

Appendix E: Revised DIA Report



Pine Garden Foundation Limited

Proposed Tai Po Kau Nature Academy
Drainage Impact Assessment (Project Profile)

October 2022

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1 Introduction

1.1 Background

- 1.1.1 This Drainage Impact Assessment – Project Profile (DIA Project Profile) has been prepared in support of a Planning Application to the Town Planning Board (TPB) for the proposed Tai Po Kau Nature Academy.
- 1.1.2 The Site is to be developed to a visitor centre, activity centre and plant nursery, with ancillary facilities including a camping ground for overnight educational activity. A Master Layout Plan (Application Site Boundary & Proposed Building GFA) is included in **Appendix A**.
- 1.1.3 This Report assesses the drainage impacts in the vicinity of the Site as a result of the proposed development, with discussion of proposed mitigation measures as required.
- 1.1.4 This DIA Project Profile Report has been prepared in accordance with the requirements of the DIA process for private sector projects set out under Drainage Services Department's (DSD's) Technical Advice Note No. 1 (Appendix I).

1.2 Information Available for the Study

- 1.2.1 Reference has been made to Drainage Services Department's (DSD's) Stormwater Drainage Manual (SDM), 5th Edition, and public drainage information presented on DSD's Record Plans and on Land's Department's GeoInfo Map website.
- 1.2.2 A local topographic survey has also been carried out for the Project, with data from the survey adopted for this DIA as necessary.

2 Project Outline

2.1 Project Title

- 2.1.1 The project title is "Proposed Tai Po Kau Nature Academy". The location of the Site is shown on **Figure 1**.

2.2 Proponent

- 2.2.1 The proponent of the project is Pine Garden Foundation Limited.

2.3 Contact Person

2.3.1 For issues relating to this DIA Study, please contact Ir Colin Moreby of AIM Group Limited at 2572 6533.

2.4 Nature and Description of the Project

2.4.1 The proposed Project Site will have an area of approximately 0.9ha.

2.4.2 The Application Site is rural in nature, with a few old buildings and largely overgrown agricultural land. The Site is to the south of Tai Po Road – Tai Po Kau with a small access road running uphill to the Site from Tai Po Kau Garden. Photographs of the existing Site and surrounding areas are included in **Appendix B**.

2.4.3 Based on the current design scheme, there will be a visitor centre, an activity centre and a plant nursery, partly reusing elements of the existing buildings. There will also be an area for overnight camping, as well as footpaths around the Site. The Master Layout Plan is included in **Appendix A**.

2.4.4 The existing Site falls from south to north and from west to east, following the natural topography of the area. The Site falls from approximately +123mPD to +112mPD (south to north) at the western end of the Site and approximately from +110mPD to +99mPD at the eastern end. There will be no substantial changes in levels at the Site as a result of the proposed development.

2.5 Planning Application and Lease Modification

2.5.1 This DIA Project Profile Report has been prepared in support of a S16 Submission to the TPB.

2.5.2 Lease Modification might be required for the proposed development.

2.6 Location and Zoning

2.6.1 The Application Site is located to the south of Tai Po Road – Tai Po Kau, approximately 400m uphill from Tai Po Kau Garden.

2.6.2 The Application Site is within an area currently zoned “Green Belt” under the Tai Po Outline Zoning Plan (OZP) (No. S/TP/29). The adjoining Tai Po Kau Nature Reserve is not covered by any OZP.

3 Planning and Implementation Programme

3.1 Planning and Implementation

- 3.1.1 The proposed development will be planned and implemented under the supervision of appropriately qualified and experienced professionals. The construction of any works for the proposed development will be carried out by a suitable Contractor.

3.2 Project Timetable

- 3.2.1 The Development is expected to be completed by 2024.

3.3 Interface with Other Projects

- 3.3.1 There is no foreseeable direct interaction with other development projects in the area, which should be considered at this time.

4 Existing Drainage

4.1 Existing Drainage Routes and Arrangements

- 4.1.1 The Site is located almost immediately adjacent to (to the south of) a substantial (in the order of 20m wide) natural streamcourse which serves a large upstream catchment, leading up to Grassy Hill. The overall catchment is shown on **Figure 2**. The overall catchment measures approximately 2.47km².
- 4.1.2 The Site itself is located beneath steep naturally vegetated hillsides within the Tai Po Kau Nature Reserve. The local upstream catchment area is shown on **Figure 3**.
- 4.1.3 Immediately to the south of the Site is a simple access road with a 300mm U-Channel on the southern side of the road. The U-channel would collect runoff from the upstream hillsides from minor storm events, but not all runoff from major events (see runoff and channel capacity calculations discussed below). Any substantial runoff would overflow the U-channel and pass overland across the road to the Site. There are no obvious significant drainage channels running down the upstream hillsides, so any runoff would be fairly evenly spread across the catchment (and the Site) rather than at specific locations.

- 4.1.4 Within the Site, there are no apparent main drainage systems, with runoff generally passing overland from south to north, towards the main streamcourse. However, there is a shallow low-lying depression towards the eastern end of the Site, which floods during rainfall events, forming a shallow pond, as indicated in **Appendix A** and on **Figure C2 (Appendix C)**.
- 4.1.5 There are no flooding blackspots in the vicinity of the Site and there is no history of flooding in the area (apart from the natural pond within the Site).
- 4.1.6 There are no known Ecologically Important Streams/Rivers in the catchment in which the Site is located.

5 Drainage Impact Assessment

5.1 Drainage Impact Assessment

General

- 5.1.1 The proposed development at the Site will involve the construction of buildings, although this will partly involve the reuse of elements of some of the existing structures on the Site. Overall, there will be a small increase in the amount of paving compared to the existing situation, with a resultant increase in runoff. These increases have been quantified, as discussed below. The existing and proposed Site areas are shown in **Figures C1 and C2 (Appendix C)** respectively.

Assessment Criteria

- 5.1.2 As the Site and local catchment areas are fairly small, the Rational Method (as set out in Section 7.5.2 of the SDM) has been used for the calculation of runoff. The overall catchment area for the main streamcourse is large (approximately 2.47km²), but, although the Rational Method is not normally appropriate for such a large catchment, it has been adopted to provide a simple indicative “order of magnitude” assessment of runoff from the overall catchment. It is considered that an accurate assessment of the runoff from the overall catchment is not necessary for a simple assessment such as this DIA.
- 5.1.3 The existing Site is gently sloping and mostly vegetated, so a runoff coefficient, C, of 0.25 has been adopted for the unpaved areas. There are some existing buildings and paved walkways around the Site and a runoff coefficient of 0.95 has been adopted for those areas.

- 5.1.4 The future Site will also be mostly vegetated and a similar value ($C = 0.25$) has been adopted for the future greenery areas. However, the project will introduce a range of different materials for various parts of the Site and different runoff coefficients have been adopted for these, as set out in **Appendix C**. For simplicity in later calculations, Appendix C sets out calculations of overall runoff coefficients for the Site under existing and future scenarios.
- 5.1.5 The local upstream catchment and the overall catchment comprise mostly steep naturally vegetated hillsides and a runoff coefficient of 0.35 has been adopted for these areas. These catchments also include some access roads and a coefficient of 0.90 has been adopted for these.
- 5.1.6 The time of concentration, t_c , for the existing Site has been calculated as 3 minutes and this value has been adopted for the future scenario as well.
- 5.1.7 Although the Site will be mostly used for “agriculture”, there will also be camping areas, so the 1 in 10-year storm event has been assessed.
- 5.1.8 In accordance with Section 6.8 of the SDM, allowances for increased rainfall intensity up to mid-21st Century and to the end of the 21st Century have been included in the runoff assessment.
- 5.1.9 There will be a small on-Site Sewage Treatment Plant (STP) and the STP will also discharge to the main stormwater channel. The flows through the STP will be small, but a nominal 5l/s has been allowed for the overall STP discharge rate (N.B. this is a conservative allowance).
- 5.1.10 The 300mm U-channel adjacent to the access road will accept some runoff from the upstream hillsides and the approximate capacity of the channel has been calculated in **Appendix D**, resulting in an assumed nominal available capacity of 0.20m³/s. This capacity has been deducted from the runoff from the local upstream catchment, i.e. the U-channel will convey this flow away from the Site.

5.2 Drainage Impact

- 5.2.1 The existing and future runoff flows from the overall Site and overall catchment are presented in **Appendix E**. For simplicity, any retention within the existing (and future) pond towards the eastern end of the Site has been ignored.
- 5.2.2 The 1 in 10-year peak discharge from the Site alone will increase from 0.204m³/s to 0.244m³/s, i.e. an increase of 0.040m³/s. The peak runoff from the Site plus the local upstream catchment (less the available

capacity of the U-channel) will increase from 0.700m³/s to 0.734m³/s, i.e. an increase of 0.034m³/s. However, the runoff from the overall catchment is estimated to be in the order of 22.3m³/s, so the local increases would be no more than 0.15% of the overall runoff. This is well within the level of accuracy of runoff estimation and the increases are therefore insignificant. It is noted that there are no nearby buildings or roads which might be affected by any changes in runoff.

- 5.2.3 A further factor to consider is that rainwater harvesting may be considered for the development, and, although the details of this have yet to be developed, this may help to reduce the runoff from the Site and surrounding catchment areas. As noted above, there would also be some retention within the pond/water feature, which would further reduce the actual peak runoff.
- 5.2.4 The Site currently receives runoff from the local upstream catchment (in excess of the available capacity of the U-channel adjacent to the road) and this will continue after the proposed development. As the runoff is expected to be widespread (rather than at discrete locations), peripheral channels will be provided. The exact arrangement(s) for the peripheral channels will be determined during later stages of Project implementation, although indicative arrangements and capacities for U-channel and trapezoidal options are included in **Appendix F**.
- 5.2.5 As the area is rural in nature and the Nature Academy is intended to retain a similar environment, it is proposed to use vegetated open channels (or “swales”) for the Site drainage, rather than standard concrete channels. Also, a standard Terminal Manhole would not be appropriate for the Site, so it is intended to provide a simple catchpit instead. The main Site drainage will convey flow generally from the peripheral channel(s) adjacent to the access road across the Site towards the main streamcourse, with runoff from the eastern portion of the Site being conveyed to the pond (water feature). However, as for the peripheral channels, the main Site drainage will be determined in detail during later stages of Project implementation.
- 5.2.6 All drainage facilities within the Site will be constructed and maintained by the Project Proponent.

6 Conclusions

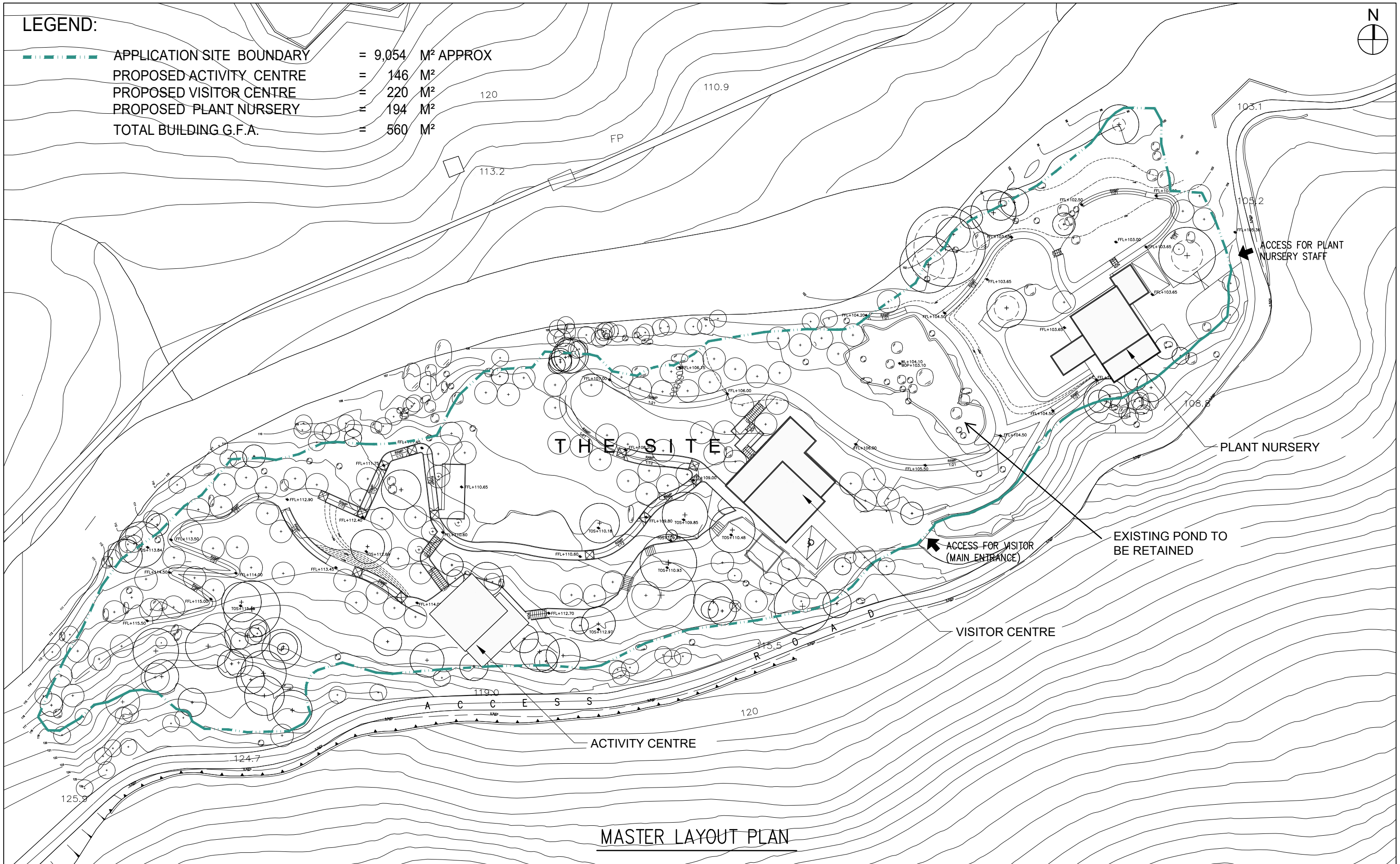
- 6.1.1 The proposed development will result in slightly greater runoff than the existing Site. However, this will be offset by the intended rainwater harvesting to be introduced as part of the Project. There will also be some retention within the pond/water feature towards the eastern end of the Site.
- 6.1.2 In comparison with the runoff from the overall catchment, the increased runoff from the Site is insignificant.
- 6.1.3 There are no nearby buildings or roads, which might be affected by runoff from the Site, so there are no potential flooding impacts.
- 6.1.4 The Site will continue to accept runoff from the local upstream catchment.
- 6.1.5 The Project Proponent will be responsible for the construction and on-going maintenance of the drainage facilities.
- 6.1.6 There will be no unacceptable drainage impacts as a result of the proposed development.
- 6.1.7 No further, more detailed assessment is considered necessary or appropriate, at least at this Stage.

Appendix A


Master Layout Plan


LEGEND:

- - - - - APPLICATION SITE BOUNDARY = 9,054 M² APPROX
- PROPOSED ACTIVITY CENTRE = 146 M²
- PROPOSED VISITOR CENTRE = 220 M²
- PROPOSED PLANT NURSERY = 194 M²
- TOTAL BUILDING G.F.A. = 560 M²



TIP TONY IP GREEN ARCHITECTS LTD.
 葉頌文環保建築師事務所
 Unit 328, Mega Cube, 8 Wang Kwong Road,
 Kowloon Bay, Hong Kong
 T (852) 3596 7800 F (852) 3612 4916
 E green@tonyip.green
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PROJECT MANAGER

 SMILEY PLANET

LANDSCAPE ARCHITECT

 SQUARE METRES DESIGN

Check all measurements on site. Do not scale off drawings.
 This drawing is to be read in conjunction with the specification and any discrepancies are to be immediately reported to the Architect.
 This drawing remains the copyright property of the Architect and is not to be reproduced in whole or in part without permission of the Architect.

| REV. | DESCRIPTION | DATE |
|------|-------------|------|
| | | |
| | | |
| | | |

PROJECT TITLE
 TAI PO KAU
 NATURE ACADEMY

DRAWING TITLE
 MASTER LAYOUT PLAN

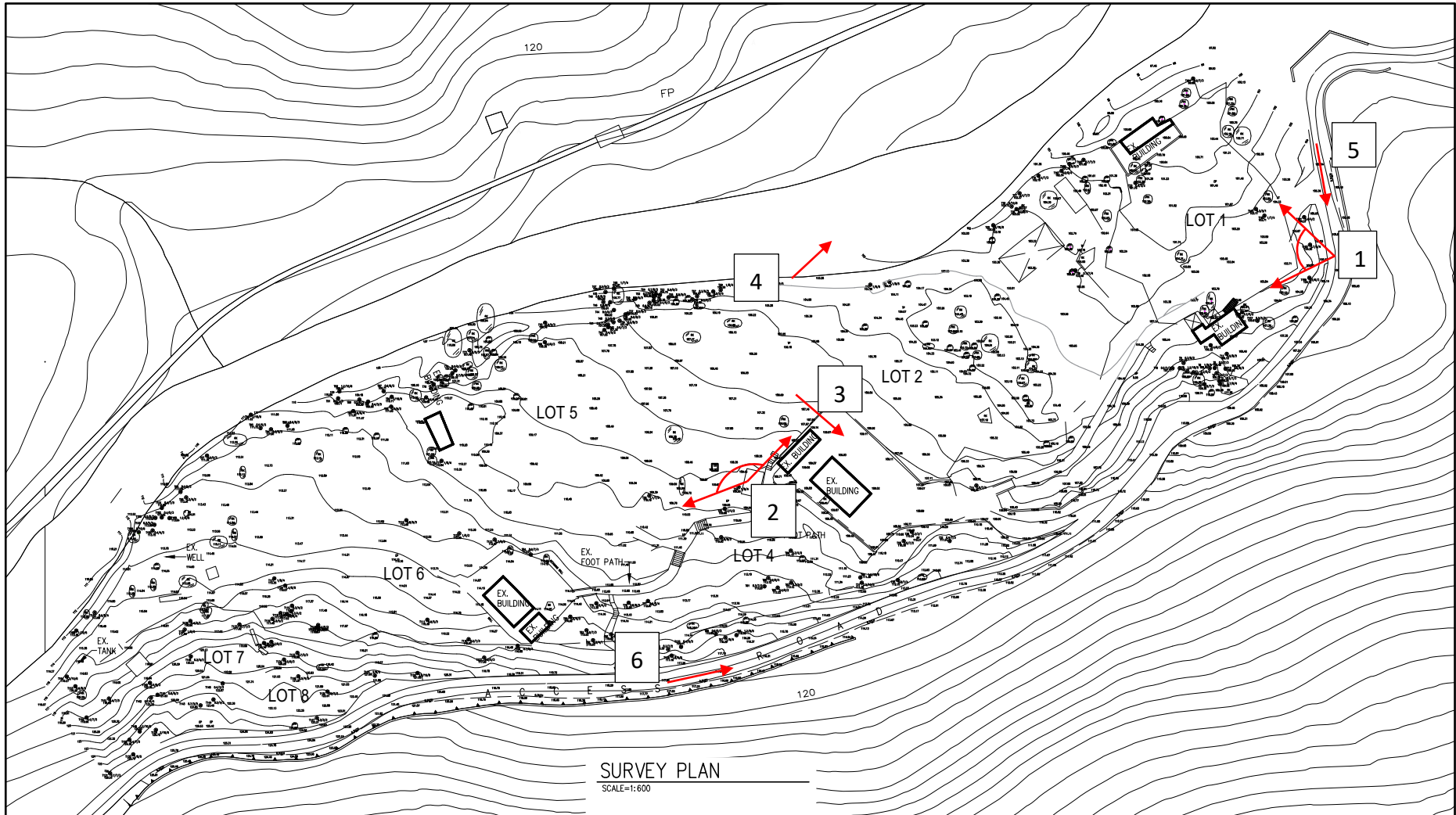
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| SCALE 1: 600 @ A3 | CHECKED BY AK |
| DATE 16/05/2022 | APPROVED BY TI |
| DRAWING NO. PLN001 | REV. NO. |

DRAWING PURPOSE

Indicative Only

Appendix B

Site Photographs



1 → Appendix B Plate Number and View

| | |
|---|--------------------------------------|
| Proposed Tai Po Kau Nature Academy | Locations of Site Photographs |
| | Figure B1 |

C197 – Proposed Tai Po Kau Nature Academy
Appendix B –Site Photographs (Dated March 2022)

See Separate Plan for Locations.



Plate 1 – Overview of the Site



Plate 2 – Overview of the Site



Plate 3 – Existing Building and Paving



Plate 4 – Main Streamcourse (north of the Site)



Plate 5 – Upstream Catchment (vegetated hillside south of the Site)



Plate 6 – Access Road and 300mm U-channel

Appendix C

Overall Runoff Coefficients

**C197 - Proposed Tai Po Kau Nature Academy
Site Areas**

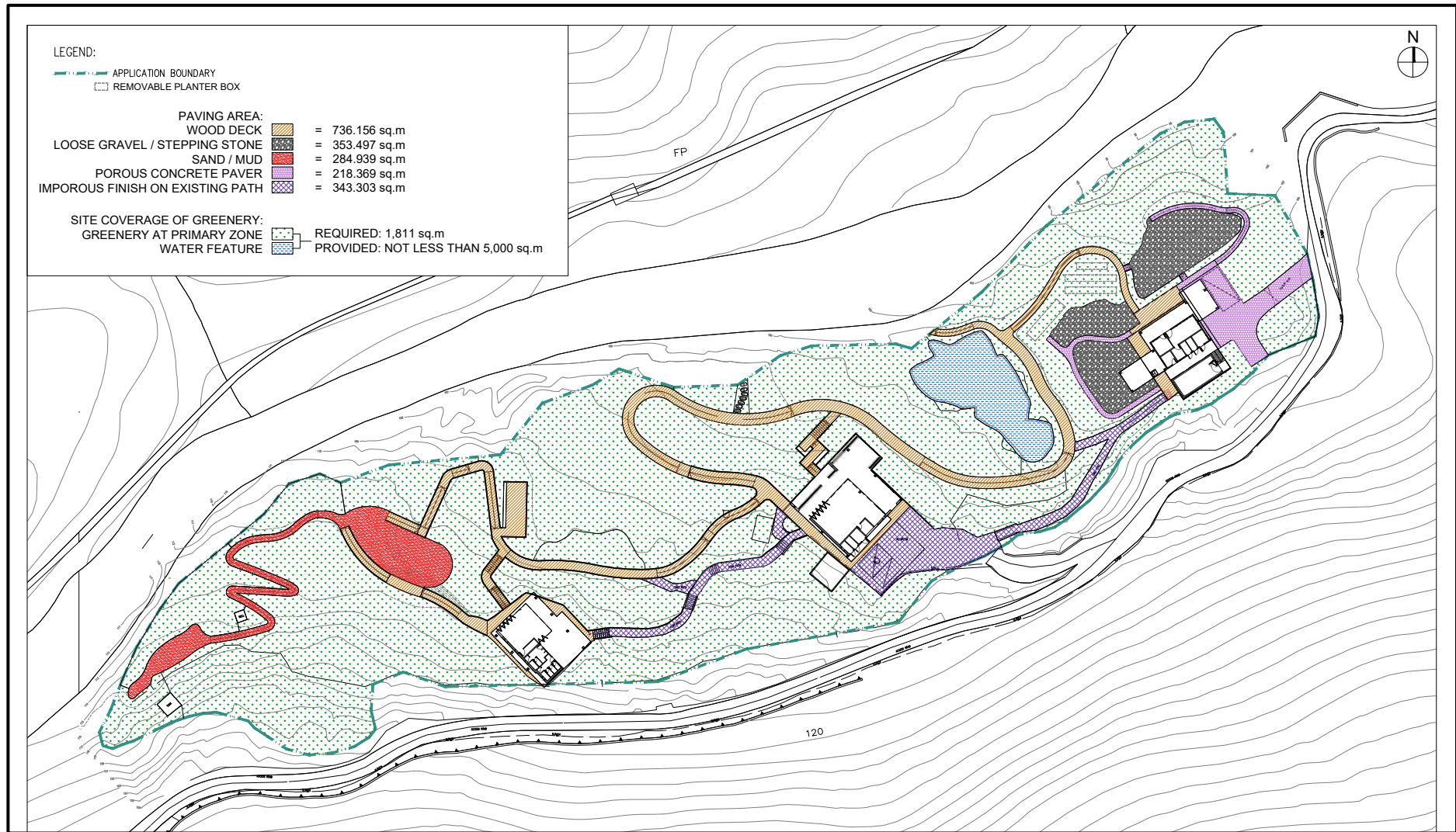
| | <u>Areas</u> | <u>Proposed C Value</u> | <u>Factored Area</u> |
|--|-----------------------------|-----------------------------------|--------------------------------|
| <u>Existing</u> | | | |
| Project Area | 9,054.000 m ² | | |
| <i>Existing Paving (from GeolInfomap measurements) as shown on Figure C1</i> | | | |
| Existing Paving | 1,241.290 m ² | 0.95 | 1,179.226 m ² |
| Existing Structure | <u>54.290 m²</u> | 0.95 | 51.576 m ² |
| Existing Paving | 1,295.580 m ² | | |
| Unpaved/Vegetated | 7,758.420 m ² | 0.25 | <u>1,939.605 m²</u> |
| | | Total Factored Area | 3,170.406 m² |
| | | Overall Runoff Coefficient | 0.35 |

Future

| | | | |
|---|------------------------------|-----------------------------------|---|
| Project Area | 9,054.000 m ² | | |
| <i>Future Areas (see AC-01 220616), as shown on Figure C2</i> | | | <u>Factored Area</u> (m ²) |
| Wood Deck | 736.156 m ² | 0.70 | 515.309 |
| Gravel/Stone | 353.497 m ² | 0.80 | 282.798 |
| Sand/Mud | 284.939 m ² | 0.25 | 71.235 |
| Porous Concrete Paving | 218.369 m ² | 0.35 | 76.429 |
| Impervious Paving | 343.303 m ² | 0.95 | 326.138 |
| Greenery | 6,292.696 m ² | 0.25 | 1,573.174 |
| Water Feature | <u>265.040 m²</u> | 1.00 | 265.040 |
| Sub-total | 8,494.000 m ² | | |
| Buildings | <u>560.000 m²</u> | 1.00 | <u>560.000</u> |
| Total | 9,054.000 m ² | Total Factored Area | 3,670.123 m² |
| | | Overall Runoff Coefficient | 0.41 |



| | |
|---|-----------------------------|
| Proposed Tai Po Kau Nature Academy | Existing Paved Areas |
| | Figure C1 |



Proposed Tai Po Kau Nature Academy

Future Site Catchment Areas

Figure C2

Appendix D

Existing U-Channel Capacity

C197 - Proposed Tai Po Kau Nature Academy
Capacity of Existing U-Channel

Based on sample section:

Upstream Level = 112.07 mPD
Downstream Level = 108.92 mPD
Difference = 3.15 mPD

Distance = 51 m

Gradient = 1 in 16.2

SAY, 1 in 20

Using Manning's Equation:

D = 300 mm

A* = 0.076 m²

P = 0.771 m

R = A/P = 0.099 m

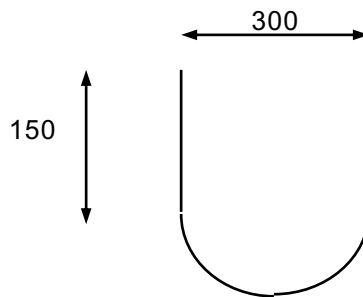
n = 0.015

(R^{2/3})/n = 14.154

s = 0.050

V = 3.16 m/s

Q = 0.242 m³/s



* Assumes 5% loss for siltation (gradient > 1:25)

Channel serves a larger catchment, so say available capacity = 0.20m³/s

Appendix E

Runoff Calculations

C197 - Proposed Tai Po Kau Nature Academy
Overall Catchment Areas and Run-off (1 in 10 Year)

Refer:
 DSD Stormwater Drainage Manual
 GeoInfo Map
 MLP for the Site

Notes:
 The existing Site comprises gently sloping vegetated soil; C = 0.25, and some existing buildings/paved areas; C = 0.95
 The future Site will comprise some buildings and various other surfaces - see Runoff Coefficients below.
 The overall catchment and local upstream catchment mostly comprise steep naturally vegetated hillsides; C = 0.35.
 The Site will be used for "Agriculture", but also overnight camping, so check the 1 in 10-year Scenario.
 The discharge from the Site will be to a Main Rural Drainage Channel (a large natural streamcourse), so also check the 1 in 50-year Scenario.
 The Site Catchment is small, so Rational Method is appropriate. Overall Catchment is large (>1.5km²), but adopt the Rational Method for simplicity and as an indication of magnitude.
 Allowances for increased rainfall intensity are to be included, in accordance with Section 6.8 of the DSD Stormwater Drainage Manual. The Site is at high elevation and will not be tidally affected.

a, b and c from the DSD Stormwater Manual (Table 3a - HKO)
 1 in 10 year a b c
 471.9 3.02 0.397

Intensity = a/(t_c+b)^c

| Catchment | Area (m ²) | Levels (mPD) ¹ | | Fall (m) | Overland, L (m) | Fall, H (m/100m) | Overland t _c (min) | Total t _c (min) | Intensity (mm/h) | Runoff Coefficient | Run-off (m ³ /s) | Remarks |
|---|---------------------------|---------------------------|------------|-------------|--------------------|---------------------|----------------------------------|-------------------------------|---------------------|-----------------------|--------------------------------|---|
| | | Upstream | Downstream | | | | | | | | | |
| Existing Situation | | | | | | | | | | | | |
| The Site (Proposed Area) | | | | | | | | | | | | |
| Overall Site Area | 9,054 | 120 | 105 | 15 | 76 | 19.7 | 2.4 | 3.0 | 231 | 0.35 | 0.204 | See separate Runoff Coefficient Calculation (Appendix C) |
| Total | | | | | | | | | | | 0.204 | |
| The Site + Local Upstream Catchment | | | | | | | | | | | | |
| Overall Local Catchment Area (including the Site) | 46,177 | 235 | 103 | 132 | 276 | 47.8 | 6.3 | 6.3 | 195 | 0.35 | 0.171 | Measured from GeoInfo Map See separate Runoff Coefficient Calculation (Appendix C) |
| The Site | 9,054 | | | | | | | | | 0.95 | 0.040 | |
| Access Road (Paved) | 786 | | | | | | | | | 0.35 | 0.688 | |
| External Vegetated Areas (Unpaved - mostly steep) | 36,337 | | | | | | | | | | 0.900 | |
| Total | | | | | | | | | | | 0.200 | |
| Available Capacity of U-channel adjacent to the Access Road | | | | | | | | | | | 0.700 | 0.700 |
| Resultant Discharge from the Site | | | | | | | | | | | | |
| Overall Catchment | | | | | | | | | | | | |
| Overall Catchment Area | ##### | 590 | 95 | 495 | 3,080 | 16.1 | 58.7 | 58.7 | 92 | 0.90 | 0.444 | Catchment data from Grassy Hill |
| Access Roads & The existing Site Buildings/Paving (Paved) | 19,301 | | | | | | | | | 0.35 | 21.905 | |
| Vegetated Areas (Unpaved) | ##### | | | | | | | | | | 22.349 | Indicative order of magnitude only |
| Total | | | | | | | | | | | | |
| Future Situation | | | | | | | | | | | | |
| The Site | | | | | | | | | | | | |
| Overall Site Area | 9,054 | | | | | | | 3.0 | 231 | 0.41 | 0.239 | See separate Runoff Coefficient Calculation (Appendix C) |
| STP Discharge (Nominal) | | | | | | | | | | | 0.005 | |
| Total | | | | | | | | | | | 0.244 | |
| The Site + Local Upstream Catchment | | | | | | | | | | | | |
| Overall Local Catchment Area (including the Site) | 46,177 | 235 | 103 | 132 | 276 | 47.8 | 6.3 | 6.3 | 195 | 0.41 | 0.201 | See separate Runoff Coefficient Calculation (Appendix C) |
| The Site | 9,054 | | | | | | | | | 0.95 | 0.040 | |
| Access Road (Paved) | 786 | | | | | | | | | 0.35 | 0.688 | |
| External Vegetated Areas (Unpaved - mostly steep) | 36,337 | | | | | | | | | | 0.005 | |
| STP Discharge (Nominal) | | | | | | | | | | | 0.934 | |
| Total | | | | | | | | | | | 0.200 | |
| Available Capacity of U-channel adjacent to the Access Road | | | | | | | | | | | 0.734 | Separate discharge via existing U-channel |
| Resultant Discharge from the Site | | | | | | | | | | | | |
| Discharge Towards The Site | | | | | | | | | | | | |
| Access Road (Paved) | | | | | | | | | | | 0.040 | Separate discharge via existing U-channel To be collected by Peripheral Channel(s) |
| External Vegetated Areas (Unpaved - mostly steep) | | | | | | | | | | | 0.688 | |
| Available Capacity of U-channel adjacent to the Access Road | | | | | | | | | | | 0.728 | |
| Overall Discharge Towards the Site | | | | | | | | | | | 0.200 | |
| | | | | | | | | | | | 0.528 | |
| Increase over Existing Situation (The Site) | | | | | | | | | | | 0.040 | |
| %age Increase | | | | | | | | | | | 19.6% | |
| %age Increase Compared to Existing Overall Catchment | | | | | | | | | | | 0.18% | |
| Future Site Runoff with climate change increase to mid-21st Century (STP Discharge + 10.4% increase in rainfall) | | | | | | | | | | | 0.269 | |
| Future Site Runoff with climate change increase to end-21st Century (STP Discharge + 13.8% increase in rainfall) | | | | | | | | | | | 0.277 | |

Appendix F

Future Peripheral Channels

C197 - Proposed Tai Po Kau Nature Academy
Capacity of Future Peripheral Channels
U-Channel Option

Check required sizing for peripheral channels. Assume a vegetated U-channel arrangement

From Runoff Calculations (Appendix E), Total Flow Towards The Site = **0.528 m³/s**

Assume Peripheral Channel divided into 2 sections. Flow/section = **0.264 m³/s**

Assume Gradient = 1 in **100**

Using Manning's Equation:

D = 650 mm

A* = 0.339 m²

P = 1.671 m

R = A/P = 0.203 m

n = 0.040 (SDM Table 13, Canals and ditches, 6. Canals with rough stony beds, weeds on earth banks (Bad))

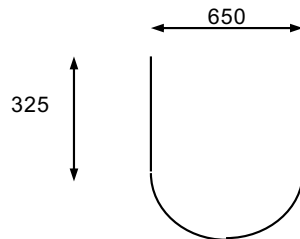
(R^{2/3})/n = 8.593

* Area Assumes 10% loss for siltation (gradient < 1:25)

s = 0.010

V = 0.86 m/s

Q = 0.292 m³/s



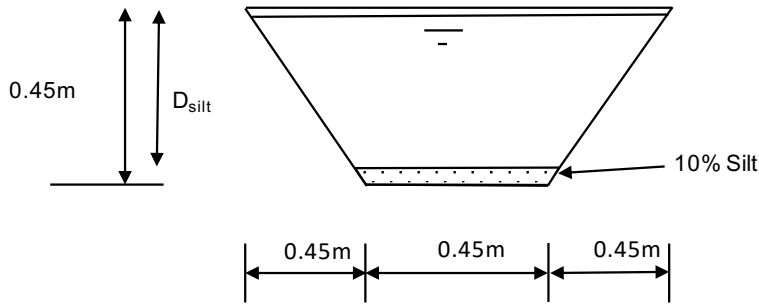
Note: Actual arrangement may be more trapezoidal (natural)

**C197 - Proposed Tai Po Kau Nature Academy
Capacity of Future Peripheral Channels
Trapezoidal Option**

Assume:

1. Peripheral Channel is trapezoidal

Peak Discharge (1 in 10-year) = **0.264 m³/s**



Overall channel gradient, say = 1 in 100 0.010

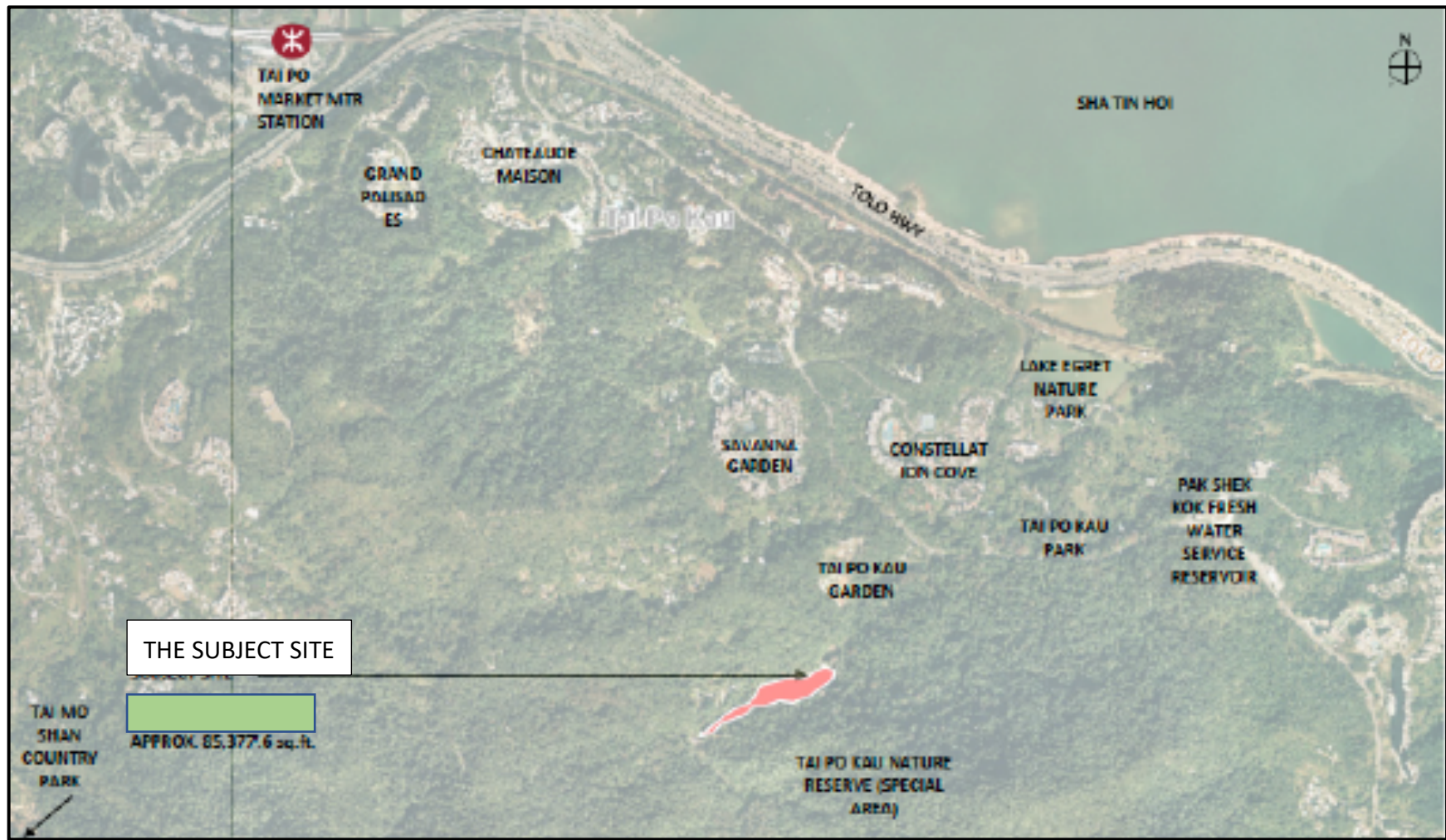
Canals with stony bed and weeds, (bad condition); say, Manning's n = 0.040 (DSD SDM Table 13)

Without Freeboard Allowance

| | |
|--|--|
| B = | 0.45 m |
| D = | 0.45 m |
| D _{silt} = D x 0.9 = | 0.41 m (allowing for 10% silt) |
| Top Width = | 1.35 m |
| A (m ²) = | 0.36 m ² |
| P (m) = | 0.45 m (base) 1.21 m (side walls) <hr/> 1.66 m |
| R (m) = A/P = | 0.22 m |
| Q (m³/s) = Av = A x R^{2/3} x S^{1/2} /n = | 0.33 m³/s (> Peak Flow) |

Appendix G

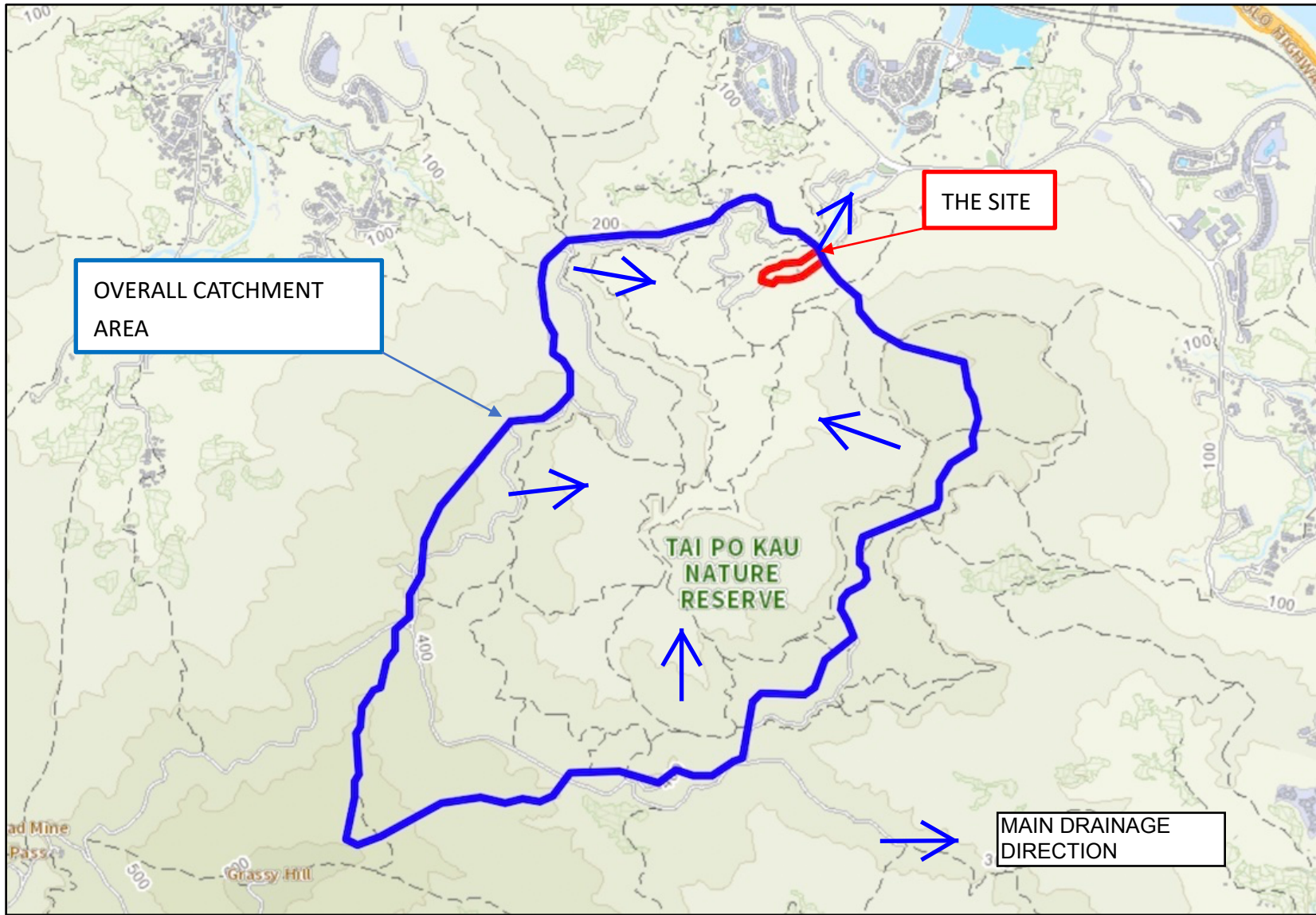
Figures



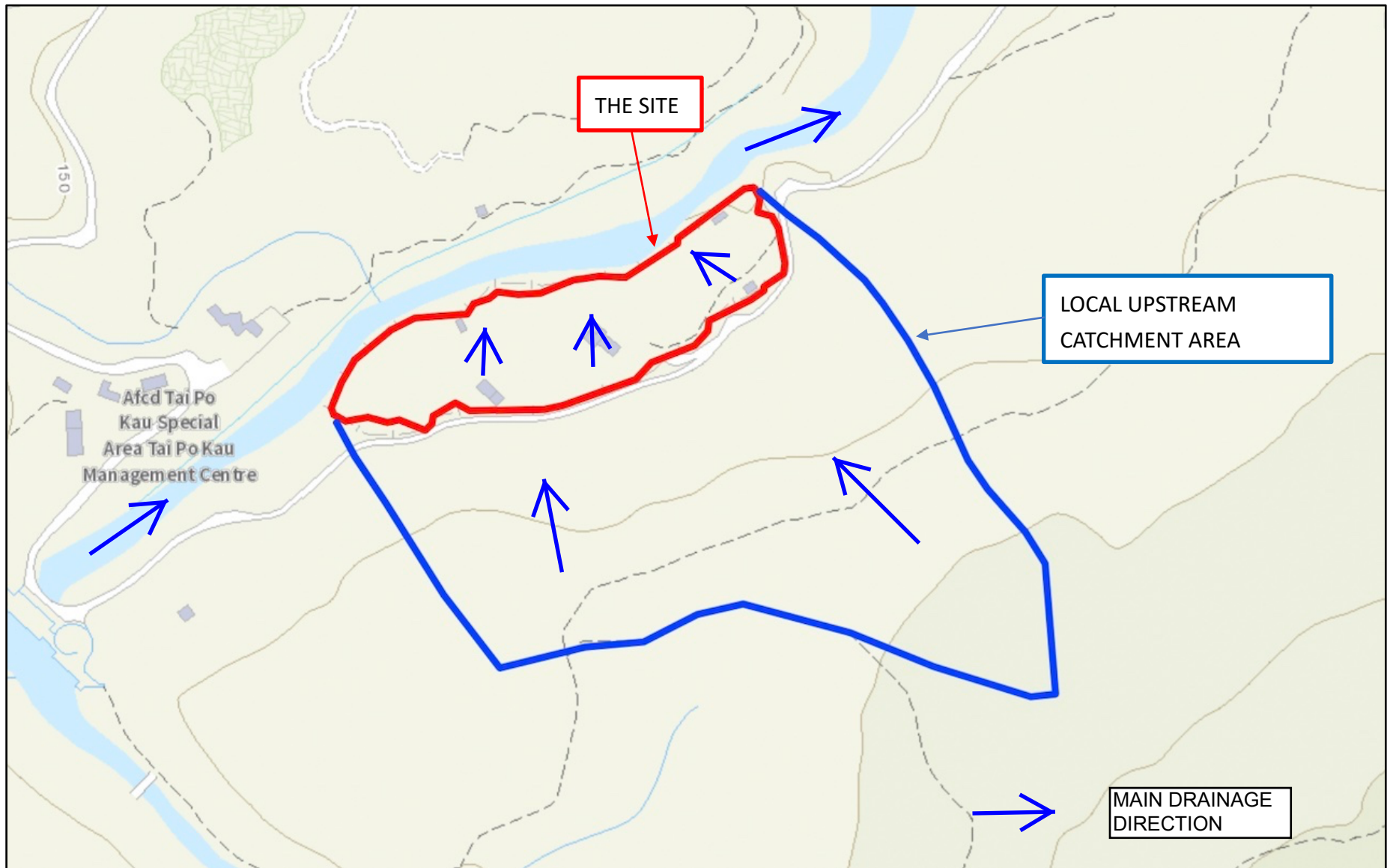
Proposed Tai Po Kau Nature Academy

Site Location Plan

Figure 1



| | |
|------------------------------------|------------------------|
| Proposed Tai Po Kau Nature Academy | Overall Catchment Area |
| | Figure 2 |



Proposed Tai Po Kau Nature Academy

Local Upstream Catchment Area

Figure 3