Hong Kong Housing Authority

Public Housing Development at Wang Chau, Yuen Long

Final Drainage Impact Assessment

REP-034-02

Final | May 2015

IMPORTANT – CONFIDENTIALITY

This project and study shall be kept confidential and any information contained in and/or related to the project/study shall not be disclosed to any person not involved in the project/study.

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Drawings

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226464/OAP/P/022	Proposed Option Layout Plan - PH Site
226464/OAP/C/010	General Boundary of Yuen Long Basin and Tin Shui Wai Basin
226464/OAP/C/011	Existing Main Stormwater Drainage Systems in the Vicinity of Project Site
226464/OAP/C/012	Overview of Proposed Stormwater Drainage
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Appendix A Hydraulic Assessment

Appendix B Hydraulic Modelling Output

1 INTRODUCTION

1.1 Project Background

1.1.1.1 Ove Arup & Partners Hong Kong Limited (Arup) was appointed by Hong Kong Housing Authority (HKHA) to conduct a drainage impact assessment (DIA) for a proposed public housing (PH) development at a potential site at Wang Chau, Yuen Long. The location of the project site and its environs in the vicinity are shown in **Drawing 226464/OAP/P/011**.

1.1.1.2 This DIA is to assess the likely impacts of the proposed development on the existing drainage system, formulate the drainage connection points and recommend the necessary improvement/upgrading/ diversion works.

1.1.1.3 The site currently falls within an area zoned "Green Belt" (GB) according to the Approved Ping Shan Outline Zoning Plan (OZP) No. S/YL-PS/14. Rezoning is required for the proposed PH site.

1.2 Objectives of the Report

1.2.1.1 The report is to present the Drainage Impact Assessment (DIA) due to the proposed PH development at Wang Chau, Yuen Long. It includes formulation of proposed storm drain systems and mitigation measures with an aim to minimize impacts to the existing drainage system, minimizing flood risk within and around the Project site, as well as maximizing the land usage within the Project site.

1.2.1.2 The report substantiates the feasibility of the Project in terms of capability and serviceability of the systems and satisfies the requirement of maintenance authority – Drainage Services Department (DSD).

1.2.1.3 Specifically, the objectives of this report are set out as follows:

- to take cognisance of the existing, committed and planned developments which may have bearing on the development;
- to assess the existing flooding susceptibility;
- to assess the flooding susceptibility of the proposed development;
- to assess the likely impacts of the proposed developments on the existing drainage system upon completion and the impacts on the proposed developments due to the existing problematic flooding problem, in particular at the southeast corner of Fuk Hi Street;
- to carry out schematic design of the drainage system arising from the development including carrying out all necessary hydraulic analysis to substantiate the proposed scheme;
- to formulate drainage connection points and details for the proposed developments to illustrate the hydraulic feasibility of the proposed connection points;

- to formulate and recommend suitable mitigation measures including necessary improvement/upgrading/diversion works to existing and planned drainage systems for the proposed developments.

1.3 Structure of this Report

1.3.1.1 The structure of this Report is as follows:

Section 1 Introduces the background of the study, as well as the purpose of this report.

Section 2 Presents the key data of the proposed development on which the impact assessments is based.

Section 3 Assess the impacts on existing and planned storm drain systems due to the development and formulate corresponding mitigation measures.

Section 4 Conclusion

1.4 Nomenclature and Abbreviations

1.4.1.1 The following **Table 1.4.1** lists out the meaning of abbreviation for expressions adopted in this report:

Table 1.4.1: Abbreviations

Abbreviations	Term
DIA	Drainage Impact Assessment
DMP	Agreement No. CE 46/2007 (DS): Review of Drainage Master Plans in Yuen Long and North Districts – Feasibility Study
DN	Nominal Diameter
DSD	Drainage Services Department
EIA	Environmental Impact Assessment
EVA	Emergency Vehicle Access
GB	Green Belt
GFA	Gross Floor Area
G/IC	Government/ Institution/ Community
HOS	Home Ownership Scheme Site
LOS	Local Open Space
OS	Open Storage
OZP	Outline Zoning Plan
PH	Public Housing Site (This Project)
PRH	Public Rental Housing Site
PR	Plot Ratio
PTI	Public Transport Interchange
VE	Village Environs
YLIE	Yuen Long Industrial Estate (Existing)

2 PROJECT DESCRIPTION

2.1 Site Location

2.1.1.1 The Project site is bounded by Long Ping Road and Long Ping Estate to the east, Chun Hing San Tsuen, Shui Tin Tsuen and Fung Chi Tsuen to the south, Wing Ning Tsuen and Long Tin Road to the west, as well as Kai Shan to the north as indicated in **Drawing 226464/OAP/P/011**. The site area is about 5.6ha.

2.2 Existing Conditions

2.2.1.1 According to the Approved Ping Shan Outline Zoning Plan (OZP) No. S/YL-PS/14, the PH site is zoned as "Green Belt" (GB). It is currently occupied by farmland, fallow land, rural residential dwellings, temporary structures and few open storages.

2.2.1.2 The surrounding areas of the Project site are characterized by a mixture of various land uses. These include high-rise residential development, villages and low-rise residential developments, natural landscapes, burial grounds and graves, open storage uses, major roads and railway tracks.

2.3 Proposed Public Housing Site

Development Proposal

2.3.1.1 The PH site consists of residential buildings for Home Ownership Scheme (HOS) and Public Rental Housing (PRH), car parks, retails, social welfare block, one 24-classroom primary school, and complementary recreational facilities. In addition, a kindergarten and an Estate Management Office (EMO) have also been planned within the PH site.

2.3.1.2 Retail facilities are planned strategically along Long Ping Road to allow street-front shops to serve the future residents. The social welfare block at the south-western tip would accommodate various welfare facilities.

2.3.1.3 **Drawing 226464/OAP/P/022** shows the latest layout plan of the proposed PH development.

Development Parameters

2.3.1.4 The planning parameters are yet to be confirmed at the stage of the study. For purpose of this DIA, technical assessment is based on the tentative planning parameters for the latest layout plan of the proposed development which are summarized in **Table 2.3.1** below.

Table 2.3.1: Summary of Development Parameters

Development	Parameter
Residential	4,019 flats (with estimated population of 12,338 [1])
Non-domestic uses (including refuse collection point (RCP), covered walkway, etc)	4,000 GFA [2] (m^2)
Retail	3,209 GFA [2] (m^2) 2,118 IFA [2] (m^2)
Primary School	24 Classrooms
Social Welfare Facilities	4,450 NOFA [3] (m^2)

Note:
[1] It is assumed that the person per flat is 3.07.
[2] GFA denotes Gross Floor Area and IFA denotes Internal Floor Area
[3] NOFA denotes Net Operating Floor Area

2.3.1.5 Based on the tentative implementation programme, the PH site would be developed in a single phase, and the planned population intake would be in year 2025.

3 DRAINAGE IMPACT ASSESSMENT

3.1 Introduction

3.1.1.1 Liaison with DSD has been made to obtain relevant information and discuss on the potential stormwater drainage impacts arising from the proposed development. A list of data/information obtained is shown in **Table 3.1.1** below.

Table 3.1.1: Information Obtained from DSD

Item No.	Information	Source of Information	Date
1	DSD drainage record plan	DSD/MN	18 Sep 2012
2	Existing and Planned works near the Study Area	DSD/DP	12 Sep 2012
3	Agreement No. CE 46/2007 (DS): Review of Drainage Master Plans in Yuen Long and North Districts – Feasibility Study –Final Report	DSD/LD	26 Mar 2012
4	Meeting with DSD – Discuss on condition of existing drainage system and arrangement of proposed drainage system	N/A	8 Feb 2013

3.2 Methodology

3.2.1.1 The following approach is adopted in carrying out the DIA:

- Identify the scope of development;
- Identify the existing and planned drainage systems within the Study area;
- Perform hydrology and hydraulic analysis to estimate the existing peak flow and corresponding performance of the existing drainage systems in terms of capacity and flood protection level;
- Examine the potential impacts arising from the development on the drainage conditions upon completion; and
- Formulate drainage proposals to serve the proposed development and to mitigate the potential impacts, including improvement or upgrading of existing drainage systems and/or implementation of flood control measures.

3.2.1.2 To minimize the drainage impact on the existing drainage systems, delineation of catchment areas will maintain the same as existing condition as far as practicable such that effective catchment areas at the two major discharge points (Kai Shan South Channel and Shan Pui River) would not be substantially affected, hence minimizing necessary upgrading works and flood protection measures.

3.2.1.3 In order to maximize the land usage within the Project site, existing watercourses across the Project site will be diverted to the proposed

peripheral drains at the slope crest along site boundary, and then collected and discharged to the proposed drainage systems.

3.3 Design Assumptions and Parameters

3.3.1.1 The drainage impacts arising from the proposed development is assessed with reference to the following information:

- Existing and planned developments within the catchment serving the proposed development, including areas upstream of the development such as Kai Shan hillside, and developments between the project site and the point of discharge to existing networks including local villages and roadways.
- Development parameters shown in Section 2;
- Hong Kong Drainage Services Department – Stormwater Drainage Manual (SDM) for Planning, Design and Management, December 2000; and
- Agreement No. CE 46/2007 (DS) – Review of Drainage Master Plans (DMP) in Yuen Long and North Districts – Feasibility Study – Final Report.

3.3.1.2 Hydraulic models are established using *InfoWorks ICM Version 4.0.0.8004* for hydraulic analysis of the drainage system.

3.3.1.3 Four hours (240 minutes) duration rainfall event, symmetrically distributed profile as recommended in the SDM is adopted and 300 minutes of storm simulation time is adopted in the hydraulic model.

3.3.1.4 The proposed drainage system within the project will be designed to 50-year capacity in accordance with DSD's criteria for urban drainage systems. The 50-year event is taken as the highest peak runoff / flood level among the scenarios as shown in the table below.

Table 3.3.1: Criteria for Urban Drainage Systems

Case	Rainfall Event	Sea Level
50A	50-year rain	10-year sea level
50B	10-year rain	50-year sea level

3.3.1.5 The sea level at catchment discharge points at Shan Pui River and Kai Shan South are extracted from DMP as shown in **Table 3.3.2**, and has been adopted as the boundary conditions for this DIA. Boundary conditions of Shan Pui River and Kai Shan South Channel in the hydraulic model should refer to the node no. "SNF1004264 (Shan Pui River)" and "SMH 90008" respectively.

Table 3.3.2: Design Sea Level at Catchment Discharge Point

Catchment Discharge Point [2]	DSD Manhole No. / Node No.	Sea Level [1]	
		10-year	50-year
Shan Pui River	SNF1004264	4.280 mPD	4.359 mPD
Kai Shan South Channel	N/A	8.91 mPD	8.80 mPD

[1] – As taken from Agreement No. CE 46/2007 (DS) – Review of Drainage Master Plans (DMP) in Yuen Long and North Districts – Feasibility Study – Final Report, provided by DSD.

[2] – Catchment discharge points refer to Drawing No. 226464/OAP/C/012.

3.3.1.6 The following rainfall runoff parameters are adopted in this study:

- Runoff coefficients = 0.90 and Routing factor = 1.0 for paved and roof surfaces;
- Runoff coefficients = 0.30 and Routing factor = 4.0 for permeable surface.

3.3.1.7 Colebrook-White and Manning equations are applied for pipe and box culvert hydraulic analysis respectively. The design roughness coefficients for Colebrook-White equation (Ks) and Manning equation (n) for existing pipeline system are 1.5mm and 0.016 respectively. The design roughness coefficients for Colebrook-White equation (Ks) and Manning equation (n) for proposed pipeline system are 0.6mm and 0.016 respectively in consideration of its reduced hydraulic performance in future due to degradation of material.

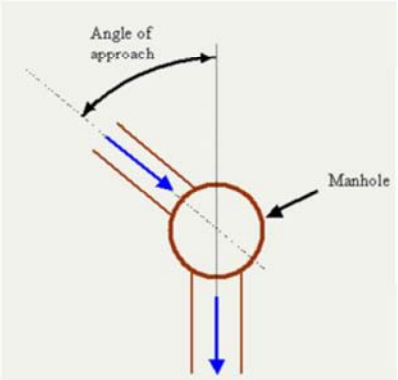
3.3.1.8 According to SDM Clause 6.5, sediment thickness should be excluded from the freeboard calculation. Therefore, no sediment depth is allowed in the hydraulic model for analyzing the design flood level and freeboard. Whilst for capacity checking, provision for sediment depth is allowed as stipulated in DSD SDM Clause 9.3.

3.3.1.9 Criteria for assessing the hydraulic performance of the proposed drainage system are based on the freeboard requirement. With reference to DMP, under this assessment, a minimum 300mm freeboard is adopted for pipeline systems and box culverts to account for inaccuracies in flood level computations.

3.3.1.10 Arising from the proposed development, land use will change from rural to urban, the Project site flood protection level will be increased from 1 in 10-years to 1 in 50-years. The site platforms will be elevated to achieve a minimum 300mm freeboard above the anticipated high water level.

3.3.1.11 In the event of the peak flow occurring in the storm drain system simultaneously with a high sea water level, the system will become surcharged and under the worst case scenario overland flow will occur. However, the extent of flood plain is not the major interest of this assessment and to simplify the hydraulic model, 2D overland flow simulation has not been adopted in the study. The detailed simulation of overland flow and corresponding flood extent maps should be referred to the DMP. The water levels as simulated in the hydraulic model under this study represent the hydraulic grade line of the storm drain system but not the actual water level of the overland flow.

3.3.1.12 The suggested user defined headloss factor (k_u) adopted for the angle of approach in the InfoWorks are as below:



Angle of approach (Degree)	Headloss Factor (k_u)
30	3.3
60	6.0
90	6.6
>90	8.0

3.4 Existing Drainage System

3.4.1 Inventory of Existing Drainage Services

3.4.1.1 With reference to the DSD drainage record plan, an inventory of the existing drainage services in the vicinity of the Project site is shown in **Table 3.4.1**.

Table 3.4.1: Existing Drainage System in Vicinity of the Project Site

Location	Type	Size (mm)	Main Channel Downstream
Along Long Ping Road	Pipeline	900Ø to 1800Ø	Existing 3500(W) x 2000(H) twin cells box culvert
West edge of Fuk Hi Street	Trapezoidal open channel	Exact dimension is not available	Existing 3500(W) x 2000(H) twin cells box culvert
Along Fuk Hi Street near Ting Fook Village	Pipeline	1200Ø	Existing 3500(W) x 2000(H) twin cells box culvert
Along Fuk Hi Street	Box culvert	3500(W) x 2000(H) Twin Cells	Shan Pui River
Kai Shan South (HOS Site)	Water course / Concrete Lined Channel	Variable	Kai Shan South Channel

3.4.1.2 A natural channel was found near the north of the project site directing runoff from the Kai Shan hillside north and drain towards an existing trapezoidal open channel along the west edge of Fuk Hi Street. The DMP indicates frequent flooding problems due to inadequate capacity of the constructed channel.

3.4.1.3 A water course / concrete lined channel (hereafter called Kai Shan South Channel) directs runoff from the southern Kai Shan hillside across the western portion of the project site and into a covered channel near the elevated MTR track.

3.4.1.4 An overview of existing drainage systems is shown in **Drawing No. 226464/OAP/C/011**.

3.4.2 Current Flooding Susceptibility

3.4.2.1 The Review of Drainage Master Plans in Yuen Long and North Districts – Feasibility Study Final Report (DMP) provides comprehensive analysis of existing drainage features within the Yuen Long District including those adjacent to the Project site. The report notably analyses flood protection levels by various return periods on the existing network, including the 50-year return period as the recommended standard for Urban Drainage Branch Networks given in the SDM (2000).

3.4.2.2 According to the DSD drainage record plan, the existing 1200Ø pipe along Fuk Hi Street is designed as an inverted siphon. It is expected that the pipeline is currently surcharged by flow and depth.

3.4.2.3 According to the DMP, the open storage yard at northeast corner of the Project site near Fuk Hi Street was identified as a problematic localized flooding area, mainly due to surface runoff from Kai Shan hillside and insufficient drainage capacity at the downstream network. The DMP reported that for some low spot areas at Ting Fook Village, flooding depth in excess of 600mm is anticipated for the 50-year return period.

3.4.2.4 In addition to the observed flooding area, the DMP has also identified areas susceptible to flooding from between 5-year and 200-year return periods in vicinity of the Project site including the following:

- 90% of pipelines at Yuen Long Industrial Estate (YLIE) will not have adequate capacity to cope with the 50-year flood event. The DMP has recommended mitigation measures including the construction of boundary walls surrounding industrial buildings and advising property owners to modify existing flood gates. It is unknown whether or to what extent these measures have been implemented.
- Intermittent areas along Fuk Hi Street and Long Ping Road are susceptible to flooding in the 5-year and 10-year return periods. This is primarily due to site constraints in which pipelines are located in low lying areas where the ground level is almost the same or lower than the 50-year design water level in the primary channel (Shan Pui River).
- Upstream portion of Kai Shan South Channel has less than 2-year flood protection level.
- The downstream portions of Shan Pui River are identified to have flood protection levels of less than 50-years for the main rural drainage channel. Notably this occurs at the catchment discharge point of the box culvert beneath Fuk Hi Street into the Shan Pui River. The DMP has recommended modification of the existing flood walls along the concerned section of channels to prevent overbank flow during extreme events and installation of flap valves at the outlet of pipelines subject to tidal flow to prevent backflow conditions. At the time of preparing this report, these measures are yet to be implemented.

3.4.2.5 A local low point of ground level +4.80mPD approximately is observed at Long Ping Road near the Long Ping Estate Bus Terminus (DSD Manhole No. SMH 1026952). Special attention shall be paid to this area where the retails, with ground level similar to this low point, are planned.

3.4.3 Existing Catchment Characteristics

3.4.3.1 The Study Area is located within the Yuen Long Basin. The general layout of the basin is shown in **Drawing No. 226464/OAP/C/010**.

3.4.3.2 **Table 3.4.2** summarises the existing catchment areas for this drainage assessment, runoff coefficients and effective catchment areas. The locations of the catchment discharge points are shown in **Drawing No. 226464/OAP/C/012**.

Table 3.4.2: Existing Catchment Areas

Catchment Discharge Point [1]	Node No. [2]	Existing Development			
		Catchment Area (m^2)	Runoff Coefficient, C	Effective Catchment Area (m^2)	Total Effective Catchment Area (m^2)
Shan Pui River	SNF 1004264	380,765	0.90 (Paved Area)	342,689	431,696
		296,690	0.30 (Grassland)	89,007	
Kai Shan South Channel	SMH 90007	151,012	0.30 (Grassland)	45,304	45,304

[1] – Catchment discharge points refer to Drawing No. 226464/OAP/C/012
[2] – Node numbers refer to Drawing Nos. 226464/OAP/C/101 – 102

3.5 Proposed Drainage System

3.5.1 Proposed Catchment Characteristics

3.5.1.1 **Table 3.5.1** summarises the proposed catchment areas for this drainage assessment, runoff coefficients and effective catchment areas. The locations of catchment discharge points are shown in **Drawing No. 226464/OAP/C/012**.

Table 3.5.1: Proposed Catchment Areas

Catchment Discharge Point [1]	Node No. [2]	Proposed Development			
		Catchment Area (m^2)	Runoff Coefficient, C	Effective Catchment Area (m^2)	Total Effective Catchment Area (m^2)
Shan Pui River	SNF 1004264	406,896	0.90 (Paved Area)	366,206	455,213
		296,690	0.30 (Grassland)	89,007	
Kai Shan South Channel	SMH 90007	149,162	0.30 (Grassland)	44,749	44,749

[1] – Catchment discharge points refer to Drawing No. 226464/OAP/C/012
[2] – Node numbers refer to Drawing Nos. 226464/OAP/C/101 – 102

3.5.1.2 For conservative assessment, it has assumed that the site permeability is zero, although the landscape area, permeable pavements and/or green roofs are planned.

3.5.2 Proposed Drainage Scheme

3.5.2.1 The proposed onsite drainage system and upgrading of the offsite drainage system are shown in **Drawing Nos. 226464/OAP/C/101 – 102** and **Drawing No. 226464/OAP/C/701**. **Table 3.5.2** below summarizes the proposed major drainage works.

Table 3.5.2: Proposed Major Drainage Works

Location	Existing Drainage System	Proposed Upgrading/ Diversion Works	Main Channel Downstream
Along Long Ping Road	900Ø to 1800Ø pipeline	1500Ø; 3500(W) x 2000(H) single cell box culvert; 3500(W) x 2000(H) twin cells box culvert	Existing 3500(W) x 2000(H) twin cells box culvert
West edge of Fuk Hi Street	Trapezoidal open channel	Divert to Proposed 3500(W) x 2000(H) twin cells box culvert	Proposed 3500(W) x 2000(H) twin cells box culvert
Along Fuk Hi Street near Ting Fook Village	1200Ø Pipeline	Divert to Proposed 3500(W) x 2000(H) twin cells box culvert	Proposed 3500(W) x 2000(H) twin cells box culvert
Along Fuk Hi Street	3500(W) x 2000(H) Twin Cells Box culvert	3500(W) x 2000(H) twin cells box culvert is proposed adjacent to the existing box culvert	Shan Pui River
Kai Shan South (HOS Site)	Water course / Concrete Lined Channel	Section within Project site to be replaced by 1200Ø pipeline and 2000(W) x 2000(H) box culvert	Kai Shan South Channel
Wang Chau Development	N/A	Proposed peripheral U-channel along the development to intercept flow from hillside; Proposed 1050Ø - 1500Ø pipeline system within the development	Proposed upgraded drainage system along Long Ping Road and existing 3500(W) x 2000(H) twin cells box culvert

[1] – Catchment discharge points and system ID refer to Drawing No. 226464/OAP/C/012

3.5.2.2 The existing watercourses from Kai Shan Hillside running across the Project site will be diverted to the proposed internal drainage system. The proposed catchment areas are designed such that flows entering the Shan Pui River and the Kai Shan South Channel will closely match with the existing regime. The delineation of catchment areas is attached in **Appendix A**.

3.5.2.3 The proposed drainage system will run under public carriageway / Emergency Vehicular Access (EVA) as far as practicable to facilitate future maintenance.

3.5.2.4 Where public drains are proposed outside the public roadways, drainage reserve areas will be allowed to ensure free and unrestricted

access at all times for maintenance. The drainage reserve layout is shown in **Drawing Nos. 226464/OAP/C/101–102**.

3.5.2.5 It is proposed that storm drainage mainlines be concrete and comply with DSD standard details. The u-channels should be in-situ or precast concrete and comply with the CEDD standard details. Adherence to the CEDD and DSD standards shall be maintained during detailed design and construction stages.

3.6 Drainage Impact Assessment

3.6.1 Estimated Flows

3.6.1.1 Hydraulic assessment on the capacity of the proposed drainage system is provided in **Appendix A**. Hydraulic modelling software *InfoWorks ICM* has been adopted to evaluate the back water effect on the proposed drainage system and to estimate the runoff and flood level for both existing and with proposed development scenarios. The modelling results are given in **Appendix B**. The key findings of the hydraulic assessment are summarized below.

3.6.1.2 **Table 3.6.1** shows the peak flow from the Study Area to the discharge points for both existing and with proposed development scenarios and its comparison with the corresponding discharge capacity.

Table 3.6.1: Estimated Peak Flows at Catchment Discharge Points

Catchment Discharge Point [1]	Node No. [1]	Existing Condition	Existing Connection		Capacity of Existing Conduit (m^3/s)
		Peak Flow (m^3/s)	Conduit Dimension (mm)	Slope (1 in)	
Shan Pui River	SNF 1004264	22.14	3500(W) x 2000(H) Twin Cells Box Culvert	600	26.35
Kai Shan South Channel	SMH 90007	2.128	Variable	50 (average)	No available data
Catchment Discharge Point [1]	**Node No. [1]**	**Proposed Development**	**Proposed Connection**		**Capacity of Proposed Conduit (m^3/s)**
		Peak Flow (m^3/s)	**Conduit Dimension (mm)**	**Slope (1 in)**	
Shan Pui River	SNF 1004264	28.93	2 Nos. of 3500(W) x 2000(H) Twin Cells Box Culvert	600	52.9
Kai Shan South Channel	SMH 90007	2.102	Ø1200 Pipe and 2000(W) x 2000(H) box culvert	200	3.0

[1] – Catchment discharge points and node layout numbers refer to Drawing Nos. 226464/OAP/C/101–102

3.6.1.3 The result revealed that the peak flow discharge to Shan Pui River under 50-year rainfall event will be increased by approximately 6.8 m^3/s due to the increased effective catchment area.

3.6.1.4 Due to the increased time of concentration and a decrease in effective catchment area from the south Kai Shan hillside, the peak runoff to the

Kai Shan South Channel will be slightly reduced. Therefore no adverse impacts on Kai Shan South Channel and downstream are expected.

3.6.1.5 The proposed drainage scheme will relieve the flooding condition at the northeast corner of the Project site near Fuk Hi Street through increased flow diversion and increased drainage capacity. Therefore flooding problems at this area will be improved.

3.6.2 Estimated Water Levels

3.6.2.1 Based on the hydraulic assessment results, the estimated water levels at the catchment discharge points under existing and with proposed development scenarios are determined.

3.6.2.2 Attention is drawn to the locations with insufficient freeboard under the existing condition (not in compliance with DSD standard). These locations are identified in **Tables 3.6.2, 3.6.3 and 3.6.4** and layout plan should be referred to the performance drawings in **Appendix B**. The existing 900Ø to 1800Ø pipeline system along Long Ping Road is surcharged by flow and/or depth with insufficient freeboard under 50-year design event due to insufficient design capacity and high water level at Shan Pui River. It is considered that the pipeline system is under sub-standard design condition to serve the existing developed area, Long Ping Estate.

Table 3.6.2: Estimated Water Level under Existing Condition (With Insufficient Freeboard) and under Proposed Condition with Mitigation Measures Implemented – Scenario 50A

Location	Node No.	Ground Level (mPD)	Existing Condition		With Proposed Development and Mitigation Measures		
			Water Level [2] (mPD)	Freeboard [3] (m)	Node No. [1]	Water Level [2] (mPD)	Freeboard [3] (m)
Fuk Hi Street	SNF 1004264	4.00	4.280	-0.280	SNF 1004264	4.281	-0.281
	SMH 1031680	4.28	4.928	-0.648	SNF 1004400	4.568	-0.288
	SMH 1031687	4.17	5.149	-0.979	SMH 1031687	5.014	-0.844
	SGJ 1006888	5.00	4.916	0.084	SGJ 1006888	4.578	0.422
Long Ping Road	SMH 1026990	5.30	5.557	-0.257	N/A	N/A	N/A
	SMH 1026956	5.10	5.709	-0.609	SMH 1026956	4.790	0.310
	SMH 1026957	4.90	5.720	-0.820	SMH 1026957	4.886	0.014
	SMH 1026951	4.93	5.731	-0.801	SMH 1026951	4.974	-0.044
	SMH 1026952	4.90	5.767	-0.867	SMH 1026952	5.070	-0.170
	SMH 1026953	5.20	5.809	-0.609	SMH 1026953	5.174	0.026
	SMH 1026954	5.25	5.981	-0.731	SMH 1026954	5.272	-0.022
	SMH 1026919	5.22	6.240	-1.020	SMH 1026919	5.427	-0.207
	SMH 1026920	5.80	6.317	-0.517	SMH 1026920	5.652	0.148
	SMH 1010759	5.80	6.389	-0.589	SMH 1010759	5.912	-0.112

Table 3.6.3: Estimated Water Level under Existing Condition (With Insufficient Freeboard) and under

Proposed Condition with Mitigation Measures Implemented – Scenario 50B

Location	Node No.	Ground Level (mPD)	Existing Condition		With Proposed Development and Mitigation Measures		
			Water Level [2] (mPD)	Freeboard [3] (m)	Node No. [1]	Water Level [2] (mPD)	Freeboard [4] (m)
Fuk Hi Street	SNF 1004264	4.00	4.359	-0.359	SNF 1004264	4.360	-0.360
	SMH 1031680	4.28	4.843	-0.563	SNF 1004400	4.564	-0.284
	SMH 1031687	4.17	5.051	-0.881	SMH 1031687	4.931	-0.761
	SGJ 1006888	5.00	4.830	0.170	SGJ 1006888	4.566	0.434
Long Ping Road	SMH 1026990	5.30	5.444	-0.144	N/A	N/A	N/A
	SMH 1026956	5.10	5.579	-0.479	SMH 1026956	4.715	0.385
	SMH 1026957	4.90	5.590	-0.690	SMH 1026957	4.780	0.120
	SMH 1026951	4.93	5.601	-0.671	SMH 1026951	4.841	0.089
	SMH 1026952	4.90	5.636	-0.736	SMH 1026952	4.907	-0.007
	SMH 1026953	5.20	5.678	-0.478	SMH 1026953	4.980	0.220
	SMH 1026954	5.25	5.847	-0.597	SMH 1026954	5.049	0.201
	SMH 1026919	5.22	6.096	-0.876	SMH 1026919	5.162	0.058
	SMH 1026920	5.80	6.173	-0.373	SMH 1026920	5.347	0.453
	SMH 1010759	5.80	6.247	-0.447	SMH 1010759	5.553	0.247

Table 3.6.4: Estimated Water Level under Existing Condition (With Insufficient Freeboard) and under Proposed Condition with Mitigation Measures Implemented - Summary

Location	Node No.	Ground Level (mPD)	Existing Condition		With Proposed Development and Mitigation Measures			Flood Level Difference (between Existing and Proposed Scenario) (m)	Remarks
			Water Level [2] (mPD)	Freeboard [3] (m)	Node No. [1]	Water Level [2] (mPD)	Freeboard [3] (m)		
Fuk Hi Street	SNF 1004264	4.00	4.359	-0.359	SNF 1004264	4.360	-0.360	0.001	Negligible Change
	SMH 1031680	4.28	4.928	-0.648	SNF 1004400	4.568	-0.288	-0.360	Situation Improved
	SMH 1031687	4.17	5.149	-0.979	SMH 1031687	5.014	-0.844	-0.135	Situation Improved
	SGJ 1006888	5.00	4.916	0.084	SGJ 1006888	4.578	0.422	-0.338	Situation Improved
Long Ping Road	SMH 1026990	5.30	5.557	-0.257	N/A	N/A	N/A	N/A	Pipeline Replaced by Box Culvert
	SMH 1026956	5.10	5.709	-0.609	SMH 1026956	4.790	0.310	-0.919	Freeboard Sufficient
	SMH 1026957	4.90	5.720	-0.820	SMH 1026957	4.886	0.014	-0.834	Situation Improved

Location	Node No.	Ground Level	Existing Condition		With Proposed Development and Mitigation Measures			Flood Level Difference (between Existing and Proposed Scenario)	Remarks
			Water Level [2]	Freeboard [3]	Node No. [1]	Water Level [2]	Freeboard [3]		
		(mPD)	(mPD)	(m)		(mPD)	(m)	(m)	
	SMH 1026951	4.93	5.731	-0.801	SMH 1026951	4.974	-0.044	-0.757	Situation Improved
	SMH 1026952	4.90	5.767	-0.867	SMH 1026952	5.070	-0.170	-0.697	Situation Improved
	SMH 1026953	5.20	5.809	-0.609	SMH 1026953	5.174	0.026	-0.635	Situation Improved
	SMH 1026954	5.25	5.981	-0.731	SMH 1026954	5.272	-0.022	-0.709	Situation Improved
	SMH 1026919	5.22	6.240	-1.020	SMH 1026919	5.427	-0.207	-0.813	Situation Improved
	SMH 1026920	5.80	6.317	-0.517	SMH 1026920	5.652	0.148	-0.665	Situation Improved
	SMH 1010759	5.80	6.389	-0.589	SMH 1010759	5.912	-0.112	-0.477	Situation Improved

[1] – Node layout numbers refer to Drawing Nos. 226464/OAP/C/101–102

[2] –The levels represent the estimated hydraulic grade line level of the system but not the actual water level of the overland flow

[3] – Negative freeboard indicates an occurrence of flooding

3.6.2.3 Under the proposed development scenario, due to the added capacity from the new box culvert at Fuk Hi Street, the 50-year peak water level within the street will be reduced. Therefore flooding problems at Fuk Hi Street will be improved. While the flooding problem could be relieved during small rain events, some street flooding is still expected to occur during large rain events as the tidal surcharge from Shan Pui River will reach closely to the existing ground level. The hydraulic model output revealed that the water level in Shan Pui River is the dominant factor as the drainage system at Fuk Hi Street is surcharged by depth only (not surcharged by flow).

3.6.2.4 Similarly, due to the added capacity from the new box culvert at Long Ping Road and diversion of flow into the new box culvert at Fuk Hi Street, the 50-year peak water level at the local low point at Long Ping Road will be reduced. This increased capacity which result in significantly decreased water level would allow retail development along the north side of Long Ping Road to remain near roadway level. While the flooding problem could be relieved during small rain events, some street flooding is still expected during large rain events due to tidal surcharge.

3.6.2.5 Due to the increase in effective catchment area, the flow discharged to Shan Pui River will be increased by approximately 6.8 m^3/s resulting in a water level rise of about 1mm at the river during the 50-year event

(0.03% higher than the 50-year design water level). The impact is considered negligible.

3.7 Permanent Mitigation Measures

3.7.1 Design Philosophy

3.7.1.1 The proposed drainage system within Project Site will be designed to have a flood protection level of 50 years.

3.7.1.2 The proposed upgrading of existing off-site drainage system will be designed to meet the 50 years flood protection level requirement as far as possible. The proposed upgrading works aims at alleviating the drainage impact as well as improving the existing sub-standard drainage system to meet the required flood protection level as far as possible.

3.7.2 Proposed Platform Level

3.7.2.1 The platform level of the proposed residential, GIC and school development is designed at a rather high level (about 10m higher than adjacent existing road level) in order to match with the existing hillside terrain as well as reduce the flooding susceptibility due to high water level at Shan Pui River.

3.7.2.2 In case any proposed site drainage becomes blocked during heavy rainfall, the proposed site topography will ensure overland flow of rainwater will be away from the Project site.

3.7.3 Peripheral Hillside Drainage

3.7.3.1 Peripheral u-channel drains are proposed along the site boundary to intercept runoff from the Kai Shan hillside. Owing to the undulating topography along the site boundary, there are a number of local low points where runoff will be entered proposed drainage system via down pipe and catchpit. To maximize the flexibility of proposed development, runoff collected by the u-channels will be directly connected to the drainage system at EVA/public road or routed along the site boundary to the nearest drainage system.

3.7.4 Shan Pui River Catchment

3.7.4.1 The layout plan including proposed pipe sizes for the Shan Pui River catchment is given in **Drawing Nos. 226464/OAP/C/101–102.** Typical sections are provided in **Drawing No. 226464/OAP/C/701**.

3.7.4.2 The peripheral u-channel drains along the boundary of the eastern portion of the site will divert flows from discrete low points into the site via down pipes and catchpits. Underground storm drains ranging from 600Ø to 1350Ø are proposed under the EVA roadway to carry flows toward the new box culvert at Long Ping Road.

3.7.4.3 Runoff from the western portion of the site will be collected by the proposed storm drains ranging from 1050Ø to 1350Ø under the public access road and then to the drainage system along Long Ping Road.

Any storm drains serving the buildings within the public housing site will be maintained by HKHA.

3.7.4.4 As revealed in the hydraulic modelling results, the existing drainage system at Long Ping Road is surcharged by flow and/or depth with insufficient freeboard. Therefore, it is proposed to upgrade the existing drainage system at Long Ping Road to meet the DSD's flood protection level requirement as far as possible. These include upgrading the existing 1650Ø to 1800Ø storm drain to 3500(W) x 2000(H) (single-cell) box culvert and existing 1800Ø storm drain to 3500(W) x 2000(H) twin-cell box culvert which will connect to the existing box culvert just west of the intersection of Long Ping Road and Fuk Hi Street. The proposed upgrading works significantly improved the sub-standard pipeline system such that its capacity is sufficient to cater for 50-year event flow, as revealed in the hydraulic modelling results under the proposed development scenario that the pipeline system is surcharged by depth only (not surcharged by flow). The insufficient freeboard under the proposed scenario as listed in **Table 3.6.4** is due to the tidal surcharge from Shan Pui River.

3.7.4.5 To improve the hydraulic performance of the existing box-culvert along Fuk Hi Street, a new 3500(W) x 2000(H) twin-cell box culvert is proposed under the southbound lane to collect flow and discharge into the Shan Pui River. A new headwall will be required at the box culvert interfacing with the river channel, and the flap valve as recommended under the DMP report will prevent backflow conditions.

3.7.4.6 Besides, it is proposed to divert the flow from the existing 450Ø pipeline (road drain), 1200Ø pipeline and trapezoidal open channel along the west edge of Fuk Hi Street and connect to the proposed 3500(W) x 2000(H) twin-cell box culvert. This will decrease the peak flow in the drainage network at Fuk Hi Street and alleviate some flooding problems. As shown in **Table 3.6.4**, the flooding level at the upstream end of the existing 1200Ø pipeline system will be significantly reduced under this proposal.

3.7.4.7 The above mitigation measures are recommended to increase the conduit capacity of the drainage system and reduce the water level at the street so as to alleviate flooding problems and minimizing the potential drainage impacts on the existing drainage systems. In particular, reducing water level allows the retail development to be accommodated along the north side and with similar elevation of Long Ping Road. Should the retail development be possibly planned on an elevated level, the extent of the proposed upgrading drainage works could be further revisited during detailed design stage.

3.7.4.8 The proposed development relies on the implementation of flood protection measures proposed by the DMP under which the existing flood walls at the project discharge point to Shan Pui River will be elevated to prevent overbank flow during extreme events and flap valves will be installed at the outlet of pipelines subject to tidal flow to

prevent backflow conditions. These flood protection measures should be installed by 2025 prior to completion of the proposed development.

3.7.5 Kai Shan South Channel Catchment

3.7.5.1 The layout plan including the proposed pipe sizes for the Kai Shan South Channel catchment is shown in **Drawing Nos. 226464/OAP/C/101**.

3.7.5.2 Offsite runoff from the southern hillside of Kai Shan will be collected by the peripheral u-channel drains and diverted into the site via down pipe and catchpit.

3.7.5.3 The existing Kai Shan South Channel which runs through the proposed Site, with a length of 125m, will be replaced by underground storm drain system while a section of channel that falls outside site boundary will be maintained and connected to the proposed box culvert at node no. SMH90006.

3.7.5.4 It is proposed that a stormwater inlet will be provided close to the site boundary to intercept flow from the upstream Kai Shan South Channel and provide a smooth transition into the underground drainage system. The inlet should be designed in detailed design stage in accordance with DSD Practice Note No. 1/2003.

3.7.5.5 Due to the conflict with the proposed basement car park, flows will be diverted via the proposed underground 1200Ø storm drain running across the site between Block 1 and 2 and then along the perimeter of the GIC site. The location of the proposed Refuse Collection Point (RCP) should be further reviewed to avoid conflict with the proposed underground pipeline.

3.7.5.6 The proposed underground storm drain system will be discharged to the existing channel near the MTR elevated track. Penetration through the site perimeter wall will be required to connect the pipe to the existing channel.

3.7.5.7 No modification of Kai Shan South Channel at downstream outside the site boundary is required as there will be no increase in runoff arising from the proposed development.

3.7.6 Sustainable Drainage Provision

3.7.6.1 It is recommended that sustainable drainage approach, e.g. green roof and rain water recycling system, shall be further considered in the detailed building design. Vegetation and greening within the housing site would increase the overall permeability of the site. For conservative approach, the effect of such mitigation measures has not been taken into account in this DIA, however it is anticipated that such measures could reduce the runoff discharging to the existing drainage system and hence reduce the corresponding drainage impact.

4 CONCLUSION

4.1.1.1 With incorporation of the proposed drainage system and upgrading of drains along Fuk Hi Street and Long Ping Road, anticipated flooding problems and/or insufficient freeboard will be reduced.

4.1.1.2 The peak flow discharge to Shan Pui River will be increased by approximately 6.8 m^3/s, resulting in a water level rise of about 1mm at the river during the 50-year event (0.03% higher than the 50-year design water level). Such impact is considered to be negligible.

4.1.1.3 The hydraulic assessment results show that the estimated water levels within the Fuk Hi Street and Long Ping Road will be significantly decreased due to added capacity from the proposed upgrading works. While the flooding problem could be relieved during small rain events, some street flooding is still expected to occur during large rain events as the tidal surcharge from Shan Pui River will reach closely to the existing ground level.

4.1.1.4 The recommended mitigation measures are aimed at alleviating the drainage impact arising from the proposed development as well as improving the existing sub-standard drainage system to meet the required flood protection level as far as possible. Should the retail development be possibly planned on an elevated level, the extent of the proposed upgrading drainage works could be further revisited during detailed design stage.

4.1.1.5 Further liaison with DSD is required to work out the details of maintenance access and drainage reserves with the aim to maximize the available land use within the proposed development.

4.1.1.6 The proposed works (including but not limited to upgrading works, diversion works and proposed additional drainage systems) should be well planned so as to tie in with the commissioning of the proposed development.

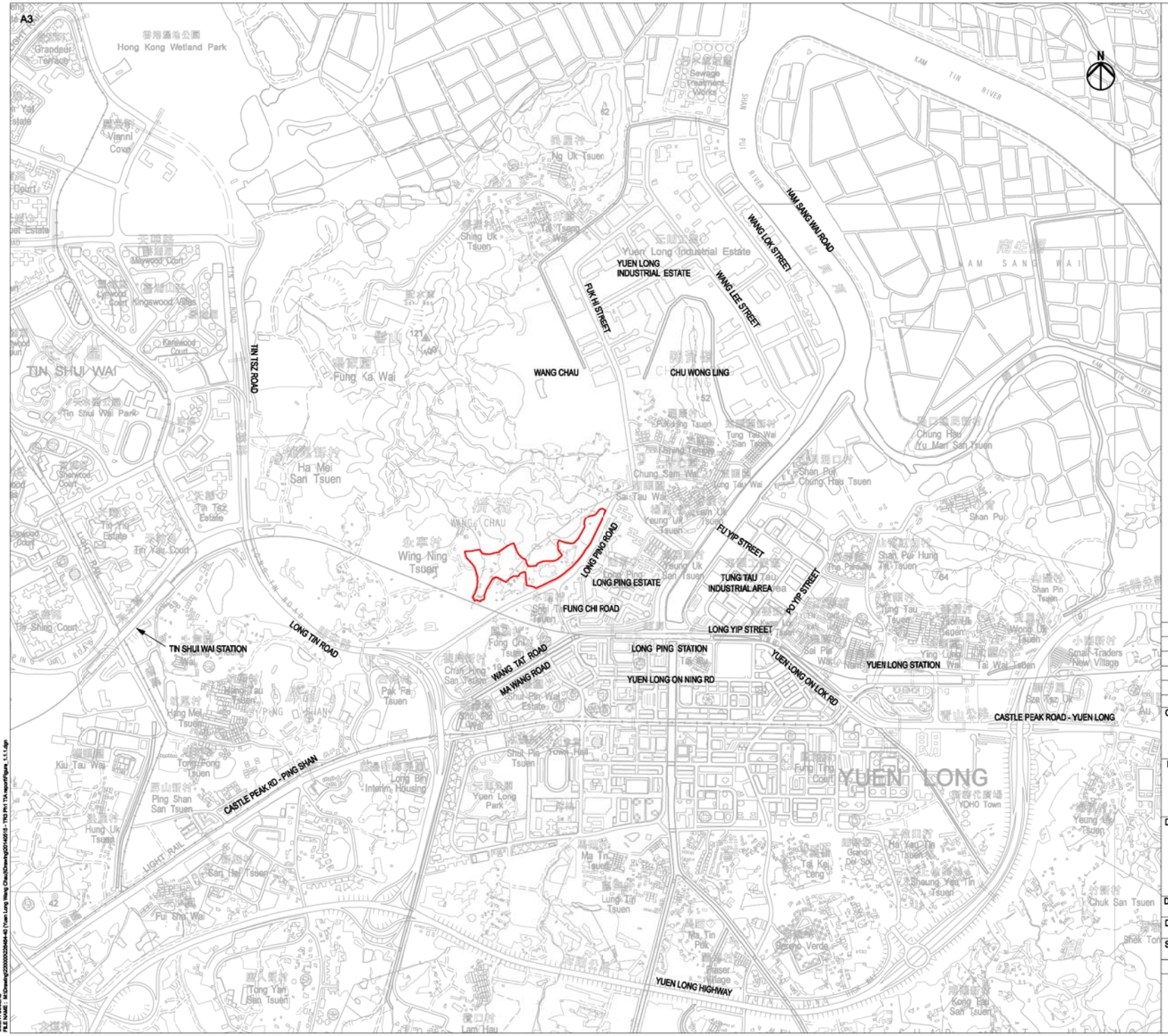
4.1.1.7 Flood protection measures identified by DMP should be designed, programmed and implemented prior to completion of the development in 2025.

5 REFERENCES

a) Drainage Services Department Stormwater Drainage Manual, Fourth Edition, May 2013.

b) Advice Note No. 1 – Application of the Drainage Impact Assessment Process to Private Sector Projects issued by Drainage Services Department, September 2010.Hong Kong Planning Standards and Guidelines, August 2011.

Drawings



Rev	Description	By	Date
A	FIRST ISSUE	KHC	09/13

Consultant

ARUP

Project title

Agreement No. CB20120293
Public Housing Development at Wang Chau, Yuen Long

Drawing title

LOCATION OF PROJECT SITE

Drawing no.				Rev.
226464/OAP/P/011				A
Drawn	Date	Checked	Approved	
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Scale		Status		
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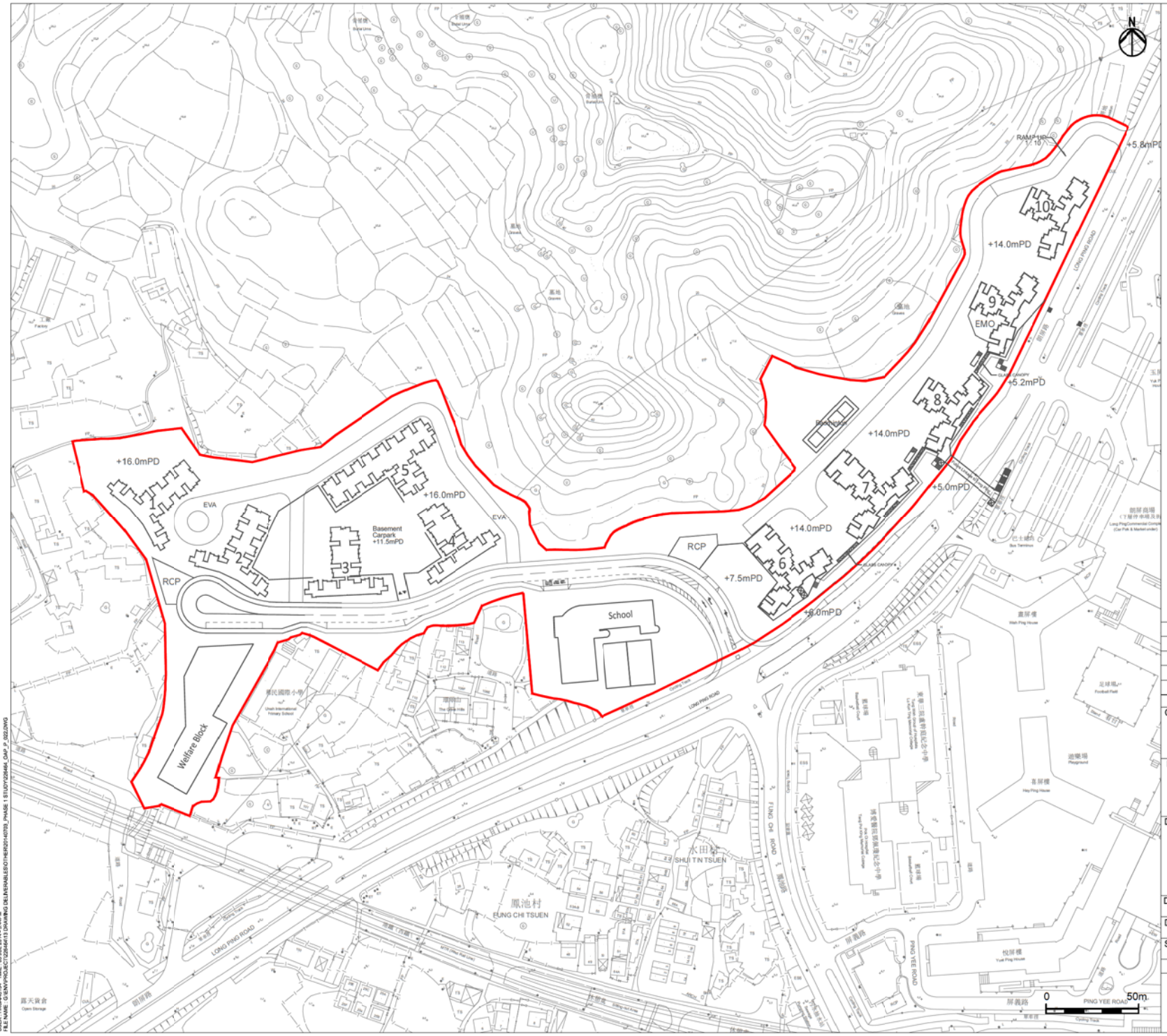
HONG KONG HOUSING AUTHORITY



Legend

Development Boundary

Rev	Description	By	Date
A	FIRST ISSUE	GL	07/14

Consultant

ARUP

Project title

Agreement No. CB20120293
Planning and Engineering Study for the Public Housing Site and Yuen Long Industrial Estate Extension at Wang Chau

Drawing title

Proposed Option Layout Plan - PH Site

Drawing no.		Rev.
226464/OAP/P/022		A
Drawn: GL	Date: 07/14	Checked: IL	Approved: ST
Scale: AS SHOWN		Status: PRELIMINARY

HONG KONG HOUSING AUTHORITY

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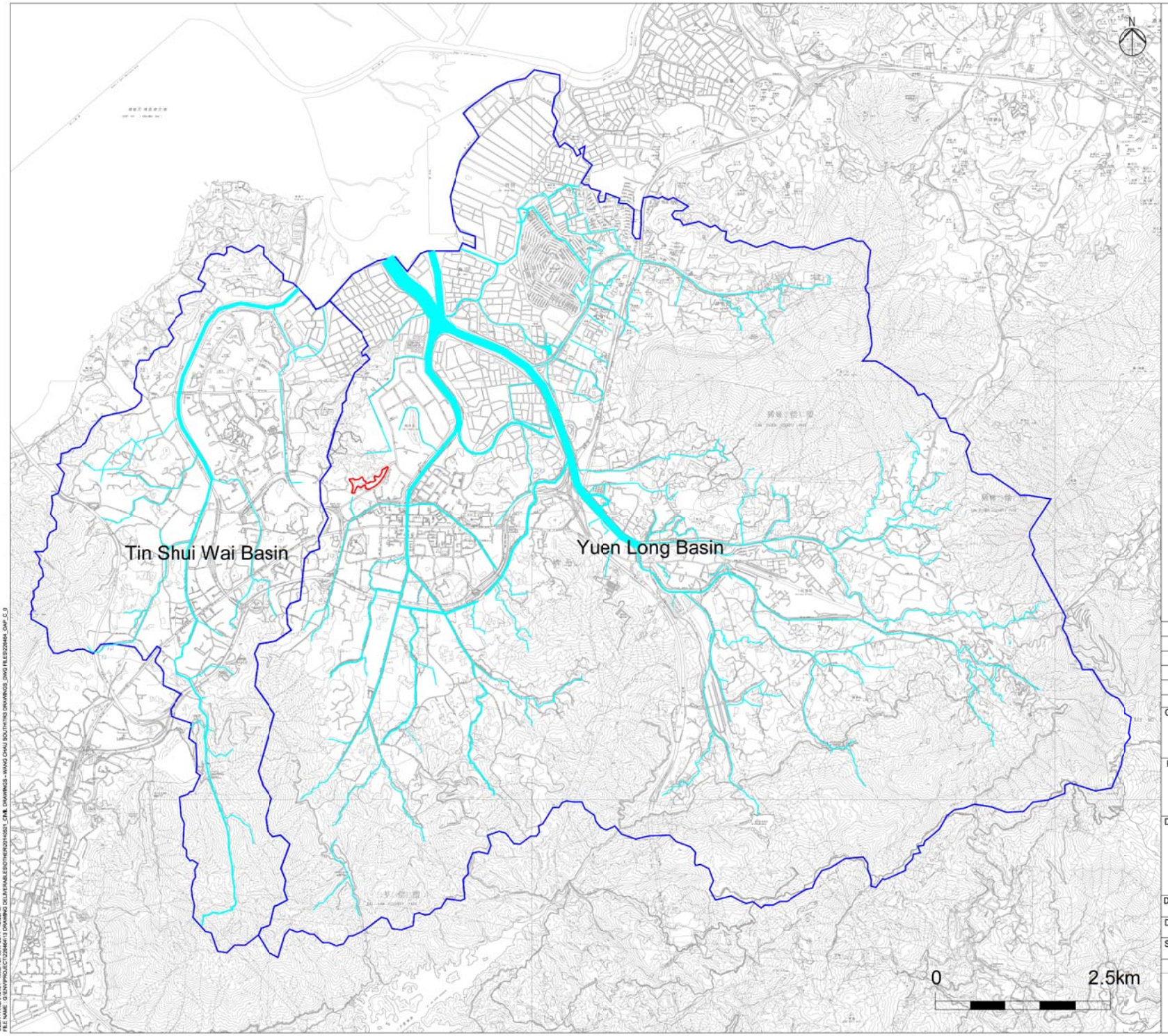

LEGEND:

DEVELOPMENT BOUNDARY

Rev	Description	By	Date
-	FIRST ISSUE	GL	05/14

Consultant

ARUP

Project title

Public Housing Development at Warg Chau, Yuen Long

Drawing title

GENERAL BOUNDARY OF YUEN LONG BASIN AND TIN SHUI WAI BASIN

Drawing no.			Rev.
226464/OAP/C/010			-
Drawn	Date	Checked	Approved
GL	05/14	MB	ST
Scale		Status	
AS SHOWN		PRELIMINARY	

HONG KONG HOUSING AUTHORITY

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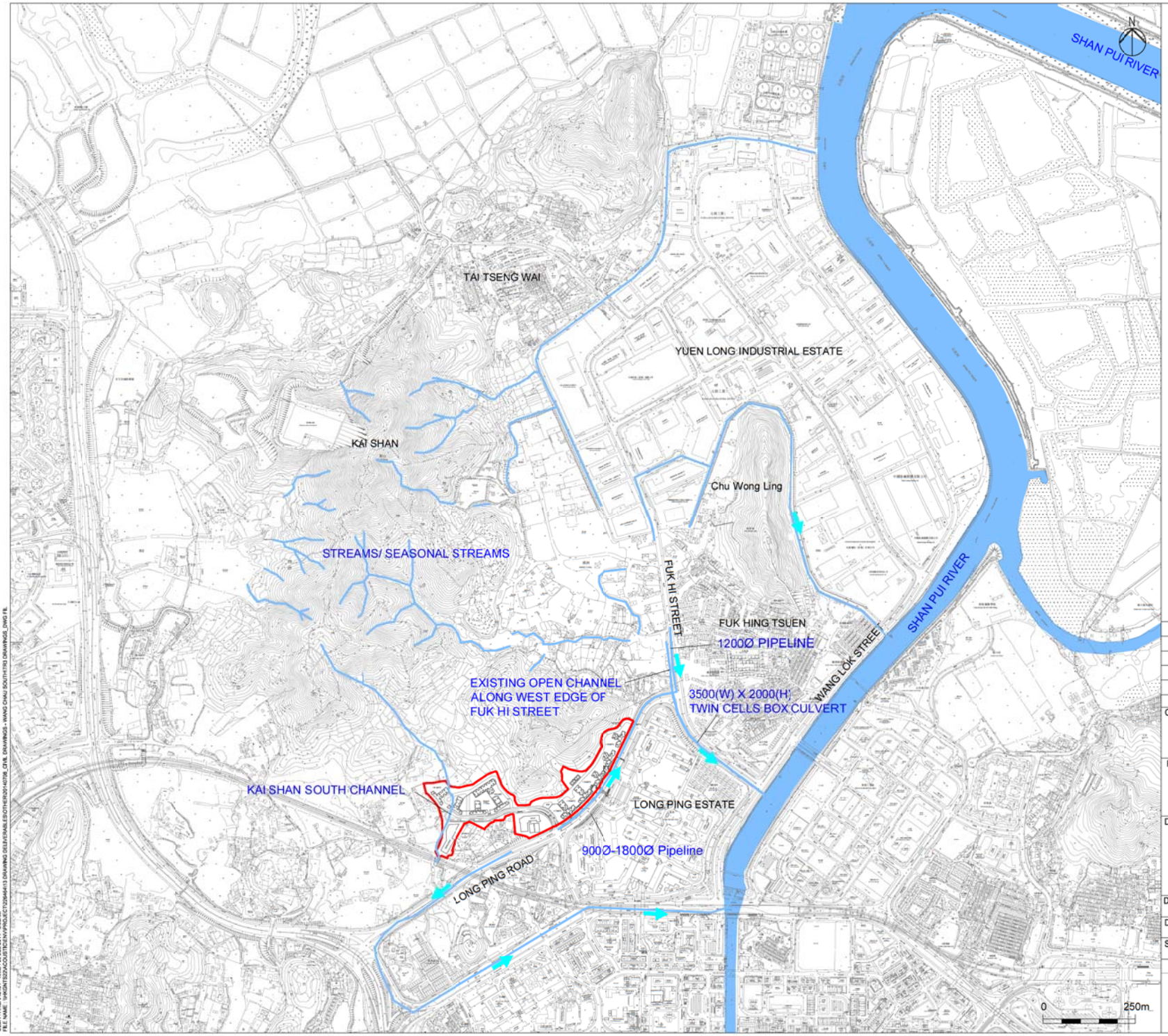


LEGEND

- DEVELOPMENT BOUNDARY
- EXISTING DRAINAGE DIRECTION
- WATERCOURSE AND DRAINAGE

REV	DESCRIPTION	BY	DATE
-	FIRST ISSUE	GL	07/14

CONSULTANT

ARUP

PROJECT TITLE

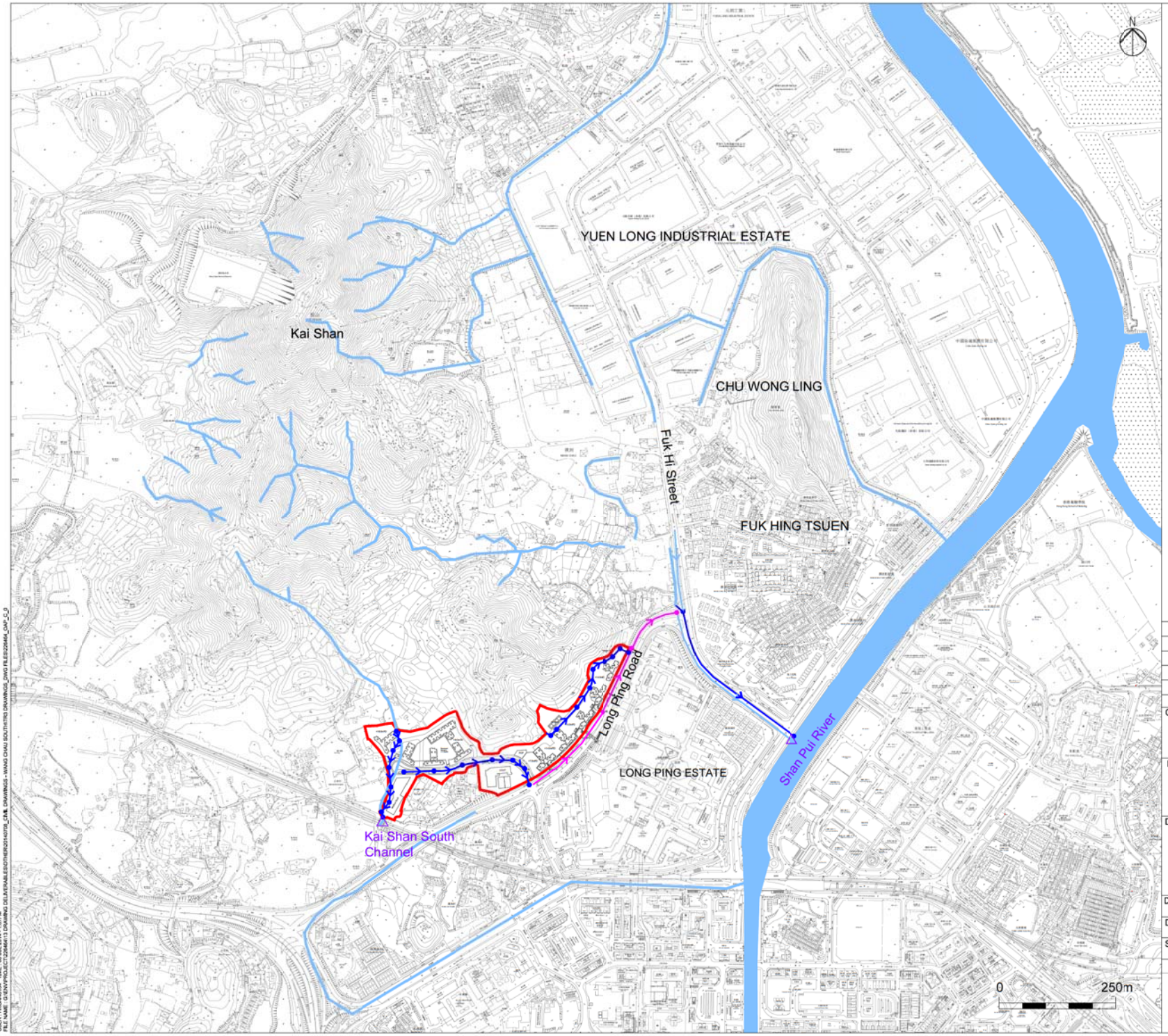
Public Housing Development at Warg Chau, Yuen Long

DRAWING TITLE

EXISTING MAIN DRAINAGE SYSTEM
IN THE VICINITY OF PROJECT SITE

DRAWING NO.			REV.
226464/OAP/C/011			-
DRAWN	DATE	CHECKED	APPROVED
GL	07/14	MB	ST
SCALE		STATUS	
NTS		PRELIMINARY	

HONG KONG HOUSING AUTHORITY



LEGEND:

- DEVELOPMENT BOUNDARY
- PROPOSED STORMWATER DRAINAGE
- UPGRADE EXISTING STORMWATER DRAINAGE PIPE
- EXISTING WATERCOURSE/ DRAINAGE
- DISCHARGE POINT

REV	DESCRIPTION	BY	DATE
-	FIRST ISSUE	GL	07/14

CONSULTANT

ARUP

PROJECT TITLE

Public Housing Development at Wang Chau, Yuen Long

DRAWING TITLE

OVERVIEW OF PROPOSED STORMWATR DRAINAGE

DRAWING NO.	REV.
226464/OAP/C/012	-

DRAWN	DATE	CHECKED	APPROVED
GL	07/14	MB	ST

SCALE	STATUS
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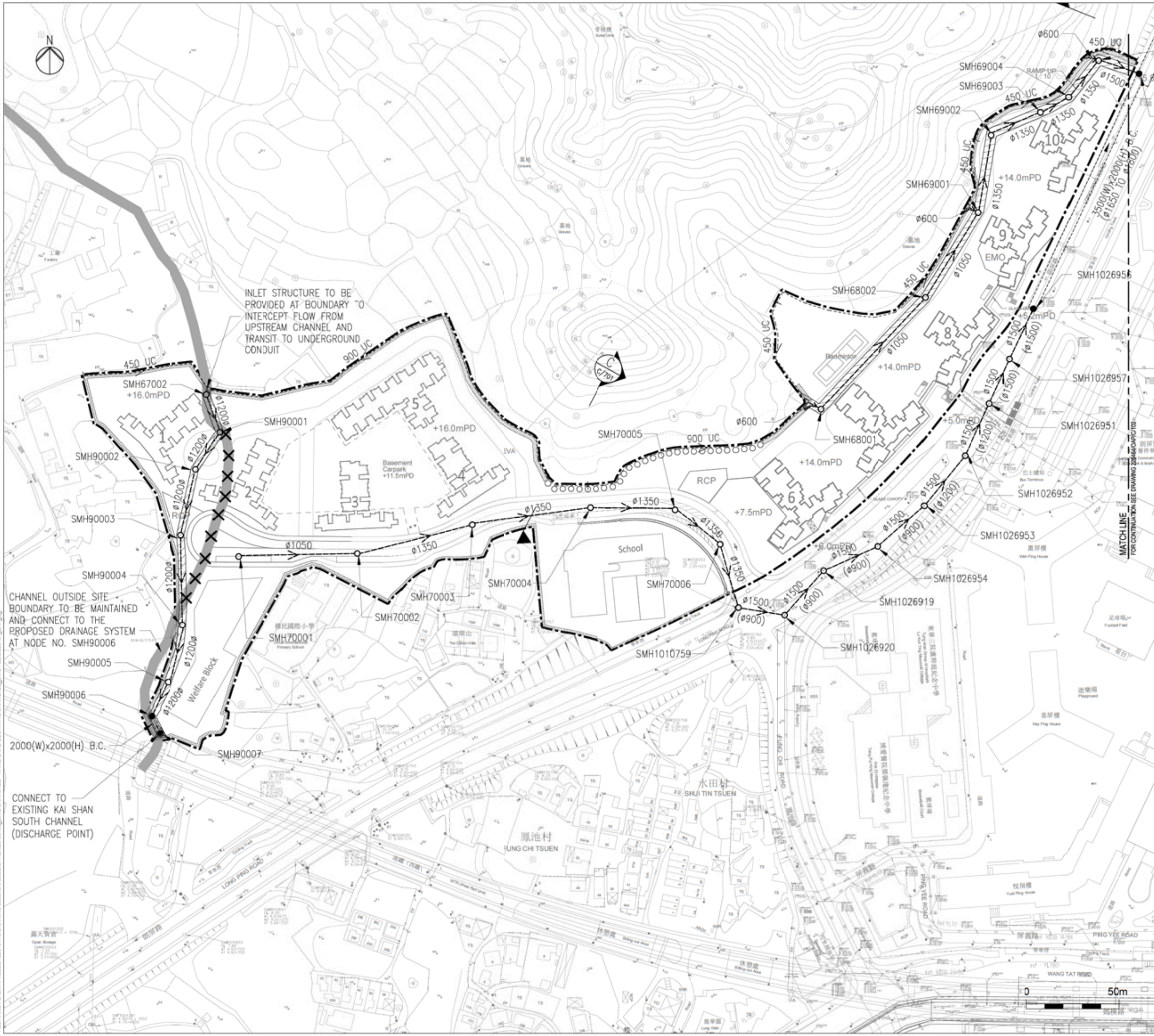
HONG KONG HOUSING AUTHORITY



LOCATION KEY PLAN

NOTES:

1. RESERVED AREA FOR PROPOSED U-CHANNEL IS ESTIMATED BY ADDING 1.25m TO THE CHANNEL WIDTH.
2. EXACT DIMENSIONS OF DRAINAGE RESERVES SUBJECT TO AGREEMENT WITH DSD.
3. FOR SITE FORMATION LAYOUT DETAILS REFER TO DRAWING NO. 226464/OAP/G/001.
4. MANHOLE/ NODE ID ARE ASSIGNED WHERE CHANGE IN GRADIENT AND/ OR PIPE SIZE.

LEGEND:

Symbol	Description
	DEVELOPMENT BOUNDARY
	PROPOSED RETAINING WALL
	PROPOSED BORED PILE WALL
	PROPOSED CATCHPIT WITH DOWNPIPE
SMH1103 ●	NODE WITH ID
SMH70001 ○	PROPOSED MANHOLE WITH ID
ø900	PROPOSED Ø900 STORMWATER DRAINAGE PIPE
ø900 (ø450)	PROPOSED Ø900 STORMWATER DRAINAGE PIPE (UPGRADE EXISTING Ø450 PIPE)
3000(W)x2000(H) B.C.	PROPOSED BOX CULVERT
450 UC	PROPOSED 450mm U-CHANNEL
	DRAINAGE RESERVE
△	DISCHARGE POINT
	EXISTING WATERCOURSE / DRAINAGE
	EXISTING WATERCOURSE / DRAINAGE TO BE DEMOLISHED

Rev	Description	By	Date
A	SECOND ISSUE	GL	01/15
-	FIRST ISSUE	GL	07/14

Consultant

ARUP

Project title

Public Housing Development at Wang Chau, Yuen Long

Drawing title

PROPOSED DRAINAGE LAYOUT PLAN

SHEET 1 OF 2

Drawing no.			Rev.
226464/OAP/C/101			A
Drawn: GL	Date: 07/14	Checked: MB	Approved: ST
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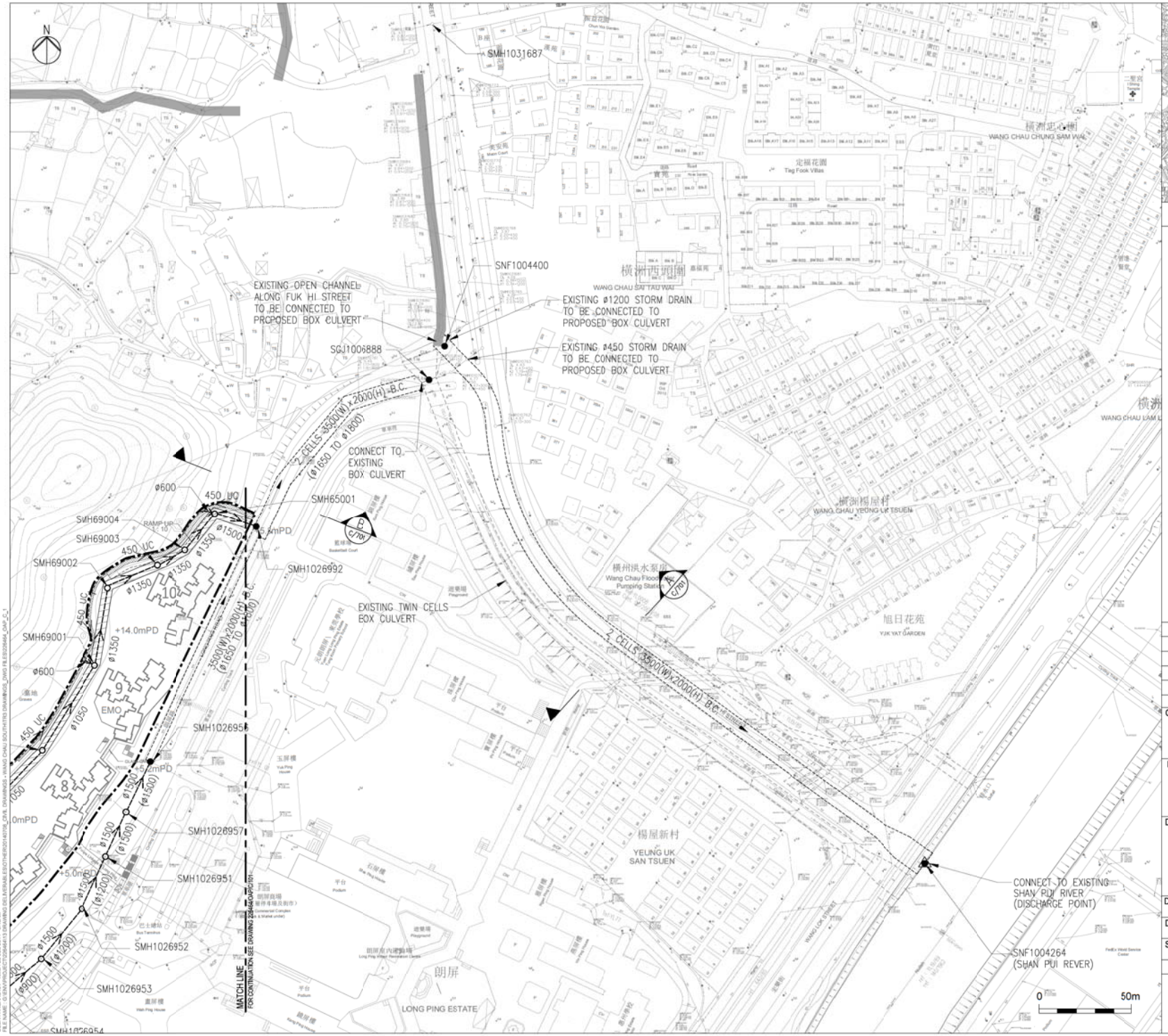


LOCATION KEY PLAN

NOTES:
1. FOR NOTES AND LEGEND REFER TO DRAWING NO. 226464/OAP/C/101.

Rev	Description	By	Date
-	FIRST ISSUE	GL	07/14

Consultant

ARUP

Project title

Public Housing Development at Wang Chau, Yuen Long

Drawing title

PROPOSED DRAINAGE LAYOUT PLAN

SHEET 2 OF 2

Drawing no.			Rev.
226464/OAP/C/102			-
Drawn	Date	Checked	Approved
GL	07/14	MB	ST
Scale		Status	
1:1000 (A1)		PRELIMINARY	

HONG KONG HOUSING AUTHORITY

MANHOLE / NODE NO.		GROUND LEVEL (mPD)		INVERT LEVEL (mPD)		GRADIENT	DIA. OF PIPE / WIDTH OF BOX CULVERT	HEIGHT OF BOX CULVERT (IF APPLICABLE)	LENGTH
U/S	D/S	U/S	D/S	U/S	D/S	1 in X	(mm)	(mm)	(m)
SNF 1004400	SNF1004264 (Shan Pui River)	4.28	4.00	0.98	0.33	595	3500 (Twin Cells)	2000 (Twin Cells)	387
SMH 68001	SMH 68002	14.00	14.00	11.650	11.377	271	1050	-	74
SMH 68002	SMH 69001	14.00	14.00	11.377	11.193	261	1050	-	48
SMH 69001	SMH 69002	14.00	14.00	11.193	11.109	525	1350	-	44
SMH 69002	SMH 69003	14.00	10.00	7.409	7.349	515	1350	-	31
SMH 69003	SMH 69004	10.00	8.84	6.149	6.113	660	1350	-	24
SMH 69004	SMH 65001	8.84	7.20	4.613	4.561	600	1350	-	31
SMH 65001	SMH 1026992	7.20	5.70	2.861	2.815	500	1500	-	23
SMH 70001	SMH 70002	16.00	16.00	13.650	13.465	400	1050	-	74
SMH 70002	SMH 70003	16.00	16.00	13.165	13.049	580	1350	-	67
SMH 70003	SMH 70004	16.00	13.00	10.349	10.135	335	1350	-	72
SMH 70004	SMH 70005	13.00	9.00	6.435	6.282	302	1350	-	46
SMH 70005	SMH 70006	9.00	7.00	4.282	4.175	298	1350	-	32
SMH 70006	SMH 1010759	7.00	5.80	3.275	3.155	300	1350	-	36
SMH 1010759	SMH 1026920	5.80	5.80	2.955	2.905	500	1500	-	25
SMH 1026920	SMH 1026919	5.80	5.22	2.354	2.290	500	1500	-	32
SMH 1026919	SMH 1026954	5.22	5.25	2.290	2.226	500	1500	-	32
SMH 1026954	SMH 1026953	5.25	5.20	2.226	2.160	500	1500	-	33
SMH 1026953	SMH 1026952	5.20	4.90	2.160	2.090	500	1500	-	35
SMH 1026952	SMH 1026951	4.90	4.93	2.090	2.028	500	1500	-	31
SMH 1026951	SMH 1026957	4.93	4.90	2.028	1.974	500	1500	-	27
SMH 1026957	SMH 1026956	4.90	5.10	1.974	1.914	500	1500	-	30
SMH 1026956	SMH 1026992	5.10	5.70	1.500	1.361	1000	3500	2000	139
SMH 1026992	SGJ 1006888	5.70	5.00	1.361	1.236	1000	3500	2000	125
SGJ 1006888	SNF1004264 (Shan Pui River)	5.00	4.00	0.980	0.330	603	3500 (Twin Cells)	2000 (Twin Cells)	392
SMH 67002	SMH 90001	16.00	16.00	11.000	10.878	196	1200	-	24
SMH 90001	SMH 90002	16.00	16.00	10.878	10.744	195	1200	-	26
SMH 90002	SMH 90003	16.00	16.00	10.744	10.539	180	1200	-	37
SMH 90003	SMH 90004	16.00	16.00	10.539	10.239	164	1200	-	49
SMH 90004	SMH 90005	16.00	16.00	10.239	10.039	150	1200	-	30
SMH 90005	SMH 90006	16.00	16.00	8.039	7.908	145	1200	-	19
SMH 90006	SMH 90007	16.00	16.00	7.486	7.460	500	2000	2000	13

NOTES:

1. THE MANHOLE SCHEDULE ONLY SHOWS MAJOR MANHOLE WHERE CHANGE IN GRADIENT AND / OR PIPES SIZES OCCUR.

Rev	Description	By	Date
B	THIRD ISSUE	GL	04/15
A	SECOND ISSUE	GL	02/15
-	FIRST ISSUE	GL	05/14

Consultant

ARUP

Project title

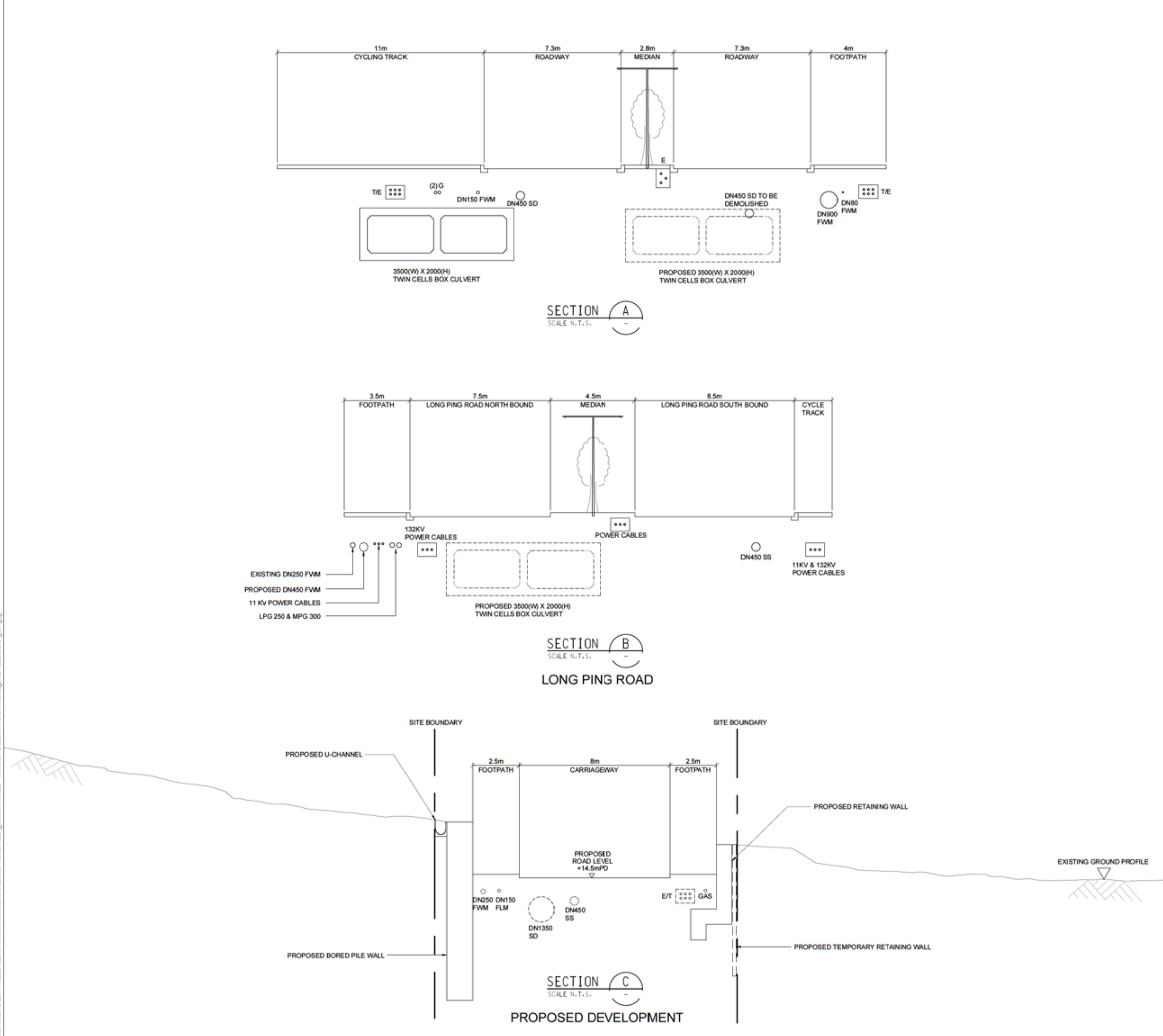
Public Housing Development at Wang Chau, Yuen Long

Drawing title

PROPOSED STORMWATER DRAINAGE MANHOLE SCHEDULE

Drawing no.			Rev.
226464/OAP/C/110			B
Drawn	Date	Checked	Approved
GL	05/14	MB	ST
Scale		Status	
N.T.S.		PRELIMINARY	

HONG KONG HOUSING AUTHORITY



NOTES:

1. THE UTILITIES SHOWN IN THIS DRAWING ARE INDICATIVE ONLY BASED ON AVAILABLE INFORMATION OBTAINED FROM UTILITY UNDERTAKERS. THE EXACT DETAILS INCLUDING SIZES, ALIGNMENTS AND LEVELS TO BE FURTHER VERIFIED AT DETAILED DESIGN.

LEGEND:

FWM	FRESH WATER MAIN
FLM	FLUSHING WATER MAIN
SS	SANITARY SEWER
SD	STORM DRAIN
E	ELECTRICAL
T	TELECOM
MPG	MEDIUM PRESSURE GAS
LPG	LOW PRESSURE GAS
O.D.	OUTER DIAMETER
I.D.	INNER DIAMETER
○	EXISTING UTILITIES
◌	PROPOSED UTILITIES

Rev	Description	By	Date
-	FIRST ISSUE	GL	05/14

Consultant

ARUP

Project title

Public Housing Development at Wang Chau, Yuen Long

Drawing title

COMMON UTILITIES SECTIONS

Drawing no. 226464/OAP/C/701			Rev. -
Drawn GL	Date 05/14	Checked MB	Approved ST
Scale N.T.S.		Status PRELIMINARY	

HONG KONG HOUSING AUTHORITY

Appendix A

Hydraulic Assessments

Subcatchment Data and Discharge Schedule

30-Mar-15

Existing

Urban ID	Urban Area (m^2)	Description	Effective Catchment Area	Existing Discharge Point	Existing Discharge System
Urban- 0	57,139	Sai Tau Wai	51,425	SMH 1031687	Ex. BC
Urban- 1	59,000	LP Estate	53,100	SGJ 1006888	Ex. BC
Urban- 2	76,792	LP Estate	69,113	SMH 1026956	Ex. BC
Urban- 3	29,989	Ex. Village	26,990	SMH 1026919	Ex. BC
Urban- 4	13,235	Ex. Village	11,912	SMH 1010759	Ex. BC
Open Storage					
ID	**Area (m^2)**				
Open Storage- 0	144,610		130,149	Natural Stream	Ex. BC
WC South Development Site					
ID	**Area (m^2)**				
WC South- 0	0				
WC South- 1	0				
WC South- 2	0				
WC South- 3	0				
WC South- 4	0				
Hillside					
ID	**Area (m^2)**				
Hillside- 0	7,019		2,106	SMH 1026951	Ex. BC
Hillside- 1	3,213		964	SMH 1026993	Ex. BC
Hillside- 2	3,661		1,098	SMH 1026993	Ex. BC
Hillside- 3	20,800		6,240	SMH 1010759	Ex. BC
Hillside- 4	12,804		3,841	Kai Shan Channel	Kai Shan
Hillside- 5	11,553		3,466	Kai Shan Channel	Kai Shan
Hillside- 6	11,538		3,461	Kai Shan Channel	Kai Shan
Hillside- 7	2,551		765	Natural Stream	Ex. BC
Hillside- 8	9,099		2,730	Natural Stream	Ex. BC
Hillside- 9	30,603		9,181	Natural Stream	Ex. BC
Hillside- 10	115,117		34,535	Kai Shan Channel	Kai Shan
Hillside- 11	130,030		39,009	Natural Stream	Ex. BC
Hillside- 12	26,020		7,806	Natural Stream	Ex. BC
Hillside- 13	8,886		2,666	Natural Stream	Ex. BC
Hillside- 14	7,421		2,226	Natural Stream	Ex. BC
Hillside- 15	9,595		2,879	Natural Stream	Ex. BC
Hillside- 16	5,579		1,674	Natural Stream	Ex. BC
Hillside- 17	12,223		3,667	Natural Stream	Ex. BC
Hillside- 18	19,990		5,997	Natural Stream	Ex. BC

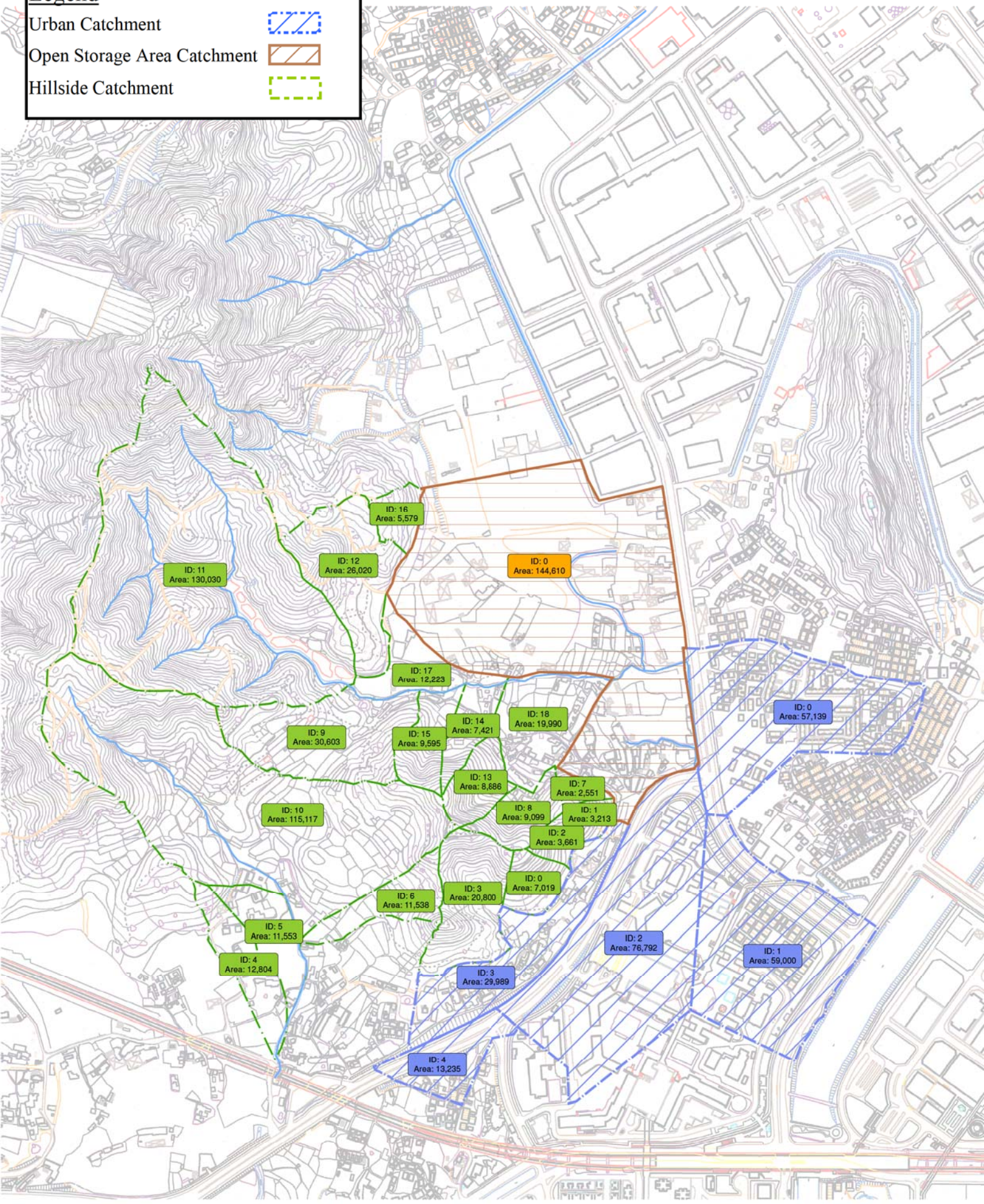
Proposed

Urban ID	Urban Area (m^2)	Description	Effective Catchment Area	Proposed Discharge Point	Proposed Discharge System
Urban- 0	57,139	Sai Tau Wai	51,425	SMH 1031687	Proposed BC
Urban- 1	59,000	LP Estate	53,100	SGJ 1006888	Ex. BC
Urban- 2	76,792	LP Estate	69,113	SMH 1026956	Ex. BC
Urban- 4	13,235	Ex. Village	11,912	SMH 1010759	Ex. BC
Open Storage					
ID	**Area (m^2)**				
Open Storage- 0	144,610		130,149	Natural Stream	Proposed BC
WC South Development Site					
ID	**Area (m^2)**				
WC South- 0	13,832	PRH Site	12,449	SMH 68001	Ex. BC
WC South- 1	7,171	HOS Site	6,454	SMH 67002	Ex. BC
WC South- 2	24,649	HOS Site	22,184	SMH 70002	Ex. BC
WC South- 3	5,826	HOS Site	5,243	SMH 70001	Ex. BC
WC South- 4	4,642	PRH Site	4,178	SMH 69001	Ex. BC
Hillside					
ID	**Area (m^2)**				
Hillside- 0	7,019		2,106	SMH 69001	Ex. BC
Hillside- 1	3,213		964	SMH 65001	Ex. BC
Hillside- 2	3,661		1,098	SMH 69001	Ex. BC
Hillside- 3	20,800		6,240	SMH 68001	Ex. BC
Hillside- 4	12,804		3,841	SMH 90001	Kai Shan
Hillside- 5	6,463		1,939	SMH 67002	Kai Shan
Hillside- 6	14,778		4,433	SMH 67002	Kai Shan
Hillside- 7	2,551		765	Natural Stream	Proposed BC
Hillside- 8	9,099		2,730	Natural Stream	Proposed BC
Hillside- 9	30,603		9,181	Natural Stream	Proposed BC
Hillside- 10	115,117		34,535	SMH 67002	Kai Shan
Hillside- 11	130,030		39,009	Natural Stream	Proposed BC
Hillside- 12	26,020		7,806	Natural Stream	Proposed BC
Hillside- 13	8,886		2,666	Natural Stream	Proposed BC
Hillside- 14	7,421		2,226	Natural Stream	Proposed BC
Hillside- 15	9,595		2,879	Natural Stream	Proposed BC
Hillside- 16	5,579		1,674	Natural Stream	Proposed BC
Hillside- 17	12,223		3,667	Natural Stream	Proposed BC
Hillside- 18	19,990		5,997	Natural Stream	Proposed BC

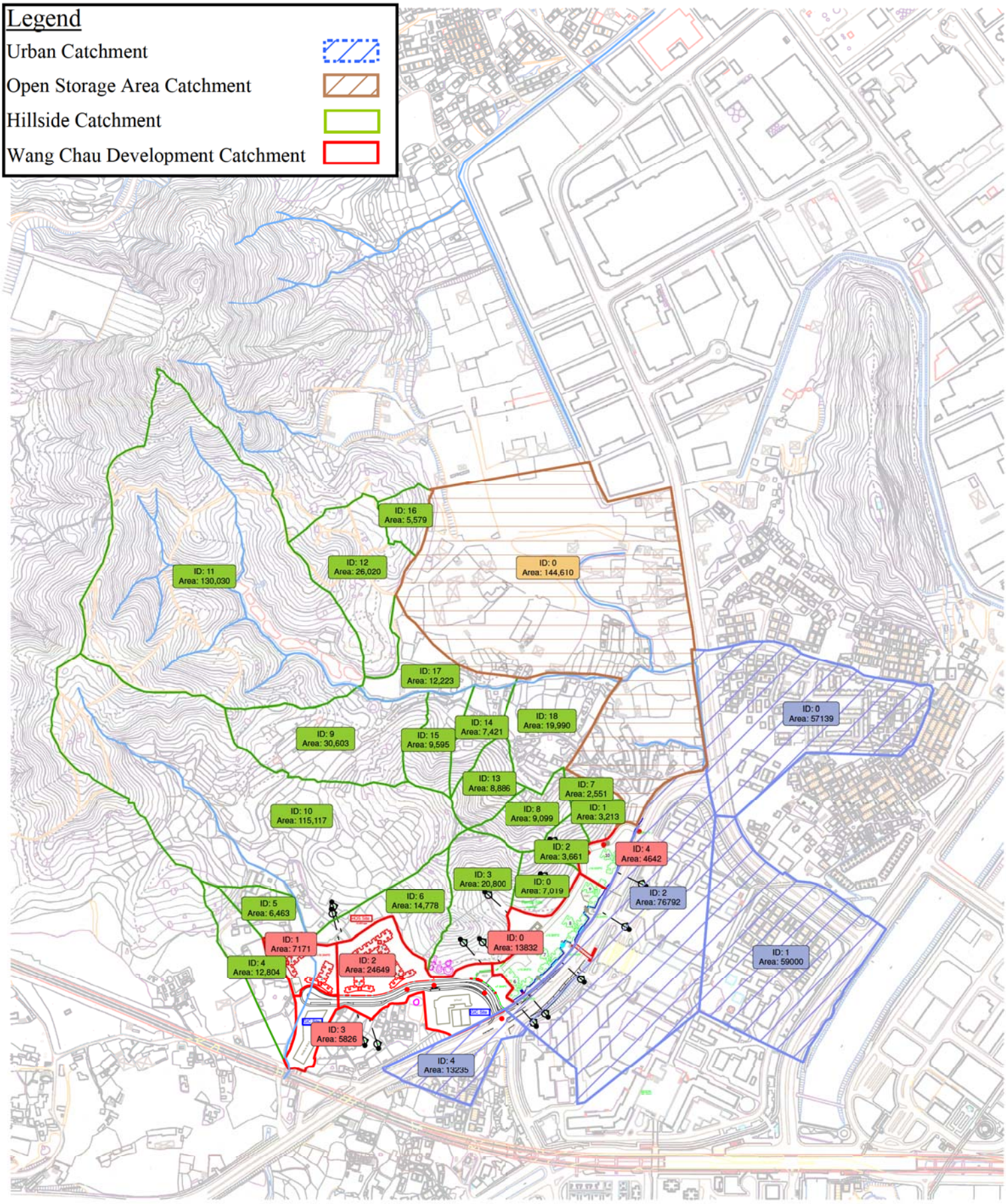
Summary

System	Total Catchment Area (m2)							
	Existing				Proposed			
	Paved	Grassland	Total	Effective	Paved	Grassland	Total	Effective
Ex. BC	380,765	296,690	677,455	431,696	205,147	34,693	239,840	195,040
Proposed BC	0	0	0	0	201,749	261,997	463,746	260,173
Kai Shan	0	151,012	151,012	45,304	0	149,162	149,162	44,749

Delineation of Sub-Catchments - Existing Scenario



Delineation of Sub-Catchments - Proposed Scenario



ARUP	Job No. 226464	Sheet No.	Rev.
	Member/Location		
Job Title: Planning and Engineering Study - Public Housing Development at Wang Chau, Yuen Long	Drg. Ref.		
Calculation: Design Assumptions - Stormwater Drainage	Made by: LTT	Date: 29/01/2015	Chd.: NY

Flow Estimation

Design Flow = CiA

Runoff Coefficient C

paved	0.90
glassland	0.30

	For Checking Existing System	For Proposed System	
Design Return Periods	10	50	yrs
a	603	687	
b	4.4	4.2	
c	0.44	0.42	

Inlet Time

Urban	2.0	min
Natural	5.0	min

Hydrology

The inlet time of natural catchment is estimated by the Brandsby William's Equation as per SDM Section 7.5.2

$$t_0 = \frac{0.14465L}{H^{0.2}A^{0.1}}$$

Hydraulic Assessment

Full-bore Capacity = VA

Colebrook-White Equation from Section 8.3.1 & Table 12 of SDM for circular pipes

$$\overline{V} = -\sqrt{32gRS_f}\log\left[\frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{32gRS_f}}\right]$$

Roughness Coefficient (Ks)			
	Existing	1.5	mm
	Proposed	0.6	mm

Manning's Equation from Section 8.3.1 & Table 12 of SDM for channels & box culverts

$$\overline{V} = \frac{R^{1/6}}{n}\sqrt{RS_f}$$

Roughness Coefficient (n) For Concrete Lined Channel = 0.016

ARUP	Job No. 226464	Sheet No.	Rev.
	Member/Location		
Job Title: Planning and Engineering Study - Public Housing Development at Wang Chau, Yuen Long	Drg. Ref.		
Calculation: Hydraulic Assessment of Existing Drainage System - Existing Flow	Made by LTT	Date 29/01/2015	Chd.

Design Rainfall Return Period: 50

Being conservative, assuming the existing channel to be RC

Drainage System			Pipe/Channel/BC											Design Data										Pipeworks Design					
																								Velocity		Capacity			
Description	US MH No.	DS MH No.	Length (m)	Type (UC/Pipe /BC/RC)	Diameter of Pipe/Channel (mm)	Height of Channel (m, For BC and RC only)	No of Cells (For BC only)	Gradient (1 in)	Area (m^2)	Perimeter (m)	Hydraulic Radius (m)	Existing / Proposed	Roughness Coefficient (mm, For Pipe only)	Catchment Ref.	Catchment ID	Paved Area (m^2)	Glassland Area (m^2)	Additional Effective Catchment Area (m^2)	Cumulative Effective Catchment Area (m^2)	t_{in} (min)	t_f (min)	t_c (min)	Intensity (mm/hr)	Full-bore (m/s)	Check for Pipe (1~4m/s)	Peak Runoff (m^3/s)	Full-bore Capacity (m^3/s)	Utilization Ratio	Check (<100%)
Ex. Open Channel along West of Fuk Hi Street	Natural Terrian (Area BC 1)	Natural Stream	667					6.11						Hillside	11	0	130,030	39,009	39,009	16.99									
	Natural Stream	Open Channel	483	RC	6000	2		74.31	12.000	10.00	1.200	Existing	0.016	Hillside	7,8,9,12,13,14, 15,16,17,18	0	131,967	39,590		16.99	0.98	17.98	186.93	8.19	OK	10.839	88.425	12%	OK
														Open Storage	0	144,610	0	130,149	208,748										
	Open Channel	SGJ 1006888	234	RC	6000	2		500	12.000	10.00	1.200	Existing	0.016			0	0	0	208,748	17.98	1.24	19.21	182.72	3.16	OK	10.595	34.088	31%	OK
Ex. DN1200 along Fuk Hi Street	SMH 1031687	SMH 1031686	176	Pipe	1200			926.32	1.131	3.77	0.300	Existing	1.5	Urban	0	57,139	0	51,425	51,425	5.00	2.66	7.66	243.11	1.10	OK	3.473	1.121	310%	NOT OK
Ex. Storm Drain along Long Ping Road discharging to Ex. BC	SMH 1026920	SMH 1026919	32	Pipe	900			180	0.636	2.83	0.225	Existing	1.5	Urban	4	13,235	0	11,912	11,912	5.00	0.26	5.26	267.41	2.09	OK	0.885	1.197	74%	OK
	SMH 1026919	SMH 1026954	32	Pipe	900			400	0.636	2.83	0.225	Existing	1.5	Urban	3	29,989	0	26,990	38,902	5.26	0.38	5.64	263.31	1.40	OK	2.842	0.802	354%	NOT OK
	SMH 1026954	SMH 1026953	33	Pipe	900			380	0.636	2.83	0.225	Existing	1.5					0	38,902	5.64	0.38	6.02	258.83	1.44	OK	2.797	0.823	340%	NOT OK
	SMH 1026953	SMH 1026952	35	Pipe	1200			800	1.131	3.77	0.300	Existing	1.5					0	38,902	6.02	0.49	6.51	253.77	1.19	OK	2.742	1.207	227%	NOT OK
	SMH 1026952	SMH 1026951	31	Pipe	1200			260	1.131	3.77	0.300	Existing	1.5	Urban	2	33,292		29,963	68,864	6.51	0.25	6.76	251.34	2.08	OK	4.808	2.121	227%	NOT OK
	SMH 1026951	SMH 1026957	27	Pipe	1500			490	1.767	4.71	0.375	Existing	1.5	Hillside	3	0	27,819	8,346	77,210	6.76	0.26	7.02	248.90	1.74	OK	5.338	2.773	192%	NOT OK
	SMH 1026957	SMH 1026956	30	Pipe	1500			230	1.767	4.71	0.375	Existing	1.5					0	77,210	7.02	0.20	7.21	247.09	2.55	OK	5.299	4.052	131%	NOT OK
	SMH 1026956	SMH 1026990	36	Pipe	1650			1100	2.138	5.18	0.413	Existing	1.5	Urban	2	43,500		39,150	116,360	7.21	0.49	7.70	242.79	1.23	OK	7.848	2.373	331%	NOT OK
	SMH 1026990	SMH 1026994	43	Pipe	1650			3000	2.138	5.18	0.413	Existing	1.5					0	116,360	7.70	0.96	8.66	234.99	0.74	NOT OK	7.595	1.433	530%	NOT OK
	SMH 1026994	SMH 1026993	49	Pipe	1650			800	2.138	5.18	0.413	Existing	1.5					0	116,360	8.66	0.56	9.23	230.79	1.45	OK	7.460	2.785	268%	NOT OK
	SMH 1026993	SMH 1026992	51	Pipe	1800			700	2.545	5.65	0.450	Existing	1.5	Hillside	1,2	0	6,874	2,062	118,422	9.23	0.52	9.75	227.13	1.63	OK	7.472	3.740	200%	NOT OK
	SMH 1026992	SMH 1010761	51	Pipe	1800			1200	2.545	5.65	0.450	Existing	1.5					0	118,422	9.75	0.68	10.43	222.62	1.25	OK	7.323	2.854	257%	NOT OK
	SMH 1010761	SGJ 1006888	36	Pipe	1800			350	2.545	5.65	0.450	Existing	1.5					0	118,422	10.43	0.26	10.69	220.99	2.31	OK	7.269	5.295	137%	NOT OK
Ex. Twin Cells Box Culvert along Fuk Hi Street	SGJ 1006888	SNF1004264 (Shan Pui River)	389	BC	3500	2	2	598	10.500	9.50	1.105	Existing	0.016	Urban	1	59,000	0	53,100	431,696	19.21	2.37	21.59	175.46	2.73		21.040	25.809	82%	OK
	SNF1004264 (Shan Pui River)																												
Ex. Kai Shan South Channel	Natural Catchment	Channel	579					10.72									151,012	45,304	45,304	16.26	0.00	16.26							
	Kai Shan South Channel	Kai Shan South Channel	221	RC	6000	1		96.09	6.000	8.00	0.750	Existing	0.016					0	45,304	16.26	0.70	16.96	190.55	5.26	NOT OK	2.399	28.422	8%	OK
	Channel		1	RC	3000	1		500.00	3.000	5.00	0.600	Existing	0.016					0	45,304	16.96	0.01	16.97	190.52	1.99	OK	2.399	5.369	45%	OK

ARUP

Job No.	Sheet No.	Rev.
226464		

Member/Location

Job Title: Planning and Engineering Study - Public Housing Development at Wang Chau, Yeen Long

Drg. Ref.

Calculation: Hydraulic Assessment of Proposed Drainage System

Made by: LTT | Date: 21 Nov 2014 | Chd.

Design Rainfall Return Period 50

Being conservative, assuming the existing channel to be RC

Drainage System			Pipe/Channel/BC											Design Data										Pipeworks Design					
																								Velocity		Capacity			
Description	US MH No.	DS MH No.	Length (m)	Type (UC/Pipe /BC/RC)	Diameter of Pipe/Channel (mm)	Height of Channel (m, For BC and RC only)	No of Cells (For BC only)	Gradient (1 in)	Area (m^2)	Perimeter (m)	Hydraulic Radius (m)	Existing / Proposed	Roughness Coefficient (mm, For Pipe only)	Catchment Ref.	Catchment ID	Paved Area (m^2)	Glassland Area (m^2)	Additional Effective Catchment Area (m^2)	Cumulative Effective Catchment Area (m^2)	t_{in} (min)	t_f (min)	t_c (min)	Intensity (mm/hr)	Full-bore (m/s)	Check for Pipe (1~4m/s)	Peak Runoff (m^3/s)	Full-bore Capacity (m^3/s)	Utilization Ratio	Check (<100%)
Ex. Open Channel at West Edge of Fuk Hi Street	Natural Terrian	Natural Stream	667					6.11						Hillside	11	0	130,030	39,009	39,009	16.99									
	Natural Sream	Open Channel	483	RC	6000	2		74.31	12.000	10.00	1.200	Existing	0.016	Hillside	7,8,9,12,13,14, 15,16,17,18	0	131,967	39,590		16.99	0.98	17.98	186.93	8.19	OK	10.839	88.425	12%	OK
														Open Storage	0	144,610	0	130,149	208,748										
	Open Channel	SNF 1004400	234	RC	6000	2		500	12.000	10.00	1.200	Existing	0.016			0	0	0	208,748	17.98	1.24	19.21	182.72	3.16	OK	10.595	34.088	31%	OK
Ex. DN1200 along Fuk Hi Street	SMH 1031687	SNF 1004400	176	Pipe	1200			926.32	1.131	3.77	0.300	Existing	1.5	Urban	0	57,139		51,425	51,425	5.00	2.66	7.66	243.11	1.10	OK	3.473	1.121	310%	NOT OK
Proposed Twin Cells Box Culvert along Fuk Hi Street	SNF 1004400	SNF1004264 (Shan Pui River)	387	BC	3500	2.0	2	595	10.500	9.50	1.105	Proposed	0.016					0	260,173	19.21	2.36	21.57	175.51	2.74	OK	12.684	25.876	49%	OK
	SNF1004264 (Shan Pui River)																												
PRH Site - Discharge to Long Ping Road	Existing Terrain	SMH 68001	142					4.44						Hillside	3		10,400	3,120	3,120	4.37									
	SMH 66001	SMH 68001	170	UC	900			500	0.723	2.31	0.313	Proposed	0.016	Hillside	3		10,400	3,120	3,120	1.00	2.20	3.20	296.38	1.29	OK	0.257	0.838	31%	OK
	SMH 68002	SMH 69001	131	UC	450			150	0.181	1.16	0.156	Proposed	0.016	Hillside	0		7,019	2,106	2,106	1.00	1.47	2.47	309.52	1.48	OK	0.181	0.241	75%	OK
	SMH 66002	SMH 69001	51	UC	450			200	0.181	1.16	0.156	Proposed	0.016	Hillside	2		3,661	1,098	1,098	1.00	0.66	1.66	326.85	1.28	OK	0.100	0.209	48%	OK
	SMH 68001	SMH 68002	82	Pipe	1050			300	0.866	3.30	0.263	Proposed	0.6	WC South	0	13,832		12,449	18,689	4.37	0.69	5.06	269.80	1.98	OK	1.401	1.546	91%	OK
	SMH 68002	SMH 69001	55	Pipe	1050			300	0.866	3.30	0.263	Proposed	0.6					0	18,689	5.06	0.46	5.52	264.33	1.98	OK	1.372	1.546	89%	OK
	SMH 69001	SMH 69002	42	Pipe	1350			500	1.431	4.24	0.338	Proposed	0.6	WC South	4	4,642		4,178	26,071	5.52	0.39	5.91	259.99	1.79	OK	1.883	2.308	82%	OK
	SMH 69002	SMH 69003	30	Pipe	1350			500	1.431	4.24	0.338	Proposed	0.6					0	26,071	5.91	0.28	6.19	257.04	1.79	OK	1.861	2.308	81%	OK
	SMH 69003	SMH 69004	18	Pipe	1350			500	1.431	4.24	0.338	Proposed	0.6					0	26,071	6.19	0.17	6.36	255.32	1.79	OK	1.849	2.308	80%	OK
	SMH 69004	SMH 65001	26	Pipe	1350			500	1.431	4.24	0.338	Proposed	0.6					0	26,071	6.36	0.24	6.60	252.90	1.79	OK	1.831	2.308	79%	OK
	SMH 64001	SMH 65001	93	UC	450			200	0.181	1.16	0.156	Proposed	0.016	Hillside	1		3,213	964	964	1.00	1.21	2.21	314.85	1.28	OK	0.084	0.209	40%	OK
	SMH 65001	SMH 1026992	23	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	27,035	6.60	0.20	6.80	250.95	1.91	OK	1.885	3.040	62%	OK

ARUP

Job No.	226464	Sheet No.	Rev.
Member/Location			
Job Title	Planning and Engineering Study - Public Housing Development at Wang Chau, Yuen Long	Drg. Ref.	
Calculation	Hydraulic Assessment of Proposed Drainage System	Made by LTT / Date 21 Nov 2014	Chd.

Design Rainfall Return Period 50

Being conservative, assuming the existing channel to be RC

Drainage System			Pipe/Channel/BC										Design Data										Pipeworks Design					
																							Velocity		Capacity			
Description	US MH No.	DS MH No.	Length (m)	Type (UC/Pipe /BC/RC)	Diameter of Pipe/Channel (mm)	Height of Channel (m, For BC and RC only)	No of Cells (For BC only)	Gradient (1 in)	Area (m^2)	Perimeter (m)	Hydraulic Radius (m)	Existing / Proposed	Roughness Coefficient (mm, For Pipe only)	Catchment Ref.	Catchment ID	Paved Area (m^2)	Grassland Area (m^2)	Additional Effective Catchment Area (m^2)	Cumulative Effective Catchment Area (m^2)	t_{in} (min)	t_f (min)	t_c (min)	Intensity (mm/hr)	Full-bore (m/s)	Check for Pipe (1~4m/s)	Peak Runoff (m^3/s)	Full-bore Capacity (m^3/s)	Utilization Ratio	Check (<100%)
HOS Site - Discharge to Long Ping Road	SMH 70001	SMH 70002	74	Pipe	1050			400	0.866	3.30	0.263	Proposed	0.6	WC South	3	5,826		5,243	5,243	3.00	0.72	3.72	288.09	1.72	OK	0.420	1.338	31%	OK
	SMH 70002	SMH 70003	64	Pipe	1350			550	1.431	4.24	0.338	Proposed	0.6	WC South	1	7,171		6,454	11,697	3.72	0.62	4.34	279.05	1.71	OK	0.907	2.200	41%	OK
	SMH 70003	SMH 70004	64	Pipe	1350			300	1.431	4.24	0.338	Proposed	0.6	WC South	2	24,649		22,184	33,881	4.34	0.46	4.80	272.96	2.32	OK	2.569	2.984	86%	OK
	SMH 70004	SMH 70005	46	Pipe	1350			300	1.431	4.24	0.338	Proposed	0.6					0	33,881	4.80	0.33	5.13	268.86	2.32	OK	2.530	2.984	85%	OK
	SMH 70005	SMH 70006	32	Pipe	1350			300	1.431	4.24	0.338	Proposed	0.6					0	33,881	5.13	0.23	5.36	266.12	2.32	OK	2.505	2.984	84%	OK
	SMH 70006	SMH 1010759	36	Pipe	1350			300	1.431	4.24	0.338	Proposed	0.6					0	33,881	5.36	0.26	5.62	263.15	2.32	OK	2.477	2.984	83%	OK
	SMH 1010759	SMH 1026920	25	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	33,881	5.62	0.22	5.84	260.74	1.91	OK	2.454	3.040	81%	OK
	SMH 1026920	SMH 1026919	32	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	33,881	5.84	0.28	6.12	257.75	1.91	OK	2.426	3.040	80%	OK
	SMH 1026919	SMH 1026954	32	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	33,881	6.12	0.28	6.40	254.88	1.91	OK	2.399	3.040	79%	OK
	SMH 1026954	SMH 1026953	33	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	33,881	6.40	0.29	6.69	252.03	1.91	OK	2.372	3.040	78%	OK
	SMH 1026953	SMH 1026952	35	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	33,881	6.69	0.31	6.99	249.12	1.91	OK	2.345	3.040	77%	OK
Proposed Drainage System along Long Ping Road	SMH 1026952	SMH 1026951	31	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	33,881	6.99	0.27	7.26	246.63	1.91	OK	2.321	3.040	76%	OK
	SMH 1026951	SMH 1026957	27	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	33,881	7.26	0.24	7.50	244.54	1.91	OK	2.301	3.040	76%	OK
	SMH 1026957	SMH 1026956	30	Pipe	1500			500	1.767	4.71	0.375	Proposed	0.6					0	33,881	7.50	0.26	7.76	242.28	1.91	OK	2.280	3.040	75%	OK
	SMH 1026956	SMH 1026992	139	BC	3500	2.0	1	1000	5.250	6.50	0.808	Proposed	0.016	Urban	2	76,792		69,113	102,994	7.76	1.35	9.11	231.62	1.71	OK	6.627	8.099	82%	OK
	SMH 1026992	SGJ 1006888	125	BC	3500	2.0	2	1000	10.500	9.50	1.105	Proposed	0.016					0	130,029	9.11	0.99	10.10	224.78	2.11	OK	8.119	19.966	41%	OK
Ex. BC along Fuk Hi Street discharge to Shan Pui River	SGJ 1006888	SNF1004264 (Shan Pui River)	389	BC	3500	2.0	2	598	10.500	9.50	1.105	Existing	0.016	Urban	1	59,000		53,100	183,129	10.10	2.37	12.47	210.73	2.73	OK	10.720	25.809	42%	OK
	SNF1004264 (Shan Pui River)																												
Kai Shan South Channel	Existing Terrain	SMH 67002	579					10.72						Hillside	10		115,117	34,535	34,535	16.71									
	SMH 67001	SMH 67002	61	UC	450			200	0.181	1.16	0.156	Proposed	0.016	Hillside	5		6,463	1,939	1,939	5.00	0.79	5.79	261.27	1.28	OK	0.141	0.209	67%	OK
	SMH 67003	SMH 67002	230	UC	900			200	0.723	2.31	0.313	Proposed	0.016	Hillside	6		14,778	4,433	4,433	1.00	1.88	2.88	301.89	2.04	OK	0.372	1.324	28%	OK
	SMH 67002	SMH 90001	22	Pipe	1200			180	1.131	3.77	0.300	Proposed	0.6					0	40,907	16.71	0.13	16.84	191.11	2.79	OK	2.172	2.835	77%	OK
	SMH 90001	SMH 90002	24	Pipe	1200			180	1.131	3.77	0.300	Proposed	0.6					0	40,907	16.84	0.14	16.98	190.56	2.79	OK	2.165	2.835	76%	OK
	SMH 90002	SMH 90003	37	Pipe	1200			180	1.131	3.77	0.300	Proposed	0.6					0	40,907	16.98	0.22	17.21	189.73	2.79	OK	2.156	2.835	76%	OK
	SMH 90003	SMH 90004	48	Pipe	1200			160	1.131	3.77	0.300	Proposed	0.6					0	40,907	17.21	0.27	17.48	188.73	2.96	OK	2.145	3.008	71%	OK
	SMH 90004	SMH 90005	32	Pipe	1200			160	1.131	3.77	0.300	Proposed	0.6					0	40,907	17.48	0.18	17.66	188.08	2.96	OK	2.137	3.008	71%	OK
	SMH 90005	SMH 90006	21	Pipe	1200			160	1.131	3.77	0.300	Proposed	0.6					0	40,907	17.66	0.12	17.77	187.65	2.96	OK	2.132	3.008	71%	OK
	SMH 90006	SMH 90007	13	BC	2000	2.0	1	500	3.000	5.00	0.600	Proposed	0.016	Hillside	4		12,804	3,841	44,749	17.77	0.11	17.88	187.26	1.99	OK	2.328	5.369	43%	OK

Appendix B

Hydraulic Modelling Output

Start of run configured for MS Windows Produced on 30/03/2015 at 14:54

InfoWorks ICM SIM

Summary results from Simulation

Version 4.0.0.8004 (x64) dated July 2013

Licence Number - WS33330158PM

Message 253: Rur finished for event 1.

Summary results for event 1 - DIA-Existing (Freebcard Analysis) M0-240
Started at 00000000000000. Run for 300.00 min. (Requestec simulation time 300.00 min)

Files used:
Network: ...eebcard20analysis29.sp Mcdel network_1 (versicn 316) (Scenario DIA-Existing (Freeboard Analysis))
State:
Runoff: ...eebcard20analysis29.rp Mcdel network_1 (versicn 316) (Scenario DIA-Existing (Freeboard Analysis)) (Inf
Rainfall: ...\sim21event.red MC-240, a=687, b=4.2, c=0.42 x1.00
DWF:
Inflows:
Levels: ...\sim21event.lev 1
RTC:
Results: ...\sim21.iwr

Total rainfall = 225617.7 m3
Total runoff = 129862.9 m3
Total inflow = 4131262.9 m3
Total outflow = 4131263.7 m3
Total lost = 0.0 m3

********** Node data **********

Node Reference	Ground Level (m AD)	Max Level (m AD)	Flood Volume (m3)	Flood Depth (m)	Flood Area (m2)	Max Stored (m3)	Inflow (m3)	Vol Balance (m3)	Vol Balance (%)
SGJ1006888	5.000	4.916	0.0	0.000	0.0	3.9	71287.2	0.000	0.000
SMH 1010759	5.800	6.389	250.5	0.589	1222.5	256.6	4943.3	-0.079	0.002
SMH 1010761	5.450	5.005	0.0	0.000	0.0	19.8	0.0	0.000	0.000
SMH 1026919	5.220	6.240	1087.0	1.020	3001.5	1092.4	7350.5	-0.377	0.003
SMH 1026920	5.800	6.317	0.6	0.517	1.0	6.8	0.0	0.000	0.000
SMH 1026951	4.930	5.731	0.9	0.801	1.0	12.3	0.0	0.000	0.000
SMH 1026952	4.900	5.767	1.0	0.867	1.0	8.8	0.0	0.000	0.000
SMH 1026953	5.200	5.809	0.7	0.609	1.0	9.3	0.0	0.000	0.000
SMH 1026954	5.250	5.981	0.8	0.731	1.0	6.7	0.0	0.000	0.000
SMH 1026956	5.100	5.709	728.5	0.609	3459.2	743.5	19955.9	-0.245	0.001
SMH 1026957	4.900	5.720	1.0	0.820	1.0	12.4	0.0	0.000	0.000
SMH 1026990	5.300	5.557	0.4	0.257	1.0	17.0	0.0	0.001	0.000
SMH 1026992	5.960	5.111	0.0	0.000	0.0	20.1	0.0	-0.000	0.000
SMH 1026993	5.790	5.228	0.0	0.000	0.0	19.8	0.0	0.000	0.000
SMH 1026994	5.680	5.392	0.0	0.000	0.0	17.6	0.0	-0.000	0.000
SMH 1031680	4.280	4.928	0.7	0.648	1.0	10.7	0.0	0.000	0.000
SMH 1031687	4.170	5.149	1832.8	0.979	5483.7	1843.0	14004.7	-0.085	0.001
SMH 90007	8.910	8.913	0.0	0.003	2.9	4.4	12321.4	-0.000	0.000
SNF1004264 (SHAN PUI RIVER)	4.000	4.280	0.9	0.280	2.0	14.1	4001400.0	-0.000	0.000

A %% indicates water lost from the system.

********** Link data **********

Link Reference	D/S Node	Pipe Len (m)	Pipe Hgt (mm)	Sed Dpth (mm)	P.Full Flow (m3/s)	Upstream < Invert Level (m AD)	Upstream Max Depth (m)	Upstream Max Flow (m3/s)	Upstream Max Vel (m/s)	Upstream Total Flow > (m3)	Downstream < Invert Level (m AD)	Downstream Max Depth (m)	Downstream Max Flow (m3/s)	Downstream Max Vel (m/s)	Downstream Total Flow > (m3)
SGJ1C06888.1	SNF1004264 (SHAN PUI RIVER)	392	2000	0	13.177	0.980	3.784	11.059	1.501	58771.2x	0.330	3.952	11.069	1.500	58771.2x
SGJ1C06888.2	SNF1004264 (SHAN PUI RIVER)	392	2000	0	13.177	0.980	3.784	11.059	1.501	58771.2x	0.330	3.952	11.069	1.500	58771.2x
SMH 1C10759.1	SMH 1026920	25	900	0	1.128	3.010	3.341	0.756	1.081	4943.4x	2.910	3.410	0.755	1.079	4943.4x
SMH 1C10761.1	SGJ1006888	36	1800	0	5.799	1.160	3.824	5.100	1.890	32250.4x	1.060	3.870	5.100	1.890	32250.4x
SMH 1C26919.1	SMH 1026954	32	900	0	0.891	2.730	3.416	1.828	2.606	12294.3+	2.650	3.334	1.828	2.623	12294.3+
SMH 1C26920.1	SMH 1026919	32	900	0	1.338	2.910	3.371	0.754	1.079	4943.4x	2.730	3.512	0.754	1.075	4943.4x
SMH 1C26951.1	SMH 1026957	27	1500	0	3.214	2.100	3.629	1.828	0.976	12294.3x	2.040	3.681	1.826	0.975	12294.3x
SMH 1C26952.1	SMH 1026951	31	1200	0	2.364	2.320	3.441	1.828	1.511	12294.3x	2.200	3.532	1.827	1.509	12294.3x
SMH 1C26953.1	SMH 1026952	35	1200	0	1.281	2.360	3.442	1.829	1.510	12294.3+	2.320	3.448	1.828	1.510	12294.3+
SMH 1C26954.1	SMH 1026953	33	900	0	0.931	2.540	3.418	1.829	2.620	12294.3+	2.450	3.361	1.828	2.637	12294.3+
SMH 1C26956.1	SMH 1026990	36	1650	0	2.523	1.810	3.864	5.090	2.228	32250.4+	1.780	3.780	5.091	2.232	32250.4+
SMH 1C26957.1	SMH 1026956	30	1500	0	4.493	2.040	3.678	1.827	0.975	12294.3x	1.910	3.799	1.826	0.974	12294.3x
SMH 1C26990.1	SMH 1026994	43	1650	0	1.327	1.670	3.854	5.091	2.230	32250.4+	1.660	3.736	5.092	2.234	32250.4+
SMH 1C26992.1	SMH 1010761	51	1800	0	3.074	1.210	3.881	5.098	1.887	32250.4+	1.170	3.842	5.098	1.889	32250.4+
SMH 1C26993.1	SMH 1026992	51	1800	0	4.072	1.390	3.814	5.095	1.886	32250.4+	1.320	3.799	5.096	1.888	32250.4+
SMH 1C26994.1	SMH 1026993	49	1650	0	3.060	1.550	3.812	5.093	2.233	32250.4+	1.490	3.740	5.094	2.236	32250.4+
SMH 1C31680.3	SGJ1006888	17	1200	0	0.000	0.990	3.935	2.043	1.665	14004.8+	0.990	3.928	2.043	1.666	14004.8+
SMH 1C31687.1	SMH 1031680	170	1200	0	-1.267	0.800	4.332	2.043	1.642	14004.8x	0.990	3.940	2.043	1.664	14004.8x
SMH 90007.1	SMH 90008	18	1450	0	28.508	7.460	1.452	2.128	0.496	12321.4x	7.107	1.804	2.128	0.291	12321.4x
SNF1004264 (SHAN PUI RIVER).1	SHAN PUI RIVER	100	4000	0	230.191	0.330	3.944	244.438	1.080	4118942.4	0.326	3.942	244.464	1.080	4118942.4

+ after total flow indicates a conduit surcharged by flow and depth at that end.
x after total flow indicates a conduit surcharged by depth only at that end.

NOTE :
(i) Maximum elevations, depths, volumes, velocities and discharges are selected from the values at each time increment and will be in general more extreme than the maximum values in the time varying results.
(ii) Maximum elevations, velocities and discharges are not necessarily calculated at the same time.
(iii) Maximum velocity is not calculated for a conduit unless the depth exceeds the base flow depth (by default, this is 5% of height for slopes <= 0.01, 10% otherwise, subject to a minimum of 0.02 m).

End of run 0 mins (elapsed) Produced on 30/03/2015 Last page

Start of run configured for MS Windows Produced on 30/03/2015 at 14:54

Infoworks ICM SIM

Summary results from Simulation

Version 4.0.0.8004 (x64) dated July 2013

Licence Number - WS33330158PM

Message 253: Run finished for event 1.

Summary results for event 1 - DIA-Existing (Freeboard Analysis) M0-240
Started at 00000000000000. Run for 300.00 min. (Requested simulation time 300.00 min)

Files used:
Network: ...eeboard20analysis29.sp Model network_1 (version 316) (Scenario DIA-Existing (Freeboard Analysis))
State:
Runoff: ...eeboard20analysis29.rp Model network_1 (version 316) (Scenario DIA-Existing (Freeboard Analysis)) (Inf
Rainfall: ...\sim23event.red M0-240, a=603, b=4.4, c=0.44 x1.00
DWF:
Inflows:
Levels: ...\sim23event.lev 1
RTC:
Results: ...\sim23.mdx

Total rainfall = 177360.7 m3
Total runoff = 202086.1 m3
Total inflow = 4203486.1 m3
Total outflow = 4203486.9 m3
Total lost = 0.0 m3

********** Node data **********

Node Reference	Ground Level (m AD)	Max Level (m AD)	Flood Volume (m3)	Flood Depth (m)	Flood Area (m2)	Max Stored (m3)	Inflow (m3)	Vol Balance (m3)	Vol Balance (%)
SGJ1006888	5.000	4.830	0.0	0.000	0.0	3.9	56039.3	0.000	0.000
SMH 1010759	5.800	6.247	114.1	0.447	723.6	120.1	3886.0	-0.090	0.002
SMH 1010761	5.450	4.918	0.0	0.000	0.0	19.4	0.0	-0.000	0.000
SMH 1026919	5.220	6.096	698.7	0.876	2319.4	704.1	5778.3	-0.378	0.009
SMH 1026920	5.800	6.173	0.4	0.373	1.0	6.7	0.0	0.000	0.000
SMH 1026951	4.930	5.601	0.8	0.671	1.0	12.2	0.0	0.000	0.000
SMH 1026952	4.900	5.636	0.8	0.736	1.0	8.6	0.0	0.000	0.000
SMH 1026953	5.200	5.678	0.6	0.478	1.0	9.2	0.0	0.000	0.000
SMH 1026954	5.250	5.847	0.7	0.597	1.0	6.5	0.0	0.001	0.000
SMH 1026956	5.100	5.579	364.6	0.479	2180.6	379.6	15687.5	-0.188	0.001
SMH 1026957	4.900	5.590	0.8	0.690	1.0	12.3	0.0	0.000	0.000
SMH 1026990	5.300	5.444	0.3	0.144	1.0	16.9	0.0	0.000	0.000
SMH 1026992	5.960	5.023	0.0	0.000	0.0	19.7	0.0	-0.000	0.000
SMH 1026993	5.790	5.137	0.0	0.000	0.0	19.3	0.0	0.000	0.000
SMH 1026994	5.680	5.294	0.0	0.000	0.0	17.1	0.0	0.000	0.000
SMH 1031680	4.280	4.843	0.7	0.563	1.0	10.6	0.0	0.000	0.000
SMH 1031687	4.170	5.051	1345.0	0.881	4461.3	1355.2	11009.3	-0.049	0.000
SMH 90007	8.910	8.803	0.0	0.000	0.0	4.0	9685.7	-0.000	0.000
SNF1004264 (SHAN PUI RIVER)	4.000	4.359	1.0	0.359	1.0	14.2	4001400.0	-0.000	0.000

A %% indicates water lost from the system.

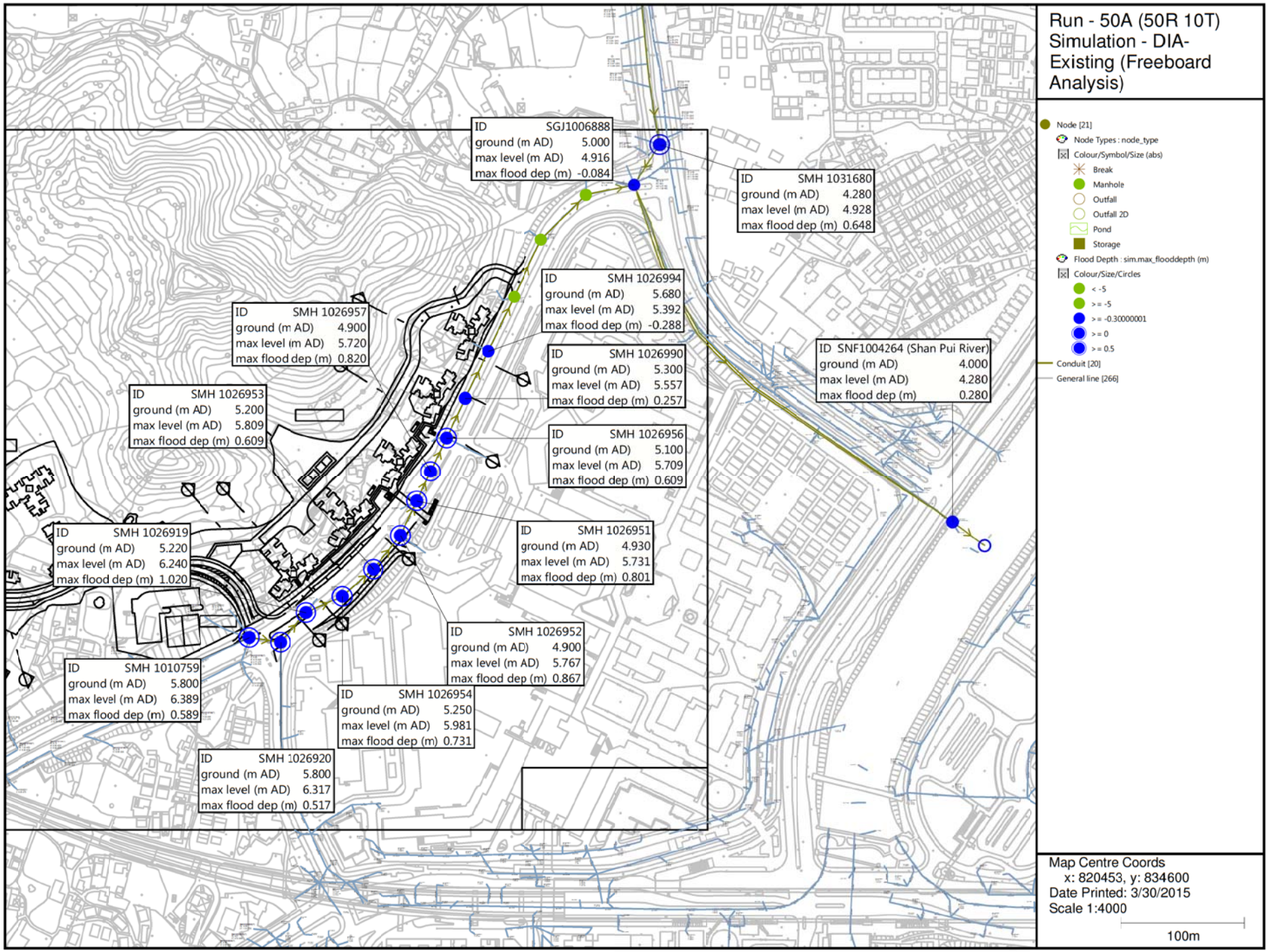
********** Link data **********

Link Reference	D/S Node	Pipe Len (m)	Pipe Hgt (mm)	Sed Dpth (mm)	P.Full Flow (m3/s)	Upstream Invert Level (m AD)	Upstream Max Depth (m)	Upstream Max Flow (m3/s)	Upstream Max Vel (m/s)	Upstream Total Flow (m3)	Downstream Invert Level (m AD)	Downstream Max Depth (m)	Downstream Max Flow (m3/s)	Downstream Max Vel (m/s)	Downstream Total Flow (m3)
SGJ1006888.1	SNF1004264 (SHAN PUI RIVER)	392	2000	0	13.177	0.980	3.738	9.452	1.283	46200.6x	0.330	4.030	9.460	1.281	46200.6x
SGJ1006888.2	SNF1004264 (SHAN PUI RIVER)	392	2000	0	13.177	0.980	3.738	9.452	1.283	46200.6x	0.330	4.030	9.460	1.281	46200.6x
SMH 1010759.1	SMH 1026920	25	900	0	1.128	3.010	3.198	0.756	1.085	3886.1x	2.910	3.267	0.755	1.083	3886.1x
SMH 1010761.1	SGJ1006888	36	1800	0	5.799	1.160	3.737	4.732	1.754	25352.5x	1.060	3.784	4.732	1.753	25352.5x
SMH 1026919.1	SMH 1026954	32	900	0	0.891	2.730	3.276	1.721	2.462	9664.8+	2.650	3.199	1.721	2.476	9664.8+
SMH 1026920.1	SMH 1026919	32	900	0	1.338	2.910	3.226	0.754	1.083	3886.1x	2.730	3.368	0.753	1.079	3886.1x
SMH 1026951.1	SMH 1026957	27	1500	0	3.214	2.100	3.498	1.730	0.924	9664.8x	2.040	3.550	1.731	0.924	9664.8x
SMH 1026952.1	SMH 1026951	31	1200	0	2.364	2.320	3.309	1.727	1.428	9664.8x	2.200	3.402	1.728	1.428	9664.8x
SMH 1026953.1	SMH 1026952	35	1200	0	1.281	2.360	3.311	1.723	1.424	9664.8+	2.320	3.317	1.725	1.426	9664.8+
SMH 1026954.1	SMH 1026953	33	900	0	0.931	2.540	3.285	1.721	2.473	9664.8+	2.450	3.230	1.721	2.487	9664.8+
SMH 1026956.1	SMH 1026990	36	1650	0	2.523	1.810	3.738	4.721	2.070	25352.5+	1.780	3.667	4.722	2.073	25352.5+
SMH 1026957.1	SMH 1026956	30	1500	0	4.493	2.040	3.547	1.734	0.926	9664.8x	1.910	3.669	1.735	0.925	9664.8x
SMH 1026990.1	SMH 1026994	43	1650	0	1.327	1.670	3.743	4.722	2.071	25352.5+	1.660	3.637	4.722	2.074	25352.5+
SMH 1026992.1	SMH 1010761	51	1800	0	3.074	1.210	3.791	4.729	1.751	25352.5+	1.170	3.755	4.730	1.752	25352.5+
SMH 1026993.1	SMH 1026992	51	1800	0	4.072	1.390	3.724	4.727	1.751	25352.5+	1.320	3.711	4.727	1.752	25352.5+
SMH 1026994.1	SMH 1026993	49	1650	0	3.060	1.550	3.715	4.724	2.073	25352.5+	1.490	3.650	4.725	2.076	25352.5+
SMH 1031680.3	SGJ1006888	17	1200	0	0.000	0.990	3.850	1.821	1.483	11009.3+	0.990	3.842	1.821	1.484	11009.3+
SMH 1031687.1	SMH 1031680	170	1200	0	-1.267	0.800	4.237	1.821	1.465	11009.3x	0.990	3.855	1.821	1.482	11009.3x
SMH 90007.1	SMH 90008	18	1450	0	28.508	7.460	1.342	1.692	0.474	9685.7	7.107	1.694	1.692	0.271	9685.7x
SNF1004264 (SHAN PUI RIVER).1	SHAN PUI RIVER	100	4000	0	230.191	0.330	4.024	241.220	1.043	4093801.2+	0.326	4.022	241.242	1.043	4093801.2+

+ after total flow indicates a conduit surcharged by flow and depth at that end.
x after total flow indicates a conduit surcharged by depth only at that end.

NOTE :
(i) Maximum elevations, depths, volumes, velocities and discharges are selected from the values at each time increment and will be in general more extreme than the maximum values in the time varying results.
(ii) Maximum elevations, velocities and discharges are not necessarily calculated at the same time.
(iii) Maximum velocity is not calculated for a conduit unless the depth exceeds the base flow depth (by default, this is 5% of height for slopes <= 0.01, 10% otherwise, subject to a minimum of 0.02 m).

End of run 0 mins (elapsed) Produced on 30/03/2015 Last page


Run - 50A (50R 10T) Simulation - DIA-Existing (Freeboard Analysis)
ID SGJ1006888
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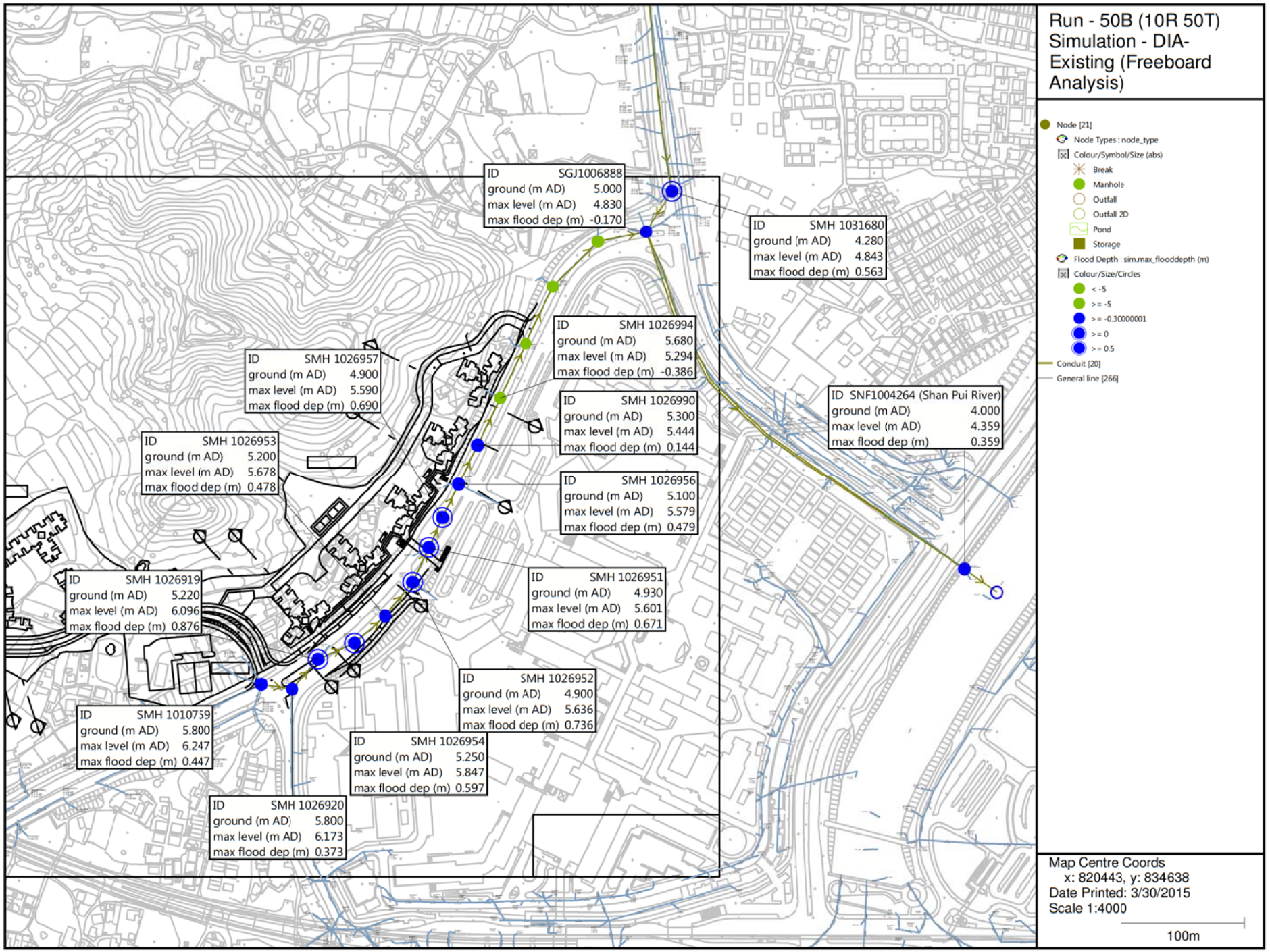
max level (m AD) 4.916
max flood dep (m) -0.084
ID SMH 1031680
ground (m AD) 4.280
max level (m AD) 4.928
max flood dep (m) 0.648
ID SMH 1026994
ground (m AD) 5.680
max level (m AD) 5.392
max flood dep (m) -0.288
ID SMH 1026957
ground (m AD) 4.900
max level (m AD) 5.720
max flood dep (m) 0.820
ID SMH 1026990
ground (m AD) 5.300
max level (m AD) 5.557
max flood dep (m) 0.257
ID SNF1004264 (Shan Pui River)
ground (m AD) 4.000
max level (m AD) 4.280
max flood dep (m) 0.280
ID SMH 1026953
ground (m AD) 5.200
max level (m AD) 5.809
max flood dep (m) 0.609
ID SMH 1026956
ground (m AD) 5.100
max level (m AD) 5.709
max flood dep (m) 0.609
ID SMH 1026919
ground (m AD) 5.220
max level (m AD) 6.240
max flood dep (m) 1.020
ID SMH 1026951
ground (m AD) 4.930
max level (m AD) 5.731
max flood dep (m) 0.801
ID SMH 1026952
ground (m AD) 4.900
max level (m AD) 5.767
max flood dep (m) 0.867
ID SMH 1010759
ground (m AD) 5.800
max level (m AD) 6.389
max flood dep (m) 0.589
ID SMH 1026954
ground (m AD) 5.250
max level (m AD) 5.981
max flood dep (m) 0.731
ID SMH 1026920
ground (m AD) 5.800
max level (m AD) 6.317
max flood dep (m) 0.517
Node [21]
Node Types : node_type
Colour/Symbol/Size (abs)
Break
Manhole
Outfall
Outfall 2D
Pond
Storage
Flood Depth : sim.max_flooddepth (m)
Colour/Size/Circles
< -5
>= -5
>= -0.30000001
>= 0
>= 0.5
Conduit [20]
General line [266]
Map Centre Coords
x: 820453, y: 834600
Date Printed: 3/30/2015
Scale 1:4000
100m


ID SGJ1006888
ground (m AD) 5.000
max level (m AD) 4.830
max flood dep (m) -0.170
ID SMH 1031680
ground (m AD) 4.280
max level (m AD) 4.843
max flood dep (m) 0.563
ID SMH 1026994
ground (m AD) 5.680
max level (m AD) 5.294
max flood dep (m) -0.386
ID SMH 1026957
ground (m AD) 4.900
max level (m AD) 5.590
max flood dep (m) 0.690
ID SMH 1026990
ground (m AD) 5.300
max level (m AD) 5.444
max flood dep (m) 0.144
ID SNF1004264 (Shan Pui River)
ground (m AD) 4.000
max level (m AD) 4.359
max flood dep (m) 0.359
ID SMH 1026953
ground (m AD) 5.200
max level (m AD) 5.678
max flood dep (m) 0.478
ID SMH 1026956
ground (m AD) 5.100
max level (m AD) 5.579
max flood dep (m) 0.479
ID SMH 1026919
ground (m AD) 5.220
max level (m AD) 6.096
max flood dep (m) 0.876
ID SMH 1026951
ground (m AD) 4.930
max level (m AD) 5.601
max flood dep (m) 0.671
ID SMH 1026952
ground (m AD) 4.900
max level (m AD) 5.636
max flood dep (m) 0.736
ID SMH 1010759
ground (m AD) 5.800
max level (m AD) 6.247
max flood dep (m) 0.447
ID SMH 1026954
ground (m AD) 5.250
max level (m AD) 5.847
max flood dep (m) 0.597
ID SMH 1026920
ground (m AD) 5.800
max level (m AD) 6.173
max flood dep (m) 0.373
Run - 50B (10R 50T) Simulation - DIA-Existing (Freeboard Analysis)
Node [21]
Node Types : node_type
Colour/Symbol/Size (abs)
Break
Manhole
Outfall
Outfall 2D
Pond
Storage
Flood Depth : sim.max_flooddepth (m)
Colour/Size/Circles
< -5
>= -5
>= -0.30000001
>= 0
>= 0.5
Conduit [20]
General line [266]
Map Centre Coords
x: 820443, y: 834638
Date Printed: 3/30/2015
Scale 1:4000
100m

Start of run configured for MS Windows Produced on 30/03/2015 at 14:54

InfoWorks ICM SIM

Summary results from Simulation

Version 4.0.0.8004 (x64) dated July 2013

Licence Number - WS33330158PM

Message 253: Run finished for event 1.

Model network_1 (version 316) (Scenario DIA-Proposed (Freebo Event - 1 WS33330158PM Produced 30/03/2015 Pg 1

Summary results for event 1 - DIA-Proposed (Freebcard Analysis) MO-240
Started at 00000000000000. Run for 300.00 min. (Requestec simulation time 300.00 min)

Files used:
Network: ...eebcard20analysis29.sp Model network_1 (versicn 316) (Scenario DIA-Proposed (Freeboard Analysis))
State:
Runoff: ...eebcard20analysis29.rp Model network_1 (versicn 316) (Scenario DIA-Proposed (Freeboard Analysis)) (Inf
Rainfall: ...\sim22event.red MC-240, a=687, b=4.2, c=0.42 x1.00
DWF:
Inflows:
Levels: ...\sim22event.lev 1
RTC:
Results: ...\sim22.iwr

Total rainfall = 232232.1 m3
Total runoff = 136120.8 m3
Total inflow = 4137520.8 m3
Total outflow = 4137515.8 m3
Total lost = 0.0 m3

Model network_1 (version 316) (Scenario DIA-Proposed (Freebo Event - 1 WS33330158PM Produced 30/03/2015 Pg 2

********** Node data **********

Node Reference	Ground Level (m AD)	Max Level (m AD)	Flood Volume (m3)	Flood Depth (m)	Flood Area (m2)	Max Stored (m3)	Inflow (m3)	Vol Balance (m3)	Vol Balance (%)
SGJ1006888	5.000	4.578	0.0	0.000	0.0	12.6	14460.8	-0.000	0.000
SMH 1010759	5.800	5.912	1.8	0.112	33.0	11.7	3245.1	-0.000	0.000
SMH 1026919	5.220	5.427	0.3	0.207	1.0	12.1	0.0	0.000	0.000
SMH 1026920	5.800	5.652	0.0	0.000	0.0	13.2	0.0	-0.000	0.000
SMH 1026951	4.930	4.974	0.1	0.044	2.4	11.8	0.0	-0.000	0.000
SMH 1026952	4.900	5.070	0.3	0.170	1.0	10.1	0.0	-0.000	0.000
SMH 1026953	5.200	5.174	0.0	0.000	0.0	12.1	0.0	-0.000	0.000
SMH 1026954	5.250	5.272	0.1	0.022	3.2	12.2	0.0	0.000	0.000
SMH 1026956	5.100	4.790	0.0	0.000	0.0	11.5	18821.1	-0.000	0.000
SMH 1026957	4.900	4.886	0.0	0.000	0.0	11.7	0.0	-0.000	0.000
SMH 1026992	5.700	4.663	0.0	0.000	0.0	82.5	0.0	0.000	0.000
SMH 1031687	4.170	5.014	1190.2	0.844	4107.3	1202.0	14004.9	-0.088	0.001
SMH 65001	7.200	4.754	0.0	0.000	0.0	6.6	262.3	-0.000	0.000
SMH 67002	16.000	11.759	0.0	0.000	0.0	2.3	11126.2	0.000	0.000
SMH 68001	14.000	12.346	0.0	0.000	0.0	2.4	5089.0	-0.000	0.000
SMH 68002	14.000	12.107	0.0	0.000	0.0	1.9	0.0	-0.000	0.000
SMH 69001	14.000	11.965	0.0	0.000	0.0	2.7	2009.7	-0.000	0.000
SMH 69002	14.000	8.167	0.0	0.000	0.0	2.7	0.0	-0.000	0.000
SMH 69003	10.000	6.921	0.0	0.000	0.0	2.7	0.0	-0.000	0.000
SMH 69004	8.840	5.378	0.0	0.000	0.0	2.7	0.0	-0.000	0.000
SMH 70001	16.000	14.154	0.0	0.000	0.0	1.8	1428.9	-0.000	0.000
SMH 70002	16.000	14.123	0.0	0.000	0.0	3.4	7799.0	-0.000	0.000
SMH 70003	16.000	11.244	0.0	0.000	0.0	3.1	0.0	-0.000	0.000
SMH 70004	13.000	7.346	0.0	0.000	0.0	3.2	0.0	-0.000	0.000
SMH 70005	9.000	6.186	0.0	0.000	0.0	6.7	0.0	0.000	0.000
SMH 70006	7.000	6.028	0.0	0.000	0.0	9.6	0.0	0.000	0.000
SMH 90001	16.000	11.646	0.0	0.000	0.0	2.3	0.0	0.000	0.000
SMH 90002	16.000	11.435	0.0	0.000	0.0	2.1	0.0	0.000	0.000
SMH 90003	16.000	11.223	0.0	0.000	0.0	2.1	0.0	0.000	0.000
SMH 90004	16.000	10.886	0.0	0.000	0.0	2.0	0.0	0.000	0.000
SMH 90005	16.000	9.021	0.0	0.000	0.0	3.0	0.0	-0.000	0.000
SMH 90006	16.000	8.927	0.0	0.000	0.0	8.6	1044.7	0.000	0.000
SMH 90007	16.000	8.916	0.3	0.006	47.9	69.8	0.0	0.000	0.000
SNF 1004400	4.280	4.568	303.1	0.288	3051.2	314.7	56828.8	-0.038	0.000
SNF1004264 (SHAN PUI RIVER)	4.000	4.281	0.9	0.281	2.0	14.1	4001400.0	-0.000	0.000

A %% indicates water lost from the system.

Model network_1 (version 316) (Scenario DIA-Proposed (Freebo Event - 1 WS33330158PM Produced 30/03/2015 Pg 3

********** Link data **********

Link Reference	D/S Node	Pipe Len (m)	Pipe Hgt (mm)	Sed Dpth (mm)	P.Full Flow (m3/s)	Upstream Invert Level (m AD)	Upstream Max Depth (m)	Upstream Max Flow (m3/s)	Upstream Max Vel (m/s)	Upstream Total Flow (m3)	Downstream Invert Level (m AD)	Downstream Max Depth (m)	Downstream Max Flow (m3/s)	Downstream Max Vel (m/s)	Downstream Total Flow (m3)
SGJ1C06888.1	SNF1004264 (SHAN PUI RIVER)	392	2000	0	13.177	0.980	3.536	7.117	0.968	26557.8x	0.330	3.952	7.131	0.966	26557.8x
SGJ1C06888.2	SNF1004264 (SHAN PUI RIVER)	392	2000	0	13.177	0.980	3.536	7.117	0.968	26557.8x	0.330	3.952	7.131	0.966	26557.8x
SMH 1C10759.1	SMH 1026920	25	1500	0	3.375	2.955	2.766	3.335	1.787	12473.1x	2.905	2.766	3.336	1.787	12473.1x
SMH 1C26919.1	SMH 1026951	32	1500	0	3.375	2.290	3.050	3.338	1.781	12473.1x	2.226	3.049	3.339	1.782	12473.1x
SMH 1C26920.1	SMH 1026919	32	1500	0	3.049	2.354	3.158	3.336	1.777	12473.1+	2.290	3.145	3.337	1.778	12473.1+
SMH 1C26951.1	SMH 1026957	27	1500	0	3.375	2.028	2.917	3.355	1.796	12473.1x	1.974	2.915	3.356	1.796	12473.1x
SMH 1C26952.1	SMH 1026951	31	1500	0	3.375	2.090	2.951	3.350	1.791	12473.1x	2.028	2.949	3.351	1.792	12473.1x
SMH 1C26953.1	SMH 1026952	35	1500	0	3.375	2.160	2.985	3.347	1.788	12473.1x	2.090	2.983	3.349	1.789	12473.1x
SMH 1C26954.1	SMH 1026953	33	1500	0	3.375	2.226	3.018	3.342	1.785	12473.1x	2.160	3.016	3.343	1.785	12473.1x
SMH 1C26956.2	SMH 1026992	139	2000	0	10.236	1.500	3.274	8.431	1.150	31294.2x	1.361	3.303	8.445	1.152	31294.2x
SMH 1C26957.1	SMH 1026956	30	1500	0	3.375	1.974	2.882	3.361	1.801	12473.1x	1.914	2.879	3.362	1.802	12473.1x
SMH 1C26992.1	SGJ1006888	125	2000	0	10.236	1.361	3.262	5.188	0.708	19327.4x	1.236	3.345	5.198	0.709	19327.4x
SMH 1C26992.2	SGJ1006888	125	2000	0	10.236	1.361	3.262	5.188	0.708	19327.4x	1.236	3.345	5.198	0.709	19327.4x
SMH 1C31687.1	SNF 1004400	170	1200	0	-1.267	0.800	4.191	2.181	1.757	14005.0x	0.990	3.587	2.182	1.783	14005.0x
SMH 65001.1	SMH 1026992	23	1500	0	3.375	2.861	1.825	1.906	1.038	7360.5x	2.815	1.854	1.907	1.038	7360.5x
SMH 67002.1	SMH 90001	24	1200	0	2.979	11.000	0.750	1.925	2.685	11126.1	10.878	0.774	1.923	2.637	11125.5
SMH 68001.1	SMH 68002	74	1050	0	1.798	11.650	0.689	1.313	2.207	5089.0	11.377	0.731	1.294	2.010	5089.0
SMH 68002.1	SMH 69001	48	1050	0	1.836	11.377	0.722	1.294	2.038	5089.0	11.193	0.775	1.301	1.906	5089.0
SMH 69001.3	SMH 69002	44	1350	0	2.479	11.193	0.768	1.850	2.203	7098.7	11.109	0.718	1.838	2.374	7098.6
SMH 69002.1	SMH 69003	31	1350	0	2.517	7.409	0.755	1.838	2.242	7098.6	7.349	0.719	1.840	2.375	7098.5
SMH 69003.2	SMH 69004	24	1350	0	2.175	6.149	0.760	1.840	2.217	7098.5	6.113	0.719	1.840	2.375	7098.4
SMH 69004.1	SMH 65001	31	1350	0	2.338	4.613	0.761	1.839	2.210	7098.4	4.561	0.718	1.835	2.372	7098.3
SMH 70001.1	SMH 70002	74	1050	0	1.485	13.650	0.504	0.403	1.216	1428.9	13.465	0.658	0.402	1.110	1428.9
SMH 70002.1	SMH 70003	67	1350	0	2.376	13.165	0.947	2.527	2.365	9228.0	13.049	0.846	2.511	2.661	9228.0
SMH 70003.1	SMH 70004	72	1350	0	3.113	10.349	0.884	2.510	2.547	9228.0	10.135	0.845	2.506	2.659	9228.0
SMH 70004.1	SMH 70005	62	1350	0	2.844	6.435	0.900	2.504	2.472	9228.0	6.282	0.841	2.486	2.651	9228.0
SMH 70005.1	SMH 70006	23	1350	0	3.901	4.282	1.793	2.484	2.412	9228.0x	4.175	1.857	2.482	2.429	9228.0x
SMH 70006.2	SMH 1010759	39	1350	0	3.169	3.275	2.727	2.480	1.633	9228.0x	3.155	2.773	2.480	1.632	9228.0x
SMH 90001.1	SMH 90002	26	1200	0	3.008	10.878	0.700	1.923	2.811	11125.4	10.744	0.700	1.923	2.810	11124.8
SMH 90002.1	SMH 90003	37	1200	0	3.113	10.744	0.684	1.923	2.888	11124.6	10.539	0.684	1.923	2.887	11123.7
SMH 90003.1	SMH 90004	49	1200	0	3.281	10.539	0.662	1.923	3.009	11123.6	10.239	0.662	1.923	3.008	11122.5
SMH 90004.1	SMH 90005	30	1200	0	3.433	10.239	0.643	1.922	3.116	11122.3	10.039	0.643	1.922	3.115	11121.6
SMH 90005.1	SMH 90006	19	1200	0	3.445	8.039	0.938	1.922	2.025	11121.6	7.908	1.026	1.922	1.866	11121.6
SMH 90006.1	SMH 90007	13	2000	0	6.834	7.486	1.434	2.102	0.733	12166.4	7.460	1.457	2.102	0.721	12166.4
SMH 90007.1	SMH 90008	18	1450	0	28.537	7.460	1.452	2.102	0.489	12166.4x	7.106	1.804	2.102	0.287	12166.4x
SNF 1004400.2	SNF1004264 (SHAN PUI RIVER)	387	2000	0	13.265	0.980	3.516	7.329	0.997	35416.9x	0.330	3.952	7.332	0.993	35416.9x
SNF 1004400.3	SNF1004264 (SHAN PUI RIVER)	387	2000	0	13.265	0.980	3.516	7.329	0.997	35416.9x	0.330	3.952	7.332	0.993	35416.9x
SNF1004264 (SHAN PUI RIVER).1	SHAN PUI RIVER	100	4000	0	230.191	0.330	3.945	250.928	1.108	4125349.4	0.326	3.942	250.986	1.109	4125349.4

+ after total flow indicates a conduit surcharged by flow and depth at that end.
x after total flow indicates a conduit surcharged by depth only at that end.

NOTE :
(i) Maximum elevations, depths, volumes, velocities and discharges are selected from the values at each time increment and will be in general more extreme than the maximum values in the time varying results.
(ii) Maximum elevations, velocities and discharges are not necessarily calculated at the same time.
(iii) Maximum velocity is not calculated for a conduit unless the depth exceeds the base flow depth (by default, this is 5% of height for slopes <= 0.01, 10% otherwise, subject to a minimum of 0.02 m).

End of run 0 mins (elapsed) Produced on 30/03/2015 Last page

Start of run configured for MS Windows Produced on 30/03/2015 at 14:54

InfoWorks ICM SIM

Summary results from Simulation

Version 4.0.0.8004 (x64) dated July 2013

Licence Number - WS33330158PM

Message 253: Run finished for event 1.

Summary results for event 1 - DIA-Proposed (Freebcard Analysis) MO-240
Started at 00000000000000. Run for 300.00 min. (Requested simulation time 300.00 min)

Files used:
Network: ...eebcard20analysis29.sp Model network_1 (version 316) (Scenario DIA-Proposed (Freeboard Analysis))
State:
Runoff: ...eebcard20analysis29.rp Model network_1 (version 316) (Scenario DIA-Proposed (Freeboard Analysis)) (Inf
Rainfall: ...\sim24event.red MC-240, a=603, b=4.4, c=0.44 x1.00
DWF:
Inflows:
Levels: ...\sim24event.lev 1
RTC:
Results: ...\sim24.iwr

Total rainfall = 182560.3 m3
Total runoff = 107005.5 m3
Total inflow = 4108405.5 m3
Total outflow = 4108401.2 m3
Total lost = 0.0 m3

********** Node data **********

Node Reference	Ground Level (m AD)	Max Level (m AD)	Flood Volume (m3)	Flood Depth (m)	Flood Area (m2)	Max Stored (m3)	Inflow (m3)	Vol Balance (m3)	Vol Balance (%)
SGJ1006888	5.000	4.566	0.0	0.000	0.0	12.6	11367.8	-0.000	0.000
SMH 1010759	5.800	5.553	0.0	0.000	0.0	9.1	2551.0	-0.000	0.000
SMH 1026919	5.220	5.162	0.0	0.000	0.0	11.5	0.0	-0.000	0.000
SMH 1026920	5.800	5.347	0.0	0.000	0.0	12.0	0.0	-0.000	0.000
SMH 1026951	4.930	4.841	0.0	0.000	0.0	11.3	0.0	0.000	0.000
SMH 1026952	4.900	4.907	0.0	0.007	3.3	9.9	0.0	0.000	0.000
SMH 1026953	5.200	4.980	0.0	0.000	0.0	11.3	0.0	0.000	0.000
SMH 1026954	5.250	5.049	0.0	0.000	0.0	11.3	0.0	-0.000	0.000
SMH 1026956	5.100	4.715	0.0	0.000	0.0	11.3	14795.5	-0.000	0.000
SMH 1026957	4.900	4.780	0.0	0.000	0.0	11.3	0.0	-0.000	0.000
SMH 1026992	5.700	4.625	0.0	0.000	0.0	81.6	0.0	0.000	0.000
SMH 1031687	4.170	4.931	880.4	0.761	3359.4	892.2	11009.5	-0.063	0.001
SMH 65001	7.200	4.682	0.0	0.000	0.0	6.4	206.2	-0.000	0.000
SMH 67002	16.000	11.613	0.0	0.000	0.0	1.9	8746.2	0.000	0.000
SMH 68001	14.000	12.252	0.0	0.000	0.0	2.1	4000.6	-0.000	0.000
SMH 68002	14.000	12.015	0.0	0.000	0.0	1.6	0.0	-0.000	0.000
SMH 69001	14.000	11.884	0.0	0.000	0.0	2.4	1579.9	-0.000	0.000
SMH 69002	14.000	8.088	0.0	0.000	0.0	2.4	0.0	-0.000	0.000
SMH 69003	10.000	6.835	0.0	0.000	0.0	2.4	0.0	-0.000	0.000
SMH 69004	8.840	5.297	0.0	0.000	0.0	2.4	0.0	-0.000	0.000
SMH 70001	16.000	14.056	0.0	0.000	0.0	1.4	1123.3	-0.000	0.000
SMH 70002	16.000	14.018	0.0	0.000	0.0	3.0	6130.9	-0.000	0.000
SMH 70003	16.000	11.140	0.0	0.000	0.0	2.8	0.0	-0.000	0.000
SMH 70004	13.000	7.240	0.0	0.000	0.0	2.8	0.0	-0.000	0.000
SMH 70005	9.000	5.708	0.0	0.000	0.0	5.0	0.0	-0.000	0.000
SMH 70006	7.000	5.637	0.0	0.000	0.0	8.3	0.0	0.000	0.000
SMH 90001	16.000	11.491	0.0	0.000	0.0	1.9	0.0	0.000	0.000
SMH 90002	16.000	11.338	0.0	0.000	0.0	1.8	0.0	0.000	0.000
SMH 90003	16.000	11.116	0.0	0.000	0.0	1.7	0.0	0.000	0.000
SMH 90004	16.000	10.800	0.0	0.000	0.0	1.7	0.0	0.000	0.000
SMH 90005	16.000	8.876	0.0	0.000	0.0	2.5	0.0	-0.000	0.000
SMH 90006	16.000	8.811	0.0	0.000	0.0	7.9	821.3	0.000	0.000
SMH 90007	16.000	8.805	0.0	0.000	0.0	64.5	0.0	0.000	0.000
SNF 1004400	4.280	4.564	291.7	0.284	2973.9	303.2	44673.4	-0.036	0.000
SNF1004264 (SHAN PUI RIVER)	4.000	4.360	1.0	0.360	1.0	14.2	4001400.0	-0.000	0.000

A %% indicates water lost from the system.

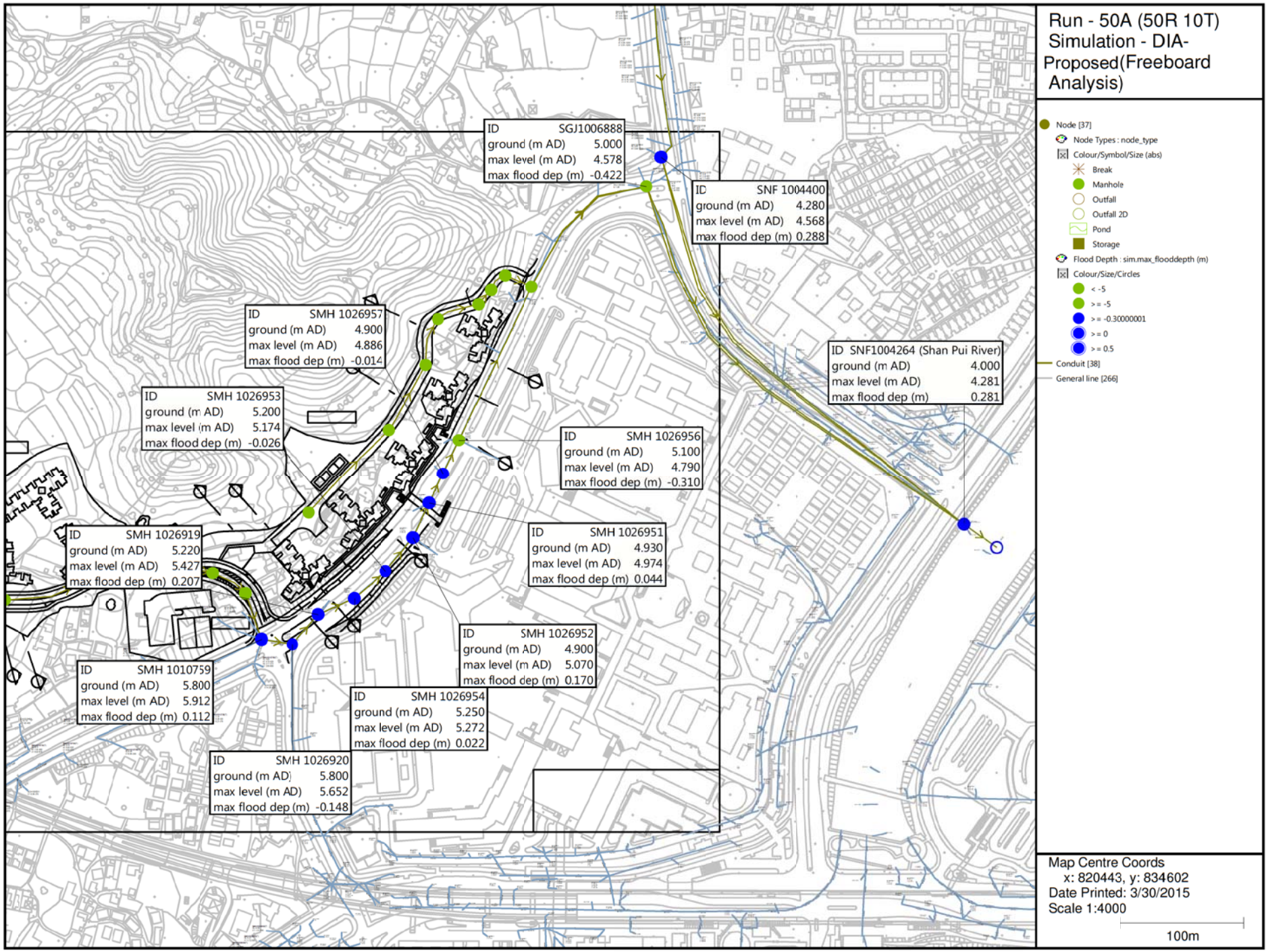
********** Link data **********

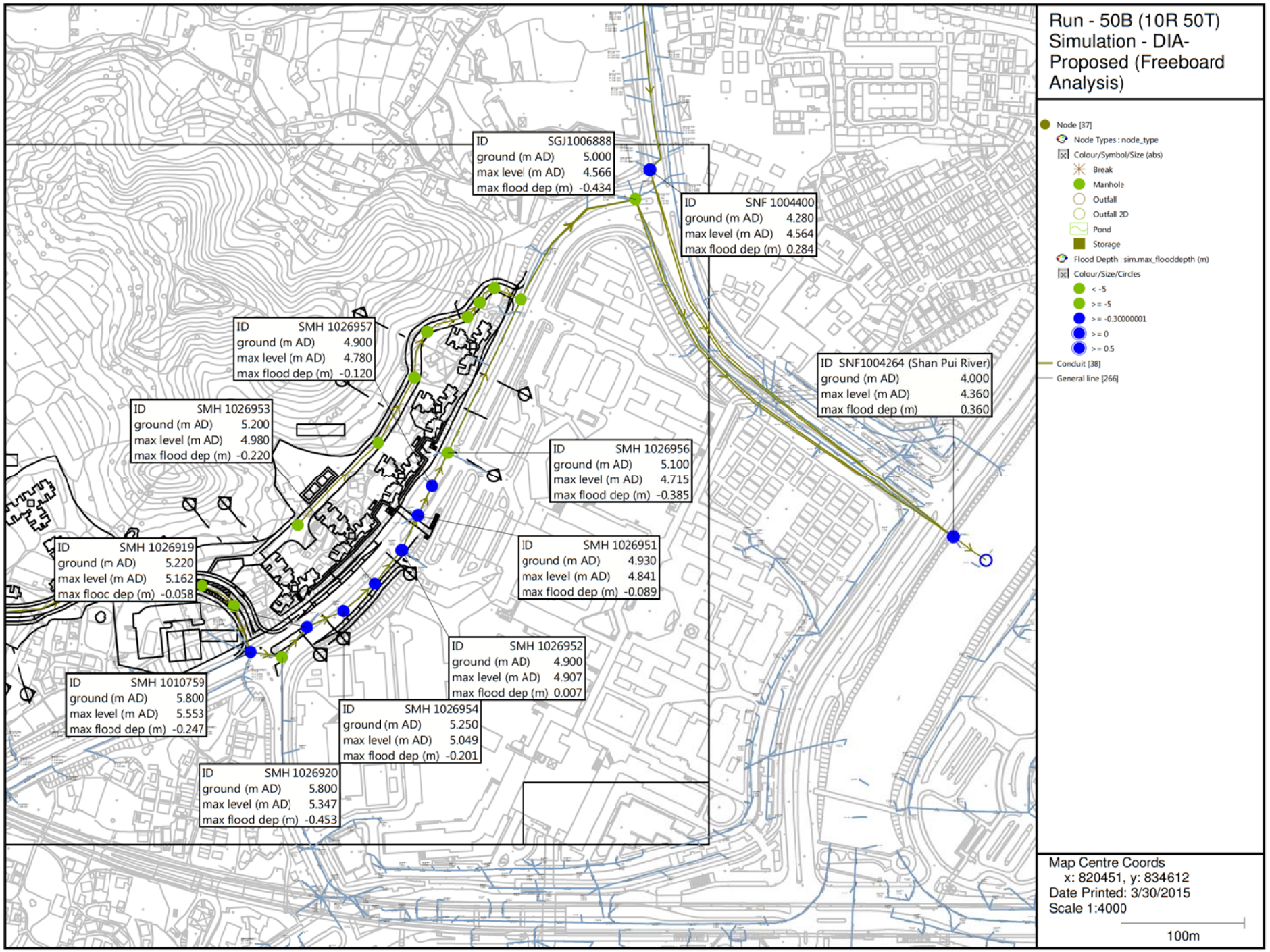
Link Reference	D/S Node	Pipe Len (m)	Pipe Hgt (mm)	Sed Dpth (mm)	P.Full Flow (m3/s)	Upstream Invert Level (m AD)	Upstream Max Depth (m)	Upstream Max Flow (m3/s)	Upstream Max Vel (m/s)	Upstream Total Flow (m3)	Downstream Invert Level (m AD)	Downstream Max Depth (m)	Downstream Max Flow (m3/s)	Downstream Max Vel (m/s)	Downstream Total Flow (m3)
SGJ1C06888.1	SNF1004264 (SHAN PUI RIVER)	392	2000	0	13.177	0.980	3.544	5.853	0.796	20877.4x	0.330	4.031	5.864	0.794	20877.4x
SGJ1C06888.2	SNF1004264 (SHAN PUI RIVER)	392	2000	0	13.177	0.980	3.544	5.853	0.796	20877.4x	0.330	4.031	5.864	0.794	20877.4x
SMH 1C10759.1	SMH 1026920	25	1500	0	3.375	2.955	2.444	2.738	1.474	9805.2x	2.905	2.458	2.738	1.474	9805.2x
SMH 1C26919.1	SMH 1026954	32	1500	0	3.375	2.290	2.807	2.747	1.474	9805.2x	2.226	2.825	2.749	1.474	9805.2x
SMH 1C26920.1	SMH 1026919	32	1500	0	3.049	2.354	2.869	2.739	1.467	9805.2x	2.290	2.879	2.741	1.468	9805.2x
SMH 1C26951.1	SMH 1026957	27	1500	0	3.375	2.028	2.793	2.777	1.490	9805.2x	1.974	2.808	2.779	1.490	9805.2x
SMH 1C26952.1	SMH 1026951	31	1500	0	3.375	2.090	2.798	2.770	1.486	9805.2x	2.028	2.815	2.772	1.487	9805.2x
SMH 1C26953.1	SMH 1026952	35	1500	0	3.375	2.160	2.800	2.764	1.483	9805.2x	2.090	2.819	2.765	1.483	9805.2x
SMH 1C26954.1	SMH 1026953	33	1500	0	3.375	2.226	2.803	2.756	1.478	9805.2x	2.160	2.822	2.757	1.479	9805.2x
SMH 1C26956.2	SMH 1026992	139	2000	0	10.236	1.500	3.204	6.948	0.948	24600.8x	1.361	3.265	6.958	0.949	24600.8x
SMH 1C26957.1	SMH 1026956	30	1500	0	3.375	1.974	2.786	2.784	1.494	9805.2x	1.914	2.803	2.785	1.494	9805.2x
SMH 1C26992.1	SGJ1006888	125	2000	0	10.236	1.361	3.238	4.266	0.582	15193.5x	1.236	3.333	4.274	0.583	15193.5x
SMH 1C26992.2	SGJ1006888	125	2000	0	10.236	1.361	3.238	4.266	0.582	15193.5x	1.236	3.333	4.274	0.583	15193.5x
SMH 1C31687.1	SNF 1004400	170	1200	0	-1.267	0.800	4.113	1.944	1.567	11009.5x	0.990	3.582	1.944	1.587	11009.5x
SMH 65001.1	SMH 1026992	23	1500	0	3.375	2.861	1.780	1.558	0.849	5786.2x	2.815	1.814	1.559	0.849	5786.2x
SMH 67002.1	SMH 90001	24	1200	0	2.979	11.000	0.612	1.530	2.646	8746.1	10.878	0.614	1.530	2.642	8745.6
SMH 68001.1	SMH 68002	74	1050	0	1.798	11.650	0.598	1.073	2.128	4000.5	11.377	0.638	1.060	1.925	4000.5
SMH 68002.1	SMH 69001	48	1050	0	1.836	11.377	0.633	1.059	1.941	4000.5	11.193	0.693	1.063	1.769	4000.5
SMH 69001.3	SMH 69002	44	1350	0	2.479	11.193	0.691	1.511	2.066	5580.4	11.109	0.648	1.510	2.222	5580.3
SMH 69002.1	SMH 69003	31	1350	0	2.517	7.409	0.679	1.509	2.099	5580.3	7.349	0.648	1.509	2.222	5580.2
SMH 69003.2	SMH 69004	24	1350	0	2.175	6.149	0.684	1.508	2.072	5580.2	6.113	0.647	1.506	2.221	5580.1
SMH 69004.1	SMH 65001	31	1350	0	2.338	4.613	0.684	1.505	2.069	5580.1	4.561	0.646	1.499	2.217	5580.0
SMH 70001.1	SMH 70002	74	1050	0	1.485	13.650	0.406	0.333	1.257	1123.3	13.465	0.553	0.329	1.110	1123.3
SMH 70002.1	SMH 70003	67	1350	0	2.376	13.165	0.846	2.072	2.212	7254.2	13.049	0.764	2.066	2.474	7254.2
SMH 70003.1	SMH 70004	72	1350	0	3.113	10.349	0.786	2.065	2.405	7254.2	10.135	0.762	2.055	2.469	7254.2
SMH 70004.1	SMH 70005	62	1350	0	2.844	6.435	0.800	2.053	2.324	7254.2	6.282	0.757	2.030	2.458	7254.2
SMH 70005.1	SMH 70006	23	1350	0	3.901	4.282	1.386	2.031	2.336	7254.2x	4.175	1.464	2.050	2.351	7254.2x
SMH 70006.2	SMH 1010759	39	1350	0	3.169	3.275	2.341	2.055	1.365	7254.2x	3.155	2.411	2.058	1.365	7254.2x
SMH 90001.1	SMH 90002	26	1200	0	3.008	10.878	0.606	1.530	2.670	8745.5	10.744	0.606	1.530	2.670	8745.0
SMH 90002.1	SMH 90003	37	1200	0	3.113	10.744	0.594	1.530	2.741	8744.8	10.539	0.594	1.529	2.740	8744.1
SMH 90003.1	SMH 90004	49	1200	0	3.281	10.539	0.575	1.529	2.853	8743.9	10.239	0.575	1.528	2.851	8743.0
SMH 90004.1	SMH 90005	30	1200	0	3.433	10.239	0.560	1.528	2.952	8742.8	10.039	0.560	1.528	2.951	8742.2
SMH 90005.1	SMH 90006	19	1200	0	3.445	8.039	0.813	1.528	1.872	8742.2	7.908	0.907	1.528	1.665	8742.2
SMH 90006.1	SMH 90007	13	2000	0	6.834	7.486	1.321	1.671	0.632	9563.5	7.460	1.345	1.671	0.621	9563.5
SMH 90007.1	SMH 90008	18	1450	0	28.537	7.460	1.341	1.671	0.469	9563.5	7.106	1.694	1.671	0.267	9563.5x
SNF 1004400.2	SNF1004264 (SHAN PUI RIVER)	387	2000	0	13.265	0.980	3.535	6.098	0.829	27841.5x	0.330	4.031	6.101	0.826	27841.5x
SNF 1004400.3	SNF1004264 (SHAN PUI RIVER)	387	2000	0	13.265	0.980	3.535	6.098	0.829	27841.5x	0.330	4.031	6.101	0.826	27841.5x
SNF1004264 (SHAN PUI RIVER).1	SHAN PUI RIVER	100	4000	0	230.191	0.330	4.024	245.915	1.063	4098837.8+	0.326	4.022	245.959	1.064	4098837.8+

+ after total flow indicates a conduit surcharged by flow and depth at that end.
x after total flow indicates a conduit surcharged by depth only at that end.

NOTE :
(i) Maximum elevations, depths, volumes, velocities and discharges are selected from the values at each time increment and will be in general more extreme than the maximum values in the time varying results.
(ii) Maximum elevations, velocities and discharges are not necessarily calculated at the same time.
(iii) Maximum velocity is not calculated for a conduit unless the depth exceeds the base flow depth (by default, this is 5% of height for slopes <= 0.01, 10% otherwise, subject to a minimum of 0.02 m).

End of run 0 mins (elapsed) Produced on 30/03/2015 Last page


Run - 50A (50R 10T) Simulation - DIA-Proposed(Freeboard Analysis)
Node [37]
Node Types : node_type
Colour/Symbol/Size (abs)
Break
Manhole
Outfall
Outfall 2D
Pond
Storage
Flood Depth : sim.max_flooddepth (m)
Colour/Size/Circles
< -5
>= -5
>= -0.30000001
>= 0
>= 0.5
Conduit [38]
General line [266]
ID SGJ1006888
ground (m AD) 5.000
max level (m AD) 4.578
max flood dep (m) -0.422
ID SNF 1004400
ground (m AD) 4.280
max level (m AD) 4.568
max flood dep (m) 0.288
ID SNF1004264 (Shan Pui River)
ground (m AD) 4.000
max level (m AD) 4.281
max flood dep (m) 0.281
ID SMH 1026957
ground (m AD) 4.900
max level (m AD) 4.886
max flood dep (m) -0.014
ID SMH 1026953
ground (m AD) 5.200
max level (m AD) 5.174
max flood dep (m) -0.026
ID SMH 1026956
ground (m AD) 5.100
max level (m AD) 4.790
max flood dep (m) -0.310
ID SMH 1026919
ground (m AD) 5.220
max level (m AD) 5.427
max flood dep (m) 0.207
ID SMH 1026951
ground (m AD) 4.930
max level (m AD) 4.974
max flood dep (m) 0.044
ID SMH 1026952
ground (m AD) 4.900
max level (m AD) 5.070
max flood dep (m) 0.170
ID SMH 1010759
ground (m AD) 5.800
max level (m AD) 5.912
max flood dep (m) 0.112
ID SMH 1026954
ground (m AD) 5.250
max level (m AD) 5.272
max flood dep (m) 0.022
ID SMH 1026920
ground (m AD) 5.800
max level (m AD) 5.652
max flood dep (m) -0.148
Map Centre Coords
x: 820443, y: 834602
Date Printed: 3/30/2015
Scale 1:4000
100m


ID SGJ1006888
ground (m AD) 5.000
max level (m AD) 4.566
max flood dep (m) -0.434
ID SNF 1004400
ground (m AD) 4.280
max level (m AD) 4.564
max flood dep (m) 0.284
ID SMH 1026957
ground (m AD) 4.900
max level (m AD) 4.780
max flood dep (m) -0.120
ID SMH 1026953
ground (m AD) 5.200
max level (m AD) 4.980
max flood dep (m) -0.220
ID SMH 1026956
ground (m AD) 5.100
max level (m AD) 4.715
max flood dep (m) -0.385
ID SNF1004264 (Shan Pui River)
ground (m AD) 4.000
max level (m AD) 4.360
max flood dep (m) 0.360
ID SMH 1026919
ground (m AD) 5.220
max level (m AD) 5.162
max flood dep (m) -0.058
ID SMH 1026951
ground (m AD) 4.930
max level (m AD) 4.841
max flood dep (m) -0.089
ID SMH 1026952
ground (m AD) 4.900
max level (m AD) 4.907
max flood dep (m) 0.007
ID SMH 1010759
ground (m AD) 5.800
max level (m AD) 5.553
max flood dep (m) -0.247
ID SMH 1026954
ground (m AD) 5.250
max level (m AD) 5.049
max flood dep (m) -0.201
ID SMH 1026920
ground (m AD) 5.800
max level (m AD) 5.347
max flood dep (m) -0.453
Run - 50B (10R 50T) Simulation - DIA-Proposed (Freeboard Analysis)
Node [37]
Node Types : node_type
Colour/Symbol/Size (abs)
Break
Manhole
Outfall
Outfall 2D
Pond
Storage
Flood Depth : sim.max_flooddepth (m)
Colour/Size/Circles
< -5
>= -5
>= -0.30000001
>= 0
>= 0.5
Conduit [38]
General line [266]
Map Centre Coords
x: 820451, y: 834612
Date Printed: 3/30/2015
Scale 1:4000
100m