PREDICTION TOOL FOR STRUCTURAL CONDITION IN GRAVITATIONAL FLOW SEWER PIPE

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DEDICATION

To the loving memories of my Parents;

Fathiah Ahmad (2005)

A Gani Osman (2016)

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ABSTRACT

Structural integrity of sewer pipe reticulation depends on static and dynamic factors of the sewer pipe. It is imperative to have a prediction tool for sewer pipe reticulation for the structural condition in order to ensure proactive maintenance. As an operator, Indah Water Konsortium Sdn. Bhd. in Malaysia is facing high rehabilitation cost due to reactive maintenance of defective and broken sewer pipes. Therefore, this study aims is to develop a prediction tool for sewer network especially for the structural condition in gravitational flow sewer pipe. Closed-circuit television inspection was used to observe the structural defect in 225, 300 and 375 mm vitrified clay pipes, and 450 and 500 mm reinforced concrete pipes. The defects were classified using the Pipeline Assessment Certification Program grading system and were categorised into Grades 1 to 5. A total of 36.6 km of gravitational flow sewer pipe was investigated and 703 defects were detected. An average of 19 defects was found for every 100 m length for all pipe types. The Categories 1, 2, 3, 4, 5, 6, 7, 8 and 9 were the combination of primary parameters of static and dynamic conditions. The probability weights were calculated based on the defect fraction obtained from the pipe depths which were 1.0, 0.58 and 0.24; pipe gradients which were 1.0, 0.43, 0.13 and 0.02; and pipe service periods which were 1.0, 0.85, 0.29 and 0.11. The failure factor comprised the remaining factors of pipe size, pipe material and sewage flow, which were divided into Categories 1 to 9. The failure factor for Categories 1, 2, 3, 4, 5, 6, 7, 8 and 9 were 0.48, 0.10, 0.24, 0.07, 0.10, 0.02, 0.11, 0.02 and 0.07, respectively, confirming that the deterioration rates based on Markov analysis between all pipe categories were degraded at 5, 4 and 3 transition steps. The coefficient 1.45 was identified based on the total sum of the failure factors which included the mean value of the failure factor. A four-step prediction tool using Condition Index calculation which incorporated the values of probability weights, failure factor and coefficient was developed. The results were calibrated into defect grades ranged in Grades 1 to 5 using the Likert Scale as a basis. Finally, a pilot test was conducted using 150 samples to validate the reliability of the prediction tool which showed an overall of 60% success. In conclusion, this study paves the way in developing a prediction tool for structural condition in sewer network but more research needed to improve its accuracy. Further research should look into reducing the aggregation scale for the static and dynamic factors.

ABSTRAK

Integriti struktur paip retikulasi kumbahan bergantung kepada faktor statik dan dinamik paip kumbahan. Adalah penting untuk mempunyai perantara ramalan paip retikulasi kumbahan untuk keadaan struktur bagi memastikan penyelengaraan yang proaktif. Sebagai pengendali, Indah Water Konsortium Sdn. Bhd. di Malaysia menanggung kos baikpulih paip yang tinggi disebabkan oleh penyelengaraan reaktif paip kumbahan yang rosak. Oleh itu, kajian ini bertujuan untuk membangunkan satu perantara ramalan untuk rangkaian kumbahan terutamanya untuk keadaan struktur pada paip kumbahan beraliran graviti. Siasatan menggunakan kamera litar tertutup telah dijalankan untuk memerhatikan kecacatan struktur dalam 225, 300 dan 375 mm paip tanah liat bervitrifikasi dan 450 dan 500 mm paip konkrit bertetulang. Kecacatan ini diklasifikasikan menggunakan sistem penggredan *Pipeline Assessment Certification Program* dan dikategorikan kepada Gred 1 hingga 5. Sepanjang 36.6 km paip kumbahan beraliran graviti telah dikaji dengan sejumlah 703 kecacatan telah dikenal pasti. Sebanyak 19 kecacatan telah ditemui untuk setiap 100 m panjang untuk semua jenis paip kumbahan. Kategori 1, 2, 3, 4, 5, 6, 7, 8 dan 9 adalah gabungan parameter utama keadaan statik dan dinamik. Wajaran kebarangkalian dikira berdasarkan pecahan kecacatan yang telah dikenal pasti dari kedalaman paip iaitu 1.0, 0.58, dan 0.24; kecerunan paip iaitu 1.0, 0.43, 0.13 dan 0.02; dan tempoh perkhidmatan paip iaitu 1.0, 0.85, 0.29 dan 0.11. Faktor kegagalan ini merangkumi faktor lain iaitu saiz paip, bahan paip dan aliran kumbahan yang dibahagikan kepada Kategori 1 hingga 9. Faktor kegagalan untuk Kategori 1, 2, 3, 4, 5, 6, 7, 8 dan 9 adalah 0.48, 0.10, 0.24, 0.07, 0.10, 0.02, 0.11, 0.02 dan 0.07, mengesahkan bahawa kadar kemerosotan berdasarkan analisis Markov di antara semua jenis paip terdegradasi pada 5, 4 dan 3 langkah peralihan. Pekali 1.45 dikenal pasti berdasarkan kepada jumlah keseluruhan faktor kegagalan di mana nilai purata untuk faktor kegagalan juga diambilkira. Perantara ramalan dengan empat-langkah menggunakan kiraan Indeks Keadaan yang menggabungkan nilai-nilai beban kebarangkalian, faktor kegagalan dan pekali telah dibangunkan. Hasil daripada pengiraan ini telah ditentukur kepada gred kecacatan yang berkisar pada Gred 1 hingga 5 menggunakan Skala *Likert* sebagai asas. Akhirnya, ujian perintis dijalankan dengan menggunakan 150 sampel untuk mengesahkan keberkesanan perantara ramalan yang menunjukkan kejayaan keseluruhan sebanyak 60%. Sebagai rumusan, kajian ini membuka laluan dalam pembangunan perantara ramalan untuk keadaan struktur paip retikulasi kumbahan, namun lebih banyak kajian diperlukan untuk meningkatkan keberkesanannya. Kajian lanjutan boleh melihat kepada pengurangan skala aggregat untuk faktor statik dan dinamik.

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LIST OF ABBREVIATIONS

AMN	-	Ammoniacal Nitrogen
ANN	-	Artificial Neural Network
BN	-	Bayesian Networks
BOD	-	Biochemical Oxygen Demand
CAPEX	-	Capital Expenditure
CCTV	-	Closed Circuit Television
CH_4	-	Methane
CI	-	Condition Index
CIPP	-	Cured-In-Place Pipe
CMMS	-	Computerized Maintenance Management Systems
CoF	-	Consequence of Failure
CSTP	-	Centralized Sewage Treatment Plant
DBKL	-	Dewan Bandaraya Kuala Lumpur
DI	-	Ductile Iron
DOE	-	Department of Environment
FOG	-	Fat, Oil and Grease
FRP	-	Fiber Reinforced Polymer
GI	-	Green Infrastructure
GIS	-	Geographical Information System
GKL	-	Greater Kuala Lumpur
HDD	-	Horizontal Directional Drilling
HDPE	-	High Density Polyethylene
HGL	-	Hydraulics Grade Line
HRT	-	Hydraulic Retention Time
IWK	-	Indah Water Konsortium Sdn. Bhd.
JPP	-	Jabatan Perkhidmatan Pembetungan
KV	-	Klang Valley
LA	-	Local Authority
LCA	-	Life Cycle Analysis
MEQR	-	Malaysia Environmental Quality Report

MESTECC	-	Ministry of Energy, Science, Technology, Environment and Climate Change
MPAJ	-	Majlis Perbandaran Ampang Jaya
MPKjg	-	Majlis Perbandaran Kajang
MPS	-	Majlis Perbandaran Selayang
MPSpg	-	Majlis Perbandaran Sepang
MSIG	-	Malaysian Sewerage Industry Guidelines
NASSCO	-	National Association of Sewer Services Companies
NetCoS	-	Network Condition Simulator
OPEX	-	Operational Expenditure
PACP	-	Pipeline Assessment and Certification Program
PCI	-	Pipeline Corrosivity Index
PE	-	Population Equivalent
PJ	-	Pipe Jacking
PVC	-	Polyvinyl Chloride
RCP	-	Reinforced Concrete Pipe
S	-	Sulphide
SCC	-	Sewerage Capital Contribution
SN	-	Sewer Network
SPAN	-	Suruhanjaya Perkhidmatan Air Negara
SS	-	Suspended Solids
SSAIM	-	Smart Sewer Asset Information Model
STP	-	Sewage Treatment Plant
SVM	-	Support Vector Machine
TEL	-	Total Energy Line
UK	-	United Kingdom
USA	-	United States of America
VCP	-	Vitrified Clay Pipe
WSIA	-	Water Services Industry Act

LIST OF SYMBOLS

F_f	-	failure factor
P	-	transition matrix
P^T	-	T-matrix
R^2	-	coefficient of determination
w_1	-	first probability weight
w_2	-	second probability weight
w_3	-	third probability weight
w_i	-	probability weights
w_n	-	weightage
X_0	-	initial state
X_t	-	t-state
η	-	coefficient
μ	-	mean value

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Domestic sewage is the liquid discharge that contains human excreta matters in suspension or solution. It is resulted from domestic activities from household, commercial, institutional and industrial premises including liquid discharges from water closets, basins, sinks, bathrooms and other sanitary appliances but excluding rainwater and prohibited effluent (Water Services Industry Act, 2006). Discharges of the untreated domestic sewage into water bodies are major pollution and causes the most significant anthropogenic impact within the environment (Resende de Morais *et al.*, 2018). Defective sewage treatment plant (STP) and sewer network (SN) are two components of daily life significantly contributing to sewage pollution worldwide. Sewage seepage from SN determines the operator to make any possible effort to prevent sewage pollution or pollutant spillover (Anton *et al.,* 2014). The sewage seepage which mostly caused by sewer pipe corrosion brings a range of risks for environmental safety in the air, water and soil settlement. The suitable method for monitoring the damaged gravitational flow sewer pipe depends on its reliability and operating life (Iurchenko *et al.,* 2016). Therefore, it is vital to predict the structural condition of the sewer pipe in order to minimize the reactive maintenance of SN.

In Malaysia, raw sewage contributes an average of 250 mg/L of biochemical oxygen demand (BOD), 300 mg/L of suspended solids (SS) and 30 mg/L of ammoniacal nitrogen (AMN) for each population equivalent (PE) of 225 liters per PE daily (SPAN, 2009). According to Malaysia Environmental Quality Report (MEQR) 2016 produced by Department of Environment (DOE) Malaysia under the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC),

sewage contributed 266 tonne BOD/d, 357 tonne SS/d and 191 tonne AMN/d as sources of pollution to the environment (DOE, 2017). In order to ensure that the raw sewage is properly transported and treated, it is important to build an effective STP and SN in accordance with Water Services Industry (Planning, Design and Construction of Sewerage System and Septic Tank) Rules 2013 under the parent act of Water Services Industry Act (WSIA) 2006 (SPAN, 2009). Currently, there are more than 7,000 public STPs and more than 20,000 km of public SNs in Malaysia which are being operated and maintained by Indah Water Konsortium Sdn. Bhd. (IWK) (IWK, 2018).

For the past 30 years, the sewerage system in Malaysia has grown and developed rapidly. Public perception towards sewerage system in Malaysia and the awareness of better sewerage facility for the better environment has also increased. Improved and advanced technology has also assisted the sewerage service in Malaysia to be more reliable, economical and meeting the standards (Sen Gupta *et al.*, 2001). These have caused the sewerage industry to be a raising business opportunity and given an indirect impact on the quality of life. The technological advances have driven the utility service into decentralize alternatives, whereby centralize network infrastructure is becoming more reliable. However, these new opportunities have implications to determine the optimal degree of the infrastructure centralization where there are not enough tools developed for planning designs (Sitzenfrei & Rauch, 2014; Eggimann *et al.*, 2015). These technological advances have also driven the Malaysian government to put an effort in reducing numbers of STP by rationalizing multipoint STPs into a centralized STP (CSTP) via the government funding, i.e. Sewerage Capital Contribution (SCC) Funding and Greater Kuala Lumpur (GKL) Funding (IWK, 2016). Nevertheless, this effort has caused the length of SN in Malaysia to increase, and the requirement for a tool to estimate sewer pipe degradation risk become crucial.

Sewerage system design can be divided into two categories; STP design and SN design. STP design mainly focuses on the process calculation; meanwhile, SN design focuses on hydraulic flow. In most countries including Malaysia, engineers are given guidelines in order to ensure sewerage system designs are consistent throughout the country. With design aspect is the main focus of structural engineers, operators

often have difficulties in maintaining sewer pipe due to an insufficient tool to estimate the risk of sewer pipe degradation. In Malaysia, guidelines are used to assist engineers in designing their sewerage system according to regulatory acceptance (SPAN, 2009). In January 1995, the government via *Jabatan Perkhidmatan Pembetungan* (JPP) had published its first sewerage design guidelines titled "Design and Installation of Sewerage Systems". The second edition was improvised and titled "Guidelines for Developers". In 2008, *Suruhanjaya Perkhidmatan Air Negara* (SPAN) had continued the JPP efforts in revising and improving the guidelines; therefore, a revision of "Malaysian Sewerage Industry Guidelines" (MSIG) was produced (SPAN, 2009). This latest revision of guidelines incorporated the valuable knowledge gained by various stakeholders based on Malaysia experience and to upkeep with the aim towards sustainable environmental management. According to MSIG Volume III; Sewer Network and Pump Stations, sewer design shall generally be by principles set out in the guidelines, which are flow rate, infiltration, velocity and pipe roughness (SPAN, 2009).

An additional parameter in design guidelines should bring more accuracy during the design stage. However, in the case of maintaining the existing sewer pipe, this principal will be a basis for the prediction tool. The best method to develop the prediction tool and achieve its objectives is via closed-circuit television (CCTV) inspection and statistical analysis (Fenner, 2000). Nevertheless, the current knowledge in sewerage system management is poor due to uncertainty in the analyses as well as the minimal usage of the databases. Common terminology and conceptual framework are needed to describe and estimating uncertainties in the sewerage system management (Deletic *et al.,* 2012; Mannina *et al.,* 2012). In view of advanced technology and the fast development of the sewerage system in Malaysia, these uncertainties need to be reduced in order for the sewerage service to be more sustainable and dependable.

In the year 2016, IWK has spent more than RM 17 million to rectify defective sewer pipes via the reactive maintenance method (IWK, 2017). Besides spending high operational cost to maintain SN, the rectification period causes major downtime to sewage flow and interruption to public service. These defective sewer pipes are one of

the causes of sewage pollution to water bodies according to MEQR 2016. Therefore, this study was initiated to develop a prediction tool by exploring the area of proactive maintenance. The prediction tool is an innovation developed in accordance to the local condition and current practicing industry. It is a novelty to the academic field as it contributes a new research in sewer pipe analysis of the Malaysia's environment.

1.2 Problem Statement

Unscheduled or reactive maintenance of SN occurred due to the lack of planning and a shortage of knowledge of sewer pipe. This problem leads to mismanagement of operational expenditure (OPEX) and disturbance to the company's cash flow. Therefore, it is imperative to have a prediction tool for SN especially for the structural condition in a gravitational flow sewer pipe in order to ensure proactive maintenance method is being conducted by the sewerage operator. The application of a decision tool that can predict the structural condition is critically required for SN. Due to the current economic status, to have a sustainable sewerage infrastructure is very crucial. Sewer pipe structural defects will lead to untimely sewer pipe collapse. To replace collapsed sewer pipe through an unscheduled maintenance or reactive maintenance will cost billions of *ringgits* and sometimes impossible due to the deep location of sewer pipe which usually be underneath of other utility lines within the public reserve's path (Sen Gupta *et al.,* 2001). This path is a public utility reserve which is usually located in the middle of a road. Sewer pipe collapse causes interruption to the sewerage service and affects other utility infrastructures surrounding the public reserve. It is also disturbing the primary usage of the road and causing road traffic safety, whereby the condition of the underground sewer pipe causes sudden damage to the road surface (Fenner, 2000; Kuliczkowska, 2015).

Moreover, additional expenses may incur during the road excavations due to the relocation of other utilities and structures. In the year 2016, IWK has spent more than RM 17 million to rehabilitate collapsed and broken sewer pipe (IWK, 2017). One of the reasons for collapse or broken sewer pipe is the static and dynamic factors of the sewer pipe (Farmani *et al.,* 2017). Static factor is the pipe criteria that will not change with time, meanwhile dynamic factor is the criteria that will change with time.

In this study, static factors such as the physical parameters (diameter of pipe, material of pipe, depth of pipe and gradient of pipe) and dynamic factors such as hydraulics condition (sewage flow) and age of structure (period of pipe service) were used as the basis to solve the workplace problem.

Figure 1.1 below summarizes the effect of sewer pipe rehabilitation via reactive maintenance method. Reactive maintenance will deter the sustainability infrastructure effort due to rehabilitation will only be conducted on untimely manner. Unscheduled sewerage service interruption will also be the reason why reactive maintenance should be avoided due to public satisfaction. Besides the disturbance to the sewerage service itself, reactive maintenance will also cause disturbance to other utility lines located surrounding the rehabilitation area beside the public reserve. Most importantly, reactive maintenance will cost higher than proactive maintenance due to urgency and unplanned expenses. Therefore, it is essential to predict the sewer pipe degradation condition in order to reduce the cost and nuisance of the public.

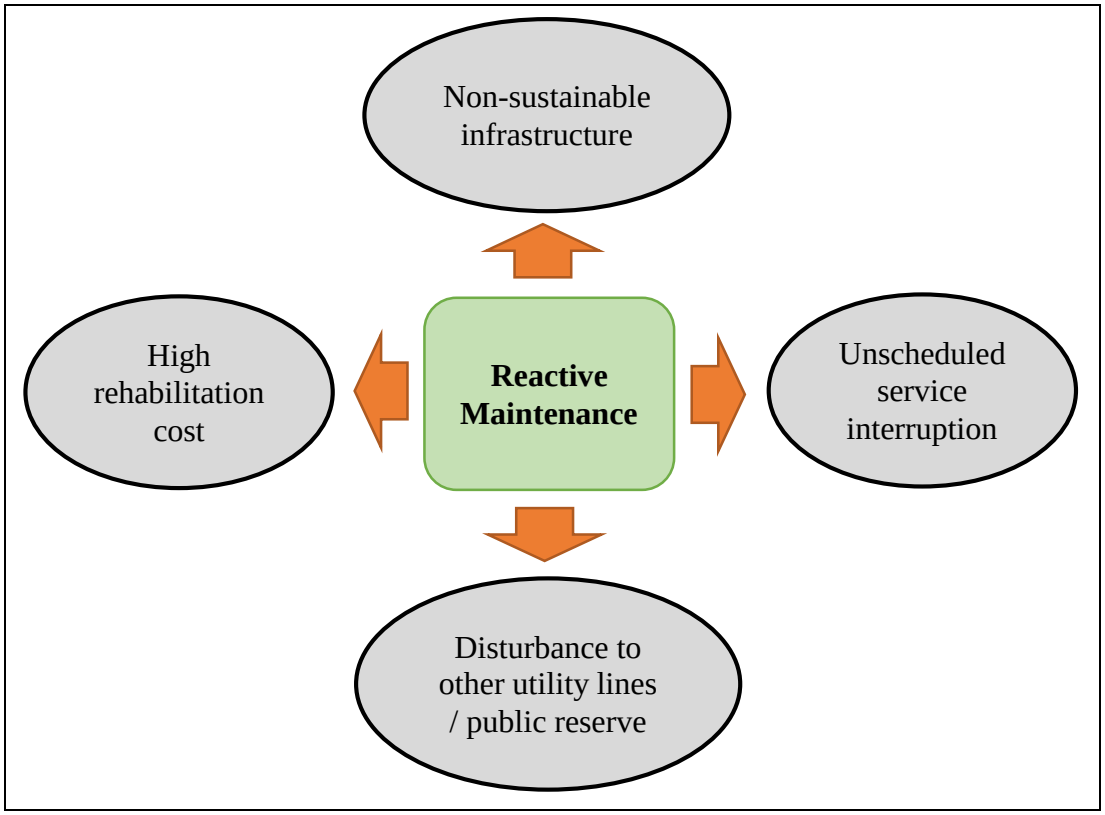

Figure 1.1 Effect of sewer pipe rehabilitation via reactive maintenance method

For effective rehabilitation, accurate predictions of future structural conditions of sewerage systems are needed for proactive maintenance. A range of sewer deterioration models has been proposed which can be improved by calibration with observed sewer condition data (Koo & Ariaratnam, 2006). However, if the historical records are lacking in the datasets, a combination of deterioration and sewer rehabilitation models are required to be calibrated, as the current state of sewer network reflects the combined effects of both methods (Egger *et al.*, 2013). The previous investigation shows that validation studies are hardly performed even though several deterioration models have been proposed. Due to the lack of reliable physical data, there is a great need for study tools to assess deterioration models and guide data management (Scheidegger *et al.*, 2011). The main criteria on the sewerage system reliability in Malaysia are on its design, while the main criteria on the sewer pipe maintenance are on the system sustainability. Therefore, if the design was not reliable, sewer pipe maintenance planning must be very trustworthy. As the current economic become uncertain, a reliable prediction tool is very crucial. IWK as an operator, responsible for maintaining the old sewer pipe, is facing many problems due to the lack of competition in the previous design.

IWK has internally produced a design manual named Manual of Practice - Hydraulic of Sewerage System which describes the hydraulics grade line (HGL) and total energy line (TEL) for the assessment of hydraulic profile in a sewer pipe (IWK, 2008). This manual is used for design purpose and was not used for estimating the structural degradation for sewer pipe maintenance and rehabilitation. Therefore, it is a great idea to use this concept as a reference to plan a prediction tool.

1.3 Research Question

This study aims to answer the following research questions:

(a) What measurement can be used to evaluate the structural defects of gravitational flow sewer pipe?

(b) How to analyse the structural condition in a gravitational flow sewer pipe using static and dynamic factors?

(c) How to identify the probability weights, failure factor and the coefficient for Condition Index (CI) in predicting the structural condition in a gravitational flow sewer pipe?

(d) How to solve the workplace problem and how to assess the tool for structural condition of gravitational flow sewer pipe?

1.4 Objective of Study

The main aim of this study is to produce a prediction tool for the structural condition in gravitational flow sewer pipe based on the effects of static and dynamic factors which allows mitigation of the workplace problem of reactive maintenance. This prediction tool may assist the sewerage operator in conducting sewer pipe proactive maintenance. The following are the specific objectives of this study:

(a) To **investigate** the structural defects in a gravitational flow sewer pipe by using the Pipeline Assessment and Certification Program (PACP) rating system from CCTV inspection.

(b) To **measure** the effects of the structural condition by assessing the static and dynamic factors in the gravitational flow sewer pipe.

(c) To **determine** the probability weights, failure factor and coefficient in CI calculation for the prediction of the structural condition in a gravitational flow sewer pipe.

(d) To **propose** a prediction tool for structural condition of a gravitational flow sewer pipe and **validate** the prediction tool via a pilot test.

1.5 Significance of Study

This study is essential in order to estimate the future structural condition in a gravitational flow sewer pipe. It will influence the sewerage industry as the rehabilitation period will be well planned and more economical with a better return on

investment. Furthermore, this study explored the importance of static and dynamic factors in the structural defect of a gravitational flow sewer pipe. It will also be beneficial to the operators and stakeholders in strategic management, structural planning and risk management related to the prediction tool. By understanding the needs of an effective sewer pipe maintenance, the users especially will benefit the quality of service, and the operator will produce an efficient time management service.

Moreover, this study will provide a recommendation on how to evaluate the performance of a particular pipe material by the sewer reticulation design proposed. It will also serve as a future reference for researchers on the subject of the structural condition in gravitational flow sewer pipe. Most importantly, this study will provide information to produce a prediction tool which will assist operators in deciding on whether to replace the sewer pipe before reactive measures take place. Other than that, this study will also have the following opportunities:

(a) Develop knowledge of existing practice in sewer pipe design,
(b) Develop a theory of the importance of static and dynamic factors in sewer pipe design,
(c) Expand the current knowledge or theory base on physical properties in sewer pipe design,
(d) Enhances current study methodology related to a current technological issue for selection of sewer pipe material, and
(e) An exploratory study on an unexamined issue of static and dynamic factors in a sewer pipe.

Using this study, IWK will be benefitted from the development of a prediction tool of the structural condition of gravitational flow sewer pipe beside improvise the existing guidelines used in sewerage design. It will also assist to determine the structural degradation condition of a certain sewer pipe. In the future, the basis of sewerage system approval in Malaysia shall move from design requirements towards sustainability of the design in order to ensure proactive rehabilitation management could be conducted, thus reducing cost in operation and management of the utility.

1.6 Scope of Study

The study was carried out based on the assessment of static and dynamic factors such as the physical parameters (diameter of pipe, material of pipe, depth of pipe and gradient of pipe), hydraulics condition (sewage flow) and age of structure (period of pipe service). Criteria of static and dynamic factors were selected for the pipe defects in gravitational flow sewer pipe were based on time-dependent (Farmani *et al.*, 2017). The static factors selected were the criteria that will not change with time; diameter of pipe, material of pipe, depth of pipe and gradient of pipe. Meanwhile, the criteria that will change with time; sewage flow and period of pipe service were selected for the dynamic factors. These static and dynamic factors were characterized into primary parameters (the type of sewer pipe for static factor and flow of sewage for dynamic factor) and secondary parameters (depth of sewer pipe and gradient of sewer pipe for static factor and service period of sewer pipe for dynamic factor). The diameter of sewer pipe varies from 225 to 500 mm in diameter with vitrified clay pipe (VCP) and reinforced concrete pipe (RCP) materials. The depths of sewer pipe were selected as less than 3 m, between 3 to 5 m and more than 5 m with the gradient ranged less than 1:200, between 1:200 to 1:400, between 1:400 to 1:600 and more than 1:600. The sewage flow ranged less than 5,000 PE, between 5,000 to 10,000 PE, between 10,000 to 20,000 PE and more than 20,000 PE. The period of pipe service ranged from less than 5 years, between 5 to 10 years, between 10 to 20 years and more than 20 years. The sites were selected within Klang Valley (KV) according to the local authority (LA); Majlis Perbandaran Ampang Jaya (MPAJ), Majlis Perbandaran Kajang (MPKjg), Majlis Perbandaran Sepang (MPSpg), Dewan Bandaraya Kuala Lumpur (DBKL) and Majlis Perbandaran Selayang (MPS).

This study was performed using CCTV inspection followed by pipe assessment using PACP protocol. A CCTV is a small camera mounted on a remote-control roller that captures insight image of the sewer pipe (Halfawy & Hengmeechai, 2014). Meanwhile, PACP is a standardised protocol in collecting and managing related to the internal pipe inspection, which was established by the National Association of Sewer Service Companies (NASSCO), United States in 2002 (Lewis *et al.*, 2016). The CCTV inspection and PACP results were used to identify the probability weights, failure

factor and coefficient in CI calculation. Markov analysis was conducted to prove future deterioration of the structural condition in gravitational flow sewer pipe. Markov analysis was selected due to its ability to describe the growing defect in the structure and ability to predict future condition of the structure (Timashev & Bushinskaya, 2015; Jin, 2016). Likert Scale was then used as the basis to develop the prediction tool in determining and simulating the sewer pipe defect (Sempewo & Kyokaali, 2016). The prediction tool is a four (4) steps tool based on the discussion for Objective 1, 2 and 3. Finally, a pilot test was conducted to validate the reliability of the prediction tool developed for this study. The outcome of this study may assist the sewerage operator in conducting sewer pipe proactive maintenance by producing a prediction tool for the structural condition in gravitational flow sewer pipe based on the effects of static and dynamic factors.

1.7 Thesis Organization

This thesis consisted of five chapters. Chapter 1 contained the introduction which includes the background of the study, problem statement, research question, the objective of the study, significance of study as well as the scope of the study. Chapter 2 covered the previous studies and literature on the theories and concepts related to SN and sewer pipes structural problems including its factors and impacts. The general principles sewage conveyance system and its sewer pipe were also reviewed. The relevant process of sewer pipe inspection and assessment were explored, and finally, the existing sewer pipe management systems were discussed and reviewed. Chapter 3 consisted of detailed methodology which includes the area of study, CCTV work, grading of sewer pipe defect, Markov analysis as well as CI calculation for the development of prediction tool and pilot test. Chapter 4 presented the results and discussion obtained from the study. Finally, Chapter 5 presented the conclusions derived from this study and the recommendations for future studies.

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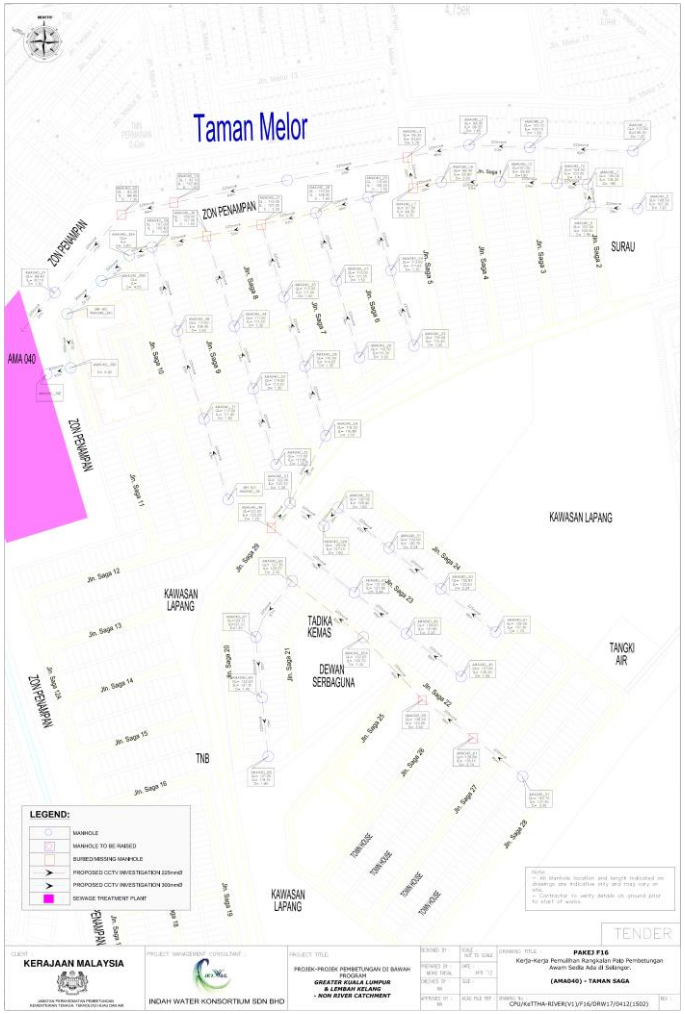
LIST OF PUBLICATIONS

Indexed Journal

1. **A Gani, A. S.**, Chelliapan, S., Kamaruddin, S. A., & Lee, W. K. 2018. Structural assessment of open channel sewer pipe in Malaysia using CCTV investigation and PACP grading system. *International Journal of Civil Engineering and Technology*, 9(10), 1819–1831.
   (Indexed by SCOPUS)

APPENDIX A

Site Maps



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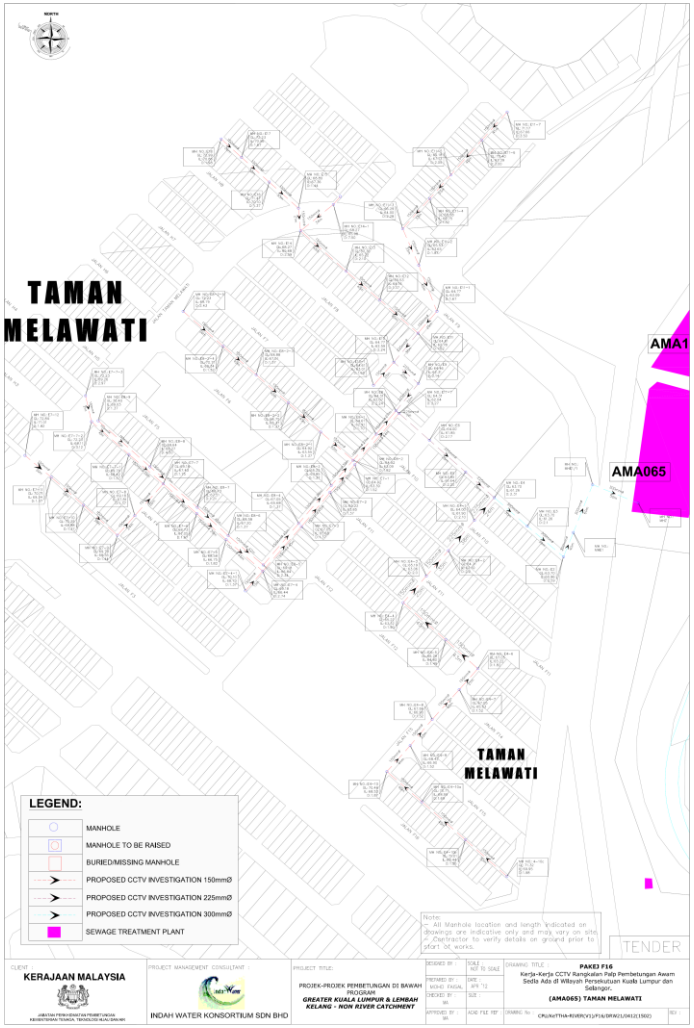

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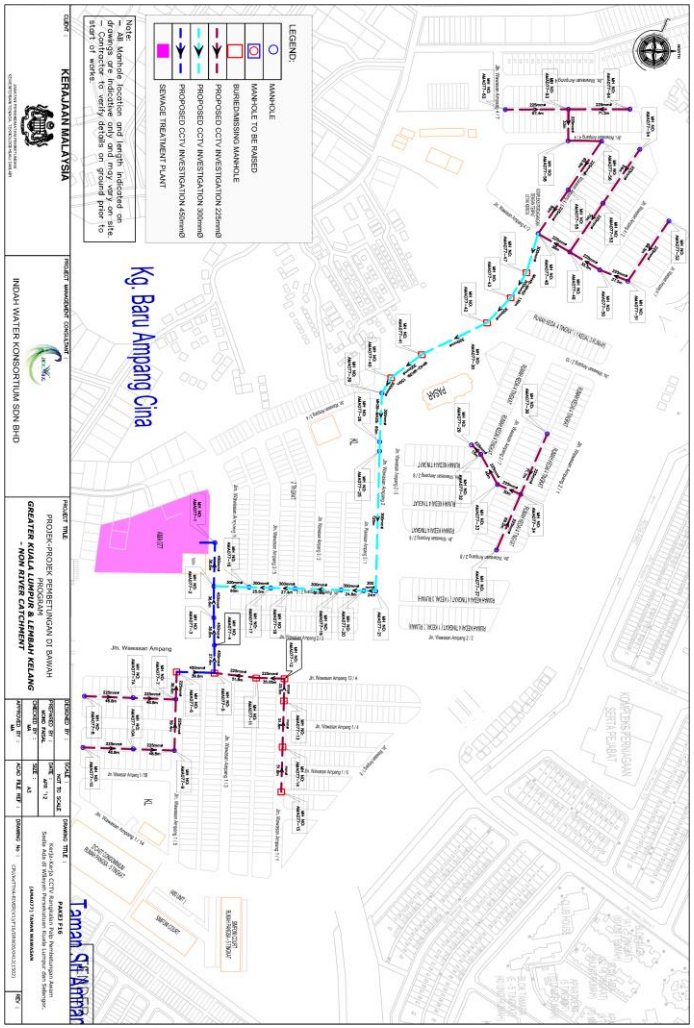
Kg. Baru Ampang Cina
AMA077
Taman Sri Ampang
LEGEND:
MANHOLE
MANHOLE TO BE RAISED
BURIED/MISSING MANHOLE
PROPOSED CCTV INVESTIGATION 225mmØ
PROPOSED CCTV INVESTIGATION 300mmØ
PROPOSED CCTV INVESTIGATION 450mmØ
SEWAGE TREATMENT PLANT
Note:
- All Manhole location and length indicated on plan are to be verified on site.
- Contractor to verify details on ground prior to start of works.
CLIENT
KERAJAAN MALAYSIA
PROJECT MANAGEMENT CONSULTANT
INDAH WATER KONSORTIUM SDN BHD
PROJECT TITLE
PROJEK-PROJEK PEMBETUNGAN DI BAWAH
GREATER KUALA LUMPUR & LEMBAH KELANG
- NON RIVER CATCHMENT
DRAWING TITLE
PAKEJ P16
Kerja-kerja CCTV Kumpulan Paip Pembetungan Awam
(AMA077) - TAMAN AMPANG INDAH
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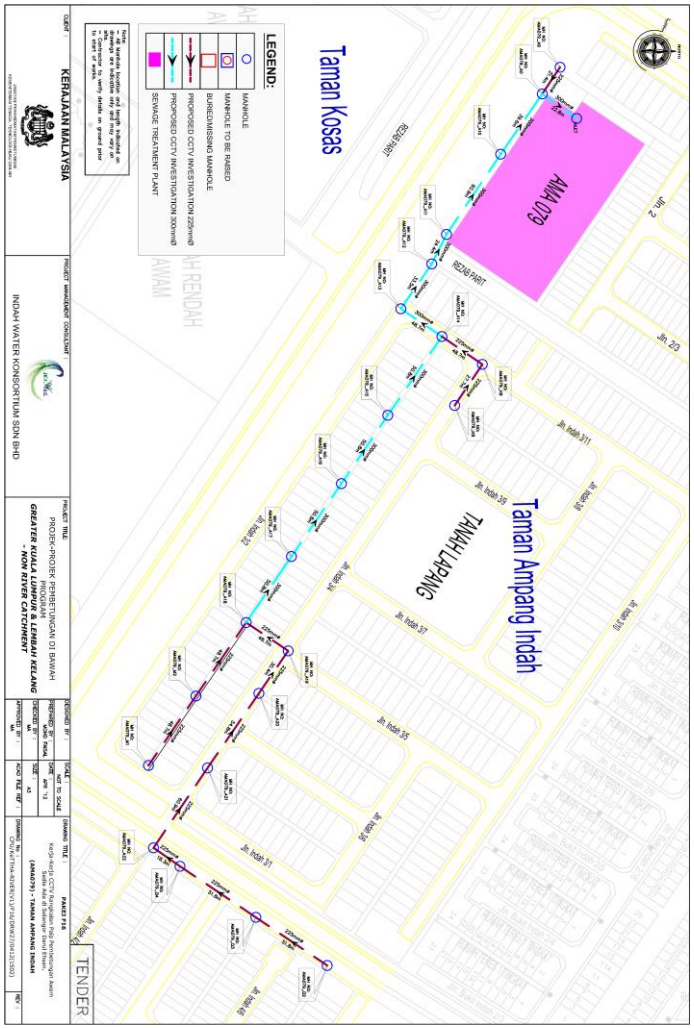
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PROPOSED CCTV INVESTIGATION 300mmØ
SEWAGE TREATMENT PLANT
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PROJECT MANAGEMENT CONSULTANT
INDAH WATER KONSORTIUM SDN BHD
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GREATER KUALA LUMPUR & LEMBAH KELANG
- NON RIVER CATCHMENT
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Kerja-kerja CCTV Kumpulan Paip Pembetungan Awam
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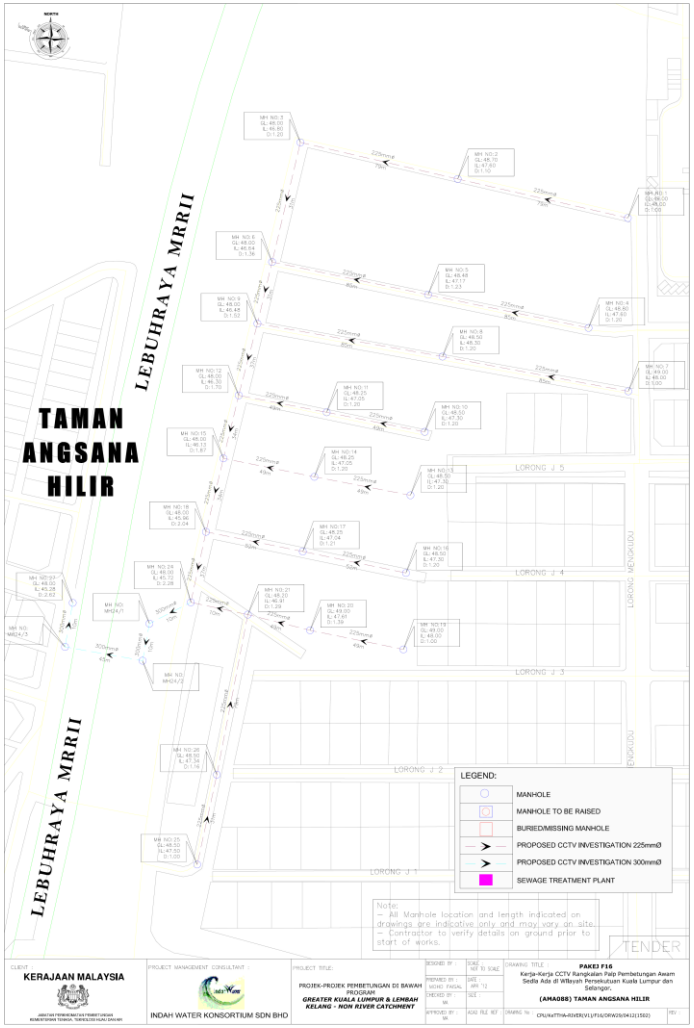

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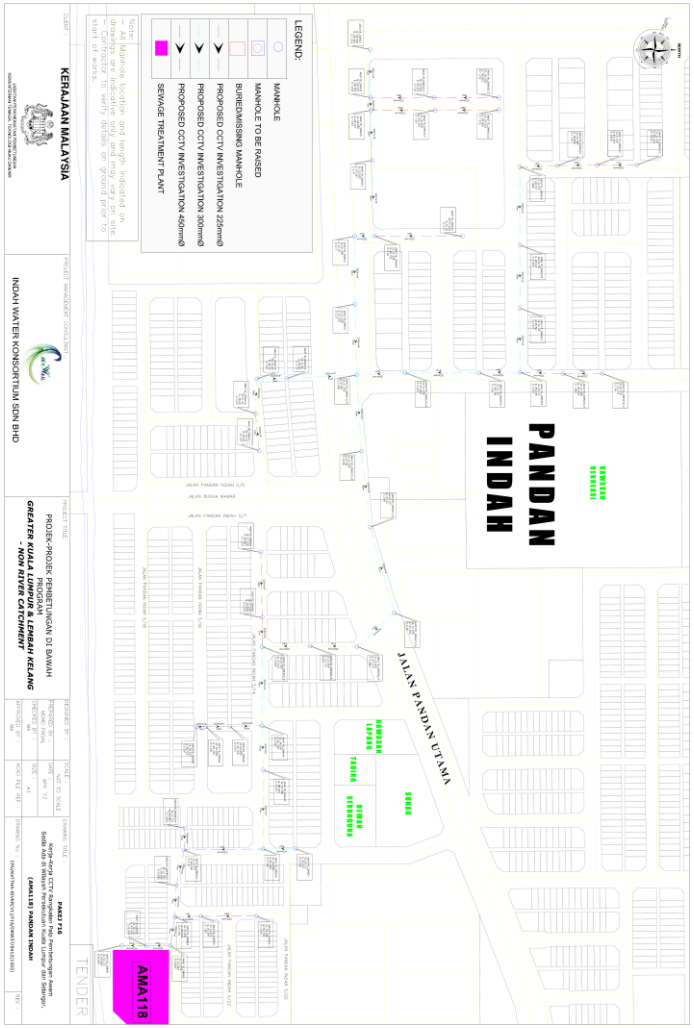

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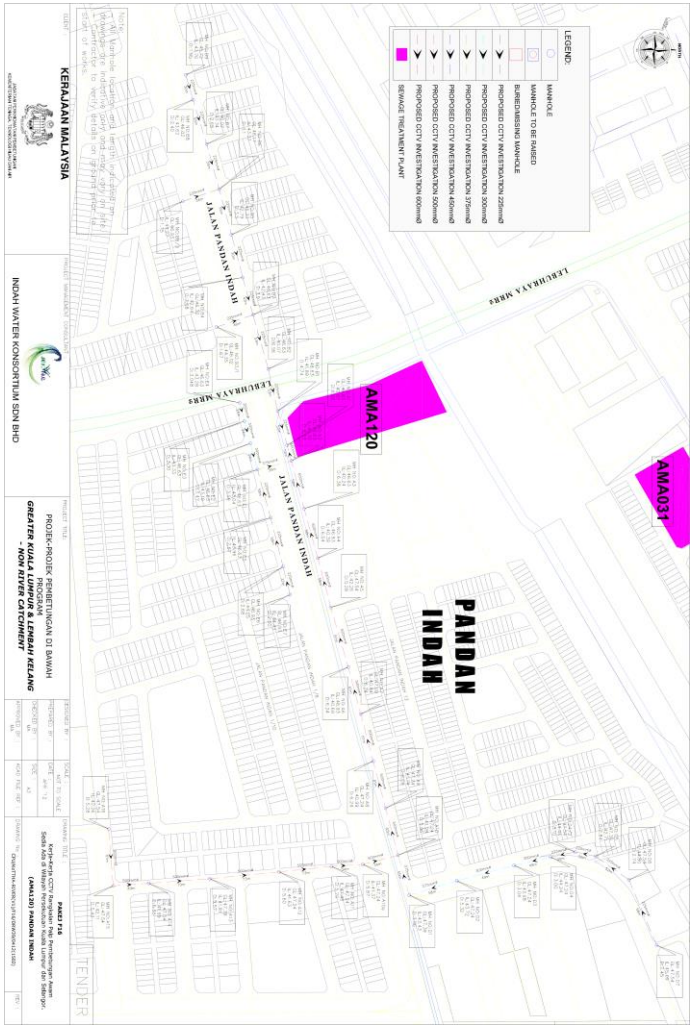

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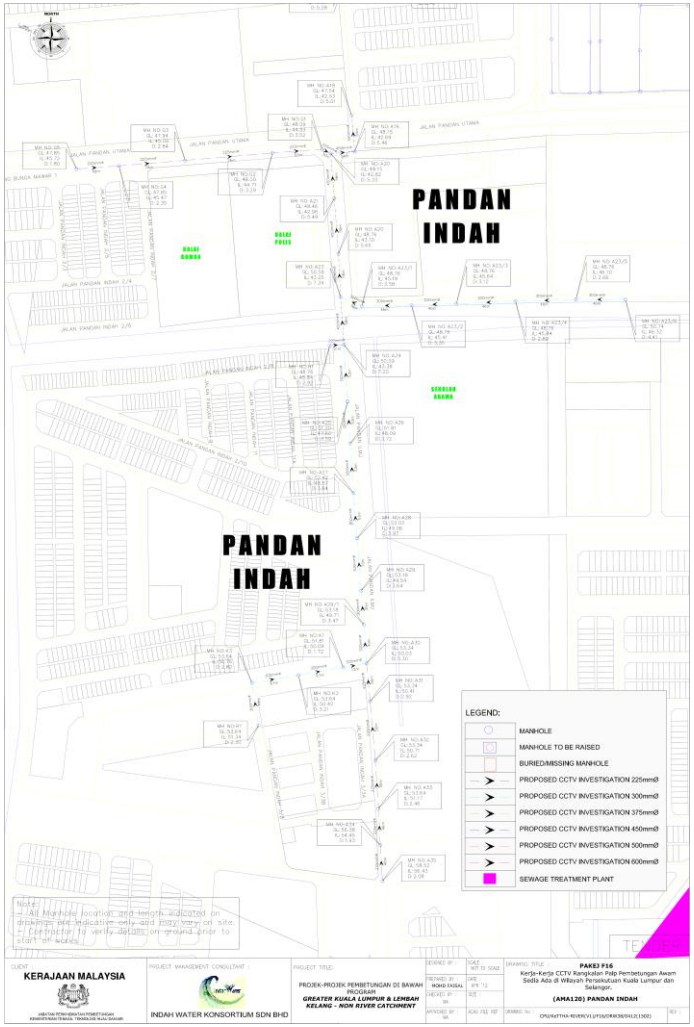

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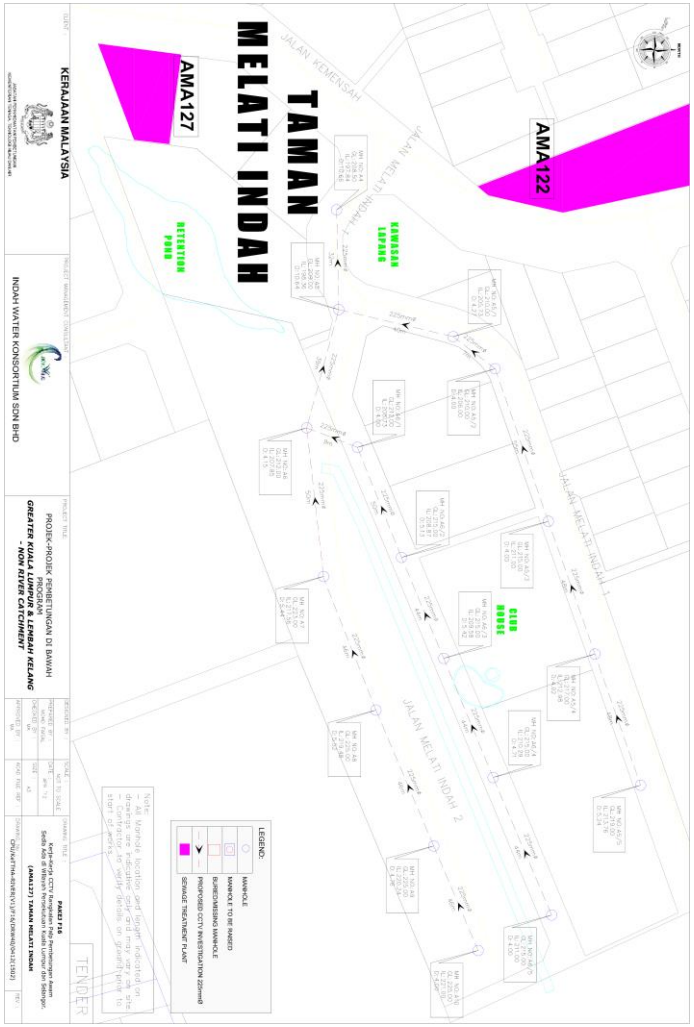

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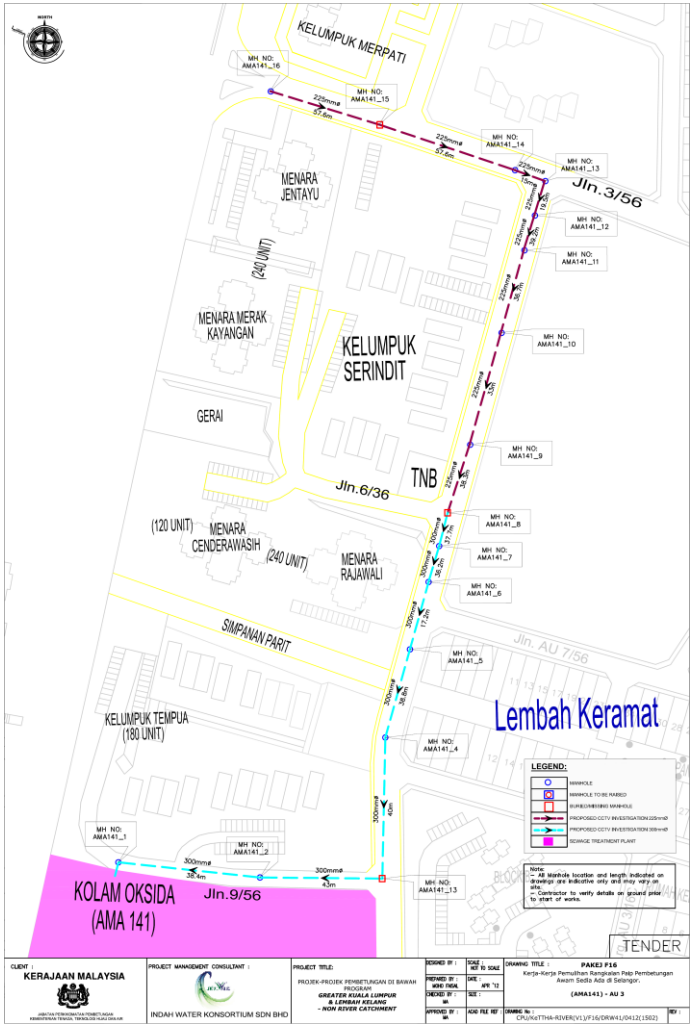

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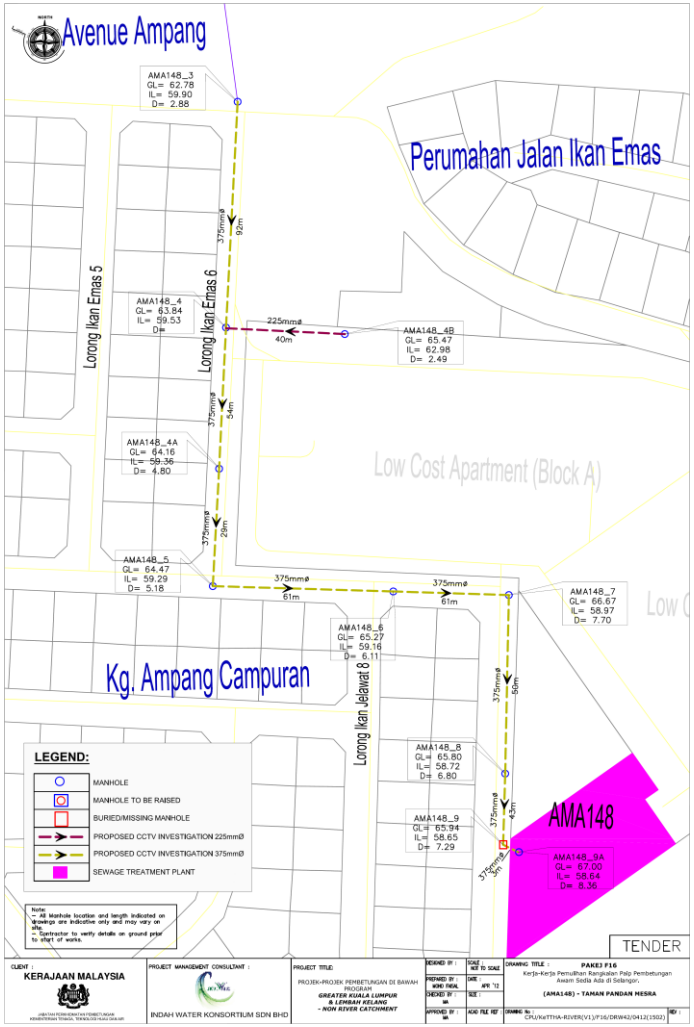

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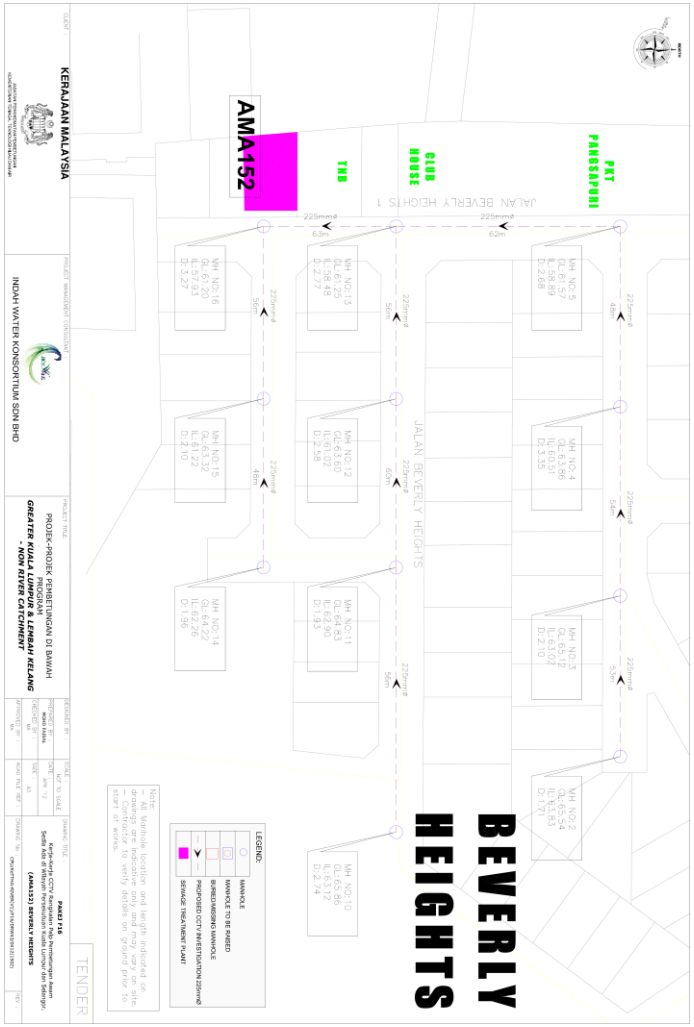

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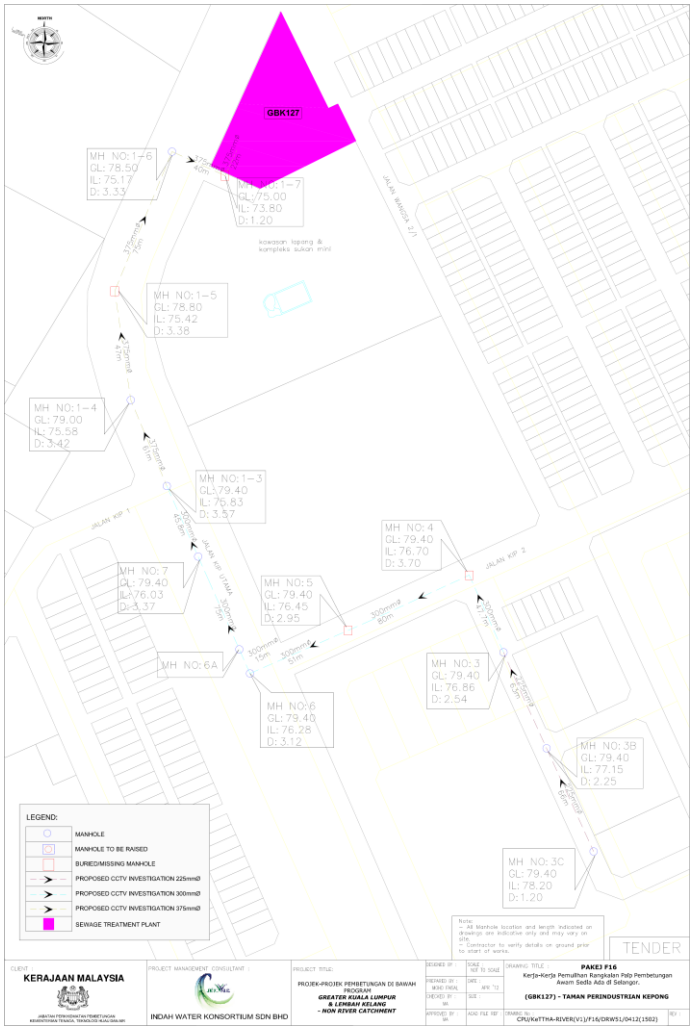

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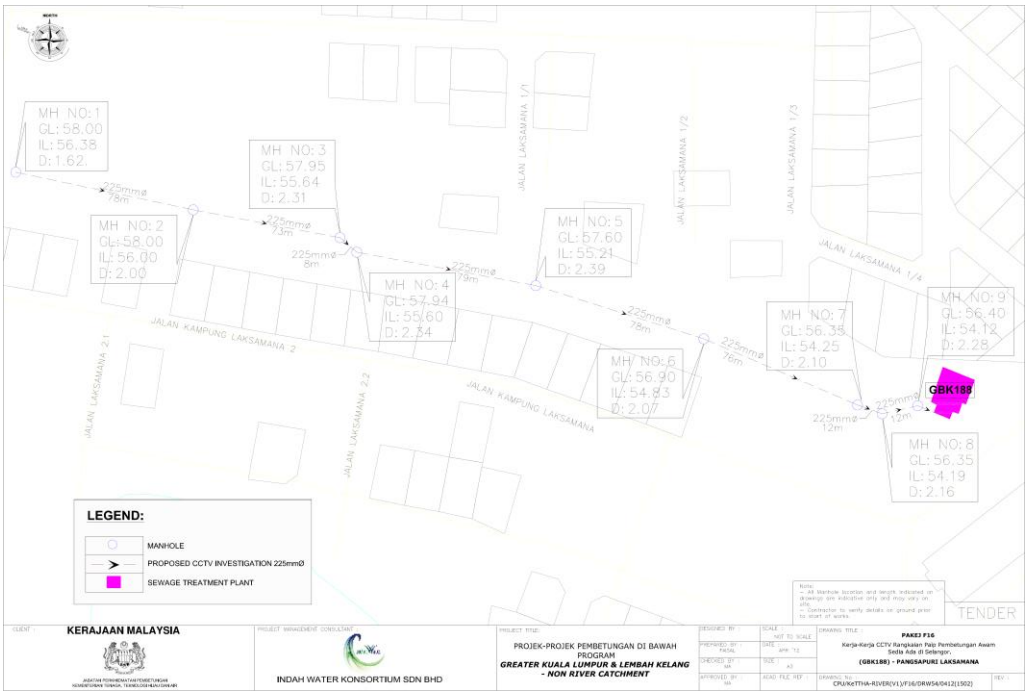

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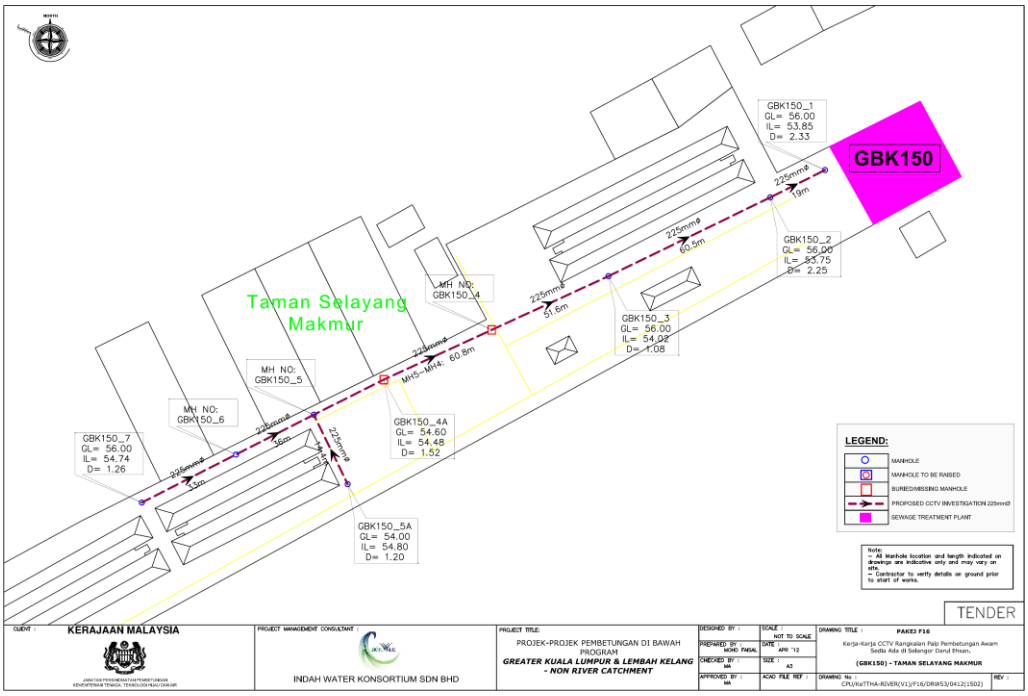

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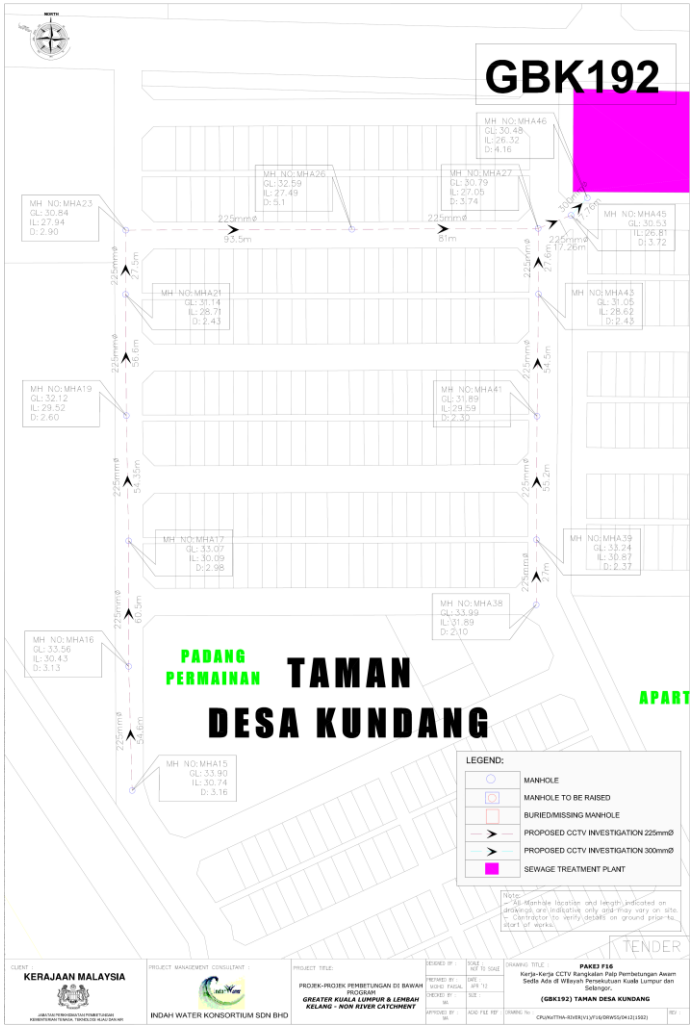

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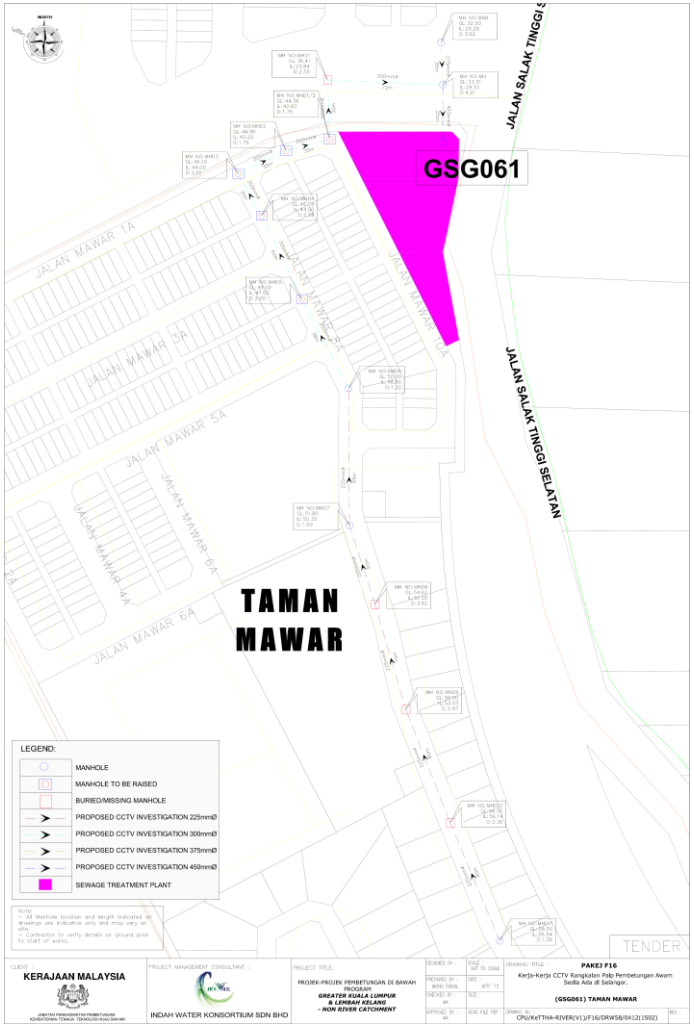

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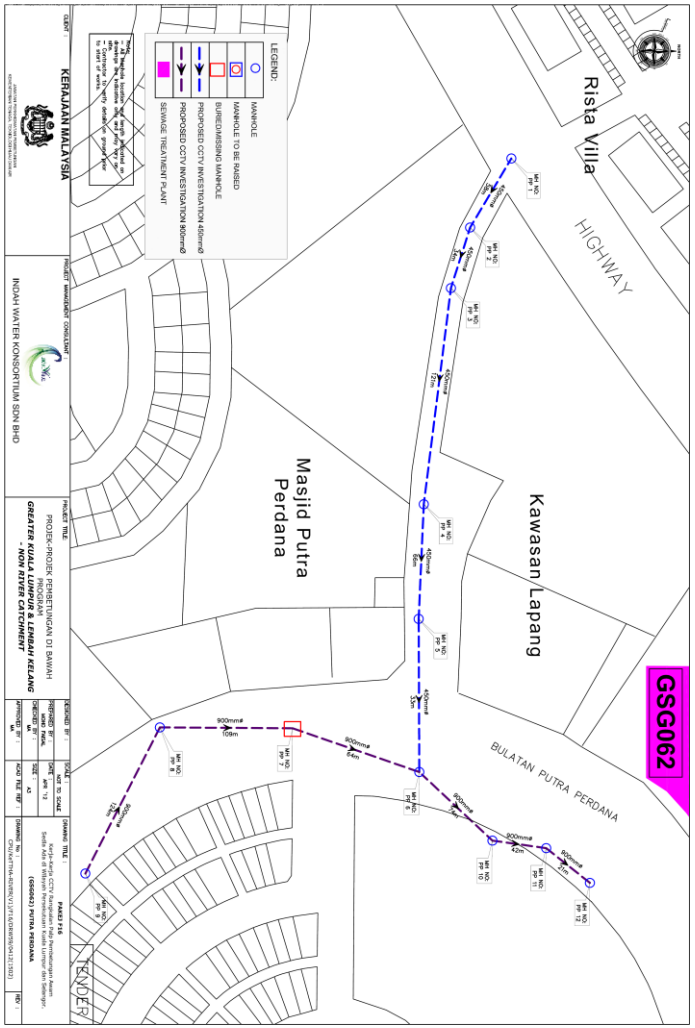

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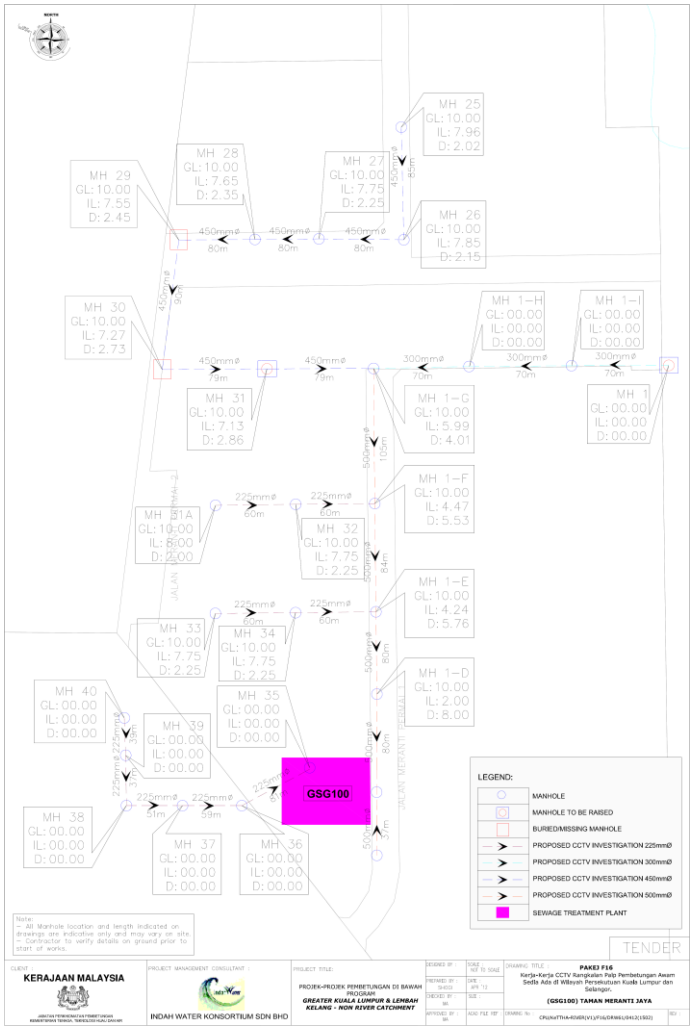

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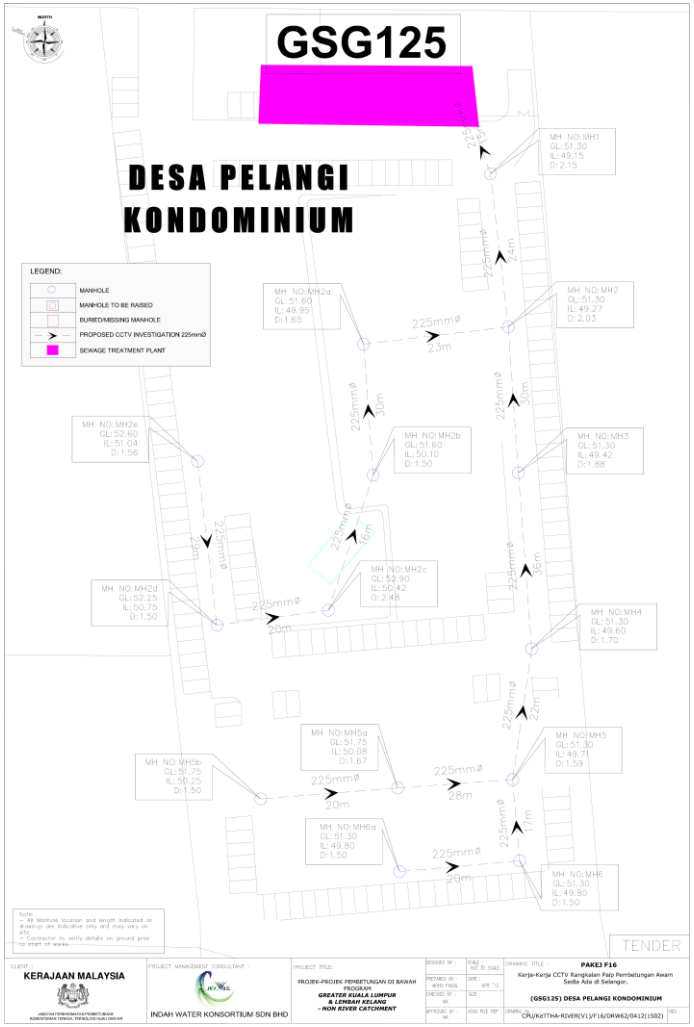

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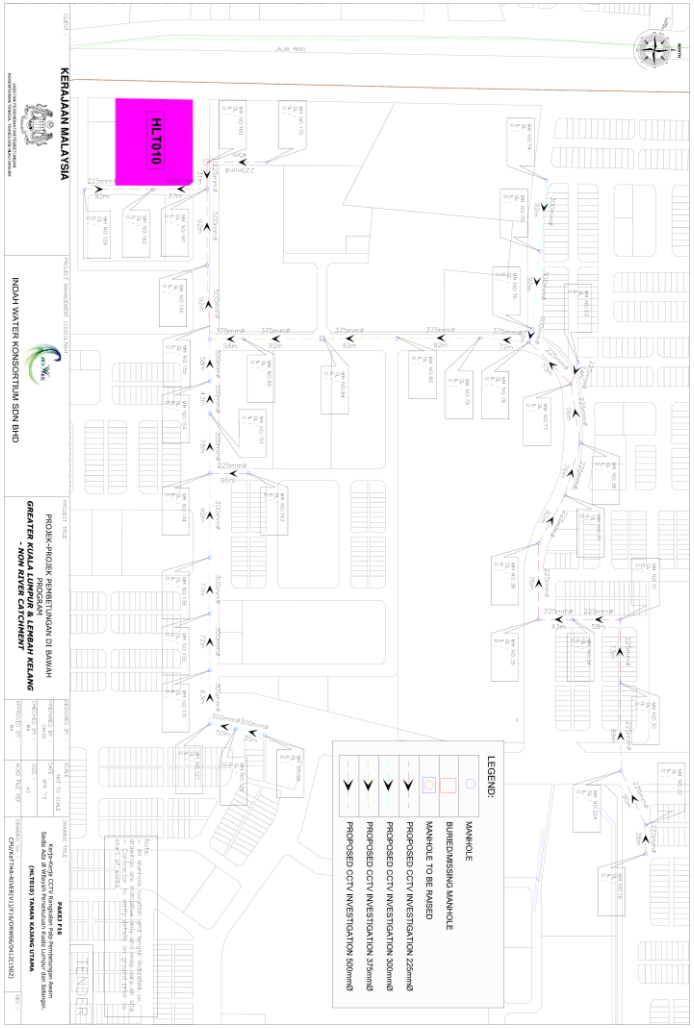

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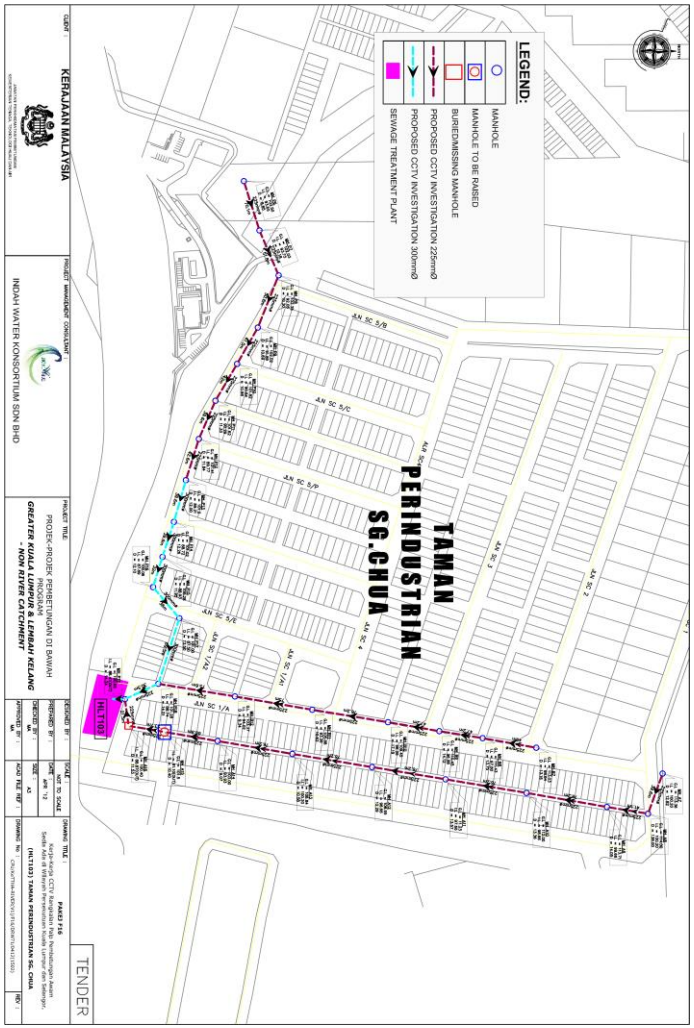

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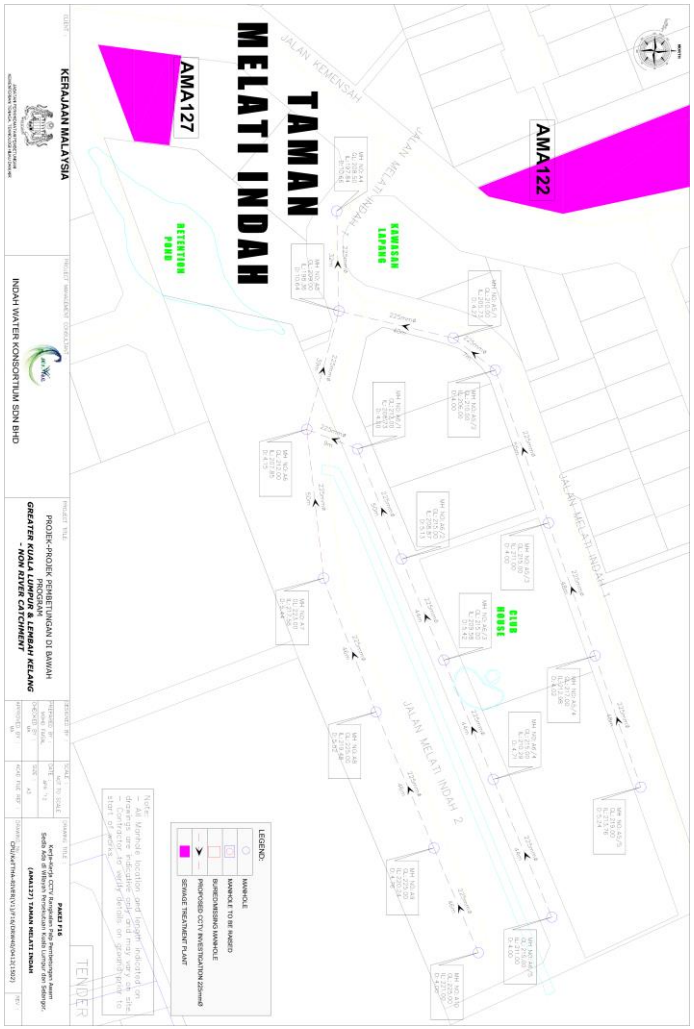

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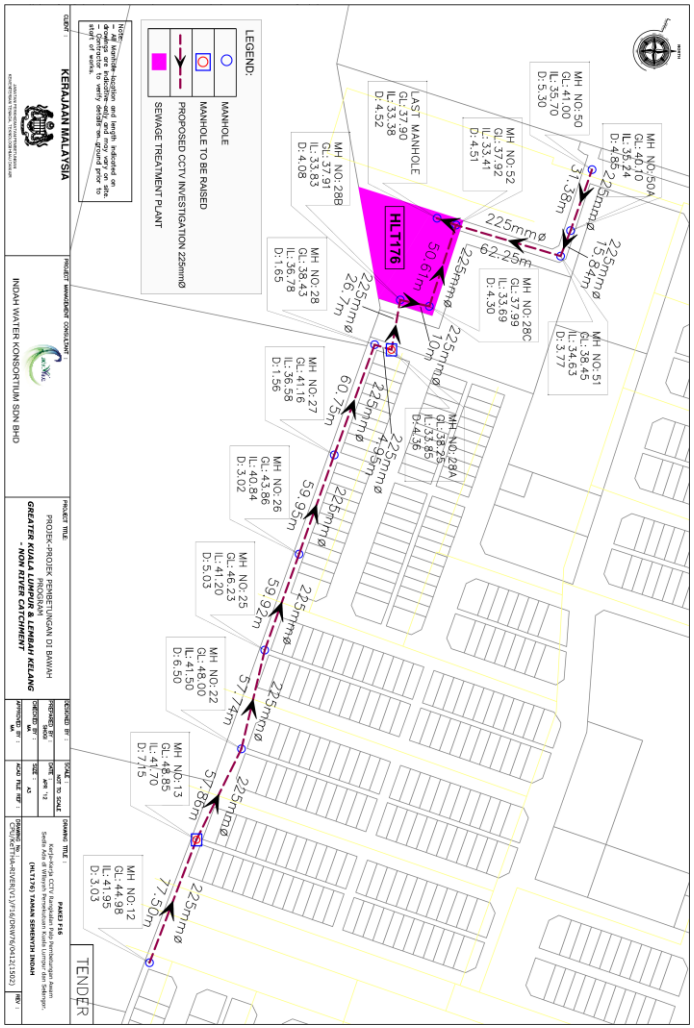
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MH NO:50
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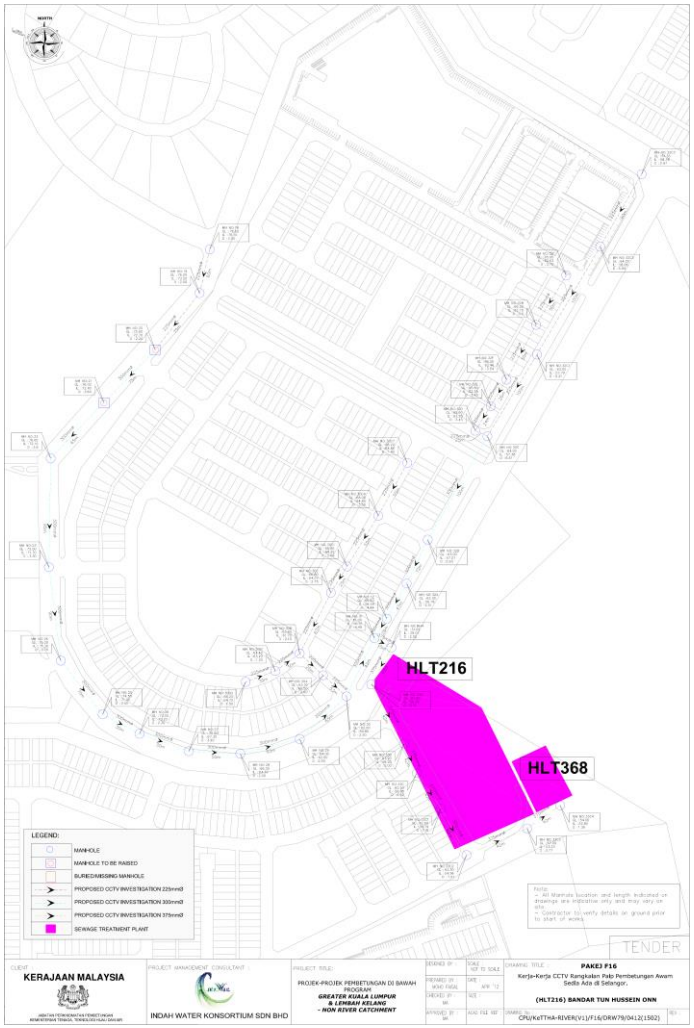
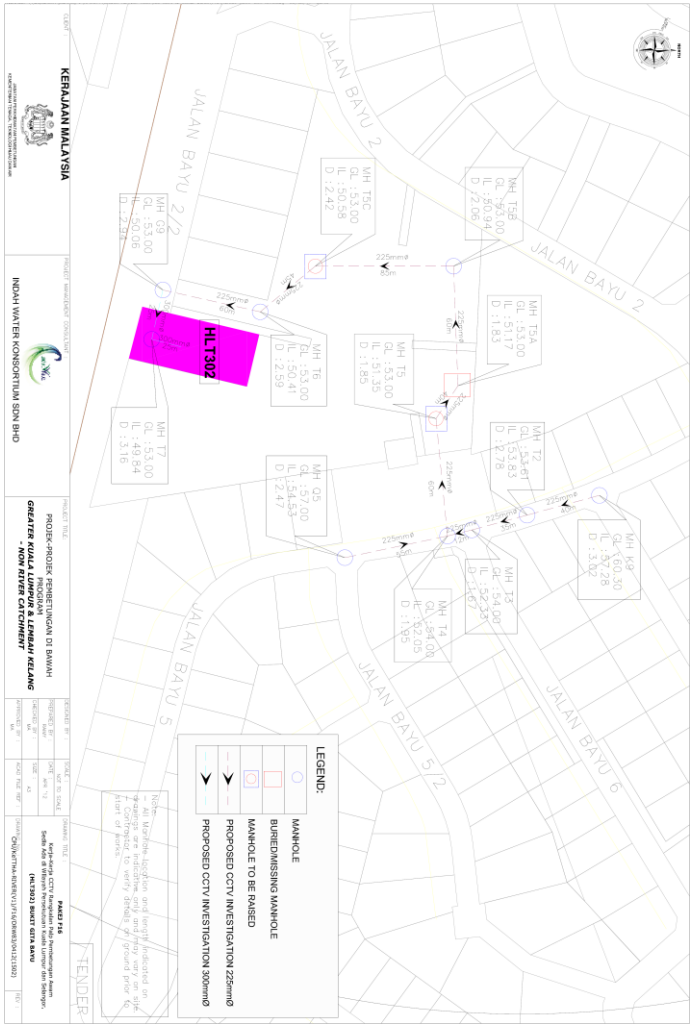
IL: 35.70
D: 5.30
MH NO:52
GL: 37.92
IL: 33.41
D: 4.51
LAST MANHOLE
GL: 37.89
IL: 33.39
D: 4.52
MH NO:28B
GL: 37.91
IL: 33.83
D: 4.08
MH NO:28C
GL: 37.99
IL: 33.69
D: 4.30
MH NO:51
GL: 38.45
IL: 34.53
D: 3.77
MH NO:28
GL: 38.43
IL: 36.78
D: 1.65
MH NO:27
GL: 41.16
IL: 36.58
D: 1.56
MH NO:26
GL: 43.86
IL: 40.84
D: 3.02
MH NO:25
GL: 46.23
IL: 41.20
D: 5.03
MH NO:22
GL: 48.00
IL: 41.50
D: 6.50
MH NO:13
GL: 48.85
IL: 41.70
D: 7.15
MH NO:12
GL: 44.98
IL: 41.95
D: 3.03
225mmø
37.36m
15.84m
62.25m
50.61m
28.7m
10.0m
60.75m
4.99m
59.95m
59.92m
57.74m
57.86m
77.50m
LEGEND:
MANHOLE
MANHOLE TO BE RAISED
PROPOSED CCTV INVESTIGATION 225mmØ
SEWAGE TREATMENT PLANT
KERAJAAN MALAYSIA
INDAH WATER KONSORTIUM SDN BHD
PROJEK-PROJEK PEMBETUNGAN DI BAWAH PROGRAM
GREATER KUALA LUMPUR & LEMBAH KELANG
- NON RIVER CATCHMENT
PAKEJ F16
(HLT176) TAMAN SEMENYIH INDAH
TENDER


HLT216
HLT368
LEGEND:
MANHOLE
MANHOLE TO BE RAISED
BURIED/MISSING MANHOLE
PROPOSED CCTV INVESTIGATION 225mmØ
PROPOSED CCTV INVESTIGATION 300mmØ
PROPOSED CCTV INVESTIGATION 375mmØ
SEWAGE TREATMENT PLANT
KERAJAAN MALAYSIA
INDAH WATER KONSORTIUM SDN BHD
PROJEK-PROJEK PEMBETUNGAN DI BAWAH PROGRAM
GREATER KUALA LUMPUR & LEMBAH KELANG
- NON RIVER CATCHMENT
PAKEJ F16
Kerja-Kerja CCTV Rangkaian Paip Pembetungan Awam Sedia Ada di Selangor.
(HLT216) BANDAR TUN HUSSEIN ONN
TENDER

HLT216



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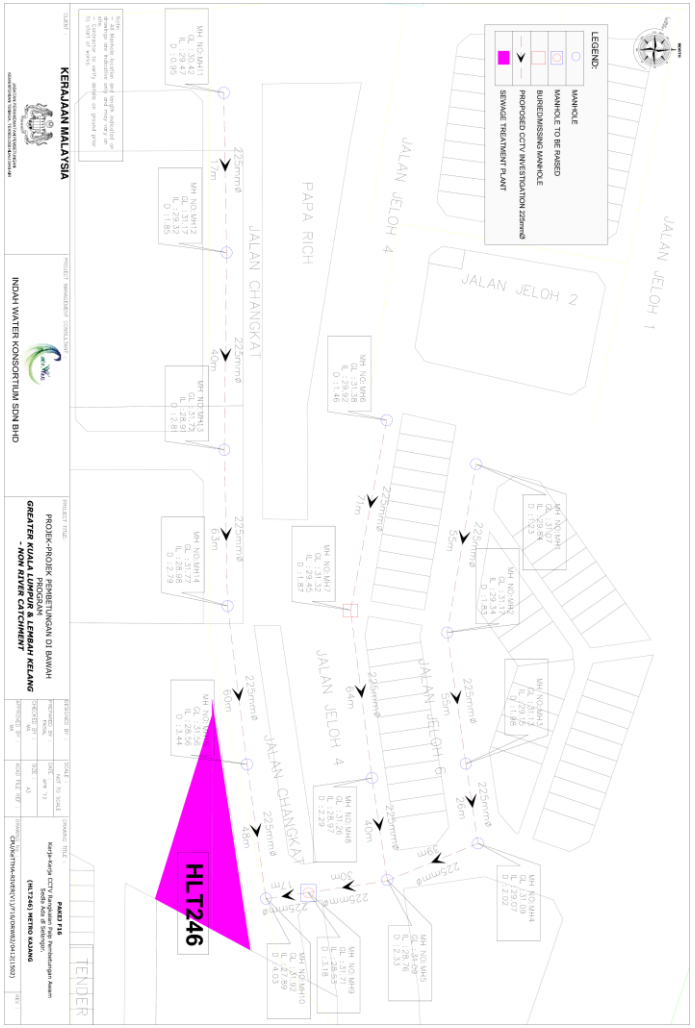

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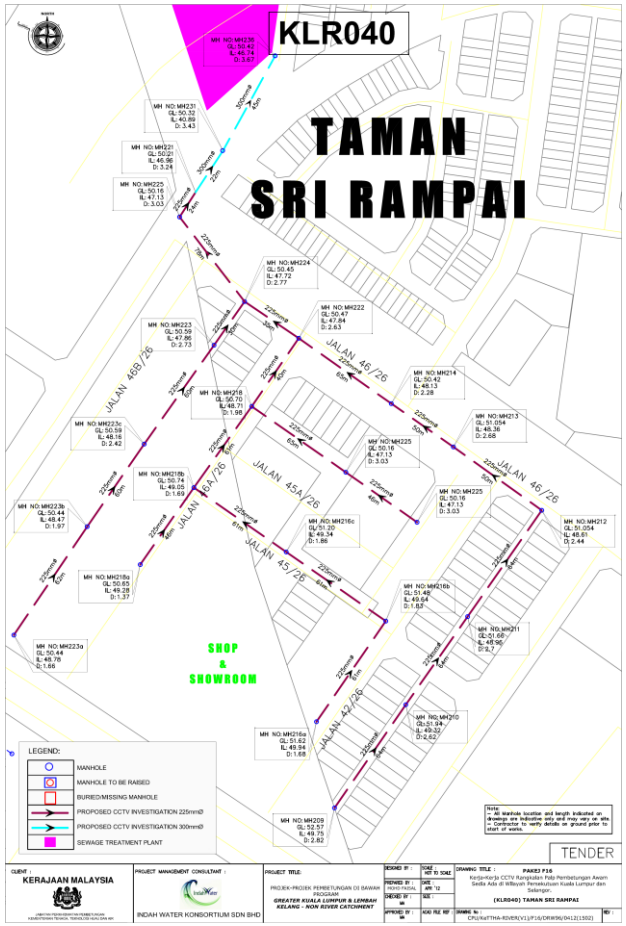
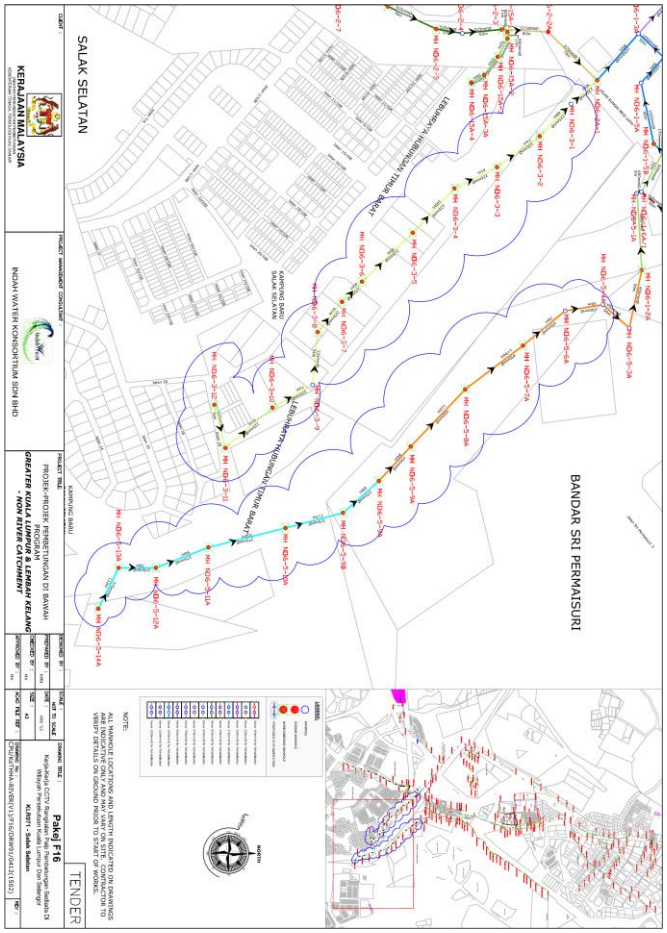


KLR040



KLR071

APPENDIX B

CCTV Results

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
1	AMA065	MPAJ	E8-2-3	67.51	E8-2-2	65.37	3	< 5,000PE	225mm Clay	> 20years	66.44	67.85	1.41	< 3m	21	< 200	45.0	40m - 60m
2	AMA065	MPAJ	E8-2-3	67.51	E8-2-2	65.37	5	< 5,000PE	225mm Clay	> 20years	66.44	67.85	1.41	< 3m	21	< 200	45.0	40m - 60m
3	AMA065	MPAJ	E11-5	67.13	E11-4	66.75	5	< 5,000PE	225mm Clay	> 20years	66.94	68.88	1.94	< 3m	105	< 200	40.0	20m - 40m
4	AMA065	MPAJ	E11-3	64.00	E11-2	63.65	1	< 5,000PE	225mm Clay	> 20years	63.83	65.91	2.08	< 3m	100	< 200	35.0	20m - 40m
5	AMA065	MPAJ	E11-3	64.00	E11-2	63.65	3	< 5,000PE	225mm Clay	> 20years	63.83	65.91	2.08	< 3m	100	< 200	35.0	20m - 40m
6	AMA065	MPAJ	E11-3	64.00	E11-2	63.65	5	< 5,000PE	225mm Clay	> 20years	63.83	65.91	2.08	< 3m	100	< 200	35.0	20m - 40m
7	AMA065	MPAJ	E7-4-1	68.73	E7-4	66.44	1	< 5,000PE	225mm Clay	> 20years	67.59	69.64	2.05	< 3m	7	< 200	15.0	< 20m
8	AMA065	MPAJ	E8-2-2	65.37	E8-2-1	63.55	4	< 5,000PE	225mm Clay	> 20years	64.46	65.84	1.38	< 3m	25	< 200	45.0	40m - 60m
9	AMA065	MPAJ	E8-2-5	69.79	E8-2-4	69.34	3	< 5,000PE	225mm Clay	> 20years	69.57	71.47	1.91	< 3m	80	< 200	36.0	20m - 40m
10	AMA065	MPAJ	E7-5	66.75	E7-4	66.44	3	< 5,000PE	225mm Clay	> 20years	66.60	68.88	2.29	< 3m	142	< 200	44.0	40m - 60m
11	AMA065	MPAJ	E7-5	66.75	E7-4	66.44	2	< 5,000PE	225mm Clay	> 20years	66.60	68.88	2.29	< 3m	142	< 200	44.0	40m - 60m
12	AMA065	MPAJ	E7-5	66.75	E7-4	66.44	4	< 5,000PE	225mm Clay	> 20years	66.60	68.88	2.29	< 3m	142	< 200	44.0	40m - 60m
13	AMA065	MPAJ	E7-4	66.44	E7-3	65.68	5	< 5,000PE	225mm Clay	> 20years	66.06	68.12	2.06	< 3m	59	< 200	45.0	40m - 60m
14	AMA065	MPAJ	E8-2-4	69.34	E8-2-3	67.51	1	< 5,000PE	225mm Clay	> 20years	68.43	69.80	1.37	< 3m	25	< 200	45.0	40m - 60m
15	AMA088	MPAJ	14	47.05	15	46.13	2	< 5,000PE	225mm Clay	> 20years	46.59	48.14	1.55	< 3m	53	< 200	49.0	40m - 60m
16	AMA088	MPAJ	14	47.05	15	46.13	3	< 5,000PE	225mm Clay	> 20years	46.59	48.14	1.55	< 3m	53	< 200	49.0	40m - 60m
17	AMA088	MPAJ	11	47.05	12	46.30	4	< 5,000PE	225mm Clay	> 20years	46.68	48.13	1.46	< 3m	65	< 200	49.0	40m - 60m
18	AMA088	MPAJ	25	47.50	26	47.34	1	< 5,000PE	225mm Clay	> 20years	47.42	48.50	1.08	< 3m	194	< 200	31.0	20m - 40m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
19	AMA088	MPAJ	19	48.00	20	47.61	3	< 5,000PE	225mm Clay	> 20years	47.81	49.00	1.20	< 3m	126	< 200	49.0	40m - 60m
20	AMA088	MPAJ	19	48.00	20	47.61	4	< 5,000PE	225mm Clay	> 20years	47.81	49.00	1.20	< 3m	126	< 200	49.0	40m - 60m
21	AMA088	MPAJ	20	47.61	21	46.91	2	< 5,000PE	225mm Clay	> 20years	47.26	48.60	1.34	< 3m	70	< 200	49.0	40m - 60m
22	AMA088	MPAJ	20	47.61	21	46.91	3	< 5,000PE	225mm Clay	> 20years	47.26	48.60	1.34	< 3m	70	< 200	49.0	40m - 60m
23	AMA088	MPAJ	6	46.64	9	46.48	2	< 5,000PE	225mm Clay	> 20years	46.56	48.00	1.44	< 3m	194	< 200	31.0	20m - 40m
24	AMA088	MPAJ	8	48.30	9	46.48	2	< 5,000PE	225mm Clay	> 20years	47.39	48.13	0.74	< 3m	47	< 200	85.0	> 80m
25	AMA088	MPAJ	8	48.30	9	46.48	3	< 5,000PE	225mm Clay	> 20years	47.39	48.13	0.74	< 3m	47	< 200	85.0	> 80m
26	AMA088	MPAJ	8	48.30	7	48.00	4	< 5,000PE	225mm Clay	> 20years	48.15	48.75	0.60	< 3m	283	200 - 400	85.0	> 80m
27	AMA118	MPAJ	G3	51.30	G2	51.16	2	< 5,000PE	300mm Clay	10-20years	51.23	51.41	0.18	< 3m	129	< 200	18.0	< 20m
28	AMA118	MPAJ	A18	48.52	A17	48.40	2	< 5,000PE	300mm Clay	10-20years	48.46	49.74	1.28	< 3m	467	400 - 600	56.0	40m - 60m
29	AMA118	MPAJ	A18	48.52	A17	48.40	3	< 5,000PE	300mm Clay	10-20years	48.46	49.74	1.28	< 3m	467	400 - 600	56.0	40m - 60m
30	AMA118	MPAJ	A18	48.52	A17	48.40	4	< 5,000PE	300mm Clay	10-20years	48.46	49.74	1.28	< 3m	467	400 - 600	56.0	40m - 60m
31	AMA118	MPAJ	A18	48.52	A17	48.40	5	< 5,000PE	300mm Clay	10-20years	48.46	49.74	1.28	< 3m	467	400 - 600	56.0	40m - 60m
32	AMA118	MPAJ	G2	51.16	G1	51.04	1	< 5,000PE	300mm Clay	10-20years	51.10	51.21	0.11	< 3m	533	400 - 600	64.0	60m - 80m
33	AMA118	MPAJ	G2	51.16	G1	51.04	2	< 5,000PE	300mm Clay	10-20years	51.10	51.21	0.11	< 3m	533	400 - 600	64.0	60m - 80m
34	AMA118	MPAJ	A19	48.71	A18	48.52	2	< 5,000PE	300mm Clay	10-20years	48.62	49.74	1.13	< 3m	400	400 - 600	76.0	60m - 80m
35	AMA118	MPAJ	A19	48.71	A18	48.52	3	< 5,000PE	300mm Clay	10-20years	48.62	49.74	1.13	< 3m	400	400 - 600	76.0	60m - 80m
36	AMA118	MPAJ	A19	48.71	A18	48.52	4	< 5,000PE	300mm Clay	10-20years	48.62	49.74	1.13	< 3m	400	400 - 600	76.0	60m - 80m
37	AMA118	MPAJ	A21	49.04	A20	48.86	2	< 5,000PE	225mm Clay	10-20years	48.95	51.02	2.07	< 3m	250	200 - 400	45.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
38	AMA118	MPAJ	A22	49.29	A21	49.04	1	< 5,000PE	225mm Clay	10-20years	49.17	51.44	2.28	< 3m	148	< 200	37.0	20m - 40m
39	AMA118	MPAJ	A22	49.29	A21	49.04	2	< 5,000PE	225mm Clay	10-20years	49.17	51.44	2.28	< 3m	148	< 200	37.0	20m - 40m
40	AMA118	MPAJ	A22	49.29	A21	49.04	3	< 5,000PE	225mm Clay	10-20years	49.17	51.44	2.28	< 3m	148	< 200	37.0	20m - 40m
41	AMA118	MPAJ	A22	49.29	A21	49.04	4	< 5,000PE	225mm Clay	10-20years	49.17	51.44	2.28	< 3m	148	< 200	37.0	20m - 40m
42	AMA118	MPAJ	G5	48.35	G4	47.06	1	< 5,000PE	300mm Clay	10-20years	47.71	50.29	2.59	< 3m	28	< 200	36.0	20m - 40m
43	AMA118	MPAJ	G5	48.35	G4	47.06	2	< 5,000PE	300mm Clay	10-20years	47.71	50.29	2.59	< 3m	28	< 200	36.0	20m - 40m
44	AMA118	MPAJ	G5/2	49.86	G5/1	49.39	1	< 5,000PE	225mm Clay	10-20years	49.63	50.90	1.28	< 3m	123	< 200	58.0	40m - 60m
45	AMA118	MPAJ	G5/2	49.86	G5/1	49.39	2	< 5,000PE	225mm Clay	10-20years	49.63	50.90	1.28	< 3m	123	< 200	58.0	40m - 60m
46	AMA118	MPAJ	G5/2	49.86	G5/1	49.39	3	< 5,000PE	225mm Clay	10-20years	49.63	50.90	1.28	< 3m	123	< 200	58.0	40m - 60m
47	AMA118	MPAJ	A16	48.24	A15	48.15	1	< 5,000PE	300mm Clay	10-20years	48.20	55.63	7.44	> 5m	422	400 - 600	38.0	20m - 40m
48	AMA118	MPAJ	A16	48.24	A15	48.15	2	< 5,000PE	300mm Clay	10-20years	48.20	55.63	7.44	> 5m	422	400 - 600	38.0	20m - 40m
49	AMA118	MPAJ	A16	48.24	A15	48.15	3	< 5,000PE	300mm Clay	10-20years	48.20	55.63	7.44	> 5m	422	400 - 600	38.0	20m - 40m
50	AMA118	MPAJ	A16	48.24	A15	48.15	1	< 5,000PE	300mm Clay	10-20years	48.20	55.63	7.44	> 5m	422	400 - 600	38.0	20m - 40m
51	AMA118	MPAJ	A15	48.15	A14/A	47.92	1	< 5,000PE	300mm Clay	10-20years	48.04	51.36	3.33	3m - 5m	291	200 - 400	67.0	60m - 80m
52	AMA118	MPAJ	A15	48.15	A14/A	47.92	2	< 5,000PE	300mm Clay	10-20years	48.04	51.36	3.33	3m - 5m	291	200 - 400	67.0	60m - 80m
53	AMA118	MPAJ	A15	48.15	A14/A	47.92	3	< 5,000PE	300mm Clay	10-20years	48.04	51.36	3.33	3m - 5m	291	200 - 400	67.0	60m - 80m
54	AMA118	MPAJ	A15	48.15	A14/A	47.92	4	< 5,000PE	300mm Clay	10-20years	48.04	51.36	3.33	3m - 5m	291	200 - 400	67.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
55	AMA118	MPAJ	A14	48.06	A13/A	47.86	1	< 5,000PE	300mm Clay	10-20years	47.96	51.20	3.24	3m - 5m	305	200 - 400	61.0	60m - 80m
56	AMA118	MPAJ	A14	48.06	A13/A	47.86	2	< 5,000PE	300mm Clay	10-20years	47.96	51.20	3.24	3m - 5m	305	200 - 400	61.0	60m - 80m
57	AMA118	MPAJ	A14	48.06	A13/A	47.86	3	< 5,000PE	300mm Clay	10-20years	47.96	51.20	3.24	3m - 5m	305	200 - 400	61.0	60m - 80m
58	AMA118	MPAJ	A14	48.06	A13/A	47.86	4	< 5,000PE	300mm Clay	10-20years	47.96	51.20	3.24	3m - 5m	305	200 - 400	61.0	60m - 80m
59	AMA118	MPAJ	G1	51.04	A13/A	47.86	5	5,000PE - 10,000PE	300mm Clay	10-20years	49.45	51.20	1.75	< 3m	20	< 200	64.0	60m - 80m
60	AMA118	MPAJ	G1	51.04	A13/A	47.86	4	5,000PE - 10,000PE	300mm Clay	10-20years	49.45	51.20	1.75	< 3m	20	< 200	64.0	60m - 80m
61	AMA118	MPAJ	A14/A	47.92	A13/A	47.86	1	5,000PE - 10,000PE	300mm Clay	10-20years	47.89	51.20	3.31	3m - 5m	583	400 - 600	35.0	20m - 40m
62	AMA118	MPAJ	A14/A	47.92	A13/A	47.86	2	5,000PE - 10,000PE	300mm Clay	10-20years	47.89	51.20	3.31	3m - 5m	583	400 - 600	35.0	20m - 40m
63	AMA118	MPAJ	A14/A	47.92	A13/A	47.86	4	5,000PE - 10,000PE	300mm Clay	10-20years	47.89	51.20	3.31	3m - 5m	583	400 - 600	35.0	20m - 40m
64	AMA118	MPAJ	A14/A	47.92	A13/Aa	47.86	5	5,000PE - 10,000PE	300mm Clay	10-20years	47.89	51.20	3.31	3m - 5m	167	< 200	10.0	< 20m
65	AMA118	MPAJ	A11	48.92	A12	48.20	2	5,000PE - 10,000PE	300mm Clay	10-20years	48.56	51.60	3.04	3m - 5m	96	< 200	69.0	60m - 80m
66	AMA118	MPAJ	A4	46.38	A3	46.20	1	10,000PE - 20,000PE	450mm Concrete	10-20years	46.29	53.04	6.75	> 5m	417	400 - 600	75.0	60m - 80m
67	AMA118	MPAJ	A4	46.38	A3	46.20	2	10,000PE - 20,000PE	450mm Concrete	10-20years	46.29	53.04	6.75	> 5m	417	400 - 600	75.0	60m - 80m
68	AMA118	MPAJ	A6/1	46.97	A6/2	46.87	1	< 5,000PE	225mm Clay	10-20years	46.92	54.56	7.64	> 5m	500	400 - 600	50.0	40m - 60m
69	AMA118	MPAJ	A6/1	46.97	A6/2	46.87	2	< 5,000PE	225mm Clay	10-20years	46.92	54.56	7.64	> 5m	500	400 - 600	50.0	40m - 60m
70	AMA118	MPAJ	A6/1	46.97	A6/2	46.87	3	< 5,000PE	225mm Clay	10-20years	46.92	54.56	7.64	> 5m	500	400 - 600	50.0	40m - 60m
71	AMA118	MPAJ	A6/1	46.97	A6/2	46.87	4	< 5,000PE	225mm Clay	10-20years	46.92	54.56	7.64	> 5m	500	400 - 600	50.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
72	AMA118	MPAJ	A6	46.77	A5	46.66	1	5,000PE - 10,000PE	300mm Clay	10-20years	46.72	54.56	7.85	> 5m	382	200 - 400	42.0	40m - 60m
73	AMA118	MPAJ	A6	46.77	A5	46.66	2	5,000PE - 10,000PE	300mm Clay	10-20years	46.72	54.56	7.85	> 5m	382	200 - 400	42.0	40m - 60m
74	AMA118	MPAJ	A6	46.77	A5	46.66	3	5,000PE - 10,000PE	300mm Clay	10-20years	46.72	54.56	7.85	> 5m	382	200 - 400	42.0	40m - 60m
75	AMA118	MPAJ	A6	46.77	A5	46.66	4	5,000PE - 10,000PE	300mm Clay	10-20years	46.72	54.56	7.85	> 5m	382	200 - 400	42.0	40m - 60m
76	AMA118	MPAJ	A6	46.77	A5	46.66	5	5,000PE - 10,000PE	300mm Clay	10-20years	46.72	54.56	7.85	> 5m	382	200 - 400	42.0	40m - 60m
77	AMA118	MPAJ	A5	46.66	A4	46.38	1	5,000PE - 10,000PE	300mm Clay	10-20years	46.52	54.56	8.04	> 5m	257	200 - 400	72.0	60m - 80m
78	AMA118	MPAJ	A5	46.66	A4	46.38	2	5,000PE - 10,000PE	300mm Clay	10-20years	46.52	54.56	8.04	> 5m	257	200 - 400	72.0	60m - 80m
79	AMA118	MPAJ	A5	46.66	A4	46.38	3	5,000PE - 10,000PE	300mm Clay	10-20years	46.52	54.56	8.04	> 5m	257	200 - 400	72.0	60m - 80m
80	AMA118	MPAJ	A5	46.66	A4	46.38	4	5,000PE - 10,000PE	300mm Clay	10-20years	46.52	54.56	8.04	> 5m	257	200 - 400	72.0	60m - 80m
81	AMA118	MPAJ	B3/1	46.82	A3	46.20	3	10,000PE - 20,000PE	450mm Concrete	> 20years	46.51	51.66	5.15	> 5m	52	< 200	32.0	20m - 40m
82	AMA118	MPAJ	B3/1	46.82	B3	46.06	2	10,000PE - 20,000PE	450mm Concrete	10-20years	46.44	51.82	5.38	> 5m	39	< 200	30.0	20m - 40m
83	AMA118	MPAJ	B3	46.06	B2	45.98	1	10,000PE - 20,000PE	450mm Concrete	10-20years	46.02	51.82	5.80	> 5m	375	200 - 400	30.0	20m - 40m
84	AMA118	MPAJ	B3	46.06	B2	45.98	2	10,000PE - 20,000PE	450mm Concrete	10-20years	46.02	51.82	5.80	> 5m	375	200 - 400	30.0	20m - 40m
85	AMA118	MPAJ	B3	46.06	B2	45.98	3	10,000PE - 20,000PE	450mm Concrete	10-20years	46.02	51.82	5.80	> 5m	375	200 - 400	30.0	20m - 40m
86	AMA118	MPAJ	B2	45.98	B1	45.90	1	10,000PE - 20,000PE	450mm Concrete	10-20years	45.94	51.97	6.03	> 5m	225	200 - 400	18.0	< 20m
87	AMA118	MPAJ	B2	45.98	B1	45.90	3	10,000PE - 20,000PE	450mm Concrete	10-20years	45.94	51.97	6.03	> 5m	225	200 - 400	18.0	< 20m
88	AMA118	MPAJ	B2	45.98	B1	45.90	4	10,000PE - 20,000PE	450mm Concrete	10-20years	45.94	51.97	6.03	> 5m	225	200 - 400	18.0	< 20m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
89	AMA118	MPAJ	B2	45.98	B1a	45.90	5	10,000PE - 20,000PE	450mm Concrete	10-20years	45.94	51.97	6.03	> 5m	188	< 200	15.0	< 20m
90	AMA118	MPAJ	B1	45.90	A1	45.87	1	10,000PE - 20,000PE	450mm Concrete	10-20years	45.89	52.12	6.24	> 5m	900	> 600	27.0	20m - 40m
91	AMA118	MPAJ	B1	45.90	A1	45.87	2	10,000PE - 20,000PE	450mm Concrete	10-20years	45.89	52.12	6.24	> 5m	900	> 600	27.0	20m - 40m
92	AMA118	MPAJ	B1	45.90	A1	45.87	3	10,000PE - 20,000PE	450mm Concrete	10-20years	45.89	52.12	6.24	> 5m	900	> 600	27.0	20m - 40m
93	AMA118	MPAJ	B1	45.90	A1	45.87	4	10,000PE - 20,000PE	450mm Concrete	10-20years	45.89	52.12	6.24	> 5m	900	> 600	27.0	20m - 40m
94	AMA118	MPAJ	A16/1	50.00	A16	48.24	1	< 5,000PE	225mm Clay	10-20years	49.12	55.87	6.75	> 5m	20	< 200	35.0	20m - 40m
95	AMA118	MPAJ	A16/1	50.00	A16	48.24	2	< 5,000PE	225mm Clay	10-20years	49.12	55.87	6.75	> 5m	20	< 200	35.0	20m - 40m
96	AMA118	MPAJ	A16/2	50.18	A16/1	50.00	2	< 5,000PE	225mm Clay	10-20years	50.09	51.96	1.87	< 3m	194	< 200	35.0	20m - 40m
97	AMA118	MPAJ	A17	48.52	A16	48.24	1	< 5,000PE	300mm Clay	10-20years	48.38	59.74	11.36	> 5m	200	200 - 400	56.0	40m - 60m
98	AMA118	MPAJ	A17	48.52	A16	48.24	2	< 5,000PE	300mm Clay	10-20years	48.38	59.74	11.36	> 5m	200	200 - 400	56.0	40m - 60m
99	AMA118	MPAJ	A17	48.52	A16	48.24	3	< 5,000PE	300mm Clay	10-20years	48.38	59.74	11.36	> 5m	200	200 - 400	56.0	40m - 60m
100	AMA118	MPAJ	G3/1	51.16	G3	48.15	1	< 5,000PE	225mm Clay	10-20years	49.66	51.21	1.56	< 3m	4	< 200	13.0	< 20m
101	AMA118	MPAJ	G3/1	51.16	G3	48.15	2	< 5,000PE	225mm Clay	10-20years	49.66	51.21	1.56	< 3m	4	< 200	13.0	< 20m
102	AMA118	MPAJ	G3	48.15	G4	47.06	2	< 5,000PE	300mm Clay	10-20years	47.61	50.90	3.29	3m - 5m	59	< 200	64.0	60m - 80m
103	AMA118	MPAJ	G3	48.15	G4	47.06	3	< 5,000PE	300mm Clay	10-20years	47.61	50.90	3.29	3m - 5m	59	< 200	64.0	60m - 80m
104	AMA120	MPAJ	A23/6	46.32	A23/5	46.10	1	< 5,000PE	300mm Clay	10-20years	46.21	49.75	3.54	3m - 5m	209	200 - 400	46.0	40m - 60m
105	AMA120	MPAJ	A23/6	46.32	A23/5	46.10	4	< 5,000PE	300mm Clay	10-20years	46.21	49.75	3.54	3m - 5m	209	200 - 400	46.0	40m - 60m
106	AMA120	MPAJ	A23/5	46.10	A23/4	45.84	1	< 5,000PE	300mm Clay	10-20years	45.97	48.76	2.79	< 3m	177	< 200	46.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
107	AMA120	MPAJ	A23/5	46.10	A23/4	45.84	2	< 5,000PE	300mm Clay	10-20years	45.97	48.76	2.79	< 3m	177	< 200	46.0	40m - 60m
108	AMA120	MPAJ	A23/5	46.10	A23/4	45.84	3	< 5,000PE	300mm Clay	10-20years	45.97	48.76	2.79	< 3m	177	< 200	46.0	40m - 60m
109	AMA120	MPAJ	A23/4	45.84	A23/3	45.64	1	< 5,000PE	300mm Clay	10-20years	45.74	48.76	3.02	3m - 5m	230	200 - 400	46.0	40m - 60m
110	AMA120	MPAJ	A23/4	45.84	A23/3	45.64	2	< 5,000PE	300mm Clay	10-20years	45.74	48.76	3.02	3m - 5m	230	200 - 400	46.0	40m - 60m
111	AMA120	MPAJ	A23/4	45.84	A23/3	45.64	3	< 5,000PE	300mm Clay	10-20years	45.74	48.76	3.02	3m - 5m	230	200 - 400	46.0	40m - 60m
112	AMA120	MPAJ	A23/4	45.84	A23/3	45.64	4	< 5,000PE	300mm Clay	10-20years	45.74	48.76	3.02	3m - 5m	230	200 - 400	46.0	40m - 60m
113	AMA120	MPAJ	A23/1	45.18	A23	43.25	2	< 5,000PE	300mm Clay	10-20years	44.22	49.68	5.47	> 5m	9	< 200	18.0	< 20m
114	AMA120	MPAJ	A23/1	45.18	A23	43.25	3	< 5,000PE	300mm Clay	10-20years	44.22	49.68	5.47	> 5m	9	< 200	18.0	< 20m
115	AMA120	MPAJ	H1	45.84	A24	43.38	1	< 5,000PE	225mm Clay	10-20years	44.61	49.68	5.07	> 5m	9	< 200	21.0	20m - 40m
116	AMA120	MPAJ	H1	45.84	A24	43.38	3	< 5,000PE	225mm Clay	10-20years	44.61	49.68	5.07	> 5m	9	< 200	21.0	20m - 40m
117	AMA120	MPAJ	A24	43.38	A23	43.25	1	5,000PE - 10,000PE	450mm Concrete	10-20years	43.32	50.59	7.28	> 5m	446	400 - 600	58.0	40m - 60m
118	AMA120	MPAJ	A21	42.96	A20	42.82	1	10,000PE - 20,000PE	450mm Concrete	10-20years	42.89	48.61	5.72	> 5m	400	400 - 600	56.0	40m - 60m
119	AMA120	MPAJ	A21	42.96	A20	42.82	2	10,000PE - 20,000PE	450mm Concrete	10-20years	42.89	48.61	5.72	> 5m	400	400 - 600	56.0	40m - 60m
120	AMA120	MPAJ	A21	42.96	A20	42.82	3	10,000PE - 20,000PE	450mm Concrete	10-20years	42.89	48.61	5.72	> 5m	400	400 - 600	56.0	40m - 60m
121	AMA120	MPAJ	A21	42.96	A20	42.82	4	10,000PE - 20,000PE	450mm Concrete	10-20years	42.89	48.61	5.72	> 5m	400	400 - 600	56.0	40m - 60m
122	AMA120	MPAJ	R1	51.34	K3	50.76	1	< 5,000PE	300mm Clay	10-20years	51.05	53.64	2.59	< 3m	84	< 200	49.0	40m - 60m
123	AMA120	MPAJ	R1	51.34	K3	50.76	2	< 5,000PE	300mm Clay	10-20years	51.05	53.64	2.59	< 3m	84	< 200	49.0	40m - 60m
124	AMA120	MPAJ	R1	51.34	K3	50.76	3	< 5,000PE	300mm Clay	10-20years	51.05	53.64	2.59	< 3m	84	< 200	49.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
125	AMA120	MPAJ	K3	50.76	K2	50.42	1	< 5,000PE	300mm Clay	10-20years	50.59	53.64	3.05	3m - 5m	197	< 200	67.0	60m - 80m
126	AMA120	MPAJ	K3	50.76	K2	50.42	2	< 5,000PE	300mm Clay	10-20years	50.59	53.64	3.05	3m - 5m	197	< 200	67.0	60m - 80m
127	AMA120	MPAJ	K3	50.76	K2	50.42	3	< 5,000PE	300mm Clay	10-20years	50.59	53.64	3.05	3m - 5m	197	< 200	67.0	60m - 80m
128	AMA120	MPAJ	K3	50.76	K2	50.42	5	< 5,000PE	300mm Clay	10-20years	50.59	53.64	3.05	3m - 5m	197	< 200	67.0	60m - 80m
129	AMA120	MPAJ	K2	50.42	K1	50.09	1	< 5,000PE	300mm Clay	10-20years	50.26	52.73	2.47	< 3m	203	200 - 400	67.0	60m - 80m
130	AMA120	MPAJ	K2	50.42	K1	50.09	2	< 5,000PE	300mm Clay	10-20years	50.26	52.73	2.47	< 3m	203	200 - 400	67.0	60m - 80m
131	AMA120	MPAJ	K2	50.42	K1	50.09	4	< 5,000PE	300mm Clay	10-20years	50.26	52.73	2.47	< 3m	203	200 - 400	67.0	60m - 80m
132	AMA120	MPAJ	K1	50.09	A30	50.03	1	< 5,000PE	300mm Clay	10-20years	50.06	52.58	2.52	< 3m	200	200 - 400	12.0	< 20m
133	AMA120	MPAJ	K1	50.09	A30	50.03	3	< 5,000PE	300mm Clay	10-20years	50.06	52.58	2.52	< 3m	200	200 - 400	12.0	< 20m
134	AMA120	MPAJ	K1	50.09	A30	50.03	4	< 5,000PE	300mm Clay	10-20years	50.06	52.58	2.52	< 3m	200	200 - 400	12.0	< 20m
135	AMA120	MPAJ	A32	50.71	A31	50.41	1	< 5,000PE	225mm Clay	10-20years	50.56	53.34	2.78	< 3m	187	< 200	56.0	40m - 60m
136	AMA120	MPAJ	A32	50.71	A31	50.41	2	< 5,000PE	225mm Clay	10-20years	50.56	53.34	2.78	< 3m	187	< 200	56.0	40m - 60m
137	AMA120	MPAJ	A32	50.71	A31	50.41	3	< 5,000PE	225mm Clay	10-20years	50.56	53.34	2.78	< 3m	187	< 200	56.0	40m - 60m
138	AMA120	MPAJ	A32	50.71	A31	50.41	4	< 5,000PE	225mm Clay	10-20years	50.56	53.34	2.78	< 3m	187	< 200	56.0	40m - 60m
139	AMA120	MPAJ	A31	50.41	A30	50.03	1	< 5,000PE	225mm Clay	10-20years	50.22	53.34	3.12	3m - 5m	147	< 200	56.0	40m - 60m
140	AMA120	MPAJ	A31	50.41	A30	50.03	2	< 5,000PE	225mm Clay	10-20years	50.22	53.34	3.12	3m - 5m	147	< 200	56.0	40m - 60m
141	AMA120	MPAJ	A31	50.41	A30	50.03	3	< 5,000PE	225mm Clay	10-20years	50.22	53.34	3.12	3m - 5m	147	< 200	56.0	40m - 60m
142	AMA120	MPAJ	A31	50.41	A30	50.03	4	< 5,000PE	225mm Clay	10-20years	50.22	53.34	3.12	3m - 5m	147	< 200	56.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
143	AMA120	MPAJ	A30	50.03	A29/1	49.71	1	5,000PE - 10,000PE	300mm Clay	10-20years	49.87	53.26	3.39	3m - 5m	125	< 200	40.0	20m - 40m
144	AMA120	MPAJ	A30	50.03	A29/1	49.71	2	5,000PE - 10,000PE	300mm Clay	10-20years	49.87	53.26	3.39	3m - 5m	125	< 200	40.0	20m - 40m
145	AMA120	MPAJ	A30	50.03	A29/1	49.71	3	5,000PE - 10,000PE	300mm Clay	10-20years	49.87	53.26	3.39	3m - 5m	125	< 200	40.0	20m - 40m
146	AMA120	MPAJ	A29	49.54	A28	49.06	1	5,000PE - 10,000PE	300mm Clay	10-20years	49.30	53.11	3.81	3m - 5m	146	< 200	70.0	60m - 80m
147	AMA120	MPAJ	A29	49.54	A28	49.06	2	5,000PE - 10,000PE	300mm Clay	10-20years	49.30	53.11	3.81	3m - 5m	146	< 200	70.0	60m - 80m
148	AMA120	MPAJ	A29	49.54	A28	49.06	4	5,000PE - 10,000PE	300mm Clay	10-20years	49.30	53.11	3.81	3m - 5m	146	< 200	70.0	60m - 80m
149	AMA120	MPAJ	A29	49.54	A28	49.06	5	5,000PE - 10,000PE	300mm Clay	10-20years	49.30	53.11	3.81	3m - 5m	146	< 200	70.0	60m - 80m
150	AMA120	MPAJ	A28	49.06	A27	48.57	1	5,000PE - 10,000PE	300mm Clay	10-20years	48.82	52.73	3.92	3m - 5m	108	< 200	53.0	40m - 60m
151	AMA120	MPAJ	A28	49.06	A27	48.57	2	5,000PE - 10,000PE	300mm Clay	10-20years	48.82	52.73	3.92	3m - 5m	108	< 200	53.0	40m - 60m
152	AMA120	MPAJ	A28	49.06	A27	48.57	3	5,000PE - 10,000PE	300mm Clay	10-20years	48.82	52.73	3.92	3m - 5m	108	< 200	53.0	40m - 60m
153	AMA120	MPAJ	A34	54.45	A33	51.17	1	< 5,000PE	225mm Clay	10-20years	52.81	55.01	2.20	< 3m	14	< 200	45.0	40m - 60m
154	AMA120	MPAJ	A34	54.45	A33	51.17	2	< 5,000PE	225mm Clay	10-20years	52.81	55.01	2.20	< 3m	14	< 200	45.0	40m - 60m
155	AMA120	MPAJ	A34	54.45	A33	51.17	3	< 5,000PE	225mm Clay	10-20years	52.81	55.01	2.20	< 3m	14	< 200	45.0	40m - 60m
156	AMA120	MPAJ	A34	54.45	A33	51.17	5	< 5,000PE	225mm Clay	10-20years	52.81	55.01	2.20	< 3m	14	< 200	45.0	40m - 60m
157	AMA120	MPAJ	A35	56.43	A34	54.45	2	< 5,000PE	225mm Clay	10-20years	55.44	57.45	2.01	< 3m	23	< 200	45.0	40m - 60m
158	AMA120	MPAJ	A35	56.43	A34	54.45	4	< 5,000PE	225mm Clay	10-20years	55.44	57.45	2.01	< 3m	23	< 200	45.0	40m - 60m
159	AMA120	MPAJ	A35	56.43	A34	54.45	5	< 5,000PE	225mm Clay	10-20years	55.44	57.45	2.01	< 3m	23	< 200	45.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
160	AMA120	MPAJ	G5	45.72	G4	45.47	1	< 5,000PE	225mm Clay	10-20years	45.60	47.85	2.26	< 3m	196	< 200	49.0	40m - 60m
161	AMA120	MPAJ	G5	45.72	G4	45.47	2	< 5,000PE	225mm Clay	10-20years	45.60	47.85	2.26	< 3m	196	< 200	49.0	40m - 60m
162	AMA120	MPAJ	G4	45.47	G3	45.09	1	< 5,000PE	225mm Clay	10-20years	45.28	47.90	2.62	< 3m	200	200 - 400	76.0	60m - 80m
163	AMA120	MPAJ	G4	45.47	G3	45.09	2	< 5,000PE	225mm Clay	10-20years	45.28	47.90	2.62	< 3m	200	200 - 400	76.0	60m - 80m
164	AMA120	MPAJ	G4	45.47	G3	45.09	4	< 5,000PE	225mm Clay	10-20years	45.28	47.90	2.62	< 3m	200	200 - 400	76.0	60m - 80m
165	AMA120	MPAJ	G3	45.09	G2	44.71	1	< 5,000PE	225mm Clay	10-20years	44.90	47.97	3.07	3m - 5m	200	200 - 400	76.0	60m - 80m
166	AMA120	MPAJ	G3	45.09	G2	44.71	2	< 5,000PE	225mm Clay	10-20years	44.90	47.97	3.07	3m - 5m	200	200 - 400	76.0	60m - 80m
167	AMA120	MPAJ	G3	45.09	G2	44.71	3	< 5,000PE	225mm Clay	10-20years	44.90	47.97	3.07	3m - 5m	200	200 - 400	76.0	60m - 80m
168	AMA120	MPAJ	G2	44.71	G1	44.33	1	< 5,000PE	225mm Clay	10-20years	44.52	48.05	3.53	3m - 5m	158	< 200	60.0	40m - 60m
169	AMA120	MPAJ	G2	44.71	G1	44.33	2	< 5,000PE	225mm Clay	10-20years	44.52	48.05	3.53	3m - 5m	158	< 200	60.0	40m - 60m
170	AMA120	MPAJ	G2	44.71	G1	44.33	3	< 5,000PE	225mm Clay	10-20years	44.52	48.05	3.53	3m - 5m	158	< 200	60.0	40m - 60m
171	AMA120	MPAJ	G1	44.33	A20	42.82	1	< 5,000PE	225mm Clay	10-20years	43.58	48.12	4.54	3m - 5m	12	< 200	18.0	< 20m
172	AMA120	MPAJ	G1	44.33	A20	42.82	2	< 5,000PE	225mm Clay	10-20years	43.58	48.12	4.54	3m - 5m	12	< 200	18.0	< 20m
173	AMA120	MPAJ	G1	44.33	A20	42.82	3	< 5,000PE	225mm Clay	10-20years	43.58	48.12	4.54	3m - 5m	12	< 200	18.0	< 20m
174	AMA120	MPAJ	A21	42.96	A20	42.82	1	< 5,000PE	225mm Clay	10-20years	42.89	48.31	5.42	> 5m	400	400 - 600	56.0	40m - 60m
175	AMA120	MPAJ	A21	42.96	A20	42.82	2	< 5,000PE	225mm Clay	10-20years	42.89	48.31	5.42	> 5m	400	400 - 600	56.0	40m - 60m
176	AMA120	MPAJ	A21	42.96	A20	42.82	3	< 5,000PE	225mm Clay	10-20years	42.89	48.31	5.42	> 5m	400	400 - 600	56.0	40m - 60m
177	AMA120	MPAJ	A12	41.63	A11	41.45	1	10,000PE - 20,000PE	500mm Concrete	10-20years	41.54	47.24	5.70	> 5m	417	400 - 600	75.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
178	AMA120	MPAJ	A12	41.63	A11	41.45	2	10,000PE - 20,000PE	500mm Concrete	10-20years	41.54	47.24	5.70	> 5m	417	400 - 600	75.0	60m - 80m
179	AMA120	MPAJ	A11	41.45	A10a	41.37	1	10,000PE - 20,000PE	500mm Concrete	10-20years	41.41	47.24	5.83	> 5m	425	400 - 600	34.0	20m - 40m
180	AMA120	MPAJ	A11	41.45	A10a	41.37	2	10,000PE - 20,000PE	500mm Concrete	10-20years	41.41	47.24	5.83	> 5m	425	400 - 600	34.0	20m - 40m
181	AMA120	MPAJ	A11	41.45	A10a	41.37	4	10,000PE - 20,000PE	500mm Concrete	10-20years	41.41	47.24	5.83	> 5m	425	400 - 600	34.0	20m - 40m
182	AMA120	MPAJ	D1	43.43	A10	41.28	1	5,000PE - 10,000PE	375mm Clay	10-20years	42.36	47.32	4.97	3m - 5m	26	< 200	55.0	40m - 60m
183	AMA120	MPAJ	D1	43.43	A10	41.28	2	5,000PE - 10,000PE	375mm Clay	10-20years	42.36	47.32	4.97	3m - 5m	26	< 200	55.0	40m - 60m
184	AMA120	MPAJ	D1	43.43	A10	41.28	3	5,000PE - 10,000PE	375mm Clay	10-20years	42.36	47.32	4.97	3m - 5m	26	< 200	55.0	40m - 60m
185	AMA120	MPAJ	D1	43.43	A10	41.28	4	5,000PE - 10,000PE	375mm Clay	10-20years	42.36	47.32	4.97	3m - 5m	26	< 200	55.0	40m - 60m
186	AMA120	MPAJ	A10a	41.37	A10	41.28	2	> 20,000PE	500mm Concrete	10-20years	41.33	47.24	5.92	> 5m	378	200 - 400	34.0	20m - 40m
187	AMA120	MPAJ	A10a	41.37	A10	41.28	3	> 20,000PE	500mm Concrete	10-20years	41.33	47.24	5.92	> 5m	378	200 - 400	34.0	20m - 40m
188	AMA120	MPAJ	A10	41.28	A9	41.14	1	> 20,000PE	500mm Concrete	10-20years	41.21	47.24	6.03	> 5m	393	200 - 400	55.0	40m - 60m
189	AMA120	MPAJ	A10	41.28	A9	41.14	2	> 20,000PE	500mm Concrete	10-20years	41.21	47.24	6.03	> 5m	393	200 - 400	55.0	40m - 60m
190	AMA120	MPAJ	A10	41.28	A9	41.14	4	> 20,000PE	500mm Concrete	10-20years	41.21	47.24	6.03	> 5m	393	200 - 400	55.0	40m - 60m
191	AMA120	MPAJ	A10	41.28	A9	41.14	5	> 20,000PE	500mm Concrete	10-20years	41.21	47.24	6.03	> 5m	393	200 - 400	55.0	40m - 60m
192	AMA120	MPAJ	A9	41.14	A8	40.99	2	> 20,000PE	500mm Concrete	10-20years	41.07	47.24	6.18	> 5m	407	400 - 600	61.0	60m - 80m
193	AMA120	MPAJ	A9	41.14	A8	40.99	3	> 20,000PE	500mm Concrete	10-20years	41.07	47.24	6.18	> 5m	407	400 - 600	61.0	60m - 80m
194	AMA120	MPAJ	A9	41.14	A8	40.99	4	> 20,000PE	500mm Concrete	10-20years	41.07	47.24	6.18	> 5m	407	400 - 600	61.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
195	AMA120	MPAJ	A8	40.99	A7	40.84	1	> 20,000PE	500mm Concrete	10-20years	40.92	47.17	6.26	> 5m	407	400 - 600	61.0	60m - 80m
196	AMA120	MPAJ	A8	40.99	A7	40.84	2	> 20,000PE	500mm Concrete	10-20years	40.92	47.17	6.26	> 5m	407	400 - 600	61.0	60m - 80m
197	AMA120	MPAJ	A8	40.99	A7	40.84	3	> 20,000PE	500mm Concrete	10-20years	40.92	47.17	6.26	> 5m	407	400 - 600	61.0	60m - 80m
198	AMA120	MPAJ	A8	40.99	A7	40.84	4	> 20,000PE	500mm Concrete	10-20years	40.92	47.17	6.26	> 5m	407	400 - 600	61.0	60m - 80m
199	AMA120	MPAJ	A15	42.11	A14	41.99	2	10,000PE - 20,000PE	500mm Concrete	10-20years	42.05	47.54	5.49	> 5m	408	400 - 600	49.0	40m - 60m
200	AMA120	MPAJ	A14	41.99	A13	41.81	1	10,000PE - 20,000PE	500mm Concrete	10-20years	41.90	47.47	5.57	> 5m	389	200 - 400	70.0	60m - 80m
201	AMA120	MPAJ	A14	41.99	A13	41.81	2	10,000PE - 20,000PE	500mm Concrete	10-20years	41.90	47.47	5.57	> 5m	389	200 - 400	70.0	60m - 80m
202	AMA120	MPAJ	A14	41.99	A13	41.81	3	10,000PE - 20,000PE	500mm Concrete	10-20years	41.90	47.47	5.57	> 5m	389	200 - 400	70.0	60m - 80m
203	AMA120	MPAJ	A13	41.81	A12	41.63	1	10,000PE - 20,000PE	500mm Concrete	10-20years	41.72	47.32	5.60	> 5m	406	400 - 600	73.0	60m - 80m
204	AMA120	MPAJ	A13	41.81	A12	41.63	2	10,000PE - 20,000PE	500mm Concrete	10-20years	41.72	47.32	5.60	> 5m	406	400 - 600	73.0	60m - 80m
205	AMA120	MPAJ	A13	41.81	A12	41.63	3	10,000PE - 20,000PE	500mm Concrete	10-20years	41.72	47.32	5.60	> 5m	406	400 - 600	73.0	60m - 80m
206	AMA120	MPAJ	A16	42.26	A15	42.11	2	10,000PE - 20,000PE	450mm Concrete	10-20years	42.19	47.54	5.36	> 5m	407	400 - 600	61.0	60m - 80m
207	AMA120	MPAJ	A16	42.26	A15	42.11	3	10,000PE - 20,000PE	450mm Concrete	10-20years	42.19	47.54	5.36	> 5m	407	400 - 600	61.0	60m - 80m
208	AMA120	MPAJ	A19	42.69	A18	42.53	2	10,000PE - 20,000PE	450mm Concrete	10-20years	42.61	47.85	5.24	> 5m	406	400 - 600	65.0	60m - 80m
209	AMA120	MPAJ	B7	43.34	B6	43.07	2	< 5,000PE	225mm Clay	10-20years	43.21	46.10	2.90	< 3m	204	200 - 400	55.0	40m - 60m
210	AMA120	MPAJ	B7	43.34	B6	43.07	3	< 5,000PE	225mm Clay	10-20years	43.21	46.10	2.90	< 3m	204	200 - 400	55.0	40m - 60m
211	AMA120	MPAJ	B7	43.34	B6	43.07	4	< 5,000PE	225mm Clay	10-20years	43.21	46.10	2.90	< 3m	204	200 - 400	55.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
212	AMA120	MPAJ	B6	43.07	B5	42.79	2	< 5,000PE	225mm Clay	10-20years	42.93	46.25	3.32	3m - 5m	196	< 200	55.0	40m - 60m
213	AMA120	MPAJ	B5	42.79	B4	42.64	1	< 5,000PE	225mm Clay	10-20years	42.72	46.33	3.61	3m - 5m	200	200 - 400	30.0	20m - 40m
214	AMA120	MPAJ	B5	42.79	B4	42.64	2	< 5,000PE	225mm Clay	10-20years	42.72	46.33	3.61	3m - 5m	200	200 - 400	30.0	20m - 40m
215	AMA120	MPAJ	B5	42.79	B4	42.64	3	< 5,000PE	225mm Clay	10-20years	42.72	46.33	3.61	3m - 5m	200	200 - 400	30.0	20m - 40m
216	AMA120	MPAJ	B5	42.79	B4	42.64	4	< 5,000PE	225mm Clay	10-20years	42.72	46.33	3.61	3m - 5m	200	200 - 400	30.0	20m - 40m
217	AMA120	MPAJ	B4	42.64	B3	42.43	1	< 5,000PE	225mm Clay	10-20years	42.54	46.63	4.10	3m - 5m	205	200 - 400	43.0	40m - 60m
218	AMA120	MPAJ	B4	42.64	B3	42.43	2	< 5,000PE	225mm Clay	10-20years	42.54	46.63	4.10	3m - 5m	205	200 - 400	43.0	40m - 60m
219	AMA120	MPAJ	B4	42.64	B3	42.43	3	< 5,000PE	225mm Clay	10-20years	42.54	46.63	4.10	3m - 5m	205	200 - 400	43.0	40m - 60m
220	AMA120	MPAJ	B4	42.64	B3	42.43	4	< 5,000PE	225mm Clay	10-20years	42.54	46.63	4.10	3m - 5m	205	200 - 400	43.0	40m - 60m
221	AMA120	MPAJ	B3/1	44.35	B3	42.43	1	< 5,000PE	225mm Clay	10-20years	43.39	46.33	2.94	< 3m	24	< 200	46.0	40m - 60m
222	AMA120	MPAJ	B3/1	44.35	B3	42.43	2	< 5,000PE	225mm Clay	10-20years	43.39	46.33	2.94	< 3m	24	< 200	46.0	40m - 60m
223	AMA120	MPAJ	B3	42.43	B2	40.07	2	< 5,000PE	225mm Clay	10-20years	41.25	46.63	5.38	> 5m	22	< 200	53.0	40m - 60m
224	AMA120	MPAJ	B3	42.43	B2	40.07	4	< 5,000PE	225mm Clay	10-20years	41.25	46.63	5.38	> 5m	22	< 200	53.0	40m - 60m
225	AMA120	MPAJ	A7	40.84	A6/2	40.69	2	> 20,000PE	500mm Concrete	10-20years	40.77	47.01	6.25	> 5m	407	400 - 600	61.0	60m - 80m
226	AMA120	MPAJ	A7	40.84	A6/2	40.69	3	> 20,000PE	500mm Concrete	10-20years	40.77	47.01	6.25	> 5m	407	400 - 600	61.0	60m - 80m
227	AMA120	MPAJ	A6	40.69	A5	40.56	2	> 20,000PE	500mm Concrete	10-20years	40.63	47.24	6.62	> 5m	469	400 - 600	61.0	60m - 80m
228	AMA120	MPAJ	A6	40.69	A5	40.56	3	> 20,000PE	500mm Concrete	10-20years	40.63	47.24	6.62	> 5m	469	400 - 600	61.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
229	AMA120	MPAJ	A5	40.56	A4	40.39	2	> 20,000PE	500mm Concrete	10-20years	40.48	47.24	6.77	> 5m	341	200 - 400	58.0	40m - 60m
230	AMA120	MPAJ	A4	40.39	A3	40.24	2	> 20,000PE	500mm Concrete	10-20years	40.32	46.78	6.47	> 5m	387	200 - 400	58.0	40m - 60m
231	AMA120	MPAJ	A4	40.39	A3	40.24	3	> 20,000PE	500mm Concrete	10-20years	40.32	46.78	6.47	> 5m	387	200 - 400	58.0	40m - 60m
232	AMA120	MPAJ	E1	43.04	A2	40.10	1	5,000PE - 10,000PE	375mm Clay	10-20years	41.57	46.63	5.06	> 5m	12	< 200	35.0	20m - 40m
233	AMA120	MPAJ	B1	41.89	A1	40.07	1	< 5,000PE	225mm Clay	10-20years	40.98	46.63	5.65	> 5m	29	< 200	53.0	40m - 60m
234	AMA120	MPAJ	B1	41.89	A1	40.07	2	< 5,000PE	225mm Clay	10-20years	40.98	46.63	5.65	> 5m	29	< 200	53.0	40m - 60m
235	AMA120	MPAJ	B1	41.89	A1	40.07	4	< 5,000PE	225mm Clay	10-20years	40.98	46.63	5.65	> 5m	29	< 200	53.0	40m - 60m
236	AMA120	MPAJ	A3	40.24	A2	40.10	1	> 20,000PE	500mm Concrete	10-20years	40.17	46.63	6.46	> 5m	414	400 - 600	58.0	40m - 60m
237	AMA120	MPAJ	A3	40.24	A2	40.10	2	> 20,000PE	500mm Concrete	10-20years	40.17	46.63	6.46	> 5m	414	400 - 600	58.0	40m - 60m
238	AMA120	MPAJ	A3	40.24	A2	40.10	3	> 20,000PE	500mm Concrete	10-20years	40.17	46.63	6.46	> 5m	414	400 - 600	58.0	40m - 60m
239	AMA120	MPAJ	B2	40.07	B1	40.06	1	< 5,000PE	225mm Clay	10-20years	40.07	46.63	6.57	> 5m	5300	> 600	53.0	40m - 60m
240	AMA120	MPAJ	B2	40.07	B1	40.06	2	< 5,000PE	225mm Clay	10-20years	40.07	46.63	6.57	> 5m	5300	> 600	53.0	40m - 60m
241	AMA120	MPAJ	B2	40.07	B1	40.06	3	< 5,000PE	225mm Clay	10-20years	40.07	46.63	6.57	> 5m	5300	> 600	53.0	40m - 60m
242	AMA120	MPAJ	B2	40.07	B1a	40.06	4	< 5,000PE	225mm Clay	10-20years	40.07	46.63	6.57	> 5m	200	200 - 400	2.0	< 20m
243	GBK188	MPS	4	55.60	5	55.21	1	< 5,000PE	225mm Clay	5-10years	55.41	57.77	2.37	< 3m	203	200 - 400	79.0	60m - 80m
244	GBK188	MPS	4	55.60	5	55.21	2	< 5,000PE	225mm Clay	5-10years	55.41	57.77	2.37	< 3m	203	200 - 400	79.0	60m - 80m
245	AMA120	MPAJ	A20	42.82	A19	42.69	2	10,000PE - 20,000PE	450mm Concrete	10-20years	42.76	48.15	5.40	> 5m	262	200 - 400	34.0	20m - 40m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
246	AMA120	MPAJ	A20	42.82	A19	42.69	3	10,000PE - 20,000PE	450mm Concrete	10-20years	42.76	48.15	5.40	> 5m	262	200 - 400	34.0	20m - 40m
247	AMA120	MPAJ	E6	44.25	E5	43.96	1	< 5,000PE	225mm Clay	10-20years	44.11	46.78	2.68	< 3m	200	200 - 400	58.0	40m - 60m
248	AMA120	MPAJ	E6	44.25	E5	43.96	2	< 5,000PE	225mm Clay	10-20years	44.11	46.78	2.68	< 3m	200	200 - 400	58.0	40m - 60m
249	AMA120	MPAJ	E5	43.96	E1	43.04	1	< 5,000PE	225mm Clay	10-20years	43.50	46.68	3.18	3m - 5m	63	< 200	58.0	40m - 60m
250	AMA120	MPAJ	E5	43.96	E1	43.04	2	< 5,000PE	225mm Clay	10-20years	43.50	46.68	3.18	3m - 5m	63	< 200	58.0	40m - 60m
251	AMA120	MPAJ	E5	43.96	E1	43.04	5	< 5,000PE	225mm Clay	10-20years	43.50	46.68	3.18	3m - 5m	63	< 200	58.0	40m - 60m
252	AMA120	MPAJ	E7	44.43	E6	44.25	2	< 5,000PE	225mm Clay	10-20years	44.34	46.93	2.59	< 3m	206	200 - 400	37.0	20m - 40m
253	AMA120	MPAJ	E4	43.33	E3	43.28	2	5,000PE - 10,000PE	300mm Clay	10-20years	43.31	46.63	3.33	3m - 5m	480	400 - 600	24.0	20m - 40m
254	AMA120	MPAJ	E3	43.33	E4	43.28	3	5,000PE - 10,000PE	300mm Clay	10-20years	43.31	46.63	3.33	3m - 5m	480	400 - 600	24.0	20m - 40m
255	AMA120	MPAJ	E3	43.33	E2	43.16	3	5,000PE - 10,000PE	300mm Clay	10-20years	43.25	46.63	3.39	3m - 5m	200	200 - 400	34.0	20m - 40m
256	AMA120	MPAJ	D7	45.09	D6	44.80	2	< 5,000PE	225mm Clay	10-20years	44.95	47.54	2.60	< 3m	200	200 - 400	58.0	40m - 60m
257	AMA120	MPAJ	D7	45.09	D6	44.80	3	< 5,000PE	225mm Clay	10-20years	44.95	47.54	2.60	< 3m	200	200 - 400	58.0	40m - 60m
258	AMA120	MPAJ	D4/2	44.44	D4	44.24	1	< 5,000PE	225mm Clay	10-20years	44.34	47.39	3.05	3m - 5m	150	< 200	30.0	20m - 40m
259	AMA120	MPAJ	D4/2	44.44	D4	44.24	3	< 5,000PE	225mm Clay	10-20years	44.34	47.39	3.05	3m - 5m	150	< 200	30.0	20m - 40m
260	AMA120	MPAJ	D4/2	44.44	D4	44.24	5	< 5,000PE	225mm Clay	10-20years	44.34	47.39	3.05	3m - 5m	150	< 200	30.0	20m - 40m
261	AMA120	MPAJ	D4/2	44.44	D5	42.71	2	< 5,000PE	225mm Clay	10-20years	43.58	47.47	3.90	3m - 5m	17	< 200	30.0	20m - 40m
262	AMA120	MPAJ	D4/2	44.44	D5	42.71	3	< 5,000PE	225mm Clay	10-20years	43.58	47.47	3.90	3m - 5m	17	< 200	30.0	20m - 40m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
263	AMA120	MPAJ	D6	44.80	D5	42.71	1	< 5,000PE	225mm Clay	10-20years	43.76	47.47	3.72	3m - 5m	25	< 200	52.0	40m - 60m
264	AMA120	MPAJ	D6	44.80	D5	42.71	2	< 5,000PE	225mm Clay	10-20years	43.76	47.47	3.72	3m - 5m	25	< 200	52.0	40m - 60m
265	AMA120	MPAJ	D6	44.80	D5	42.71	3	< 5,000PE	225mm Clay	10-20years	43.76	47.47	3.72	3m - 5m	25	< 200	52.0	40m - 60m
266	AMA120	MPAJ	D6	44.80	D5	42.71	4	< 5,000PE	225mm Clay	10-20years	43.76	47.47	3.72	3m - 5m	25	< 200	52.0	40m - 60m
267	AMA120	MPAJ	D4	44.24	D3	43.98	2	5,000PE - 10,000PE	300mm Clay	10-20years	44.11	47.24	3.13	3m - 5m	188	< 200	49.0	40m - 60m
268	AMA120	MPAJ	D4	44.24	D3	43.98	3	5,000PE - 10,000PE	300mm Clay	10-20years	44.11	47.24	3.13	3m - 5m	188	< 200	49.0	40m - 60m
269	AMA120	MPAJ	D4	44.24	D3	43.98	4	5,000PE - 10,000PE	300mm Clay	10-20years	44.11	47.24	3.13	3m - 5m	188	< 200	49.0	40m - 60m
270	AMA120	MPAJ	D3	43.98	D2	43.72	2	5,000PE - 10,000PE	300mm Clay	10-20years	43.85	47.24	3.39	3m - 5m	188	< 200	49.0	40m - 60m
271	AMA120	MPAJ	D3	43.98	D2	43.72	4	5,000PE - 10,000PE	300mm Clay	10-20years	43.85	47.24	3.39	3m - 5m	188	< 200	49.0	40m - 60m
272	AMA120	MPAJ	B9	43.76	B8	43.62	1	< 5,000PE	225mm Clay	10-20years	43.69	45.87	2.18	< 3m	214	200 - 400	30.0	20m - 40m
273	AMA120	MPAJ	B9	43.76	B8	43.62	2	< 5,000PE	225mm Clay	10-20years	43.69	45.87	2.18	< 3m	214	200 - 400	30.0	20m - 40m
274	AMA120	MPAJ	B9	43.76	B8	43.62	3	< 5,000PE	225mm Clay	10-20years	43.69	45.87	2.18	< 3m	214	200 - 400	30.0	20m - 40m
275	AMA120	MPAJ	B8	43.62	B7	43.34	2	< 5,000PE	225mm Clay	10-20years	43.48	46.02	2.54	< 3m	196	< 200	55.0	40m - 60m
276	AMA120	MPAJ	D2	43.72	D1	43.43	3	5,000PE - 10,000PE	375mm Clay	10-20years	43.58	47.32	3.75	3m - 5m	200	200 - 400	58.0	40m - 60m
277	AMA120	MPAJ	D2	43.72	D1	43.43	2	5,000PE - 10,000PE	375mm Clay	10-20years	43.58	47.32	3.75	3m - 5m	200	200 - 400	58.0	40m - 60m
278	AMA120	MPAJ	D2	43.72	D1	43.43	4	5,000PE - 10,000PE	375mm Clay	10-20years	43.58	47.32	3.75	3m - 5m	200	200 - 400	58.0	40m - 60m
279	AMA120	MPAJ	D2	43.72	D1	43.43	5	5,000PE - 10,000PE	375mm Clay	> 20years	43.58	47.32	3.75	3m - 5m	200	200 - 400	58.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
280	AMA127	MPAJ	A6/1	208.73	A6	207.85	1	< 5,000PE	225mm Clay	10-20years	208.29	212.00	3.71	3m - 5m	10	< 200	9.0	< 20m
281	AMA127	MPAJ	A6/1	208.73	A6	207.85	4	< 5,000PE	225mm Clay	10-20years	208.29	212.00	3.71	3m - 5m	10	< 200	9.0	< 20m
282	AMA127	MPAJ	A6/2	208.87	A6/1	208.73	1	< 5,000PE	225mm Clay	10-20years	208.80	213.50	4.70	3m - 5m	357	200 - 400	50.0	40m - 60m
283	AMA127	MPAJ	A6/2	208.87	A6/1	208.73	2	< 5,000PE	225mm Clay	10-20years	208.80	213.50	4.70	3m - 5m	357	200 - 400	50.0	40m - 60m
284	AMA127	MPAJ	A6/2	208.87	A6/1	208.73	3	< 5,000PE	225mm Clay	10-20years	208.80	213.50	4.70	3m - 5m	357	200 - 400	50.0	40m - 60m
285	AMA127	MPAJ	A6/2	208.87	A6/1	208.73	4	< 5,000PE	225mm Clay	10-20years	208.80	213.50	4.70	3m - 5m	357	200 - 400	50.0	40m - 60m
286	AMA127	MPAJ	A10	221.00	A9	220.24	2	< 5,000PE	225mm Clay	10-20years	220.62	225.00	4.38	3m - 5m	61	< 200	46.0	40m - 60m
287	AMA127	MPAJ	A10	221.00	A9	220.24	3	< 5,000PE	225mm Clay	10-20years	220.62	225.00	4.38	3m - 5m	61	< 200	46.0	40m - 60m
288	AMA127	MPAJ	A8	219.48	A7	217.56	2	< 5,000PE	225mm Clay	10-20years	218.52	224.00	5.48	> 5m	24	< 200	46.0	40m - 60m
289	AMA127	MPAJ	A8	219.48	A7	217.56	3	< 5,000PE	225mm Clay	10-20years	218.52	224.00	5.48	> 5m	24	< 200	46.0	40m - 60m
290	AMA127	MPAJ	A9	220.24	A8	219.48	2	< 5,000PE	225mm Clay	10-20years	219.86	225.00	5.14	> 5m	61	< 200	46.0	40m - 60m
291	AMA127	MPAJ	A6	207.85	A5	198.36	2	< 5,000PE	225mm Clay	10-20years	203.11	210.50	7.39	> 5m	4	< 200	39.0	20m - 40m
292	AMA127	MPAJ	A7	217.56	A6	207.85	3	< 5,000PE	225mm Clay	10-20years	212.71	217.50	4.80	3m - 5m	5	< 200	50.0	40m - 60m
293	AMA127	MPAJ	A5/5	213.76	A5/4	212.98	2	< 5,000PE	225mm Clay	10-20years	213.37	218.00	4.63	3m - 5m	62	< 200	48.0	40m - 60m
294	AMA127	MPAJ	A5/2	206.00	A5/1	205.73	1	< 5,000PE	225mm Clay	10-20years	205.87	210.00	4.13	3m - 5m	26	< 200	7.0	< 20m
295	AMA127	MPAJ	A5/2	206.00	A5/1	205.73	4	< 5,000PE	225mm Clay	10-20years	205.87	210.00	4.13	3m - 5m	26	< 200	7.0	< 20m
296	AMA127	MPAJ	A5/1	205.73	A5	198.36	2	< 5,000PE	225mm Clay	10-20years	202.05	209.50	7.45	> 5m	5	< 200	40.0	20m - 40m
297	AMA127	MPAJ	A5/1	205.73	A5	198.36	4	< 5,000PE	225mm Clay	10-20years	202.05	209.50	7.45	> 5m	5	< 200	40.0	20m - 40m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
298	AMA127	MPAJ	A5/3	211.00	A5/2	206.00	1	< 5,000PE	225mm Clay	10-20years	208.50	212.50	4.00	3m - 5m	11	< 200	55.0	40m - 60m
299	AMA127	MPAJ	A5/3	211.00	A5/2	206.00	2	< 5,000PE	225mm Clay	10-20years	208.50	212.50	4.00	3m - 5m	11	< 200	55.0	40m - 60m
300	AMA127	MPAJ	A5/3	211.00	A5/2	206.00	4	< 5,000PE	225mm Clay	10-20years	208.50	212.50	4.00	3m - 5m	11	< 200	55.0	40m - 60m
301	AMA127	MPAJ	A6/3	209.58	A6/2	208.87	2	< 5,000PE	225mm Clay	10-20years	209.23	215.00	5.77	> 5m	62	< 200	44.0	40m - 60m
302	AMA127	MPAJ	A6/4	210.29	A6/3	209.58	3	< 5,000PE	225mm Clay	10-20years	209.94	215.00	5.07	> 5m	62	< 200	44.0	40m - 60m
303	GBK192	MPS	A39	30.89	A41	29.59	1	< 5,000PE	225mm Clay	5-10years	30.24	37.57	7.33	> 5m	42	< 200	55.2	40m - 60m
304	GBK192	MPS	A39	30.89	A41	29.59	2	< 5,000PE	225mm Clay	5-10years	30.24	37.57	7.33	> 5m	42	< 200	55.2	40m - 60m
305	GBK192	MPS	A38	31.89	A39	30.87	1	< 5,000PE	225mm Clay	5-10years	31.38	33.62	2.24	< 3m	26	< 200	27.0	20m - 40m
306	GBK192	MPS	A38	31.89	A39	30.87	2	< 5,000PE	225mm Clay	5-10years	31.38	33.62	2.24	< 3m	26	< 200	27.0	20m - 40m
307	GBK192	MPS	A41	29.59	A43	28.62	1	< 5,000PE	225mm Clay	5-10years	29.11	31.47	2.37	< 3m	56	< 200	54.5	40m - 60m
308	GBK192	MPS	A41	29.59	A43	28.62	2	< 5,000PE	225mm Clay	5-10years	29.11	31.47	2.37	< 3m	56	< 200	54.5	40m - 60m
309	GBK192	MPS	A41	29.59	A43	28.62	3	< 5,000PE	225mm Clay	5-10years	29.11	31.47	2.37	< 3m	56	< 200	54.5	40m - 60m
310	GBK192	MPS	A27	27.05	A45	26.81	1	5,000PE - 10,000PE	300mm Clay	5-10years	26.93	30.66	3.73	3m - 5m	72	< 200	17.3	< 20m
311	GBK192	MPS	A27	27.05	A45	26.81	2	5,000PE - 10,000PE	300mm Clay	5-10years	26.93	30.66	3.73	3m - 5m	72	< 200	17.3	< 20m
312	GBK192	MPS	A15	30.74	A16	30.43	1	< 5,000PE	225mm Clay	5-10years	30.59	33.73	3.15	3m - 5m	176	< 200	54.6	40m - 60m
313	GBK192	MPS	A15	30.74	A16	30.43	2	< 5,000PE	225mm Clay	5-10years	30.59	33.73	3.15	3m - 5m	176	< 200	54.6	40m - 60m
314	GBK192	MPS	A17	30.09	A19	29.52	1	< 5,000PE	225mm Clay	5-10years	29.81	32.60	2.80	< 3m	95	< 200	54.4	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
315	GBK192	MPS	A17	30.09	A19	29.52	2	< 5,000PE	225mm Clay	5-10years	29.81	32.60	2.80	< 3m	95	< 200	54.4	40m - 60m
316	GBK192	MPS	A21	28.71	A23	27.94	1	< 5,000PE	225mm Clay	5-10years	28.33	30.99	2.67	< 3m	36	< 200	27.5	20m - 40m
317	GBK192	MPS	A21	28.71	A23	27.94	3	< 5,000PE	225mm Clay	5-10years	28.33	30.99	2.67	< 3m	36	< 200	27.5	20m - 40m
318	GBK192	MPS	A19	29.52	A21	28.71	1	< 5,000PE	225mm Clay	5-10years	29.12	31.63	2.52	< 3m	70	< 200	56.6	40m - 60m
319	GBK192	MPS	A19	29.52	A21	28.71	2	< 5,000PE	225mm Clay	5-10years	29.12	31.63	2.52	< 3m	70	< 200	56.6	40m - 60m
320	GBK192	MPS	A19	29.52	A21	28.71	3	< 5,000PE	225mm Clay	5-10years	29.12	31.63	2.52	< 3m	70	< 200	56.6	40m - 60m
321	GBK192	MPS	A23	27.94	A26	27.49	2	< 5,000PE	225mm Clay	5-10years	27.72	31.72	4.01	3m - 5m	208	200 - 400	93.5	> 80m
322	GBK192	MPS	A26	27.49	A27	27.05	1	< 5,000PE	225mm Clay	5-10years	27.27	31.69	4.42	3m - 5m	184	< 200	81.0	> 80m
323	GBK192	MPS	A26	27.49	A27	27.05	2	< 5,000PE	225mm Clay	5-10years	27.27	31.69	4.42	3m - 5m	184	< 200	81.0	> 80m
324	GBK192	MPS	A26	27.49	A27	27.05	4	< 5,000PE	225mm Clay	5-10years	27.27	31.69	4.42	3m - 5m	184	< 200	81.0	> 80m
325	HLT216	MPKjg	32	56.59	31	56.51	2	< 5,000PE	300mm Clay	10-20years	56.55	63.80	7.25	> 5m	350	200 - 400	28.0	20m - 40m
326	HLT216	MPKjg	32B	57.07	32A	56.78	2	< 5,000PE	300mm Clay	10-20years	56.93	62.65	5.73	> 5m	248	200 - 400	72.0	60m - 80m
327	HLT216	MPKjg	32B	57.07	32A	56.78	3	< 5,000PE	300mm Clay	10-20years	56.93	62.65	5.73	> 5m	248	200 - 400	72.0	60m - 80m
328	HLT216	MPKjg	30B-1	63.20	30B	61.70	3	< 5,000PE	225mm Clay	10-20years	62.45	64.10	1.65	< 3m	20	< 200	30.0	20m - 40m
329	HLT216	MPKjg	30B-1	63.20	30B	61.70	4	< 5,000PE	225mm Clay	10-20years	62.45	64.10	1.65	< 3m	20	< 200	30.0	20m - 40m
330	HLT216	MPKjg	30B-1	63.20	30B	61.70	5	< 5,000PE	225mm Clay	10-20years	62.45	64.10	1.65	< 3m	20	< 200	30.0	20m - 40m
331	HLT216	MPKjg	30B-2	64.70	30B-1	63.20	4	< 5,000PE	225mm Clay	10-20years	63.95	65.30	1.35	< 3m	20	< 200	30.0	20m - 40m
332	HLT216	MPKjg	32C-2	58.06	32C-1	57.79	1	< 5,000PE	225mm Clay	10-20years	57.93	63.50	5.58	> 5m	370	200 - 400	100.0	> 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
333	HLT216	MPKjg	32C-2	58.06	32C-1	57.79	2	< 5,000PE	225mm Clay	10-20years	57.93	63.50	5.58	> 5m	370	200 - 400	100.0	> 80m
334	HLT216	MPKjg	32C-2	58.06	32C-1	57.79	3	< 5,000PE	225mm Clay	10-20years	57.93	63.50	5.58	> 5m	370	200 - 400	100.0	> 80m
335	HLT216	MPKjg	32C-1	57.79	32C	57.38	1	< 5,000PE	225mm Clay	10-20years	57.59	63.50	5.92	> 5m	244	200 - 400	100.0	> 80m
336	HLT216	MPKjg	32C-1	57.79	32C	57.38	2	< 5,000PE	225mm Clay	10-20years	57.59	63.50	5.92	> 5m	244	200 - 400	100.0	> 80m
337	HLT216	MPKjg	32C-1	57.79	32C	57.38	3	< 5,000PE	225mm Clay	10-20years	57.59	63.50	5.92	> 5m	244	200 - 400	100.0	> 80m
338	HLT216	MPKjg	32C-3	58.38	32C-2	58.06	1	< 5,000PE	225mm Clay	10-20years	58.22	62.68	4.46	3m - 5m	281	200 - 400	90.0	> 80m
339	HLT216	MPKjg	32C-3	58.38	32C-2	58.06	2	< 5,000PE	225mm Clay	10-20years	58.22	62.68	4.46	3m - 5m	281	200 - 400	90.0	> 80m
340	HLT216	MPKjg	32C-3	58.38	32C-2	58.06	3	< 5,000PE	225mm Clay	10-20years	58.22	62.68	4.46	3m - 5m	281	200 - 400	90.0	> 80m
341	HLT216	MPKjg	32C-3	58.38	32C-2	58.06	4	< 5,000PE	225mm Clay	10-20years	58.22	62.68	4.46	3m - 5m	281	200 - 400	90.0	> 80m
342	HLT216	MPKjg	26	70.20	27	67.30	1	< 5,000PE	300mm Clay	10-20years	68.75	71.50	2.75	< 3m	10	< 200	30.0	20m - 40m
343	HLT216	MPKjg	26	70.20	27	67.30	2	< 5,000PE	300mm Clay	10-20years	68.75	71.50	2.75	< 3m	10	< 200	30.0	20m - 40m
344	HLT216	MPKjg	26	70.20	27	67.30	4	< 5,000PE	300mm Clay	10-20years	68.75	71.50	2.75	< 3m	10	< 200	30.0	20m - 40m
345	HLT216	MPKjg	32C	57.38	32B	57.07	4	< 5,000PE	300mm Clay	10-20years	57.23	63.50	6.28	> 5m	323	200 - 400	100.0	> 80m
346	HLT216	MPKjg	30	59.80	31	56.51	3	< 5,000PE	300mm Clay	10-20years	58.16	61.50	3.35	3m - 5m	13	< 200	42.0	40m - 60m
347	HLT216	MPKjg	27	67.30	28	64.30	3	< 5,000PE	300mm Clay	10-20years	65.80	68.40	2.60	< 3m	17	< 200	50.0	40m - 60m
348	HLT216	MPKjg	24	71.30	25	71.00	2	< 5,000PE	300mm Clay	10-20years	71.15	74.75	3.60	3m - 5m	233	200 - 400	70.0	60m - 80m
349	HLT216	MPKjg	24	71.30	25	71.00	3	< 5,000PE	300mm Clay	10-20years	71.15	74.75	3.60	3m - 5m	233	200 - 400	70.0	60m - 80m
350	HLT216	MPKjg	21	72.40	22	72.10	2	< 5,000PE	300mm Clay	10-20years	72.25	76.00	3.75	3m - 5m	217	200 - 400	65.0	60m - 80m
351	KLR071	DBKL	3-2	34.12	3-3	33.12	2	< 5,000PE	225mm Clay	> 20years	33.62	36.37	2.75	< 3m	47	< 200	47.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
352	KLR071	DBKL	3-4	32.23	3-5	31.42	2	10,000PE - 20,000PE	375mm Clay	> 20years	31.83	35.04	3.22	3m - 5m	80	< 200	65.0	60m - 80m
353	KLR071	DBKL	3-4	32.23	3-5	31.42	3	10,000PE - 20,000PE	375mm Clay	> 20years	31.83	35.04	3.22	3m - 5m	80	< 200	65.0	60m - 80m
354	KLR071	DBKL	3-5a	30.39	3-6	30.09	2	10,000PE - 20,000PE	375mm Clay	> 20years	30.24	33.74	3.50	3m - 5m	110	< 200	33.0	20m - 40m
355	KLR071	DBKL	3-6	30.09	3-7	29.41	4	10,000PE - 20,000PE	375mm Clay	> 20years	29.75	32.99	3.24	3m - 5m	66	< 200	45.0	40m - 60m
356	KLR071	DBKL	1-11	33.86	1-10	33.33	4	10,000PE - 20,000PE	450mm Concrete	> 20years	33.60	36.70	3.11	3m - 5m	85	< 200	45.0	40m - 60m
357	KLR071	DBKL	1-11a	34.03	1-11	33.86	5	10,000PE - 20,000PE	450mm Concrete	> 20years	33.95	37.44	3.50	3m - 5m	306	200 - 400	52.0	40m - 60m
358	KLR071	DBKL	1-14	36.93	1-13	35.97	3	10,000PE - 20,000PE	375mm Clay	> 20years	36.45	40.33	3.88	3m - 5m	54	< 200	52.0	40m - 60m
359	KLR071	DBKL	1-16	39.41	1-15	37.81	3	5,000PE - 10,000PE	300mm Clay	> 20years	38.61	43.43	4.82	3m - 5m	36	< 200	58.0	40m - 60m
360	KLR071	DBKL	1-15	37.81	1-14	36.93	2	5,000PE - 10,000PE	300mm Clay	> 20years	37.37	41.83	4.46	3m - 5m	56	< 200	49.0	40m - 60m
361	KLR071	DBKL	1-2	28.63	1-29	28.15	1	> 20,000PE	500mm Concrete	> 20years	28.39	34.10	5.71	> 5m	62	< 200	30.0	20m - 40m
362	KLR071	DBKL	3-7	29.41	1-1	29.18	1	> 20,000PE	500mm Concrete	> 20years	29.30	34.42	5.13	> 5m	209	200 - 400	48.0	40m - 60m
363	KLR071	DBKL	3-6a	29.58	3-7	29.41	5	10,000PE - 20,000PE	375mm Clay	> 20years	29.50	32.16	2.67	< 3m	341	200 - 400	58.0	40m - 60m
364	HLT246	MPKjg	5	28.76	9	28.53	1	< 5,000PE	225mm Clay	5-10years	28.65	31.40	2.76	< 3m	130	< 200	30.0	20m - 40m
365	HLT246	MPKjg	5	28.76	9	28.53	2	< 5,000PE	225mm Clay	5-10years	28.65	31.40	2.76	< 3m	130	< 200	30.0	20m - 40m
366	HLT246	MPKjg	7	29.45	8	28.97	3	< 5,000PE	225mm Clay	5-10years	29.21	30.21	1.00	< 3m	133	< 200	64.0	60m - 80m
367	HLT246	MPKjg	1	29.84	2	29.34	3	< 5,000PE	225mm Clay	5-10years	29.59	31.12	1.53	< 3m	110	< 200	55.0	40m - 60m
368	HLT302	MPKjg	T5B	50.94	T5C	50.58	1	< 5,000PE	225mm Clay	< 5years	50.76	53.00	2.24	< 3m	236	200 - 400	85.0	> 80m
369	HLT302	MPKjg	T5B	50.94	T5C	50.58	4	< 5,000PE	225mm Clay	< 5years	50.76	53.00	2.24	< 3m	236	200 - 400	85.0	> 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
370	HLT302	MPKjg	T6	50.41	G9	50.06	1	< 5,000PE	225mm Clay	< 5years	50.24	53.00	2.77	< 3m	171	< 200	60.0	40m - 60m
371	HLT302	MPKjg	T3	52.33	T4	52.05	1	< 5,000PE	225mm Clay	< 5years	52.19	54.00	1.81	< 3m	43	< 200	12.0	< 20m
372	HLT302	MPKjg	T3	52.33	T4	52.05	3	< 5,000PE	225mm Clay	< 5years	52.19	54.00	1.81	< 3m	43	< 200	12.0	< 20m
373	HLT302	MPKjg	T2	53.83	T3	52.33	2	< 5,000PE	225mm Clay	< 5years	53.08	53.81	0.73	< 3m	23	< 200	35.0	20m - 40m
374	HLT302	MPKjg	T2	53.83	T3	52.33	3	< 5,000PE	225mm Clay	< 5years	53.08	53.81	0.73	< 3m	23	< 200	35.0	20m - 40m
375	HLT302	MPKjg	K9	57.28	T2	53.83	2	< 5,000PE	225mm Clay	< 5years	55.56	56.96	1.41	< 3m	12	< 200	40.0	20m - 40m
376	HLT302	MPKjg	T5A	51.17	T5B	50.94	1	< 5,000PE	225mm Clay	< 5years	51.06	53.00	1.95	< 3m	261	200 - 400	60.0	40m - 60m
377	HLT302	MPKjg	T5A	51.17	T5B	50.94	2	< 5,000PE	225mm Clay	< 5years	51.06	53.00	1.95	< 3m	261	200 - 400	60.0	40m - 60m
378	HLT302	MPKjg	T5A	51.17	T5B	50.94	4	< 5,000PE	225mm Clay	< 5years	51.06	53.00	1.95	< 3m	261	200 - 400	60.0	40m - 60m
379	HLT302	MPKjg	T4	52.05	T5	51.35	2	< 5,000PE	225mm Clay	< 5years	51.70	53.50	1.80	< 3m	86	< 200	60.0	40m - 60m
380	GSG100	MPSpg	40	7.75	39	7.70	2	< 5,000PE	225mm Clay	5-10years	7.73	10.00	2.28	< 3m	780	> 600	39.0	20m - 40m
381	GSG100	MPSpg	1-F	4.47	1-E	4.24	1	10,000PE - 20,000PE	500mm Concrete	5-10years	4.36	10.00	5.65	> 5m	365	200 - 400	84.0	> 80m
382	GSG100	MPSpg	1-D	2.00	1-C	1.50	1	10,000PE - 20,000PE	500mm Concrete	5-10years	1.75	10.00	8.25	> 5m	160	< 200	80.0	60m - 80m
383	GSG100	MPSpg	1-H	6.12	1-G	5.99	2	5,000PE - 10,000PE	300mm Clay	5-10years	6.06	10.00	3.95	3m - 5m	385	200 - 400	50.0	40m - 60m
384	GSG100	MPSpg	1	6.50	1-I	6.31	2	5,000PE - 10,000PE	300mm Clay	5-10years	6.41	10.00	3.60	3m - 5m	368	200 - 400	70.0	60m - 80m
385	GSG100	MPSpg	1	6.50	1-I	6.31	3	5,000PE - 10,000PE	300mm Clay	5-10years	6.41	10.00	3.60	3m - 5m	368	200 - 400	70.0	60m - 80m
386	GSG100	MPSpg	1	6.50	1-I	6.31	4	5,000PE - 10,000PE	300mm Clay	5-10years	6.41	10.00	3.60	3m - 5m	368	200 - 400	70.0	60m - 80m
387	GSG100	MPSpg	31	7.13	1-G	5.99	2	5,000PE - 10,000PE	450mm Concrete	5-10years	6.56	10.00	3.44	3m - 5m	69	< 200	79.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
388	GSG100	MPSpg	31A	8.00	32	7.75	4	< 5,000PE	225mm Clay	5-10years	7.88	10.00	2.13	< 3m	240	200 - 400	60.0	40m - 60m
389	GSG100	MPSpg	31A	8.00	32	7.75	5	< 5,000PE	225mm Clay	5-10years	7.88	10.00	2.13	< 3m	240	200 - 400	60.0	40m - 60m
390	GSG100	MPSpg	32	7.75	1-F	4.47	2	< 5,000PE	225mm Clay	5-10years	6.11	10.00	3.89	3m - 5m	18	< 200	60.0	40m - 60m
391	GSG100	MPSpg	32	7.75	1-F	4.47	3	< 5,000PE	225mm Clay	5-10years	6.11	10.00	3.89	3m - 5m	18	< 200	60.0	40m - 60m
392	GSG100	MPSpg	39	7.70	38	7.60	1	< 5,000PE	225mm Clay	5-10years	7.65	10.00	2.35	< 3m	370	200 - 400	37.0	20m - 40m
393	GSG100	MPSpg	39	7.70	38	7.60	4	< 5,000PE	225mm Clay	5-10years	7.65	10.00	2.35	< 3m	370	200 - 400	37.0	20m - 40m
394	GSG100	MPSpg	38	7.60	37	7.44	2	< 5,000PE	225mm Clay	5-10years	7.52	10.00	2.48	< 3m	319	200 - 400	51.0	40m - 60m
395	GSG100	MPSpg	38	7.60	37	7.44	4	< 5,000PE	225mm Clay	5-10years	7.52	10.00	2.48	< 3m	319	200 - 400	51.0	40m - 60m
396	GSG100	MPSpg	37	7.44	36	7.31	2	< 5,000PE	225mm Clay	5-10years	7.38	10.00	2.63	< 3m	454	400 - 600	59.0	40m - 60m
397	GSG100	MPSpg	37	7.44	36	7.31	3	< 5,000PE	225mm Clay	5-10years	7.38	10.00	2.63	< 3m	454	400 - 600	59.0	40m - 60m
398	GSG100	MPSpg	36	7.31	35	7.13	1	< 5,000PE	225mm Clay	5-10years	7.22	10.00	2.78	< 3m	450	400 - 600	81.0	> 80m
399	GSG100	MPSpg	36	7.31	35	7.13	2	< 5,000PE	225mm Clay	5-10years	7.22	10.00	2.78	< 3m	450	400 - 600	81.0	> 80m
400	GSG100	MPSpg	36	7.31	35	7.13	3	< 5,000PE	225mm Clay	5-10years	7.22	10.00	2.78	< 3m	450	400 - 600	81.0	> 80m
401	GSG100	MPSpg	36	7.31	35	7.13	4	< 5,000PE	225mm Clay	5-10years	7.22	10.00	2.78	< 3m	450	400 - 600	81.0	> 80m
402	GSG125	MPSpg	1A	49.15	STP	49.00	1	< 5,000PE	225mm Clay	< 5years	49.08	57.80	8.72	> 5m	100	< 200	15.0	< 20m
403	GBK127	MPS	6A	76.20	7	76.03	2	5,000PE - 10,000PE	300mm Clay	10-20years	76.12	79.40	3.29	3m - 5m	441	400 - 600	75.0	60m - 80m
404	GBK127	MPS	6A	76.20	7	76.03	3	5,000PE - 10,000PE	300mm Clay	10-20years	76.12	79.40	3.29	3m - 5m	441	400 - 600	75.0	60m - 80m
405	GBK127	MPS	1-3	75.83	1-4	75.58	2	10,000PE - 20,000PE	375mm Clay	10-20years	75.71	79.20	3.50	3m - 5m	244	200 - 400	61.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
406	GBK127	MPS	1-6	75.17	1-7	73.80	5	10,000PE - 20,000PE	375mm Clay	10-20years	74.49	76.75	2.27	< 3m	29	< 200	40.0	20m - 40m
407	GBK127	MPS	3B	77.15	3	76.86	2	< 5,000PE	225mm Clay	10-20years	77.01	79.40	2.40	< 3m	224	200 - 400	65.0	60m - 80m
408	GBK127	MPS	5	76.45	6	76.28	5	5,000PE - 10,000PE	300mm Clay	10-20years	76.37	79.40	3.04	3m - 5m	300	200 - 400	51.0	40m - 60m
409	AMA152	MPAJ	10	63.12	11	62.90	1	< 5,000PE	225mm Clay	5-10years	63.01	65.35	2.34	< 3m	255	200 - 400	56.0	40m - 60m
410	AMA152	MPAJ	10	63.12	11	62.90	2	< 5,000PE	225mm Clay	5-10years	63.01	65.35	2.34	< 3m	255	200 - 400	56.0	40m - 60m
411	AMA152	MPAJ	10	63.12	11	62.90	4	< 5,000PE	225mm Clay	5-10years	63.01	65.35	2.34	< 3m	255	200 - 400	56.0	40m - 60m
412	AMA152	MPAJ	12	61.02	13	58.48	1	< 5,000PE	225mm Clay	5-10years	59.75	62.43	2.68	< 3m	22	< 200	56.0	40m - 60m
413	AMA152	MPAJ	12	61.02	13	58.48	2	< 5,000PE	225mm Clay	5-10years	59.75	62.43	2.68	< 3m	22	< 200	56.0	40m - 60m
414	AMA152	MPAJ	12	61.02	13	58.48	3	< 5,000PE	225mm Clay	5-10years	59.75	62.43	2.68	< 3m	22	< 200	56.0	40m - 60m
415	AMA152	MPAJ	12	61.02	13	58.48	4	< 5,000PE	225mm Clay	5-10years	59.75	62.43	2.68	< 3m	22	< 200	56.0	40m - 60m
416	AMA152	MPAJ	11	62.90	12	61.02	1	< 5,000PE	225mm Clay	5-10years	61.96	64.22	2.26	< 3m	32	< 200	60.0	40m - 60m
417	AMA152	MPAJ	11	62.90	12	61.02	2	< 5,000PE	225mm Clay	5-10years	61.96	64.22	2.26	< 3m	32	< 200	60.0	40m - 60m
418	AMA152	MPAJ	11	62.90	12	61.02	3	< 5,000PE	225mm Clay	5-10years	61.96	64.22	2.26	< 3m	32	< 200	60.0	40m - 60m
419	AMA152	MPAJ	13	58.48	16	57.93	1	< 5,000PE	225mm Clay	5-10years	58.21	61.23	3.03	3m - 5m	115	< 200	63.0	60m - 80m
420	AMA152	MPAJ	13	58.48	16	57.93	2	< 5,000PE	225mm Clay	5-10years	58.21	61.23	3.03	3m - 5m	115	< 200	63.0	60m - 80m
421	AMA152	MPAJ	13	58.48	16	57.93	4	< 5,000PE	225mm Clay	5-10years	58.21	61.23	3.03	3m - 5m	115	< 200	63.0	60m - 80m
422	AMA152	MPAJ	15	61.22	16	57.93	1	< 5,000PE	225mm Clay	5-10years	59.58	62.26	2.69	< 3m	17	< 200	56.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
423	AMA152	MPAJ	15	61.22	16	57.93	2	< 5,000PE	225mm Clay	5-10years	59.58	62.26	2.69	< 3m	17	< 200	56.0	40m - 60m
424	AMA152	MPAJ	15	61.22	16	57.93	3	< 5,000PE	225mm Clay	5-10years	59.58	62.26	2.69	< 3m	17	< 200	56.0	40m - 60m
425	AMA152	MPAJ	14	62.26	15	61.22	1	< 5,000PE	225mm Clay	5-10years	61.74	63.77	2.03	< 3m	46	< 200	48.0	40m - 60m
426	AMA152	MPAJ	14	62.26	15	61.22	2	< 5,000PE	225mm Clay	5-10years	61.74	63.77	2.03	< 3m	46	< 200	48.0	40m - 60m
427	AMA152	MPAJ	14	62.26	15	61.22	3	< 5,000PE	225mm Clay	5-10years	61.74	63.77	2.03	< 3m	46	< 200	48.0	40m - 60m
428	AMA152	MPAJ	2	63.83	3	63.02	1	< 5,000PE	225mm Clay	5-10years	63.43	65.33	1.91	< 3m	65	< 200	53.0	40m - 60m
429	AMA152	MPAJ	2	63.83	3	63.02	2	< 5,000PE	225mm Clay	5-10years	63.43	65.33	1.91	< 3m	65	< 200	53.0	40m - 60m
430	AMA152	MPAJ	2	63.83	3	63.02	3	< 5,000PE	225mm Clay	5-10years	63.43	65.33	1.91	< 3m	65	< 200	53.0	40m - 60m
431	AMA152	MPAJ	2	63.83	3	63.02	4	< 5,000PE	225mm Clay	5-10years	63.43	65.33	1.91	< 3m	65	< 200	53.0	40m - 60m
432	AMA152	MPAJ	3	63.02	4	60.51	1	< 5,000PE	225mm Clay	5-10years	61.77	64.49	2.72	< 3m	22	< 200	54.0	40m - 60m
433	AMA152	MPAJ	3	63.02	4	60.51	2	< 5,000PE	225mm Clay	5-10years	61.77	64.49	2.72	< 3m	22	< 200	54.0	40m - 60m
434	AMA152	MPAJ	4	60.51	5	58.89	1	< 5,000PE	225mm Clay	5-10years	59.70	62.72	3.02	3m - 5m	30	< 200	48.0	40m - 60m
435	AMA152	MPAJ	4	60.51	5	58.89	2	< 5,000PE	225mm Clay	5-10years	59.70	62.72	3.02	3m - 5m	30	< 200	48.0	40m - 60m
436	AMA152	MPAJ	4	60.51	5	58.89	3	< 5,000PE	225mm Clay	5-10years	59.70	62.72	3.02	3m - 5m	30	< 200	48.0	40m - 60m
437	AMA152	MPAJ	5	58.89	13	58.48	1	< 5,000PE	225mm Clay	5-10years	58.69	61.41	2.72	< 3m	151	< 200	62.0	60m - 80m
438	AMA152	MPAJ	5	58.89	13	58.48	2	< 5,000PE	225mm Clay	5-10years	58.69	61.41	2.72	< 3m	151	< 200	62.0	60m - 80m
439	AMA152	MPAJ	5	58.89	13	58.48	4	< 5,000PE	225mm Clay	5-10years	58.69	61.41	2.72	< 3m	151	< 200	62.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
440	AMA148	MPAJ	8	58.72	9	58.65	1	10,000PE - 20,000PE	375mm Clay	5-10years	58.69	65.87	7.19	> 5m	571	400 - 600	40.0	20m - 40m
441	AMA148	MPAJ	8	58.72	9	58.65	2	10,000PE - 20,000PE	375mm Clay	5-10years	58.69	65.87	7.19	> 5m	571	400 - 600	40.0	20m - 40m
442	AMA148	MPAJ	4A	59.36	5	59.29	2	5,000PE - 10,000PE	375mm Clay	5-10years	59.33	64.32	4.99	3m - 5m	414	400 - 600	29.0	20m - 40m
443	AMA148	MPAJ	4A	59.36	5	59.29	3	5,000PE - 10,000PE	375mm Clay	5-10years	59.33	64.32	4.99	3m - 5m	414	400 - 600	29.0	20m - 40m
444	AMA148	MPAJ	4B	62.98	4	59.53	1	< 5,000PE	225mm Clay	5-10years	61.26	64.66	3.41	3m - 5m	12	< 200	40.0	20m - 40m
445	AMA148	MPAJ	4B	62.98	4	59.53	2	< 5,000PE	225mm Clay	5-10years	61.26	64.66	3.41	3m - 5m	12	< 200	40.0	20m - 40m
446	KLR040	DBKL	212	48.61	213	48.36	2	< 5,000PE	225mm Clay	> 20years	48.49	51.05	2.57	< 3m	200	200 - 400	50.0	40m - 60m
447	KLR040	DBKL	212	48.61	213	48.36	3	< 5,000PE	225mm Clay	> 20years	48.49	51.05	2.57	< 3m	200	200 - 400	50.0	40m - 60m
448	KLR040	DBKL	212	48.61	213	48.36	4	< 5,000PE	225mm Clay	> 20years	48.49	51.05	2.57	< 3m	200	200 - 400	50.0	40m - 60m
449	KLR040	DBKL	231	40.89	236	40.74	1	5,000PE - 10,000PE	300mm Clay	> 20years	40.82	50.37	9.56	> 5m	300	200 - 400	45.0	40m - 60m
450	KLR040	DBKL	231	40.89	236	40.74	2	5,000PE - 10,000PE	300mm Clay	> 20years	40.82	50.37	9.56	> 5m	300	200 - 400	45.0	40m - 60m
451	KLR040	DBKL	231	40.89	236	40.74	3	5,000PE - 10,000PE	300mm Clay	> 20years	40.82	50.37	9.56	> 5m	300	200 - 400	45.0	40m - 60m
452	KLR040	DBKL	223b	48.47	223c	48.16	1	< 5,000PE	225mm Clay	> 20years	48.32	50.52	2.21	< 3m	194	< 200	60.0	40m - 60m
453	KLR040	DBKL	223b	48.47	223c	48.16	4	< 5,000PE	225mm Clay	> 20years	48.32	50.52	2.21	< 3m	194	< 200	60.0	40m - 60m
454	KLR040	DBKL	210	49.32	211	48.96	5	< 5,000PE	225mm Clay	> 20years	49.14	51.80	2.66	< 3m	178	< 200	64.0	60m - 80m
455	KLR040	DBKL	210	49.32	211	48.96	4	< 5,000PE	225mm Clay	> 20years	49.14	51.80	2.66	< 3m	178	< 200	64.0	60m - 80m
456	KLR040	DBKL	211	48.96	212	48.61	1	< 5,000PE	225mm Clay	> 20years	48.79	51.36	2.58	< 3m	183	< 200	64.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
457	KLR040	DBKL	211	48.96	212	48.61	2	< 5,000PE	225mm Clay	> 20years	48.79	51.36	2.58	< 3m	183	< 200	64.0	60m - 80m
458	KLR040	DBKL	211	48.96	212	48.61	3	< 5,000PE	225mm Clay	> 20years	48.79	51.36	2.58	< 3m	183	< 200	64.0	60m - 80m
459	KLR040	DBKL	211	48.96	212	48.61	4	< 5,000PE	225mm Clay	> 20years	48.79	51.36	2.58	< 3m	183	< 200	64.0	60m - 80m
460	KLR040	DBKL	210a	49.75	210	49.32	1	< 5,000PE	225mm Clay	> 20years	49.54	52.26	2.73	< 3m	149	< 200	64.0	60m - 80m
461	KLR040	DBKL	210a	49.75	210	49.32	5	< 5,000PE	225mm Clay	> 20years	49.54	52.26	2.73	< 3m	149	< 200	64.0	60m - 80m
462	KLR040	DBKL	210a	49.75	210	49.32	4	< 5,000PE	225mm Clay	> 20years	49.54	52.26	2.73	< 3m	149	< 200	64.0	60m - 80m
463	KLR040	DBKL	225	47.13	221	46.96	2	< 5,000PE	225mm Clay	> 20years	47.05	50.00	2.96	< 3m	141	< 200	24.0	20m - 40m
464	KLR040	DBKL	218a	49.28	218	49.05	3	< 5,000PE	225mm Clay	> 20years	49.17	50.68	1.52	< 3m	200	200 - 400	46.0	40m - 60m
465	KLR040	DBKL	218a	49.28	218	49.05	4	< 5,000PE	225mm Clay	> 20years	49.17	50.68	1.52	< 3m	200	200 - 400	46.0	40m - 60m
466	GBK150	MPS	5	54.84	4A	54.80	2	< 5,000PE	225mm Clay	10-20years	54.82	55.30	0.48	< 3m	900	> 600	36.0	20m - 40m
467	GBK150	MPS	3	54.02	2	53.75	3	< 5,000PE	225mm Clay	10-20years	53.89	56.00	2.11	< 3m	224	200 - 400	60.5	60m - 80m
468	AMA163	MPAJ	A6	58.15	A5	57.22	1	5,000PE - 10,000PE	300mm Clay	< 5years	57.69	62.02	4.34	3m - 5m	66	< 200	61.0	60m - 80m
469	AMA163	MPAJ	A6	58.15	A5	57.22	3	5,000PE - 10,000PE	300mm Clay	< 5years	57.69	62.02	4.34	3m - 5m	66	< 200	61.0	60m - 80m
470	AMA163	MPAJ	A7	58.25	A6	58.15	2	5,000PE - 10,000PE	300mm Clay	< 5years	58.20	62.17	3.97	3m - 5m	250	200 - 400	25.0	20m - 40m
471	AMA163	MPAJ	A8	58.44	A7	58.25	2	5,000PE - 10,000PE	300mm Clay	< 5years	58.35	62.02	3.68	3m - 5m	305	200 - 400	58.0	40m - 60m
472	AMA163	MPAJ	A8	58.44	A7	58.25	3	5,000PE - 10,000PE	300mm Clay	< 5years	58.35	62.02	3.68	3m - 5m	305	200 - 400	58.0	40m - 60m
473	AMA163	MPAJ	A8	58.44	A7	58.25	4	5,000PE - 10,000PE	300mm Clay	< 5years	58.35	62.02	3.68	3m - 5m	305	200 - 400	58.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
474	AMA163	MPAJ	B1	57.36	A5	57.22	1	5,000PE - 10,000PE	300mm Clay	< 5years	57.29	61.87	4.58	3m - 5m	307	200 - 400	43.0	40m - 60m
475	AMA163	MPAJ	B1	57.36	A5	57.22	2	5,000PE - 10,000PE	300mm Clay	< 5years	57.29	61.87	4.58	3m - 5m	307	200 - 400	43.0	40m - 60m
476	AMA163	MPAJ	B3	57.66	B2	57.50	1	5,000PE - 10,000PE	300mm Clay	< 5years	57.58	62.02	4.44	3m - 5m	269	200 - 400	43.0	40m - 60m
477	AMA163	MPAJ	A10	60.52	A9	60.35	2	5,000PE - 10,000PE	300mm Clay	< 5years	60.44	61.27	0.84	< 3m	341	200 - 400	58.0	40m - 60m
478	AMA163	MPAJ	A10	60.52	A9	60.35	3	5,000PE - 10,000PE	300mm Clay	< 5years	60.44	61.27	0.84	< 3m	341	200 - 400	58.0	40m - 60m
479	AMA163	MPAJ	D2	60.99	A10	60.82	1	< 5,000PE	225mm Clay	< 5years	60.91	61.72	0.81	< 3m	394	200 - 400	67.0	60m - 80m
480	AMA163	MPAJ	A10/1	61.14	A10	60.82	1	< 5,000PE	225mm Clay	< 5years	60.98	61.72	0.74	< 3m	156	< 200	50.0	40m - 60m
481	AMA163	MPAJ	A10/1	61.14	A10	60.82	2	< 5,000PE	225mm Clay	< 5years	60.98	61.72	0.74	< 3m	156	< 200	50.0	40m - 60m
482	AMA163	MPAJ	A12	61.07	D2	60.99	1	< 5,000PE	225mm Clay	< 5years	61.03	62.63	1.60	< 3m	800	> 600	64.0	60m - 80m
483	AMA163	MPAJ	A12	61.07	D2	60.99	2	< 5,000PE	225mm Clay	< 5years	61.03	62.63	1.60	< 3m	800	> 600	64.0	60m - 80m
484	AMA163	MPAJ	A12	61.07	D2	60.99	4	< 5,000PE	225mm Clay	< 5years	61.03	62.63	1.60	< 3m	800	> 600	64.0	60m - 80m
485	AMA163	MPAJ	A12	61.07	D2a	60.99	5	< 5,000PE	225mm Clay	< 5years	61.03	62.63	1.60	< 3m	500	400 - 600	40.0	20m - 40m
486	AMA163	MPAJ	A13	61.71	A12	61.07	1	< 5,000PE	225mm Clay	< 5years	61.39	63.09	1.70	< 3m	109	< 200	70.0	60m - 80m
487	AMA163	MPAJ	A13	61.71	A12	61.07	2	< 5,000PE	225mm Clay	< 5years	61.39	63.09	1.70	< 3m	109	< 200	70.0	60m - 80m
488	AMA163	MPAJ	A13	61.71	A12	61.07	3	< 5,000PE	225mm Clay	< 5years	61.39	63.09	1.70	< 3m	109	< 200	70.0	60m - 80m
489	AMA163	MPAJ	A14	61.96	A13	61.17	2	< 5,000PE	225mm Clay	< 5years	61.57	63.32	1.76	< 3m	89	< 200	70.0	60m - 80m
490	AMA163	MPAJ	A13/1	61.44	A13	61.17	1	< 5,000PE	225mm Clay	< 5years	61.31	63.17	1.87	< 3m	163	< 200	44.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
491	AMA163	MPAJ	A13/1	61.44	A13	61.17	3	< 5,000PE	225mm Clay	< 5years	61.31	63.17	1.87	< 3m	163	< 200	44.0	40m - 60m
492	AMA163	MPAJ	A13/1	61.44	A13	61.17	4	< 5,000PE	225mm Clay	< 5years	61.31	63.17	1.87	< 3m	163	< 200	44.0	40m - 60m
493	AMA163	MPAJ	A13/1	61.44	A13	61.17	5	< 5,000PE	225mm Clay	< 5years	61.31	63.17	1.87	< 3m	163	< 200	44.0	40m - 60m
494	AMA163	MPAJ	A10/15B	61.75	A10/15C	61.61	2	< 5,000PE	225mm Clay	< 5years	61.68	64.31	2.63	< 3m	229	200 - 400	32.0	20m - 40m
495	AMA163	MPAJ	A15	62.34	A14	61.96	1	< 5,000PE	225mm Clay	< 5years	62.15	63.63	1.48	< 3m	121	< 200	46.0	40m - 60m
496	AMA163	MPAJ	A15	62.34	A14	61.96	3	< 5,000PE	225mm Clay	< 5years	62.15	63.63	1.48	< 3m	121	< 200	46.0	40m - 60m
497	AMA163	MPAJ	A10/15A	63.09	A10/15B	62.88	1	< 5,000PE	225mm Clay	< 5years	62.99	65.23	2.25	< 3m	200	200 - 400	42.0	40m - 60m
498	AMA163	MPAJ	A10/15A	63.09	A10/15B	62.88	2	< 5,000PE	225mm Clay	< 5years	62.99	65.23	2.25	< 3m	200	200 - 400	42.0	40m - 60m
499	AMA163	MPAJ	A10/13A	61.96	A10/13	61.75	3	< 5,000PE	225mm Clay	< 5years	61.86	64.19	2.33	< 3m	205	200 - 400	43.0	40m - 60m
500	AMA163	MPAJ	A17	61.92	A16	61.63	4	< 5,000PE	225mm Clay	< 5years	61.78	64.16	2.38	< 3m	200	200 - 400	58.0	40m - 60m
501	AMA163	MPAJ	D2	43.72	A21	42.72	2	< 5,000PE	225mm Clay	< 5years	43.22	47.24	4.02	3m - 5m	58	< 200	58.0	40m - 60m
502	AMA163	MPAJ	D2	43.72	A21	42.72	3	< 5,000PE	225mm Clay	< 5years	43.22	47.24	4.02	3m - 5m	58	< 200	58.0	40m - 60m
503	AMA163	MPAJ	D2	43.72	A21	42.72	4	< 5,000PE	225mm Clay	< 5years	43.22	47.24	4.02	3m - 5m	58	< 200	58.0	40m - 60m
504	AMA163	MPAJ	A3	56.88	A2	56.80	1	10,000PE - 20,000PE	375mm Clay	< 5years	56.84	61.50	4.66	3m - 5m	425	400 - 600	34.0	20m - 40m
505	AMA163	MPAJ	A9	60.35	A8	54.88	1	5,000PE - 10,000PE	300mm Clay	< 5years	57.62	61.57	3.96	3m - 5m	11	< 200	58.0	40m - 60m
506	AMA163	MPAJ	A9	60.35	A8	54.88	2	5,000PE - 10,000PE	300mm Clay	< 5years	57.62	61.57	3.96	3m - 5m	11	< 200	58.0	40m - 60m
507	AMA163	MPAJ	A9	60.35	A8	54.88	3	5,000PE - 10,000PE	300mm Clay	< 5years	57.62	61.57	3.96	3m - 5m	11	< 200	58.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
508	AMA163	MPAJ	A19	62.49	A18	62.20	4	< 5,000PE	225mm Clay	< 5years	62.35	64.77	2.43	< 3m	200	200 - 400	58.0	40m - 60m
509	AMA163	MPAJ	A10/15H	60.29	A10/15	60.21	3	< 5,000PE	225mm Clay	< 5years	60.25	63.78	3.53	3m - 5m	450	400 - 600	36.0	20m - 40m
510	AMA163	MPAJ	A10/15G	60.54	A10/15H	60.29	1	< 5,000PE	225mm Clay	< 5years	60.42	64.00	3.59	3m - 5m	208	200 - 400	52.0	40m - 60m
511	AMA163	MPAJ	A10/15F	60.80	A10/15G	60.54	1	< 5,000PE	225mm Clay	< 5years	60.67	64.00	3.33	3m - 5m	208	200 - 400	54.0	40m - 60m
512	AMA163	MPAJ	A10/15E	61.07	A10/15F	60.80	1	< 5,000PE	225mm Clay	< 5years	60.94	64.00	3.07	3m - 5m	200	200 - 400	54.0	40m - 60m
513	AMA163	MPAJ	A10/15E	61.07	A10/15F	60.80	2	< 5,000PE	225mm Clay	< 5years	60.94	64.00	3.07	3m - 5m	200	200 - 400	54.0	40m - 60m
514	AMA163	MPAJ	A12/2	60.62	A12/1	60.38	1	< 5,000PE	225mm Clay	< 5years	60.50	62.17	1.67	< 3m	196	< 200	47.0	40m - 60m
515	AMA163	MPAJ	A12/1	60.38	A12a	60.07	1	< 5,000PE	225mm Clay	< 5years	60.23	62.63	2.41	< 3m	152	< 200	47.0	40m - 60m
516	AMA040	MPAJ	65	133.00	65A	130.70	1	< 5,000PE	225mm Clay	10-20years	131.85	134.25	2.40	< 3m	29	< 200	66.0	60m - 80m
517	AMA040	MPAJ	65	133.00	65A	130.70	2	< 5,000PE	225mm Clay	10-20years	131.85	134.25	2.40	< 3m	29	< 200	66.0	60m - 80m
518	AMA040	MPAJ	65	133.00	65A	130.70	3	< 5,000PE	225mm Clay	10-20years	131.85	134.25	2.40	< 3m	29	< 200	66.0	60m - 80m
519	AMA040	MPAJ	65	133.00	65A	130.70	4	< 5,000PE	225mm Clay	10-20years	131.85	134.25	2.40	< 3m	29	< 200	66.0	60m - 80m
520	AMA040	MPAJ	65	133.00	65A	130.70	5	< 5,000PE	225mm Clay	10-20years	131.85	134.25	2.40	< 3m	29	< 200	66.0	60m - 80m
521	AMA040	MPAJ	61	135.15	65	133.00	3	< 5,000PE	225mm Clay	10-20years	134.08	137.70	3.63	3m - 5m	27	< 200	59.0	40m - 60m
522	AMA040	MPAJ	61	135.15	65	133.00	4	< 5,000PE	225mm Clay	10-20years	134.08	137.70	3.63	3m - 5m	27	< 200	59.0	40m - 60m
523	AMA040	MPAJ	69	121.10	68	119.15	3	< 5,000PE	225mm Clay	10-20years	120.13	121.75	1.63	< 3m	28	< 200	55.0	40m - 60m
524	AMA040	MPAJ	65A	130.70	66	125.07	1	< 5,000PE	225mm Clay	10-20years	127.89	129.65	1.77	< 3m	14	< 200	80.0	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
525	AMA040	MPAJ	65A	130.70	66	125.07	2	< 5,000PE	225mm Clay	10-20years	127.89	129.65	1.77	< 3m	14	< 200	80.0	60m - 80m
526	AMA040	MPAJ	65A	130.70	66	125.07	3	< 5,000PE	225mm Clay	10-20years	127.89	129.65	1.77	< 3m	14	< 200	80.0	60m - 80m
527	AMA040	MPAJ	26	115.30	27	111.55	4	< 5,000PE	225mm Clay	10-20years	113.43	114.75	1.33	< 3m	20	< 200	74.0	60m - 80m
528	AMA040	MPAJ	32	115.80	33	113.25	4	< 5,000PE	225mm Clay	10-20years	114.53	115.75	1.22	< 3m	29	< 200	75.0	60m - 80m
529	GSG061	MPSpg	D2	43.20	D1/2	42.60	3	< 5,000PE	300mm Clay	10-20years	42.90	44.66	1.76	< 3m	50	< 200	30.0	20m - 40m
530	GSG061	MPSpg	D6	48.80	D5	47.00	2	< 5,000PE	300mm Clay	10-20years	47.90	49.50	1.60	< 3m	21	< 200	38.0	20m - 40m
531	GSG061	MPSpg	D6	48.80	D5	47.00	3	< 5,000PE	300mm Clay	10-20years	47.90	49.50	1.60	< 3m	21	< 200	38.0	20m - 40m
532	GSG061	MPSpg	D6	48.80	D5	47.00	4	< 5,000PE	300mm Clay	10-20years	47.90	49.50	1.60	< 3m	21	< 200	38.0	20m - 40m
533	GSG061	MPSpg	D7	50.35	D6	48.80	3	< 5,000PE	225mm Clay	10-20years	49.58	50.93	1.36	< 3m	43	< 200	66.0	60m - 80m
534	GSG061	MPSpg	D7	50.35	D6	48.80	4	< 5,000PE	225mm Clay	10-20years	49.58	50.93	1.36	< 3m	43	< 200	66.0	60m - 80m
535	HLT176	MPKjg	28C	33.69	52	33.41	1	< 5,000PE	225mm Clay	10-20years	33.55	37.96	4.41	3m - 5m	181	< 200	50.6	40m - 60m
536	HLT176	MPKjg	28C	33.69	52	33.41	2	< 5,000PE	225mm Clay	10-20years	33.55	37.96	4.41	3m - 5m	181	< 200	50.6	40m - 60m
537	HLT176	MPKjg	28C	33.69	52	33.41	4	< 5,000PE	225mm Clay	10-20years	33.55	37.96	4.41	3m - 5m	181	< 200	50.6	40m - 60m
538	HLT176	MPKjg	28C	33.69	52	33.41	5	< 5,000PE	225mm Clay	10-20years	33.55	37.96	4.41	3m - 5m	181	< 200	50.6	40m - 60m
539	HLT176	MPKjg	13	41.70	22	41.50	3	< 5,000PE	225mm Clay	10-20years	41.60	48.43	6.83	> 5m	289	200 - 400	57.9	40m - 60m
540	HLT176	MPKjg	12	41.95	13	41.70	1	< 5,000PE	225mm Clay	10-20years	41.83	46.92	5.10	> 5m	310	200 - 400	77.5	60m - 80m
541	HLT176	MPKjg	12	41.95	13	41.70	3	< 5,000PE	225mm Clay	10-20years	41.83	46.92	5.10	> 5m	310	200 - 400	77.5	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
542	HLT176	MPKjg	51	34.63	52	33.41	2	< 5,000PE	225mm Clay	10-20years	34.02	38.19	4.17	3m - 5m	51	< 200	62.3	60m - 80m
543	HLT176	MPKjg	51	34.63	52	33.41	4	< 5,000PE	225mm Clay	10-20years	34.02	38.19	4.17	3m - 5m	51	< 200	62.3	60m - 80m
544	HLT176	MPKjg	50	35.70	50A	35.24	2	< 5,000PE	225mm Clay	10-20years	35.47	40.55	5.08	> 5m	68	< 200	31.4	20m - 40m
545	HLT176	MPKjg	50	35.70	50A	35.24	4	< 5,000PE	225mm Clay	10-20years	35.47	40.55	5.08	> 5m	68	< 200	31.4	20m - 40m
546	HLT127	MPKjg	72	38.80	73	38.57	1	5,000PE - 10,000PE	300mm Clay	10-20years	38.69	43.03	4.35	3m - 5m	348	200 - 400	80.0	60m - 80m
547	HLT127	MPKjg	72	38.80	73	38.57	3	5,000PE - 10,000PE	300mm Clay	10-20years	38.69	43.03	4.35	3m - 5m	348	200 - 400	80.0	60m - 80m
548	HLT127	MPKjg	102	36.15	103	35.90	1	< 5,000PE	225mm Clay	10-20years	36.03	38.40	2.38	< 3m	180	< 200	45.0	40m - 60m
549	HLT103	MPKjg	P8	92.05	P9	91.89	1	< 5,000PE	225mm Clay	10-20years	91.97	103.28	11.31	> 5m	316	200 - 400	50.6	40m - 60m
550	HLT103	MPKjg	B12	94.02	P18	86.74	2	< 5,000PE	225mm Clay	10-20years	90.38	102.33	11.95	> 5m	10	< 200	75.6	60m - 80m
551	HLT103	MPKjg	P16	87.89	P17	87.50	2	< 5,000PE	300mm Clay	10-20years	87.70	100.53	12.84	> 5m	92	< 200	36.0	20m - 40m
552	HLT103	MPKjg	P16	87.89	P17	87.50	4	< 5,000PE	300mm Clay	10-20years	87.70	100.53	12.84	> 5m	92	< 200	36.0	20m - 40m
553	HLT103	MPKjg	P19	86.41	STP	85.90	1	5,000PE - 10,000PE	300mm Clay	10-20years	86.16	100.65	14.50	> 5m	39	< 200	20.0	< 20m
554	HLT103	MPKjg	P13	89.21	P14	88.72	3	< 5,000PE	300mm Clay	10-20years	88.97	101.20	12.24	> 5m	81	< 200	39.6	20m - 40m
555	HLT103	MPKjg	P12	89.77	P13	89.21	2	< 5,000PE	225mm Clay	10-20years	89.49	101.31	11.82	> 5m	76	< 200	42.6	40m - 60m
556	HLT103	MPKjg	P9	91.89	P10	90.84	1	< 5,000PE	225mm Clay	10-20years	91.37	101.92	10.56	> 5m	40	< 200	41.5	40m - 60m
557	HLT103	MPKjg	B10	96.26	B11	93.26	1	< 5,000PE	225mm Clay	10-20years	94.76	107.67	12.91	> 5m	25	< 200	76.2	60m - 80m
558	HLT103	MPKjg	B10	96.26	B11	93.26	3	< 5,000PE	225mm Clay	10-20years	94.76	107.67	12.91	> 5m	25	< 200	76.2	60m - 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
570	AMA141	MPAJ	4	69.00	13	68.50	1	5,000PE - 10,000PE	300mm Clay	5-10years	68.75	73.80	5.05	> 5m	80	< 200	40.0	20m - 40m
560	AMA141	MPAJ	4	69.00	13	68.50	1	5,000PE - 10,000PE	300mm Clay	5-10years	68.75	73.80	5.05	> 5m	80	< 200	40.0	20m - 40m
561	AMA141	MPAJ	4	69.00	13	68.50	4	5,000PE - 10,000PE	300mm Clay	5-10years	68.75	73.80	5.05	> 5m	80	< 200	40.0	20m - 40m
562	AMA141	MPAJ	4	69.00	13	68.50	5	5,000PE - 10,000PE	300mm Clay	5-10years	68.75	73.80	5.05	> 5m	80	< 200	40.0	20m - 40m
563	AMA141	MPAJ	5	69.30	4	69.00	2	5,000PE - 10,000PE	300mm Clay	5-10years	69.15	72.10	2.95	< 3m	129	< 200	38.8	20m - 40m
564	AMA141	MPAJ	5	69.30	4	69.00	3	5,000PE - 10,000PE	300mm Clay	5-10years	69.15	72.10	2.95	< 3m	129	< 200	38.8	20m - 40m
565	AMA141	MPAJ	5	69.30	4	69.00	4	5,000PE - 10,000PE	300mm Clay	5-10years	69.15	72.10	2.95	< 3m	129	< 200	38.8	20m - 40m
566	AMA141	MPAJ	6	70.00	5	69.30	2	5,000PE - 10,000PE	300mm Clay	5-10years	69.65	72.40	2.75	< 3m	25	< 200	17.2	< 20m
567	AMA141	MPAJ	6	70.00	5	69.30	3	5,000PE - 10,000PE	300mm Clay	5-10years	69.65	72.40	2.75	< 3m	25	< 200	17.2	< 20m
568	AMA141	MPAJ	8	70.60	7	70.25	3	5,000PE - 10,000PE	300mm Clay	5-10years	70.43	72.40	1.98	< 3m	108	< 200	37.7	20m - 40m
569	AMA141	MPAJ	7	70.25	6	70.00	3	5,000PE - 10,000PE	300mm Clay	5-10years	70.13	72.40	2.28	< 3m	145	< 200	36.2	20m - 40m
570	AMA141	MPAJ	13	68.50	2	68.30	1	5,000PE - 10,000PE	300mm Clay	5-10years	68.40	73.40	5.00	> 5m	190	< 200	38.0	20m - 40m
571	AMA141	MPAJ	13	68.50	2	68.30	2	5,000PE - 10,000PE	300mm Clay	5-10years	68.40	73.40	5.00	> 5m	190	< 200	38.0	20m - 40m
572	AMA141	MPAJ	2	68.30	1	68.00	1	5,000PE - 10,000PE	300mm Clay	5-10years	68.15	73.40	5.25	> 5m	128	< 200	38.4	20m - 40m
573	AMA079	MPAJ	A18	55.80	A17	55.60	3	5,000PE - 10,000PE	300mm Clay	10-20years	55.70	58.30	2.60	< 3m	254	200 - 400	50.8	40m - 60m
574	AMA079	MPAJ	A18	55.80	A17	55.60	1	5,000PE - 10,000PE	300mm Clay	5-10years	55.70	58.30	2.60	< 3m	254	200 - 400	50.8	40m - 60m
575	AMA079	MPAJ	A18	55.80	A17	55.60	2	5,000PE - 10,000PE	300mm Clay	10-20years	55.70	58.30	2.60	< 3m	254	200 - 400	50.8	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
576	AMA079	MPAJ	A17	55.60	A16	55.30	5	5,000PE - 10,000PE	300mm Clay	10-20years	55.45	58.30	2.85	< 3m	169	< 200	50.8	40m - 60m
577	AMA077	MPAJ	47	45.00	43	44.00	2	5,000PE - 10,000PE	300mm Clay	> 20years	44.50	47.00	2.50	< 3m	65	< 200	65.0	60m - 80m
578	AMA077	MPAJ	47	45.00	43	44.00	3	5,000PE - 10,000PE	300mm Clay	> 20years	44.50	47.00	2.50	< 3m	65	< 200	65.0	60m - 80m
579	AMA077	MPAJ	47	45.00	43	44.00	4	5,000PE - 10,000PE	300mm Clay	> 20years	44.50	47.00	2.50	< 3m	65	< 200	65.0	60m - 80m
580	AMA077	MPAJ	47	45.00	43	44.00	5	5,000PE - 10,000PE	300mm Clay	> 20years	44.50	47.00	2.50	< 3m	65	< 200	65.0	60m - 80m
581	AMA077	MPAJ	43	44.00	42	43.50	3	5,000PE - 10,000PE	300mm Clay	> 20years	43.75	46.00	2.25	< 3m	120	< 200	60.0	40m - 60m
582	AMA077	MPAJ	43	44.00	42	43.50	4	5,000PE - 10,000PE	300mm Clay	> 20years	43.75	46.00	2.25	< 3m	120	< 200	60.0	40m - 60m
583	AMA077	MPAJ	43	44.00	42	43.50	5	5,000PE - 10,000PE	300mm Clay	> 20years	43.75	46.00	2.25	< 3m	120	< 200	60.0	40m - 60m
584	AMA077	MPAJ	19	42.30	18	41.90	3	5,000PE - 10,000PE	300mm Clay	> 20years	42.10	45.00	2.90	< 3m	154	< 200	61.7	60m - 80m
585	AMA077	MPAJ	19	42.30	18	41.90	4	5,000PE - 10,000PE	300mm Clay	> 20years	42.10	45.00	2.90	< 3m	154	< 200	61.7	60m - 80m
586	AMA077	MPAJ	18	41.90	17	41.60	3	5,000PE - 10,000PE	300mm Clay	> 20years	41.75	44.20	2.45	< 3m	91	< 200	27.4	20m - 40m
587	AMA077	MPAJ	17	41.60	16	41.20	3	5,000PE - 10,000PE	300mm Clay	> 20years	41.40	45.00	3.60	3m - 5m	64	< 200	25.5	20m - 40m
588	AMA163	MPAJ	B3	55.88	B4	55.21	1	5,000PE - 10,000PE	300mm Clay	< 5years	55.55	58.30	2.76	< 3m	97	< 200	65.0	60m - 80m
589	AMA163	MPAJ	B3	55.88	B4	55.21	2	5,000PE - 10,000PE	300mm Clay	< 5years	55.55	58.30	2.76	< 3m	97	< 200	65.0	60m - 80m
590	AMA163	MPAJ	B4	55.21	B5	54.86	1	5,000PE - 10,000PE	300mm Clay	< 5years	55.04	58.00	2.97	< 3m	166	< 200	58.0	40m - 60m
591	AMA163	MPAJ	B5	54.86	B6	54.55	1	5,000PE - 10,000PE	300mm Clay	< 5years	54.71	57.40	2.70	< 3m	171	< 200	53.0	40m - 60m
592	AMA163	MPAJ	B6	54.55	B7	54.12	1	5,000PE - 10,000PE	300mm Clay	< 5years	54.34	58.00	3.67	3m - 5m	128	< 200	55.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
593	AMA148	MPAJ	5	59.29	6	59.00	1	5,000PE - 10,000PE	375mm Clay	5-10years	59.15	62.10	2.96	< 3m	121	< 200	35.0	20m - 40m
594	AMA148	MPAJ	5	59.29	6	59.00	2	5,000PE - 10,000PE	375mm Clay	5-10years	59.15	62.10	2.96	< 3m	121	< 200	35.0	20m - 40m
595	AMA148	MPAJ	5	59.29	6	59.00	3	5,000PE - 10,000PE	375mm Clay	5-10years	59.15	62.10	2.96	< 3m	121	< 200	35.0	20m - 40m
596	AMA148	MPAJ	5	59.29	6	59.00	4	5,000PE - 10,000PE	375mm Clay	5-10years	59.15	62.10	2.96	< 3m	121	< 200	35.0	20m - 40m
597	AMA148	MPAJ	6	59.00	7	58.88	1	5,000PE - 10,000PE	375mm Clay	5-10years	58.94	61.90	2.96	< 3m	250	200 - 400	30.0	20m - 40m
598	AMA148	MPAJ	6	59.00	7	58.88	2	5,000PE - 10,000PE	375mm Clay	5-10years	58.94	61.90	2.96	< 3m	250	200 - 400	30.0	20m - 40m
599	AMA148	MPAJ	7	58.88	8	58.72	1	5,000PE - 10,000PE	375mm Clay	5-10years	58.80	61.70	2.90	< 3m	200	200 - 400	32.0	20m - 40m
600	AMA148	MPAJ	7	58.88	8	58.72	2	5,000PE - 10,000PE	375mm Clay	5-10years	58.80	61.70	2.90	< 3m	200	200 - 400	32.0	20m - 40m
601	AMA148	MPAJ	9	58.65	10	58.50	2	5,000PE - 10,000PE	375mm Clay	5-10years	58.58	61.50	2.93	< 3m	267	200 - 400	40.0	20m - 40m
602	AMA148	MPAJ	10	58.50	11	58.20	1	5,000PE - 10,000PE	375mm Clay	5-10years	58.35	63.00	4.65	3m - 5m	133	< 200	40.0	20m - 40m
603	AMA148	MPAJ	10	58.50	11	58.20	2	5,000PE - 10,000PE	375mm Clay	5-10years	58.35	63.00	4.65	3m - 5m	133	< 200	40.0	20m - 40m
604	AMA148	MPAJ	10	58.50	11	58.20	3	5,000PE - 10,000PE	375mm Clay	5-10years	58.35	63.00	4.65	3m - 5m	133	< 200	40.0	20m - 40m
605	AMA148	MPAJ	12	57.90	13	57.70	1	5,000PE - 10,000PE	375mm Clay	5-10years	57.80	62.75	4.95	3m - 5m	190	< 200	38.0	20m - 40m
606	HLT127	MPKjg	82	39.65	83	37.27	1	5,000PE - 10,000PE	375mm Clay	10-20years	38.46	41.40	2.94	< 3m	19	< 200	45.0	40m - 60m
607	HLT127	MPKjg	82	39.65	83	37.27	2	5,000PE - 10,000PE	375mm Clay	10-20years	38.46	41.40	2.94	< 3m	19	< 200	45.0	40m - 60m
608	HLT127	MPKjg	82	39.65	83	37.27	3	5,000PE - 10,000PE	375mm Clay	10-20years	38.46	41.40	2.94	< 3m	19	< 200	45.0	40m - 60m
609	HLT127	MPKjg	82	39.65	83	37.27	4	5,000PE - 10,000PE	375mm Clay	10-20years	38.46	41.40	2.94	< 3m	19	< 200	45.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
610	HLT127	MPKjg	82	39.65	83	37.27	5	5,000PE - 10,000PE	375mm Clay	10-20years	38.46	41.40	2.94	< 3m	19	< 200	45.0	40m - 60m
611	HLT127	MPKjg	83	37.27	86	37.14	1	5,000PE - 10,000PE	375mm Clay	10-20years	37.21	40.15	2.95	< 3m	346	200 - 400	45.0	40m - 60m
612	HLT127	MPKjg	83	37.27	86	37.14	2	5,000PE - 10,000PE	375mm Clay	10-20years	37.21	40.15	2.95	< 3m	346	200 - 400	45.0	40m - 60m
613	HLT127	MPKjg	83	37.27	86	37.14	3	5,000PE - 10,000PE	375mm Clay	10-20years	37.21	40.15	2.95	< 3m	346	200 - 400	45.0	40m - 60m
614	HLT127	MPKjg	83	37.27	86	37.14	4	5,000PE - 10,000PE	375mm Clay	10-20years	37.21	40.15	2.95	< 3m	346	200 - 400	45.0	40m - 60m
615	HLT127	MPKjg	83	37.27	86	37.14	5	5,000PE - 10,000PE	375mm Clay	10-20years	37.21	40.15	2.95	< 3m	346	200 - 400	45.0	40m - 60m
616	HLT127	MPKjg	86	37.14	87	36.28	2	5,000PE - 10,000PE	375mm Clay	10-20years	36.71	39.70	2.99	< 3m	60	< 200	52.0	40m - 60m
617	HLT127	MPKjg	86	37.14	87	36.28	3	5,000PE - 10,000PE	375mm Clay	10-20years	36.71	39.70	2.99	< 3m	60	< 200	52.0	40m - 60m
618	HLT127	MPKjg	87	36.28	88	35.98	3	5,000PE - 10,000PE	375mm Clay	10-20years	36.13	39.10	2.97	< 3m	200	200 - 400	60.0	40m - 60m
619	HLT127	MPKjg	88	35.98	89	35.71	3	5,000PE - 10,000PE	375mm Clay	10-20years	35.85	38.80	2.96	< 3m	200	200 - 400	54.0	40m - 60m
620	HLT127	MPKjg	89	35.71	90	35.45	3	5,000PE - 10,000PE	375mm Clay	10-20years	35.58	38.55	2.97	< 3m	215	200 - 400	56.0	40m - 60m
621	HLT127	MPKjg	89	35.71	90	35.45	4	5,000PE - 10,000PE	375mm Clay	10-20years	35.58	38.55	2.97	< 3m	215	200 - 400	56.0	40m - 60m
622	HLT127	MPKjg	90	35.45	91	34.35	4	5,000PE - 10,000PE	375mm Clay	10-20years	34.90	37.85	2.95	< 3m	68	< 200	75.0	60m - 80m
623	KLR071	DBKL	6-5-14A	38.60	6-5-13A	38.20	4	5,000PE - 10,000PE	375mm Clay	> 20years	38.40	41.30	2.90	< 3m	280	200 - 400	112.0	> 80m
624	KLR071	DBKL	6-5-14A	38.60	6-5-13A	38.20	5	5,000PE - 10,000PE	375mm Clay	> 20years	38.40	41.30	2.90	< 3m	280	200 - 400	112.0	> 80m
625	KLR071	DBKL	6-5-13A	38.20	6-5-12A	37.80	5	5,000PE - 10,000PE	375mm Clay	> 20years	38.00	40.90	2.90	< 3m	195	< 200	78.0	60m - 80m
626	KLR071	DBKL	6-5-12A	37.80	6-5-11A	37.50	5	5,000PE - 10,000PE	375mm Clay	> 20years	37.65	40.60	2.95	< 3m	300	200 - 400	90.0	> 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
627	KLR071	DBKL	6-5-11A	37.50	6-5-10A	37.15	3	5,000PE - 10,000PE	375mm Clay	> 20years	37.33	40.60	3.28	3m - 5m	291	200 - 400	102.0	> 80m
628	KLR071	DBKL	6-5-11A	37.50	6-5-10A	37.15	4	5,000PE - 10,000PE	375mm Clay	> 20years	37.33	40.60	3.28	3m - 5m	291	200 - 400	102.0	> 80m
629	KLR071	DBKL	6-5-10A	37.15	6-5-9B	36.90	4	5,000PE - 10,000PE	375mm Clay	> 20years	37.03	41.50	4.48	3m - 5m	452	400 - 600	113.0	> 80m
630	KLR071	DBKL	6-5-9B	36.90	6-5-9A	36.65	1	10,000PE - 20,000PE	375mm Clay	> 20years	36.78	42.00	5.23	> 5m	272	200 - 400	68.0	60m - 80m
631	KLR071	DBKL	6-5-9B	36.90	6-5-9A	36.65	2	10,000PE - 20,000PE	375mm Clay	> 20years	36.78	42.00	5.23	> 5m	272	200 - 400	68.0	60m - 80m
632	KLR071	DBKL	6-5-9A	36.65	6-5-8A	36.10	2	10,000PE - 20,000PE	375mm Clay	10-20years	36.38	42.00	5.63	> 5m	153	< 200	84.0	> 80m
633	GSG100	MPSpg	31	7.13	1-G	5.99	1	5,000PE - 10,000PE	450mm Concrete	5-10years	6.56	10.00	3.44	3m - 5m	69	< 200	79.0	60m - 80m
634	GSG100	MPSpg	31	7.13	1-G	5.99	3	5,000PE - 10,000PE	450mm Concrete	5-10years	6.56	10.00	3.44	3m - 5m	69	< 200	79.0	60m - 80m
635	GSG100	MPSpg	1-G	5.99	1-H	5.20	1	5,000PE - 10,000PE	450mm Concrete	5-10years	5.60	10.00	4.41	3m - 5m	101	< 200	80.0	60m - 80m
636	AMA120	MPAJ	A23	43.25	A22	42.85	1	5,000PE - 10,000PE	450mm Concrete	10-20years	43.05	47.50	4.45	3m - 5m	138	< 200	55.0	40m - 60m
637	AMA120	MPAJ	A23	43.25	A22	42.85	2	5,000PE - 10,000PE	450mm Concrete	10-20years	43.05	47.50	4.45	3m - 5m	138	< 200	55.0	40m - 60m
638	AMA120	MPAJ	A23	43.25	A22	42.85	3	5,000PE - 10,000PE	450mm Concrete	10-20years	43.05	47.50	4.45	3m - 5m	138	< 200	55.0	40m - 60m
639	AMA120	MPAJ	A22	42.85	A21	42.35	2	5,000PE - 10,000PE	450mm Concrete	10-20years	42.60	46.80	4.20	3m - 5m	116	< 200	58.0	40m - 60m
640	AMA120	MPAJ	A22	42.85	A21	42.35	3	5,000PE - 10,000PE	450mm Concrete	10-20years	42.60	46.80	4.20	3m - 5m	116	< 200	58.0	40m - 60m
641	AMA120	MPAJ	A22a	43.15	A22	42.85	2	5,000PE - 10,000PE	450mm Concrete	10-20years	43.00	46.50	3.50	3m - 5m	193	< 200	58.0	40m - 60m
642	AMA120	MPAJ	A25	43.76	A24	43.38	1	5,000PE - 10,000PE	450mm Concrete	10-20years	43.57	50.50	6.93	> 5m	158	< 200	60.0	40m - 60m
643	AMA163	MPAJ	A2	56.80	A1	56.70	1	10,000PE - 20,000PE	375mm Clay	< 5years	56.75	61.50	4.75	3m - 5m	350	200 - 400	35.0	20m - 40m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
644	AMA163	MPAJ	A2	56.80	A1	56.70	2	10,000PE - 20,000PE	375mm Clay	< 5years	56.75	61.50	4.75	3m - 5m	350	200 - 400	35.0	20m - 40m
645	AMA163	MPAJ	A2	56.80	A1	56.70	3	10,000PE - 20,000PE	375mm Clay	< 5years	56.75	61.50	4.75	3m - 5m	350	200 - 400	35.0	20m - 40m
646	AMA163	MPAJ	A2	56.80	A1	56.70	4	10,000PE - 20,000PE	375mm Clay	< 5years	56.75	61.50	4.75	3m - 5m	350	200 - 400	35.0	20m - 40m
647	AMA163	MPAJ	A1	56.70	A1a	56.50	1	10,000PE - 20,000PE	375mm Clay	< 5years	56.60	61.30	4.70	3m - 5m	150	< 200	30.0	20m - 40m
648	AMA163	MPAJ	A1	56.70	A1a	56.50	2	10,000PE - 20,000PE	375mm Clay	< 5years	56.60	61.30	4.70	3m - 5m	150	< 200	30.0	20m - 40m
649	AMA163	MPAJ	A1	56.70	A1a	56.50	3	10,000PE - 20,000PE	375mm Clay	< 5years	56.60	61.30	4.70	3m - 5m	150	< 200	30.0	20m - 40m
650	AMA163	MPAJ	A1a	56.50	A1b	56.20	2	10,000PE - 20,000PE	375mm Clay	< 5years	56.35	61.30	4.95	3m - 5m	67	< 200	20.0	< 20m
651	GSG100	MPSpg	1-H	5.20	1-I	4.80	1	10,000PE - 20,000PE	450mm Concrete	5-10years	5.00	9.80	4.80	3m - 5m	200	200 - 400	80.0	60m - 80m
652	GSG100	MPSpg	1-H	5.20	1-I	4.80	2	10,000PE - 20,000PE	450mm Concrete	5-10years	5.00	9.80	4.80	3m - 5m	200	200 - 400	80.0	60m - 80m
653	GSG100	MPSpg	1-H	5.20	1-I	4.80	3	10,000PE - 20,000PE	450mm Concrete	5-10years	5.00	9.80	4.80	3m - 5m	200	200 - 400	80.0	60m - 80m
654	GSG100	MPSpg	1-H	5.20	1-I	4.80	4	10,000PE - 20,000PE	450mm Concrete	5-10years	5.00	9.80	4.80	3m - 5m	200	200 - 400	80.0	60m - 80m
655	GSG100	MPSpg	1-H	5.20	1-I	4.80	5	10,000PE - 20,000PE	450mm Concrete	5-10years	5.00	9.80	4.80	3m - 5m	200	200 - 400	80.0	60m - 80m
656	GSG100	MPSpg	1-I	4.80	1-J	4.50	2	10,000PE - 20,000PE	450mm Concrete	5-10years	4.65	9.50	4.85	3m - 5m	200	200 - 400	60.0	40m - 60m
657	GSG100	MPSpg	1-I	4.80	1-J	4.50	3	10,000PE - 20,000PE	450mm Concrete	5-10years	4.65	9.50	4.85	3m - 5m	200	200 - 400	60.0	40m - 60m
658	GSG100	MPSpg	1-I	4.80	1-J	4.50	4	10,000PE - 20,000PE	450mm Concrete	5-10years	4.65	9.50	4.85	3m - 5m	200	200 - 400	60.0	40m - 60m
659	GSG100	MPSpg	1-J	4.50	1-K	4.00	2	10,000PE - 20,000PE	450mm Concrete	5-10years	4.25	9.20	4.95	3m - 5m	100	< 200	50.0	40m - 60m
660	GSG100	MPSpg	1-J	4.50	1-K	4.00	3	10,000PE - 20,000PE	450mm Concrete	5-10years	4.25	9.20	4.95	3m - 5m	100	< 200	50.0	40m - 60m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
661	GSG100	MPSpg	1-J	4.50	1-K	4.00	1	10,000PE - 20,000PE	450mm Concrete	5-10years	4.25	9.80	5.55	> 5m	60	< 200	30.0	20m - 40m
662	GSG062	MPSpg	PP4	56.40	PP5	56.05	1	10,000PE - 20,000PE	450mm Concrete	10-20years	56.23	60.60	4.38	3m - 5m	189	< 200	66.0	60m - 80m
663	GSG062	MPSpg	PP4	56.40	PP5	56.05	2	10,000PE - 20,000PE	450mm Concrete	10-20years	56.23	60.60	4.38	3m - 5m	189	< 200	66.0	60m - 80m
664	GSG062	MPSpg	PP4	56.40	PP5	56.05	3	10,000PE - 20,000PE	450mm Concrete	10-20years	56.23	60.60	4.38	3m - 5m	189	< 200	66.0	60m - 80m
665	GSG062	MPSpg	PP4	56.40	PP5	56.05	4	10,000PE - 20,000PE	450mm Concrete	10-20years	56.23	60.60	4.38	3m - 5m	189	< 200	66.0	60m - 80m
666	GSG062	MPSpg	PP4	56.40	PP5	56.05	5	10,000PE - 20,000PE	450mm Concrete	10-20years	56.23	60.60	4.38	3m - 5m	189	< 200	66.0	60m - 80m
667	GSG062	MPSpg	PP5	56.05	PP6	55.80	1	10,000PE - 20,000PE	450mm Concrete	10-20years	55.93	60.50	4.58	3m - 5m	132	< 200	33.0	20m - 40m
668	GSG062	MPSpg	PP5	56.05	PP6	55.80	2	10,000PE - 20,000PE	450mm Concrete	10-20years	55.93	60.50	4.58	3m - 5m	132	< 200	33.0	20m - 40m
669	GSG062	MPSpg	PP5	56.05	PP6	55.80	3	10,000PE - 20,000PE	450mm Concrete	10-20years	55.93	60.50	4.58	3m - 5m	132	< 200	33.0	20m - 40m
670	GSG062	MPSpg	PP1	56.30	PP2	55.90	2	10,000PE - 20,000PE	450mm Concrete	10-20years	56.10	60.00	3.90	3m - 5m	145	< 200	58.0	40m - 60m
671	GSG062	MPSpg	PP1	56.30	PP2	55.90	3	10,000PE - 20,000PE	450mm Concrete	10-20years	56.10	60.00	3.90	3m - 5m	145	< 200	58.0	40m - 60m
672	GSG062	MPSpg	PP2	55.90	PP3	55.65	2	10,000PE - 20,000PE	450mm Concrete	10-20years	55.78	60.20	4.43	3m - 5m	136	< 200	34.0	20m - 40m
673	AMA077	MPAJ	5	42.00	4	41.70	1	10,000PE - 20,000PE	450mm Concrete	> 20years	41.85	45.80	3.95	3m - 5m	91	< 200	27.4	20m - 40m
674	AMA077	MPAJ	5	42.00	4	41.70	2	10,000PE - 20,000PE	450mm Concrete	> 20years	41.85	45.80	3.95	3m - 5m	91	< 200	27.4	20m - 40m
675	AMA077	MPAJ	5	42.00	4	41.70	3	10,000PE - 20,000PE	450mm Concrete	> 20years	41.85	45.80	3.95	3m - 5m	91	< 200	27.4	20m - 40m
676	AMA077	MPAJ	5	42.00	4	41.70	4	10,000PE - 20,000PE	450mm Concrete	> 20years	41.85	45.80	3.95	3m - 5m	91	< 200	27.4	20m - 40m
677	AMA077	MPAJ	5	42.00	4	41.70	5	10,000PE - 20,000PE	450mm Concrete	> 20years	41.85	45.80	3.95	3m - 5m	91	< 200	27.4	20m - 40m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
678	AMA077	MPAJ	4	41.70	3	41.35	2	10,000PE - 20,000PE	450mm Concrete	> 20years	41.53	45.80	4.27	3m - 5m	113	< 200	39.6	20m - 40m
679	AMA077	MPAJ	4	41.70	3	41.35	3	10,000PE - 20,000PE	450mm Concrete	> 20years	41.53	45.80	4.27	3m - 5m	113	< 200	39.6	20m - 40m
680	AMA077	MPAJ	4	41.70	3	41.35	4	10,000PE - 20,000PE	450mm Concrete	> 20years	41.53	45.80	4.27	3m - 5m	113	< 200	39.6	20m - 40m
681	AMA077	MPAJ	3	41.35	2	41.00	2	10,000PE - 20,000PE	450mm Concrete	> 20years	41.18	45.80	4.63	3m - 5m	105	< 200	36.6	20m - 40m
682	AMA077	MPAJ	3	41.35	2	41.00	3	10,000PE - 20,000PE	450mm Concrete	> 20years	41.18	45.80	4.63	3m - 5m	105	< 200	36.6	20m - 40m
683	AMA077	MPAJ	3	41.35	2	41.00	5	10,000PE - 20,000PE	450mm Concrete	> 20years	41.18	45.80	4.63	3m - 5m	105	< 200	36.6	20m - 40m
684	AMA077	MPAJ	2	41.00	1	40.70	1	10,000PE - 20,000PE	450mm Concrete	> 20years	40.85	46.00	5.15	> 5m	122	< 200	36.6	20m - 40m
685	AMA077	MPAJ	2	41.00	1	40.70	2	10,000PE - 20,000PE	450mm Concrete	> 20years	40.85	46.00	5.15	> 5m	122	< 200	36.6	20m - 40m
686	HLT010	MPKjg	161	82.50	162	81.20	2	> 20,000PE	500mm Concrete	> 20years	81.85	88.50	6.65	> 5m	28	< 200	37.0	20m - 40m
687	HLT010	MPKjg	161	82.50	162	81.20	3	> 20,000PE	500mm Concrete	> 20years	81.85	88.50	6.65	> 5m	28	< 200	37.0	20m - 40m
688	HLT010	MPKjg	161	82.50	162	81.20	4	> 20,000PE	500mm Concrete	> 20years	81.85	88.50	6.65	> 5m	28	< 200	37.0	20m - 40m
689	HLT010	MPKjg	161	82.50	162	81.20	5	> 20,000PE	500mm Concrete	> 20years	81.85	88.50	6.65	> 5m	28	< 200	37.0	20m - 40m
690	HLT010	MPKjg	156	82.90	161	82.50	2	> 20,000PE	500mm Concrete	> 20years	82.70	88.30	5.60	> 5m	230	200 - 400	92.0	> 80m
691	HLT010	MPKjg	156	82.90	161	82.50	3	> 20,000PE	500mm Concrete	> 20years	82.70	88.30	5.60	> 5m	230	200 - 400	92.0	> 80m
692	HLT010	MPKjg	156	82.90	161	82.50	4	> 20,000PE	500mm Concrete	> 20years	82.70	88.30	5.60	> 5m	230	200 - 400	92.0	> 80m
693	HLT010	MPKjg	155	83.25	156	82.90	2	> 20,000PE	500mm Concrete	> 20years	83.08	88.30	5.22	> 5m	263	200 - 400	92.0	> 80m
694	HLT010	MPKjg	155	83.25	156	82.90	3	> 20,000PE	500mm Concrete	> 20years	83.08	88.30	5.22	> 5m	263	200 - 400	92.0	> 80m

No.	Catch-ment	LA	MH (US)	US IL (m)	MH (DS)	DS IL (m)	Pipe Defect Grade	Range Flow (PE)	Pipe Type	Service Period (year)	Avg. IL (m)	Avg. GL (m)	Avg. Pipe Depth (m)	Range Pipe Depth (m)	Gradient (1:x)	Range Gradient	Pipe Length (m)	Range Pipe Length (m)
695	HLT010	MPKjg	154	83.70	155	83.25	2	> 20,000PE	500mm Concrete	> 20years	83.48	88.50	5.03	> 5m	129	< 200	58.0	40m - 60m
696	AMA163	MPAJ	a	52.00	b	51.90	3	< 5,000PE	225mm Clay	< 5years	51.95	54.80	2.85	< 3m	820	> 600	82.0	> 80m
697	HLT176	MPKjg	a	43.20	b	43.10	1	< 5,000PE	225mm Clay	10-20years	43.15	47.30	4.15	3m - 5m	700	> 600	70.0	60m - 80m
698	HLT176	MPKjg	a	37.30	b	37.20	1	< 5,000PE	225mm Clay	10-20years	37.25	41.00	3.75	3m - 5m	550	400 - 600	55.0	40m - 60m
699	HLT176	MPKjg	a	37.30	b	37.20	2	< 5,000PE	225mm Clay	10-20years	37.25	41.00	3.75	3m - 5m	550	400 - 600	55.0	40m - 60m
700	HLT127	MPKjg	a	35.00	b	34.90	1	5,000PE - 10,000PE	300mm Clay	10-20years	34.95	37.20	2.25	< 3m	420	400 - 600	42.0	40m - 60m
701	AMA141	MPAJ	a	71.10	b	70.90	2	5,000PE - 10,000PE	300mm Clay	5-10years	71.00	73.60	2.60	< 3m	250	200 - 400	50.0	40m - 60m
702	AMA077	MPAJ	a	48.20	b	47.80	4	10,000PE - 20,000PE	450mm Concrete	> 20years	48.00	53.50	5.50	> 5m	187	< 200	75.0	60m - 80m
703	HLT127	MPKjg	a	35.60	b	35.20	4	10,000PE - 20,000PE	375mm Clay	10-20years	35.40	38.00	2.60	< 3m	163	< 200	65.0	60m - 80m

APPENDIX C

Pilot Test Results

Sample ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	Actual Defect Grade	w_1	w_2	w_3	F_f	CI Value	Simula-ted Defect Grade
P001	Category 1	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.48	0.99	5
P002	Category 1	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.48	0.99	5
P003	Category 1	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.48	0.99	5
P004	Category 1	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.48	0.99	5
P005	Category 1	< 3m	1:200 – 1:400	> 20years	4	1.00	0.43	1.00	0.48	0.80	4
P006	Category 2	< 3m	1:400 – 1:600	10-20years	2	1.00	0.13	0.85	0.10	0.14	
P007	Category 1	< 3m	< 1:200	10-20years	4	1.00	1.00	0.85	0.48	0.94	
P008	Category 3	< 3m	< 1:200	10-20years	5	1.00	1.00	0.85	0.24	0.47	5
P009	Category 7	> 5m	1:400 – 1:600	10-20years	2	0.24	0.13	0.85	0.11	0.09	2
P010	Category 7	> 5m	< 1:200	> 20years	3	0.24	1.00	1.00	0.11	0.17	
P011	Category 7	> 5m	< 1:200	10-20years	2	0.24	1.00	0.85	0.11	0.16	
P012	Category 1	> 5m	< 1:200	10-20years	2	0.24	1.00	0.85	0.48	0.69	
P013	Category 2	> 5m	1:200 – 1:400	10-20years	3	0.24	0.43	0.85	0.10	0.10	
P014	Category 2	3m - 5m	< 1:200	10-20years	3	0.58	1.00	0.85	0.10	0.17	
P015	Category 2	> 5m	< 1:200	10-20years	3	0.24	1.00	0.85	0.10	0.14	3
P016	Category 1	> 5m	< 1:200	10-20years	3	0.24	1.00	0.85	0.48	0.69	3
P017	Category 6	> 5m	1:400 – 1:600	10-20years	1	0.24	0.13	0.85	0.02	0.02	
P018	Category 2	< 3m	1:200 – 1:400	10-20years	4	1.00	0.43	0.85	0.10	0.16	4
P019	Category 2	< 3m	1:200 – 1:400	10-20years	4	1.00	0.43	0.85	0.10	0.16	4
P020	Category 1	< 3m	< 1:200	10-20years	4	1.00	1.00	0.85	0.48	0.94	
P021	Category 1	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.48	0.80	4
P022	Category 1	< 3m	< 1:200	10-20years	5	1.00	1.00	0.85	0.48	0.94	5
P023	Category 1	< 3m	< 1:200	10-20years	5	1.00	1.00	0.85	0.48	0.94	5
P024	Category 1	< 3m	1:200 – 1:400	10-20years	4	1.00	0.43	0.85	0.48	0.75	4
P025	Category 1	3m - 5m	1:200 – 1:400	10-20years	3	0.58	0.43	0.85	0.48	0.62	3
P026	Category 8	> 5m	1:400 – 1:600	10-20years	2	0.24	0.13	0.85	0.02	0.02	2
P027	Category 4	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.07	0.12	4
P028	Category 8	> 5m	1:400 – 1:600	10-20years	2	0.24	0.13	0.85	0.02	0.02	2
P029	Category 7	> 5m	1:400 – 1:600	10-20years	3	0.24	0.13	0.85	0.11	0.09	
P030	Category 7	> 5m	1:400 – 1:600	10-20years	2	0.24	0.13	0.85	0.11	0.09	2
P031	Category 1	< 3m	1:200 – 1:400	10-20years	4	1.00	0.43	0.85	0.48	0.75	4
P032	Category 9	> 5m	1:200 – 1:400	10-20years	2	0.24	0.43	0.85	0.07	0.07	2
P033	Category 9	> 5m	1:400 – 1:600	10-20years	3	0.24	0.13	0.85	0.07	0.06	
P034	Category 1	< 3m	1:200 – 1:400	5-10years	2	1.00	0.43	0.29	0.48	0.57	
P035	Category 3	3m - 5m	1:400 – 1:600	10-20years	2	0.58	0.13	0.85	0.24	0.26	2
P036	Category 3	3m - 5m	1:200 – 1:400	10-20years	3	0.58	0.43	0.85	0.24	0.31	3
P037	Category 1	< 3m	1:200 – 1:400	10-20years	3	1.00	0.43	0.85	0.48	0.75	
P038	Category 1	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.48	0.80	4
P039	Category 3	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.24	0.40	4
P040	Category 3	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.24	0.40	4
P041	Category 1	< 3m	1:200 – 1:400	10-20years	3	1.00	0.43	0.85	0.48	0.75	
P042	Category 1	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.48	0.80	4
P043	Category 1	> 5m	< 1:200	10-20years	3	0.24	1.00	0.85	0.48	0.69	3
P044	Category 1	> 5m	< 1:200	10-20years	2	0.24	1.00	0.85	0.48	0.69	
P045	Category 1	> 5m	< 1:200	10-20years	2	0.24	1.00	0.85	0.48	0.69	
P046	Category 1	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.48	0.80	4
P047	Category 1	> 5m	< 1:200	10-20years	4	0.24	1.00	0.85	0.48	0.69	
P048	Category 1	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.48	0.80	4
P049	Category 1	> 5m	< 1:200	10-20years	2	0.24	1.00	0.85	0.48	0.69	
P050	Category 1	> 5m	< 1:200	10-20years	3	0.24	1.00	0.85	0.48	0.69	3
P051	Category 1	> 5m	< 1:200	5-10years	2	0.24	1.00	0.29	0.48	0.51	2
P052	Category 1	< 3m	< 1:200	5-10years	3	1.00	1.00	0.29	0.48	0.76	
P053	Category 3	3m - 5m	< 1:200	5-10years	2	0.58	1.00	0.29	0.24	0.31	
P054	Category 1	3m - 5m	< 1:200	5-10years	2	0.58	1.00	0.29	0.48	0.62	
P055	Category 1	< 3m	< 1:200	5-10years	3	1.00	1.00	0.29	0.48	0.76	
P056	Category 1	< 3m	< 1:200	5-10years	3	1.00	1.00	0.29	0.48	0.76	
P057	Category 1	3m - 5m	1:200 – 1:400	5-10years	2	0.58	0.43	0.29	0.48	0.43	2

Sample ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	Actual Defect Grade	w_1	w_2	w_3	F_f	CI Value	Simula-ted Defect Grade
P058	Category 2	> 5m	1:200 – 1:400	10-20years	2	0.24	0.43	0.85	0.10	0.10	2
P059	Category 1	< 3m	< 1:200	10-20years	5	1.00	1.00	0.85	0.48	0.94	5
P060	Category 1	< 3m	< 1:200	10-20years	4	1.00	1.00	0.85	0.48	0.94	
P061	Category 2	3m - 5m	< 1:200	10-20years	3	0.58	1.00	0.85	0.10	0.17	
P062	Category 2	3m - 5m	1:200 – 1:400	10-20years	3	0.58	0.43	0.85	0.10	0.13	3
P063	Category 2	3m - 5m	1:200 – 1:400	10-20years	2	0.58	0.43	0.85	0.10	0.13	
P064	Category 5	3m - 5m	< 1:200	> 20years	4	0.58	1.00	1.00	0.10	0.18	
P065	Category 7	3m - 5m	< 1:200	> 20years	4	0.58	1.00	1.00	0.11	0.20	4
P066	Category 1	< 3m	< 1:200	5-10years	3	1.00	1.00	0.29	0.48	0.76	
P067	Category 1	< 3m	< 1:200	5-10years	3	1.00	1.00	0.29	0.48	0.76	
P068	Category 1	< 3m	< 1:200	< 5years	3	1.00	1.00	0.11	0.48	0.70	3
P069	Category 1	< 3m	< 1:200	< 5years	3	1.00	1.00	0.11	0.48	0.70	3
P070	Category 1	< 3m	< 1:200	< 5years	2	1.00	1.00	0.11	0.48	0.70	
P071	Category 1	< 3m	< 1:200	< 5years	2	1.00	1.00	0.11	0.48	0.70	
P072	Category 1	< 3m	> 1:600	5-10years	2	1.00	0.02	0.29	0.48	0.43	2
P073	Category 8	> 5m	1:200 – 1:400	5-10years	1	0.24	0.43	0.29	0.02	0.01	1
P074	Category 8	> 5m	< 1:200	5-10years	1	0.24	1.00	0.29	0.02	0.02	
P075	Category 3	3m - 5m	1:200 – 1:400	5-10years	2	0.58	0.43	0.29	0.24	0.22	2
P076	Category 1	3m - 5m	< 1:200	5-10years	3	0.58	1.00	0.29	0.48	0.62	3
P077	Category 1	< 3m	1:400 – 1:600	5-10years	3	1.00	0.13	0.29	0.48	0.47	
P078	Category 1	> 5m	< 1:200	< 5years	1	0.24	1.00	0.11	0.48	0.45	
P079	Category 5	< 3m	< 1:200	10-20years	5	1.00	1.00	0.85	0.10	0.20	5
P080	Category 1	< 3m	< 1:200	5-10years	4	1.00	1.00	0.29	0.48	0.76	4
P081	Category 1	< 3m	< 1:200	5-10years	4	1.00	1.00	0.29	0.48	0.76	4
P082	Category 1	3m - 5m	< 1:200	5-10years	3	0.58	1.00	0.29	0.48	0.62	3
P083	Category 1	< 3m	< 1:200	5-10years	4	1.00	1.00	0.29	0.48	0.76	4
P084	Category 1	3m - 5m	< 1:200	5-10years	2	0.58	1.00	0.29	0.48	0.62	
P085	Category 1	< 3m	1:200 – 1:400	> 20years	4	1.00	0.43	1.00	0.48	0.80	4
P086	Category 3	> 5m	1:200 – 1:400	> 20years	3	0.24	0.43	1.00	0.24	0.28	3
P087	Category 1	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.48	0.99	5
P088	Category 1	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.48	0.99	5
P089	Category 1	< 3m	1:200 – 1:400	> 20years	4	1.00	0.43	1.00	0.48	0.80	4
P090	Category 1	< 3m	> 1:600	10-20years	2	1.00	0.02	0.85	0.48	0.62	
P091	Category 1	< 3m	1:200 – 1:400	10-20years	3	1.00	0.43	0.85	0.48	0.75	
P092	Category 3	3m - 5m	< 1:200	< 5years	3	0.58	1.00	0.11	0.24	0.28	3
P093	Category 3	3m - 5m	1:200 – 1:400	< 5years	2	0.58	0.43	0.11	0.24	0.19	
P094	Category 3	3m - 5m	1:200 – 1:400	< 5years	1	0.58	0.43	0.11	0.24	0.19	1
P095	Category 1	< 3m	1:200 – 1:400	< 5years	1	1.00	0.43	0.11	0.48	0.51	
P096	Category 1	< 3m	< 1:200	< 5years	2	1.00	1.00	0.11	0.48	0.70	
P097	Category 1	< 3m	< 1:200	< 5years	3	1.00	1.00	0.11	0.48	0.70	3
P098	Category 1	< 3m	< 1:200	< 5years	2	1.00	1.00	0.11	0.48	0.70	
P099	Category 1	< 3m	1:200 – 1:400	< 5years	2	1.00	0.43	0.11	0.48	0.51	2
P100	Category 1	< 3m	< 1:200	< 5years	3	1.00	1.00	0.11	0.48	0.70	3
P101	Category 1	< 3m	1:200 – 1:400	< 5years	2	1.00	0.43	0.11	0.48	0.51	2
P102	Category 1	3m - 5m	< 1:200	< 5years	4	0.58	1.00	0.11	0.48	0.56	
P103	Category 5	3m - 5m	1:400 – 1:600	< 5years	1	0.58	0.13	0.11	0.10	0.06	1
P104	Category 3	3m - 5m	< 1:200	< 5years	3	0.58	1.00	0.11	0.24	0.28	3
P105	Category 1	3m - 5m	1:200 – 1:400	< 5years	1	0.58	0.43	0.11	0.48	0.37	1
P106	Category 1	3m - 5m	1:200 – 1:400	< 5years	1	0.58	0.43	0.11	0.48	0.37	1
P107	Category 1	3m - 5m	1:200 – 1:400	< 5years	2	0.58	0.43	0.11	0.48	0.37	
P108	Category 1	< 3m	< 1:200	10-20years	5	1.00	1.00	0.85	0.48	0.94	5
P109	Category 1	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.48	0.80	4
P110	Category 1	< 3m	< 1:200	10-20years	4	1.00	1.00	0.85	0.48	0.94	
P111	Category 1	< 3m	< 1:200	10-20years	4	1.00	1.00	0.85	0.48	0.94	
P112	Category 1	< 3m	< 1:200	10-20years	4	1.00	1.00	0.85	0.48	0.94	
P113	Category 1	3m - 5m	< 1:200	10-20years	4	0.58	1.00	0.85	0.48	0.80	4
P114	Category 1	> 5m	< 1:200	10-20years	4	0.24	1.00	0.85	0.48	0.69	
P115	Category 3	3m - 5m	1:200 – 1:400	10-20years	3	0.58	0.43	0.85	0.24	0.31	3
P116	Category 1	> 5m	1:200 – 1:400	10-20years	1	0.24	0.43	0.85	0.48	0.50	
P117	Category 1	> 5m	< 1:200	10-20years	2	0.24	1.00	0.85	0.48	0.69	
P118	Category 3	> 5m	< 1:200	10-20years	1	0.24	1.00	0.85	0.24	0.35	
P119	Category 2	> 5m	< 1:200	10-20years	3	0.24	1.00	0.85	0.10	0.14	3
P120	Category 1	> 5m	< 1:200	10-20years	2	0.24	1.00	0.85	0.48	0.69	

Sample ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	Actual Defect Grade	w_1	w_2	w_3	F_f	CI Value	Simula-ted Defect Grade
P121	Category 1	> 5m	< 1:200	10-20years	3	0.24	1.00	0.85	0.48	0.69	3
P122	Category 3	< 3m	< 1:200	5-10years	4	1.00	1.00	0.29	0.24	0.38	4
P123	Category 3	< 3m	< 1:200	5-10years	3	1.00	1.00	0.29	0.24	0.38	
P124	Category 3	< 3m	< 1:200	5-10years	3	1.00	1.00	0.29	0.24	0.38	
P125	Category 3	> 5m	< 1:200	5-10years	2	0.24	1.00	0.29	0.24	0.25	2
P126	Category 3	> 5m	< 1:200	5-10years	1	0.24	1.00	0.29	0.24	0.25	
P127	Category 3	< 3m	< 1:200	10-20years	5	1.00	1.00	0.85	0.24	0.47	5
P128	Category 3	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.24	0.50	5
P129	Category 3	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.24	0.50	5
P130	Category 3	< 3m	< 1:200	> 20years	4	1.00	1.00	1.00	0.24	0.50	
P131	Category 3	< 3m	< 1:200	< 5years	2	1.00	1.00	0.11	0.24	0.35	
P132	Category 4	< 3m	< 1:200	5-10years	4	1.00	1.00	0.29	0.07	0.11	4
P133	Category 4	< 3m	1:200 – 1:400	5-10years	2	1.00	0.43	0.29	0.07	0.08	2
P134	Category 4	< 3m	1:200 – 1:400	5-10years	2	1.00	0.43	0.29	0.07	0.08	2
P135	Category 4	< 3m	1:200 – 1:400	5-10years	2	1.00	0.43	0.29	0.07	0.08	2
P136	Category 4	3m - 5m	< 1:200	5-10years	3	0.58	1.00	0.29	0.07	0.09	3
P137	Category 4	< 3m	< 1:200	10-20years	5	1.00	1.00	0.85	0.07	0.14	5
P138	Category 4	< 3m	1:200 – 1:400	10-20years	5	1.00	0.43	0.85	0.07	0.11	
P139	Category 4	< 3m	1:200 – 1:400	10-20years	4	1.00	0.43	0.85	0.07	0.11	4
P140	Category 4	< 3m	< 1:200	10-20years	4	1.00	1.00	0.85	0.07	0.14	
P141	Category 4	< 3m	< 1:200	> 20years	5	1.00	1.00	1.00	0.07	0.14	5
P142	Category 6	3m - 5m	< 1:200	10-20years	2	0.58	1.00	0.85	0.02	0.03	2
P143	Category 5	3m - 5m	< 1:200	< 5years	3	0.58	1.00	0.11	0.10	0.12	3
P144	Category 5	3m - 5m	< 1:200	< 5years	2	0.58	1.00	0.11	0.10	0.12	
P145	Category 7	3m - 5m	< 1:200	5-10years	3	0.58	1.00	0.29	0.11	0.14	3
P146	Category 7	3m - 5m	< 1:200	> 20years	4	0.58	1.00	1.00	0.11	0.20	4
P147	Category 9	> 5m	1:200 – 1:400	> 20years	3	0.24	0.43	1.00	0.07	0.08	3
P148	Category 1	3m - 5m	1:400 – 1:600	10-20years	2	0.58	0.13	0.85	0.48	0.52	2
P149	Category 3	< 3m	1:200 – 1:400	5-10years	2	1.00	0.43	0.29	0.24	0.28	
P150	Category 7	> 5m	< 1:200	> 20years	4	0.24	1.00	1.00	0.11	0.17	4

APPENDIX D

Simulation Data

Simu-lation ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	w_1	w_2	w_3	F_f	CI Value	Simulated Defect Grade
S001	Category 1	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.48	0.99	5
S002	Category 1	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.48	0.94	5
S003	Category 1	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.48	0.76	4
S004	Category 1	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.48	0.70	3
S005	Category 1	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.48	0.80	4
S006	Category 1	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.48	0.75	4
S007	Category 1	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.48	0.57	3
S008	Category 1	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.48	0.51	2
S009	Category 1	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.48	0.71	4
S010	Category 1	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.48	0.66	3
S011	Category 1	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.48	0.47	2
S012	Category 1	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.48	0.41	2
S013	Category 1	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.48	0.67	3
S014	Category 1	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.48	0.62	3
S015	Category 1	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.48	0.43	2
S016	Category 1	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.48	0.37	1
S017	Category 1	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.48	0.85	4
S018	Category 1	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.48	0.80	4
S019	Category 1	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.48	0.62	3
S020	Category 1	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.48	0.56	3
S021	Category 1	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.48	0.67	3
S022	Category 1	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.48	0.62	3
S023	Category 1	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.48	0.43	2
S024	Category 1	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.48	0.37	1
S025	Category 1	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.48	0.57	3
S026	Category 1	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.48	0.52	2
S027	Category 1	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.48	0.33	1
S028	Category 1	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.48	0.27	1
S029	Category 1	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.48	0.53	2
S030	Category 1	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.48	0.48	2
S031	Category 1	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.48	0.29	1
S032	Category 1	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.48	0.24	1
S033	Category 1	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.48	0.74	4
S034	Category 1	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.48	0.69	3
S035	Category 1	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.48	0.51	2
S036	Category 1	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.48	0.45	2
S037	Category 1	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.48	0.55	2
S038	Category 1	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.48	0.50	2
S039	Category 1	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.48	0.32	1
S040	Category 1	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.48	0.26	1
S041	Category 1	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.48	0.45	2
S042	Category 1	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.48	0.40	1
S043	Category 1	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.48	0.22	1
S044	Category 1	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.48	0.16	1
S045	Category 1	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.48	0.42	2
S046	Category 1	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.48	0.37	1
S047	Category 1	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.48	0.18	1
S048	Category 1	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.48	0.12	1
S049	Category 2	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.10	0.21	5
S050	Category 2	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.10	0.20	5
S051	Category 2	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.10	0.16	4
S052	Category 2	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.10	0.15	3
S053	Category 2	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.10	0.17	4
S054	Category 2	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.10	0.16	4
S055	Category 2	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.10	0.12	3
S056	Category 2	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.10	0.11	2
S057	Category 2	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.10	0.15	3
S058	Category 2	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.10	0.14	3

Simulation ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	w_1	w_2	w_3	F_f	CI Value	Simulated Defect Grade
S059	Category 2	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.10	0.10	2
S060	Category 2	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.10	0.09	2
S061	Category 2	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.10	0.14	3
S062	Category 2	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.10	0.13	3
S063	Category 2	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.10	0.09	2
S064	Category 2	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.10	0.08	1
S065	Category 2	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.10	0.18	5
S066	Category 2	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.10	0.17	4
S067	Category 2	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.10	0.13	3
S068	Category 2	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.10	0.12	3
S069	Category 2	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.10	0.14	3
S070	Category 2	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.10	0.13	3
S071	Category 2	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.10	0.09	2
S072	Category 2	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.10	0.08	1
S073	Category 2	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.10	0.12	3
S074	Category 2	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.10	0.11	2
S075	Category 2	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.10	0.07	1
S076	Category 2	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.10	0.06	1
S077	Category 2	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.10	0.11	2
S078	Category 2	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.10	0.10	2
S079	Category 2	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.10	0.06	1
S080	Category 2	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.10	0.05	1
S081	Category 2	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.10	0.15	3
S082	Category 2	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.10	0.14	3
S083	Category 2	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.10	0.11	2
S084	Category 2	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.10	0.09	2
S085	Category 2	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.10	0.12	3
S086	Category 2	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.10	0.10	2
S087	Category 2	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.10	0.07	1
S088	Category 2	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.10	0.05	1
S089	Category 2	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.10	0.09	2
S090	Category 2	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.10	0.08	1
S091	Category 2	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.10	0.05	1
S092	Category 2	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.10	0.03	1
S093	Category 2	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.10	0.09	2
S094	Category 2	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.10	0.08	1
S095	Category 2	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.10	0.04	1
S096	Category 2	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.10	0.03	1
S097	Category 3	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.24	0.50	5
S098	Category 3	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.24	0.47	5
S099	Category 3	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.24	0.38	4
S100	Category 3	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.24	0.35	3
S101	Category 3	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.24	0.40	4
S102	Category 3	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.24	0.38	4
S103	Category 3	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.24	0.28	3
S104	Category 3	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.24	0.25	2
S105	Category 3	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.24	0.35	3
S106	Category 3	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.24	0.33	3
S107	Category 3	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.24	0.24	2
S108	Category 3	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.24	0.21	2
S109	Category 3	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.24	0.33	3
S110	Category 3	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.24	0.31	3
S111	Category 3	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.24	0.22	2
S112	Category 3	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.24	0.19	1
S113	Category 3	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.24	0.43	5
S114	Category 3	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.24	0.40	4
S115	Category 3	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.24	0.31	3
S116	Category 3	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.24	0.28	3
S117	Category 3	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.24	0.33	3
S118	Category 3	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.24	0.31	3
S119	Category 3	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.24	0.22	2
S120	Category 3	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.24	0.19	1
S121	Category 3	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.24	0.28	3
S122	Category 3	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.24	0.26	2

Simulation ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	w_1	w_2	w_3	F_f	CI Value	Simulated Defect Grade
S123	Category 3	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.24	0.17	1
S124	Category 3	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.24	0.14	1
S125	Category 3	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.24	0.26	2
S126	Category 3	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.24	0.24	2
S127	Category 3	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.24	0.15	1
S128	Category 3	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.24	0.12	1
S129	Category 3	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.24	0.37	4
S130	Category 3	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.24	0.35	3
S131	Category 3	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.24	0.25	2
S132	Category 3	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.24	0.22	2
S133	Category 3	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.24	0.28	3
S134	Category 3	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.24	0.25	2
S135	Category 3	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.24	0.16	1
S136	Category 3	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.24	0.13	1
S137	Category 3	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.24	0.23	2
S138	Category 3	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.24	0.20	2
S139	Category 3	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.24	0.11	1
S140	Category 3	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.24	0.08	1
S141	Category 3	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.24	0.21	2
S142	Category 3	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.24	0.18	1
S143	Category 3	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.24	0.09	1
S144	Category 3	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.24	0.06	1
S145	Category 4	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.07	0.14	5
S146	Category 4	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.07	0.14	5
S147	Category 4	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.07	0.11	4
S148	Category 4	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.07	0.10	3
S149	Category 4	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.07	0.12	4
S150	Category 4	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.07	0.11	4
S151	Category 4	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.07	0.08	2
S152	Category 4	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.07	0.07	2
S153	Category 4	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.07	0.10	3
S154	Category 4	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.07	0.10	3
S155	Category 4	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.07	0.07	2
S156	Category 4	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.07	0.06	2
S157	Category 4	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.07	0.10	3
S158	Category 4	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.07	0.09	3
S159	Category 4	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.07	0.06	2
S160	Category 4	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.07	0.05	1
S161	Category 4	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.07	0.12	4
S162	Category 4	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.07	0.12	4
S163	Category 4	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.07	0.09	3
S164	Category 4	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.07	0.08	2
S165	Category 4	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.07	0.10	3
S166	Category 4	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.07	0.09	3
S167	Category 4	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.07	0.06	2
S168	Category 4	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.07	0.05	1
S169	Category 4	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.07	0.08	2
S170	Category 4	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.07	0.08	2
S171	Category 4	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.07	0.05	1
S172	Category 4	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.07	0.04	1
S173	Category 4	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.07	0.08	2
S174	Category 4	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.07	0.07	2
S175	Category 4	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.07	0.04	1
S176	Category 4	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.07	0.03	1
S177	Category 4	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.07	0.11	4
S178	Category 4	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.07	0.10	3
S179	Category 4	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.07	0.07	2
S180	Category 4	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.07	0.07	2
S181	Category 4	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.07	0.08	2
S182	Category 4	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.07	0.07	2
S183	Category 4	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.07	0.05	1
S184	Category 4	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.07	0.04	1
S185	Category 4	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.07	0.07	2
S186	Category 4	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.07	0.06	2

Simulation ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	w_1	w_2	w_3	F_f	CI Value	Simulated Defect Grade
S187	Category 4	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.07	0.03	1
S188	Category 4	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.07	0.02	1
S189	Category 4	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.07	0.06	2
S190	Category 4	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.07	0.05	1
S191	Category 4	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.07	0.03	1
S192	Category 4	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.07	0.02	1
S193	Category 5	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.10	0.21	5
S194	Category 5	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.10	0.20	5
S195	Category 5	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.10	0.16	4
S196	Category 5	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.10	0.15	4
S197	Category 5	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.10	0.17	4
S198	Category 5	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.10	0.16	4
S199	Category 5	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.10	0.12	3
S200	Category 5	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.10	0.11	2
S201	Category 5	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.10	0.15	4
S202	Category 5	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.10	0.14	3
S203	Category 5	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.10	0.10	2
S204	Category 5	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.10	0.09	2
S205	Category 5	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.10	0.14	3
S206	Category 5	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.10	0.13	3
S207	Category 5	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.10	0.09	2
S208	Category 5	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.10	0.08	1
S209	Category 5	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.10	0.18	5
S210	Category 5	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.10	0.17	4
S211	Category 5	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.10	0.13	3
S212	Category 5	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.10	0.12	3
S213	Category 5	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.10	0.14	3
S214	Category 5	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.10	0.13	3
S215	Category 5	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.10	0.09	2
S216	Category 5	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.10	0.08	1
S217	Category 5	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.10	0.12	3
S218	Category 5	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.10	0.11	2
S219	Category 5	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.10	0.07	1
S220	Category 5	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.10	0.06	1
S221	Category 5	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.10	0.11	2
S222	Category 5	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.10	0.10	2
S223	Category 5	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.10	0.06	1
S224	Category 5	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.10	0.05	1
S225	Category 5	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.10	0.15	4
S226	Category 5	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.10	0.14	3
S227	Category 5	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.10	0.11	2
S228	Category 5	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.10	0.09	2
S229	Category 5	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.10	0.12	3
S230	Category 5	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.10	0.10	2
S231	Category 5	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.10	0.07	1
S232	Category 5	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.10	0.05	1
S233	Category 5	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.10	0.09	2
S234	Category 5	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.10	0.08	1
S235	Category 5	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.10	0.05	1
S236	Category 5	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.10	0.03	1
S237	Category 5	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.10	0.09	2
S238	Category 5	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.10	0.08	1
S239	Category 5	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.10	0.04	1
S240	Category 5	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.10	0.03	1
S241	Category 6	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.02	0.04	3
S242	Category 6	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.02	0.04	3
S243	Category 6	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.02	0.03	2
S244	Category 6	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.02	0.03	2
S245	Category 6	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.02	0.03	2
S246	Category 6	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.02	0.03	2
S247	Category 6	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.02	0.02	2
S248	Category 6	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.02	0.02	2
S249	Category 6	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.02	0.03	2
S250	Category 6	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.02	0.03	2

Simulation ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	w_1	w_2	w_3	F_f	CI Value	Simulated Defect Grade
S251	Category 6	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.02	0.02	2
S252	Category 6	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.02	0.02	2
S253	Category 6	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.02	0.03	2
S254	Category 6	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.02	0.03	2
S255	Category 6	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.02	0.02	2
S256	Category 6	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.02	0.02	2
S257	Category 6	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.02	0.04	3
S258	Category 6	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.02	0.03	2
S259	Category 6	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.02	0.03	2
S260	Category 6	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.02	0.02	2
S261	Category 6	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.02	0.03	2
S262	Category 6	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.02	0.03	2
S263	Category 6	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.02	0.02	2
S264	Category 6	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.02	0.02	2
S265	Category 6	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.02	0.02	2
S266	Category 6	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.02	0.02	2
S267	Category 6	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.02	0.01	1
S268	Category 6	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.02	0.01	1
S269	Category 6	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.02	0.02	2
S270	Category 6	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.02	0.02	2
S271	Category 6	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.02	0.01	1
S272	Category 6	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.02	0.01	1
S273	Category 6	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.02	0.03	2
S274	Category 6	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.02	0.03	2
S275	Category 6	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.02	0.02	2
S276	Category 6	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.02	0.02	2
S277	Category 6	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.02	0.02	2
S278	Category 6	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.02	0.02	2
S279	Category 6	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.02	0.01	1
S280	Category 6	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.02	0.01	1
S281	Category 6	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.02	0.02	2
S282	Category 6	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.02	0.02	2
S283	Category 6	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.02	0.01	1
S284	Category 6	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.02	0.01	1
S285	Category 6	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.02	0.02	2
S286	Category 6	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.02	0.02	2
S287	Category 6	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.02	0.01	1
S288	Category 6	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.02	0.01	1
S289	Category 7	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.11	0.23	5
S290	Category 7	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.11	0.22	5
S291	Category 7	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.11	0.17	4
S292	Category 7	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.11	0.16	3
S293	Category 7	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.11	0.18	4
S294	Category 7	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.11	0.17	4
S295	Category 7	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.11	0.13	3
S296	Category 7	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.11	0.12	2
S297	Category 7	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.11	0.16	3
S298	Category 7	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.11	0.15	3
S299	Category 7	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.11	0.11	2
S300	Category 7	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.11	0.09	2
S301	Category 7	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.11	0.15	3
S302	Category 7	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.11	0.14	3
S303	Category 7	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.11	0.10	2
S304	Category 7	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.11	0.09	2
S305	Category 7	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.11	0.20	4
S306	Category 7	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.11	0.18	4
S307	Category 7	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.11	0.14	3
S308	Category 7	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.11	0.13	3
S309	Category 7	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.11	0.15	3
S310	Category 7	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.11	0.14	3
S311	Category 7	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.11	0.10	2
S312	Category 7	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.11	0.08	1
S313	Category 7	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.11	0.13	3
S314	Category 7	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.11	0.12	2

Simulation ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	w_1	w_2	w_3	F_f	CI Value	Simulated Defect Grade
S315	Category 7	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.11	0.08	1
S316	Category 7	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.11	0.06	1
S317	Category 7	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.11	0.12	2
S318	Category 7	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.11	0.11	2
S319	Category 7	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.11	0.07	1
S320	Category 7	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.11	0.05	1
S321	Category 7	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.11	0.17	4
S322	Category 7	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.11	0.16	3
S323	Category 7	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.11	0.12	2
S324	Category 7	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.11	0.10	2
S325	Category 7	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.11	0.13	3
S326	Category 7	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.11	0.12	2
S327	Category 7	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.11	0.07	1
S328	Category 7	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.11	0.06	1
S329	Category 7	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.11	0.10	2
S330	Category 7	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.11	0.09	2
S331	Category 7	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.11	0.05	1
S332	Category 7	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.11	0.04	1
S333	Category 7	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.11	0.10	2
S334	Category 7	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.11	0.08	1
S335	Category 7	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.11	0.04	1
S336	Category 7	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.11	0.03	1
S337	Category 8	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.02	0.04	4
S338	Category 8	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.02	0.04	4
S339	Category 8	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.02	0.03	3
S340	Category 8	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.02	0.03	3
S341	Category 8	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.02	0.03	3
S342	Category 8	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.02	0.03	3
S343	Category 8	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.02	0.02	2
S344	Category 8	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.02	0.02	2
S345	Category 8	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.02	0.03	3
S346	Category 8	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.02	0.03	3
S347	Category 8	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.02	0.02	2
S348	Category 8	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.02	0.02	2
S349	Category 8	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.02	0.03	3
S350	Category 8	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.02	0.03	3
S351	Category 8	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.02	0.02	2
S352	Category 8	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.02	0.02	2
S353	Category 8	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.02	0.04	4
S354	Category 8	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.02	0.03	3
S355	Category 8	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.02	0.03	3
S356	Category 8	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.02	0.02	2
S357	Category 8	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.02	0.03	3
S358	Category 8	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.02	0.03	3
S359	Category 8	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.02	0.02	2
S360	Category 8	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.02	0.02	2
S361	Category 8	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.02	0.02	2
S362	Category 8	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.02	0.02	2
S363	Category 8	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.02	0.01	1
S364	Category 8	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.02	0.01	1
S365	Category 8	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.02	0.02	2
S366	Category 8	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.02	0.02	2
S367	Category 8	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.02	0.01	1
S368	Category 8	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.02	0.01	1
S369	Category 8	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.02	0.03	3
S370	Category 8	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.02	0.03	3
S371	Category 8	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.02	0.02	2
S372	Category 8	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.02	0.02	2
S373	Category 8	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.02	0.02	2
S374	Category 8	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.02	0.02	2
S375	Category 8	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.02	0.01	1
S376	Category 8	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.02	0.01	1
S377	Category 8	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.02	0.02	2
S378	Category 8	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.02	0.02	2

Simu-lation ID	Category	Pipe Depth	Pipe Gradient	Pipe Service Period	w_1	w_2	w_3	F_f	CI Value	Simulated Defect Grade
S379	Category 8	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.02	0.01	1
S380	Category 8	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.02	0.01	1
S381	Category 8	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.02	0.02	2
S382	Category 8	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.02	0.02	2
S383	Category 8	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.02	0.01	1
S384	Category 8	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.02	0.01	1
S385	Category 9	< 3m	< 1:200	> 20years	1.00	1.00	1.00	0.07	0.14	5
S386	Category 9	< 3m	< 1:200	10-20years	1.00	1.00	0.85	0.07	0.14	5
S387	Category 9	< 3m	< 1:200	5-10years	1.00	1.00	0.29	0.07	0.11	4
S388	Category 9	< 3m	< 1:200	< 5years	1.00	1.00	0.11	0.07	0.10	3
S389	Category 9	< 3m	1:200 – 1:400	> 20years	1.00	0.43	1.00	0.07	0.12	4
S390	Category 9	< 3m	1:200 – 1:400	10-20years	1.00	0.43	0.85	0.07	0.11	4
S391	Category 9	< 3m	1:200 – 1:400	5-10years	1.00	0.43	0.29	0.07	0.08	3
S392	Category 9	< 3m	1:200 – 1:400	< 5years	1.00	0.43	0.11	0.07	0.07	2
S393	Category 9	< 3m	1:400 – 1:600	> 20years	1.00	0.13	1.00	0.07	0.10	3
S394	Category 9	< 3m	1:400 – 1:600	10-20years	1.00	0.13	0.85	0.07	0.10	3
S395	Category 9	< 3m	1:400 – 1:600	5-10years	1.00	0.13	0.29	0.07	0.07	2
S396	Category 9	< 3m	1:400 – 1:600	< 5years	1.00	0.13	0.11	0.07	0.06	2
S397	Category 9	< 3m	> 1:600	> 20years	1.00	0.02	1.00	0.07	0.10	3
S398	Category 9	< 3m	> 1:600	10-20years	1.00	0.02	0.85	0.07	0.09	3
S399	Category 9	< 3m	> 1:600	5-10years	1.00	0.02	0.29	0.07	0.06	2
S400	Category 9	< 3m	> 1:600	< 5years	1.00	0.02	0.11	0.07	0.05	1
S401	Category 9	3m - 5m	< 1:200	> 20years	0.58	1.00	1.00	0.07	0.12	4
S402	Category 9	3m - 5m	< 1:200	10-20years	0.58	1.00	0.85	0.07	0.12	4
S403	Category 9	3m - 5m	< 1:200	5-10years	0.58	1.00	0.29	0.07	0.09	3
S404	Category 9	3m - 5m	< 1:200	< 5years	0.58	1.00	0.11	0.07	0.08	3
S405	Category 9	3m - 5m	1:200 – 1:400	> 20years	0.58	0.43	1.00	0.07	0.10	3
S406	Category 9	3m - 5m	1:200 – 1:400	10-20years	0.58	0.43	0.85	0.07	0.09	3
S407	Category 9	3m - 5m	1:200 – 1:400	5-10years	0.58	0.43	0.29	0.07	0.06	2
S408	Category 9	3m - 5m	1:200 – 1:400	< 5years	0.58	0.43	0.11	0.07	0.05	1
S409	Category 9	3m - 5m	1:400 – 1:600	> 20years	0.58	0.13	1.00	0.07	0.08	3
S410	Category 9	3m - 5m	1:400 – 1:600	10-20years	0.58	0.13	0.85	0.07	0.08	3
S411	Category 9	3m - 5m	1:400 – 1:600	5-10years	0.58	0.13	0.29	0.07	0.05	1
S412	Category 9	3m - 5m	1:400 – 1:600	< 5years	0.58	0.13	0.11	0.07	0.04	1
S413	Category 9	3m - 5m	> 1:600	> 20years	0.58	0.02	1.00	0.07	0.08	3
S414	Category 9	3m - 5m	> 1:600	10-20years	0.58	0.02	0.85	0.07	0.07	2
S415	Category 9	3m - 5m	> 1:600	5-10years	0.58	0.02	0.29	0.07	0.04	1
S416	Category 9	3m - 5m	> 1:600	< 5years	0.58	0.02	0.11	0.07	0.03	1
S417	Category 9	> 5m	< 1:200	> 20years	0.24	1.00	1.00	0.07	0.11	4
S418	Category 9	> 5m	< 1:200	10-20years	0.24	1.00	0.85	0.07	0.10	3
S419	Category 9	> 5m	< 1:200	5-10years	0.24	1.00	0.29	0.07	0.07	2
S420	Category 9	> 5m	< 1:200	< 5years	0.24	1.00	0.11	0.07	0.07	2
S421	Category 9	> 5m	1:200 – 1:400	> 20years	0.24	0.43	1.00	0.07	0.08	3
S422	Category 9	> 5m	1:200 – 1:400	10-20years	0.24	0.43	0.85	0.07	0.07	2
S423	Category 9	> 5m	1:200 – 1:400	5-10years	0.24	0.43	0.29	0.07	0.05	1
S424	Category 9	> 5m	1:200 – 1:400	< 5years	0.24	0.43	0.11	0.07	0.04	1
S425	Category 9	> 5m	1:400 – 1:600	> 20years	0.24	0.13	1.00	0.07	0.07	2
S426	Category 9	> 5m	1:400 – 1:600	10-20years	0.24	0.13	0.85	0.07	0.06	2
S427	Category 9	> 5m	1:400 – 1:600	5-10years	0.24	0.13	0.29	0.07	0.03	1
S428	Category 9	> 5m	1:400 – 1:600	< 5years	0.24	0.13	0.11	0.07	0.02	1
S429	Category 9	> 5m	> 1:600	> 20years	0.24	0.02	1.00	0.07	0.06	2
S430	Category 9	> 5m	> 1:600	10-20years	0.24	0.02	0.85	0.07	0.05	1
S431	Category 9	> 5m	> 1:600	5-10years	0.24	0.02	0.29	0.07	0.03	1
S432	Category 9	> 5m	> 1:600	< 5years	0.24	0.02	0.11	0.07	0.02	1

APPENDIX E

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STRUCTURAL ASSESSMENT OFOPEN CHANNEL SEWER PIPE IN MALAYSIA USING CCTV INVESTIGATION AND PACP GRADING SYSTEM

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ABSTRACT

The deteriorating sewer pipe structural condition in Malaysia is affecting its main function which is transporting sewage to sewage treatment plant (STP). The deteriorating condition also affects other structures surrounding it. Assessing the sewage flow will help to assemble the related static and dynamic factors of structural design in sewer pipe; therefore, assist in mitigating the problem. The main objective of this study is to develop a prediction tool for the structural condition in open channel sewer pipe in order to facilitate operator in estimating the degradation risk of a certain sewer pipe. Closed-circuit television (CCTV) investigation was used to observe the structural condition of sewer pipe; therefore, it can be classified using pipeline assessment and certification program (PACP) grading system. The Markov chain model was later used to predict the future structural condition in open channel sewer pipe prior to the development of prediction tool. A total of 36.6 km length of sewer pipe which covers an estimated 22.5% of total length of sewer pipe within the study area was assessed.

Keywords: Sewage treatment plant, Open channel sewer pipepipeline assessment and certification program (PACP), Closed-circuit television (CCTV)