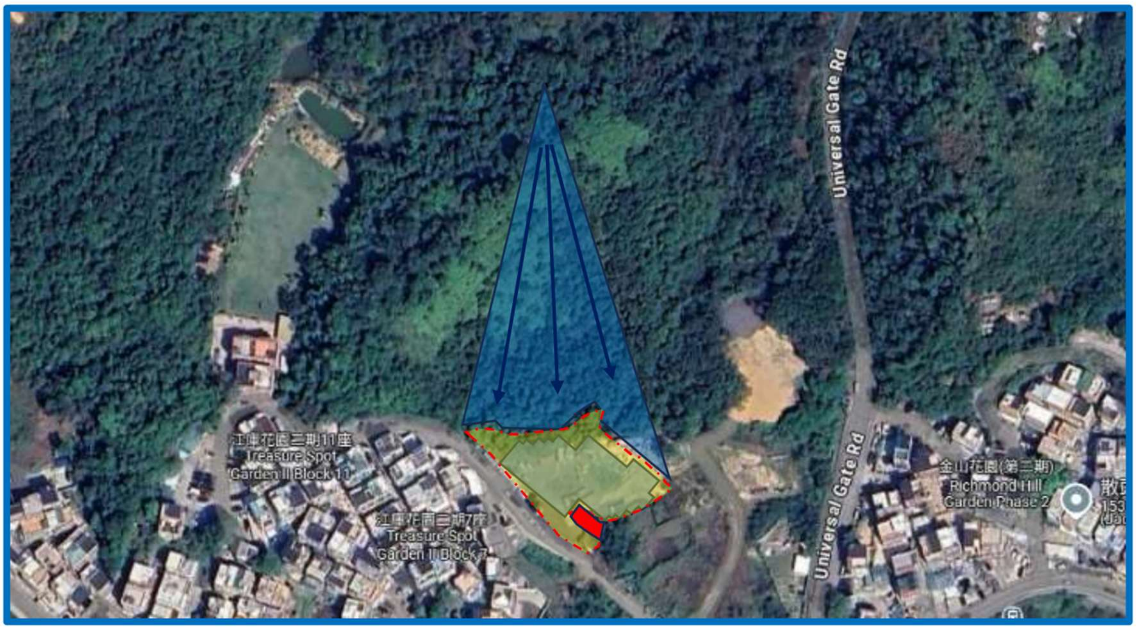
Site Area:	1,494.67m^2
Class of Site:	A
Proposed Plot Ratio for Non-domestic:	5.20 < 9.5
Proposed Site Coverage above for Non-domestic (Above 15m):	62.42% < 80%
Proposed Building Height:	34.50mPD
Absolute Height:	31.0m
Proposed No. of storey:	10 storeys

No. of beds						
Floor	No. of storey	Dorm		Isolation room		Staff
		Each floor	Sub-total	Each floor	Sub-total	
1/F-5/F	5	41	205	2	10	0
6/F	1	18	18	0	0	0
7/F	1	11	11	0	0	0
8F	1	0	0	0	0	12
	Total		234		10	12

4. Drainage Impact Assessment

i) Catchment Areas





Catchment Area 1 (Application Site, existing, concrete paved) = 1,495m^2
Catchment Area 1 (Application Site, proposed to be paved with asphalt) = 1,495m^2
Catchment Area 2 (From the adjacent hillside, grass land) = 5,000m^2
Catchment Area 3 (Lot No. 238, DD 23) = 58m^2

ii) Design Manuel

In evaluating the drainage impact arising from the Propose Development, the following sources of information have been specifically referred to:

- Stormwater Drainage Manual (SDM) Fifth Edition, January 2018
- Storm Drainage Manual (SDM) – Corrigendum No. 1/2022
- DSD's Advice Note No. 1 – Application of the Drainage Impact Assessment Process to Private Sector Projects; and
- Drainage Record Plan obtained from the GeoInfo map Services of the Lands Department (https://www.map.gov.hk/gm/?lg=en)

iii) Design Method

a) Rational Method (DSD STORMWATER DRAINAGE MANUAL 7.5.2)

$Q_p = 0.278CiA$

Where

Q_p = peak runoff in m^3/s

C = runoff coefficient (dimensionless)

i = rainfall intensity in mm/hr

A = catchment area in km^2

b) Runoff Coefficient

In Hong Kong, a value of C = 1.0 is commonly used in developed urban areas. In less developed areas, appropriate C values in order to ensure that the design would be fully cost-effective.

Surface Characteristics	Runoff coefficient, C*
Asphalt	0.70-0.95
Concrete	0.80-0.95
Brick	0.70-0.85
Grassland (heavy soil**)	
Flat	0.13-0.25
Steep	0.25-0.35
Grassland (sandy soil)	
Flat	0.05-0.15
Steep	0.15-0.20

The existing site has been concreted while majority of vegetations have been cleared, C1 of the existing site is taken as 0.8 conservatively.

The surface of the site will be covered by Asphalt, C1 of the proposed developed site should be 0.95 and the surface of the adjacent hill side is Grassland (sandy soil, steep), the C2 should be 0.2. The Lot No. 238, DD 23 is mainly Grassland (sandy soil, flat), the C3 should be 0.15.

c) 6.6.1 Village Drainage and Main Rural Catchment Drainage Channels
'Village Drainage' refers to the local stormwater drainage system within a village. A stormwater drain conveying stormwater runoff from an upstream catchment but happens to pass through a village may need to be considered as either a 'Main Rural Catchment Drainage Channel' or 'Village Drainage', depending on the nature and size of the upstream catchment. In any case, the impact of a 50-year event should be assessed in the planning and design of village drainage system to check whether a higher standard than 10 years is justified. (50 Years is used.)

d) Rainfall Intensity

Table 2d – Intensity-Duration-Frequency (IDF) Relationship of North District Area for durations not exceeding 240 minutes

Duration (min)	**Extreme Intensity (mm/h) for various Return Periods T (year)**						
	2	5	10	20	50	100	200
240	29.0	38.2	44.5	50.7	59.1	65.6	72.3
120	42.4	54.9	63.2	71.2	81.8	89.8	97.8
60	62.0	77.1	86.1	94.3	104	111	118
30	85.7	103	113	122	133	141	148
15	108	129	141	151	164	173	182
10	120	141	155	168	187	203	219
5	139	162	177	192	214	231	251

Notes:

1. based on continuous rainfall recorded at GEO rain gauges N05 (40 years), N34 (24 years), N46 (24 years), N33 (24 years), N35 (24 years), N36 (24 years), N45 (24 years) and HKO rain gauges EPC (31 years), SSH (20 years), TKL (38 years), R24 (40 years), R29 (39 years), R30_KAT (34 years), SEK (27 years) up to 2023.
2. rainfall IDF relationships are derived from regional frequency analysis of extreme rainfall of local rain gauges.
3. the trends of the extreme rainfalls observed at HKO Headquarters are used to infer the trends at other locations.

i (rainfall intensity) = 214mm/hr (Duration of 5 min is adopted as conservative approach)

e) Climate Change

Climate change is taken into account in drainage system capacity check calculation.

- 16.0% Rainfall intensity increase for end of 21st century (2081 – 2100) is included referring to SDM, Table 28.
- The tide level adopted in this assessment is referred to Table 9 in the SDM which is given in below:

Table 9 Mean Higher High Water (MHHW) Levels (in mPD)

Replace the table with the following:

Table 9 – Mean Higher High Water (MHHW) Levels (in mPD)

North Point/ Quarry Bay (1954-2019)	Tai Po Kau (1963-2019)	Tsim Bei Tsui (1974-2019)	Tai O (1985-2019)
2.01	2.02	2.32	2.13

Notes: Data period for analysis at Tai O tide station does not cover 1998-2010 inclusive.

Given that the MHHW level of Tai Po Kau is 2.02mPD while the foundation level of ground level of the proposed development is about 3.5mPD, risk of flooding is not expected.

f) Calculations of Water Flow

Existing Situation

Qp = 0.278 CiA

C1 = 0.8 (Concrete) (Existing Site)

C2 = 0.2 (Grass Land, Sandy Soil, Steep) (Adjacent Area)

C3 = 0.15 (Grass Land, Sandy Soil, Flat) (Adjacent Area)

i = 214 mm/hr

A1 = 1,495m^2 (0.001495km^2) (Existing Site)

A2 = 5,000m^2 (0.005000km^2) (Adjacent Hill Side)

A3 = 58m^2 (0.000058km^2) (Lot No. 238, DD 23)

Qp = 0.278 x 214 x ((0.8 x 0.001495) + (0.2 x 0.005000) + (0.15 x 0.000058))

Qp =0.1312 m^3/s or 7,872 l/min

Proposed Development Situation

Qp = 0.278 CiA

C1 = 0.95 (Asphalt) (Application Site)

C2 = 0.2 (Grass Land, Sandy Soil) (Adjacent Area)

C3 = 0.15 (Grass Land, Sandy Soil, Flat) (Adjacent Area)

i = 214 mm/hr

A1 = 1,495m^2 (0.001495km^2) (Existing Site)

A2 = 5,000m^2 (0.005000km^2) (Adjacent Hill Side)

A3 = 58m^2 (0.000058km^2) (Lot No. 238, DD 23)

Qp = 0.278 x 214 x ((0.95 x 0.001495) + (0.2 x 0.005000) + (0.15 x 0.000058))

Qp =0.1445 m^3/s or 8,670 l/min

By considering Future Site Runoff with climate change increase to end of 21st Century and deposition of sediment, 16.0% and 10% of discharge is added respectively.

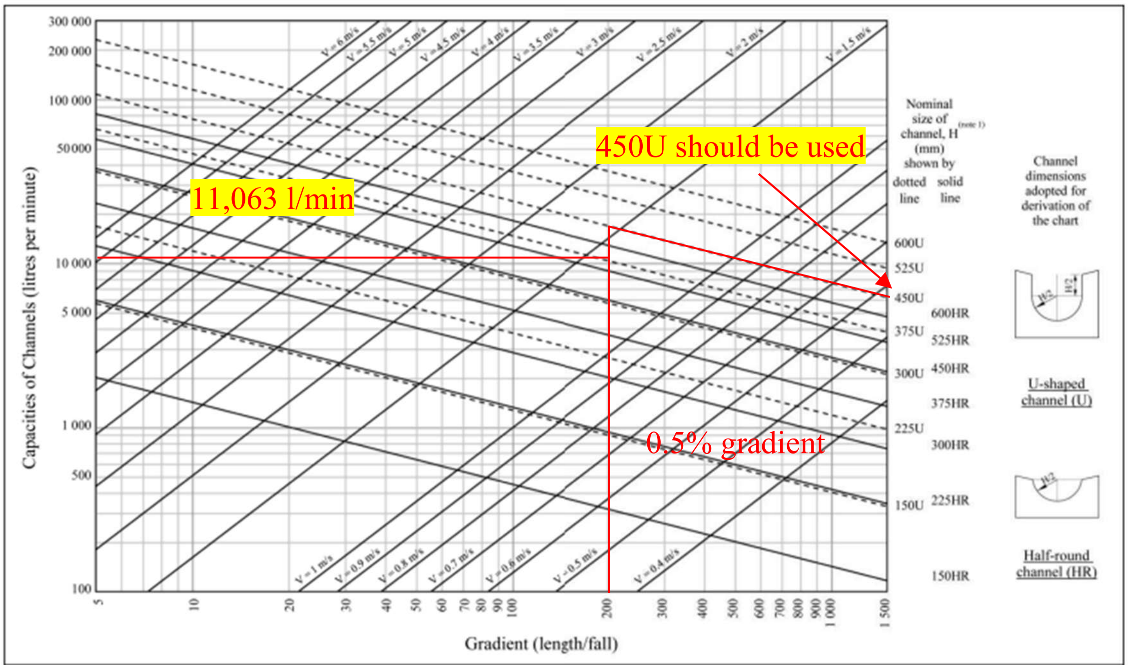
$Qp_{(Design)}$ = Qp x 116% x 110% = 0.1844 m^3/s or 11,063 l/min

For conservative calculations, all catchment areas are combined for all U-Channels.

g) Design of U-channel

GEO Technical Guidance Note No. 43 (TGN 43) Guidelines on Hydraulic

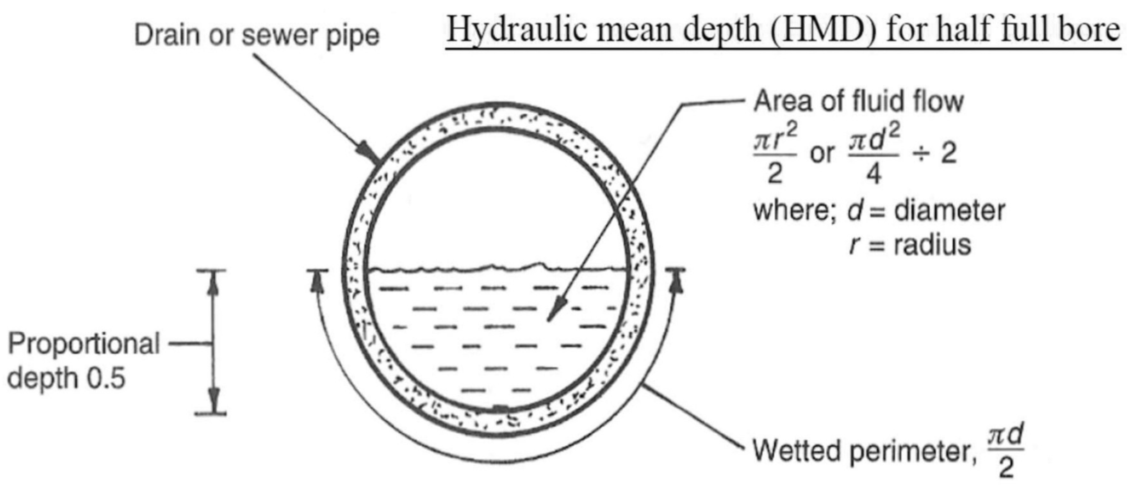
Figure 1 - Chart for the rapid design of U-shaped and half-round channels up to 600 mm



Note: (1) Refer to the latest CEDD Standard Drawings for the details of U-shaped (U) and half-round (HR) channels.

For 11,063 l/min, 450 U-channel will be used

h) Design of Pipe



$$HMD = \frac{\pi r^2}{2} \div \frac{\pi d}{2}$$

Depth of flow	HMD
0.25	Pipe dia. (m) / 6.67
0.33	Pipe dia. (m) / 5.26
0.50	Pipe dia. (m) / 4.00
0.66	Pipe dia. (m) / 3.45
0.75	Pipe dia. (m) / 3.33
Full	Pipe dia. (m) / 4.00

69

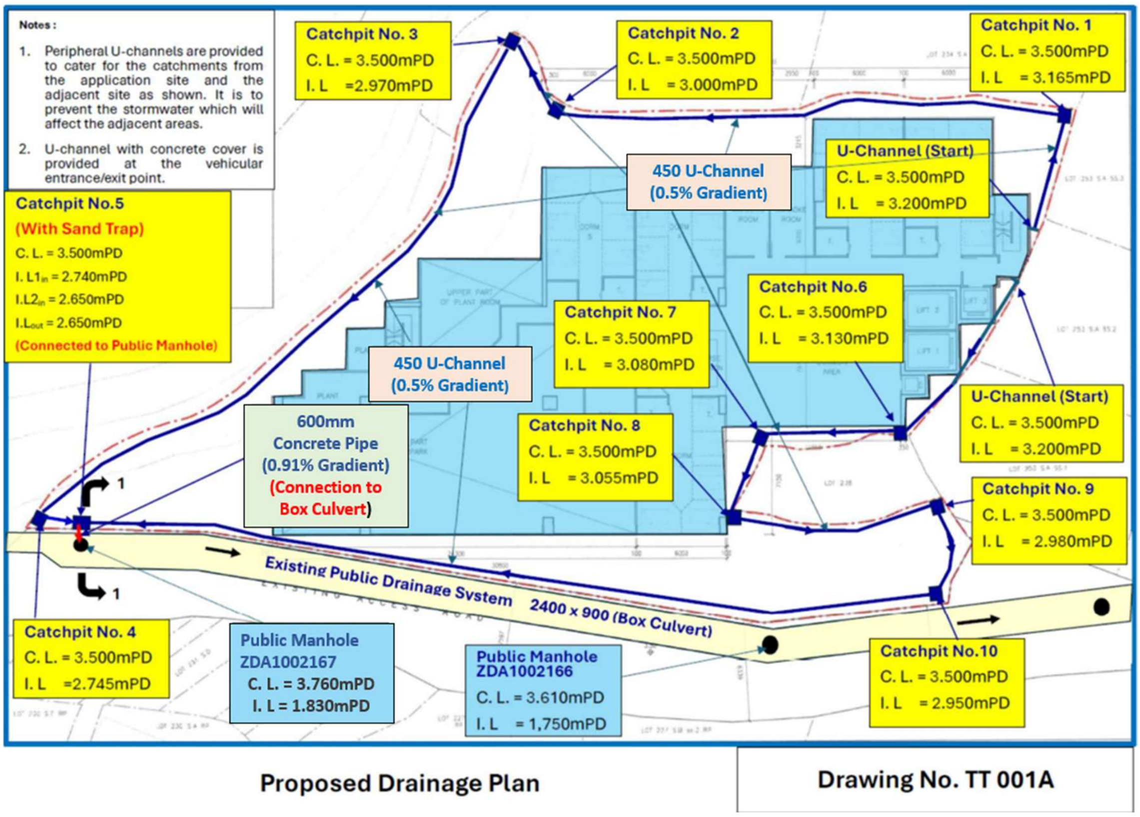
The 0.5 full bore, a self-cleansing velocity of 1.8m/s and 600mm pipe is used.

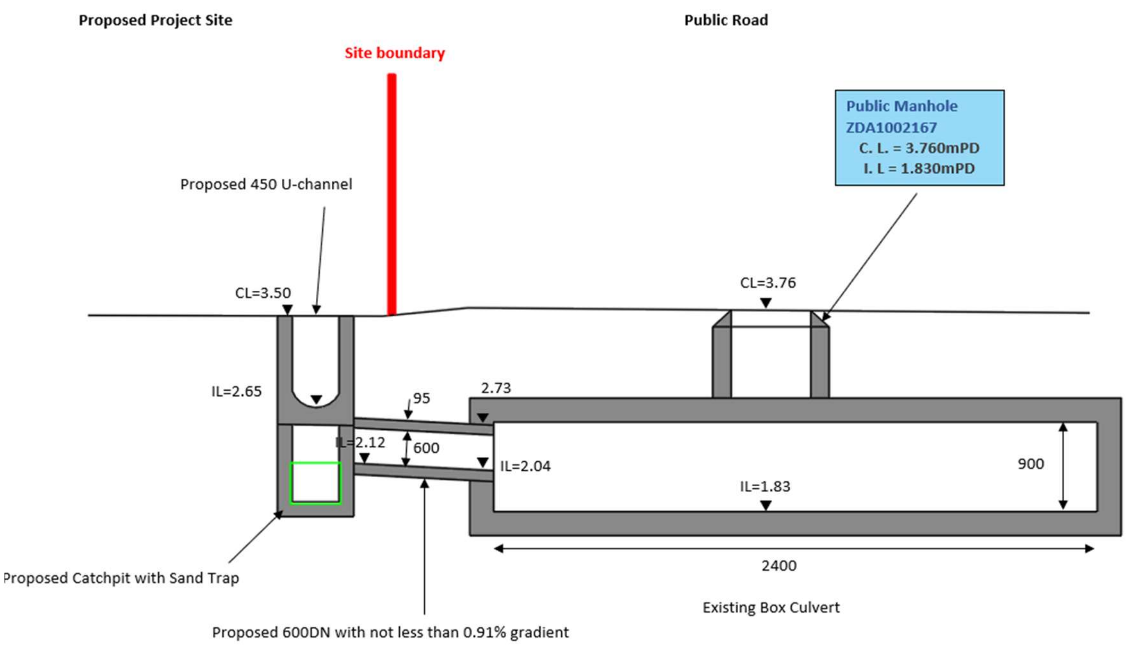
The capacity of the pipe:

$Q = V \times A = (1.8) \times \pi \times (0.600/2)^2 \times 0.5 = 0.2545\ m^3/s > 0.1844\ m^3/s$, OK

Chezy's formula:
$V = C\sqrt{(m \times i)}$
where
V = velocity of flow = 1.8m/s
m = hydraulic mean depth (HMD) → HMD = 0.600 / 4.00 = 0.15
C = Chezy coefficient = $(0.15)^{1/6}$/(0.015(concrete pipe))= 48.59
$1.8 = 48.59 \times (0.15 \times i)^{0.5}$
$(1.8/48.59)^2 = 0.15 \times i$
Thus i = 0.009147 or 0.91% (i = inclination or gradient as 1/X)

iv) Drainage Plan





Section 1-1

Details and method statement for connection of proposed DN600 pipe to the existing box culvert should be submitted for DSD's approval before the connection works. CCTV inspection should be conducted before and after the connection works. DSD should be informed before commencement of the works and the connection works should be conducted in dry season.

Given that the Project site is in close proximity to the existing box culvert located at the southwest side, construction works should be carefully scheduled to maintain the structural integrity of the existing box culvert. Mitigation measures for construction stage are recommended below:

- Less impulsive piling methods such as silent piling and screw piling shall be used near the box culvert to minimize vibration during piling.
- Construction materials and plants shall be located away from the box culvert as far as practicable to minimize loading on the box culvert
- Steel road plates shall be provided at the entrance of the construction site to protect the box culvert from damage caused by heavy vehicles.

In addition, excavation and lateral support (ELS) work would be conducted before major construction work which can prevent damage of the box culvert from ground movement during construction works. No adverse impact on the structural integrity of the existing box culvert is anticipated with implication of the above mitigation measures. Details of construction methods and mitigation measures should be further reviewed during detailed design stage.

5. Calculation of Capacity of existing Box Culvert

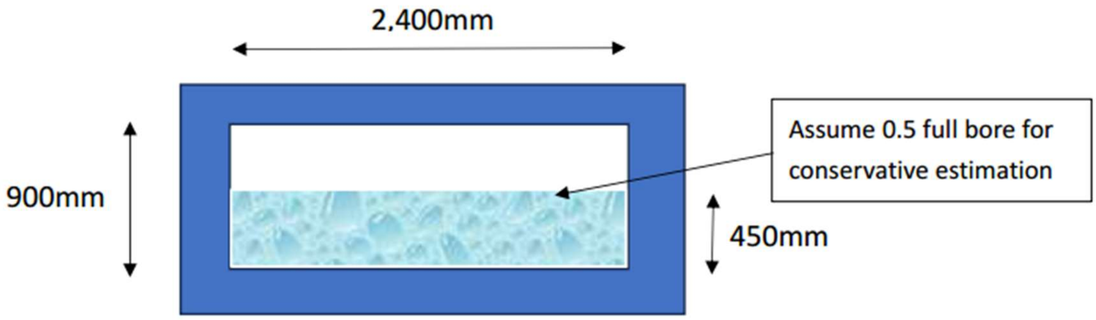
Size of existing box culvert = 2,400mm x 900mm

Invert Level ZDA1002167 = 1.83mPD

Invert Level ZDA1002166 = 1.75mPD

Distance between two manholes =60m

Gradient = (1.83-1.75)/60 = 0.00133 or 0.133%



Typical Cross Section
Of the Existing Box Culvert

Mannings's formula:
$C = m^{1/6} / n$
Where C = Chezy coefficient
n = coefficient of roughness (0.015 for concrete)
m = hydraulic mean depth (HMD) = area of flow / wetted perimeter

Area of flow = 2.4 x 0.45 = 1.08
Wetted perimeter = 0.45 x 2 + 2.4 = 3.3
m = 1.08 / 3.3 = 0.327

$C=0.327^{1/6} / 0.015 = 55.34$

Chezy's formula:

$V = C\sqrt{(m \times i)}$

$V = 55.34 \sqrt{(0.327 \times 0.00133)} = 1.154$ m/s

Capacity of the Existing Box Culvert

$Q = 1.154 \times 1.08 = 1.246\ m^3/s$

Total flow from the proposed development

$=0.1844\ m^3/s < 1.246\ m^3/s$ (Adequate Capacity)

6. Temporary Drainage Arrangements during Construction Stage

Proper measures shall be taken to maintain the existing drainage characteristics of the catchment areas and to minimize drainage impacts associated with the construction works. The principal drainage impacts which are associated with construction of the works have been identified as follows:

(a) Erosion of ground materials;
(b) Sediment transportation to existing downstream drainage system; and
(c) Obstruction to drainage systems.

Temporary drainage system designed with sufficient capacity shall be provided to prevent flood risk within the Application Site. For example, perimeter channels should be provided at site boundary to intercept surface runoff from outside the Application Site so that overland flow across the Application Site can be avoided. Moreover, permanent U-channel shall be constructed prior to commencement of other construction works which can form part of temporary drainage system during construction stage.

To ensure proper operation of the site drainage channels and desilting facilities, inspection of the temporary drainage system shall be carried out on a weekly basis and the desilting facilities shall be cleaned on a daily basis.

If excavated materials are not possible to transport away the excavated materials within the same day, the materials should be covered by tarpaulin/ impervious sheets. Stockpiles of construction materials of more than $50m^3$ in an open area shall also be covered with tarpaulin or similar fabric during rainstorms.

All runoff discharge into the existing drainage system will be settled in a silt trap to ensure no sediment will be discharge into the existing system. Silt traps will normally be provided along the site drainage immediately upstream of the proposed discharge point to the existing Site. The silt traps shall be inspected daily and immediately after each rainstorm.

Liaison shall be carried out with relevant parties regarding temporary drainage arrangements to ensure that the drainage system is functioning adequately.

Further guidelines and site practices outlined in EPD's Practice Note ProPECC PN1/94, DSD Technical Circular No. 14/2000 – Temporary Flow Diversions and Temporary Works Affecting Capacity in Stormwater Drainage System, and DSD Practice Note No. 1/2004 – Design Rainfall Depth for Temporary Works within the Dry Season shall be followed as far as practicable to minimize the adverse drainage impact caused by the construction works.

7. Conclusion

U-channels with catchpits are proposed to convey runoff from the proposed Project site for collection. The collected runoff will be discharge to the existing box culvert by drainage pipe.

The Project Proponent will be responsible for the construction and on-going maintenance of the drainage facilities.

No change of total catchment areas and the increase in stormwater flow is small (from 0.1312 m^3/s to 0.1445 m^3/s), there will be no unacceptable drainage impacts as a result of the proposed development.

The assessment reviews the U-channel and drainage pipe have the sufficient capacity to cater for the drainage flow from the proposed Project site.

Temporary drainage impact mitigation measures and monitoring and audit are proposed to ensure that the existing drainage system will not be affected during the construction stage.