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Engineering the Future

# HERVEY BAY CITY COUNCIL

# URANGAN DRAINAGE STUDY - ELIZABETH ST PIER STREET PILOT STREET GUARD STREET

## ULTIMATE DEVELOPMENT SCENARIO

**Revised Final Report**

**JULY 2003**
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# URANGAN DRAINAGE STUDY
# REVISED FINAL REPORT

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# EXECUTIVE SUMMARY

The majority of the Urangan Coastal Strip between Elizabeth Street and Pulgul Street is low lying, with ground elevations in some areas less than RL 2.0 m AHD. Large areas have ground levels less than RL 4.0 m AHD. In comparison, the level of the Highest Astronomic Tide is RL 2.1 m AHD. Due to existing low ground levels and the fact that a natural ridge exists along the foreshore, properties within the Urangan catchment are regularly inundated during storm events. The problem is presently exacerbated by an undersized stormwater drainage system.

It has been determined that the cost of constructing relief drainage works to conventional design standards would be prohibitively expensive. The cost of the drainage works, which would need to be apportioned between landowners within the catchment, would act as a significant deterrent to redevelopment in the future.

However, a subsequent Concept Design Phase Investigation identified an innovative and cost effective solution for the region. The solution comprises the following elements:

- Upgrading the main drainage lines in the catchment to convey the minor event flow (2 year or 10 year depending on the requirements for each subcatchment),
- Allowing water to pond in road reserves, particularly during major storm events such as the 20, 50, and 100 year event, and
- Setting fill levels or habitable floor levels which take into account the ponding of water in road reserves.

Allowing water to pond within the catchment during significant flood events minimises the pipe drainage requirements for the catchment. Providing main drain lines capable of conveying the minor event flow minimises the extent of ponding or nuisance flooding during minor storm events which, by definition, occur more frequently than relatively rare major event storms. In addition, the upgraded stormwater drains provide sufficient capacity to ensure that ponded water depths, while a key element of the drainage design, do not become excessive and pose a significant risk to public safety.

Due to the complex nature of the proposed works, detailed modelling of the works was necessary. The detailed modelling, the results of which are presented in this report, confirmed the viability of the drainage scheme and allowed the refinement of the pipe sizes developed during the Concept Design Phase Investigation.

The overall cost of the drainage scheme, including the construction of gross pollutant traps at the downstream end of each of the four main drainage lines, is M$3.62.

It is important to note the following with regard to the derived drainage scheme and this report:

- By taking advantage of the storage available in the road reserve, the drainage scheme does not rigorously comply with the requirements of the *Queensland Urban Drainage Manual* and the *Hervey Bay City Council Development Manual* for new developments.

  However, the proposed works are relief drainage works, and the *Queensland Urban Drainage Manual* permits the relaxation of design standards for relief works in order that cost effective solutions can be implemented. It is estimated that drainage works to achieve full compatibility to the requirements of the *Queensland Urban Drainage Manual* for the Urangan Coastal Strip would cost well in excess of M$10 (Gutteridge Haskins and Davey 1996, Drainage Strategy No. 41). Such a cost is likely to compromise the viability of future development in the catchment. In comparison, the cost of the relief drainage works proposed for the coastal strip are considered to be within reason.

- The main report presents calculated flood levels for the 20, 50, and 100 year major storm events. The choice of immunity level for buildings does not affect the cost of relief drainage works as the pipe sizes adopted for the catchment are largely governed by minor (2 and 10 year) event storms. For example, the adoption of a 50 year immunity level only allows a reduction in the minimum habitable floor level or fill level compared to that required for the 100 year event.

- The modelling has considered the ultimate extent of development within the catchment and has assumed that private properties have been filled to above the major event storm level. Council can decide whether to impose a fill requirement or to simply accept a minimum floor level for each property as development or redevelopment applications are assessed.

- The original final report was issued in February 2000 and was revised in 2003 to reflect a reduction in catchment area afforded by the development of a site at the corner of Elizabeth Street and Dayman Street and the redirection of runoff from the site to the adjacent Lowlands catchment.

In summary, detailed modelling has confirmed the viability of a cost effective relief drainage scheme for the Urangan Coastal Strip between Elizabeth Street and Pulgul Street. Required pipe sizes and development levels are shown on Figures 2, 3, and 4 for the 20, 50, and 100 year events respectively.

# 1.0 INTRODUCTION

## 1.1 Overview

The majority of the Urangan Coastal Strip between Elizabeth Street and Pulgul Street is relatively low lying, with ground elevations in some areas less than RL 2.0 m AHD. Large areas have ground levels less than RL 4.0 m AHD. In comparison, the level of Highest Astronomic Tide is RL 2.1 m AHD (Hervey Bay City Council 1997, p 16-14). Due to existing ground levels and the fact that a natural ridge exists along the foreshore, properties within the catchment are regularly inundated during storm events. The problem is presently exacerbated by an undersized stormwater drainage system.

Cardno and Davies was commissioned by Council on 19 October 1998 to conduct a stormwater drainage investigation to determine a cost effective drainage solution which would allow future development within the catchment.

The resultant Concept Design Phase investigation produced a solution which involved a combination of pipe drainage works to convey minor event flows, road regrading to redefine catchment boundaries, and the filling of properties to allow the road reserve to store water during major events without inundating residences.

Due to the reliance of the solution upon storage within the catchment, it was necessary to confirm the viability of the solution using a detailed hydraulic model. Cardno & Davies was commissioned by Hervey Bay City Council in February 1999 to complete the required modelling of the ultimate development scenario.

A final report was prepared in relation to the modelling in February 2000. The report has been revised in 2003 to reflect a reduction in catchment area afforded by the development of a site at the corner of Elizabeth Street and Dayman Street. As a result of the redirection of runoff from the site to the adjacent Lowlands catchment, the size of relief drainage works in Elizabeth Street and Pier Street has been reduced.

Section 2 details the derivation of hydrologic inputs for the model while Section 3 describes the formulation of the hydraulic model. Section 4 presents the results of the analysis and recommended drainage works for each part of the catchment.

## 1.2 Modelling Package

The catchment was analysed using Version 8.5 of the XP Software XP-STORM package (XP Software 2002). XP-STORM replaces the former XP-UDD and EXTRAN hydraulic models.

XP-STORM comprises Runoff and Hydraulic (UDD/EXTRAN) modes to allow the simulation and hydraulic routing of rainfall. The Hydraulic (UDD/EXTRAN) mode of the package is an hydraulic flow routing model for both open channel and closed conduits in dendritic and looped networks. The Hydraulic mode receives hydrograph input at specific nodal locations directly from the output of the Runoff mode of the program. The model uses a combination of implicit and explicit finite difference formulations to dynamically route runoff throughout the modelled drainage system.

The XP-STORM model used for the analysis had the following capabilities:

- Maximum Nodes: 500
- Maximum Links: 500
- Maximum Texts: 40
- Maximum Pictures: 10
- Maximum Cards: 150,000

License options for the model included:

- Profile Plotting
- Pumps/ Orifices
- Full Equations (rather than simple kinematic wave approach for conduits)
- All conduit shapes

A major feature of the program is that data can be input to XP-STORM models entirely via ASCII text files. Extensive use of this facility was made during the investigation to improve the quality of the model and to facilitate data entry. Data was input to EXCEL spreadsheets, output in a suitable text file format and then imported to the XP-STORM model.

# 2.0 HYDROLOGY

## 2.1 Overview

To correctly represent the runoff characteristics of the study area, the 68.34 hectare catchment was divided into a total of 72 subcatchments with an average area of 0.95 hectares, as follows:

- Elizabeth Street (A) 25 subcatchments, total area 20.84 hectares
- Pier Street (B) 14 subcatchments, total area 14.06 hectares
- Pilot Street (C) 12 subcatchments, total area 10.49 hectares
- Guard Street (D) 21 subcatchments, total area 22.96 hectares

The adopted sub catchment layout is shown on **Figure A1- Catchment Definition** of **Appendix A- Hydrologic Data**. Data pertinent to each subcatchment is presented in **Table A1- Catchment Areas, Weighted Runoff Coefficients and Times of Concentration** in Appendix A.

The division of the catchment was based upon internal ridge lines, existing inlets to the stormwater drainage system, and proposed stormwater drainage inlets and road regrading works. Each subcatchment area was assigned to a node in the XP-STORM model.

Hydrographs were derived for each subcatchment for storm durations ranging from fifteen minutes to two hours for events with recurrence intervals of 2, 10, 20, 50, and 100 years. The standard storm durations presented in *Australian Rainfall and Runoff* (Institution of Engineers 1987) were considered applicable to the catchment area. Consequently, storm durations of 15 minutes, 20 minutes, 25 minutes, 30 minutes, 45 minutes, 1 hour, 90 minutes, and 2 hours were considered.

In order to facilitate future modelling of intermediate development scenarios and to provide maximum consistency with the *Queensland Urban Drainage Manual* (QUDM) (Neville Jones & Associates et al 1992) and the *Hervey Bay City Council Development Manual* (Hervey Bay City Council 1997), simplistic runoff hydrographs were derived based on the Rational Method.

## 2.2 Selection of Hydrograph Derivation Method

### 2.2.1 Available Options

The Runoff mode of XP-STORM provides the following methods of hydrograph generation (XP-Software 1998, pp 164-174):

- SWMM Runoff Non-Linear Reservoir Method,
- Kinematic Wave Method,
- Laurenson Non-Linear Method (RAFTS),
- SCS Unit Hydrograph Method,
- Other Unit Hydrograph Methods including:
  - Nash,
  - Santa Barbara Urban Hydrograph,
  - Snyder,
  - Snyder (Alameda Modified),
  - Time Area (ILSAX), and
  - Rational Formula,
- User Defined Hydrograph.

The following sections describe the strengths and weaknesses of the available hydrograph derivation techniques and provide the rationale for the adoption of a Rational Method based approach to the derivation of hydrographs and the use of User Defined hydrographs for the importation of the hydrographs to the hydraulic model.

### 2.2.2 Laurenson Non Linear Method

The Laurenson non-linear method (as applied in the XP Software RAFTS computer model) uses Laurenson's 1964 non-linear runoff routing procedure with modifications by Aitken to allow greater flexibility to model both rural and urban catchments (XP Software 1998, p 167).

Routing of each local subarea is performed using either Muskingum Method or more simplistic lagging by a specified time period, with the storage of each subcatchment being obtained via the following equation:

$$\mathbf{s = B\ q^{(n+1)}}$$

Where: s = volume of storage (hrs.$m^3$/s)
q = instantaneous rate of runoff ($m^3$/s)
n = non-linearity exponent (default value: -0.285)
B = storage delay time coefficient

To provide a suitable value of the B parameter for Australian conditions, Aitken derived the following relationship from on a study of six urban Australian catchments (Aitken 1975, as quoted in XP Software 1998, p 167):

$$\mathbf{B = 0.285\ A^{0.52}\ (1+U)^{-1.97}\ S_c^{-0.50}}$$

Where: A = subcatchment area ($km^2$)
U = urbanisation factor
$S_c$ = main drainage slope of catchment (%)

The Urbanisation factor is calculated from the fraction impervious value of a catchment and varies between zero for a completely pervious catchment, to unity for a catchment with fifty percent impervious area, and to two for a completely impervious catchment area (XP Software 1998, p 168). Subareas within each catchment can be treated as a single area (with an appropriate fraction imperviousness) or as two areas (pervious and impervious) for which individual hydrographs are derived and then combined. Due to the dependence of the B parameter upon the urbanisation factor, the choice of single area or dual area definition for each subarea impacts significantly upon the magnitude of the B parameter and therefore the peak flow calculated for the catchment.

The B parameter is also modified by a multiplication factor (PERN) to account for differences in subcatchment roughness. To differentiate between local catchments with the same degree of urbanisation but different roughnesses the Laurenson (RAFTS) method provides an empirical relationship between the average subcatchment Manning's 'n' and a lag multiplication factor (PERN), which varies between 0.5 for completely impervious areas, to 3.0 for forested catchments (XP Software 1998, p 168).

On catchments where calibration data is available, the procedure typically employed is to adjust loss rates, routing characteristics, PERN values, catchment slopes, and the BX parameter (which allows for the multiplication of the B values derived for each subcatchment by a uniform value) until a satisfactory calibration is achieved.

However, on urban catchments such as the one under investigation in this case, there is usually no data available for model calibration. In order to derive peak flows which can be applied with confidence to the hydraulic model, it is common practice to calibrate the peak flow predicted by the Laurenson (RAFTS) model to the peak flow calculated by the Rational Method according to the *Queensland Urban Drainage Manual* (QUDM) (Neville Jones & Associates et al 1992, Section 5).

To achieve the required calibration, rainfall loss rates, subcatchment slopes, and the BX parameter are typically adjusted within reasonable limits until an acceptable agreement is achieved with QUDM with respect to time of concentration and peak flow rates for each recurrence interval under investigation. The peak flows derived via the Laurenson (RAFTS) method need to agree with those derived according to the QUDM Rational Method for each point of inflow to the hydraulic model. For stormwater drainage analysis, there are normally dozens of inflow points for which hydrographs are required.

Similar studies which have used the Laurenson (RAFTS) method have adopted the following proportional rainfall loss rates in order to achieve acceptable calibration across the range of recurrence intervals considered (Cardno & Davies 1998, Appendix A):

| | | |
|---|---|---|
| • 2 Year Event | Pervious (first) area | 0.4 |
| | Impervious (second) area | 0.23 |
| • 50 Year Event | Pervious (first) area | 0.19 |
| | Impervious (second) area | 0.0 |

Consequently, for a typical urban subarea with a fraction impervious value of 0.5, in order to achieve peak flows consistent with the Rational method, proportional loss rates equivalent to about thirty percent and ten percent of the rainfall incident upon the catchment are required for the 2 year and 50 year events respectively.

Given the formulation of the supporting equations and non-linear nature of the Laurenson (RAFTS) method, it is not possible to exactly match the peak flow and time of concentration predicted by the Rational Method for each subarea and the range of recurrence intervals requiring analysis. The quality of the agreement is also potentially affected when intermediate stages of development are considered due to the method of inclusion of the fraction impervious value in the equation for the derivation of the B parameter.

Of particular importance in this case is the likely future development of the catchment. As the catchment is largely developed with individual lots in private ownership, filling or other redevelopment of blocks is unlikely to occur at a single time or with any significant degree of coordination between groups of land holders. Consequently, development will be staged and require the analysis of a number of intermediate development scenarios. For each intermediate scenario, reliable estimates of the peak flow from various parts of the catchment will be required.

Further, as the results of the analysis will be used as part of the development approval process as redevelopment of the catchment proceeds, to minimise the potential for unnecessary disputes between Council and developers, it is important in the long term that the flows calculated for the ultimate and any intermediate development scenario be derived in accordance with a commonly accepted and understood standard such as the *Queensland Urban Drainage Manual*.

Given the above, it was considered that a hydrograph derivation method which provided the best possible consistency with the QUDM Rational Method was required. For this reason, the Laurenson (RAFTS) method for hydrograph derivation was not used in the study in favour of a method which provided direct compatibility with the Rational Method (refer Section 2.2.4).

### 2.2.3 Time Area Method

The time area method is a unit hydrograph approach which forms the basis of the ILSAX stormwater drainage program (O'Loughlin, 1988). The time area method assumes that each subarea of a catchment will respond in a linear manner to rainfall according to a user defined time of concentration (XP Software 1998, p 173).

Using this model, it is possible to derive hydrographs with peak flow rates which agree exactly with those calculated via the Rational Method. The time of concentration of each subcatchment can be defined according to the *Queensland Urban Drainage Manual* (QUDM) (Neville Jones & Associates et al 1992, pp 5-12 to 5-20). Due to the assumed linear time area relationship, the method produces either triangular (when the storm duration is less than or equal to the time of concentration of the sub area under consideration) or trapezoidal (when the storm duration is greater than the time of concentration of the sub area) shaped hydrographs, with a time to peak (and time to zero following the cessation of rainfall) equivalent to the nominated time of concentration of each subcatchment.

The only drawback with the method is that it is necessary to set separate proportional loss rates for each subarea in order to produce peak flow rate estimates which agree with those of the Rational Method. As each subcatchment differs slightly with respect to fraction impervious and therefore runoff coefficient, it would be necessary to create separate rainfall loss models for each subcatchment. Further, different sets of loss models would be required for each recurrence interval to be investigated in order to allow for the variation in runoff coefficient with recurrence interval.

In the XP-STORM package, rainfall loss rates are defined as individual events and then assigned to each subarea as appropriate. In the case of the study area, a total of 216 separate rainfall loss scenarios would have had to have been defined (three for each subarea) and then assigned to the subareas of the model.

Given this, it was decided not to adopt the Time Area Method in favour of a strictly Rational Method based approach (refer Section 2.2.4).

### 2.2.4 Rational Method/ User Defined Inflows

The XP-STORM package presently supports the generation of hydrographs by the derivation of unit hydrographs according to the Rational Method (XP Software 1998, p173).

For each subarea of a catchment, the time of concentration and runoff coefficient of the subarea is entered and a hydrograph either triangular (when the storm duration is less than or equal to the time of concentration of the sub area under consideration) or trapezoidal (when the storm duration is greater than the time of concentration of the sub area) in shape produced. The hydrograph should have a time to peak (and time to zero following the cessation of rainfall) equivalent to the nominated time of concentration of the subarea concerned.

The method permits the direct specification of times of concentration and runoff coefficients in accordance with the *Queensland Urban Drainage Manual* (QUDM) (Neville Jones & Associates 1992). Consequently, hydrographs with peak flow rates and hydrograph shapes which are entirely consistent with QUDM can be readily produced for any recurrence interval or intermediate development scenario (refer Section 2.2.2). Given this, a Rational Method based approach was considered the most appropriate and adopted for use in the study.

However, during the investigation it was discovered that the time to peak (i.e. time of concentration) of the hydrographs produced by the method was a third greater than the specified time of concentration. When this software error was reported to XP Software, the company indicated that it was aware of the problem and recommended that, due to the error, the method should not be used. Further, the company indicated that it intended to remove the Rational Method generation technique from future releases of the XP-Storm package (XP Software 1999).

As the consideration of available methods had indicated that a Rational Method based approach was optimal for the investigation (refer Section 2.2.2), a solution to the time of concentration problem could have been achieved by the adjustment of specified time of concentration values to provide hydrographs with the required time to peak. However, as it was likely that the hydrograph derivation technique would not be available at a later date, it was decided that such an approach was not acceptable.

Consequently, in order to provide the desired hydrographs based on the Rational Method, recourse was made to the option available in XP-STORM to directly input "User Defined" hydrographs to the model (XP Software 1998, p 148). It can be noted that this technique differs from the other methods of hydrograph generation in that hydrographs are directly input to the model rather than being generated by the Runoff mode of the XP-STORM package. When the Runoff mode of the package is used, the program calculates hydrographs and then generates an interface file which is read at the start of the Hydraulic or EXTRAN mode run. The Runoff and Hydraulic modes of the program are otherwise entirely separate models.

The use of user defined hydrographs obviated the need to use the Runoff mode of the package. Due to the relatively simplistic nature of the hydrographs input to the model, the hydrographs were able to be produced using a spreadsheet. The spreadsheet was formatted in a manner which allowed the output of text files in a format which could be directly input to the model using the XPX file importation option of XP-STORM (XP Software 2002, pp 110-115).

The runoff hydrograph spreadsheet featured a master worksheet containing the following information for each subarea of the catchment:

- Name of nodes in the model to which inflow was to be attached,
- Time of concentration of the subarea
- Total area of the subcatchment
- Breakdown of area into the various zones present within the catchment (eg Foreshore Residential)
- Calculated runoff coefficients for the 2, 10, and 100 year events weighted according to the composition of the subcatchment.

Underlying worksheets took the information presented in the master worksheet and provided tables of hydrographs in XPX file format. For each recurrence interval considered, worksheets were produced for each storm duration requiring investigation. The only information input to the underlying worksheets was the rainfall intensity and storm duration represented by the worksheet.

The contents of each worksheet were output as text files and then imported to the Hydraulic (EXTRAN) mode XP-STORM model as required. The importation of a data file for each storm duration and recurrence interval under investigation was similar in terms of user effort to specifying the interface file which would have been produced if the Runoff mode of the package had been used to derive hydrographs.

Overall, it was considered that the spreadsheet based approach facilitated analysis of the catchment and will provide a superior method for the consideration of intermediate development scenarios or alternate recurrence interval events in the future. Entry of data to a spreadsheet is straightforward (and therefore less prone to human error) compared to the relatively tortuous requirements for data entry directly to the XP-STORM model itself, particularly for users unfamiliar with the model or for those who only need to use the model on an infrequent basis. Obtaining summary printouts of adopted data for particular runs is also facilitated, thereby contributing to quality assurance for the analysis.

In order to provide an acceptable coverage of the range of storm durations which could potentially cause peak flood levels and flows within the catchment, the standard storm durations presented in *Australian Rainfall and Runoff* (Institution of Engineers Australia 1987) were adopted for analysis. It was considered that the time difference between the standard storm durations for the short duration (15 to 20 minute) storms likely to produce peak conditions for minor events was sufficiently small to negate the requirement for the assessment of intermediate durations.

The only potential concern in relation to the use of a hydrographs based on the Rational method was with respect to the runoff volume produced by the hydrograph. As the XP-STORM model was being used in the investigation specifically to account for storage effects, it was important that the model incorporated the likely volume of runoff from the catchment.

The acceptability of the use of the QUDM runoff coefficient as a volumetric runoff coefficient was therefore investigated. Based on the runoff coefficients adopted for each of the various land uses within the study area (refer Section 2.3.2), the following runoff coefficients were found to be typical for the catchment:

- Minor Events
  - 2 Year:0.71 (i.e. loss of 29% of total runoff volume via infiltration)
  - 10 Year: 0.85 (i.e. loss of 15% of total runoff volume via infiltration)

- Major Events
  - 20 Year: 0.89 (i.e. loss of 11% of total runoff volume via infiltration)
  - 50 Year: 0.97 (i.e. loss of 3% of total runoff volume via infiltration)
  - 100 Year: 0.99 (i.e. loss of 1% of total runoff volume via infiltration)

For the major storm event according to the Rational Method, virtually all of the rainfall is converted to runoff. This is consistent with the general practice of assuming catchment saturation at the commencement of a major storm event such as the 100 year event. Consequently, the use of hydrographs based on the Rational Method is acceptable with respect to the volume of runoff for major storm events.

For minor storm events, it is likely that the catchment will not be saturated at the commencement of the event and that therefore some loss of rainfall to infiltration could be expected. The Rational Method runoff coefficient used as a volumetric runoff coefficient predicts a rainfall loss of between 29 percent (2 year event) and 15 percent (10 Year event). In comparison, a similar loss rate was adopted for modelling minor storm events using the Laurenson (RAFTS) method in order to provide flows compatible with QUDM (refer Section 2.2.2).

Consideration of typical soil loss rates and the effect of antecedent weather conditions according to the method of the United States Department of Agriculture (USDA method, as quoted in Chow and Queensland Water Resources 1980) indicated that, for the short storm durations under consideration, loss rates of the order of thirty percent were not unreasonable for the soil types present within the study area.

Therefore, it was concluded that the use of Rational Method peak runoff coefficients as volumetric runoff coefficients provided overall runoff volumes equivalent to those which would be produced via the other commonly used method for hydrograph derivation (i.e. Laurenson (RAFTS)) and which were acceptable with respect to likely infiltration during actual rainfall events.

In summary, it was found that the optimal method for hydrograph derivation given the nature of the catchment and its likely future development was provided by a direct application of the Rational Method. This provided inflow hydrographs entirely consistent with the *Hervey Bay City Council Development Manual* (Hervey Bay City Council 1997) and the *Queensland Urban Drainage Manual.*

## 2.3 Derivation of Hydrologic Parameters

### 2.3.1 Time of Concentration

Section 5.05.4 of the *Queensland Urban Drainage Manual* (QUDM)(Neville Jones & Associates 1992, p 5-15) notes that:

> *"The use of standard inlet times for developed catchments is recommended because of the uncertainty related to the calculation of time of overland flow. The standard inlet times should be adopted except where subcatchment characteristics indicate that detailed overland flow calculations are justified."*

Section 16.3.3 of the Hervey Bay City Council *Development Manual* (Hervey Bay City Council 1997, p 16-6) allows the use of the standard inlet times presented in QUDM.

Given the above and the transparency of calculation offered by the use of standard inlet times, the standard inlet times presented in Table 5.05.1 of QUDM were adopted for the analysis. Due to the relatively low grades within the study area, the majority of the subareas were assigned a time of concentration of 15 minutes. As the inlet time is defined as **"the combined time for overland flow and channel flow to the gully inlet under consideration"** (Neville Jones & Associates et al 1992, p 5-15), the time of concentration at nodes not directly connected to the underground stormwater drainage network was reduced to account for the likely channel (i.e. road) travel time to the closest inlet to the inflow point.

The time of concentration adopted for each subcatchment is shown in **Table A1- Catchment Areas, Weighted Runoff Coefficients and Times of Concentration** in **Appendix A- Hydrologic Data**.

### 2.3.2 Rainfall Intensity

Rainfall intensities for the catchment were derived in accordance with Volumes 1 and 2 of *Australian Rainfall and Runoff* (Institution of Engineers Australia 1987). The derived rainfall intensities are listed in **Table 1- Design Rainfall Intensities**.

**TABLE 1**
**Design Rainfall Intensities**

| Storm Duration | Rainfall Intensity (mm/h) | | | | |
|---|---|---|---|---|---|
| | 2 Year | 10 Year | 20 Year | 50 Year | 100 Year |
| 15 Min | 94.8 | 134 | 154 | 180 | 200 |
| 20 Min | 82.8 | 117 | 134 | 157 | 174 |
| 25 Min | 74.1 | 105 | 120 | 140 | 156 |
| 30 Min | 67.5 | 95.2 | 109 | 128 | 142 |
| 45 Min | 54.3 | 76.4 | 87.6 | 102 | 113 |
| 1 Hour | 46.2 | 65.0 | 74.4 | 86.8 | 96.3 |
| 90 Min | 35.7 | 50.7 | 58.2 | 68.2 | 75.9 |
| 2 Hour | 29.6 | 42.4 | 48.8 | 57.3 | 63.8 |

### 2.3.3 Fraction Impervious Values and Runoff Coefficients

Appropriate fraction impervious values for each type of landuse within the catchment were derived based on the zonings presented in the Hervey Bay City Council publication *Statement of Proposals, Hervey Bay Planning Scheme Amendment* (August 1998). The zoning plan for the Urangan precinct is reproduced as **Figure A2- Zoning Plan** in **Appendix A- Hydrologic Data.**

The majority of the study area is designated as medium density. It contains the following land use types:

- Residential Low Density
- Residential Medium Density
- Foreshore Medium Density
- Local Shopping
- Village Centre
- Open Space

The area of each type of zoning present within each of the subcatchments defined for the investigation is presented in **Table A1- Catchment Areas, Weighted Runoff Coefficients, and Times of Concentration** in **Appendix A- Hydrologic Data.**

The zonings presented in the Statement of Proposals were adopted for use in the study except for the Open Space zone indicated to the North of King Street between Pier Street and Pilot Street. For the analysis, it was assumed that this area would be developed as a Medium Density Residential area.

The fraction impervious values listed for various development categories in the *Queensland Urban Drainage Manual* (Neville Jones & Associates 1992, p 5-10) were correlated with the various land use zonings present within the study area according to the *Hervey Bay City Council Development Manual* (Hervey Bay City Council 1997, p 16-6) to provide appropriate fraction impervious values for each land use within the catchment. The adopted fraction impervious values were then applied to Table 5.04.2 of QUDM (Neville Jones & Associates et al 1992, p 5-11) to derive suitable values of the runoff coefficient for the 10 year event. The derived values were subsequently compared to those adopted for the *Toogoom Area Drainage Study* (John Wilson and Partners 1998) and any coefficients significantly different to those adopted for the Toogoom study altered appropriately.

Frequency factors of 0.85, 1.05, 1.15 and 1.20 were applied to the 10 year event coefficients to derive the coefficients applicable to the 2, 20, 50 and 100 year events respectively (Neville Jones & Associates 1992, p 5-11). As recommended by QUDM, runoff coefficient values in excess of unity were rounded down to 1.0.

The adopted values of fraction impervious and runoff coefficient are listed in **Table 2- Adopted Fraction Impervious Values and Runoff Coefficients.**

**TABLE 2**
**Adopted Fraction Impervious Values and Runoff Coefficients**

| **Land Use** | **QUDM Equivalent** | **Adopted Fraction Impervious** | **Adopted Runoff Coefficient** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **2 Year** | **10 Year** | **20 Year** | **50 Year** | **100 Year** |
| Residential Low Density | Urban Residential High Density | 0.7 | 0.701 | 0.825 | 0.866 | 0.949 | 0.99 |
| Residential Medium Density | Urban Residential High Density | 0.8 | 0.723 | 0.850 | 0.893 | 0.978 | 1.0 |
| Foreshore Medium Density | Urban Residential High Density | 0.8 | 0.723 | 0.850 | 0.893 | 0.978 | 1.0 |
| Local Shopping | Central Business | 1.0 | 0.765 | 0.900 | 0.945 | 1.0 | 1.0 |
| Village Centre | Commercial | 0.9 | 0.748 | 0.880 | 0.924 | 1.0 | 1.0 |
| Road Reserve | Road | 0.7 | 0.701 | 0.850 | 0.893 | 0.978 | 1.0 |
| Open Space | Open Space | 0.0 | 0.561 | 0.660 | 0.693 | 0.759 | 0.792 |

# 3.0 HYDRAULIC MODELLING

## 3.1 General

The XP-STORM model of the Urangan catchment developed for the study contained the following number of links and nodes:

- 269 Links, comprising:
  - 114 Surface links (natural channels)
  - 7 Weirs to represent surface overflow conditions
  - 90 Links to represent the underground drainage system (closed circular conduits)
  - 58 Special links to represent the connections between the surface and underground drainage networks.
- 199 nodes, comprising:
  - 102 Nodes to model the surface network (71 nodes receiving inflow hydrographs)
  - 97 Nodes to model the underground drainage network.
- 12 Points of outlet:
  - 10 outlet points for the existing/ proposed drainage system
  - 2 outlet points for overland flow at the downstream end of Pier and Pulgul Streets.

To facilitate the use of the model, the following colour convention was adopted:

| | |
|---|---|
| ▪ Surface links: | Red |
| ▪ Surface Nodes: | Red if not receiving inflow hydrographs<br>Black if receiving inflow |
| ▪ Underground Links: | Blue |
| ▪ Underground Nodes: | Blue |
| ▪ Surface to Underground Links: | Black |

The naming convention adopted in general for nodes was as follows:

**Node name: N*#%%/&&$**

| | | | |
|---|---|---|---|
| Where: | N | = | Node |
| | * | = | Catchment (A, B, C, or D, for Elizabeth St, Pilot St, Pier St, or Guard St respectively) |
| | # | = | S (surface node) or U (Underground node) |
| | %% | = | Drainage Line number (eg 01, 02 etc for each catchment) |
| | && | = | Node number on drainage line in downstream direction (i.e. 01, 02, 03 etc) |
| | $ | = | Optional letter (A) to signify upstream end of short pipes discharging to main drainage line with otherwise the same node name. |

For example, node NAS03/02 is a node located on the surface of catchment A (Elizabeth Street) and is the second node in the third drainage line of the catchment. In general, the underground drainage nodes were named after the corresponding surface node.

The naming convention adopted in general for links was as follows:

**Link name: L*#%%/&&$@~~**

| | | | |
|---|---|---|---|
| Where | L | = | Link |
| | *#%%/&&$ | = | Name of node at upstream end of link, |
| | @ | = | Name of downstream catchment (A, B, C, or D) Optionally used if direction of link was to another catchment or contrary to direction of other links |
| | ~~ | = | Name of drainage line number at downstream end of link (eg 01) Optionally used if direction of link was to another catchment or contrary to the direction of other links. |

For example, link LBU01/04 is an underground link in catchment B (Pilot Street) with upstream node NBU01/04. Link LBS01/04C02 is a surface link in catchment B with upstream link NBS01/04). The link drains to drainage line 02 on catchment C (Pier Street).

The use of the above naming format allowed the creation of a unique set of node and link names for the model.

The adopted model layout is shown in **Figures B1 to B5- Model Layout** in **Appendix B-Hydraulic Data.**

All of the data necessary to define the links and nodes for the model was created in spreadsheets to facilitate data entry and modification. Each spreadsheet was output as a text file in XPX format (XP Software 1998, pp 110 to 115) and subsequently imported to the XP-STORM model. Separate spreadsheets were created for the surface network, the underground drainage network, and the cross links (i.e. gully inlets) between the surface and underground networks.

## 3.2 Surface Network

To correctly account for the available storage within road reserves within the catchment, the road network was divided into a total of 114 channel links. The location of the links and associated nodes was based on crest and sag locations within the existing road network and proposed road regrading works.

The cross sectional information required for the model was obtained from spot levels and contours of the catchment derived from the asset data capture program undertaken by Hervey Bay City Council. The accuracy of the level information collected by the asset data capture program is understood to be ± 70 mm and therefore quite reliable for flood modelling purposes (Cardno & Davies 1998). This level information was correlated with the information collected regarding pipe inverts to provide details of surface levels within the study area. Checks were conducted upon the collected data to ensure that adopted node invert levels and minimum cross section levels were consistent with respect to the adopted direction of flow for each link.

For each link, cross sections were extracted at a point midway between the upstream and downstream nodes of the link. In all cases, the orientation of sections was assumed to be left to right looking downstream.

For the analysis, it was assumed that the following roads would be regraded (Refer **Figure 2- Pilot Street 20 Year Stormwater Truck Drainage Strategy**):

- Coral Street
- Shell Street between Elizabeth Street and Pier Street
- Sandy Street
- King Street between Pilot Street and Pier Street
- Beulah Street
- Johnson Street
- Hibiscus Street between Elizabeth Street and Pier Street
- Pier Street between Dayman Street and King Street
- Corner of Pilot Street and Charlton Esplanade

King Street is designated as a Collector Road under the *Hervey Bay Planning Scheme Amendment* (Hervey Bay City Council 1998, Road Hierarchy Plan). Accordingly, a pavement width of 7.5 metres (Hervey Bay City Council 1997, Table 13.2.1) was adopted for the section of the street to be regraded. The remainder of the streets to be regraded are designated as Residential Access Streets under the Planning Scheme. For these streets, a pavement width of 5.5 metres (Hervey Bay City Council 1997, Table 13.2.1) was adopted. A cross fall of 1 in 40 was assumed for all new road surfaces.

For all regraded roads, a mountable type M1 kerb and channel (Hervey Bay City Council Standard Drawing R-11, 1998) was assumed. In existing areas, a type barrier type B1 kerb and channel was adopted (Standard Drawing R-11).

To account for future filling works encroaching within the road reserve, it was assumed that filling would be permitted to a point one metre inside the road reserve on both sides of the road. A ground slope of 1 (V) in 6 (H) was assumed for the fill batter (Hervey Bay City Council Standard Drawing R-04, 1998).

Road gradings for each new road were based upon existing road level junction constraints. Where possible, road gradings of 0.25 % were adopted.

For each section, it was possible to define three portions and to assign different Mannings 'n' values to each portion. For the analysis, each section was divided into the left verge, the road (including kerb and channel), and the right verge. For existing roads a Mannings n roughness value of 0.018 was adopted while for new roads a value of 0.014 was considered appropriate. Verges were considered to have an 'n' value of 0.04.

The general data relating to the surface link network is listed in **Table B1- Surface Links- General Data** in **Appendix B- Hydraulic Data**. Cross sectional data input to the model is presented in **Table B2- Surface Links- Cross Sections** in **Appendix B- Hydraulic Data**. Adopted surface node invert levels are shown in **Table B3- Adopted Invert Levels for Surface Nodes** in **Appendix B- Hydraulic Data**.

In addition to the channel links, seven weir type links (modelled as multilinks in XP-STORM) were added to the model to account for situations where water levels would need to rise to a certain level prior to overland flow commencing. Weirs were input to allow for overland flow at the downstream end of Pilot Street and at the downstream end of Pulgul Street. For the Pilot Street overland flow path, it was assumed that a 20 metre wide flow path would be available to convey flow during major storm events.

Three weirs were used to define flow conditions at the junction of King Street and Pilot Street. At this location, water ponds in Pilot Street prior to discharging across the slightly higher King Street to the downstream area of Pilot Street. Weirs were used to define this flow relationship. Two additional weirs were used to allow for the transfer of flow between nodes on Dayman Street. Details of the surface weir links are listed in **Table B4- Surface Weirs** of **Appendix B- Hydraulic Data**.

## 3.3 Underground Network

### 3.3.1 General

The underground stormwater drainage system was modelled using closed conduit links. Information relating to the existing drainage network was collected by Council as part of its Asset Data Capture program. This information was used to recreate the existing drainage system in the XP-STORM model.

Conduits were also added to the model to represent the proposed relief drainage works. These conduits were adjusted as appropriate during the course of the investigation to provide adequate drainage capacity.

In addition to the inclusion of links to represent the main drainage lines, links were also added at points of major inflow to the stormwater system to allow the effect of pipes connecting gully pits to the main drainage line to be accounted for when considering the acceptability of calculated water levels.

A total of 97 links were added to the model to account for the underground drainage system. A Mannings 'n' value of 0.013 was adopted for all pipes. All pertinent data relating to the underground drainage network is presented in **Table B5- Stormwater Drainage Details** in **Appendix B- Hydraulic Data**. The table includes information on the length, diameter and number of pipes, together with node connectivity information and adopted junction loss values (refer Section 3.3.2).

Of the proposed remedial works, the Pier Street beach outfall has been designed. Details of the proposed outfall were therefore incorporated in the 2003 model. The outfall design was drawn from Cardno MBK drawings 2919/37.01-01 to 19.

Invert levels for the underground drainage system (i.e. node inverts) were adopted based on the results of the asset data capture program for the existing drainage system and calculated allowing 600 mm minimum cover to the top of pipes for new drainage lines. Adopted invert levels for the stormwater drainage system are presented in **Table B6- Adopted Invert Levels for Underground Nodes** in **Appendix B- Hydraulic Data.**

### 3.3.2 Manhole Losses

Although loss coefficients can be input to account for manhole losses, the Hydraulic (EXTRAN) mode of XP-STORM is not capable of dynamically altering manhole losses to suit flow conditions. Only a single coefficient (multiplied by the velocity head in the downstream pipe) can be input for each pipe to represent losses at junctions throughout a storm event.

In order to assign appropriate manhole loss coefficients, recourse was made to the generalised values presented by Argue in the publication *Storm Drainage Design in Small Urban Catchments- A Handbook for Australian Practice* (1986). Argue recommends single values for given junction scenarios which eliminates the need for extensive reference to charts as required under the *Queensland Urban Drainage Manual* (QUDM)(Neville Jones & Associates et al 1992, Section 5 and Volume 2). When comparing designs completed using his simplified values and designs completed using the Missouri Charts (Sangster et al 1958, as quoted in Argue 1986, p 45), Argue found that the resultant difference between the designs was minimal (Argue 1986, p 106).

The values proposed by Argue (Argue 1986, pp 46-48) were compared with values likely to be derived from the QUDM charts and a generally conservative amalgam of junction pit loss coefficient values derived. The manhole loss coefficients adopted for the investigation for various pipe configuration scenarios are listed in **Table B7- Adopted Manhole Loss Coefficients** in **Appendix B- Hydraulic Data**. The loss coefficients adopted for each junction are listed in **Table B5- Stormwater Drainage Details** in **Appendix B- Hydraulic Data.** The loss values entered for each link refer to the upstream end of the pipe concerned.

### 3.3.3 Gross Pollutant Traps

It is understood that Council is considering the installation of gross pollutant traps as a water quality improvement measure (Cardno & Davies 1999). To ensure that the inclusion of the traps will not compromise the design of the relief drainage works, the potential head loss associated with gross pollutant traps was included in the XP-STORM model of the catchment.

For the analysis, it was assumed that gross pollutant traps would be installed near the downstream end of all relief drainage lines. Gross pollutant traps were added to the following nodes in the model (refer **Figures B1 to B5- Model Layout** in **Appendix B- Hydraulic Data**):

| | | |
|---|---|---|
| (A) | Elizabeth Street Catchment | NAU01/12 |
| (B) | Pier Street Catchment | NBU01/12 |
| (C) | Pilot Street Catchment | NCU01/11 |
| (D) | Guard Street Catchment | NDU01/07 |

No gross pollutant traps were added to existing drainage lines on the basis that the existing drainage lines are already undersized and that the additional head loss caused by adding traps to the existing lines would only exacerbate flooding problems. If Council were to install gross pollutant traps on existing drainage lines, it was considered that works to compensate for the increase in flood level would be completed in conjunction with trap installation (eg upgrading of adjacent pipes to provide the same overall head loss as previously) to provide a no-worsening solution.

CSR-Humes recommend a loss coefficient of 1.5 for its precast Humeceptor gross pollutant trap (CSR-Humes 1996). Rocla indicate that the appropriate loss coefficient for its Cleansall pollutant trap is between 0.75 and 1.8 (Rocla 1998).

Discussions were held with representatives of CDS Technologies (producer of the CDS pollutant removal unit). The representatives indicated that their units are purpose designed for each site to an allowable head loss specified by the client. Consequently, no figure can be directly applied to the modelling of losses due to CDS units.

Given the loss coefficient values quoted by CSR-Humes and Rocla, a manhole loss coefficient of 1.5 was adopted for each gross pollutant trap. This figure was added to the loss coefficient applicable to the node at which the trap was placed to provide a slightly conservative estimate of the likely head loss associated with the introduction of each gross pollutant trap.

## 3.4 Stormwater Inlet Pits

### 3.4.1 General

To model stormwater inlet pits and the interaction between the surface and underground drainage networks during surcharge conditions in the pipe system, stormwater inlet pits were modelled as weirs via the multiple conduit/ diversion option in the XP-STORM model (XP Software 2002, pp 243-244). Inlet pits were modelled using weirs rather than rating curves due to the ability of the Hydraulic (EXTRAN) mode of XP-STORM to model the drowning of weirs when the downstream water level approaches the upstream water level, thereby allowing the simulation of surcharge conditions and restricted inflow conditions during major storm events.

The required weir relationships were derived by first considering the inlet capacity of each of the various types of inlet pit present within the catchment. Hervey Bay City Council standard 1 bay, 2 bay, 3 bay and 4 bay side entry pits (Hervey Bay City Council standard drawings SD 010 and SD 011 Revision 0) were considered together with grated inlets (existing drainage system only). It can be noted that side entry pits were included for all new drainage lines analysed. For all types of inlet, separate inlet capacity curves were derived for sag and on grade conditions.

The inlet capacity curves were then converted to equivalent weir relationships by calculating the length of weir required at each defined water level to produce a flow equivalent to the inlet capacity for that level.

For weir relations, XP-STORM requires that the weir length, coefficient and discharge exponent is specified for each depth entered in the relation.

It was found that the standard value of discharge exponent (1.5) produced a significant variation in the weir length required with increasing depth. To minimise the variation in weir length with depth (and to thereby reduce the potential for instabilities in the model), a discharge exponent of 0.2 was adopted. A standard weir discharge coefficient of 1.7 was adopted for all water depths.

Further, the weir tables had to be adjusted at very small depths because the low exponent value generated appreciable flows at very small depths over the weir. This was overcome by using weir parameters for flow depths to 0.001 m (1 mm head on the weir) as listed in **Table 3- Inflow Rating Curves- Weir Correction Parameters**.

**TABLE 3**
**Inflow Rating Curves - Weir Correction Parameters**

| Head on Weir (m) | Weir Length (m) | Exponent | Coefficient |
|---|---|---|---|
| 0.0 | As for head 0.08 | 1.5 | 0.1 |
| 0.001 | As for head 0.08 | 1.0 | 1.0 |
| 0.08 | Calculated | 0.2 | 1.7 |

The adopted inlet capacity curves are presented in **Table B8- Inlet Capacity of Side Entry Pits and Grates** and **Table B9- Equivalent Weir Dimensions for Inlet Pits** in **Appendix B- Hydraulic Data.**

Due to the number of inlet pits present within the catchment, inlet pits draining to the same node on the underground drainage system were aggregated and modelled as a single inlet.

The weir relation used to define flow into the underground drainage system was also used to define flow to the surface in the event of surcharge conditions within the pipe network. Due to current limitations of the Hydraulic (EXTRAN) mode of XP-STORM, it is not possible to model one directional weirs. Such a facility would have allowed the specification of separate relations for flow into and out of the underground system. Other methods to provide the desired replication of flow conditions were not able to be justified due to the prohibitively large number of links and nodes which would be required. A review of the surcharge capacity of inlets indicated that the use of inflow capacity curves underestimated the outflow capacity to some degree.

### 3.4.2 Sag Inlets

The Hervey Bay City Council side entry pit capacity curves for sag conditions are presently based upon the United States Department of Transportation formula for weir flow. At higher depths above the invert level of the pit, the capacity of inlets will be limited by orifice type flow (Neville Jones & Associates et al 1992, p 5-47). Based on the available orifice area for each of the various side entry pit types (calculated from Hervey Bay City Council standard drawings), curves were produced for each type of side entry pit for weir and orifice type flow conditions and the resulting flow envelope adopted.

It can be noted that the inlet curves for side entry pits are not based on model tests of the actual Council design. Full size model testing of Brisbane City Council gully inlets by the Urban Water Resources Centre, University of South Australia (Argue 1994, as quoted in Brisbane City Council 1994, Chart QUDM-1) has indicated that the capture rate of inlet pits when the water level is about 90 mm above the top of the kerb is significantly less than that predicted by the orifice equation.

Although the orifice equation and normal hydraulic considerations indicate that the flow into an inlet should increase with increasing water level, the results of model testing led to the recommendation that the capacity of inlets not be extrapolated beyond a certain point. A similar result was obtained from testing of the Rocla 'Drainway' unit (Argue 1993, as quoted in QUDM Volume 2).

Given the experimental results, the inflow relations for inlet pits were conservatively limited at depth, to reflect the outcome of model testing of other pit types.

Based on the orifice area of the Hervey Bay side entry pits and the orifice area of the Brisbane City Council and Drainway inlets, the following limiting flow capacities were conservatively adopted for the study:

- 1 Bay 270 L/s
- 2 Bay 310 L/s
- 3 Bay 375 L/s
- 4 Bay 475 L/s

The calculated sag capacities were reduced by 20 percent to account for blockage effects (Hervey Bay City Council 1997, p 16-9, Neville Jones & Associates 1992, p 5-42).

For grated inlets to the existing drainage system, a grate with a gross area of 0.5 $m^2$ was assumed. This area was reduced by 25 percent to account for the reduction in waterway area caused by the bars of the grate. The inlet capacity of the grate was defined according to the weir and orifice equations (Neville Jones & Associates 1992, pp 5-47 to 5-48). The calculated capacity of the grate inlet was reduced by 50 percent to account for blockage effects (Hervey Bay City Council 1997, p 16-9, Neville Jones & Associates 1992, p 5-42)

### 3.4.3 On Grade Inlets

The inlet capacities of on grade side entry pits and grates were derived from the Hervey Bay City Council gully pit capacity charts which relate captured flow to gutter flow. In order to provide the required level-inflow capacity relation, the water depth associated with various gutter flows was determined.

The water level for a given gutter flow varies according to the longitudinal and cross slope of the road and road width. To provide typical water levels for the types of road present within the study area, roads with widths of 8 metres and 12 metres and longitudinal slopes of between 0.25 percent and five percent were analysed using the backwater program HEC-RAS. The roads were assumed to have a cross fall of 1 in 30 and to lie within a 20 metre road reserve. The results of the analysis were used to assign water levels to a range of gutter flows and thereby establish the necessary stage discharge relations for on grade side entry pits and grates.

The calculated on grade capacities were reduced by 20 percent in the case of side entry pits and 50 percent in the case of grates to account for blockage effects (Hervey Bay City Council 1997, p 16-9, Neville Jones & Associates 1992, p 5-42).

## 3.5 Tailwater Levels

The following tailwater levels were adopted for the analysis (Hervey Bay City Council 1997, p 16-14):

- Minor Storm Event (2 and 10 Year) — RL 1.50 m AHD (MHWS + 0.3 m Greenhouse Effect).
- Major Storm Event (20, 50, and 100 Year) — RL 2.40 m AHD (HAT + 0.3 m Greenhouse Effect).

## 3.6 Model Parameters

The Hydraulic (EXTRAN) mode of XP-STORM allows the creation of hotstart files for use in design runs. For both the Minor and Major events, hotstart files were created by defining small (0.01 cumec) flows in upstream areas of the catchment and then running the model for a sufficient period to provide stable conditions within the model. The hotstart file produced by the model was then used to define initial water levels and flows in the system for design event modelling.

Due to the difference in tailwater level (refer Section 3.5), separate hotstart files were produced for minor and major flood events.

The minor drainage design standard for the catchment varies between the 2 year and 10 year event. For this reason, both the 2 year and 10 year events were modelled to ensure the adequacy of the designed relief drainage system for minor event flooding. The 20, 50, and 100 year events were modelled to allow the assessment of system performance under major event flooding.

For each recurrence interval analysed, standard storm durations of between 15 minutes and ninety minutes were input to the model. The results of modelling were output in CSV (comma separated variable) format and imported to spreadsheets. The spreadsheets were used to determine peak flood levels, flows and velocities across the range of storm durations modelled.

For the analysis, a relatively short time step of 2 seconds was adopted due to the complexity of the model. For the analysis of major storm events, the time step was reduced to 1 second to promote stability. Model run times for major event storms were found to be considerably longer than those required for minor storm events. This was attributed to the drowning of inlet pits during major flow conditions and the model having to complete a significant number of iterations to produce a solution at each time step.

# 4.0 MODELLING RESULTS

## 4.1 General

Modelling of the Urangan system was an iterative process involving the resizing of pipe elements and the addition or deletion of inlet pits until an acceptable solution was achieved for the drainage of minor event flows. The performance of the relief drainage system under major storm events was then assessed and pipe sizes adjusted if necessary to produce acceptable conditions during major events.

For the analysis of major event storms, storms with recurrence intervals of 20, 50, and 100 years were considered. It is important to note that the same relief drainage system was adopted for all of the major events. The selection of a major event other than the 100 year event for the specification of habitable floor levels only provides a reduction in the required floor level and does not impact on the drainage works adopted for the catchment.

For the minor storm events (2 and 10 year recurrence interval) storm durations of between 15 and 25 minutes were found in general to produce peak conditions within the catchment. For the major storm events (20, 50, and 100 year), storm durations of between 15 minutes and 1 hour were found to produce peak conditions.

The results of modelling of the adopted relief drainage works are presented in the following tables in **Appendix C- Model Results**:

**General:**

Table C1 - Surface Network- Peak Water Levels and Depths

**Minor Event Results**

*2 Year Event:*
Table C2 - Peak Water Levels- Surface Network- 2 Year Event
Table C3 - Peak Water Levels- Underground Network- 2 Year Event
Table C4 - Peak Flows and Velocities- Surface Network- 2 Year Event
Table C5 - Peak Flows and Velocities- Underground Network- 2 Year Event

*10 Year Event:*
Table C6 - Peak Water Levels- Surface Network- 10 Year Event
Table C7 - Peak Water Levels- Underground Network- 10 Year Event
Table C8 - Peak Flows and Velocities- Surface Network- 10 Year Event
Table C9 - Peak Flows and Velocities- Underground Network- 10 Year Event

**Major Event Results**

*20 Year Event:*
Table C10 - Peak Water Levels- Surface Network- 10 Year Event
Table C11 - Peak Water Levels- Underground Network- 10 Year Event
Table C12 - Peak Flows and Velocities- Surface Network- 10 Year Event
Table C13 - Peak Flows and Velocities- Underground Network- 10 Year Event

*50 Year Event:*

| | | |
|---|---|---|
| Table C14 | - | Peak Water Levels- Surface Network- 10 Year Event |
| Table C15 | - | Peak Water Levels- Underground Network- 10 Year Event |
| Table C16 | - | Peak Flows and Velocities- Surface Network- 10 Year Event |
| Table C17 | - | Peak Flows and Velocities- Underground Network- 10 Year Event |

*100 Year Event:*

| | | |
|---|---|---|
| Table C18 | - | Peak Water Levels- Surface Network- 100 Year Event |
| Table C19 | - | Peak Water Levels- Underground Network- 100 Year Event |
| Table C20 | - | Peak Flows and Velocities- Surface Network- 100 Year Event |
| Table C21 | - | Peak Flows and Velocities- Underground Network- 100 Year Event |

**KEY RESULTS OF STUDY:**

*The recommended drainage works and floor levels for the catchment are presented in:*

***Figure 2- Pilot Street - 20 Year***
***Figure 3- Pilot Street - 50 Year***
***Figure 4- Pilot Street - 100 Year***

*The proposed relief drainage works are tabulated in **Table B5- Stormwater Drainage Details** in **Appendix B- Hydraulic Data**. This table also lists the pipes proposed between each gully pit and the main drainage lines.*

*The invert levels adopted for each drainage line are presented in **Table B6- Adopted Invert Levels for Underground Nodes** in Appendix B. The adopted number and size of inlet pits are listed in **Table B10- Adopted Inlet Pits** in Appendix B.*

*The calculated flood levels for the catchment are summarised in **Table C1- Surface Network- Peak Water Levels and Depths** in **Appendix C- Model Results**.*

Table C1 provides a summary of the peak water levels calculated within the study area. Flood levels presented in the table can be located via Figures B1 to B5 in **Appendix B- Model Data.**

Each table lists the relevant peak value obtained from the range of storm durations modelled and quotes the storm duration which produced the peak value.

In the case of the underground drainage network peak water level tables (Tables C3, C7, C11, C15 and C19), the surface level applicable to each node is specified together with whether the water level in the underground system is above (i.e. surcharging) or within 150 mm of the surface level.
In the case of the peak flow and velocity tables for the surface (i.e. road) network (Tables C4, C8, C12, C16, and C20), the water depth at the upstream and downstream ends of each link is listed together with the resultant value of velocity multiplied by depth.

It can be noted that for relief drainage works of the type considered in the investigation, the Queensland Urban Drainage Manual (Neville Jones & Associates et al 1992, p 11-3) notes that

> *"Whilst the criteria set down in this Manual should be adhered to if possible for relief drainage works, economic and physical limitations may require the adoption of less stringent criteria."*

Consequently, the judgement of whether proposed drainage works are acceptable is somewhat subjective in relief drainage investigations. The following design criteria were adopted for the investigation:

**DRAINAGE DESIGN CRITERIA**

**Minor Events (2 and 10 Year)**

| | | |
|---|---|---|
| *Pipe Drainage:* | In General: | Freeboard to surface invert >150 mm. No surcharge within existing drainage lines connected to new drainage lines. |
| | Worst Case: | Water level within 150 mm of surface invert. No surcharging allowed on new drainage lines. |
| *Surface Drainage:* | In General: | Water levels in road system and above gully pits to be not greater than the top of kerb level. |
| | Worst Case: | Maximum depth of water not to exceed 250 mm in areas serviced by new drainage lines. |

**Major Events (20, 50, and 100 Year):**

| | | |
|---|---|---|
| *Surface Drainage:* | In General: | Water depth not to exceed 450 mm.<br>Velocity Depth product not to exceed 0.6 $m^2/s$. |
| | Worst Case: | Absolute maximum water depth (neglecting tailwater) 1,200 mm.<br>Increase in water depth above tailwater level not to exceed 750 mm.<br>Velocity Depth product not to exceed 0.9 $m^2/s$. |

It can be noted that the adopted maximum depth criteria is consistent with that specified by Hervey Bay City Council (Hervey Bay City Council 1997, p 16-20) and QUDM (Neville Jones & Associates 1992, p 6-17).

The following sections detail the drainage solution adopted for each major subcatchment and provide comment with respect to the acceptability of the proposed solution.

## 4.2 Minimum Floor Level

The minimum habitable floor level to be adopted at any point in the study area is the maximum of the flood level due to local flooding and that due to ocean storm surge. At the downstream end of the catchment the minimum level is governed by the ocean storm surge level.

Hervey Bay City Council has indicated that the following minimum habitable floor levels are applicable for the Urangan catchment for the case of ocean storm surge (Hervey Bay Beach Report Table 7.1, Charts 7-10 and 7-11, p160, John Wilson & Partners Toogoom Area Drainage Study 1998, as quoted in Lavey, 2000):

- 20 Year Event RL 3.40 m AHD
- 50 Year Event RL 3.80 m AHD
- 100 Year Event RL 4.15 m AHD

The levels quoted above include the ocean level for each event plus the following components:

- Greenhouse allowance 0.3 m
- Wave Setup 0.2 m for 20 year event
  0.3 m for 50 year event
  0.38 m for 100 year event
- Wave runup 0.1 m
- Freeboard 0.3 m
- Habitable floor level allowance 0.15 m

It can be noted that the fill level required to achieve immunity to flooding is 150 mm less than the specified habitable floor level. The specified habitable floor level therefore has a freeboard of 450mm.

In upstream areas of the catchment, flood levels due to local catchment events govern minimum required floor levels. In such areas, the habitable floor level was defined as being 250 mm above the relevant flood level. In order to provide a transition between the 450 mm freeboard specified for the storm surge event and the 250 mm freeboard adopted for catchment flooding, a freeboard of 350 mm was applied to the flood level predicted for catchment flooding either side of Shell Street.

The required minimum habitable floor levels within the catchment are shown on the following figures:

**Figure 2- Pilot Street- 20 Year**
**Figure 3- Pilot Street- 50 Year**
**Figure 4- Pilot Street- 100 Year**

It can be noted that the criterion for minimum habitable floor level can differ depending on the land use (eg Commercial versus Residential) and type of development. The levels adopted for this report relate to residential land use. Council can therefore consider the relaxation of nominated habitable floor levels in certain circumstances.

## 4.3 Elizabeth Street Catchment (A)

**Drainage design standard: Q10**

The inclusion of the properties between Coral Street and Dayman Street in the total catchment area of the Urangan coastal strip necessitated the extension of the Elizabeth Street drainage system derived in the Concept Phase Investigation to the low point located on Elizabeth Street midway between Coral Street and Dayman Street.

The following drainage system was found to be necessary for the Elizabeth Street catchment:

- Midway between Coral St and Dayman St to Coral St — 1/450 Dia
- Coral St to Shell St — 1/600 Dia
- Shell St to downstream of King St — 1/900 Dia
- Downstream of King St to Hibiscus St — 2/900 Dia
- Hibiscus St to low point upstream of Charlton Esplanade — 3/900 Dia
- Low point to ocean — 3/1,200 Dia

Adopted invert levels varied from RL 0.0 m AHD at the outlet of the system to RL 2.1 m AHD at the low point between Dayman Street and Coral Street.

### *Minor Storm Event Performance*

Under minor event flow conditions, the pipe drainage system complies with the requirements of the *Queensland Urban Drainage Manual* (QUDM)(Neville Jones & Associates 1992, Section 5) and the Hervey Bay City Council *Development Manual* (Hervey Bay City Council 1997).

The existing drainage lines on King Street and Cyprus Street will ultimately be connected to the new Elizabeth Street pipe system. The analysis indicated that tailwater levels in the new drainage line were sufficiently low to prevent surcharging on existing drainage lines.

Flow conditions within the existing drainage line between Hibiscus Street and Charlton Esplanade (LAU07/03 and LBU06/01) were found to be acceptable due to the low inlet capacity of the system and the difficulty of providing relief drainage to this location.

Water depths in the road system were found to be 150 mm or less within new drainage areas and were therefore considered to be within acceptable limits.

### *Major Storm Event Performance*

For major event flooding, the drainage system was found to surcharge (i.e. the water level in the underground system is greater than the adjacent ground level) over the majority of its length.

However, except at the low points located upstream of Charlton Esplanade (NAS01/11) and downstream of King Street (NAS01/09), water levels in the road network were found to be less than 450 mm. At the two low points, water depths up to 580 mm were calculated.

Due to the lack of an overland flow path to the ocean at the downstream end of Elizabeth Street, the low point upstream of Charlton Esplanade acts as a collection point for flow not collected in the upstream pipe drainage system. As a consequence, ponding of water to a reasonable depth is unavoidable. Although the calculated depth is considerable, enlargement of the downstream drainage system to further reduce the flood level at the low point is not considered to be warranted.

The low point downstream of King Street collects surface runoff from a considerable length of King Street. Only a relatively small portion of the runoff in King Street is collected by the existing drainage line on King Street, with the remainder of the runoff travelling to the low point on Elizabeth Street.

As the resultant depth of flooding is not considered to be excessive, it is preferable to accept the depth of flooding at the low point instead of upgrading the existing King Street drainage system which would be likely to just move the problem to a point further downstream.

The velocity depth product at all locations for all major events was found to be 0.5 $m^2/s$ or less (in general less than 0.3 $m^2/s$) and therefore considered to be acceptable.

Overall, it was concluded that the proposed drainage system performs acceptably for both minor and major events.

## 4.4 Pier Street Catchment (B)

**Drainage design standard:** **Q10**

As was the case for the Elizabeth Street catchment, the inclusion of the entire region between Coral Street and Dayman Street to the Urangan coastal strip catchment necessitated the extension of the Pier Street stormwater drainage system developed as part of the Concept Phase Investigation to the low point at the intersection of Pier Street and Dayman Street.

The proposed regrading of Pier Street south of King Street will result in the creation of sag conditions at the intersection of Pier Street with Coral Street and Pier Street with Shell Street. The drainage system therefore also needs to extend upstream of King Street in order to collect water from these sags.

The following drainage system was found to be necessary for the Pier Street catchment:

- Coral St to Shell St — 1/600 Dia
- Shell St to King St — 1/750 Dia
- King St to downstream of between King St and Hibiscus St — 1/900 Dia
- Between King St and Hibiscus St to Charlton Esplande — 1/1,200 Dia
- Charlton Esplanade — 2/900 Dia
- Outlet to ocean — 2/2.1x0.6 RCBC and 1/750 Dia low flow pipe

Adopted invert levels for the drainage line varied from RL 0.0 m AHD at the outlet to the ocean to RL 2.0 m AHD at Coral Street.

### *Minor Storm Event Performance*

The proposed system was found to perform acceptably under minor flow conditions.

Flow conditions within the existing drainage line commencing at Johnson Street and running between Hibiscus Street and Charlton Esplanade (LBU05/01 and LBU04/02) were found to be acceptable due to the low inlet capacity of the system and the connection of the system to the trunk drainage line from Pier Street.

The maximum depth of water in the road system was found to be generally less than 150 mm and at worst 220 mm. The 220 mm depth was obtained on Charlton Esplanade and resulted in a flood level of RL 2.7 m (NBS06/02), which is well below the likely storm surge level. Consequently, these water depths were considered to be acceptable.

### *Major Storm Event Performance*

For major event flooding, the drainage system was found to surcharge (i.e. the water level in the underground system is greater than the adjacent ground level) over the majority of its length.

However, except on Charlton Esplanade (NBS01/11 and NBS 01/12), water levels in the road network were found to be generally 300 mm or less and considered to be acceptable for major event conditions.

When considering conditions along Charlton Esplanade, the effect of tailwater levels on flooding needs to be recognised. With a tailwater level of RL 2.4 m AHD for the major event, Charlton Esplanade is already flooded to depths of between 40 mm (NBS01/11) and 360 mm (NBS01/12) at the start of a rainfall event. Ponding of water during the major event produces a relative increase in water depth of up to 480 mm at both locations. Therefore, the effect of catchment runoff on flood levels along Charlton Esplanade is not as great as an initial review of water depths would suggest. The enlargement of the pipes draining the Esplanade would only provide an incremental benefit as the largest pipe sizes would only produce flood depths approaching 360 mm. Therefore, an acceptable limit to ponding depth needs to be determined.

It is considered that the drainage proposed downstream of Charlton Esplanade provides a reasonable degree of flood control. If the drainage was increased in size to 2/ 1,800 mm diameter pipes, it is estimated that flood levels would be reduced by about 100 mm, providing an overall peak water depth of up to 720 mm. Given the minimal reduction in water level afforded by the enlargement and the likely additional cost associated with the use of larger pipes, it is considered that the use of the proposed drainage is acceptable.

The velocity depth product at all locations for the major events was found to be 0.7 $m^2/s$ or less (in general less than 0.3 $m^2/s$) and therefore acceptable.

Overall, it was concluded that the proposed drainage system performs acceptably for both minor and major events.

## 4.5 Pilot Street Catchment (C)

**Drainage design standard:** **Q2/ Q10 with Overland Flow Path Outlet at end of Pilot Street**

Within this catchment, it was decided to retain the existing stormwater drainage system on Pilot Street upstream of King Street. Relief drainage works were therefore designed for the length of Pilot Street between King Street and Charlton Esplanade. For this catchment, it is proposed to construct an overland flow path at the end of Pilot Street to allow for the discharge of flow during large flood events to the ocean.

For the length of the new drainage system, a single 1,050 mm diameter pipe is proposed.

Adopted invert levels for the drainage line varied from RL 0.0 m AHD at the outlet of the system to RL 1.31 m AHD near King Street.

### *Minor Storm Event Performance*

The adopted pipe size provides for the drainage of the 10 year event flow downstream of King Street without surcharging. The reduction in tailwater level afforded by the provision of relief drainage downstream of King Street was found to result in the existing drainage system upstream of King Street performing acceptably for the 2 year design event. The acceptable performance of the existing system in this region was attributed to the reduced design standard, the low inlet capacity of existing pits and the reduction of tailwater levels due to the introduction of larger diameter pipes downstream of King Street.

The existing drainage system on Charlton Esplanade (LCU04/02 and LCU1) was found to surcharge to a depth of about 200 mm for the 2 year event.

The depth of water in the road system upstream of King Street for the 2 year event was found to be 240 mm or less.

Downstream of King Street, the maximum water depth reached during the 10 year event was 180 mm or less, which was judged to be acceptable.

### *Major Storm Event Performance*

For major event flooding, the proposed drainage system was found to surcharge. Water depths in the road system between King Street and Charlton Esplanade were found to be 580 mm (NCS01/08) or less. Although the maximum depth reached in this region was relatively high, it was considered to be acceptable for the following reasons:

- Minimum fill levels in adjacent lots which are considerably higher than the peak flood level (RL 3.71 m AHD) (refer Section 4.2),
- Inundation would be for a relatively short period, and
- There is a relatively large contributing catchment area to the sag.

The inlet pits provided at the point of maximum depth could be enlarged to reduce this flood level if required. However, this would result in an increase in flood levels upstream and thereby increase flood levels within the existing drainage network. Given the water levels calculated in the region upstream of King Street (i.e. NCS01/04 and NCS01/05), on balance it was considered preferable to accept the conditions downstream of King Street.

Upstream of King Street, the major storm event produces water depths of up to 450 mm. Given the nature of the drainage in the area, this water depth was considered to be acceptable.

Of particular importance is the result that water levels in Pilot Street do not increase sufficiently during the 100 year event to cause flow to enter the proposed overland flow path to the ocean. Due to road grading constraints, the level in the sag area downstream of King Street would have to increase by at least 100 mm in order for the overland flow path to come into use even for the 100 year event.

Given that the proposed drainage solution provides flood levels less than those which would occur if the overland flow path actually conveyed flow, it is considered that the drainage of the catchment is best served by a system which does not rely on the overland flow path. Although an overland flow path could be established to allow for discharge during extreme flood events, its value would need to be balanced against the increased potential for flooding during king tide/ storm surge events which would result from channel excavation.

Consideration could be given to reducing the pipe sizes adopted for the catchment and allowing more ponding to occur in the downstream part of the catchment. However, any reduction in pipe size would result in a worsening of flooding in the existing system upstream of King Street and a likely increase in water depths in the region between King Street and Charlton Esplanade. On balance, it was concluded that the proposed drainage works provided an acceptable compromise between pipe size and flood levels.

The velocity depth product at all locations for the major event was found to be 0.3 $m^2/s$ or less and therefore acceptable.

Overall, it was concluded that the proposed drainage system performs acceptably for both minor and major events.

## 4.6 Guard Street Catchment (D)

**Drainage design standard:** **Q2, with Overland Flow Path Outlet at end of Pulgul Street**

The following drainage system was found to be necessary to drain the Guard Street catchment:

- King St to Hibiscus St 1/450 Dia
- Hibiscus St to Larsen St 1/825 Dia
- Larsen St to Outlet 2/1,200 Dia

Adopted invert levels for the drainage line varied from RL 0.05 m AHD to RL 1.8 m AHD at King Street.

***Minor Storm Event Performance***

The proposed system was found to perform acceptably under minor flow conditions. Although the calculated water level in the underground system was within 150 mm of the surface at one point (NDS01/04A), it was considered that increasing the size of pipes downstream was not warranted.

Water depths in Guard Street for the minor event were found to be 155 mm or less and were therefore considered to be acceptable.

Despite the use of the 2 year design standard, the existing drainage line which runs from Shell Street beneath King Street, Hibiscus Street and Prince Street (LCU03/02, LDU02/03, LDU03/03, LDU07/01 and LDU08/01) was found to surcharge significantly under minor flow conditions. Water depths of up to 320 mm were obtained in the road network above the drainage line. Unfortunately, due to the location of the existing drainage line beneath developed properties and the lack of an existing overland flow path, it is unlikely that the construction of relief drainage works would be viable.

The existing drainage line in Pulgul Street performs acceptably under minor flow conditions except at the downstream end of the system at the intersection of Pulgul Street and Charlton Esplanade (NDS04/05) where surcharging occurs. This could be attributable in part to the limited information available with regard to the existing outlet in the area. A water depth of 520 mm was obtained for the minor event storm. As the area concerned was located some distance from the relief drainage works under investigation, the buildup of water at this point was not considered to be significant. Water depths in upstream areas of Pulgul Street were found to be acceptable.

At present, water surcharging from the system and overland flow ponds at the intersection before travelling along Charlton Esplanade and discharging via the Guard Street outlet. Enlargement of the outlet of the Pulgul Street system or the provision of an overland flow path to the ocean with a lower invert level than at present could minimise the extent of flooding which is predicted to occur.

***Major Storm Event Performance***

For major event flooding, the proposed Guard Street drainage system was found to surcharge over its entire length.

Maximum water depths of up to 1,070 mm (NDS01/05) were obtained in Guard Street for the major storm event. However, the effect of tailwater conditions needs to be borne in mind when considering this result. With a tailwater level of RL 2.4 m AHD for the major event, Guard Street is already flooded to depths of between 200 mm (NDS01/07) and 500 mm (NDS01/05). Ponding of water during the major event produces a relative increase in water depth of up to 570 mm. Therefore, it can be concluded that the effect of catchment runoff on flood levels along Guard Street is not as great as an initial review of water depths would suggest.

The enlargement of the proposed Guard Street drainage system would only provide an incremental benefit as the largest pipe sizes would still only provide flood depths approaching 500 mm. Further, increasing the pipe size would negate the benefit obtained in terms of reduced pipe size by adopting a 2 year rather than a 10 year design standard for the area.

Given the above, it is considered that the proposed drainage system provides an acceptable level of drainage for the major storm event and that the enlargement of the drainage system is not warranted.

Water depths of up to 620 mm were calculated for the existing drainage system between above Shell Street and Charlton Esplanade. As noted in the consideration of the performance of the system under the minor event, it is unlikely that relief drainage works in this area would be viable from a cost perspective.

If relief works were to be considered, it is likely that the Guard street system would need to be extended to collect water ponded in sags in King Street, Hibiscus Street, and Prince Street. In each case, a distance of around 200 metres would need to be piped together with the enlargement of the trunk drainage system on Guard Street.

Calculated water depths within Pulgul Street were found to be generally acceptable except at the intersection of Pulgul Street and Charlton Esplanade (NDS04/05). At this point, a water depth of 740 mm was obtained. As noted for the minor storm event performance, works to the existing overland flow path at this point could achieve a considerable reduction in water level.

The velocity depth product at all locations was found to be generally less than 0.6 $m^2/s$ and therefore acceptable. At one location (LDS01/02), a product of 1.5 $m^2/s$ was obtained. Due to the significant change in road elevation and short length of the channel concerned, additional pipe works would be unlikely to improve the situation at this point.

Overall, it was concluded that the proposed drainage system performs acceptably for both minor and major events.

## 4.7 Estimated Cost of Works

Based on the drainage system proposed for each catchment and its associated inlet works, an estimate of the cost of constructing the drainage system was made.

Construction costs were adopted based on the cost of similar works in the Hervey Bay area. The rates used in the costing are presented in **Table D1- Typical Construction Costs** in **Appendix D- Estimated Construction Costs**. The costs reflect typical construction costs for 2003.

The estimated cost of works is presented in **Table 4- Estimated Cost of Construction**.

It can be noted that the costs listed in Table 4 are estimates of the cost of construction only. The costing included an allowance of $140,000 for the connection of the existing system to the new drainage system where necessary.

CDS Technologies was approached regarding the likely cost of gross pollutant traps. They provided the following preliminary estimates of cost:

- Elizabeth Street (A) $200,000
- Pier Street (B) $130,000
- Pilot Street (C) $110,000
- Guard Street (D) $130,000

The above figures are of a preliminary nature only and could only be confirmed following greater investigation. The costs are considered to be of the same order as other commercially available GPT units.

It can be noted that the costs presented in Table 4 do not include the cost of the road regrading works proposed as part of the drainage solution for the catchment.

**TABLE 4**
**Estimated Cost of Construction**

| Catchment | Main Line | Inlet Pits + Minor Drainage Feeding to Main System | Gross Pollutant Traps | Total |
|---|---|---|---|---|
| Elizabeth Street (A) | $570,000 | $210,000 | $200,000 | $980,000 |
| Pier Street (B) | $610,000 | $140,000 | $130,000 | $880,000 |
| Pilot Street (C) | $295,000 | $105,000 | $110,000 | $510,000 |
| Guard Street (D) | $385,000 | $130,000 | $130,000 | $645,000 |
| *SUBTOTAL* | *$1,860,000* | *$585,000* | *$570,000* | *$3,015,000* |
| Contingencies (10%) | $186,000 | $58,500 | $57,000 | $301,500 |
| Services Contingency (10%) | $186,000 | $58,500 | $57,000 | $301,500 |
| **TOTAL** | **$2,232,000** | **$702,000** | **$684,000** | **$3,618,000** |

# 5.0 CONCLUSION

A comprehensive XP-STORM hydraulic model of part of the Urangan Coastal strip was created to confirm the viability of relief drainage works proposed following a Concept Design Review of available drainage alternatives for the region.

The proposed drainage works consist of piped systems for Elizabeth Street, Pier Street, Pilot Street and Guard Street, together with some road regrading work to provide improved catchment definition. Proposed habitable floor levels are sufficiently high to allow for the storage of runoff during major storm events without causing the inundation of habitable areas.

The analysis involved the iterative derivation of pipe sizes suitable under specified Minor and Major event flooding conditions and the determination of fill levels for the catchment.

**KEY RESULTS OF STUDY:**

*The recommended drainage works and floor levels for the catchment are presented in:*

***Figure 2- Pilot Street - 20 Year***
***Figure 3- Pilot Street - 50 Year***
***Figure 4- Pilot Street - 100 Year***

*The proposed relief drainage works are tabulated in* ***Table B5- Stormwater Drainage Details*** *in* ***Appendix B- Hydraulic Data.*** *This table also lists the pipes proposed between each gully pit and the main drainage lines.*

*The invert levels adopted for each drainage line are presented in* ***Table B6- Adopted Invert Levels for Underground Nodes*** *in Appendix B. The adopted number and size of inlet pits are listed in* ***Table B10- Adopted Inlet Pits*** *in Appendix B.*

*The calculated flood levels for the catchment are summarised in* ***Table C1- Surface Network- Peak Water Levels and Depths*** *in* ***Appendix C- Model Results.***

# 6.0 REFERENCES


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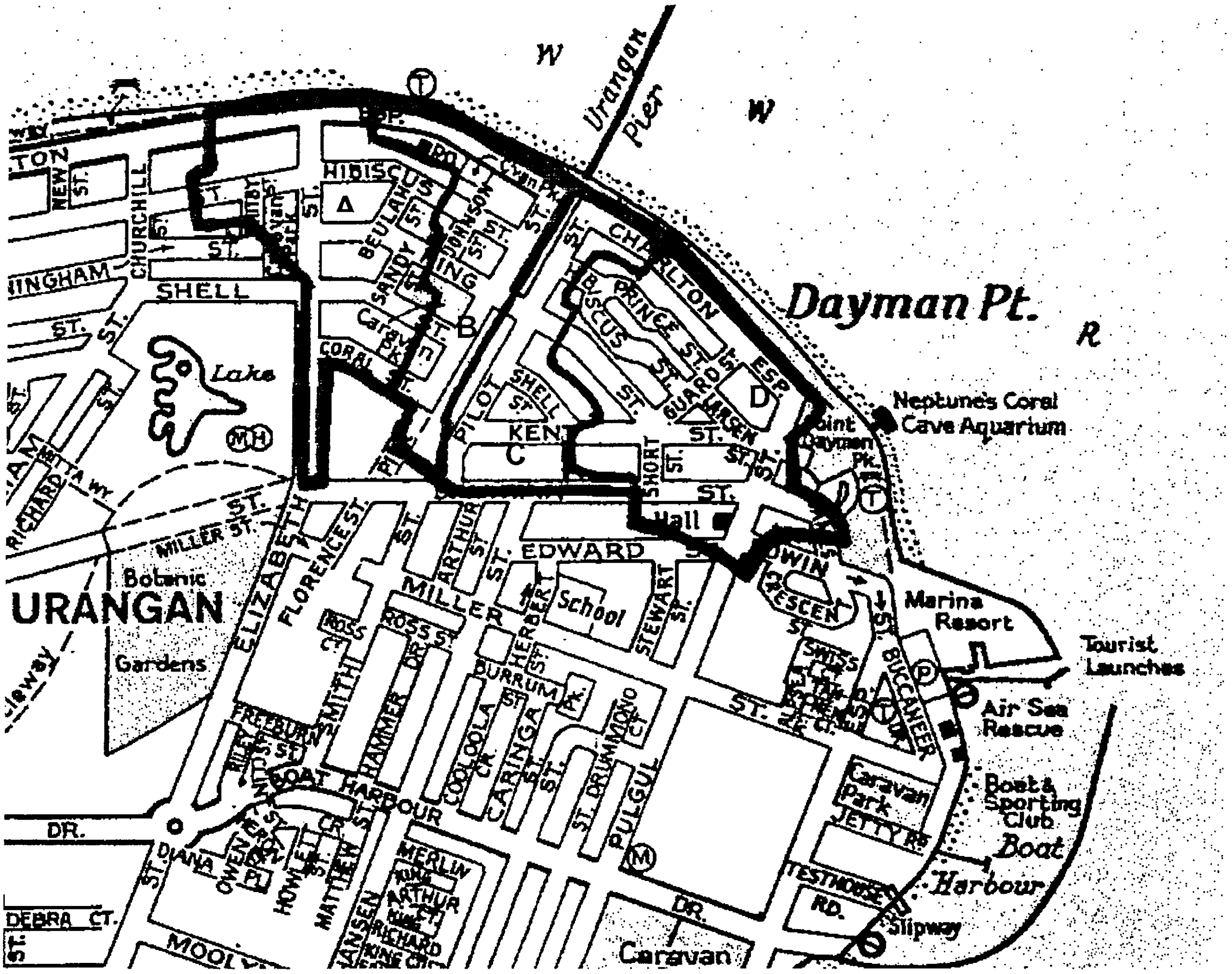
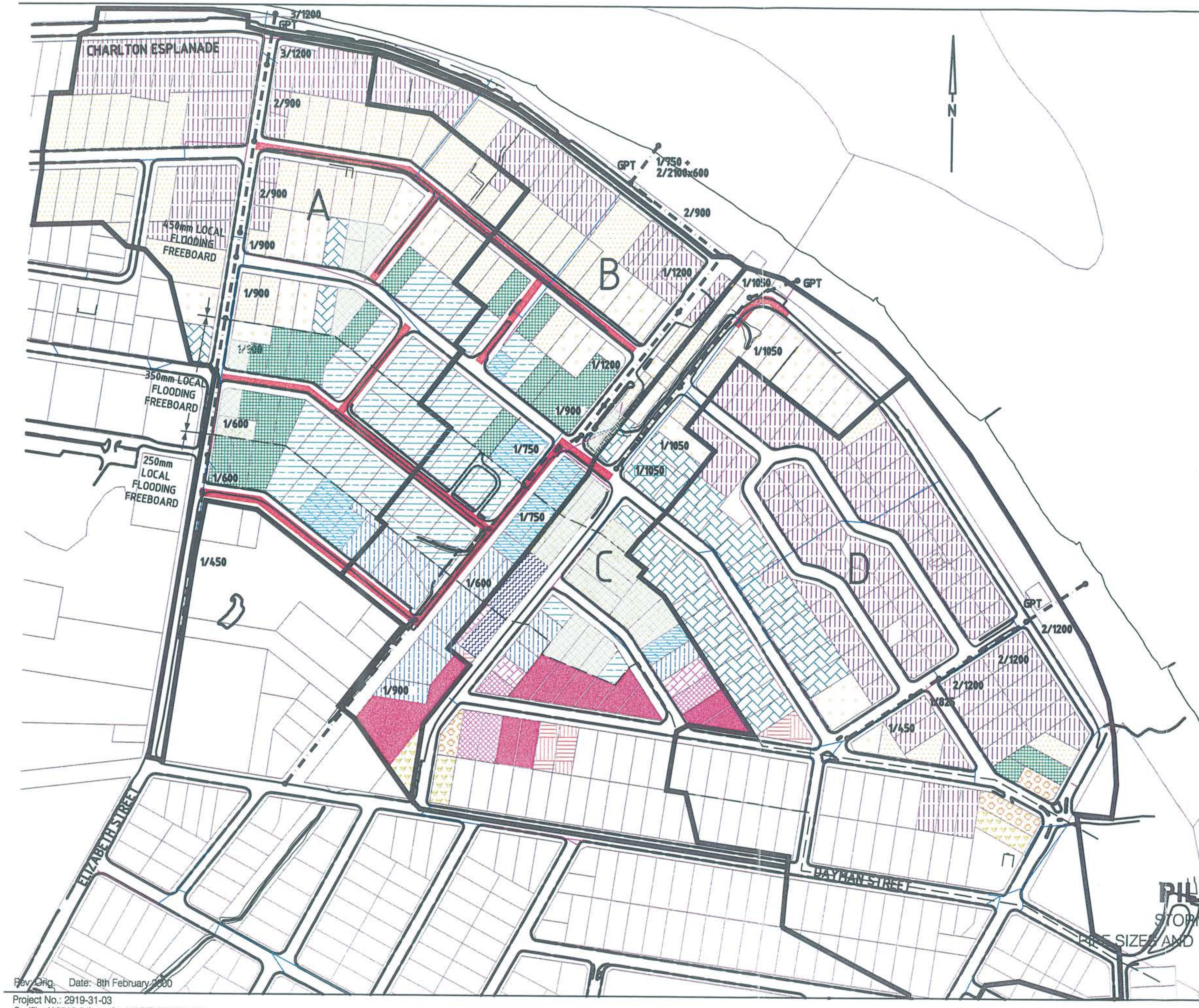



**Locality Plan**
**FIGURE 1**

Cardno MBK




## ALLOTMENT HABITABLE FLOOR LEVELS

| LEVEL | COLOUR |
|---|---|
| R.L. 3.800 | |
| R.L. 3.950 | |
| R.L. 4.100 | |
| R.L. 4.250 | |
| R.L. 4.400 | |
| R.L. 4.600 | |
| R.L. 4.800 | |
| R.L. 5.000 | |
| R.L. 5.200 | |
| R.L. 5.400 | |
| R.L. 5.600 | |
| R.L. 5.800 | |
| R.L. 6.000 | |
| R.L. 6.200 | |
| R.L. 6.500 | |
| R.L. 6.800 | |
| Exist. levels satisfactory | |

## CATCHMENT TABLE

| CATCHMENT | AREA |
|---|---|
| A | 14.921 Ha. |
| B | 14.713 Ha. |
| C | 10.485 Ha. |
| D | 22.957 Ha. |
| TOTAL | 63.076 Ha. |

## LEGEND

- EXISTING STORMWATER DRAINAGE
- PROPOSED TRUNK DRAINAGE
- ROADS TO BE REGRADED TO DEFINE SUB-CATCHMENT BOUNDARIES

NOTES:
1. If lots are filled to achieve flood immunity, minimum fill level is 150mm less than nominated flood level.
2. GPT = Gross Pollutant Trap.
3. For details of gully pits refer to table B10 in appendix B of this report.
4. For details of pipes connecting gully pits to trunk drainage refer to table B5 in appendix B of this report.
5. Freeboard of 450mm applied to storm surge levels to obtain flood levels.

Scale 1:4000

# PILOT STREET - 50 YEAR

STORMWATER TRUNK DRAINAGE STRATEGY
PIPE SIZES AND FILL LEVEL - ULTIMATE DEVELOPMENT

# FIGURE 3

Rev: Orig. Date: 8th February 2000
Project No.: 2919-31-03
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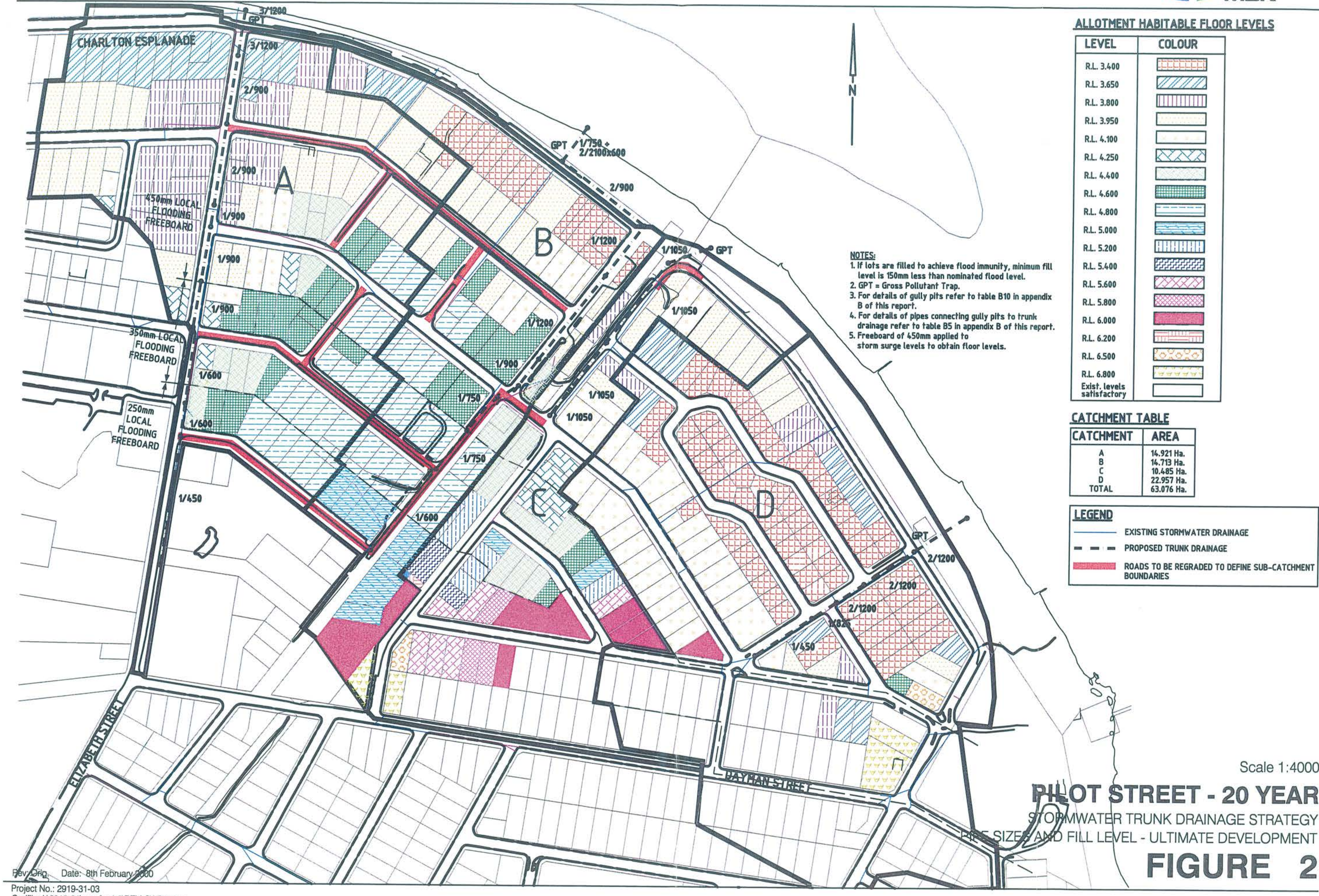


**ALLOTMENT HABITABLE FLOOR LEVELS**

| LEVEL | COLOUR |
|---|---|
| R.L. 3.400 | |
| R.L. 3.650 | |
| R.L. 3.800 | |
| R.L. 3.950 | |
| R.L. 4.100 | |
| R.L. 4.250 | |
| R.L. 4.400 | |
| R.L. 4.600 | |
| R.L. 4.800 | |
| R.L. 5.000 | |
| R.L. 5.200 | |
| R.L. 5.400 | |
| R.L. 5.600 | |
| R.L. 5.800 | |
| R.L. 6.000 | |
| R.L. 6.200 | |
| R.L. 6.500 | |
| R.L. 6.800 | |
| Exist. levels satisfactory | |

**CATCHMENT TABLE**

| CATCHMENT | AREA |
|---|---|
| A | 14.921 Ha. |
| B | 14.713 Ha. |
| C | 10.485 Ha. |
| D | 22.957 Ha. |
| TOTAL | 63.076 Ha. |

**LEGEND**

- EXISTING STORMWATER DRAINAGE
- PROPOSED TRUNK DRAINAGE
- ROADS TO BE REGRADED TO DEFINE SUB-CATCHMENT BOUNDARIES

**NOTES:**

1. If lots are filled to achieve flood immunity, minimum fill level is 150mm less than nominated flood level.
2. GPT = Gross Pollutant Trap.
3. For details of gully pits refer to table B10 in appendix B of this report.
4. For details of pipes connecting gully pits to trunk drainage refer to table B5 in appendix B of this report.
5. Freeboard of 450mm applied to storm surge levels to obtain floor levels.

Scale 1:4000

# PILOT STREET - 20 YEAR

STORMWATER TRUNK DRAINAGE STRATEGY

PIPE SIZES AND FILL LEVEL - ULTIMATE DEVELOPMENT

# FIGURE 2

Rev: Orig. Date: 8th February 2000

Project No.: 2919-31-03

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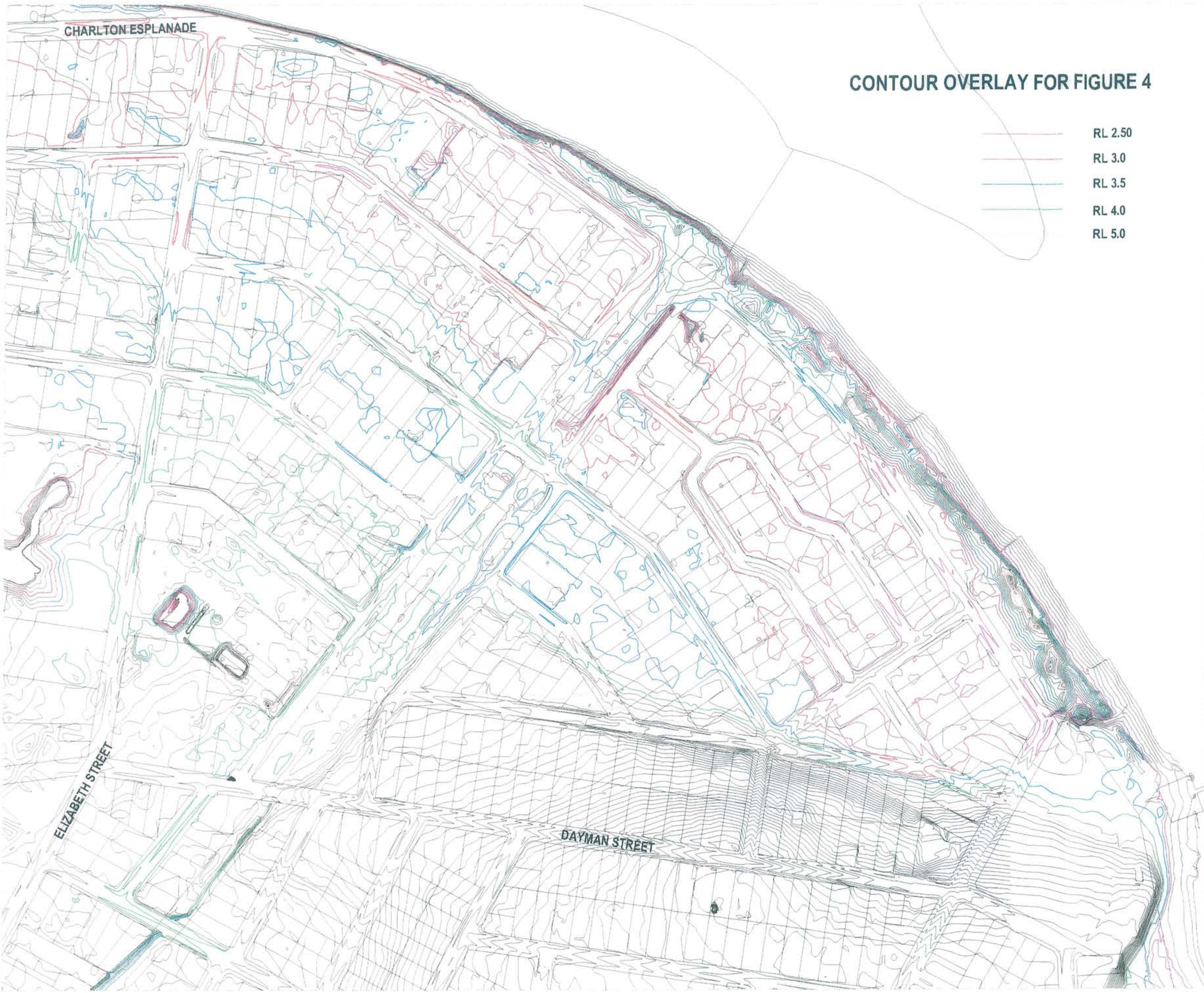
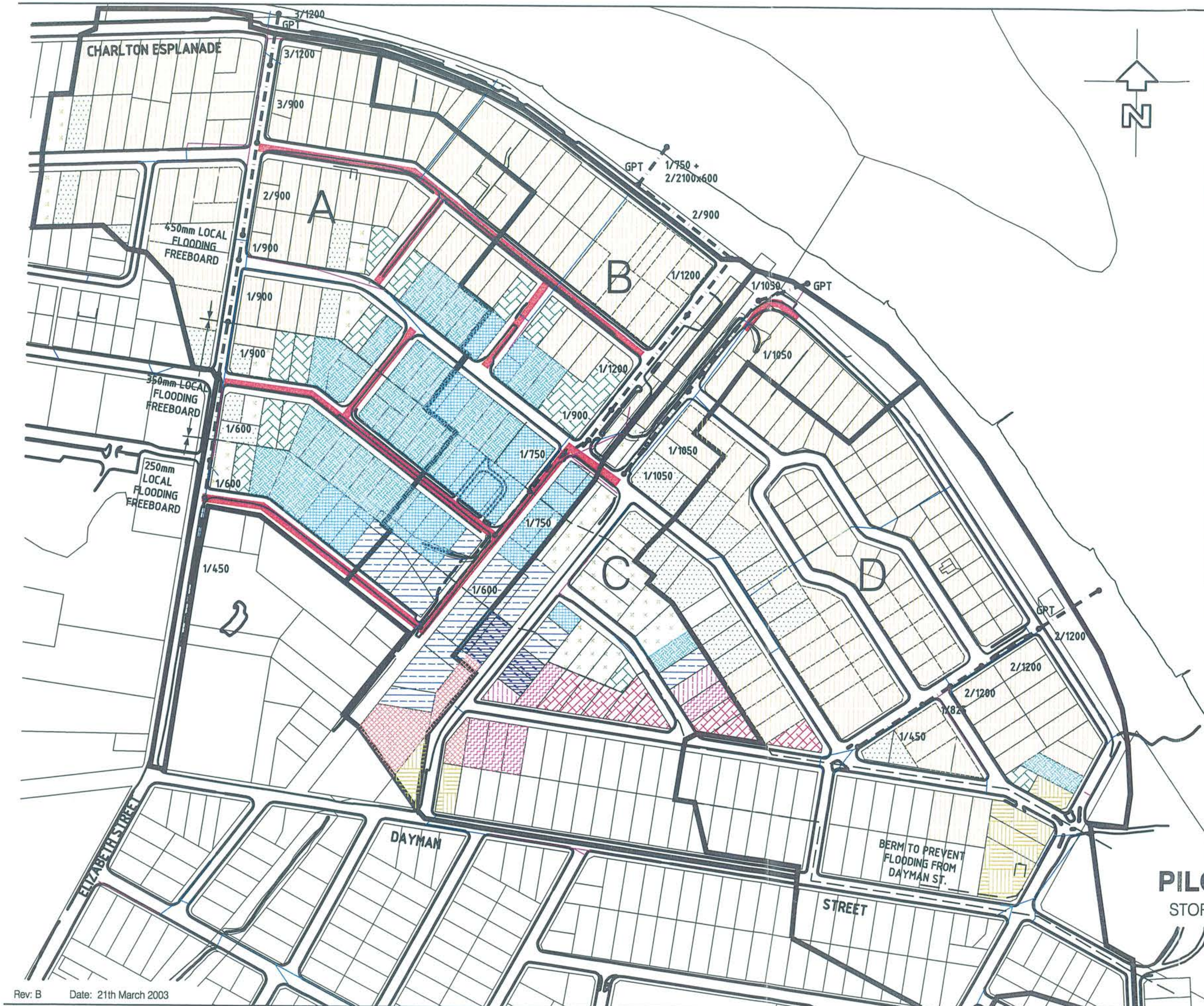

CONTOUR OVERLAY FOR FIGURE 4
RL 2.50
RL 3.0
RL 3.5
RL 4.0
RL 5.0
CHARLTON ESPLANADE
ELIZABETH STREET
DAYMAN STREET

Cardno MBK




**ALLOTMENT HABITABLE FLOOR LEVELS**

| LEVEL | COLOUR |
|---|---|
| R.L. 4.150 | |
| R.L. 4.300 | |
| R.L. 4.450 | |
| R.L. 4.600 | |
| R.L. 4.800 | |
| R.L. 5.000 | |
| R.L. 5.200 | |
| R.L. 5.400 | |
| R.L. 5.600 | |
| R.L. 5.800 | |
| R.L. 6.000 | |
| R.L. 6.200 | |
| R.L. 6.500 | |
| R.L. 6.800 | |
| Exist. levels satisfactory | |

**CATCHMENT TABLE**

| CATCHMENT | AREA |
|---|---|
| A | 14.921 Ha. |
| B | 14.713 Ha. |
| C | 10.485 Ha. |
| D | 22.957 Ha. |
| TOTAL | 63.076 Ha. |

**LEGEND**

- EXISTING STORMWATER DRAINAGE
- PROPOSED TRUNK DRAINAGE
- ROADS TO BE REGRADED TO DEFINE SUB-CATCHMENT BOUNDARIES

**NOTES:**

1. If lots are filled to achieve flood immunity, minimum fill level is 150mm less than nominated flood level.
2. GPT = Gross Pollutant Trap.
3. For details of gully pits refer to table B10 in appendix B of this report.
4. For details of pipes connecting gully pits to trunk drainage refer to table B5 in appendix B of this report.
5. Freeboard of 450mm applied to storm surge levels to obtain floor levels.

Scale 1:4000

# PILOT STREET - 100 YEAR

STORMWATER TRUNK DRAINAGE STRATEGY
PIPE SIZES AND FLOOR LEVEL
ULTIMATE DEVELOPMENT

# FIGURE 4

Rev: B Date: 21th March 2003

Project No.: 2919-31-02
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X-Ref: :

Revision B - REVISED FREEBOARD

# APPENDIX A

## Hydrologic Data

### List of Tables



### List of Figures

TABLE A1

**Catchment Areas, Weighted Runoff Coefficients and Times of Concentration**

| | | | Adopted Basic Runoff Coefficients | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $C_2$ | 0.701 | 0.701 | 0.723 | 0.723 | 0.765 | 0.748 | 0.561 | | | | | |
| | | $C_{10}$ | 0.85 | 0.825 | 0.85 | 0.85 | 0.9 | 0.88 | 0.66 | | | | | |
| | | $C_{20}$ | 0.893 | 0.866 | 0.893 | 0.893 | 0.945 | 0.924 | 0.693 | | | | | |
| | | $C_{50}$ | 0.978 | 0.949 | 0.978 | 0.978 | 1 | 1 | 0.759 | | | | | |
| | | $C_{100}$ | 1 | 0.99 | 1 | 1 | 1 | 1 | 0.792 | | | | | |
| Node | Inlet Time | Total Area | Area Components | | | | | | | Weighted C Values | | | | |
| | | | Road | Res. Low Density | Res. Med. Density | Foreshore Med. Den. | Local Shopping | Village Centre | Beach | 2 Year Event | 10 Year Event | 20 Year Event | 50 Year Event | 100 Year Event |
| | (Min) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | | | | | |
| *A- Elizabeth Street* | | | | | | | | | | | | | | |
| NAS01/02 | 5 | 0.308 | 0.308 | | 0 | | | | | 0.7 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS01/04 | 15 | 0.602 | 0.234 | | | 0.368 | | | | 0.71 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS01/05 | 15 | 0.267 | 0.084 | | | 0.083 | 0.1 | | | 0.73 | 0.87 | 0.91 | 0.99 | 1.00 |
| NAS01/06 | 15 | 0.549 | 0.168 | | | 0.381 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS01/07 | 15 | 0.338 | 0.102 | | | 0.236 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS01/08 | 15 | 1.341 | 0.282 | | 0.05 | 1.009 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS01/09 | 15 | 0.8 | 0.22 | | | 0.58 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS01/10 | 15 | 0.739 | 0.256 | | | 0.281 | | 0.202 | | 0.72 | 0.86 | 0.91 | 0.98 | 1.00 |
| NAS01/11 | 15 | 0.74 | 0.216 | | 0.328 | | 0.094 | 0.102 | | 0.73 | 0.86 | 0.9 | 0.98 | 1.00 |
| NAS01/12 | 15 | 0.632 | 0.237 | | | | | 0.395 | | 0.73 | 0.87 | 0.91 | 0.99 | 1.00 |
| NAS02/02 | 12.3 | 0.716 | 0.21 | | | 0.506 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS03/02 | 10.4 | 1.278 | 0.268 | | | 1.01 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS03/03 | 15 | 0.748 | 0.174 | | | 0.574 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS05/02 | 15 | 0.432 | 0.078 | | | 0.354 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS05/03 | 15 | 0.307 | 0.105 | | | 0.202 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS05/04 | 15 | 0.608 | 0.204 | | | 0.404 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS05/05 | 15 | 0.438 | 0.14 | | | 0.298 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS05/06 | 15 | 0.344 | 0.04 | | 0.051 | 0.253 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS07/02 | 15 | 0.763 | 0.232 | | | 0.216 | 0.315 | | | 0.73 | 0.87 | 0.91 | 0.99 | 1.00 |
| NAS07/03 | 15 | 1.22 | 0.203 | | | 0.416 | 0.501 | 0.1 | | 0.74 | 0.87 | 0.92 | 0.99 | 1.00 |
| NAS07/01 | 14 | 0.431 | 0.077 | | | 0.199 | 0.155 | | | 0.73 | 0.87 | 0.91 | 0.99 | 1.00 |
| NAS08/02 | 15 | 0.923 | 0.298 | | | 0.625 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS08/03 | 15 | 0.397 | 0.172 | | | 0.225 | | | | 0.71 | 0.85 | 0.89 | 0.98 | 1.00 |
| NAS12/02 | 15 | 2.432 | 0.345 | | 1.217 | 0.64 | | | 0.23 | 0.7 | 0.83 | 0.87 | 0.96 | 1.00 |

| Node | Inlet Time (Min) | Total Area (ha) | Area Components: Road (ha) | Res. Low Density (ha) | Res. Med. Density (ha) | Foreshore Med. Den. (ha) | Local Shopping (ha) | Village Centre (ha) | Beach (ha) | Weighted C Values: 2 Year Event | 10 Year Event | 20 Year Event | 50 Year Event | 100 Year Event |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***B- Pier Street*** | | | | | | | | | | | | | | |
| NBS01/04 | 15 | 2.01 | 0.527 | | 1.079 | 0.404 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NBS01/05 | 15 | 1.854 | 0.528 | | 0.719 | 0.607 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NBS01/07 | 15 | 1.155 | 0.356 | | 0.293 | 0.304 | 0.202 | | | 0.72 | 0.86 | 0.9 | 0.98 | 1.00 |
| NBS01/08 | 15 | 0.494 | 0.143 | | 0.09 | | 0.261 | | | 0.74 | 0.88 | 0.92 | 0.99 | 1.00 |
| NBS01/09 | 13 | 0.676 | 0.126 | | 0.107 | | 0.443 | | | 0.75 | 0.88 | 0.93 | 0.99 | 1.00 |
| NBS01/10 | 15 | 0.28 | 0.121 | | 0.108 | | 0.051 | | | 0.72 | 0.86 | 0.9 | 0.98 | 1.00 |
| NBS01/11 | 15 | 0.451 | 0.182 | | 0.103 | | 0.166 | | | 0.73 | 0.87 | 0.91 | 0.99 | 1.00 |
| NBS01/12 | 15 | 1.775 | 0.441 | | | | 0.552 | 0.317 | 0.465 | 0.69 | 0.82 | 0.86 | 0.93 | 0.95 |
| NBS02/01 | 11.2 | 0.197 | 0.045 | | | 0.152 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NBS04/02 | 15 | 1.673 | 0.361 | | | 0.302 | 0.708 | 0.302 | | 0.74 | 0.88 | 0.92 | 0.99 | 1.00 |
| NBS05/01 | 15 | 0.335 | 0.134 | | 0.101 | | 0.1 | | | 0.73 | 0.86 | 0.91 | 0.98 | 1.00 |
| NBS06/01 | 15 | 0.651 | 0.231 | | | | | 0.42 | | 0.73 | 0.87 | 0.91 | 0.99 | 1.00 |
| NBS06/02 | 12.4 | 0.73 | 0.225 | | | | 0.167 | 0.338 | | 0.74 | 0.88 | 0.92 | 0.99 | 1.00 |
| ***C- Pilot Street*** | | | | | | | | | | | | | | |
| NCS01/01 | 15 | 0.301 | 0.271 | | 0.03 | | | | | 0.7 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS01/02 | 9.8 | 2.26 | 0.548 | | 1.427 | 0.285 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS01/03 | 13.2 | 0.626 | 0.346 | | 0.043 | 0.237 | | | | 0.71 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS01/04 | 15 | 1.173 | 0.454 | | 0.028 | 0.691 | | | | 0.71 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS01/05 | 15 | 0.432 | 0.162 | | 0.027 | 0.243 | | | | 0.71 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS01/06 | 15 | 0.603 | 0.296 | | 0.039 | 0.268 | | | | 0.71 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS01/08 | 15 | 0.292 | 0.095 | | 0.035 | 0.162 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS01/09 | 15 | 0.59 | 0.192 | 0.281 | 0.117 | | | | | 0.71 | 0.84 | 0.88 | 0.96 | 1.00 |
| NCS01/10 | 14 | 0.585 | 0.24 | 0.121 | 0.224 | | | | | 0.71 | 0.84 | 0.89 | 0.97 | 1.00 |
| NCS03/01 | 13.4 | 1.385 | 0.218 | | 1.095 | 0.072 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS03/02 | 15 | 1.013 | 0.193 | | | 0.82 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NCS04/02 | 15 | 1.225 | 0.355 | 0.776 | | | | | 0.094 | 0.69 | 0.82 | 0.86 | 0.94 | 0.98 |
| **D- Guard Street** | | | | | | | | | | | | | | |
| NDS01/02 | 10 | 1.759 | 0.528 | | 1.231 | | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS01/04 | 15 | 1.254 | 0.479 | 0.614 | | 0.161 | | | | 0.7 | 0.84 | 0.88 | 0.96 | 1.00 |
| NDS01/05 | 15 | 1.058 | 0.328 | 0.054 | | 0.676 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS01/06 | 12.8 | 0.863 | 0.291 | 0.572 | | | | | | 0.7 | 0.83 | 0.88 | 0.96 | 0.99 |
| NDS01/07 | 15 | 1.522 | 0.371 | 0.406 | | | | | 0.745 | 0.63 | 0.75 | 0.79 | 0.86 | 0.90 |
| NDS02/01 | 13 | 0.184 | 0.103 | | | 0.081 | | | | 0.71 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS02/02 | 15 | 1.28 | 0.249 | | | 1.031 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |

| Node | Inlet Time (Min) | Total Area (ha) | Area Components | | | | | | | Weighted C Values | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Road (ha) | Res. Low Density (ha) | Res. Med. Density (ha) | Foreshore Med. Den. (ha) | Local Shopping (ha) | Village Centre (ha) | Beach (ha) | 2 Year Event | 10 Year Event | 20 Year Event | 50 Year Event | 100 Year Event |
| NDS02/04 | 15 | 1.835 | 0.374 | | 0.202 | 1.259 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS03/01 | 13 | 0.068 | 0.068 | | | | | | | 0.7 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS03/02 | 11 | 0.822 | 0.14 | 0.285 | 0.397 | | | | | 0.71 | 0.84 | 0.88 | 0.97 | 1.00 |
| NDS03/03 | 15 | 1.044 | 0.363 | 0.453 | | 0.228 | | | | 0.71 | 0.84 | 0.88 | 0.97 | 1.00 |
| NDS04/01 | 13 | 0.994 | 0.27 | | 0.724 | | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS04/02 | 13 | 0.226 | 0.205 | | 0.021 | | | | | 0.7 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS04/03 | 13 | 0.179 | 0.179 | | | | | | | 0.7 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS04/04 | 13 | 0.691 | 0.112 | | | | | | 0.579 | 0.58 | 0.69 | 0.73 | 0.79 | 0.83 |
| NDS04/05 | 15 | 1.33 | 0.285 | 0.298 | | | 0.207 | | 0.54 | 0.65 | 0.78 | 0.81 | 0.89 | 0.91 |
| NDS05/01 | 13 | 2.18 | 0.576 | 1.459 | | | 0.145 | | | 0.71 | 0.84 | 0.88 | 0.96 | 0.99 |
| NDS06/02 | 14.1 | 1.32 | 0.186 | | 1.003 | 0.131 | | | | 0.72 | 0.85 | 0.89 | 0.98 | 1.00 |
| NDS06/03 | 10 | 1.52 | 0.283 | | 0.849 | | 0.388 | | | 0.73 | 0.86 | 0.91 | 0.98 | 1.00 |
| NDS07/01 | 15 | 1.598 | 0.455 | 0.712 | 0.431 | | | | | 0.71 | 0.84 | 0.88 | 0.97 | 1.00 |
| NDS08/01 | 15 | 1.23 | 0.33 | 0.643 | | | | | 0.257 | 0.67 | 0.8 | 0.84 | 0.92 | 0.95 |
| **TOTAL** | | **63.076** | **17.618** | **6.674** | **12.169** | **16.974** | **4.555** | **2.176** | **2.91** | | | | | |

TABLE A2
Peak Flows- Minor Events

| Node Name | 2 Year Event 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) | 10 Year Event 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *A- Elizabeth Street* | | | | | | | | | | | | | | | | |
| NAS01/02 | 0.057 | 0.050 | 0.044 | 0.040 | 0.033 | 0.028 | 0.021 | 0.018 | 0.098 | 0.085 | 0.076 | 0.069 | 0.056 | 0.047 | 0.037 | 0.031 |
| NAS01/04 | 0.113 | 0.098 | 0.088 | 0.080 | 0.064 | 0.055 | 0.042 | 0.035 | 0.191 | 0.167 | 0.149 | 0.135 | 0.109 | 0.092 | 0.072 | 0.060 |
| NAS01/05 | 0.051 | 0.045 | 0.040 | 0.037 | 0.029 | 0.025 | 0.019 | 0.016 | 0.087 | 0.076 | 0.068 | 0.061 | 0.049 | 0.042 | 0.033 | 0.027 |
| NAS01/06 | 0.104 | 0.091 | 0.081 | 0.074 | 0.060 | 0.051 | 0.039 | 0.033 | 0.174 | 0.152 | 0.136 | 0.124 | 0.099 | 0.084 | 0.066 | 0.055 |
| NAS01/07 | 0.064 | 0.056 | 0.050 | 0.046 | 0.037 | 0.031 | 0.024 | 0.020 | 0.107 | 0.093 | 0.084 | 0.076 | 0.061 | 0.052 | 0.041 | 0.034 |
| NAS01/08 | 0.254 | 0.222 | 0.199 | 0.181 | 0.146 | 0.124 | 0.096 | 0.079 | 0.425 | 0.371 | 0.332 | 0.302 | 0.242 | 0.206 | 0.161 | 0.134 |
| NAS01/09 | 0.152 | 0.133 | 0.119 | 0.108 | 0.087 | 0.074 | 0.057 | 0.047 | 0.254 | 0.221 | 0.198 | 0.180 | 0.144 | 0.123 | 0.096 | 0.080 |
| NAS01/10 | 0.140 | 0.122 | 0.110 | 0.100 | 0.080 | 0.068 | 0.053 | 0.044 | 0.237 | 0.207 | 0.185 | 0.168 | 0.135 | 0.115 | 0.090 | 0.075 |
| NAS01/11 | 0.142 | 0.124 | 0.111 | 0.101 | 0.081 | 0.069 | 0.054 | 0.044 | 0.237 | 0.207 | 0.185 | 0.168 | 0.135 | 0.115 | 0.090 | 0.075 |
| NAS01/12 | 0.122 | 0.106 | 0.095 | 0.087 | 0.070 | 0.059 | 0.046 | 0.038 | 0.205 | 0.179 | 0.160 | 0.146 | 0.117 | 0.099 | 0.078 | 0.065 |
| NAS02/02 | 0.136 | 0.119 | 0.106 | 0.097 | 0.078 | 0.066 | 0.051 | 0.042 | 0.227 | 0.198 | 0.177 | 0.161 | 0.129 | 0.110 | 0.086 | 0.072 |
| NAS03/02 | 0.242 | 0.212 | 0.189 | 0.173 | 0.139 | 0.118 | 0.091 | 0.076 | 0.405 | 0.353 | 0.316 | 0.288 | 0.231 | 0.196 | 0.153 | 0.128 |
| NAS03/03 | 0.142 | 0.124 | 0.111 | 0.101 | 0.081 | 0.069 | 0.053 | 0.044 | 0.237 | 0.207 | 0.185 | 0.168 | 0.135 | 0.115 | 0.090 | 0.075 |
| NAS05/02 | 0.082 | 0.072 | 0.064 | 0.058 | 0.047 | 0.040 | 0.031 | 0.026 | 0.137 | 0.119 | 0.107 | 0.097 | 0.078 | 0.066 | 0.052 | 0.043 |
| NAS05/03 | 0.058 | 0.051 | 0.046 | 0.041 | 0.033 | 0.028 | 0.022 | 0.018 | 0.097 | 0.085 | 0.076 | 0.069 | 0.055 | 0.047 | 0.037 | 0.031 |
| NAS05/04 | 0.115 | 0.101 | 0.090 | 0.082 | 0.066 | 0.056 | 0.043 | 0.036 | 0.193 | 0.168 | 0.150 | 0.137 | 0.110 | 0.093 | 0.073 | 0.061 |
| NAS05/05 | 0.083 | 0.073 | 0.065 | 0.059 | 0.048 | 0.041 | 0.031 | 0.026 | 0.139 | 0.121 | 0.108 | 0.099 | 0.079 | 0.067 | 0.052 | 0.044 |
| NAS05/06 | 0.065 | 0.057 | 0.051 | 0.046 | 0.037 | 0.032 | 0.025 | 0.020 | 0.109 | 0.095 | 0.085 | 0.077 | 0.062 | 0.053 | 0.041 | 0.034 |
| NAS07/02 | 0.147 | 0.128 | 0.115 | 0.104 | 0.084 | 0.072 | 0.055 | 0.046 | 0.248 | 0.216 | 0.193 | 0.176 | 0.141 | 0.120 | 0.094 | 0.078 |
| NAS07/03 | 0.238 | 0.208 | 0.186 | 0.169 | 0.136 | 0.116 | 0.090 | 0.074 | 0.396 | 0.345 | 0.309 | 0.281 | 0.226 | 0.192 | 0.150 | 0.125 |
| NAS07/01 | 0.083 | 0.072 | 0.065 | 0.059 | 0.047 | 0.040 | 0.031 | 0.026 | 0.140 | 0.122 | 0.109 | 0.099 | 0.080 | 0.068 | 0.053 | 0.044 |
| NAS08/02 | 0.175 | 0.153 | 0.137 | 0.125 | 0.100 | 0.085 | 0.066 | 0.055 | 0.293 | 0.255 | 0.228 | 0.208 | 0.167 | 0.142 | 0.111 | 0.092 |
| NAS08/03 | 0.074 | 0.065 | 0.058 | 0.053 | 0.043 | 0.036 | 0.028 | 0.023 | 0.126 | 0.110 | 0.098 | 0.089 | 0.072 | 0.061 | 0.048 | 0.040 |
| NAS12/02 | 0.449 | 0.392 | 0.351 | 0.319 | 0.257 | 0.219 | 0.169 | 0.140 | 0.753 | 0.657 | 0.587 | 0.534 | 0.429 | 0.365 | 0.285 | 0.238 |
| *B- Pier Street* | | | | | | | | | | | | | | | | |
| NBS01/04 | 0.381 | 0.333 | 0.298 | 0.271 | 0.218 | 0.186 | 0.144 | 0.119 | 0.638 | 0.556 | 0.497 | 0.452 | 0.363 | 0.309 | 0.241 | 0.201 |
| NBS01/05 | 0.352 | 0.307 | 0.275 | 0.250 | 0.201 | 0.171 | 0.132 | 0.110 | 0.588 | 0.513 | 0.459 | 0.417 | 0.335 | 0.285 | 0.222 | 0.186 |
| NBS01/07 | 0.219 | 0.191 | 0.171 | 0.156 | 0.125 | 0.107 | 0.082 | 0.068 | 0.371 | 0.323 | 0.289 | 0.263 | 0.211 | 0.179 | 0.140 | 0.117 |
| NBS01/08 | 0.096 | 0.084 | 0.075 | 0.069 | 0.055 | 0.047 | 0.036 | 0.030 | 0.162 | 0.141 | 0.126 | 0.115 | 0.092 | 0.079 | 0.061 | 0.051 |
| NBS01/09 | 0.134 | 0.117 | 0.104 | 0.095 | 0.076 | 0.065 | 0.050 | 0.042 | 0.222 | 0.194 | 0.173 | 0.157 | 0.126 | 0.107 | 0.084 | 0.070 |
| NBS01/10 | 0.053 | 0.046 | 0.042 | 0.038 | 0.030 | 0.026 | 0.020 | 0.017 | 0.090 | 0.078 | 0.070 | 0.064 | 0.051 | 0.043 | 0.034 | 0.028 |
| NBS01/11 | 0.087 | 0.076 | 0.068 | 0.062 | 0.050 | 0.042 | 0.033 | 0.027 | 0.146 | 0.128 | 0.114 | 0.104 | 0.083 | 0.071 | 0.055 | 0.046 |
| NBS01/12 | 0.323 | 0.282 | 0.252 | 0.230 | 0.185 | 0.157 | 0.121 | 0.101 | 0.543 | 0.474 | 0.424 | 0.385 | 0.309 | 0.263 | 0.205 | 0.171 |
| NBS02/01 | 0.037 | 0.033 | 0.029 | 0.027 | 0.021 | 0.018 | 0.014 | 0.012 | 0.062 | 0.054 | 0.049 | 0.044 | 0.036 | 0.030 | 0.024 | 0.020 |
| NBS04/02 | 0.326 | 0.285 | 0.255 | 0.232 | 0.187 | 0.159 | 0.123 | 0.102 | 0.549 | 0.479 | 0.428 | 0.390 | 0.313 | 0.266 | 0.208 | 0.173 |
| NBS05/01 | 0.064 | 0.056 | 0.050 | 0.046 | 0.037 | 0.031 | 0.024 | 0.020 | 0.108 | 0.094 | 0.084 | 0.076 | 0.061 | 0.052 | 0.041 | 0.034 |

| Node Name | 2 Year Event | | | | | | | | 10 Year Event | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) | 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) |
| **NBS06/01** | 0.125 | 0.109 | 0.098 | 0.089 | 0.072 | 0.061 | 0.047 | 0.039 | 0.211 | 0.184 | 0.165 | 0.150 | 0.120 | 0.102 | 0.080 | 0.067 |
| **NBS06/02** | 0.142 | 0.124 | 0.111 | 0.101 | 0.081 | 0.069 | 0.054 | 0.044 | 0.240 | 0.209 | 0.187 | 0.170 | 0.136 | 0.116 | 0.091 | 0.076 |
| ***C- Pilot Street*** | | | | | | | | | | | | | | | | |
| **NCS01/01** | 0.056 | 0.048 | 0.043 | 0.040 | 0.032 | 0.027 | 0.021 | 0.017 | 0.095 | 0.083 | 0.074 | 0.068 | 0.054 | 0.046 | 0.036 | 0.030 |
| **NCS01/02** | 0.429 | 0.374 | 0.335 | 0.305 | 0.245 | 0.209 | 0.161 | 0.134 | 0.717 | 0.625 | 0.559 | 0.509 | 0.408 | 0.347 | 0.271 | 0.226 |
| **NCS01/03** | 0.117 | 0.102 | 0.092 | 0.083 | 0.067 | 0.057 | 0.044 | 0.037 | 0.199 | 0.173 | 0.155 | 0.141 | 0.113 | 0.096 | 0.075 | 0.063 |
| **NCS01/04** | 0.219 | 0.192 | 0.172 | 0.156 | 0.126 | 0.107 | 0.083 | 0.068 | 0.372 | 0.324 | 0.290 | 0.264 | 0.212 | 0.180 | 0.141 | 0.117 |
| **NCS01/05** | 0.081 | 0.071 | 0.063 | 0.058 | 0.046 | 0.039 | 0.030 | 0.025 | 0.137 | 0.119 | 0.107 | 0.097 | 0.078 | 0.066 | 0.052 | 0.043 |
| **NCS01/06** | 0.113 | 0.098 | 0.088 | 0.080 | 0.065 | 0.055 | 0.042 | 0.035 | 0.191 | 0.167 | 0.149 | 0.136 | 0.109 | 0.093 | 0.072 | 0.060 |
| **NCS01/08** | 0.055 | 0.048 | 0.043 | 0.039 | 0.032 | 0.027 | 0.021 | 0.017 | 0.093 | 0.081 | 0.072 | 0.066 | 0.053 | 0.045 | 0.035 | 0.029 |
| **NCS01/09** | 0.110 | 0.096 | 0.086 | 0.079 | 0.063 | 0.054 | 0.042 | 0.034 | 0.185 | 0.161 | 0.144 | 0.131 | 0.105 | 0.090 | 0.070 | 0.058 |
| **NCS01/10** | 0.109 | 0.096 | 0.086 | 0.078 | 0.063 | 0.053 | 0.041 | 0.034 | 0.183 | 0.160 | 0.143 | 0.130 | 0.104 | 0.089 | 0.069 | 0.058 |
| **NCS03/01** | 0.263 | 0.229 | 0.205 | 0.187 | 0.150 | 0.128 | 0.099 | 0.082 | 0.439 | 0.383 | 0.343 | 0.312 | 0.250 | 0.213 | 0.166 | 0.139 |
| **NCS03/02** | 0.192 | 0.168 | 0.150 | 0.137 | 0.110 | 0.094 | 0.072 | 0.060 | 0.321 | 0.280 | 0.251 | 0.228 | 0.183 | 0.156 | 0.121 | 0.101 |
| **NCS04/02** | 0.223 | 0.194 | 0 174 | 0.159 | 0.127 | 0.109 | 0.084 | 0.070 | 0.375 | 0.327 | 0.292 | 0.266 | 0.213 | 0.181 | 0.142 | 0.118 |
| ***D- Guard Street*** | | | | | | | | | | | | | | | | |
| **NDS01/02** | 0.334 | 0.291 | 0.261 | 0.238 | 0.191 | 0.163 | 0.126 | 0.104 | 0.558 | 0.487 | 0.435 | 0.396 | 0.318 | 0.270 | 0.211 | 0.176 |
| **NDS01/04** | 0.231 | 0.202 | 0.181 | 0.165 | 0.132 | 0.113 | 0.087 | 0.072 | 0.393 | 0.343 | 0.307 | 0.279 | 0.224 | 0.190 | 0.148 | 0.124 |
| **NDS01/05** | 0.201 | 0.175 | 0.157 | 0.143 | 0.115 | 0.098 | 0.076 | 0.063 | 0.336 | 0.293 | 0.262 | 0.238 | 0.191 | 0.162 | 0.127 | 0.106 |
| **NDS01/06** | 0.159 | 0.139 | 0.124 | 0.113 | 0.091 | 0.078 | 0.060 | 0.050 | 0.267 | 0.233 | 0.208 | 0.190 | 0.152 | 0.129 | 0.101 | 0.084 |
| **NDS01/07** | 0.253 | 0.221 | 0.197 | 0.180 | 0.145 | 0.123 | 0.095 | 0.079 | 0.426 | 0.371 | 0.332 | 0.302 | 0.243 | 0.206 | 0.161 | 0.134 |
| **NDS02/01** | 0.034 | 0.030 | 0.027 | 0.025 | 0.020 | 0.017 | 0.013 | 0.011 | 0.058 | 0.051 | 0.046 | 0.041 | 0.033 | 0.028 | 0.022 | 0.018 |
| **NDS02/02** | 0.243 | 0.212 | 0.190 | 0.173 | 0.139 | 0.118 | 0.091 | 0.076 | 0.406 | 0.354 | 0.317 | 0.288 | 0.231 | 0.197 | 0.153 | 0.128 |
| **NDS02/04** | 0.348 | 0.304 | 0.272 | 0.248 | 0.199 | 0.170 | 0.131 | 0.109 | 0.582 | 0.508 | 0.454 | 0.413 | 0.331 | 0.282 | 0.220 | 0.184 |
| **NDS03/01** | 0.013 | 0.011 | 0.010 | 0.009 | 0.007 | 0.006 | 0.005 | 0.004 | 0.022 | 0.019 | 0.017 | 0.015 | 0.012 | 0.010 | 0.008 | 0.007 |
| **NDS03/02** | 0.154 | 0.134 | 0.120 | 0.109 | 0.088 | 0.075 | 0.058 | 0.048 | 0.258 | 0.225 | 0.201 | 0.183 | 0.147 | 0.125 | 0.097 | 0.081 |
| **NDS03/03** | 0.195 | 0.171 | 0.153 | 0.139 | 0.112 | 0.095 | 0.074 | 0.061 | 0.327 | 0.285 | 0.255 | 0.232 | 0.186 | 0.158 | 0.124 | 0.103 |
| **NDS04/01** | 0.189 | 0.165 | 0.147 | 0.134 | 0.108 | 0.092 | 0.071 | 0.059 | 0.315 | 0.275 | 0.246 | 0.224 | 0.180 | 0.153 | 0.119 | 0.100 |
| **NDS04/02** | 0.042 | 0.036 | 0.033 | 0.030 | 0.024 | 0.020 | 0.016 | 0.013 | 0.072 | 0.063 | 0.056 | 0.051 | 0.041 | 0.035 | 0.027 | 0.023 |
| **NDS04/03** | 0.033 | 0.029 | 0.026 | 0.023 | 0.019 | 0.016 | 0.012 | 0.010 | 0.057 | 0.050 | 0.044 | 0.040 | 0.032 | 0.027 | 0.021 | 0.018 |
| **NDS04/04** | 0.106 | 0.092 | 0.083 | 0.075 | 0.060 | 0.051 | 0.040 | 0.033 | 0.178 | 0.155 | 0.139 | 0.126 | 0.101 | 0.086 | 0.067 | 0.056 |
| **NDS04/05** | 0.228 | 0.199 | 0.178 | 0.162 | 0.130 | 0.111 | 0.086 | 0.071 | 0.387 | 0.338 | 0.302 | 0.275 | 0.220 | 0.187 | 0.146 | 0.122 |
| **NDS05/01** | 0.408 | 0.356 | 0.319 | 0.290 | 0.233 | 0.199 | 0.154 | 0.127 | 0.683 | 0.596 | 0.533 | 0.485 | 0.389 | 0.331 | 0.258 | 0.216 |
| **NDS06/02** | 0.250 | 0.219 | 0.196 | 0.178 | 0.143 | 0.122 | 0.094 | 0.078 | 0.419 | 0.365 | 0.326 | 0.297 | 0.238 | 0.203 | 0.158 | 0.132 |
| **NDS06/03** | 0.292 | 0.255 | 0.229 | 0.208 | 0.167 | 0.143 | 0.110 | 0.091 | 0.488 | 0.425 | 0.380 | 0.346 | 0.278 | 0.236 | 0.184 | 0.154 |
| **NDS07/01** | 0.299 | 0.261 | 0.234 | 0.213 | 0.171 | 0.146 | 0.113 | 0.093 | 0.501 | 0.437 | 0.391 | 0.355 | 0.285 | 0.242 | 0.189 | 0.158 |
| **NDS08/01** | 0.217 | 0.190 | 0.170 | 0.155 | 0.124 | 0.106 | 0.082 | 0.068 | 0.367 | 0.320 | 0.286 | 0.260 | 0.209 | 0.178 | 0.139 | 0.116 |

TABLE A3
Peak Flows- Major Events

| Node Name | 20 Year Event | | | | | | | | 50 Year Event | | | | | | | | 100 Year Event | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) | 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) | 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) |
| *A- Elizabeth Street* | | | | | | | | | | | | | | | | | | | | | | | | |
| NAS01/02 | 0.117 | 0.102 | 0.091 | 0.083 | 0.067 | 0.057 | 0.044 | 0.037 | 0.151 | 0.132 | 0.118 | 0.107 | 0.086 | 0.073 | 0.057 | 0.048 | 0.171 | 0.149 | 0.133 | 0.121 | 0.097 | 0.082 | 0.065 | 0.055 |
| NAS01/04 | 0.229 | 0.200 | 0.179 | 0.163 | 0.130 | 0.111 | 0.087 | 0.073 | 0.295 | 0.257 | 0.230 | 0.209 | 0.168 | 0.142 | 0.112 | 0.094 | 0.335 | 0.292 | 0.261 | 0.237 | 0.190 | 0.161 | 0.127 | 0.107 |
| NAS01/05 | 0.104 | 0.091 | 0.081 | 0.074 | 0.059 | 0.050 | 0.039 | 0.033 | 0.132 | 0.115 | 0.103 | 0.094 | 0.075 | 0.064 | 0.050 | 0.042 | 0.149 | 0.129 | 0.116 | 0.105 | 0.084 | 0.071 | 0.056 | 0.047 |
| NAS01/06 | 0.209 | 0.182 | 0.163 | 0.148 | 0.119 | 0.101 | 0.079 | 0.066 | 0.269 | 0.235 | 0.210 | 0.191 | 0.153 | 0.130 | 0.102 | 0.086 | 0.306 | 0.266 | 0.238 | 0.216 | 0.173 | 0.147 | 0.116 | 0.097 |
| NAS01/07 | 0.129 | 0.112 | 0.100 | 0.091 | 0.073 | 0.062 | 0.049 | 0.041 | 0.166 | 0.145 | 0.129 | 0.117 | 0.094 | 0.080 | 0.063 | 0.053 | 0.188 | 0.164 | 0.146 | 0.133 | 0.107 | 0.090 | 0.071 | 0.060 |
| NAS01/08 | 0.511 | 0.445 | 0.398 | 0.362 | 0.290 | 0.247 | 0.193 | 0.162 | 0.658 | 0.573 | 0.512 | 0.466 | 0.373 | 0.317 | 0.249 | 0.209 | 0.747 | 0.650 | 0.581 | 0.528 | 0.423 | 0.359 | 0.283 | 0.238 |
| NAS01/09 | 0.305 | 0.266 | 0.238 | 0.216 | 0.173 | 0.147 | 0.115 | 0.097 | 0.393 | 0.342 | 0.306 | 0.278 | 0.223 | 0.189 | 0.149 | 0.125 | 0.445 | 0.388 | 0.347 | 0.315 | 0.252 | 0.214 | 0.169 | 0.142 |
| NAS01/10 | 0.288 | 0.251 | 0.224 | 0.204 | 0.164 | 0.139 | 0.109 | 0.091 | 0.363 | 0.316 | 0.282 | 0.257 | 0.206 | 0.175 | 0.137 | 0.115 | 0.411 | 0.358 | 0.320 | 0.291 | 0.233 | 0.198 | 0.156 | 0.131 |
| NAS01/11 | 0.285 | 0.249 | 0.222 | 0.202 | 0.162 | 0.138 | 0.108 | 0.090 | 0.363 | 0.316 | 0.283 | 0.257 | 0.206 | 0.175 | 0.137 | 0.115 | 0.412 | 0.359 | 0.321 | 0.291 | 0.233 | 0.198 | 0.156 | 0.131 |
| NAS01/12 | 0.246 | 0.215 | 0.192 | 0.174 | 0.140 | 0.119 | 0.093 | 0.078 | 0.313 | 0.273 | 0.244 | 0.222 | 0.178 | 0.151 | 0.119 | 0.100 | 0.352 | 0.306 | 0.274 | 0.249 | 0.199 | 0.169 | 0.133 | 0.112 |
| NAS02/02 | 0.273 | 0.238 | 0.213 | 0.193 | 0.155 | 0.132 | 0.103 | 0.086 | 0.351 | 0.306 | 0.274 | 0.249 | 0.199 | 0.169 | 0.133 | 0.112 | 0.399 | 0.347 | 0.310 | 0.282 | 0.226 | 0.192 | 0.151 | 0.127 |
| NAS03/02 | 0.487 | 0.424 | 0.379 | 0.345 | 0.277 | 0.235 | 0.184 | 0.154 | 0.627 | 0.546 | 0.488 | 0.444 | 0.356 | 0.302 | 0.237 | 0.199 | 0.711 | 0.620 | 0.554 | 0.503 | 0.403 | 0.342 | 0.270 | 0.227 |
| NAS03/03 | 0.285 | 0.248 | 0.222 | 0.202 | 0.162 | 0.138 | 0.108 | 0.090 | 0.367 | 0.320 | 0.286 | 0.260 | 0.208 | 0.177 | 0.139 | 0.117 | 0.416 | 0.363 | 0.324 | 0.295 | 0.236 | 0.200 | 0.158 | 0.133 |
| NAS05/02 | 0.165 | 0.143 | 0.128 | 0.117 | 0.094 | 0.080 | 0.062 | 0.052 | 0.212 | 0.185 | 0.165 | 0.150 | 0.120 | 0.102 | 0.080 | 0.067 | 0.240 | 0.209 | 0.187 | 0.170 | 0.136 | 0.116 | 0.091 | 0.077 |
| NAS05/03 | 0.117 | 0.102 | 0.091 | 0.083 | 0.067 | 0.056 | 0.044 | 0.037 | 0.151 | 0.131 | 0.117 | 0.107 | 0.085 | 0.073 | 0.057 | 0.048 | 0.171 | 0.149 | 0.133 | 0.121 | 0.097 | 0.082 | 0.065 | 0.054 |
| NAS05/04 | 0.232 | 0.202 | 0.181 | 0.164 | 0.132 | 0.112 | 0.088 | 0.073 | 0.298 | 0.260 | 0.232 | 0.211 | 0.169 | 0.144 | 0.113 | 0.095 | 0.338 | 0.295 | 0.263 | 0.239 | 0.192 | 0.163 | 0.128 | 0.108 |
| NAS05/05 | 0.167 | 0.145 | 0.130 | 0.118 | 0.095 | 0.081 | 0.063 | 0.053 | 0.215 | 0.187 | 0.167 | 0.152 | 0.122 | 0.104 | 0.081 | 0.068 | 0.244 | 0.212 | 0.190 | 0.172 | 0.138 | 0.117 | 0.092 | 0.078 |
| NAS05/06 | 0.131 | 0.114 | 0.102 | 0.093 | 0.075 | 0.063 | 0.050 | 0.042 | 0.169 | 0.147 | 0.131 | 0.120 | 0.096 | 0.081 | 0.064 | 0.054 | 0.192 | 0.167 | 0.149 | 0.135 | 0.109 | 0.092 | 0.073 | 0.061 |
| NAS07/02 | 0.297 | 0.259 | 0.232 | 0.211 | 0.169 | 0.144 | 0.112 | 0.094 | 0.378 | 0.330 | 0.295 | 0.268 | 0.215 | 0.182 | 0.143 | 0.120 | 0.425 | 0.370 | 0.330 | 0.300 | 0.241 | 0.204 | 0.161 | 0.135 |
| NAS07/03 | 0.481 | 0.419 | 0.374 | 0.341 | 0.273 | 0.232 | 0.182 | 0.152 | 0.605 | 0.527 | 0.471 | 0.428 | 0.343 | 0.291 | 0.229 | 0.192 | 0.679 | 0.592 | 0.528 | 0.480 | 0.385 | 0.327 | 0.257 | 0.216 |
| NAS07/01 | 0.168 | 0.146 | 0.131 | 0.119 | 0.095 | 0.081 | 0.064 | 0.053 | 0.214 | 0.186 | 0.166 | 0.151 | 0.121 | 0.103 | 0.081 | 0.068 | 0.240 | 0.209 | 0.187 | 0.170 | 0.136 | 0.115 | 0.091 | 0.076 |
| NAS08/02 | 0.352 | 0.307 | 0.274 | 0.249 | 0.200 | 0.170 | 0.133 | 0.111 | 0.453 | 0.395 | 0.353 | 0.321 | 0.257 | 0.218 | 0.171 | 0.144 | 0.514 | 0.448 | 0.400 | 0.363 | 0.291 | 0.247 | 0.195 | 0.164 |
| NAS08/03 | 0.151 | 0.132 | 0.118 | 0.107 | 0.086 | 0.073 | 0.057 | 0.048 | 0.195 | 0.170 | 0.152 | 0.138 | 0.111 | 0.094 | 0.074 | 0.062 | 0.221 | 0.192 | 0.172 | 0.156 | 0.125 | 0.106 | 0.084 | 0.070 |
| NAS12/02 | 0.906 | 0.790 | 0.706 | 0.642 | 0.515 | 0.438 | 0.343 | 0.287 | 1.169 | 1.019 | 0.910 | 0.828 | 0.663 | 0.563 | 0.443 | 0.372 | 1.354 | 1.179 | 1.053 | 0.958 | 0.767 | 0.651 | 0.513 | 0.432 |
| *B- Pier Street* | | | | | | | | | | | | | | | | | | | | | | | | |
| NBS01/04 | 0.766 | 0.668 | 0.597 | 0.543 | 0.435 | 0.370 | 0.290 | 0.243 | 0.987 | 0.859 | 0.768 | 0.698 | 0.560 | 0.475 | 0.373 | 0.314 | 1.119 | 0.975 | 0.871 | 0.791 | 0.634 | 0.538 | 0.424 | 0.357 |
| NBS01/05 | 0.707 | 0.616 | 0.551 | 0.501 | 0.402 | 0.341 | 0.267 | 0.224 | 0.910 | 0.793 | 0.708 | 0.644 | 0.516 | 0.438 | 0.344 | 0.289 | 1.032 | 0.899 | 0.803 | 0.730 | 0.585 | 0.496 | 0.391 | 0.329 |
| NBS01/07 | 0.445 | 0.388 | 0.347 | 0.315 | 0.253 | 0.215 | 0.168 | 0.141 | 0.567 | 0.494 | 0.441 | 0.401 | 0.322 | 0.273 | 0.215 | 0.180 | 0.643 | 0.560 | 0.500 | 0.455 | 0.364 | 0.309 | 0.244 | 0.205 |
| NBS01/08 | 0.195 | 0.170 | 0.152 | 0.138 | 0.111 | 0.094 | 0.074 | 0.062 | 0.245 | 0.213 | 0.191 | 0.173 | 0.139 | 0.118 | 0.093 | 0.078 | 0.275 | 0.240 | 0.214 | 0.195 | 0.156 | 0.132 | 0.104 | 0.088 |
| NBS01/09 | 0.269 | 0.235 | 0.210 | 0.191 | 0.153 | 0.130 | 0.102 | 0.085 | 0.335 | 0.292 | 0.261 | 0.237 | 0.190 | 0.161 | 0.127 | 0.107 | 0.376 | 0.328 | 0.293 | 0.266 | 0.213 | 0.181 | 0.143 | 0.120 |
| NBS01/10 | 0.108 | 0.094 | 0.084 | 0.076 | 0.061 | 0.052 | 0.041 | 0.034 | 0.137 | 0.120 | 0.107 | 0.097 | 0.078 | 0.066 | 0.052 | 0.044 | 0.156 | 0.136 | 0.121 | 0.110 | 0.088 | 0.075 | 0.059 | 0.050 |
| NBS01/11 | 0.176 | 0.153 | 0.137 | 0.125 | 0.100 | 0.085 | 0.066 | 0.056 | 0.224 | 0.195 | 0.174 | 0.158 | 0.127 | 0.108 | 0.085 | 0.071 | 0.251 | 0.219 | 0.195 | 0.178 | 0.142 | 0.121 | 0.095 | 0.080 |
| NBS01/12 | 0.654 | 0.570 | 0.509 | 0.463 | 0.372 | 0.316 | 0.247 | 0.207 | 0.827 | 0.720 | 0.644 | 0.585 | 0.469 | 0.398 | 0.313 | 0.263 | 0.939 | 0.818 | 0.730 | 0.664 | 0.532 | 0.451 | 0.356 | 0.299 |
| NBS02/01 | 0.075 | 0.065 | 0.058 | 0.053 | 0.043 | 0.036 | 0.028 | 0.024 | 0.097 | 0.084 | 0.075 | 0.068 | 0.055 | 0.047 | 0.037 | 0.031 | 0.110 | 0.096 | 0.085 | 0.078 | 0.062 | 0.053 | 0.042 | 0.035 |
| NBS04/02 | 0.659 | 0.574 | 0.514 | 0.467 | 0.375 | 0.318 | 0.249 | 0.209 | 0.830 | 0.723 | 0.646 | 0.587 | 0.471 | 0.400 | 0.314 | 0.264 | 0.931 | 0.811 | 0.725 | 0.659 | 0.528 | 0.448 | 0.353 | 0.297 |
| NBS05/01 | 0.131 | 0.114 | 0.102 | 0.092 | 0.074 | 0.063 | 0.049 | 0.041 | 0.164 | 0.143 | 0.128 | 0.116 | 0.093 | 0.079 | 0.062 | 0.052 | 0.186 | 0.162 | 0.145 | 0.132 | 0.106 | 0.090 | 0.071 | 0.059 |

| Node Name | 20 Year Event | | | | | | | | 50 Year Event | | | | | | | | 100 Year Event | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) | 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) | 15 Min Storm ($m^3/s$) | 20 Min Storm ($m^3/s$) | 25 Min Storm ($m^3/s$) | 30 Min Storm ($m^3/s$) | 45 Min Storm ($m^3/s$) | 1 Hour Storm ($m^3/s$) | 90 Min Storm ($m^3/s$) | 2 Hour Storm ($m^3/s$) |
| NBS06/01 | 0.254 | 0.221 | 0.198 | 0.180 | 0.144 | 0.122 | 0.096 | 0.080 | 0.323 | 0.281 | 0.251 | 0.228 | 0.183 | 0.156 | 0.122 | 0.103 | 0.362 | 0.316 | 0.282 | 0.256 | 0.205 | 0.174 | 0.137 | 0.116 |
| NBS06/02 | 0.288 | 0.251 | 0.224 | 0.204 | 0.163 | 0.139 | 0.109 | 0.091 | 0.362 | 0.315 | 0.282 | 0.256 | 0.205 | 0.174 | 0.137 | 0.115 | 0.406 | 0.354 | 0.316 | 0.287 | 0.230 | 0.195 | 0.154 | 0.130 |
| *C- Pilot Street* | | | | | | | | | | | | | | | | | | | | | | | | |
| NCS01/01 | 0.115 | 0.100 | 0.089 | 0.081 | 0.065 | 0.055 | 0.043 | 0.036 | 0.148 | 0.129 | 0.115 | 0.105 | 0.084 | 0.071 | 0.056 | 0.047 | 0.168 | 0.146 | 0.130 | 0.119 | 0.095 | 0.081 | 0.063 | 0.053 |
| NCS01/02 | 0.861 | 0.751 | 0.671 | 0.610 | 0.490 | 0.416 | 0.326 | 0.273 | 1.109 | 0.966 | 0.864 | 0.785 | 0.629 | 0.534 | 0.420 | 0.353 | 1.258 | 1.096 | 0.979 | 0.890 | 0.713 | 0.605 | 0.477 | 0.401 |
| NCS01/03 | 0.239 | 0.208 | 0.186 | 0.169 | 0.136 | 0.115 | 0.090 | 0.076 | 0.307 | 0.268 | 0.239 | 0.217 | 0.174 | 0.148 | 0.116 | 0.098 | 0.348 | 0.304 | 0.271 | 0.246 | 0.197 | 0.168 | 0.132 | 0.111 |
| NCS01/04 | 0.447 | 0.390 | 0.348 | 0.317 | 0.254 | 0.216 | 0.169 | 0.142 | 0.576 | 0.502 | 0.448 | 0.407 | 0.327 | 0.277 | 0.218 | 0.183 | 0.653 | 0.569 | 0.508 | 0.462 | 0.370 | 0.314 | 0.247 | 0.208 |
| NCS01/05 | 0.165 | 0.143 | 0.128 | 0.117 | 0.094 | 0.080 | 0.062 | 0.052 | 0.212 | 0.185 | 0.165 | 0.150 | 0.120 | 0.102 | 0.080 | 0.067 | 0.240 | 0.209 | 0.187 | 0.170 | 0.136 | 0.116 | 0.091 | 0.077 |
| NCS01/06 | 0.230 | 0.200 | 0.179 | 0.163 | 0.131 | 0.111 | 0.087 | 0.073 | 0.296 | 0.258 | 0.230 | 0.209 | 0.168 | 0.143 | 0.112 | 0.094 | 0.336 | 0.292 | 0.261 | 0.237 | 0.190 | 0.161 | 0.127 | 0.107 |
| NCS01/08 | 0.111 | 0.097 | 0.087 | 0.079 | 0.063 | 0.054 | 0.042 | 0.035 | 0.143 | 0.125 | 0.112 | 0.101 | 0.081 | 0.069 | 0.054 | 0.046 | 0.163 | 0.142 | 0.126 | 0.115 | 0.092 | 0.078 | 0.062 | 0.052 |
| NCS01/09 | 0.222 | 0.194 | 0.173 | 0.158 | 0.126 | 0.107 | 0.084 | 0.070 | 0.284 | 0.247 | 0.221 | 0.201 | 0.161 | 0.137 | 0.107 | 0.090 | 0.328 | 0.286 | 0.256 | 0.232 | 0.186 | 0.158 | 0.124 | 0.105 |
| NCS01/10 | 0.223 | 0.194 | 0.174 | 0.158 | 0.127 | 0.108 | 0.084 | 0.071 | 0.284 | 0.248 | 0.221 | 0.201 | 0.161 | 0.137 | 0.108 | 0.090 | 0.326 | 0.284 | 0.253 | 0.230 | 0.185 | 0.157 | 0.123 | 0.104 |
| NCS03/01 | 0.528 | 0.460 | 0.411 | 0.374 | 0.300 | 0.255 | 0.200 | 0.167 | 0.680 | 0.592 | 0.529 | 0.481 | 0.386 | 0.327 | 0.257 | 0.216 | 0.771 | 0.672 | 0.600 | 0.545 | 0.437 | 0.371 | 0.292 | 0.246 |
| NCS03/02 | 0.386 | 0.336 | 0.301 | 0.274 | 0.219 | 0.186 | 0.146 | 0.122 | 0.497 | 0.433 | 0.387 | 0.352 | 0.282 | 0.240 | 0.188 | 0.158 | 0.564 | 0.491 | 0.439 | 0.399 | 0.320 | 0.271 | 0.214 | 0.180 |
| NCS04/02 | 0.451 | 0.393 | 0.351 | 0.320 | 0.256 | 0.218 | 0.171 | 0.143 | 0.577 | 0.502 | 0.449 | 0.408 | 0.327 | 0.278 | 0.218 | 0.183 | 0.668 | 0.582 | 0.520 | 0.473 | 0.379 | 0.321 | 0.253 | 0.213 |
| *D- Guard Street* | | | | | | | | | | | | | | | | | | | | | | | | |
| NDS01/02 | 0.670 | 0.584 | 0.522 | 0.475 | 0.381 | 0.324 | 0.253 | 0.212 | 0.863 | 0.752 | 0.672 | 0.611 | 0.490 | 0.416 | 0.327 | 0.274 | 0.979 | 0.853 | 0.762 | 0.693 | 0.555 | 0.471 | 0.371 | 0.312 |
| NDS01/04 | 0.473 | 0.412 | 0.368 | 0.335 | 0.269 | 0.228 | 0.179 | 0.150 | 0.603 | 0.525 | 0.469 | 0.427 | 0.342 | 0.290 | 0.228 | 0.192 | 0.698 | 0.608 | 0.543 | 0.494 | 0.396 | 0.336 | 0.264 | 0.223 |
| NDS01/05 | 0.403 | 0.351 | 0.314 | 0.286 | 0.229 | 0.195 | 0.152 | 0.128 | 0.519 | 0.452 | 0.404 | 0.368 | 0.295 | 0.250 | 0.197 | 0.165 | 0.589 | 0.513 | 0.458 | 0.417 | 0.334 | 0.283 | 0.223 | 0.188 |
| NDS01/06 | 0.325 | 0.283 | 0.253 | 0.230 | 0.185 | 0.157 | 0.123 | 0.103 | 0.415 | 0.361 | 0.323 | 0.294 | 0.235 | 0.200 | 0.157 | 0.132 | 0.476 | 0.414 | 0.370 | 0.336 | 0.270 | 0.229 | 0.180 | 0.152 |
| NDS01/07 | 0.515 | 0.449 | 0.401 | 0.365 | 0.293 | 0.249 | 0.195 | 0.163 | 0.656 | 0.571 | 0.510 | 0.464 | 0.372 | 0.316 | 0.248 | 0.208 | 0.763 | 0.664 | 0.593 | 0.539 | 0.432 | 0.367 | 0.289 | 0.243 |
| NDS02/01 | 0.070 | 0.061 | 0.055 | 0.050 | 0.040 | 0.034 | 0.027 | 0.022 | 0.090 | 0.079 | 0.070 | 0.064 | 0.051 | 0.044 | 0.034 | 0.029 | 0.102 | 0.089 | 0.080 | 0.072 | 0.058 | 0.049 | 0.039 | 0.033 |
| NDS02/02 | 0.488 | 0.425 | 0.380 | 0.346 | 0.277 | 0.236 | 0.184 | 0.155 | 0.628 | 0.547 | 0.489 | 0.445 | 0.356 | 0.303 | 0.238 | 0.200 | 0.713 | 0.621 | 0.554 | 0.504 | 0.404 | 0.343 | 0.270 | 0.227 |
| NDS02/04 | 0.699 | 0.609 | 0.545 | 0.496 | 0.397 | 0.338 | 0.264 | 0.222 | 0.901 | 0.785 | 0.701 | 0.637 | 0.511 | 0.434 | 0.341 | 0.286 | 1.022 | 0.890 | 0.795 | 0.722 | 0.579 | 0.491 | 0.387 | 0.326 |
| NDS03/01 | 0.026 | 0.023 | 0.020 | 0.018 | 0.015 | 0.013 | 0.010 | 0.008 | 0.033 | 0.029 | 0.026 | 0.024 | 0.019 | 0.016 | 0.013 | 0.011 | 0.038 | 0.033 | 0.029 | 0.027 | 0.021 | 0.018 | 0.014 | 0.012 |
| NDS03/02 | 0.310 | 0.270 | 0.241 | 0.219 | 0.176 | 0.150 | 0.117 | 0.098 | 0.399 | 0.348 | 0.311 | 0.283 | 0.227 | 0.192 | 0.151 | 0.127 | 0.458 | 0.399 | 0.356 | 0.324 | 0.259 | 0.220 | 0.173 | 0.146 |
| NDS03/03 | 0.393 | 0.343 | 0.307 | 0.279 | 0.224 | 0.190 | 0.149 | 0.125 | 0.507 | 0.442 | 0.395 | 0.359 | 0.288 | 0.244 | 0.192 | 0.161 | 0.581 | 0.506 | 0.452 | 0.411 | 0.329 | 0.280 | 0.220 | 0.185 |
| NDS04/01 | 0.379 | 0.330 | 0.295 | 0.268 | 0.215 | 0.183 | 0.143 | 0.120 | 0.488 | 0.425 | 0.380 | 0.345 | 0.277 | 0.235 | 0.185 | 0.155 | 0.553 | 0.482 | 0.431 | 0.391 | 0.314 | 0.266 | 0.210 | 0.176 |
| NDS04/02 | 0.086 | 0.075 | 0.067 | 0.061 | 0.049 | 0.042 | 0.033 | 0.027 | 0.111 | 0.097 | 0.086 | 0.079 | 0.063 | 0.053 | 0.042 | 0.035 | 0.126 | 0.110 | 0.098 | 0.089 | 0.071 | 0.061 | 0.048 | 0.040 |
| NDS04/03 | 0.068 | 0.059 | 0.053 | 0.048 | 0.039 | 0.033 | 0.026 | 0.022 | 0.088 | 0.077 | 0.068 | 0.062 | 0.050 | 0.042 | 0.033 | 0.028 | 0.100 | 0.087 | 0.078 | 0.070 | 0.056 | 0.048 | 0.038 | 0.032 |
| NDS04/04 | 0.216 | 0.188 | 0.168 | 0.153 | 0.123 | 0.104 | 0.082 | 0.068 | 0.273 | 0.238 | 0.213 | 0.194 | 0.155 | 0.132 | 0.103 | 0.087 | 0.319 | 0.278 | 0.248 | 0.226 | 0.181 | 0.154 | 0.121 | 0.102 |
| NDS04/05 | 0.461 | 0.402 | 0.359 | 0.327 | 0.262 | 0.223 | 0.174 | 0.146 | 0.593 | 0.516 | 0.462 | 0.420 | 0.336 | 0.286 | 0.224 | 0.188 | 0.674 | 0.587 | 0.524 | 0.477 | 0.382 | 0.324 | 0.255 | 0.215 |
| NDS05/01 | 0.821 | 0.716 | 0.640 | 0.582 | 0.467 | 0.397 | 0.311 | 0.260 | 1.048 | 0.913 | 0.816 | 0.742 | 0.595 | 0.505 | 0.397 | 0.333 | 1.201 | 1.046 | 0.935 | 0.850 | 0.681 | 0.578 | 0.455 | 0.383 |
| NDS06/02 | 0.503 | 0.438 | 0.392 | 0.356 | 0.286 | 0.243 | 0.190 | 0.159 | 0.648 | 0.564 | 0.504 | 0.459 | 0.368 | 0.312 | 0.245 | 0.206 | 0.735 | 0.640 | 0.572 | 0.520 | 0.416 | 0.353 | 0.278 | 0.234 |
| NDS06/03 | 0.592 | 0.516 | 0.461 | 0.420 | 0.337 | 0.286 | 0.224 | 0.188 | 0.746 | 0.650 | 0.581 | 0.528 | 0.423 | 0.359 | 0.282 | 0.237 | 0.846 | 0.737 | 0.658 | 0.598 | 0.479 | 0.407 | 0.321 | 0.270 |
| NDS07/01 | 0.602 | 0.525 | 0.469 | 0.427 | 0.342 | 0.291 | 0.228 | 0.191 | 0.776 | 0.676 | 0.604 | 0.549 | 0.440 | 0.374 | 0.294 | 0.247 | 0.890 | 0.775 | 0.692 | 0.629 | 0.504 | 0.428 | 0.337 | 0.284 |
| NDS08/01 | 0.442 | 0.386 | 0.345 | 0.313 | 0.251 | 0.214 | 0.167 | 0.140 | 0.567 | 0.494 | 0.441 | 0.401 | 0.322 | 0.273 | 0.215 | 0.180 | 0.650 | 0.567 | 0.506 | 0.460 | 0.369 | 0.313 | 0.246 | 0.207 |

Scale 1:5000

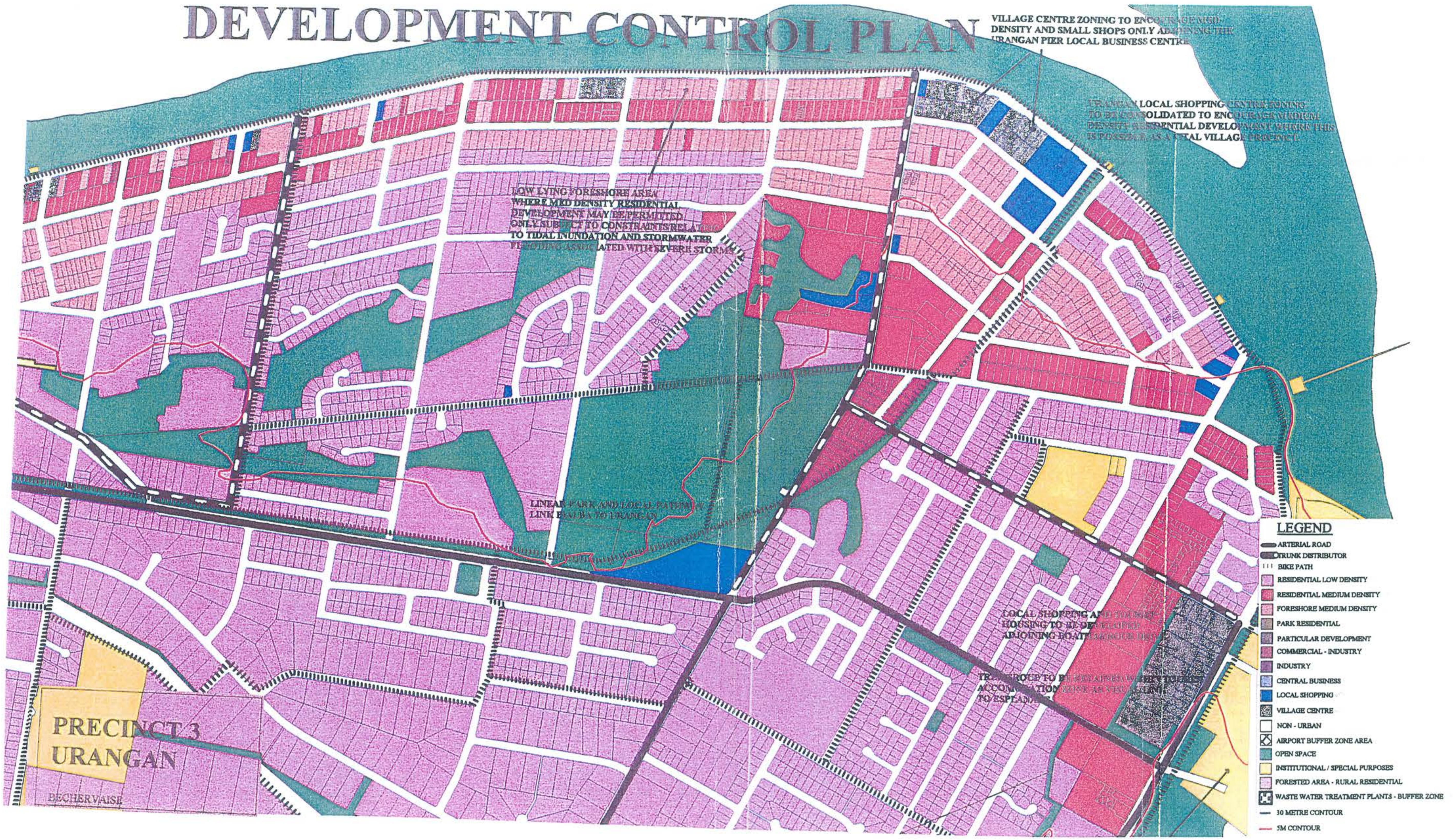
# URANGAN CATCHMENT

RELIEF DRAINAGE INVESTIGATION
CATCHMENT PLAN

## FIGURE A1

Rev: A Date: 21th March 2003

Project No.: 2919/31/02
Autocad: I:\2919-31\Acad 2003\FIGURE-A1.DWG
X-Ref:




From *Statement of Proposals, Hervey Bay Planning Scheme Amendment*, Hervey Bay City Council, August 1998

Zoning Plan
**FIGURE A2**

# APPENDIX B

# Hydraulic Data

## List of Tables



## List of Figures

**TABLE B1**
**Surface Links- General Data**

| Surface Link Name | Upstream Node | Downstream Node | Channel Length (m) | Left Bank Chainage (m) | Right Bank Chainage (m) | Left Bank n (-) | Channel n (-) | Right Bank n (-) | Section Min Elev (m AHD) |
|---|---|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | | | |
| LAS01/01 | NAS01/01 | NAS01/02 | 140 | 0 | 4.01 | 0.04 | 0.018 | 0.04 | 4.463 |
| LAS01/03 | NAS01/03 | NAS01/04 | 55 | 0 | 4.01 | 0.04 | 0.018 | 0.04 | 4.117 |
| LAS01/03A1 | NAS01/03 | NAS01/02 | 100 | 6 | 10 | 0.04 | 0.018 | 0.04 | 4.096 |
| LAS01/04 | NAS01/04 | NAS01/05 | 35 | 0 | 6.01 | 0.04 | 0.018 | 0.04 | 3.75 |
| LAS01/05 | NAS01/05 | NAS01/06 | 85 | 0 | 6.01 | 0.04 | 0.018 | 0.04 | 4.005 |
| LAS01/06 | NAS01/06 | NAS01/07 | 57 | 0 | 6.01 | 0.04 | 0.018 | 0.04 | 3.6 |
| LAS01/07 | NAS01/07 | NAS01/08 | 63 | 4 | 16.01 | 0.04 | 0.018 | 0.04 | 3.213 |
| LAS01/08 | NAS01/08 | NAS01/09 | 22 | 4 | 17.01 | 0.04 | 0.018 | 0.04 | 3 |
| LAS01/10 | NAS01/10 | NAS01/11 | 85 | 3 | 17.01 | 0.04 | 0.018 | 0.04 | 2.95 |
| LAS01/10A1 | NAS01/10 | NAS01/09 | 98 | 3 | 16.01 | 0.04 | 0.018 | 0.04 | 3.078 |
| LAS01/10A8 | NAS01/10 | NAS08/03 | 76 | 7 | 19.01 | 0.04 | 0.018 | 0.04 | 2.929 |
| LAS01/12A1 | NAS01/12 | NAS01/11 | 30 | 3 | 17.01 | 0.04 | 0.018 | 0.04 | 2.75 |
| LAS02/01 | NAS02/01 | NAS02/02 | 99 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.561 |
| LAS02/02 | NAS02/02 | NAS01/04 | 84 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.221 |
| LAS03/01 | NAS03/01 | NAS03/02 | 103 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.239 |
| LAS03/02 | NAS03/02 | NAS03/03 | 67 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.049 |
| LAS03/03 | NAS03/03 | NAS01/06 | 71 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.854 |
| LAS04/01A3 | NAS04/01 | NAS03/02 | 58 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.242 |
| LAS04/01A5 | NAS04/01 | NAS05/03 | 63 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.294 |
| LAS05/01 | NAS05/01 | NAS05/02 | 62 | 7 | 19.01 | 0.04 | 0.018 | 0.04 | 4.182 |
| LAS05/02 | NAS05/02 | NAS05/03 | 22 | 7 | 19.01 | 0.04 | 0.018 | 0.04 | 4.119 |
| LAS05/03 | NAS05/03 | NAS05/04 | 58 | 7 | 19.01 | 0.04 | 0.018 | 0.04 | 3.927 |
| LAS05/04 | NAS05/04 | NAS05/05 | 44 | 7 | 19.01 | 0.04 | 0.018 | 0.04 | 3.795 |
| LAS05/05 | NAS05/05 | NAS05/06 | 20 | 7 | 19.01 | 0.04 | 0.018 | 0.04 | 3.5 |
| LAS05/06 | NAS05/06 | NAS01/08 | 78 | 7 | 18.01 | 0.04 | 0.018 | 0.04 | 3.25 |
| LAS06/01A5 | NAS06/01 | NAS05/04 | 57.5 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.986 |
| LAS06/01A7 | NAS06/01 | NAS07/02 | 64 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.457 |
| LAS07/01 | NAS07/01 | NAS07/02 | 32 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.059 |
| LAS07/03A2 | NAS07/03 | NAS07/02 | 30 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 2.909 |
| LAS07/04 | NAS07/04 | NAS01/10 | 70 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.297 |
| LAS07/04A7 | NAS07/04 | NAS07/03 | 103.5 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.199 |
| LAS08/01 | NAS08/01 | NAS08/02 | 107 | 1 | 13.01 | 0.04 | 0.018 | 0.04 | 3.342 |
| LAS08/02 | NAS08/02 | NAS08/03 | 35 | 1 | 13.01 | 0.04 | 0.018 | 0.04 | 2.931 |
| LAS09/01 | NAS09/01 | NAS08/02 | 95 | 6.5 | 13.01 | 0.04 | 0.018 | 0.04 | 3.442 |
| LAS10/01 | NAS10/01 | NAS01/12 | 110 | 2 | 7 | 0.04 | 0.018 | 0.04 | 3.076 |
| LAS12/01 | NAS12/01 | NAS12/02 | 100 | 6 | 18 | 0.04 | 0.018 | 0.04 | 2.828 |
| LAS12/03 | NAS12/03 | NAS12/02 | 74 | 6 | 18 | 0.04 | 0.018 | 0.04 | 2.783 |
| LAS12/03A1 | NAS12/03 | NAS01/12 | 21 | 6 | 19 | 0.04 | 0.018 | 0.04 | 2.89 |
| ***B- Pier Street*** | | | | | | | | | |
| LAS02/01B1 | NAS02/01 | NBS01/04 | 92 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.63 |
| LAS03/01B1 | NAS03/01 | NBS01/05 | 98 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.292 |
| LAS05/01B2 | NAS05/01 | NBS02/01 | 20 | 1 | 13.01 | 0.04 | 0.018 | 0.04 | 4.305 |
| LAS07/03B6 | NAS11/01 | NAS07/03 | 54 | 0 | 3.5 | 0.04 | 0.02 | 0.04 | 3.239 |
| LAS10/01B6 | NAS10/01 | NBS06/01 | 118 | 0 | 6.01 | 0.04 | 0.018 | 0.04 | 2.977 |
| LAS11/01B6 | NAS11/01 | NBS06/01 | 54 | 0 | 3.5 | 0.04 | 0.02 | 0.04 | 3.168 |
| LBS01/03 | NBS01/03 | NBS01/04 | 119 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.715 |
| LBS01/04 | NBS01/04A | NBS01/05 | 63 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.465 |
| LBS01/04B1 | NBS01/04A | NBS01/04 | 59 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.615 |
| LBS01/06 | NBS01/06 | NBS01/07 | 44 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.165 |
| LBS01/06B1 | NBS01/06 | NBS01/05 | 79 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.315 |
| LBS01/07 | NBS01/07 | NBS01/08 | 66 | 4 | 16.01 | 0.04 | 0.018 | 0.04 | 3.465 |
| LBS01/09 | NBS01/09 | NBS01/10 | 60 | 3.5 | 16.01 | 0.04 | 0.018 | 0.04 | 3.029 |
| LBS01/09B1 | NBS01/09 | NBS01/08 | 54 | 4.5 | 16.51 | 0.04 | 0.018 | 0.04 | 3.087 |
| LBS01/10 | NBS01/10 | NBS01/11 | 66 | 3.5 | 16.01 | 0.04 | 0.018 | 0.04 | 2.667 |
| LBS01/11 | NBS01/11 | NBS01/12 | 124 | 2.51 | 8.5 | 0.04 | 0.018 | 0.04 | 2.203 |
| LBS02/01 | NBS02/01 | NBS01/07 | 125 | 1 | 13.01 | 0.04 | 0.018 | 0.04 | 3.863 |
| LBS02/01B5 | NBS02/01 | NBS05/01 | 73 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 4.227 |
| LBS03/01 | NBS03/01 | NBS01/07 | 35 | 5.975 | 14.025 | 0.04 | 0.014 | 0.04 | 3.99 |
| LBS04/01 | NBS04/01 | NBS04/02 | 71 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.397 |

| Surface Link Name | Upstream Node | Downstream Node | Channel Length (m) | Left Bank Chainage (m) | Right Bank Chainage (m) | Left Bank n (-) | Channel n (-) | Right Bank n (-) | Section Min Elev (m AHD) |
|---|---|---|---|---|---|---|---|---|---|
| LBS04/01A7 | NBS04/01 | NAS07/01 | 38 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.445 |
| LBS04/02B1 | NBS04/02 | NBS01/12 | 122 | 0 | 2.5 | 0.04 | 0.02 | 0.04 | 2.641 |
| LBS04/03 | NBS04/03 | NBS01/09 | 61.5 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.454 |
| LBS04/03B4 | NBS04/03 | NBS04/02 | 70 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.338 |
| LBS05/01 | NBS05/01 | NBS04/02 | 48 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.607 |
| LBS06/01 | NBS06/01 | NBS06/02 | 100 | 0 | 5.01 | 0.04 | 0.018 | 0.04 | 2.674 |
| LBS06/02 | NBS06/02 | NBS01/12 | 78 | 0 | 5.01 | 0.04 | 0.018 | 0.04 | 2.162 |
| ***C- Pilot Street*** | | | | | | | | | |
| LBS03/01C1 | NBS03/01 | NCS01/07 | 27 | 6.975 | 15.025 | 0.04 | 0.014 | 0.04 | 3.94 |
| LCS01/01 | NCS01/01 | NCS01/02 | 124 | 9 | 17.01 | 0.04 | 0.018 | 0.04 | 5.801 |
| LCS01/02 | NCS01/02 | NCS01/03 | 102 | 8.5 | 16.51 | 0.04 | 0.018 | 0.04 | 4.893 |
| LCS01/03 | NCS01/03 | NCS01/04 | 52 | 8 | 16.01 | 0.04 | 0.018 | 0.04 | 4.1 |
| LCS01/04 | NCS01/04 | NCS01/05 | 44 | 8 | 16.01 | 0.04 | 0.018 | 0.04 | 3.502 |
| LCS01/05 | NCS01/05 | NCS01/06 | 64 | 7.5 | 16.01 | 0.04 | 0.018 | 0.04 | 3.5 |
| LCS01/07 | NCS01/07 | NCS01/08 | 28 | 7 | 12.51 | 0.04 | 0.018 | 0.04 | 3.349 |
| LCS01/08 | NCS01/08 | NCS01/09 | 82 | 7.5 | 12.51 | 0.04 | 0.018 | 0.04 | 3.113 |
| LCS01/09D3 | NCS01/09 | NDS03/01 | 42 | 6.51 | 19.01 | 0.04 | 0.018 | 0.04 | 2.951 |
| LCS01/10C1 | NCS01/10 | NCS01/09 | 122 | 7.5 | 12.51 | 0.04 | 0.018 | 0.04 | 3.053 |
| LCS01/11 | NCS01/11 | NCS04/02 | 66 | 17.975 | 24.025 | 0.04 | 0.014 | 0.04 | 3.39 |
| LCS01/11C1 | NCS01/11 | NCS01/10 | 30 | 6.975 | 13.025 | 0.04 | 0.014 | 0.04 | 3.415 |
| LCS02/01 | NCS02/01 | NCS01/02 | 128 | 6.5 | 16.51 | 0.04 | 0.018 | 0.04 | 5.231 |
| LCS02/01C3 | NCS02/01 | NCS03/01 | 108 | 3.5 | 14.01 | 0.04 | 0.018 | 0.04 | 5.589 |
| LCS03/01 | NCS03/01 | NCS03/02 | 98 | 8.5 | 19.01 | 0.04 | 0.018 | 0.04 | 4.292 |
| LCS03/02 | NCS03/02 | NCS01/04 | 110 | 8 | 19.01 | 0.04 | 0.018 | 0.04 | 3.358 |
| LCS04/01 | NCS04/01 | NCS04/02 | 102 | 3 | 9.01 | 0.04 | 0.018 | 0.04 | 3.25 |
| ***D- Guard Street*** | | | | | | | | | |
| LCS03/01D1 | NCS03/01 | NDS01/01 | 5 | 5 | 29.01 | 0.04 | 0.018 | 0.04 | 5.51 |
| LCS04/01D8 | NCS04/01 | NDS08/01 | 104 | 20 | 28.01 | 0.04 | 0.018 | 0.04 | 3.172 |
| LDS01/01 | NDS01/01 | NDS01/02 | 146 | 5 | 14.01 | 0.04 | 0.018 | 0.04 | 5.227 |
| LDS01/02 | NDS01/02 | NDS01/03 | 24 | 8 | 24.01 | 0.04 | 0.018 | 0.04 | 5 |
| LDS01/03 | NDS01/03 | NDS01/04 | 78 | 3.5 | 16.51 | 0.04 | 0.018 | 0.04 | 2.465 |
| LDS01/03D2 | NDS01/03 | NDS02/04 | 130 | 6 | 18.01 | 0.04 | 0.018 | 0.04 | 3.292 |
| LDS01/04 | NDS01/04 | NDS01/05 | 24 | 3 | 16.01 | 0.04 | 0.018 | 0.04 | 1.902 |
| LDS01/06 | NDS01/06 | NDS01/05 | 52 | 4 | 17.01 | 0.04 | 0.018 | 0.04 | 2.061 |
| LDS01/07 | NDS01/07 | NDS01/06 | 64 | 4 | 16.51 | 0.04 | 0.018 | 0.04 | 2.144 |
| LDS02/01 | NDS02/01 | NDS02/02 | 58 | 1 | 14.01 | 0.04 | 0.018 | 0.04 | 3.172 |
| LDS02/03 | NDS02/03 | NDS02/02 | 64 | 6 | 18.01 | 0.04 | 0.018 | 0.04 | 3.216 |
| LDS02/03D2 | NDS02/03 | NDS02/04 | 50 | 2 | 14.51 | 0.04 | 0.018 | 0.04 | 3.19 |
| LDS03/01 | NDS03/01 | NDS03/02 | 70 | 1 | 14.01 | 0.04 | 0.018 | 0.04 | 2.7 |
| LDS03/02 | NDS03/02 | NDS03/03 | 120 | 1 | 14.51 | 0.04 | 0.018 | 0.04 | 2.638 |
| LDS03/02D7 | NDS03/02 | NDS07/01 | 130 | 1 | 13.01 | 0.04 | 0.018 | 0.04 | 2.656 |
| LDS03/04 | NDS03/04 | NDS03/03 | 62 | 5 | 17.51 | 0.04 | 0.018 | 0.04 | 2.567 |
| LDS03/04D1 | NDS03/04 | NDS01/04 | 136 | 1.5 | 15.01 | 0.04 | 0.018 | 0.04 | 2.408 |
| LDS04/01 | NDS04/01 | NDS04/02 | 24 | 0 | 14.01 | 0.04 | 0.018 | 0.04 | 10.598 |
| LDS04/02 | NDS04/02 | NDS04/03 | 72 | 4.5 | 17.51 | 0.04 | 0.018 | 0.04 | 7.775 |
| LDS04/03 | NDS04/03 | NDS04/04 | 48 | 4.5 | 21.51 | 0.04 | 0.018 | 0.04 | 4.577 |
| LDS04/03D6 | NDS04/03 | NDS06/03 | 88 | 5 | 18.51 | 0.04 | 0.018 | 0.04 | 3.65 |
| LDS04/04 | NDS04/04 | NDS04/05 | 54 | 4 | 16.51 | 0.04 | 0.018 | 0.04 | 2.386 |
| LDS05/01 | NDS05/01 | NDS04/02 | 28 | 5 | 0 | 0.04 | 0.018 | 0.04 | 10.094 |
| LDS06/01 | NDS06/01 | NDS06/02 | 78 | 2.5 | 14 | 0.04 | 0.018 | 0.04 | 3.671 |
| LDS06/02 | NDS06/02 | NDS06/03 | 66 | 2 | 14 | 0.04 | 0.018 | 0.04 | 2.867 |
| LDS06/03 | NDS06/03 | NDS01/05 | 118 | 6 | 18.01 | 0.04 | 0.018 | 0.04 | 2.031 |
| LDS07/02 | NDS07/02 | NDS07/01 | 96 | 5 | 18.51 | 0.04 | 0.018 | 0.04 | 2.464 |
| LDS07/02D1 | NDS07/02 | NDS01/06 | 86 | 2 | 14.51 | 0.04 | 0.018 | 0.04 | 2.401 |
| LDS08/02 | NDS08/02 | NDS08/01 | 58 | 4.5 | 13.01 | 0.04 | 0.018 | 0.04 | 2.465 |
| LDS08/02D1 | NDS08/02 | NDS01/07 | 114 | 45 | 53.51 | 0.04 | 0.018 | 0.04 | 2.37 |
| LDS09/01 | NDS09/01 | NDS01/07 | 35 | 5 | 12.51 | 0.04 | 0.018 | 0.04 | 2.384 |
| LDS09/01D4 | NDS09/01 | NDS04/05 | 74 | 33.5 | 40.51 | 0.04 | 0.018 | 0.04 | 2.457 |

Note: Shaded links represent those roads which are to be regraded

# TABLE B2
## Surface Links- Cross Sections

| Surface | | No. of | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Name | | Points | Points in order of increasing chainage, Chainage in first row, elevation in second | | | | | | | | | | | | | | | | | | | |
| *A- Elizabeth Street* | | | | | | | | | | | | | | | | | | | | | | |
| LAS01/01 | Ch | 6 | 0.000 | 0.010 | 4.000 | 4.010 | 9.000 | 10.000 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 4.585 | 4.463 | 4.463 | 4.500 | 4.667 | | | | | | | | | | | | | | |
| LAS01/03A1 | Ch | 6 | 0.000 | 0.010 | 1.000 | 6.000 | 6.010 | 10.000 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 4.397 | 4.230 | 4.096 | 4.096 | 4.250 | | | | | | | | | | | | | | |
| LAS01/03 | Ch | 6 | 0.000 | 0.010 | 4.000 | 4.010 | 9.000 | 10.000 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 4.223 | 4.117 | 4.117 | 4.250 | 4.416 | | | | | | | | | | | | | | |
| LAS01/04 | Ch | 6 | 0.000 | 0.010 | 6.000 | 6.010 | 9.000 | 10.000 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 4.052 | 3.750 | 3.900 | 4.000 | 4.167 | | | | | | | | | | | | | | |
| LAS01/05 | Ch | 6 | 0.000 | 0.010 | 6.000 | 6.010 | 9.000 | 10.000 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 4.073 | 4.005 | 4.155 | 4.111 | 4.278 | | | | | | | | | | | | | | |
| LAS01/06 | Ch | 6 | 0.000 | 0.010 | 6.000 | 6.010 | 9.000 | 10.000 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 3.788 | 3.600 | 3.750 | 3.902 | 4.069 | | | | | | | | | | | | | | |
| LAS01/07 | Ch | 10 | 0.000 | 0.010 | 1.000 | 4.000 | 4.010 | 10.000 | 16.000 | 16.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.657 | 3.490 | 3.400 | 3.250 | 3.363 | 3.213 | 3.363 | 3.453 | 3.620 | | | | | | | | | | |
| LAS01/08 | Ch | 10 | 0.000 | 0.010 | 1.000 | 4.000 | 4.010 | 10.500 | 17.000 | 17.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.407 | 3.240 | 3.150 | 3.000 | 3.129 | 3.000 | 3.150 | 3.210 | 3.377 | | | | | | | | | | |
| LAS01/10A1 | Ch | 10 | 0.000 | 0.010 | 1.000 | 3.000 | 3.010 | 9.500 | 16.000 | 16.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.819 | 3.652 | 3.228 | 3.078 | 3.240 | 3.100 | 3.250 | 3.340 | 3.507 | | | | | | | | | | |
| LAS01/10 | Ch | 10 | 0.000 | 0.010 | 1.000 | 3.000 | 3.010 | 10.000 | 17.000 | 17.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.327 | 3.160 | 3.100 | 2.950 | 3.183 | 2.950 | 3.100 | 3.160 | 3.327 | | | | | | | | | | |
| LAS01/12A1 | Ch | 10 | 0.000 | 0.010 | 1.000 | 3.000 | 3.010 | 10.000 | 17.000 | 17.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.227 | 3.060 | 3.000 | 2.850 | 3.107 | 2.750 | 2.900 | 2.960 | 3.127 | | | | | | | | | | |
| LAS02/01 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 5.045 | 4.880 | 4.701 | 4.561 | 4.584 | 4.646 | 4.584 | 4.561 | 4.701 | 4.880 | 5.047 | | | | | | | | |
| LAS02/02 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.705 | 4.540 | 4.361 | 4.221 | 4.244 | 4.306 | 4.244 | 4.221 | 4.361 | 4.540 | 4.707 | | | | | | | | |
| LAS03/01 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.723 | 4.558 | 4.379 | 4.239 | 4.262 | 4.324 | 4.262 | 4.239 | 4.379 | 4.558 | 4.725 | | | | | | | | |
| LAS03/02 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.510 | 4.345 | 4.166 | 4.026 | 4.049 | 4.111 | 4.049 | 4.026 | 4.166 | 4.345 | 4.512 | | | | | | | | |
| LAS03/03 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.338 | 4.173 | 3.994 | 3.854 | 3.877 | 3.939 | 3.877 | 3.854 | 3.994 | 4.173 | 4.340 | | | | | | | | |
| LAS04/01A3 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.726 | 4.561 | 4.382 | 4.242 | 4.265 | 4.327 | 4.265 | 4.242 | 4.382 | 4.561 | 4.728 | | | | | | | | |
| LAS04/01A5 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.778 | 4.613 | 4.434 | 4.294 | 4.317 | 4.379 | 4.317 | 4.294 | 4.434 | 4.613 | 4.780 | | | | | | | | |
| LAS05/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 7.000 | 7.010 | 13.000 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.678 | 4.512 | 4.332 | 4.182 | 4.515 | 4.182 | 4.332 | 4.499 | | | | | | | | | | | |
| LAS05/02 | Ch | 9 | 0.000 | 0.010 | 1.000 | 7.000 | 7.010 | 13.000 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.449 | 4.269 | 4.269 | 4.119 | 4.319 | 4.227 | 4.377 | 4.543 | | | | | | | | | | | |
| LAS05/03 | Ch | 9 | 0.000 | 0.010 | 1.000 | 7.000 | 7.010 | 13.000 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.424 | 4.257 | 4.077 | 3.927 | 4.052 | 3.985 | 4.102 | 4.269 | | | | | | | | | | | |
| LAS05/04 | Ch | 9 | 0.000 | 0.010 | 1.000 | 7.000 | 7.010 | 13.000 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.292 | 4.125 | 3.945 | 3.795 | 3.945 | 3.825 | 3.975 | 4.142 | | | | | | | | | | | |

| Surface Link Name | | No. of Points | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Points in order of increasing chainage, Chainage in first row, elevation in second | | | | | | | | | | | | | | | | | | | |
| LAS05/05 | Ch | 9 | 0.000 | 0.010 | 1.000 | 7.000 | 7.010 | 13.000 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.032 | 3.866 | 3.686 | 3.536 | 3.750 | 3.500 | 3.650 | 3.817 | | | | | | | | | | | |
| LAS05/06 | Ch | 10 | 0.000 | 0.010 | 1.000 | 7.000 | 7.010 | 12.500 | 18.000 | 18.000 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.747 | 3.580 | 3.400 | 3.250 | 3.407 | 3.250 | 3.400 | 3.430 | 3.597 | | | | | | | | | | |
| LAS06/01A5 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.470 | 4.305 | 4.126 | 3.986 | 4.009 | 4.071 | 4.009 | 3.986 | 4.126 | 4.305 | 4.472 | | | | | | | | |
| LAS06/01A7 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.941 | 3.776 | 3.597 | 3.457 | 3.480 | 3.542 | 3.480 | 3.457 | 3.597 | 3.776 | 3.943 | | | | | | | | |
| LAS07/01 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.543 | 3.378 | 3.199 | 3.059 | 3.082 | 3.144 | 3.082 | 3.059 | 3.199 | 3.378 | 3.545 | | | | | | | | |
| LAS07/03A2 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.393 | 3.228 | 3.049 | 2.909 | 2.932 | 2.994 | 2.932 | 2.909 | 3.049 | 3.228 | 3.395 | | | | | | | | |
| LAS07/04A7 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.683 | 3.518 | 3.339 | 3.199 | 3.222 | 3.284 | 3.222 | 3.199 | 3.339 | 3.518 | 3.685 | | | | | | | | |
| LAS07/04 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.781 | 3.616 | 3.437 | 3.297 | 3.320 | 3.382 | 3.320 | 3.297 | 3.437 | 3.616 | 3.783 | | | | | | | | |
| LAS08/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 1.010 | 7.000 | 13.000 | 13.010 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 3.421 | 3.421 | 3.342 | 3.592 | 3.342 | 3.492 | 3.672 | 3.839 | | | | | | | | | | | |
| LAS08/02 | Ch | 9 | 0.000 | 0.010 | 1.000 | 1.010 | 7.000 | 13.000 | 13.010 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 3.161 | 3.131 | 3.056 | 3.306 | 2.931 | 3.081 | 3.261 | 3.428 | | | | | | | | | | | |
| LAS01/10A8 | Ch | 9 | 0.000 | 0.010 | 1.000 | 7.000 | 7.010 | 13.000 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 3.453 | 3.286 | 3.106 | 2.929 | 3.350 | 3.110 | 3.185 | 3.215 | | | | | | | | | | | |
| LAS09/01 | Ch | 10 | 0.000 | 0.010 | 1.000 | 6.500 | 6.510 | 9.750 | 13.000 | 13.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.879 | 3.712 | 3.547 | 3.523 | 3.604 | 3.442 | 3.517 | 3.697 | 3.864 | | | | | | | | | | |
| LAS10/01 | Ch | 5 | 0.000 | 1.000 | 2.000 | 2.010 | 7.000 | | | | | | | | | | | | | | | |
| | Elev | 5 | 11.000 | 3.423 | 3.256 | 3.076 | 3.326 | | | | | | | | | | | | | | | |
| LAS12/03A1 | Ch | 11 | 0.000 | 0.010 | 1.500 | 6.000 | 6.010 | 6.310 | 12.000 | 18.690 | 18.990 | 19.000 | 25.000 | | | | | | | | | |
| | Elev | 11 | 11.000 | 3.390 | 3.140 | 3.036 | 2.890 | 2.915 | 3.101 | 3.064 | 3.039 | 3.138 | 3.200 | | | | | | | | | |
| LAS12/03 | Ch | 11 | 0.000 | 0.010 | 1.500 | 6.000 | 6.010 | 6.310 | 12.000 | 17.690 | 17.990 | 18.000 | 25.000 | | | | | | | | | |
| | Elev | 11 | 11.000 | 3.250 | 3.000 | 2.933 | 2.783 | 2.808 | 3.084 | 3.074 | 3.049 | 3.224 | 3.300 | | | | | | | | | |
| LAS12/01 | Ch | 11 | 0.000 | 0.010 | 1.500 | 6.000 | 6.010 | 6.310 | 12.000 | 17.690 | 17.990 | 18.000 | 40.000 | | | | | | | | | |
| | Elev | 11 | 11.000 | 3.250 | 3.000 | 2.978 | 2.828 | 2.853 | 3.182 | 2.919 | 2.894 | 3.044 | 3.500 | | | | | | | | | |
| ***B- Pier Street*** | | | | | | | | | | | | | | | | | | | | | | |
| LBS01/03 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 5.199 | 5.034 | 4.855 | 4.715 | 4.738 | 4.800 | 4.738 | 4.715 | 4.855 | 5.034 | 5.201 | | | | | | | | |
| LBS01/04 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.949 | 4.784 | 4.605 | 4.465 | 4.488 | 4.550 | 4.488 | 4.465 | 4.605 | 4.784 | 4.951 | | | | | | | | |
| LBS01/04B1 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 5.099 | 4.934 | 4.755 | 4.615 | 4.638 | 4.700 | 4.638 | 4.615 | 4.755 | 4.934 | 5.101 | | | | | | | | |
| LBS01/06B1 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.799 | 4.634 | 4.455 | 4.315 | 4.338 | 4.400 | 4.338 | 4.315 | 4.455 | 4.634 | 4.801 | | | | | | | | |
| LBS01/06 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.649 | 4.484 | 4.305 | 4.165 | 4.188 | 4.250 | 4.188 | 4.165 | 4.305 | 4.484 | 4.651 | | | | | | | | |
| LBS01/07 | Ch | 10 | 0.000 | 0.010 | 1.000 | 4.000 | 4.010 | 10.000 | 16.000 | 16.010 | 19.500 | 20.500 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.887 | 3.720 | 3.615 | 3.465 | 3.676 | 3.576 | 3.726 | 3.831 | 3.998 | | | | | | | | | | |
| LBS01/09B1 | Ch | 10 | 0.000 | 0.010 | 1.000 | 4.500 | 4.510 | 10.500 | 16.500 | 16.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.806 | 3.640 | 3.535 | 3.385 | 3.326 | 3.087 | 3.237 | 3.640 | 3.494 | | | | | | | | | | |
| LBS01/09 | Ch | 10 | 0.000 | 0.010 | 1.000 | 3.500 | 3.510 | 9.750 | 16.000 | 16.010 | 19.500 | 20.500 | | | | | | | | | | |

| Surface Link Name | | No. of Points | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Points in order of increasing chainage, Chainage in first row, elevation in second | | | | | | | | | | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.421 | 3.254 | 3.179 | 3.029 | 3.442 | 3.353 | 3.503 | 3.608 | 3.775 | | | | | | | | | | |
| LBS01/10 | Ch | 10 | 0.000 | 0.010 | 1.000 | 3.500 | 3.510 | 9.750 | 16.000 | 16.010 | 19.500 | 20.500 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.058 | 2.892 | 2.817 | 2.667 | 2.927 | 3.017 | 3.167 | 3.272 | 3.439 | | | | | | | | | | |
| LAS02/01B1 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 5.114 | 4.949 | 4.770 | 4.630 | 4.653 | 4.715 | 4.653 | 4.630 | 4.770 | 4.949 | 5.116 | | | | | | | | |
| LAS03/01B1 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.776 | 4.611 | 4.432 | 4.292 | 4.315 | 4.377 | 4.315 | 4.292 | 4.432 | 4.611 | 4.778 | | | | | | | | |
| LAS05/01B2 | Ch | 9 | 0.000 | 0.010 | 1.000 | 1.010 | 7.000 | 13.000 | 13.010 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.672 | 4.505 | 4.355 | 4.605 | 4.305 | 4.455 | 4.635 | 4.802 | | | | | | | | | | | |
| LBS02/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 1.010 | 7.000 | 13.000 | 13.010 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.341 | 4.174 | 4.024 | 4.238 | 3.863 | 4.013 | 4.193 | 4.360 | | | | | | | | | | | |
| LBS03/01 | Ch | 12 | 0.000 | 0.010 | 1.000 | 5.975 | 6.250 | 6.525 | 10.000 | 13.475 | 13.750 | 14.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.444 | 4.279 | 4.130 | 3.990 | 4.013 | 4.100 | 4.013 | 3.990 | 4.130 | 4.279 | 4.446 | | | | | | | | |
| LBS04/01A7 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.929 | 3.764 | 3.585 | 3.445 | 3.468 | 3.530 | 3.468 | 3.445 | 3.585 | 3.764 | 3.931 | | | | | | | | |
| LBS04/01 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.881 | 3.716 | 3.537 | 3.397 | 3.420 | 3.482 | 3.420 | 3.397 | 3.537 | 3.716 | 3.883 | | | | | | | | |
| LBS04/03B4 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.822 | 3.657 | 3.478 | 3.338 | 3.361 | 3.423 | 3.361 | 3.338 | 3.478 | 3.657 | 3.824 | | | | | | | | |
| LBS04/03 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.938 | 3.773 | 3.594 | 3.454 | 3.477 | 3.539 | 3.477 | 3.454 | 3.594 | 3.773 | 3.940 | | | | | | | | |
| LBS02/01B5 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.711 | 4.546 | 4.367 | 4.227 | 4.250 | 4.312 | 4.250 | 4.227 | 4.367 | 4.546 | 4.713 | | | | | | | | |
| LBS05/01 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.091 | 3.926 | 3.747 | 3.607 | 3.630 | 3.692 | 3.630 | 3.607 | 3.747 | 3.926 | 4.093 | | | | | | | | |
| LBS01/11 | Ch | 6 | 0.000 | 0.010 | 1.000 | 2.500 | 2.510 | 8.500 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 2.565 | 2.398 | 2.353 | 2.203 | 2.390 | | | | | | | | | | | | | | |
| LAS10/01B6 | Ch | 6 | 0.000 | 0.010 | 6.000 | 6.010 | 11.000 | 12.000 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 3.227 | 2.977 | 3.127 | 3.277 | 3.444 | | | | | | | | | | | | | | |
| LBS06/01 | Ch | 6 | 0.000 | 0.010 | 5.000 | 5.010 | 13.500 | 14.500 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 2.924 | 2.674 | 2.824 | 3.079 | 3.246 | | | | | | | | | | | | | | |
| LBS06/02 | Ch | 6 | 0.000 | 0.010 | 6.000 | 6.010 | 10.500 | 11.500 | | | | | | | | | | | | | | |
| | Elev | 6 | 11.000 | 2.591 | 2.162 | 2.312 | 2.432 | 2.599 | | | | | | | | | | | | | | |
| LAS11/01 | Ch | 3 | 0.000 | 0.010 | 3.500 | | | | | | | | | | | | | | | | | |
| | Elev | 3 | 11.000 | 3.239 | 3.294 | | | | | | | | | | | | | | | | | |
| LAS11/01B6 | Ch | 3 | 0.000 | 0.010 | 3.500 | | | | | | | | | | | | | | | | | |
| | Elev | 3 | 11.000 | 3.168 | 3.223 | | | | | | | | | | | | | | | | | |
| LBS04/02B1 | Ch | 3 | 0.000 | 0.010 | 2.500 | | | | | | | | | | | | | | | | | |
| | Elev | 3 | 11.000 | 2.641 | 2.835 | | | | | | | | | | | | | | | | | |
| ***C- Pilot Street*** | | | | | | | | | | | | | | | | | | | | | | |
| LCS01/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 9.000 | 9.010 | 12.500 | 17.000 | 17.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 6.752 | 6.604 | 6.362 | 6.212 | 6.082 | 5.801 | 5.591 | 6.044 | | | | | | | | | | | |
| LCS01/02 | Ch | 10 | 0.000 | 0.010 | 1.000 | 8.500 | 8.510 | 12.500 | 16.500 | 16.510 | 20.000 | 21.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 5.435 | 5.268 | 5.043 | 4.893 | 5.003 | 4.972 | 5.122 | 5.227 | 5.394 | | | | | | | | | | |
| LCS01/03 | Ch | 10 | 0.000 | 0.010 | 1.000 | 8.000 | 8.010 | 12.000 | 16.000 | 16.010 | 20.000 | 21.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 4.626 | 4.460 | 4.250 | 4.100 | 4.189 | 4.202 | 4.352 | 4.472 | 4.639 | | | | | | | | | | |
| LCS01/04 | Ch | 10 | 0.000 | 0.010 | 1.000 | 8.000 | 8.010 | 12.000 | 16.000 | 16.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 4.057 | 3.891 | 3.681 | 3.531 | 3.656 | 3.502 | 3.652 | 3.742 | 3.909 | | | | | | | | | | |

| Surface | | No. of | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Link Name | | Points | Points in order of increasing chainage, Chainage in first row, elevation in second | | | | | | | | | | | | | | | | | | | |
| LCS01/05 | Ch | 10 | 0.000 | 0.010 | 1.000 | 7.500 | 7.510 | 11.750 | 16.000 | 16.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 4.042 | 3.875 | 3.680 | 3.530 | 3.693 | 3.500 | 3.650 | 3.740 | 3.907 | | | | | | | | | | |
| LCS01/07 | Ch | 10 | 0.000 | 0.010 | 1.000 | 7.000 | 7.010 | 9.750 | 12.500 | 12.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.890 | 3.723 | 3.543 | 3.393 | 3.442 | 3.349 | 3.499 | 3.694 | 3.861 | | | | | | | | | | |
| LCS01/08 | Ch | 10 | 0.000 | 0.010 | 1.000 | 7.500 | 7.510 | 10.000 | 12.500 | 12.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.604 | 3.437 | 3.242 | 3.092 | 3.206 | 3.113 | 2.263 | 3.458 | 3.625 | | | | | | | | | | |
| LCS01/10C1 | Ch | 10 | 0.000 | 0.010 | 1.000 | 7.500 | 7.510 | 10.000 | 12.500 | 12.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.650 | 3.483 | 3.288 | 3.138 | 3.086 | 3.053 | 3.203 | 3.398 | 3.565 | | | | | | | | | | |
| LCS01/11C1 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 10.000 | 12.475 | 12.750 | 13.025 | 19.000 | 20.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 3.899 | 3.734 | 3.555 | 3.415 | 3.438 | 3.500 | 3.438 | 3.415 | 3.555 | 3.734 | 3.901 | | | | | | | | |
| LCS02/01 | Ch | 9 | 0.000 | 0.010 | 6.500 | 6.510 | 11.500 | 16.500 | 16.510 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 5.946 | 5.381 | 5.231 | 5.841 | 5.563 | 5.713 | 5.788 | 5.955 | | | | | | | | | | | |
| LCS02/01C3 | Ch | 9 | 0.000 | 0.010 | 1.000 | 3.500 | 3.510 | 8.750 | 14.000 | 14.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 6.142 | 5.975 | 5.900 | 5.750 | 5.881 | 5.589 | 5.739 | 6.866 | | | | | | | | | | | |
| LCS03/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 8.500 | 8.510 | 14.000 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.834 | 4.667 | 4.442 | 4.292 | 4.295 | 4.371 | 4.521 | 4.688 | | | | | | | | | | | |
| LCS03/02 | Ch | 9 | 0.000 | 0.010 | 1.000 | 8.000 | 8.010 | 13.500 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.232 | 4.065 | 3.855 | 3.705 | 3.664 | 3.358 | 3.508 | 3.675 | | | | | | | | | | | |
| LCS01/09D3 | Ch | 9 | 0.000 | 0.010 | 1.000 | 6.500 | 6.510 | 12.750 | 19.000 | 19.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 3.446 | 3.279 | 3.114 | 2.964 | 3.033 | 2.951 | 3.101 | 3.268 | | | | | | | | | | | |
| LCS04/01 | Ch | 11 | 0.000 | 0.010 | 1.000 | 3.000 | 3.010 | 6.000 | 9.000 | 9.010 | 12.500 | 30.000 | 34.000 | | | | | | | | | |
| | Elev | 11 | 11.000 | 3.627 | 3.460 | 3.400 | 3.250 | 3.404 | 3.358 | 3.508 | 3.500 | 3.500 | 3.750 | | | | | | | | | |
| LCS01/11 | Ch | 13 | 0.000 | 0.010 | 11.000 | 12.000 | 17.975 | 18.250 | 18.525 | 21.000 | 23.475 | 23.750 | 24.025 | 30.000 | 31.000 | | | | | | | |
| | Elev | 13 | 11.000 | 4.000 | 3.876 | 3.709 | 3.530 | 3.390 | 3.413 | 3.475 | 3.413 | 3.390 | 3.530 | 3.709 | 3.876 | | | | | | | |
| LBS03/01C1 | Ch | 12 | 0.000 | 0.010 | 1.000 | 6.975 | 7.250 | 7.525 | 11.000 | 14.475 | 14.750 | 15.025 | 21.000 | 22.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.424 | 4.259 | 4.080 | 3.940 | 3.963 | 4.050 | 3.963 | 3.940 | 4.080 | 4.259 | 4.426 | | | | | | | | |
| LCS03/01D1 | Ch | 8 | 0.000 | 0.010 | 5.000 | 5.010 | 15.500 | 29.000 | 29.010 | 30.000 | | | | | | | | | | | | |
| | Elev | 8 | 11.000 | 6.925 | 6.150 | 6.000 | 5.985 | 5.510 | 5.670 | 5.700 | | | | | | | | | | | | |
| *D- Guard Street* | | | | | | | | | | | | | | | | | | | | | | |
| LDS01/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 5.000 | 5.010 | 9.500 | 14.000 | 14.010 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 5.664 | 5.497 | 5.377 | 5.227 | 5.477 | 5.468 | 5.618 | 6.400 | | | | | | | | | | | |
| LDS01/02 | Ch | 10 | 0.000 | 0.010 | 1.000 | 8.000 | 8.010 | 11.000 | 19.000 | 24.000 | 24.010 | 29.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 5.467 | 5.300 | 5.150 | 5.000 | 5.250 | 5.500 | 3.350 | 5.500 | 5.750 | | | | | | | | | | |
| LDS01/03 | Ch | 10 | 0.000 | 0.010 | 1.000 | 3.500 | 3.510 | 10.000 | 16.500 | 16.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 2.857 | 2.690 | 2.615 | 2.465 | 2.692 | 2.490 | 2.640 | 2.715 | 2.882 | | | | | | | | | | |
| LDS01/04 | Ch | 10 | 0.000 | 0.010 | 1.000 | 3.000 | 3.010 | 9.500 | 16.000 | 16.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 2.278 | 2.112 | 2.052 | 1.902 | 2.308 | 1.982 | 2.133 | 2.223 | 2.390 | | | | | | | | | | |
| LDS01/06 | Ch | 10 | 0.000 | 0.010 | 1.000 | 4.000 | 4.010 | 10.500 | 17.000 | 17.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 2.468 | 2.301 | 2.211 | 2.061 | 2.332 | 2.117 | 2.320 | 2.380 | 2.547 | | | | | | | | | | |
| LDS01/07 | Ch | 10 | 0.000 | 0.010 | 1.000 | 4.000 | 4.010 | 10.250 | 16.500 | 16.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 2.550 | 2.384 | 2.294 | 2.144 | 2.300 | 2.144 | 2.294 | 2.369 | 2.536 | | | | | | | | | | |
| LDS02/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 1.010 | 7.500 | 14.000 | 14.010 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 3.489 | 3.332 | 3.172 | 3.432 | 3.172 | 3.332 | 3.482 | 3.649 | | | | | | | | | | | |
| LDS02/03 | Ch | 10 | 0.000 | 0.010 | 1.000 | 2.000 | 2.010 | 8.250 | 14.500 | 14.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.537 | 3.370 | 3.340 | 3.190 | 3.711 | 3.345 | 3.493 | 3.628 | 3.795 | | | | | | | | | | |
| LDS02/03D2 | Ch | 10 | 0.000 | 0.010 | 1.000 | 2.000 | 2.010 | 8.250 | 14.500 | 14.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.537 | 3.370 | 3.340 | 3.190 | 3.711 | 3.343 | 3.493 | 3.628 | 3.795 | | | | | | | | | | |
| LDS01/03D2 | Ch | 10 | 0.000 | 0.010 | 1.000 | 6.000 | 6.010 | 12.000 | 18.000 | 18.010 | 19.000 | 20.000 | | | | | | | | | | |

| Surface Link Name | | No. of Points | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Points in order of increasing chainage, Chainage in first row, elevation in second | | | | | | | | | | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.959 | 3.792 | 3.642 | 3.492 | 3.792 | 3.292 | 3.442 | 3.472 | 3.639 | | | | | | | | | | |
| LDS03/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 1.010 | 7.000 | 14.000 | 14.010 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 3.017 | 2.850 | 2.700 | 3.033 | 2.715 | 2.865 | 3.015 | 3.182 | | | | | | | | | | | |
| LDS03/02 | Ch | 9 | 0.000 | 0.010 | 1.000 | 1.010 | 7.000 | 14.500 | 14.510 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 2.954 | 2.788 | 2.638 | 2.860 | 2.652 | 2.802 | 2.937 | 3.104 | | | | | | | | | | | |
| LDS03/04 | Ch | 10 | 0.000 | 0.010 | 1.000 | 5.000 | 5.010 | 12.000 | 17.500 | 17.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.119 | 2.952 | 2.832 | 2.682 | 2.817 | 2.567 | 2.717 | 2.762 | 2.929 | | | | | | | | | | |
| LDS03/04D1 | Ch | 10 | 0.000 | 0.010 | 1.000 | 1.500 | 1.510 | 8.000 | 15.000 | 15.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 2.740 | 2.573 | 2.558 | 2.408 | 2.605 | 2.456 | 2.606 | 2.726 | 2.893 | | | | | | | | | | |
| LDS04/01 | Ch | 5 | 0.000 | 0.010 | 14.000 | 14.010 | 22.000 | | | | | | | | | | | | | | | |
| | Elev | 5 | 16.000 | 10.598 | 10.643 | 10.781 | 10.469 | | | | | | | | | | | | | | | |
| LDS04/02 | Ch | 8 | 0.000 | 0.010 | 4.500 | 4.510 | 10.500 | 17.500 | 17.510 | 25.000 | | | | | | | | | | | | |
| | Elev | 8 | 16.000 | 7.916 | 7.916 | 7.775 | 7.969 | 7.917 | 8.056 | 8.125 | | | | | | | | | | | | |
| LDS04/03 | Ch | 9 | 0.000 | 0.010 | 1.000 | 4.500 | 4.510 | 9.500 | 21.500 | 21.510 | 25.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.672 | 4.505 | 4.400 | 4.250 | 4.462 | 4.577 | 4.654 | 4.792 | | | | | | | | | | | |
| LDS04/04 | Ch | 9 | 0.000 | 0.010 | 1.000 | 4.000 | 4.010 | 10.000 | 16.500 | 16.510 | 24.500 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 2.792 | 2.625 | 2.536 | 2.386 | 2.850 | 2.386 | 2.536 | 2.849 | | | | | | | | | | | |
| LDS05/01 | Ch | 5 | 0.000 | 0.010 | 5.000 | 5.010 | 11.000 | | | | | | | | | | | | | | | |
| | Elev | 5 | 16.000 | 10.094 | 10.423 | 10.314 | 10.598 | | | | | | | | | | | | | | | |
| LDS06/01 | Ch | 9 | 0.000 | 0.010 | 1.000 | 2.500 | 2.510 | 8.500 | 14.000 | 17.500 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.026 | 3.859 | 3.814 | 3.671 | 4.179 | 3.774 | 4.500 | 4.900 | | | | | | | | | | | |
| LDS06/02 | Ch | 8 | 0.000 | 0.010 | 1.000 | 2.000 | 2.010 | 8.000 | 14.000 | 20.000 | | | | | | | | | | | | |
| | Elev | 8 | 11.000 | 3.241 | 3.074 | 3.044 | 2.901 | 4.059 | 2.867 | 3.750 | | | | | | | | | | | | |
| LDS04/03D6 | Ch | 9 | 0.000 | 0.010 | 5.000 | 5.010 | 12.000 | 18.500 | 18.510 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 4.625 | 4.106 | 3.963 | 4.036 | 3.650 | 3.778 | 3.793 | 3.960 | | | | | | | | | | | |
| LDS06/03 | Ch | 10 | 0.000 | 0.010 | 1.000 | 6.000 | 6.010 | 12.000 | 18.000 | 18.010 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 2.707 | 2.539 | 2.389 | 2.239 | 2.364 | 2.031 | 2.181 | 2.211 | 2.377 | | | | | | | | | | |
| LDS03/02D7 | Ch | 9 | 0.000 | 0.010 | 1.000 | 1.010 | 6.000 | 13.000 | 13.010 | 19.000 | 20.000 | | | | | | | | | | | |
| | Elev | 9 | 11.000 | 2.973 | 2.806 | 2.656 | 2.748 | 2.656 | 2.806 | 2.986 | 3.153 | | | | | | | | | | | |
| LDS07/02 | Ch | 10 | 0.000 | 0.010 | 1.000 | 5.000 | 5.010 | 12.500 | 18.500 | 18.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 2.929 | 2.762 | 2.642 | 2.492 | 2.695 | 2.464 | 2.614 | 2.629 | 2.769 | | | | | | | | | | |
| LDS07/02D1 | Ch | 10 | 0.000 | 0.010 | 1.000 | 2.000 | 2.010 | 7.500 | 14.500 | 14.510 | 19.000 | 20.000 | | | | | | | | | | |
| | Elev | 10 | 11.000 | 3.133 | 2.967 | 2.937 | 2.787 | 2.681 | 2.401 | 2.551 | 2.686 | 2.853 | | | | | | | | | | |
| LCS04/01D8 | Ch | 12 | 0.000 | 0.010 | 4.000 | 8.500 | 13.000 | 20.000 | 20.010 | 24.500 | 28.000 | 28.010 | 32.000 | 33.000 | | | | | | | | |
| | Elev | 12 | 11.000 | 4.985 | 4.750 | 4.500 | 4.250 | 3.322 | 3.172 | 3.396 | 3.212 | 3.362 | 3.482 | 3.648 | | | | | | | | |
| LDS08/02 | Ch | 13 | 0.000 | 0.010 | 1.000 | 4.500 | 4.510 | 9.000 | 13.000 | 13.010 | 20.000 | 28.000 | 32.000 | 34.000 | 43.500 | | | | | | | |
| | Elev | 13 | 11.000 | 2.887 | 2.720 | 2.615 | 2.465 | 2.702 | 2.491 | 2.641 | 2.662 | 2.750 | 3.000 | 3.250 | 4.885 | | | | | | | |
| LDS08/02D1 | Ch | 14 | 0.000 | 0.010 | 7.500 | 19.000 | 22.000 | 32.500 | 38.000 | 45.000 | 45.010 | 49.500 | 53.500 | 53.510 | 57.000 | 58.000 | | | | | | |
| | Elev | 14 | 11.000 | 4.594 | 4.000 | 2.750 | 2.500 | 2.500 | 2.611 | 2.595 | 2.370 | 2.566 | 2.392 | 2.542 | 2.647 | 2.814 | | | | | | |
| LDS09/01 | Ch | 13 | 0.000 | 0.010 | 1.000 | 5.000 | 5.010 | 8.000 | 12.500 | 12.510 | 20.000 | 31.000 | 34.000 | 56.000 | 59.000 | | | | | | | |
| | Elev | 13 | 11.000 | 2.833 | 2.667 | 2.547 | 2.397 | 2.730 | 2.384 | 2.534 | 2.550 | 2.750 | 3.000 | 5.000 | 5.250 | | | | | | | |
| LDS09/01D4 | Ch | 14 | 0.000 | 0.010 | 2.500 | 9.000 | 13.000 | 21.000 | 25.000 | 33.500 | 33.510 | 37.000 | 40.500 | 40.510 | 44.000 | 45.000 | | | | | | |
| | Elev | 14 | 11.000 | 4.800 | 4.750 | 4.250 | 3.750 | 3.250 | 3.000 | 2.682 | 2.532 | 2.632 | 2.457 | 2.607 | 2.697 | 2.864 | | | | | | |

Note: Shaded links represent those roads which are to be regraded

# TABLE B3
## Adopted Invert Levels for Surface Nodes

| NODE Name | Node IL (m AHD) |
|---|---|
| ***A- Elizabeth Street*** | |
| NAS01/01 | 4.655 |
| NAS01/02 | 4.000 |
| NAS01/03 | 4.194 |
| NAS01/04 | 3.800 |
| NAS01/05 | 3.651 |
| NAS01/06 | 3.610 |
| NAS01/07 | 3.323 |
| NAS01/08 | 3.003 |
| NAS01/09 | 2.799 |
| NAS01/10 | 3.167 |
| NAS01/11 | 2.537 |
| NAS01/12 | 2.836 |
| NAS02/01 | 4.745 |
| NAS02/02 | 4.377 |
| NAS03/01 | 4.368 |
| NAS03/02 | 4.110 |
| NAS03/03 | 3.943 |
| NAS04/01 | 4.373 |
| NAS05/01 | 4.310 |
| NAS05/02 | 4.180 |
| NAS05/03 | 4.100 |
| NAS05/04 | 3.800 |
| NAS05/05 | 3.602 |
| NAS05/06 | 3.450 |
| NAS06/01 | 4.066 |
| NAS07/01 | 3.270 |
| NAS07/02 | 2.847 |
| NAS07/03 | 2.971 |
| NAS07/04 | 3.426 |
| NAS08/01 | 3.833 |
| NAS08/02 | 3.202 |
| NAS08/03 | 2.900 |
| NAS09/01 | 3.917 |
| NAS10/01 | 3.288 |
| NAS11/01 | 3.506 |
| NAS12/01 | 3.250 |
| NAS12/02 | 2.722 |
| NAS12/03 | 2.935 |
| ***B- Pier Street*** | |
| NBS01/03 | 4.915 |
| NBS01/04 | 4.515 |
| NBS01/04A | 4.715 |
| NBS01/05 | 4.215 |
| NBS01/06 | 4.415 |
| NBS01/07 | 3.755 |
| NBS01/08 | 3.080 |
| NBS01/09 | 3.406 |
| NBS01/10 | 2.827 |
| NBS01/11 | 2.357 |
| NBS01/12 | 2.036 |
| NBS02/01 | 4.300 |
| NBS03/01 | 4.090 |
| NBS04/01 | 3.620 |
| NBS04/02 | 3.173 |
| NBS04/03 | 3.502 |

| NODE Name | Node IL (m AHD) |
|---|---|
| NBS05/01 | 4.040 |
| NBS06/01 | 2.829 |
| NBS06/02 | 2.477 |
| ***C- Pilot Street*** | |
| NCS01/01 | 6.275 |
| NCS01/02 | 5.088 |
| NCS01/03 | 4.607 |
| NCS01/04 | 3.589 |
| NCS01/05 | 3.500 |
| NCS01/06 | 3.452 |
| NCS01/07 | 3.403 |
| NCS01/08 | 3.134 |
| NCS01/09 | 3.050 |
| NCS01/10 | 3.366 |
| NCS01/11 | 3.665 |
| NCS02/01 | 5.750 |
| NCS03/01 | 5.520 |
| NCS03/02 | 3.600 |
| NCS04/01 | 3.447 |
| NCS04/02 | 3.175 |
| ***D- Guard Street*** | |
| NDS01/01 | 5.500 |
| NDS01/02 | 5.181 |
| NDS01/03 | 3.339 |
| NDS01/04 | 2.159 |
| NDS01/05 | 1.900 |
| NDS01/06 | 2.100 |
| NDS01/07 | 2.200 |
| NDS02/01 | 3.273 |
| NDS02/02 | 3.061 |
| NDS02/03 | 3.294 |
| NDS02/04 | 3.151 |
| NDS03/01 | 2.950 |
| NDS03/02 | 2.690 |
| NDS03/03 | 2.412 |
| NDS03/04 | 2.582 |
| NDS04/01 | 10.873 |
| NDS04/02 | 9.750 |
| NDS04/03 | 6.041 |
| NDS04/04 | 3.481 |
| NDS04/05 | 2.226 |
| NDS05/01 | 10.341 |
| NDS06/01 | 4.000 |
| NDS06/02 | 3.114 |
| NDS06/03 | 2.653 |
| NDS07/01 | 2.392 |
| NDS07/02 | 2.554 |
| NDS08/01 | 2.351 |
| NDS08/02 | 2.500 |
| NDS09/01 | 2.588 |
| NCS01/12 | 0.544 |
| NDS04/06 | 0.545 |

Note: Shaded entries represent those roads which are to be regraded

## TABLE B4
## Surface Weirs

$TABLE
/* Specdiv turns weir on, specname gives name of weir */

| | | | SPECDIV | SPECNAME |
|---|---|---|---|---|
| "LCS01/OUT" | 1 | 1 | 4 | "LCS01/OUT" |
| "LDS04/OUT" | 1 | 1 | 4 | "LDS04/OUT" |
| "LCS01/11B1" | 1 | 1 | 4 | "LCS01/11B1" |
| "LDS01/02D6" | 1 | 1 | 4 | "LDS01/02D6" |
| "LCS01/06" | 1 | 1 | 4 | "LCS01/06" |
| "LCS01/07D2" | 1 | 1 | 4 | "LCS01/07D2" |
| "LCS01/06D2" | 1 | 1 | 4 | "LCS01/06D2" |

$TABLE_END
$TABLE
/* SPEC1 turns on special pipe*/

| | | | SPEC1 |
|---|---|---|---|
| "LCS01/OUT" | 0 | 1 | 1 |
| "LDS04/OUT" | 0 | 1 | 1 |
| "LCS01/11B1" | 0 | 1 | 1 |
| "LDS01/02D6" | 0 | 1 | 1 |
| "LCS01/06" | 0 | 1 | 1 |
| "LCS01/07D2" | 0 | 1 | 1 |
| "LCS01/06D2" | 0 | 1 | 1 |

$TABLE_END
/* SCV1= Depth, SCV2= Length, SCV3= Exponent, SCV4= Coefficient */

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATA SCV1 "LCS01/OUT" | 1 | 11 | 0 | 0.062 | 0.063 | 0.075 | 0.085 | 0.335 | 0.585 | 0.835 | 1.085 | 1.335 | 6.335 | | | |
| DATA SCV1 "LDS04/OUT" | 1 | 14 | 0 | 0.474 | 0.475 | 0.524 | 0.774 | 1.024 | 1.106 | 1.274 | 1.524 | 1.774 | 2.024 | 2.274 | 2.356 | 7.356 |
| DATA SCV1 "LCS01/11B1" | 1 | 8 | 0 | 0.513 | 0.514 | 0.563 | 0.634 | 0.789 | 0.835 | 5.563 | | | | | | |
| DATA SCV1 "LDS01/02D6" | 1 | 8 | 0 | 0.119 | 0.12 | 0.17 | 0.369 | 0.619 | 0.719 | 5.719 | | | | | | |
| DATA SCV1 "LCS01/06" | 1 | 7 | 0 | 0.298 | 0.299 | 0.305 | 0.459 | 0.488 | 5.488 | | | | | | | |
| DATA SCV1 "LCS01/07D2" | 1 | 7 | 0 | 0.001 | 0.05 | 0.097 | 0.347 | 0.507 | 5.507 | | | | | | | |
| DATA SCV1 "LCS01/06D2" | 1 | 7 | 0 | 0.001 | 0.05 | 0.118 | 0.258 | 0.298 | 5.298 | | | | | | | |
| DATA SCV2 "LCS01/OUT" | 1 | 11 | 0 | 0.001 | 0.361 | 0.361 | 1.408 | 20.598 | 36.771 | 51.66 | 57.678 | 60.525 | 64.048 | | | |
| DATA SCV2 "LDS04/OUT" | 1 | 14 | 0 | 0.001 | 0.324 | 0.324 | 3.499 | 6.692 | 23.39 | 27.12 | 31.74 | 35.44 | 40.21 | 45.07 | 47.83 | 59.58 |
| DATA SCV2 "LCS01/11B1" | 1 | 8 | 0 | 0.001 | 0.109 | 0.109 | 0.834 | 4.138 | 6.705 | 26.274 | | | | | | |
| DATA SCV2 "LDS01/02D6" | 1 | 8 | 0 | 0.001 | 0.0957 | 0.0957 | 1.673 | 3.63 | 6.861 | 8.721 | | | | | | |
| DATA SCV2 "LCS01/06" | 1 | 7 | 0 | 0.001 | 0.0491 | 0.0491 | 3.532 | 5.102 | 19.313 | | | | | | | |
| DATA SCV2 "LCS01/07D2" | 1 | 7 | 0 | 3.09 | 3.09 | 6 | 10 | 13.5 | 13.5 | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATA SCV2 "LCS01/06D2" | 1 | 7 | 0 | 1.69 | 1.69 | 3.97 | 16.66 | 18 | 18 | | | | | | | |
| DATA SCV3 "LCS01/OUT" | 1 | 11 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | | | |
| DATA SCV3 "LDS04/OUT" | 1 | 14 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| DATA SCV3 "LCS01/11B1" | 1 | 8 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | | | | | | |
| DATA SCV3 "LDS01/02D6" | 1 | 8 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | | | | | | |
| DATA SCV3 "LCS01/06" | 1 | 7 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | | | | | | | |
| DATA SCV3 "LCS01/07D2" | 1 | 7 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | | | | | | | |
| DATA SCV3 "LCS01/06D2" | 1 | 7 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | | | | | | | |
| DATA SCV4 "LCS01/OUT" | 1 | 11 | 0.1 | 0.1 | 1 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | | | |
| DATA SCV4 "LDS04/OUT" | 1 | 14 | 0.1 | 0.1 | 1 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |
| DATA SCV4 "LCS01/11B1" | 1 | 28 | 0.1 | 0.1 | 1 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | | | | | | |
| DATA SCV4 "LDS01/02D6" | 1 | 8 | 0.1 | 0.1 | 1 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | | | | | | |
| DATA SCV4 "LCS01/06" | 1 | 7 | 0.1 | 0.1 | 1 | 1.7 | 1.7 | 1.7 | 1.7 | | | | | | | |
| DATA SCV4 "LCS01/07D2" | 1 | 7 | 0.1 | 1 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | | | | | | | |
| DATA SCV4 "LCS01/06D2" | 1 | 7 | 0.1 | 1 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | | | | | | | |

TABLE B5
Stormwater Drainage Details

| Link Name | Upstream Node | Downstream Node | Pipe Length (m) | Pipe Diameter (mm) | No. of Barrels | Pipe n | Entry Loss |
|---|---|---|---|---|---|---|---|
| *A- Elizabeth Street* | | | | | | | |
| LAU01/02 | NAU01/02 | NAU01/04 | 158 | 450 | 1 | 0.013 | 4.5 |
| LAU01/04 | NAU01/04 | NAU01/05 | 34 | 600 | 1 | 0.013 | 1 |
| LAU01/04A | NAU01/04A | NAU01/04 | 7 | 450 | 2 | 0.013 | 4 |
| LAU01/05 | NAU01/05 | NAU01/06 | 83 | 600 | 1 | 0.013 | 1 |
| LAU01/05A | NAU01/05A | NAU01/05 | 5 | 600 | 1 | 0.013 | 4 |
| LAU01/06 | NAU01/06 | NAU01/07 | 53 | 900 | 1 | 0.013 | 1.2 |
| LAU01/06A | NAU01/06A | NAU01/06 | 5 | 600 | 2 | 0.013 | 4 |
| LAU01/07 | NAU01/07 | NAU01/08 | 65 | 900 | 1 | 0.013 | 0.5 |
| LAU01/07A | NAU01/07A | NAU01/07 | 6 | 375 | 1 | 0.013 | 4 |
| LAU01/08 | NAU01/08 | NAU01/09 | 20 | 900 | 1 | 0.013 | 1.5 |
| LAU01/08A | NAU01/08A | NAU01/08 | 10 | 375 | 2 | 0.013 | 4 |
| LAU01/09 | NAU01/09 | NAU01/10 | 102 | 900 | 2 | 0.013 | 1 |
| LAU01/09A | NAU01/09A | NAU01/09 | 6 | 900 | 2 | 0.013 | 4 |
| LAU01/10 | NAU01/10 | NAU01/11 | 85 | 900 | 3 | 0.013 | 1 |
| LAU01/10A | NAU01/10A | NAU01/10 | 12 | 450 | 2 | 0.013 | 4 |
| LAU01/11 | NAU01/11 | NAU01/12 | 22 | 1200 | 3 | 0.013 | 0.5 |
| LAU01/11A | NAU01/11A | NAU01/11 | 8 | 600 | 3 | 0.013 | 4 |
| LAU01/12 | NAU01/12 | NAUOUT1 | 25 | 1200 | 3 | 0.013 | 2 |
| LAU01/12A | NAU01/12A | NAU01/12 | 10 | 375 | 2 | 0.013 | 4 |
| LAU03/03 | NAU03/03 | NAU01/06 | 69 | 375 | 1 | 0.013 | 5.25 |
| LAU05/02 | NAU05/02 | NAU05/04 | 68 | 375 | 1 | 0.013 | 4 |
| LAU05/04 | NAU05/04 | NAU05/06 | 75 | 375 | 1 | 0.013 | 3.5 |
| LAU05/05 | NAU05/05 | NAU01/08 | 104 | 375 | 1 | 0.013 | 6.5 |
| LAU05/06 | NAU05/06 | NAU01/08 | 80 | 375 | 1 | 0.013 | 1 |
| LAU08/02 | NAU08/02 | NAU08/03 | 50 | 300 | 1 | 0.013 | 4 |
| LAU08/03 | NAU08/03 | NAU01/10 | 82 | 600 | 1 | 0.013 | 6 |
| LAU07/02 | NAU07/02 | NAU07/03 | 48 | 450 | 1 | 0.013 | 9 |
| LAU07/03 | NAU07/03 | NAU06/01 | 121 | 450 | 1 | 0.013 | 2.5 |
| LAU12/02 | NAU12/02 | NAUOUT2 | 38 | 300 | 1 | 0.013 | 4 |
| *B- Pier Street* | | | | | | | |
| LBU06/01 | NAU06/01 | NBU1 | 14 | 450 | 1 | 0.013 | 1 |
| LBU1 | NBU1 | NBUOUT1 | 30 | 300 | 1 | 0.013 | 0.2 |
| LBU05/01 | NBU05/01 | NBU04/02 | 57 | 375 | 1 | 0.013 | 6.5 |
| LBU04/02 | NBU04/02 | NBU01/12 | 130 | 375 | 1 | 0.013 | 0.5 |
| LBU01/12 | NBU01/12 | NBUOUT2 | 33.5 | 2.1x0.6 | 2 | 0.013 | 2.5 |
| LBU01/12A | NBU01/12A | NBU01/12 | 11.1 | 825 | 3 | 0.013 | 4 |
| LBU01/04 | NBU01/04 | NBU01/05 | 127 | 600 | 1 | 0.013 | 1.5 |
| LBU01/04A | NBU01/04A | NBU01/04 | 8 | 600 | 2 | 0.013 | 5.25 |
| LBU01/05 | NBU01/05 | NBU01/06 | 77 | 750 | 1 | 0.013 | 1 |
| LBU01/05A | NBU01/05A | NBU01/05 | 5 | 600 | 3 | 0.013 | 4 |
| LBU01/06 | NBU01/06 | NBU01/07 | 46 | 750 | 1 | 0.013 | 0.2 |
| LBU01/07 | NBU01/07 | NBU01/08 | 54 | 900 | 1 | 0.013 | 2.5 |
| LBU01/07A | NBU01/07A | NBU01/07 | 15 | 375 | 3 | 0.013 | 4 |
| LBU01/08 | NBU01/08 | NBU01/10 | 125 | 1200 | 1 | 0.013 | 1 |
| LBU01/08A | NBU01/08A | NBU01/08 | 6 | 750 | 2 | 0.013 | 4 |
| LBU01/10 | NBU01/10 | NBU01/11 | 73 | 1200 | 1 | 0.013 | 0.5 |
| LBU01/10A | NBU01/10A | NBU01/10 | 6 | 450 | 1 | 0.013 | 4 |
| LBU01/11 | NBU01/11 | NBU01/12 | 123 | 900 | 2 | 0.013 | 3.5 |
| LBU01/11A | NBU01/11A | NBU01/11 | 8 | 600 | 2 | 0.013 | 4 |
| LBU01/12LF | NBU01/12 | NBUOUT2A | 45.2 | 750 | 1 | 0.013 | 4 |
| *C- Pilot Street* | | | | | | | |
| LCU01/04 | NCU01/04 | NCU01/05 | 57 | 600 | 1 | 0.013 | 6.5 |
| LCU01/05 | NCU01/05 | NCU01/06 | 62 | 600 | 1 | 0.013 | 1.5 |
| LCU01/05A | NCU01/05A | NCU01/05 | 9 | 450 | 2 | 0.013 | 4 |
| LCU01/06 | NCU01/06 | NCU01/07 | 34 | 1050 | 1 | 0.013 | 2.5 |
| LCU01/06A | NCU01/06A | NCU01/06 | 10 | 450 | 2 | 0.013 | 4 |

| Link Name | Upstream Node | Downstream Node | Pipe Length (m) | Pipe Diameter (mm) | No. of Barrels | Pipe n | Entry Loss |
|---|---|---|---|---|---|---|---|
| LCU01/07 | NCU01/07 | NCU01/08 | 27 | 1050 | 1 | 0.013 | 2.5 |
| LCU01/08 | NCU01/08 | NCU01/09 | 83 | 1050 | 1 | 0.013 | 1 |
| LCU01/09 | NCU01/09 | NCU01/11 | 114 | 1050 | 1 | 0.013 | 1 |
| LCU01/09A | NCU01/09A | NCU01/09 | 15 | 375 | 3 | 0.013 | 6 |
| LCU01/11 | NCU01/11 | NCUOUT | 54 | 1050 | 1 | 0.013 | 4 |
| LDU03/01 | NDU03/01 | NCU01/09 | 40 | 375 | 1 | 0.013 | 4 |
| LCU04/02 | NCU04/02 | NCU1 | 49 | 300 | 1 | 0.013 | 6.5 |
| LCU1 | NCU1 | NCUOUT2 | 30 | 600 | 1 | 0.013 | 2.5 |
| LCU03/02 | NCU03/02 | NDU02/03 | 130 | 300 | 1 | 0.013 | 4.5 |
| ***D- Guard Street*** | | | | | | | |
| LDU02/03 | NDU02/03 | NDU03/03 | 70 | 600 | 1 | 0.013 | 2.5 |
| LDU03/03 | NDU03/03 | NDU07/01 | 79 | 600 | 1 | 0.013 | 3 |
| LDU07/01 | NDU07/01 | NDU08/01 | 86 | 600 | 1 | 0.013 | 2.5 |
| LDU08/01 | NDU08/01 | NDUOUT1 | 82 | 600 | 1 | 0.013 | 0.5 |
| LDU02/02 | NDU02/02 | NDU02/03 | 67 | 300 | 1 | 0.013 | 6.5 |
| LDU02/04 | NDU02/04 | NDU02/03 | 73 | 300 | 1 | 0.013 | 6.5 |
| LDU01/02 | NDU01/02 | NDU01/03 | 56 | 375 | 2 | 0.013 | 10.5 |
| LDU01/03 | NDU01/03 | NDU01/04 | 73 | 450 | 1 | 0.013 | 1 |
| LDU01/04 | NDU01/04 | NDU01/05 | 36 | 825 | 1 | 0.013 | 0.5 |
| LDU01/04A | NDU01/04A | NDU01/04 | 17 | 375 | 2 | 0.013 | 4 |
| LDU01/05 | NDU01/05 | NDU01/06 | 49 | 1200 | 2 | 0.013 | 1 |
| LDU01/05A | NDU01/05A | NDU01/05 | 20 | 1200 | 2 | 0.013 | 4 |
| LDU01/06 | NDU01/06 | NDU01/07 | 59 | 1200 | 2 | 0.013 | 1 |
| LDU01/06A | NDU01/06A | NDU01/06 | 20 | 450 | 2 | 0.013 | 4 |
| LDU01/07 | NDU01/07 | NDUOUT2 | 90 | 1200 | 2 | 0.013 | 2 |
| LDU01/07A | NDU01/07A | NDU01/07 | 13 | 450 | 2 | 0.013 | 4 |
| LDU06/03 | NDU06/03 | NDU1 | 110 | 375 | 1 | 0.013 | 6 |
| LDU1 | NDU1 | NDU01/05 | 18 | 375 | 1 | 0.013 | 2.5 |
| LDU05/01 | NDU05/01 | NDU04/02 | 40 | 450 | 1 | 0.013 | 6.5 |
| LDU04/02 | NDU04/02 | NDU04/03 | 80 | 375 | 1 | 0.013 | 2.5 |
| LDU04/03 | NDU04/03 | NDU04/04 | 44 | 375 | 1 | 0.013 | 1 |
| LDU04/03A | NDU04/03A | NDU04/03 | 25 | 375 | 1 | 0.013 | 4 |
| LDU04/04 | NDU04/04 | NDU04/05 | 67 | 375 | 1 | 0.013 | 2.5 |
| LDU04/04A | NDU04/04A | NDU04/04 | 7 | 375 | 1 | 0.013 | 4 |
| LDU04/05 | NDU04/05 | NDUOUT3 | 80 | 375 | 1 | 0.013 | 2.5 |
| LDU04/05A | NDU04/05A | NDU04/05 | 18 | 200 | 1 | 0.013 | 6.5 |
| LDU04/01 | NDU04/01 | NDU04/02 | 25 | 375 | 1 | 0.013 | 6.5 |

Note: Shaded Links represent new drainage lines

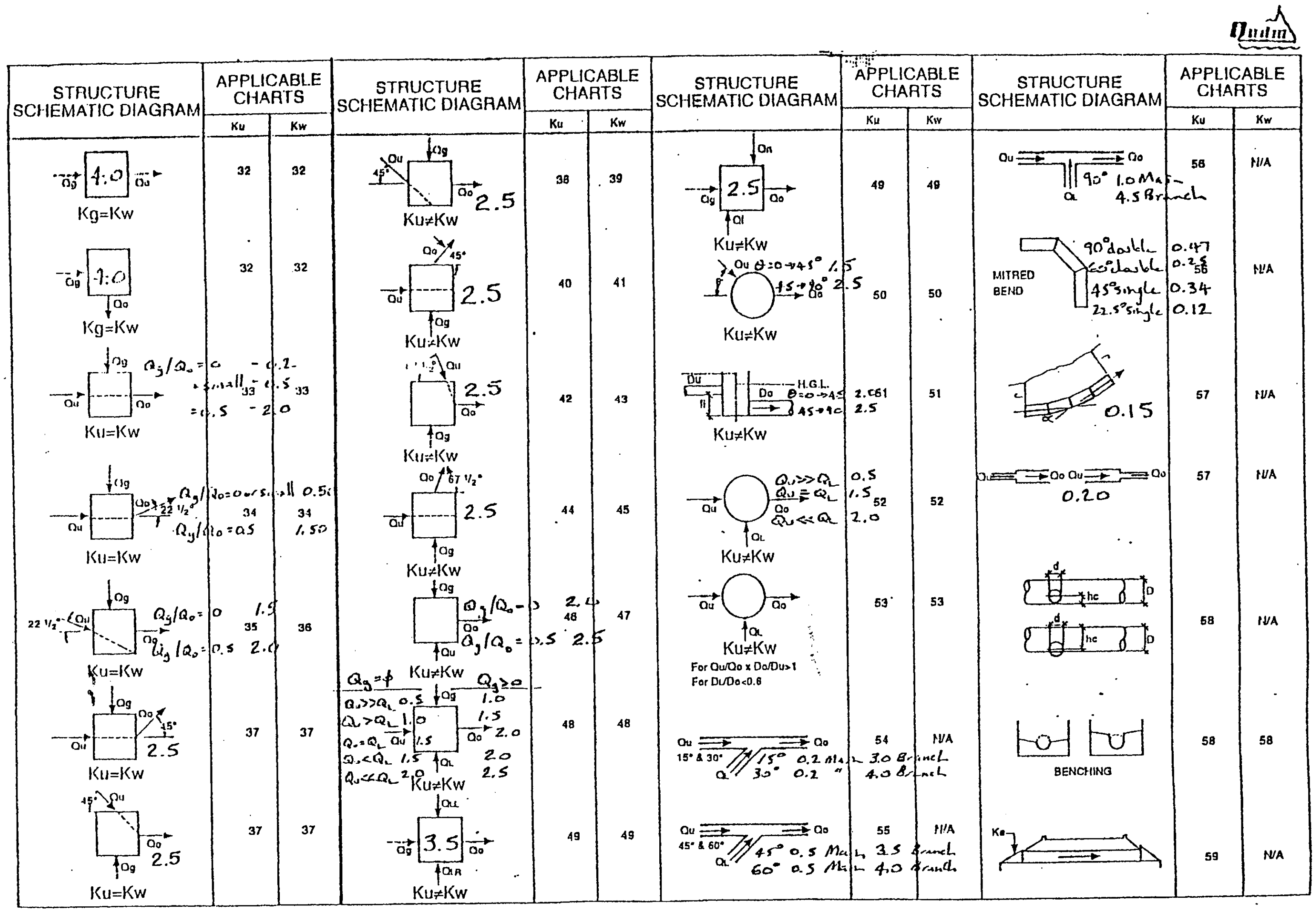
## TABLE B6
## Adopted Invert Levels for Underground Nodes

| Node Name | Invert Level m AHD |
|---|---|
| ***A-Elizabeth Street*** | |
| NAU01/02 | 2.100 |
| NAU01/04 | 1.800 |
| NAU01/04A | 2.000 |
| NAU01/05 | 1.600 |
| NAU01/05A | 1.800 |
| NAU01/06 | 1.500 |
| NAU01/06A | 1.700 |
| NAU01/07 | 1.290 |
| NAU01/07A | 1.500 |
| NAU01/08 | 1.020 |
| NAU01/08A | 1.200 |
| NAU01/09 | 0.940 |
| NAU01/09A | 1.200 |
| NAU01/10 | 0.530 |
| NAU01/10A | 0.700 |
| NAU01/11 | 0.190 |
| NAU01/11A | 0.400 |
| NAU01/12 | 0.100 |
| NAU01/12A | 0.300 |
| NAUOUT1 | 0.000 |
| NAU03/03 | 2.500 |
| NAU05/02 | 3.032 |
| NAU05/04 | 2.690 |
| NAU05/05 | 2.672 |
| NAU05/06 | 2.680 |
| NAU08/02 | 2.562 |
| NAU08/03 | 2.291 |
| NAU07/02 | 2.165 |
| NAU07/03 | 2.021 |
| NAU06/01 | 1.529 |
| NAU12/02 | 2.113 |
| NAUOUT2 | 0.744 |
| ***B- Pier Street*** | |
| NBU1 | 0.378 |
| NBUOUT1 | 0.350 |
| NBU05/01 | 2.300 |
| NBU04/02 | 1.853 |
| NBU01/12 | 0.190 |
| NBU01/12A | 0.250 |
| NBUOUT2 | 1.100 |
| NBUOUT2A | 0.100 |
| NBU01/04 | 2.000 |
| NBU01/04A | 2.200 |
| NBU01/05 | 1.800 |
| NBU01/05A | 2.200 |
| NBU01/06 | 1.600 |
| NBU01/07 | 1.500 |
| NBU01/07A | 2.200 |
| NBU01/08 | 1.000 |
| NBU01/08A | 1.300 |
| NBU01/10 | 0.700 |
| NBU01/10A | 1.000 |
| NBU01/11 | 0.500 |
| NBU01/11A | 0.800 |
| ***C- Pilot Street*** | |
| NCU01/04 | 2.979 |
| NCU01/05 | 2.527 |
| NCU01/05A | 2.554 |
| NCU01/06 | 1.583 |
| NCU01/06A | 1.613 |
| NCU01/07 | 1.310 |
| NCU01/08 | 1.270 |
| NCU01/09 | 0.850 |

| Node Name | Invert Level m AHD |
|---|---|
| NCU01/09A | 2.230 |
| NCU01/11 | 0.270 |
| NCUOUT | 0.000 |
| NCUOUT2 | 0.000 |
| NDU03/01 | 2.241 |
| NCU04/02 | 2.370 |
| NCU1 | 1.771 |
| NCU03/02 | 2.970 |
| ***D- Guard Street*** | |
| NDU02/03 | 1.954 |
| NDU03/03 | 1.602 |
| NDU07/01 | 1.222 |
| NDU08/01 | 1.160 |
| NDUOUT1 | 0.900 |
| NDU02/02 | 2.387 |
| NDU02/04 | 2.511 |
| NDU01/02 | 4.081 |
| NDU01/03 | 1.800 |
| NDU01/04 | 0.500 |
| NDU01/04A | 0.551 |
| NDU01/05 | 0.260 |
| NDU01/05A | 0.300 |
| NDU01/06 | 0.211 |
| NDU01/06A | 0.291 |
| NDU01/07 | 0.152 |
| NDU01/07A | 0.178 |
| NDUOUT2 | 0.050 |
| NDU06/03 | 2.054 |
| NDU1 | 1.270 |
| NDU05/01 | 9.571 |
| NDU04/02 | 8.950 |
| NDU04/03 | 4.533 |
| NDU04/03A | 4.733 |
| NDU04/04 | 2.821 |
| NDU04/04A | 2.921 |
| NDU04/05 | 1.845 |
| NDU04/05A | 1.890 |
| NDUOUT3 | 0.900 |
| NDU04/01 | 10.173 |

Note: Shaded entries represent new drainage lines

## TABLE B7
## Adopted Manhole Loss Coefficients




| | |
|---|---|
| ☐ DENOTES STRUCTURE WITH GRATE (GUTTER) INFLOW | ○ DENOTES STRUCTURE WITH NO GRATE (GUTTER) INFLOW |

*Index to Pressure Change Coefficient Charts*

CHART NO. 31

**TABLE B8**
**Inlet Capacity of Side Entry Pits and Grates**

| Depth | 1 Bay Side Entry Pit | | 2 Bay Side Entry Pit | | 3 Bay Side Entry Pit | | 4 Bay Side Entry Pit | | Grated | |
|---|---|---|---|---|---|---|---|---|---|---|
| | On grade ($m^3/s$) | Sag ($m^3/s$) | On grade ($m^3/s$) | Sag ($m^3/s$) | On grade ($m^3/s$) | Sag ($m^3/s$) | On grade ($m^3/s$) | Sag ($m^3/s$) | On grade ($m^3/s$) | Sag ($m^3/s$) |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.080 | 0.007 | 0.027 | 0.020 | 0.054 | 0.020 | 0.081 | 0.020 | 0.108 | 0.013 | 0.020 |
| 0.099 | 0.010 | 0.037 | 0.031 | 0.074 | 0.038 | 0.112 | 0.040 | 0.149 | 0.020 | 0.027 |
| 0.113 | 0.014 | 0.045 | 0.038 | 0.091 | 0.053 | 0.136 | 0.060 | 0.182 | 0.027 | 0.033 |
| 0.125 | 0.016 | 0.053 | 0.044 | 0.106 | 0.062 | 0.158 | 0.074 | 0.211 | 0.032 | 0.038 |
| 0.144 | 0.021 | 0.065 | 0.050 | 0.131 | 0.077 | 0.196 | 0.101 | 0.261 | 0.039 | 0.047 |
| 0.158 | 0.022 | 0.075 | 0.053 | 0.150 | 0.086 | 0.225 | 0.122 | 0.300 | 0.043 | 0.054 |
| 0.170 | 0.023 | 0.084 | 0.055 | 0.168 | 0.093 | 0.251 | 0.142 | 0.335 | 0.045 | 0.061 |
| 0.179 | 0.023 | 0.090 | 0.056 | 0.180 | 0.098 | 0.269 | 0.160 | 0.359 | 0.045 | 0.065 |
| 0.189 | 0.023 | 0.092 | 0.056 | 0.184 | 0.101 | 0.276 | 0.176 | 0.368 | 0.045 | 0.071 |
| 0.198 | 0.023 | 0.094 | 0.056 | 0.188 | 0.102 | 0.282 | 0.191 | 0.376 | 0.045 | 0.076 |
| 0.205 | 0.023 | 0.096 | 0.056 | 0.191 | 0.104 | 0.286 | 0.202 | 0.380 | 0.045 | 0.080 |
| 0.213 | 0.023 | 0.097 | 0.056 | 0.195 | 0.104 | 0.291 | 0.210 | 0.380 | 0.045 | 0.085 |
| 0.219 | 0.023 | 0.099 | 0.056 | 0.197 | 0.104 | 0.295 | 0.216 | 0.380 | 0.045 | 0.088 |
| 0.250 | 0.023 | 0.105 | 0.056 | 0.210 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.108 |
| 0.300 | 0.023 | 0.115 | 0.056 | 0.229 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.142 |
| 0.350 | 0.023 | 0.123 | 0.056 | 0.247 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.157 |
| 0.400 | 0.023 | 0.131 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.168 |
| 0.500 | 0.023 | 0.146 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.188 |
| 0.750 | 0.023 | 0.179 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.230 |
| 1.000 | 0.023 | 0.206 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.250 |
| 1.500 | 0.023 | 0.216 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.250 |
| 2.000 | 0.023 | 0.216 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.250 |
| 3.000 | 0.023 | 0.216 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.250 |
| 3.500 | 0.023 | 0.216 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.250 |
| 4.000 | 0.023 | 0.216 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.250 |
| 5.000 | 0.023 | 0.216 | 0.056 | 0.248 | 0.104 | 0.300 | 0.216 | 0.380 | 0.045 | 0.250 |

Note Allowable values quoted

## TABLE B9
## Equivalent Weir Dimensions for Inlet Pits

| Depth | 1 Bay Side Entry Pit | | 2 Bay Side Entry Pit | | 3 Bay Side Entry Pit | | 4 Bay Side Entry Pit | | Grated | |
|---|---|---|---|---|---|---|---|---|---|---|
| | On grade (m) | Sag (m) | On grade (m) | Sag (m) | On grade (m) | Sag (m) | On grade (m) | Sag (m) | On grade (m) | Sag (m) |
| 0.000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 0.080 | 0.0070 | 0.0216 | 0.0253 | 0.0431 | 0.0221 | 0.0630 | 0.0205 | 0.0808 | 0.0122 | 0.0278 |
| 0.099 | 0.0097 | 0.0298 | 0.0371 | 0.0594 | 0.0397 | 0.0869 | 0.0384 | 0.1115 | 0.0182 | 0.0352 |
| 0.113 | 0.0124 | 0.0364 | 0.0438 | 0.0725 | 0.0525 | 0.1060 | 0.0553 | 0.1361 | 0.0232 | 0.0409 |
| 0.125 | 0.0143 | 0.0423 | 0.0487 | 0.0844 | 0.0602 | 0.1235 | 0.0665 | 0.1585 | 0.0272 | 0.0461 |
| 0.144 | 0.0180 | 0.0524 | 0.0526 | 0.1044 | 0.0710 | 0.1528 | 0.0863 | 0.1962 | 0.0318 | 0.0553 |
| 0.158 | 0.0191 | 0.0603 | 0.0545 | 0.1201 | 0.0777 | 0.1758 | 0.1019 | 0.2257 | 0.0337 | 0.0628 |
| 0.170 | 0.0195 | 0.0673 | 0.0557 | 0.1341 | 0.0816 | 0.1963 | 0.1154 | 0.2521 | 0.0345 | 0.0698 |
| 0.179 | 0.0193 | 0.0723 | 0.0557 | 0.1440 | 0.0846 | 0.2100 | 0.1286 | 0.2700 | 0.0344 | 0.0754 |
| 0.189 | 0.0190 | 0.0741 | 0.0554 | 0.1477 | 0.0869 | 0.2154 | 0.1407 | 0.2770 | 0.0342 | 0.0819 |
| 0.198 | 0.0189 | 0.0758 | 0.0552 | 0.1510 | 0.0879 | 0.2202 | 0.1522 | 0.2831 | 0.0341 | 0.0879 |
| 0.205 | 0.0187 | 0.0770 | 0.0550 | 0.1535 | 0.0890 | 0.2238 | 0.1606 | 0.2864 | 0.0340 | 0.0927 |
| 0.213 | 0.0186 | 0.0784 | 0.0548 | 0.1563 | 0.0887 | 0.2279 | 0.1657 | 0.2865 | 0.0340 | 0.0982 |
| 0.219 | 0.0185 | 0.0795 | 0.0547 | 0.1583 | 0.0884 | 0.2310 | 0.1703 | 0.2865 | 0.0340 | 0.1023 |
| 0.250 | 0.0180 | 0.0846 | 0.0540 | 0.1686 | 0.0873 | 0.2349 | 0.1698 | 0.2868 | 0.0340 | 0.1248 |
| 0.300 | 0.0174 | 0.0924 | 0.0530 | 0.1841 | 0.0858 | 0.2352 | 0.1697 | 0.2871 | 0.0340 | 0.1641 |
| 0.350 | 0.0168 | 0.0995 | 0.0523 | 0.1984 | 0.0845 | 0.2355 | 0.1697 | 0.2875 | 0.0340 | 0.1819 |
| 0.400 | 0.0164 | 0.1062 | 0.0516 | 0.1997 | 0.0844 | 0.2357 | 0.1696 | 0.2877 | 0.0340 | 0.1945 |
| 0.500 | 0.0157 | 0.1185 | 0.0505 | 0.2000 | 0.0844 | 0.2361 | 0.1696 | 0.2882 | 0.0339 | 0.2175 |
| 0.750 | 0.0145 | 0.1449 | 0.0485 | 0.2006 | 0.0844 | 0.2368 | 0.1695 | 0.2891 | 0.0339 | 0.2664 |
| 1.000 | 0.0136 | 0.1673 | 0.0471 | 0.2010 | 0.0843 | 0.2373 | 0.1694 | 0.2897 | 0.0339 | 0.2893 |
| 1.500 | 0.0126 | 0.1762 | 0.0466 | 0.2017 | 0.0843 | 0.2381 | 0.1693 | 0.2906 | 0.0339 | 0.2894 |
| 2.000 | 0.0119 | 0.1766 | 0.0466 | 0.2021 | 0.0842 | 0.2386 | 0.1692 | 0.2913 | 0.0339 | 0.2894 |
| 3.000 | 0.0110 | 0.1771 | 0.0466 | 0.2028 | 0.0842 | 0.2394 | 0.1691 | 0.2922 | 0.0339 | 0.2894 |
| 3.500 | 0.0106 | 0.1774 | 0.0466 | 0.2030 | 0.0842 | 0.2397 | 0.1691 | 0.2926 | 0.0338 | 0.2895 |
| 4.000 | 0.0103 | 0.1775 | 0.0465 | 0.2032 | 0.0841 | 0.2399 | 0.1690 | 0.2929 | 0.0338 | 0.2895 |
| 5.000 | 0.0099 | 0.1778 | 0.0465 | 0.2036 | 0.0841 | 0.2403 | 0.1690 | 0.2934 | 0.0338 | 0.2895 |


Scale 1:5000

**URANGAN CATCHMENT**

RELIEF DRAINAGE INVESTIGATION

XP-STORM MODEL LAYOUT

# FIGURE B1

Rev: A Date: 20th March 2003

Project No.: 2919-31-02
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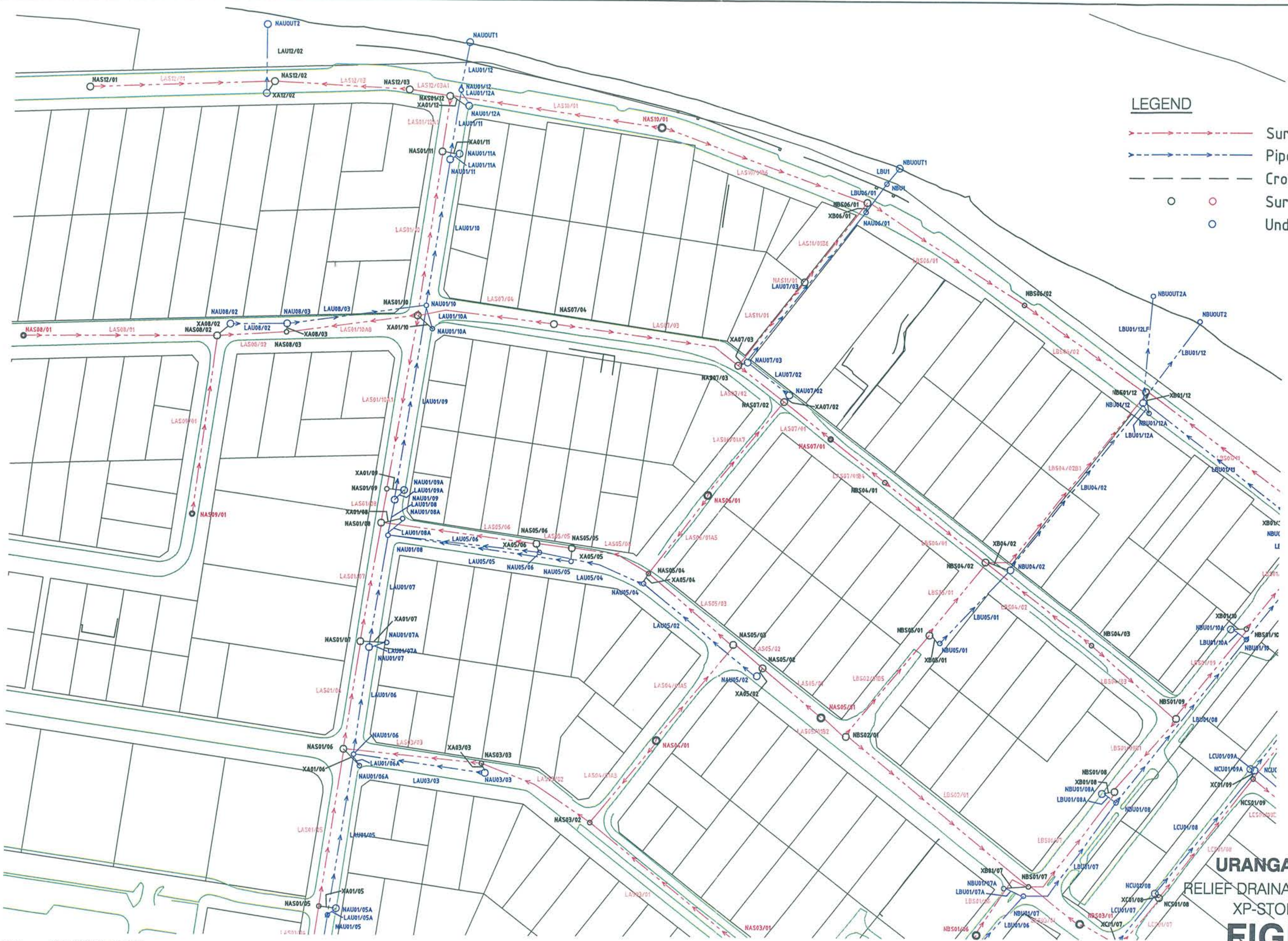
X-Ref: :I:\2919-31\Acad 2003\hbayxr-1.dwg

Cardno MBK




Scale 1:2000

**URANGAN CATCHMENT**

RELIEF DRAINAGE INVESTIGATION

XP-STORM MODEL LAYOUT

# FIGURE B2

Rev: A    Date: 20th March 2003

Project No.: 2919-31-02

Cadfile: I:\2919-31\Acad 2003\hbayfgB2.dwg

X-Ref: :I:\2919-31\Acad 2003\hbayxr-1.dwg


Cardno MBK

Scale 1:2000

**URANGAN CATCHMENT**

RELIEF DRAINAGE INVESTIGATION

XP-STORM MODEL LAYOUT

# FIGURE B3

Rev: A Date: 20th March 2003

Project No.: 2919-31-02

Cadfile: I:\2919-31\Acad 2003\hbayfgB3.dwg

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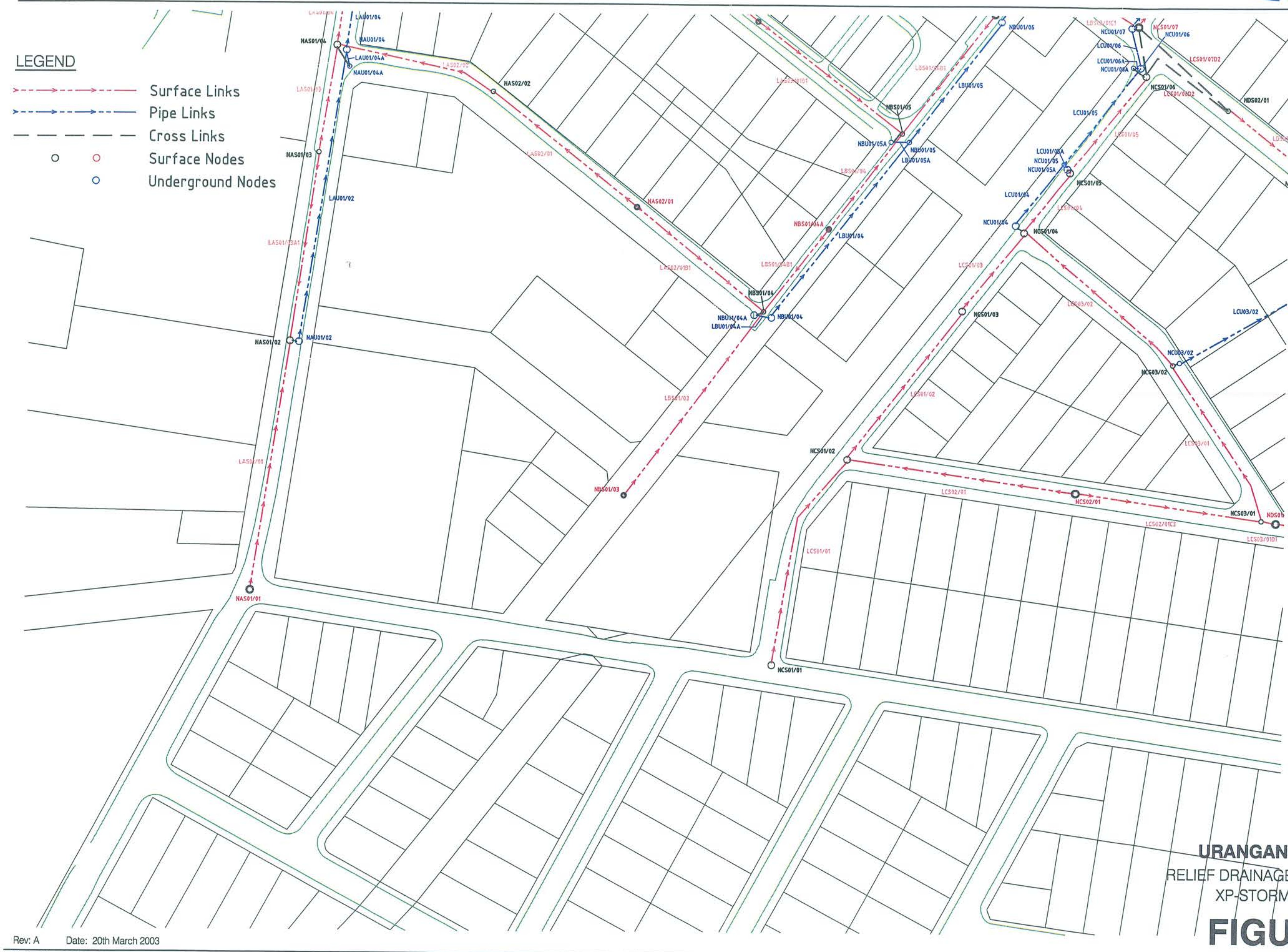


Scale 1:2000

**URANGAN CATCHMENT**

RELIEF DRAINAGE INVESTIGATION

XP-STORM MODEL LAYOUT

# FIGURE B4

Rev: A Date: 20th March 2003

Project No.: 2919-31-02
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X-Ref: :I:\2919-31\Acad 2003\hbayxr-1.dwg

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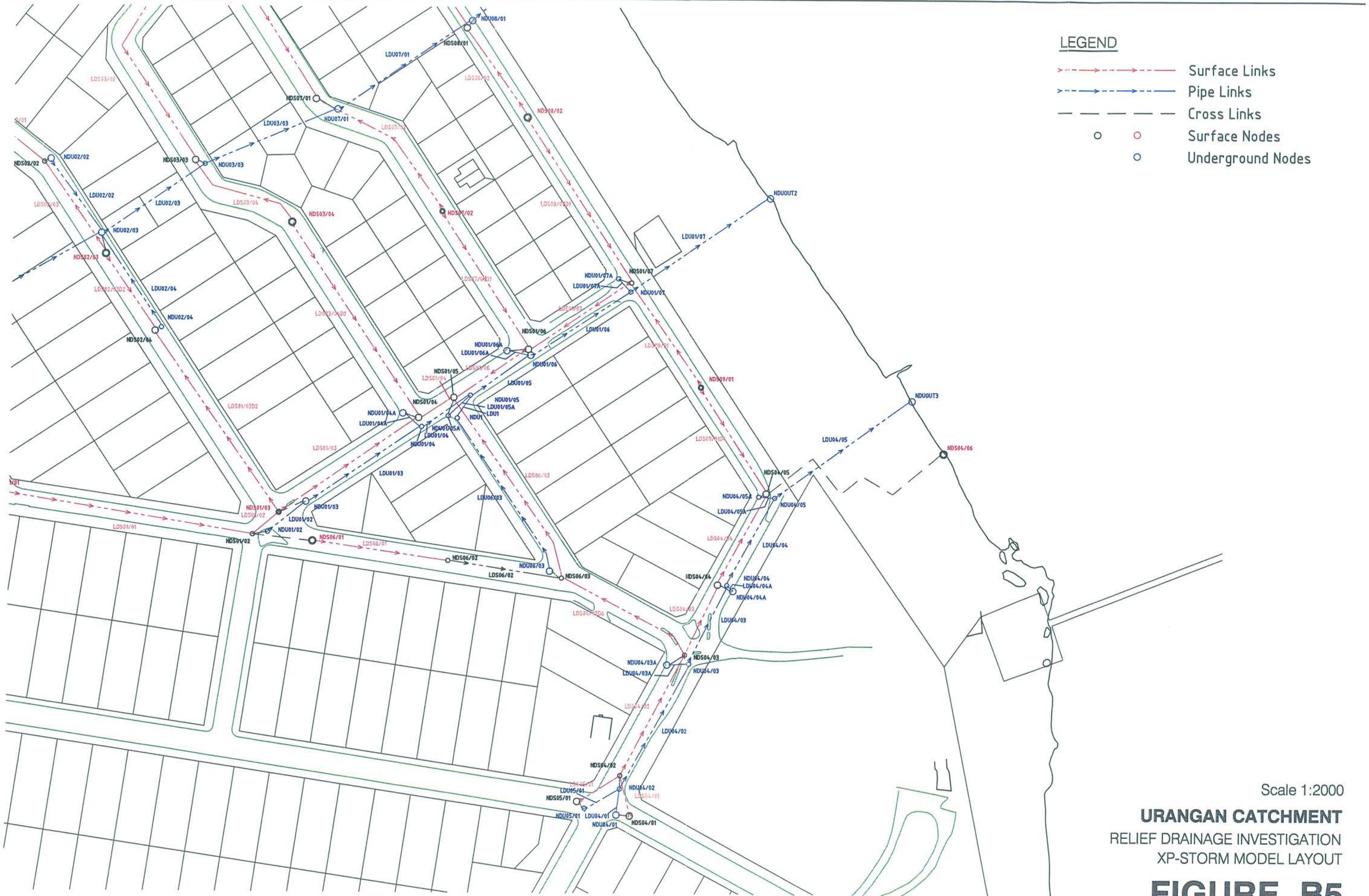


Scale 1:2000

**URANGAN CATCHMENT**

RELIEF DRAINAGE INVESTIGATION

XP-STORM MODEL LAYOUT

# FIGURE B5

Rev: A Date: 20th March 2003

Project No.: 2919-31-02

Cadfile: I:\2919-31\Acad 2003\hbayfgB5.dwg

X-Ref: :I:\2919-31\Acad 2003\hbayxr-1.dwg

# APPENDIX C

# Model Results

## List of Tables

## TABLE C1
## Surface Network- Peak Water Levels and Depths

| Node Name | Invert Level (m AHD) | Maximum Water Level (m AHD) | | | | | Maximum Depth (m) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 Year Event | 10 Year Event | 20 Year Event | 50 Year Event | 100 Year Event | 2 Year Event | 10 Year Event | 20 Year Event | 50 Year Event | 100 Year Event |
| ***A- Elizabeth Street*** | | | | | | | | | | | |
| NAS01/01 | 4.655 | 4.655 | 4.655 | 4.655 | 4.655 | 4.655 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS01/02 | 4.000 | 4.037 | 4.048 | 4.052 | 4.072 | 4.086 | 0.037 | 0.048 | 0.052 | 0.072 | 0.086 |
| NAS01/03 | 4.194 | 4.194 | 4.194 | 4.194 | 4.194 | 4.194 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS01/04 | 3.800 | 3.909 | 3.937 | 3.966 | 4.002 | 4.021 | 0.109 | 0.137 | 0.166 | 0.202 | 0.221 |
| NAS01/05 | 3.651 | 3.718 | 3.741 | 3.832 | 3.888 | 3.910 | 0.067 | 0.090 | 0.181 | 0.237 | 0.259 |
| NAS01/06 | 3.610 | 3.719 | 3.746 | 3.813 | 3.870 | 3.892 | 0.109 | 0.136 | 0.203 | 0.260 | 0.282 |
| NAS01/07 | 3.323 | 3.390 | 3.414 | 3.456 | 3.495 | 3.517 | 0.067 | 0.091 | 0.133 | 0.172 | 0.194 |
| NAS01/08 | 3.003 | 3.102 | 3.133 | 3.228 | 3.332 | 3.377 | 0.099 | 0.130 | 0.225 | 0.329 | 0.374 |
| NAS01/09 | 2.799 | 2.886 | 2.917 | 3.230 | 3.333 | 3.378 | 0.087 | 0.118 | 0.431 | 0.534 | 0.579 |
| NAS01/10 | 3.167 | 3.212 | 3.227 | 3.234 | 3.315 | 3.353 | 0.045 | 0.060 | 0.067 | 0.148 | 0.186 |
| NAS01/11 | 2.537 | 2.617 | 2.644 | 2.673 | 2.921 | 3.116 | 0.080 | 0.107 | 0.136 | 0.384 | 0.579 |
| NAS01/12 | 2.836 | 2.928 | 2.986 | 3.018 | 3.027 | 3.114 | 0.092 | 0.150 | 0.182 | 0.191 | 0.278 |
| NAS02/01 | 4.745 | 4.745 | 4.745 | 4.745 | 4.773 | 4.795 | 0.000 | 0.000 | 0.000 | 0.028 | 0.050 |
| NAS02/02 | 4.377 | 4.437 | 4.458 | 4.467 | 4.483 | 4.492 | 0.060 | 0.081 | 0.090 | 0.106 | 0.115 |
| NAS03/01 | 4.368 | 4.368 | 4.368 | 4.368 | 4.424 | 4.454 | 0.000 | 0.000 | 0.000 | 0.056 | 0.086 |
| NAS03/02 | 4.110 | 4.219 | 4.252 | 4.265 | 4.283 | 4.295 | 0.109 | 0.142 | 0.155 | 0.173 | 0.185 |
| NAS03/03 | 3.943 | 4.042 | 4.072 | 4.089 | 4.116 | 4.131 | 0.099 | 0.129 | 0.146 | 0.173 | 0.188 |
| NAS04/01 | 4.373 | 4.373 | 4.373 | 4.373 | 4.373 | 4.373 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS05/01 | 4.310 | 4.318 | 4.325 | 4.327 | 4.331 | 4.334 | 0.008 | 0.015 | 0.017 | 0.021 | 0.024 |
| NAS05/02 | 4.180 | 4.265 | 4.293 | 4.304 | 4.314 | 4.320 | 0.084 | 0.113 | 0.124 | 0.134 | 0.140 |
| NAS05/03 | 4.100 | 4.165 | 4.187 | 4.198 | 4.217 | 4.225 | 0.065 | 0.087 | 0.098 | 0.117 | 0.125 |
| NAS05/04 | 3.800 | 3.888 | 3.916 | 3.927 | 3.940 | 3.949 | 0.088 | 0.116 | 0.127 | 0.140 | 0.149 |
| NAS05/05 | 3.602 | 3.725 | 3.748 | 3.758 | 3.778 | 3.790 | 0.123 | 0.146 | 0.156 | 0.176 | 0.188 |
| NAS05/06 | 3.450 | 3.536 | 3.570 | 3.584 | 3.604 | 3.615 | 0.086 | 0.120 | 0.134 | 0.154 | 0.165 |
| NAS06/01 | 4.066 | 4.066 | 4.066 | 4.066 | 4.066 | 4.066 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS07/01 | 3.270 | 3.308 | 3.323 | 3.364 | 3.458 | 3.498 | 0.037 | 0.052 | 0.094 | 0.188 | 0.228 |
| NAS07/02 | 2.847 | 3.119 | 3.260 | 3.364 | 3.456 | 3.497 | 0.272 | 0.413 | 0.517 | 0.609 | 0.650 |
| NAS07/03 | 2.971 | 3.119 | 3.260 | 3.364 | 3.457 | 3.497 | 0.148 | 0.289 | 0.393 | 0.486 | 0.526 |
| NAS07/04 | 3.426 | 3.426 | 3.426 | 3.426 | 3.457 | 3.496 | 0.000 | 0.000 | 0.000 | 0.031 | 0.070 |
| NAS08/01 | 3.833 | 3.833 | 3.833 | 3.833 | 3.833 | 3.833 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS08/02 | 3.202 | 3.323 | 3.350 | 3.354 | 3.369 | 3.379 | 0.121 | 0.148 | 0.152 | 0.167 | 0.177 |
| NAS08/03 | 2.900 | 2.985 | 3.020 | 3.171 | 3.323 | 3.357 | 0.085 | 0.120 | 0.271 | 0.423 | 0.457 |
| NAS09/01 | 3.917 | 3.917 | 3.917 | 3.917 | 3.917 | 3.917 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS10/01 | 3.288 | 3.288 | 3.288 | 3.288 | 3.288 | 3.288 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS11/01 | 3.506 | 3.506 | 3.506 | 3.506 | 3.506 | 3.506 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS12/01 | 3.250 | 3.250 | 3.250 | 3.250 | 3.250 | 3.250 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NAS12/02 | 2.722 | 3.004 | 3.093 | 3.131 | 3.166 | 3.189 | 0.282 | 0.371 | 0.409 | 0.444 | 0.467 |
| NAS12/03 | 2.935 | 3.000 | 3.073 | 3.100 | 3.126 | 3.144 | 0.065 | 0.138 | 0.165 | 0.191 | 0.209 |
| ***B- Pier Street*** | | | | | | | | | | | |
| NBS01/03 | 4.915 | 4.915 | 4.915 | 4.915 | 4.915 | 4.915 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NBS01/04 | 4.515 | 4.607 | 4.638 | 4.704 | 4.773 | 4.798 | 0.092 | 0.123 | 0.189 | 0.258 | 0.283 |
| NBS01/04A | 4.715 | 4.715 | 4.715 | 4.715 | 4.765 | 4.786 | 0.000 | 0.000 | 0.000 | 0.050 | 0.071 |
| NBS01/05 | 4.215 | 4.315 | 4.348 | 4.365 | 4.434 | 4.472 | 0.100 | 0.133 | 0.150 | 0.219 | 0.257 |
| NBS01/06 | 4.415 | 4.415 | 4.415 | 4.415 | 4.433 | 4.458 | 0.000 | 0.000 | 0.000 | 0.018 | 0.043 |
| NBS01/07 | 3.755 | 3.838 | 3.864 | 3.875 | 3.886 | 3.892 | 0.083 | 0.109 | 0.120 | 0.131 | 0.137 |
| NBS01/08 | 3.080 | 3.162 | 3.190 | 3.202 | 3.289 | 3.358 | 0.082 | 0.110 | 0.122 | 0.209 | 0.278 |
| NBS01/09 | 3.406 | 3.496 | 3.528 | 3.536 | 3.543 | 3.546 | 0.090 | 0.122 | 0.130 | 0.137 | 0.140 |
| NBS01/10 | 2.827 | 2.911 | 2.935 | 2.948 | 2.966 | 2.980 | 0.084 | 0.108 | 0.121 | 0.139 | 0.153 |
| NBS01/11 | 2.357 | 2.454 | 2.477 | 2.722 | 2.818 | 2.877 | 0.097 | 0.120 | 0.365 | 0.461 | 0.520 |
| NBS01/12 | 2.036 | 2.154 | 2.203 | 2.720 | 2.816 | 2.874 | 0.118 | 0.167 | 0.684 | 0.780 | 0.838 |
| NBS02/01 | 4.300 | 4.329 | 4.341 | 4.345 | 4.352 | 4.356 | 0.029 | 0.041 | 0.045 | 0.052 | 0.056 |
| NBS03/01 | 4.090 | 4.090 | 4.090 | 4.090 | 4.090 | 4.090 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NBS04/01 | 3.620 | 3.620 | 3.620 | 3.620 | 3.620 | 3.620 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NBS04/02 | 3.173 | 3.362 | 3.433 | 3.431 | 3.462 | 3.479 | 0.189 | 0.260 | 0.258 | 0.289 | 0.306 |
| NBS04/03 | 3.502 | 3.502 | 3.521 | 3.526 | 3.531 | 3.534 | 0.000 | 0.018 | 0.024 | 0.029 | 0.032 |
| NBS05/01 | 4.040 | 4.076 | 4.089 | 4.095 | 4.104 | 4.109 | 0.036 | 0.049 | 0.055 | 0.064 | 0.069 |
| NBS06/01 | 2.829 | 2.934 | 2.963 | 2.979 | 2.996 | 3.006 | 0.105 | 0.134 | 0.150 | 0.167 | 0.177 |
| NBS06/02 | 2.477 | 2.665 | 2.697 | 2.720 | 2.816 | 2.874 | 0.188 | 0.220 | 0.243 | 0.339 | 0.397 |
| ***C- Pilot Street*** | | | | | | | | | | | |
| NCS01/01 | 6.275 | 6.450 | 6.497 | 6.517 | 6.533 | 6.539 | 0.175 | 0.222 | 0.242 | 0.258 | 0.264 |

| Node Name | Invert Level (m AHD) | Maximum Water Level (m AHD) | | | | | Maximum Depth (m) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 Year Event | 10 Year Event | 20 Year Event | 50 Year Event | 100 Year Event | 2 Year Event | 10 Year Event | 20 Year Event | 50 Year Event | 100 Year Event |
| NCS01/02 | 5.088 | 5.269 | 5.306 | 5.322 | 5.345 | 5.358 | 0.181 | 0.218 | 0.234 | 0.257 | 0.269 |
| NCS01/03 | 4.607 | 4.740 | 4.764 | 4.775 | 4.795 | 4.806 | 0.133 | 0.157 | 0.168 | 0.188 | 0.199 |
| NCS01/04 | 3.589 | 3.829 | 3.889 | 3.928 | 3.976 | 4.004 | 0.240 | 0.300 | 0.339 | 0.387 | 0.415 |
| NCS01/05 | 3.500 | 3.704 | 3.822 | 3.871 | 3.921 | 3.950 | 0.204 | 0.322 | 0.371 | 0.421 | 0.450 |
| NCS01/06 | 3.452 | 3.539 | 3.603 | 3.644 | 3.698 | 3.733 | 0.087 | 0.151 | 0.192 | 0.246 | 0.281 |
| NCS01/07 | 3.403 | 3.441 | 3.534 | 3.599 | 3.673 | 3.711 | 0.038 | 0.131 | 0.196 | 0.270 | 0.308 |
| NCS01/08 | 3.134 | 3.220 | 3.332 | 3.597 | 3.673 | 3.711 | 0.086 | 0.198 | 0.463 | 0.539 | 0.577 |
| NCS01/09 | 3.050 | 3.112 | 3.131 | 3.150 | 3.185 | 3.200 | 0.062 | 0.081 | 0.100 | 0.135 | 0.150 |
| NCS01/10 | 3.366 | 3.448 | 3.478 | 3.492 | 3.508 | 3.518 | 0.082 | 0.112 | 0.126 | 0.142 | 0.152 |
| NCS01/11 | 3.665 | 3.665 | 3.665 | 3.665 | 3.665 | 3.665 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NCS01/12 | 0.544 | 1.500 | 1.500 | 2.400 | 2.400 | 2.400 | 0.956 | 0.956 | 1.856 | 1.856 | 1.856 |
| NCS02/01 | 5.750 | 5.750 | 5.750 | 5.750 | 5.750 | 5.750 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NCS03/01 | 5.520 | 5.558 | 5.572 | 5.578 | 5.588 | 5.595 | 0.038 | 0.052 | 0.058 | 0.068 | 0.075 |
| NCS03/02 | 3.600 | 3.891 | 3.972 | 4.002 | 4.042 | 4.066 | 0.291 | 0.372 | 0.402 | 0.442 | 0.466 |
| NCS04/01 | 3.447 | 3.447 | 3.482 | 3.498 | 3.539 | 3.563 | 0.000 | 0.035 | 0.051 | 0.092 | 0.116 |
| NCS04/02 | 3.175 | 3.370 | 3.482 | 3.499 | 3.541 | 3.566 | 0.195 | 0.307 | 0.324 | 0.366 | 0.391 |
| ***D- Guard Street*** | | | | | | | | | | | |
| NDS01/01 | 5.500 | 5.541 | 5.554 | 5.559 | 5.581 | 5.601 | 0.041 | 0.054 | 0.059 | 0.081 | 0.101 |
| NDS01/02 | 5.181 | 5.336 | 5.456 | 5.506 | 5.571 | 5.598 | 0.155 | 0.275 | 0.325 | 0.390 | 0.417 |
| NDS01/03 | 3.339 | 3.396 | 3.441 | 3.475 | 3.502 | 3.520 | 0.057 | 0.102 | 0.136 | 0.163 | 0.181 |
| NDS01/04 | 2.159 | 2.265 | 2.361 | 2.798 | 2.906 | 2.970 | 0.106 | 0.202 | 0.639 | 0.747 | 0.811 |
| NDS01/05 | 1.900 | 2.040 | 2.259 | 2.798 | 2.906 | 2.970 | 0.140 | 0.359 | 0.898 | 1.006 | 1.070 |
| NDS01/06 | 2.100 | 2.198 | 2.278 | 2.798 | 2.907 | 2.971 | 0.098 | 0.178 | 0.698 | 0.807 | 0.871 |
| NDS01/07 | 2.200 | 2.300 | 2.357 | 2.799 | 2.908 | 2.971 | 0.100 | 0.157 | 0.599 | 0.708 | 0.771 |
| NDS02/01 | 3.273 | 3.455 | 3.550 | 3.615 | 3.684 | 3.721 | 0.182 | 0.277 | 0.342 | 0.411 | 0.448 |
| NDS02/02 | 3.061 | 3.454 | 3.549 | 3.615 | 3.683 | 3.720 | 0.393 | 0.488 | 0.554 | 0.622 | 0.659 |
| NDS02/03 | 3.294 | 3.452 | 3.543 | 3.604 | 3.671 | 3.708 | 0.158 | 0.249 | 0.310 | 0.377 | 0.414 |
| NDS02/04 | 3.151 | 3.462 | 3.541 | 3.601 | 3.666 | 3.702 | 0.311 | 0.390 | 0.450 | 0.515 | 0.551 |
| NDS03/01 | 2.950 | 3.086 | 3.111 | 3.134 | 3.168 | 3.182 | 0.136 | 0.161 | 0.184 | 0.218 | 0.232 |
| NDS03/02 | 2.690 | 2.762 | 2.788 | 2.811 | 2.912 | 2.975 | 0.072 | 0.098 | 0.121 | 0.222 | 0.285 |
| NDS03/03 | 2.412 | 2.730 | 2.775 | 2.811 | 2.913 | 2.974 | 0.318 | 0.363 | 0.399 | 0.501 | 0.562 |
| NDS03/04 | 2.582 | 2.715 | 2.739 | 2.799 | 2.909 | 2.972 | 0.133 | 0.157 | 0.217 | 0.327 | 0.390 |
| NDS04/01 | 10.873 | 10.894 | 10.902 | 10.905 | 10.910 | 10.913 | 0.021 | 0.029 | 0.032 | 0.037 | 0.040 |
| NDS04/02 | 9.750 | 9.876 | 9.888 | 9.895 | 9.908 | 9.915 | 0.126 | 0.138 | 0.145 | 0.158 | 0.165 |
| NDS04/03 | 6.041 | 6.158 | 6.184 | 6.196 | 6.214 | 6.225 | 0.117 | 0.143 | 0.155 | 0.173 | 0.184 |
| NDS04/04 | 3.481 | 3.624 | 3.667 | 3.688 | 3.714 | 3.726 | 0.143 | 0.186 | 0.207 | 0.233 | 0.245 |
| NDS04/05 | 2.226 | 2.747 | 2.816 | 2.845 | 2.907 | 2.970 | 0.521 | 0.590 | 0.619 | 0.681 | 0.744 |
| NDS04/06 | 0.545 | 1.500 | 1.500 | 2.400 | 2.400 | 2.400 | 0.955 | 0.955 | 1.855 | 1.855 | 1.855 |
| NDS05/01 | 10.341 | 10.517 | 10.585 | 10.602 | 10.627 | 10.643 | 0.176 | 0.244 | 0.261 | 0.286 | 0.302 |
| NDS06/01 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 4.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| NDS06/02 | 3.114 | 3.307 | 3.354 | 3.370 | 3.391 | 3.403 | 0.193 | 0.240 | 0.256 | 0.277 | 0.289 |
| NDS06/03 | 2.653 | 2.931 | 2.982 | 2.960 | 2.990 | 3.008 | 0.278 | 0.329 | 0.307 | 0.337 | 0.355 |
| NDS07/01 | 2.392 | 2.633 | 2.725 | 2.808 | 2.912 | 2.974 | 0.241 | 0.333 | 0.416 | 0.520 | 0.582 |
| NDS07/02 | 2.554 | 2.628 | 2.713 | 2.799 | 2.909 | 2.971 | 0.074 | 0.159 | 0.245 | 0.355 | 0.417 |
| NDS08/01 | 2.351 | 2.479 | 2.524 | 2.799 | 2.909 | 2.972 | 0.128 | 0.173 | 0.448 | 0.558 | 0.621 |
| NDS08/02 | 2.500 | 2.500 | 2.523 | 2.799 | 2.908 | 2.972 | 0.000 | 0.023 | 0.299 | 0.408 | 0.472 |
| NDS09/01 | 2.588 | 2.741 | 2.799 | 2.820 | 2.908 | 2.971 | 0.153 | 0.211 | 0.232 | 0.320 | 0.383 |

**TABLE C2**
**Peak Water Levels- Surface Network- 2 Year Event**

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| **A- Elizabeth Street** | | | | |
| NAS01/01 | 4.655 | 4.655 | 15 Min | 0.000 |
| NAS01/02 | 4.000 | 4.037 | 15 Min | 0.037 |
| NAS01/03 | 4.194 | 4.194 | 15 Min | 0.000 |
| NAS01/04 | 3.800 | 3.909 | 15 Min | 0.109 |
| NAS01/05 | 3.651 | 3.718 | 15 Min | 0.067 |
| NAS01/06 | 3.610 | 3.719 | 15 Min | 0.109 |
| NAS01/07 | 3.323 | 3.390 | 15 Min | 0.067 |
| NAS01/08 | 3.003 | 3.102 | 15 Min | 0.099 |
| NAS01/09 | 2.799 | 2.886 | 15 Min | 0.087 |
| NAS01/10 | 3.167 | 3.212 | 15 Min | 0.045 |
| NAS01/11 | 2.537 | 2.617 | 15 Min | 0.080 |
| NAS01/12 | 2.836 | 2.928 | 25 Min | 0.092 |
| NAS02/01 | 4.745 | 4.745 | 15 Min | 0.000 |
| NAS02/02 | 4.377 | 4.437 | 15 Min | 0.060 |
| NAS03/01 | 4.368 | 4.368 | 15 Min | 0.000 |
| NAS03/02 | 4.110 | 4.219 | 15 Min | 0.109 |
| NAS03/03 | 3.943 | 4.042 | 15 Min | 0.099 |
| NAS04/01 | 4.373 | 4.373 | 15 Min | 0.000 |
| NAS05/01 | 4.310 | 4.318 | 15 Min | 0.008 |
| NAS05/02 | 4.180 | 4.265 | 15 Min | 0.084 |
| NAS05/03 | 4.100 | 4.165 | 15 Min | 0.065 |
| NAS05/04 | 3.800 | 3.888 | 20 Min | 0.088 |
| NAS05/05 | 3.602 | 3.725 | 20 Min | 0.123 |
| NAS05/06 | 3.450 | 3.536 | 20 Min | 0.086 |
| NAS06/01 | 4.066 | 4.066 | 15 Min | 0.000 |
| NAS07/01 | 3.270 | 3.308 | 15 Min | 0.037 |
| NAS07/02 | 2.847 | 3.119 | 45 Min | 0.272 |
| NAS07/03 | 2.971 | 3.119 | 45 Min | 0.148 |
| NAS07/04 | 3.426 | 3.426 | 15 Min | 0.000 |
| NAS08/01 | 3.833 | 3.833 | 15 Min | 0.000 |
| NAS08/02 | 3.202 | 3.323 | 30 Min | 0.121 |
| NAS08/03 | 2.900 | 2.985 | 20 Min | 0.085 |
| NAS09/01 | 3.917 | 3.917 | 15 Min | 0.000 |
| NAS10/01 | 3.288 | 3.288 | 15 Min | 0.000 |
| NAS11/01 | 3.506 | 3.506 | 15 Min | 0.000 |
| NAS12/01 | 3.250 | 3.250 | 15 Min | 0.000 |
| NAS12/02 | 2.722 | 3.004 | 45 Min | 0.282 |
| NAS12/03 | 2.935 | 3.000 | 45 Min | 0.065 |
| ***B- Pier Street*** | | | | |
| NBS01/03 | 4.915 | 4.915 | 15 Min | 0.000 |
| NBS01/04 | 4.515 | 4.607 | 15 Min | 0.092 |
| NBS01/04A | 4.715 | 4.715 | 15 Min | 0.000 |
| NBS01/05 | 4.215 | 4.315 | 15 Min | 0.100 |
| NBS01/06 | 4.415 | 4.415 | 15 Min | 0.000 |
| NBS01/07 | 3.755 | 3.838 | 15 Min | 0.083 |
| NBS01/08 | 3.080 | 3.162 | 15 Min | 0.082 |
| NBS01/09 | 3.406 | 3.496 | 15 Min | 0.090 |
| NBS01/10 | 2.827 | 2.911 | 15 Min | 0.084 |
| NBS01/11 | 2.357 | 2.454 | 15 Min | 0.097 |
| NBS01/12 | 2.036 | 2.154 | 15 Min | 0.118 |
| NBS02/01 | 4.300 | 4.329 | 15 Min | 0.029 |
| NBS03/01 | 4.090 | 4.090 | 15 Min | 0.000 |
| NBS04/01 | 3.620 | 3.620 | 15 Min | 0.000 |
| NBS04/02 | 3.173 | 3.362 | 20 Min | 0.189 |

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| NBS04/03 | 3.502 | 3.502 | 15 Min | 0.000 |
| NBS05/01 | 4.040 | 4.076 | 15 Min | 0.036 |
| NBS06/01 | 2.829 | 2.934 | 20 Min | 0.105 |
| NBS06/02 | 2.477 | 2.665 | 15 Min | 0.188 |
| ***C- Pilot Street*** | | | | |
| NCS01/01 | 6.275 | 6.450 | 15 Min | 0.175 |
| NCS01/02 | 5.088 | 5.269 | 15 Min | 0.181 |
| NCS01/03 | 4.607 | 4.740 | 15 Min | 0.133 |
| NCS01/04 | 3.589 | 3.829 | 15 Min | 0.240 |
| NCS01/05 | 3.500 | 3.704 | 20 Min | 0.204 |
| NCS01/06 | 3.452 | 3.539 | 20 Min | 0.087 |
| NCS01/07 | 3.403 | 3.441 | 45 Min | 0.038 |
| NCS01/08 | 3.134 | 3.220 | 45 Min | 0.086 |
| NCS01/09 | 3.050 | 3.112 | 15 Min | 0.062 |
| NCS01/10 | 3.366 | 3.448 | 15 Min | 0.082 |
| NCS01/11 | 3.665 | 3.665 | 15 Min | 0.000 |
| NCS01/12 | 0.544 | 1.500 | 15 Min | 0.956 |
| NCS02/01 | 5.750 | 5.750 | 15 Min | 0.000 |
| NCS03/01 | 5.520 | 5.558 | 15 Min | 0.038 |
| NCS03/02 | 3.600 | 3.891 | 20 Min | 0.291 |
| NCS04/01 | 3.447 | 3.447 | 15 Min | 0.000 |
| NCS04/02 | 3.175 | 3.370 | 45 Min | 0.195 |
| ***D- Guard Street*** | | | | |
| NDS01/01 | 5.500 | 5.541 | 20 Min | 0.041 |
| NDS01/02 | 5.181 | 5.336 | 15 Min | 0.155 |
| NDS01/03 | 3.339 | 3.396 | 20 Min | 0.057 |
| NDS01/04 | 2.159 | 2.265 | 60 Min | 0.106 |
| NDS01/05 | 1.900 | 2.040 | 15 Min | 0.140 |
| NDS01/06 | 2.100 | 2.198 | 45 Min | 0.098 |
| NDS01/07 | 2.200 | 2.300 | 45 Min | 0.100 |
| NDS02/01 | 3.273 | 3.455 | 30 Min | 0.182 |
| NDS02/02 | 3.061 | 3.454 | 30 Min | 0.393 |
| NDS02/03 | 3.294 | 3.452 | 45 Min | 0.158 |
| NDS02/04 | 3.151 | 3.462 | 20 Min | 0.311 |
| NDS03/01 | 2.950 | 3.086 | 20 Min | 0.136 |
| NDS03/02 | 2.690 | 2.762 | 20 Min | 0.072 |
| NDS03/03 | 2.412 | 2.730 | 45 Min | 0.318 |
| NDS03/04 | 2.582 | 2.715 | 45 Min | 0.133 |
| NDS04/01 | 10.873 | 10.894 | 15 Min | 0.021 |
| NDS04/02 | 9.750 | 9.876 | 15 Min | 0.126 |
| NDS04/03 | 6.041 | 6.158 | 15 Min | 0.117 |
| NDS04/04 | 3.481 | 3.624 | 15 Min | 0.143 |
| NDS04/05 | 2.226 | 2.747 | 45 Min | 0.521 |
| NDS04/06 | 0.545 | 1.500 | 15 Min | 0.955 |
| NDS05/01 | 10.341 | 10.517 | 15 Min | 0.176 |
| NDS06/01 | 4.000 | 4.000 | 15 Min | 0.000 |
| NDS06/02 | 3.114 | 3.307 | 15 Min | 0.193 |
| NDS06/03 | 2.653 | 2.931 | 15 Min | 0.278 |
| NDS07/01 | 2.392 | 2.633 | 30 Min | 0.241 |
| NDS07/02 | 2.554 | 2.628 | 30 Min | 0.074 |
| NDS08/01 | 2.351 | 2.479 | 20 Min | 0.128 |
| NDS08/02 | 2.500 | 2.500 | 15 Min | 0.000 |
| NDS09/01 | 2.588 | 2.741 | 45 Min | 0.153 |

## TABLE C3
## Peak Water Levels- Underground Network- 2 Year Event

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| NAU01/02 | 2.100 | 2.378 | 20 Min | 0.278 | 4.000 | - | 4.037 |
| NAU01/04 | 1.800 | 2.351 | 20 Min | 0.551 | 3.800 | - | 3.909 |
| NAU01/04A | 2.000 | 2.398 | 20 Min | 0.398 | 3.800 | - | 3.909 |
| NAU01/05 | 1.600 | 2.318 | 20 Min | 0.718 | 3.651 | - | 3.718 |
| NAU01/05A | 1.800 | 2.340 | 20 Min | 0.540 | 3.651 | - | 3.718 |
| NAU01/06 | 1.500 | 2.159 | 20 Min | 0.659 | 3.610 | - | 3.719 |
| NAU01/06A | 1.700 | 2.205 | 20 Min | 0.505 | 3.610 | - | 3.719 |
| NAU01/07 | 1.290 | 2.038 | 20 Min | 0.748 | 3.323 | - | 3.390 |
| NAU01/07A | 1.500 | 2.041 | 20 Min | 0.541 | 3.323 | - | 3.390 |
| NAU01/08 | 1.020 | 1.962 | 20 Min | 0.942 | 3.003 | - | 3.102 |
| NAU01/08A | 1.200 | 2.003 | 20 Min | 0.803 | 3.003 | - | 3.102 |
| NAU01/09 | 0.940 | 1.805 | 20 Min | 0.865 | 2.799 | - | 2.886 |
| NAU01/09A | 1.200 | 1.854 | 20 Min | 0.654 | 2.799 | - | 2.886 |
| NAU01/10 | 0.530 | 1.634 | 20 Min | 1.104 | 3.167 | - | 3.212 |
| NAU01/10A | 0.700 | 1.635 | 20 Min | 0.935 | 3.167 | - | 3.212 |
| NAU01/11 | 0.190 | 1.541 | 20 Min | 1.351 | 2.537 | - | 2.617 |
| NAU01/11A | 0.400 | 1.556 | 20 Min | 1.156 | 2.537 | - | 2.617 |
| NAU01/12 | 0.100 | 1.531 | 20 Min | 1.431 | 2.836 | - | 2.928 |
| NAU01/12A | 0.300 | 1.536 | 20 Min | 1.236 | 2.836 | - | 2.928 |
| NAU03/03 | 2.500 | 2.684 | 15 Min | 0.184 | 3.943 | - | 4.042 |
| NAU05/02 | 3.032 | 3.146 | 15 Min | 0.114 | 4.180 | - | 4.265 |
| NAU05/04 | 2.690 | 3.058 | 20 Min | 0.368 | 3.800 | - | 3.888 |
| NAU05/05 | 2.672 | 2.780 | 20 Min | 0.108 | 3.602 | - | 3.725 |
| NAU05/06 | 2.680 | 2.790 | 20 Min | 0.110 | 3.450 | - | 3.536 |
| NAU06/01 | 1.529 | 2.579 | 30 Min | 1.050 | 2.829 | - | 2.934 |
| NAU07/02 | 2.165 | 3.118 | 45 Min | 0.953 | 2.847 | SURCH | 3.119 |
| NAU07/03 | 2.021 | 2.992 | 30 Min | 0.971 | 2.971 | SURCH | 3.119 |
| NAU08/02 | 2.562 | 2.661 | 30 Min | 0.099 | 3.202 | - | 3.323 |
| NAU08/03 | 2.291 | 2.450 | 20 Min | 0.159 | 2.900 | - | 2.985 |
| NAU12/02 | 2.113 | 2.992 | 45 Min | 0.879 | 2.722 | SURCH | 3.004 |
| NAUOUT1 | 0.000 | 1.500 | 15 Min | 1.500 | | | |
| NAUOUT2 | 0.744 | 1.500 | 15 Min | 0.756 | | | |
| ***B- Pier Street*** | | | | | | | |
| NBU01/04 | 2.000 | 2.866 | 20 Min | 0.866 | 4.515 | - | 4.607 |
| NBU01/04A | 2.200 | 2.939 | 20 Min | 0.739 | 4.515 | - | 4.607 |
| NBU01/05 | 1.800 | 2.522 | 20 Min | 0.722 | 4.215 | - | 4.315 |
| NBU01/05A | 2.200 | 2.554 | 20 Min | 0.354 | 4.215 | - | 4.315 |
| NBU01/06 | 1.600 | 2.269 | 20 Min | 0.669 | | | |
| NBU01/07 | 1.500 | 2.145 | 20 Min | 0.645 | 3.755 | - | 3.838 |
| NBU01/07A | 2.200 | 2.292 | 20 Min | 0.091 | 3.755 | - | 3.838 |
| NBU01/08 | 1.000 | 1.907 | 20 Min | 0.907 | 3.080 | - | 3.162 |
| NBU01/08A | 1.300 | 1.918 | 20 Min | 0.618 | 3.080 | - | 3.162 |
| NBU01/10 | 0.700 | 1.821 | 20 Min | 1.121 | 2.827 | - | 2.911 |
| NBU01/10A | 1.000 | 1.827 | 20 Min | 0.827 | 2.827 | - | 2.911 |
| NBU01/11 | 0.500 | 1.776 | 20 Min | 1.276 | 2.357 | - | 2.454 |
| NBU01/11A | 0.800 | 1.779 | 20 Min | 0.979 | 2.357 | - | 2.454 |
| NBU01/12 | 0.190 | 1.601 | 20 Min | 1.411 | 2.036 | - | 2.154 |
| NBU01/12A | 0.250 | 1.634 | 20 Min | 1.384 | 2.036 | - | 2.154 |
| NBU04/02 | 1.853 | 2.064 | 20 Min | 0.211 | 3.173 | - | 3.362 |
| NBU05/01 | 2.300 | 2.339 | 15 Min | 0.039 | 4.040 | - | 4.076 |
| NBU1 | 0.378 | 2.472 | 30 Min | 2.094 | | | |
| NBUOUT1 | 0.350 | 1.500 | 15 Min | 1.150 | | | |
| NBUOUT2 | 1.100 | 1.500 | 15 Min | 0.400 | | | |
| NBUOUT2A | 0.100 | 1.500 | 15 Min | 1.400 | | | |

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***C- Pilot Street*** | | | | | | | |
| NCU01/04 | 2.979 | 3.452 | 20 Min | 0.473 | 3.589 | <150 | 3.829 |
| NCU01/05 | 2.527 | 3.268 | 20 Min | 0.741 | 3.500 | - | 3.704 |
| NCU01/05A | 2.554 | 3.683 | 20 Min | 1.129 | 3.500 | SURCH | 3.704 |
| NCU01/06 | 1.583 | 2.368 | 20 Min | 0.785 | 3.452 | - | 3.539 |
| NCU01/06A | 1.613 | 2.450 | 20 Min | 0.837 | 3.452 | - | 3.539 |
| NCU01/07 | 1.310 | 2.196 | 20 Min | 0.886 | 3.403 | - | 3.441 |
| NCU01/08 | 1.270 | 2.020 | 25 Min | 0.750 | 3.134 | - | 3.220 |
| NCU01/09 | 0.850 | 1.899 | 25 Min | 1.049 | 3.050 | - | 3.112 |
| NCU01/09A | 2.230 | 2.264 | 15 Min | 0.034 | 3.050 | - | 3.112 |
| NCU01/11 | 0.270 | 1.746 | 25 Min | 1.476 | | | |
| NCU03/02 | 2.970 | 3.849 | 20 Min | 0.879 | 3.600 | SURCH | 3.891 |
| NCU04/02 | 2.370 | 3.367 | 45 Min | 0.997 | 3.175 | SURCH | 3.370 |
| NCU1 | 1.771 | 1.835 | 30 Min | 0.064 | | | |
| NCUOUT | 0.000 | 1.500 | 15 Min | 1.500 | | | |
| NCUOUT2 | 0.000 | 1.500 | 15 Min | 1.500 | | | |
| ***D- Guard Street*** | | | | | | | |
| NDU01/02 | 4.081 | 4.372 | 15 Min | 0.291 | 5.181 | - | 5.336 |
| NDU01/03 | 1.800 | 2.708 | 15 Min | 0.908 | 3.339 | - | 3.396 |
| NDU01/04 | 0.500 | 1.741 | 15 Min | 1.241 | 2.159 | - | 2.265 |
| NDU01/04A | 0.551 | 2.042 | 45 Min | 1.491 | 2.159 | <150 | 2.265 |
| NDU01/05 | 0.260 | 1.677 | 15 Min | 1.417 | 1.900 | - | 2.040 |
| NDU01/05A | 0.300 | 1.707 | 15 Min | 1.407 | 1.900 | - | 2.040 |
| NDU01/06 | 0.211 | 1.643 | 15 Min | 1.432 | 2.100 | - | 2.198 |
| NDU01/06A | 0.291 | 1.708 | 15 Min | 1.417 | 2.100 | - | 2.198 |
| NDU01/07 | 0.152 | 1.597 | 15 Min | 1.445 | 2.200 | - | 2.300 |
| NDU01/07A | 0.178 | 1.711 | 45 Min | 1.533 | 2.200 | - | 2.300 |
| NDU02/02 | 2.387 | 3.454 | 30 Min | 1.067 | 3.061 | SURCH | 3.454 |
| NDU02/03 | 1.954 | 2.968 | 45 Min | 1.014 | 3.294 | - | 3.452 |
| NDU02/04 | 2.511 | 3.460 | 20 Min | 0.949 | 3.151 | SURCH | 3.462 |
| NDU03/01 | 2.241 | 2.286 | 90 Min | 0.045 | 2.950 | - | 3.086 |
| NDU03/03 | 1.602 | 2.734 | 45 Min | 1.132 | 2.412 | SURCH | 2.730 |
| NDU04/01 | 10.173 | 10.183 | 15 Min | 0.010 | 10.873 | - | 10.894 |
| NDU04/02 | 8.950 | 9.118 | 15 Min | 0.168 | 9.750 | - | 9.876 |
| NDU04/03 | 4.533 | 4.740 | 15 Min | 0.207 | 6.041 | - | 6.158 |
| NDU04/03A | 4.733 | 4.860 | 15 Min | 0.127 | 6.041 | - | 6.158 |
| NDU04/04 | 2.821 | 3.626 | 15 Min | 0.805 | 3.481 | SURCH | 3.624 |
| NDU04/04A | 2.921 | 3.625 | 15 Min | 0.704 | 3.481 | SURCH | 3.624 |
| NDU04/05 | 1.845 | 2.676 | 30 Min | 0.831 | 2.226 | SURCH | 2.747 |
| NDU04/05A | 1.890 | 2.749 | 45 Min | 0.859 | 2.226 | SURCH | 2.747 |
| NDU05/01 | 9.571 | 9.877 | 15 Min | 0.306 | 10.341 | - | 10.517 |
| NDU06/03 | 2.054 | 2.256 | 15 Min | 0.202 | 2.653 | - | 2.931 |
| NDU07/01 | 1.222 | 2.607 | 30 Min | 1.385 | 2.392 | SURCH | 2.633 |
| NDU08/01 | 1.160 | 2.127 | 25 Min | 0.967 | 2.351 | - | 2.479 |
| NDU1 | 1.270 | 1.748 | 15 Min | 0.478 | | | |
| NDUOUT1 | 0.900 | 1.500 | 15 Min | 0.600 | | | |
| NDUOUT2 | 0.050 | 1.500 | 15 Min | 1.450 | | | |
| NDUOUT3 | 0.900 | 1.500 | 15 Min | 0.600 | | | |

TABLE C4

Peak Flows and Velocities- Surface Network- 2 Year Event

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| LAS01/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 |
| LAS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| LAS01/03A1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 |
| LAS01/04 | 0.05 | 15 Min | 0.49 | 0.11 | 0.05 | 0.07 | 0.03 |
| LAS01/05 | 0.01 | 15 Min | 0.06 | 0.07 | 0.00 | 0.11 | 0.01 |
| LAS01/06 | 0.05 | 15 Min | 0.45 | 0.11 | 0.05 | 0.07 | 0.03 |
| LAS01/07 | 0.10 | 15 Min | 0.30 | 0.07 | 0.02 | 0.10 | 0.03 |
| LAS01/08 | 0.39 | 15 Min | 0.70 | 0.10 | 0.07 | 0.09 | 0.06 |
| LAS01/10 | 0.06 | 15 Min | 0.31 | 0.04 | 0.01 | 0.08 | 0.02 |
| LAS01/10A1 | 0.05 | 15 Min | 0.18 | 0.04 | 0.01 | 0.09 | 0.02 |
| LAS01/10A8 | 0.02 | 20 Min | 0.29 | 0.04 | 0.01 | 0.08 | 0.02 |
| LAS01/12A1 | 0.06 | 20 Min | 0.59 | 0.09 | 0.05 | 0.08 | 0.05 |
| LAS02/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 |
| LAS02/01B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LAS02/02 | 0.13 | 15 Min | 0.47 | 0.06 | 0.03 | 0.11 | 0.05 |
| LAS03/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| LAS03/01B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| LAS03/02 | 0.20 | 15 Min | 0.56 | 0.11 | 0.06 | 0.10 | 0.05 |
| LAS03/03 | 0.25 | 15 Min | 0.69 | 0.10 | 0.07 | 0.11 | 0.07 |
| LAS04/01A3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| LAS04/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 |
| LAS05/01 | 0.00 | 15 Min | 0.01 | 0.01 | 0.00 | 0.08 | 0.00 |
| LAS05/01B2 | 0.00 | 15 Min | -0.05 | 0.01 | 0.00 | 0.03 | 0.00 |
| LAS05/02 | 0.05 | 15 Min | 0.36 | 0.08 | 0.03 | 0.06 | 0.02 |
| LAS05/03 | 0.09 | 15 Min | 0.29 | 0.06 | 0.02 | 0.09 | 0.03 |
| LAS05/04 | 0.15 | 20 Min | 0.36 | 0.09 | 0.03 | 0.12 | 0.04 |
| LAS05/05 | 0.16 | 20 Min | 0.65 | 0.12 | 0.08 | 0.09 | 0.06 |
| LAS05/06 | 0.18 | 20 Min | 0.48 | 0.09 | 0.04 | 0.10 | 0.05 |
| LAS06/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LAS06/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.27 | 0.00 |
| LAS07/01 | 0.08 | 15 Min | 0.27 | 0.04 | 0.01 | 0.27 | 0.07 |
| LAS07/03A2 | 0.17 | 15 Min | 0.41 | 0.15 | 0.06 | 0.27 | 0.11 |
| LAS07/04 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 |
| LAS07/04A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS08/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LAS08/02 | 0.07 | 30 Min | 0.72 | 0.12 | 0.09 | 0.08 | 0.06 |
| LAS09/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LAS10/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LAS10/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| LAS11/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS11/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| LAS12/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.28 | 0.00 |
| LAS12/03 | -0.03 | 45 Min | -0.05 | 0.07 | 0.00 | 0.28 | -0.02 |
| LAS12/03A1 | 0.03 | 45 Min | 0.30 | 0.07 | 0.02 | 0.09 | 0.03 |
| ***B- Pier Street*** | | | | | | | |
| LBS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LBS01/04 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| LBS01/04B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LBS01/06 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 |
| LBS01/06B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| LBS01/07 | 0.09 | 15 Min | 0.60 | 0.08 | 0.05 | 0.08 | 0.05 |
| LBS01/09 | 0.05 | 15 Min | 0.65 | 0.09 | 0.06 | 0.08 | 0.05 |
| LBS01/09B1 | 0.07 | 15 Min | 0.52 | 0.09 | 0.05 | 0.08 | 0.04 |
| LBS01/10 | 0.07 | 15 Min | 0.53 | 0.08 | 0.04 | 0.10 | 0.05 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LBS01/11 | 0.06 | 15 Min | 0.28 | 0.10 | 0.03 | 0.12 | 0.03 |
| LBS02/01 | 0.01 | 25 Min | 0.26 | 0.03 | 0.01 | 0.08 | 0.02 |
| LBS02/01B5 | 0.03 | 15 Min | 0.29 | 0.03 | 0.01 | 0.04 | 0.01 |
| LBS03/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 |
| LBS03/01C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 |
| LBS04/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 |
| LBS04/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 |
| LBS04/02B1 | 0.15 | 20 Min | 0.89 | 0.19 | 0.17 | 0.12 | 0.10 |
| LBS04/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LBS05/01 | 0.09 | 15 Min | 0.32 | 0.04 | 0.01 | 0.19 | 0.06 |
| LBS06/01 | 0.06 | 20 Min | 0.31 | 0.10 | 0.03 | 0.19 | 0.06 |
| LBS06/02 | 0.17 | 15 Min | 0.65 | 0.19 | 0.12 | 0.12 | 0.08 |
| ***C- Pilot Street*** | | | | | | | |
| LCS01/01 | 0.05 | 15 Min | 0.42 | 0.18 | 0.07 | 0.18 | 0.08 |
| LCS01/02 | 0.47 | 15 Min | 0.66 | 0.18 | 0.12 | 0.13 | 0.09 |
| LCS01/03 | 0.58 | 15 Min | 0.68 | 0.13 | 0.09 | 0.24 | 0.16 |
| LCS01/04 | 0.72 | 20 Min | 0.62 | 0.24 | 0.15 | 0.20 | 0.13 |
| LCS01/05 | 0.27 | 20 Min | 0.41 | 0.20 | 0.08 | 0.09 | 0.04 |
| LCS01/06 | 0.00 | 15 Min | 0.00 | 0.09 | 0.00 | 0.04 | 0.00 |
| LCS01/06D2 | 0.13 | 20 Min | 0.74 | 0.09 | 0.06 | 0.18 | 0.14 |
| LCS01/07 | 0.04 | 45 Min | 0.25 | 0.04 | 0.01 | 0.09 | 0.02 |
| LCS01/07D2 | -0.06 | 30 Min | -0.37 | 0.04 | -0.01 | 0.18 | -0.07 |
| LCS01/08 | 0.00 | 15 Min | 0.11 | 0.09 | 0.01 | 0.06 | 0.01 |
| LCS01/09D3 | 0.15 | 15 Min | 0.20 | 0.06 | 0.01 | 0.14 | 0.03 |
| LCS01/10C1 | 0.10 | 15 Min | 0.39 | 0.08 | 0.03 | 0.06 | 0.02 |
| LCS01/11 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 |
| LCS01/11B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| LCS01/11C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 |
| LCS01/OUT | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.96 | 0.00 |
| LCS02/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 |
| LCS02/01C3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 |
| LCS03/01 | 0.25 | 15 Min | 0.22 | 0.04 | 0.01 | 0.29 | 0.06 |
| LCS03/01D1 | 0.01 | 15 Min | 0.18 | 0.04 | 0.01 | 0.04 | 0.01 |
| LCS03/02 | 0.22 | 20 Min | 0.32 | 0.29 | 0.09 | 0.24 | 0.08 |
| LCS04/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 |
| LCS04/01D8 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| ***D- Guard Street*** | | | | | | | |
| LDS01/01 | 0.01 | 20 Min | 0.15 | 0.04 | 0.01 | 0.15 | 0.02 |
| LDS01/02 | 0.03 | 15 Min | 1.70 | 0.15 | 0.26 | 0.06 | 0.10 |
| LDS01/02D6 | 0.00 | 15 Min | 0.00 | 0.15 | 0.00 | 0.00 | 0.00 |
| LDS01/03 | 0.10 | 20 Min | 0.45 | 0.06 | 0.03 | 0.11 | 0.05 |
| LDS01/03D2 | -0.08 | 20 Min | -0.18 | 0.06 | -0.01 | 0.31 | -0.05 |
| LDS01/04 | 0.08 | 45 Min | 0.68 | 0.11 | 0.07 | 0.14 | 0.09 |
| LDS01/06 | 0.08 | 45 Min | 0.37 | 0.10 | 0.04 | 0.14 | 0.05 |
| LDS01/07 | 0.14 | 45 Min | 0.29 | 0.10 | 0.03 | 0.10 | 0.03 |
| LDS02/01 | -0.10 | 15 Min | 0.15 | 0.18 | 0.03 | 0.39 | 0.06 |
| LDS02/03 | -0.08 | 20 Min | -0.10 | 0.16 | -0.02 | 0.39 | -0.04 |
| LDS02/03D2 | -0.13 | 20 Min | 0.30 | 0.16 | 0.05 | 0.31 | 0.09 |
| LDS03/01 | 0.13 | 20 Min | 0.48 | 0.14 | 0.07 | 0.07 | 0.03 |
| LDS03/02 | 0.06 | 20 Min | 0.18 | 0.07 | 0.01 | 0.32 | 0.06 |
| LDS03/02D7 | 0.17 | 20 Min | 0.19 | 0.07 | 0.01 | 0.24 | 0.05 |
| LDS03/04 | -0.20 | 45 Min | -0.17 | 0.13 | -0.02 | 0.32 | -0.05 |
| LDS03/04D1 | 0.18 | 45 Min | 0.42 | 0.13 | 0.06 | 0.11 | 0.04 |
| LDS04/01 | 0.19 | 15 Min | 0.23 | 0.02 | 0.00 | 0.13 | 0.03 |
| LDS04/02 | 0.49 | 15 Min | 1.89 | 0.13 | 0.24 | 0.12 | 0.22 |
| LDS04/03 | 0.31 | 15 Min | 1.44 | 0.12 | 0.17 | 0.14 | 0.21 |
| LDS04/03D6 | 0.18 | 15 Min | 0.50 | 0.12 | 0.06 | 0.28 | 0.14 |
| LDS04/04 | 0.40 | 15 Min | 0.76 | 0.14 | 0.11 | 0.52 | 0.39 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LDS04/OUT | 0.01 | 45 Min | 0.36 | 0.52 | 0.19 | 0.96 | 0.34 |
| LDS05/01 | 0.28 | 15 Min | 1.41 | 0.18 | 0.25 | 0.13 | 0.18 |
| LDS06/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 |
| LDS06/02 | 0.22 | 15 Min | 0.43 | 0.19 | 0.08 | 0.28 | 0.12 |
| LDS06/03 | 0.57 | 15 Min | 0.84 | 0.28 | 0.23 | 0.14 | 0.12 |
| LDS07/02 | -0.07 | 30 Min | -0.08 | 0.07 | -0.01 | 0.24 | -0.02 |
| LDS07/02D1 | 0.05 | 30 Min | 0.40 | 0.07 | 0.03 | 0.10 | 0.04 |
| LDS08/02 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LDS08/02D1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| LDS09/01 | 0.26 | 45 Min | 0.80 | 0.15 | 0.12 | 0.10 | 0.08 |
| LDS09/01D4 | -0.27 | 45 Min | -0.10 | 0.15 | -0.02 | 0.52 | -0.05 |

**TABLE C5**
**Peak Flows and Velocities- Underground Network- 2 Year Event**

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| ***A- Elizabeth Street*** | | | |
| LAU01/02 | 0.04 | 20 Min | 0.48 |
| LAU01/04 | 0.16 | 20 Min | 0.84 |
| LAU01/04A | 0.15 | 15 Min | 0.82 |
| LAU01/05 | 0.25 | 20 Min | 0.87 |
| LAU01/05A | 0.09 | 15 Min | 0.79 |
| LAU01/06 | 0.56 | 20 Min | 1.18 |
| LAU01/06A | 0.25 | 15 Min | 0.93 |
| LAU01/07 | 0.58 | 20 Min | 1.03 |
| LAU01/07A | 0.01 | 20 Min | 0.11 |
| LAU01/08 | 0.80 | 20 Min | 1.27 |
| LAU01/08A | 0.09 | 20 Min | 0.42 |
| LAU01/09 | 1.32 | 20 Min | 1.04 |
| LAU01/09A | 0.54 | 15 Min | 0.51 |
| LAU01/10 | 1.48 | 20 Min | 0.77 |
| LAU01/10A | 0.03 | 45 Min | 0.08 |
| LAU01/11 | 1.69 | 20 Min | 0.48 |
| LAU01/11A | 0.25 | 15 Min | 0.29 |
| LAU01/12 | 1.72 | 20 Min | 0.50 |
| LAU01/12A | 0.03 | 25 Min | 0.15 |
| LAU03/03 | 0.08 | 15 Min | 0.99 |
| LAU05/02 | 0.03 | 15 Min | 0.62 |
| LAU05/04 | 0.05 | 20 Min | 0.72 |
| LAU05/05 | 0.05 | 45 Min | 0.88 |
| LAU05/06 | 0.08 | 20 Min | 1.26 |
| LAU07/02 | 0.15 | 15 Min | 0.98 |
| LAU07/03 | 0.16 | 15 Min | 1.15 |
| LAU08/02 | 0.02 | 30 Min | 0.67 |
| LAU08/03 | 0.15 | 20 Min | 0.94 |
| LAU12/02 | 0.14 | 45 Min | 1.91 |
| ***B- Pier Street*** | | | |
| LBU01/04 | 0.29 | 20 Min | 1.00 |
| LBU01/04A | 0.29 | 20 Min | 0.79 |
| LBU01/05 | 0.55 | 20 Min | 1.29 |
| LBU01/05A | 0.27 | 20 Min | 1.02 |
| LBU01/06 | 0.55 | 20 Min | 1.40 |
| LBU01/07 | 0.64 | 20 Min | 1.16 |
| LBU01/07A | 0.12 | 15 Min | 1.10 |
| LBU01/08 | 0.84 | 20 Min | 0.84 |
| LBU01/08A | 0.22 | 15 Min | 0.29 |
| LBU01/10 | 0.87 | 20 Min | 0.77 |
| LBU01/10A | 0.03 | 15 Min | 0.19 |
| LBU01/11 | 0.93 | 20 Min | 0.73 |
| LBU01/11A | 0.07 | 15 Min | 0.13 |
| LBU01/12 | 1.35 | 20 Min | 0.80 |
| LBU01/12A | 0.63 | 15 Min | 0.39 |
| LBU01/12LF | 0.27 | 20 Min | 0.61 |
| LBU04/02 | 0.09 | 20 Min | 1.03 |
| LBU05/01 | 0.00 | 15 Min | 0.42 |
| LBU06/01 | 0.17 | 30 Min | 1.07 |
| LBU1 | 0.17 | 30 Min | 2.38 |
| ***C- Pilot Street*** | | | |
| LCU01/04 | 0.18 | 30 Min | 1.05 |
| LCU01/05 | 0.61 | 30 Min | 2.08 |
| LCU01/05A | 0.46 | 15 Min | 1.42 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| LCU01/06 | 0.78 | 20 Min | 1.10 |
| LCU01/06A | 0.19 | 20 Min | 0.59 |
| LCU01/07 | 0.78 | 20 Min | 1.11 |
| LCU01/08 | 0.81 | 25 Min | 1.08 |
| LCU01/09 | 0.85 | 25 Min | 0.98 |
| LCU01/09A | 0.07 | 15 Min | 0.43 |
| LCU01/11 | 0.85 | 25 Min | 0.98 |
| LCU03/02 | 0.08 | 45 Min | 1.12 |
| LCU04/02 | 0.07 | 45 Min | 1.64 |
| LCU1 | 0.07 | 45 Min | 0.53 |
| ***D- Guard Street*** | | | |
| LDU01/02 | 0.30 | 15 Min | 1.70 |
| LDU01/03 | 0.30 | 15 Min | 1.87 |
| LDU01/04 | 0.49 | 15 Min | 0.91 |
| LDU01/04A | 0.27 | 45 Min | 1.22 |
| LDU01/05 | 1.42 | 15 Min | 0.60 |
| LDU01/05A | 0.86 | 15 Min | 0.36 |
| LDU01/06 | 1.58 | 15 Min | 0.67 |
| LDU01/06A | 0.18 | 45 Min | 0.57 |
| LDU01/07 | 1.72 | 15 Min | 0.73 |
| LDU01/07A | 0.24 | 45 Min | 0.75 |
| LDU02/02 | 0.08 | 15 Min | 1.17 |
| LDU02/03 | 0.26 | 30 Min | 1.01 |
| LDU02/04 | 0.08 | 15 Min | 1.18 |
| LDU03/01 | 0.03 | 15 Min | 0.49 |
| LDU03/03 | 0.28 | 15 Min | 1.00 |
| LDU04/01 | 0.00 | 15 Min | 0.33 |
| LDU04/02 | 0.16 | 15 Min | 3.05 |
| LDU04/03 | 0.18 | 15 Min | 2.25 |
| LDU04/03A | 0.03 | 15 Min | 0.59 |
| LDU04/04 | 0.18 | 15 Min | 1.63 |
| LDU04/04A | 0.06 | 15 Min | 0.57 |
| LDU04/05 | 0.18 | 30 Min | 1.63 |
| LDU04/05A | 0.04 | 30 Min | 1.31 |
| LDU05/01 | 0.12 | 15 Min | 1.44 |
| LDU06/03 | 0.07 | 15 Min | 0.90 |
| LDU07/01 | 0.40 | 30 Min | 1.41 |
| LDU08/01 | 0.50 | 25 Min | 1.77 |
| LDU1 | 0.08 | 15 Min | 0.67 |

## TABLE C6
Peak Water Levels- Surface Network- 10 Year Event

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| **A- Elizabeth Street** | | | | |
| NAS01/01 | 4.655 | 4.655 | 15 Min | 0.000 |
| NAS01/02 | 4.000 | 4.048 | 15 Min | 0.048 |
| NAS01/03 | 4.194 | 4.194 | 15 Min | 0.000 |
| NAS01/04 | 3.800 | 3.937 | 15 Min | 0.137 |
| NAS01/05 | 3.651 | 3.741 | 15 Min | 0.090 |
| NAS01/06 | 3.610 | 3.746 | 15 Min | 0.136 |
| NAS01/07 | 3.323 | 3.414 | 15 Min | 0.091 |
| NAS01/08 | 3.003 | 3.133 | 15 Min | 0.130 |
| NAS01/09 | 2.799 | 2.917 | 15 Min | 0.118 |
| NAS01/10 | 3.167 | 3.227 | 15 Min | 0.060 |
| NAS01/11 | 2.537 | 2.644 | 15 Min | 0.107 |
| NAS01/12 | 2.836 | 2.986 | 45 Min | 0.150 |
| NAS02/01 | 4.745 | 4.745 | 15 Min | 0.000 |
| NAS02/02 | 4.377 | 4.458 | 15 Min | 0.081 |
| NAS03/01 | 4.368 | 4.368 | 15 Min | 0.000 |
| NAS03/02 | 4.110 | 4.252 | 15 Min | 0.142 |
| NAS03/03 | 3.943 | 4.072 | 15 Min | 0.129 |
| NAS04/01 | 4.373 | 4.373 | 15 Min | 0.000 |
| NAS05/01 | 4.310 | 4.325 | 15 Min | 0.015 |
| NAS05/02 | 4.180 | 4.293 | 15 Min | 0.113 |
| NAS05/03 | 4.100 | 4.187 | 15 Min | 0.087 |
| NAS05/04 | 3.800 | 3.916 | 20 Min | 0.116 |
| NAS05/05 | 3.602 | 3.748 | 15 Min | 0.146 |
| NAS05/06 | 3.450 | 3.570 | 20 Min | 0.120 |
| NAS06/01 | 4.066 | 4.066 | 15 Min | 0.000 |
| NAS07/01 | 3.270 | 3.323 | 15 Min | 0.052 |
| NAS07/02 | 2.847 | 3.260 | 60 Min | 0.413 |
| NAS07/03 | 2.971 | 3.260 | 60 Min | 0.289 |
| NAS07/04 | 3.426 | 3.426 | 15 Min | 0.000 |
| NAS08/01 | 3.833 | 3.833 | 15 Min | 0.000 |
| NAS08/02 | 3.202 | 3.350 | 25 Min | 0.148 |
| NAS08/03 | 2.900 | 3.020 | 25 Min | 0.120 |
| NAS09/01 | 3.917 | 3.917 | 15 Min | 0.000 |
| NAS10/01 | 3.288 | 3.288 | 15 Min | 0.000 |
| NAS11/01 | 3.506 | 3.506 | 15 Min | 0.000 |
| NAS12/01 | 3.250 | 3.250 | 15 Min | 0.000 |
| NAS12/02 | 2.722 | 3.093 | 45 Min | 0.371 |
| NAS12/03 | 2.935 | 3.073 | 45 Min | 0.138 |
| ***B- Pier Street*** | | | | |
| NBS01/03 | 4.915 | 4.915 | 15 Min | 0.000 |
| NBS01/04 | 4.515 | 4.638 | 15 Min | 0.123 |
| NBS01/04A | 4.715 | 4.715 | 15 Min | 0.000 |
| NBS01/05 | 4.215 | 4.348 | 20 Min | 0.133 |
| NBS01/06 | 4.415 | 4.415 | 15 Min | 0.000 |
| NBS01/07 | 3.755 | 3.864 | 15 Min | 0.109 |
| NBS01/08 | 3.080 | 3.190 | 15 Min | 0.110 |
| NBS01/09 | 3.406 | 3.528 | 15 Min | 0.122 |
| NBS01/10 | 2.827 | 2.935 | 15 Min | 0.108 |
| NBS01/11 | 2.357 | 2.477 | 15 Min | 0.120 |
| NBS01/12 | 2.036 | 2.203 | 20 Min | 0.167 |
| NBS02/01 | 4.300 | 4.341 | 15 Min | 0.041 |
| NBS03/01 | 4.090 | 4.090 | 15 Min | 0.000 |
| NBS04/01 | 3.620 | 3.620 | 15 Min | 0.000 |
| NBS04/02 | 3.173 | 3.433 | 25 Min | 0.260 |

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| NBS04/03 | 3.502 | 3.521 | 15 Min | 0.018 |
| NBS05/01 | 4.040 | 4.089 | 15 Min | 0.049 |
| NBS06/01 | 2.829 | 2.963 | 20 Min | 0.134 |
| NBS06/02 | 2.477 | 2.697 | 15 Min | 0.220 |
| ***C- Pilot Street*** | | | | |
| NCS01/01 | 6.275 | 6.497 | 15 Min | 0.222 |
| NCS01/02 | 5.088 | 5.306 | 15 Min | 0.218 |
| NCS01/03 | 4.607 | 4.764 | 15 Min | 0.157 |
| NCS01/04 | 3.589 | 3.889 | 15 Min | 0.300 |
| NCS01/05 | 3.500 | 3.822 | 20 Min | 0.322 |
| NCS01/06 | 3.452 | 3.603 | 20 Min | 0.151 |
| NCS01/07 | 3.403 | 3.534 | 30 Min | 0.131 |
| NCS01/08 | 3.134 | 3.332 | 30 Min | 0.198 |
| NCS01/09 | 3.050 | 3.131 | 15 Min | 0.081 |
| NCS01/10 | 3.366 | 3.478 | 15 Min | 0.112 |
| NCS01/11 | 3.665 | 3.665 | 15 Min | 0.000 |
| NCS01/12 | 0.544 | 1.500 | 15 Min | 0.956 |
| NCS02/01 | 5.750 | 5.750 | 15 Min | 0.000 |
| NCS03/01 | 5.520 | 5.572 | 15 Min | 0.052 |
| NCS03/02 | 3.600 | 3.972 | 20 Min | 0.372 |
| NCS04/01 | 3.447 | 3.482 | 60 Min | 0.035 |
| NCS04/02 | 3.175 | 3.482 | 60 Min | 0.307 |
| ***D- Guard Street*** | | | | |
| NDS01/01 | 5.500 | 5.554 | 20 Min | 0.054 |
| NDS01/02 | 5.181 | 5.456 | 15 Min | 0.275 |
| NDS01/03 | 3.339 | 3.441 | 15 Min | 0.102 |
| NDS01/04 | 2.159 | 2.361 | 30 Min | 0.202 |
| NDS01/05 | 1.900 | 2.259 | 30 Min | 0.359 |
| NDS01/06 | 2.100 | 2.278 | 30 Min | 0.178 |
| NDS01/07 | 2.200 | 2.357 | 25 Min | 0.157 |
| NDS02/01 | 3.273 | 3.550 | 30 Min | 0.277 |
| NDS02/02 | 3.061 | 3.549 | 30 Min | 0.488 |
| NDS02/03 | 3.294 | 3.543 | 30 Min | 0.249 |
| NDS02/04 | 3.151 | 3.541 | 30 Min | 0.390 |
| NDS03/01 | 2.950 | 3.111 | 15 Min | 0.161 |
| NDS03/02 | 2.690 | 2.788 | 20 Min | 0.098 |
| NDS03/03 | 2.412 | 2.775 | 30 Min | 0.363 |
| NDS03/04 | 2.582 | 2.739 | 30 Min | 0.157 |
| NDS04/01 | 10.873 | 10.902 | 15 Min | 0.029 |
| NDS04/02 | 9.750 | 9.888 | 15 Min | 0.138 |
| NDS04/03 | 6.041 | 6.184 | 15 Min | 0.143 |
| NDS04/04 | 3.481 | 3.667 | 15 Min | 0.186 |
| NDS04/05 | 2.226 | 2.816 | 25 Min | 0.590 |
| NDS04/06 | 0.545 | 1.500 | 15 Min | 0.955 |
| NDS05/01 | 10.341 | 10.585 | 15 Min | 0.244 |
| NDS06/01 | 4.000 | 4.000 | 15 Min | 0.000 |
| NDS06/02 | 3.114 | 3.354 | 15 Min | 0.240 |
| NDS06/03 | 2.653 | 2.982 | 15 Min | 0.329 |
| NDS07/01 | 2.392 | 2.725 | 30 Min | 0.333 |
| NDS07/02 | 2.554 | 2.713 | 30 Min | 0.159 |
| NDS08/01 | 2.351 | 2.524 | 20 Min | 0.173 |
| NDS08/02 | 2.500 | 2.523 | 20 Min | 0.023 |
| NDS09/01 | 2.588 | 2.799 | 25 Min | 0.211 |

**TABLE C7**
**Peak Water Levels- Underground Network- 10 Year Event**

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| NAU01/02 | 2.100 | 3.500 | 25 Min | 1.400 | 4.000 | - | 4.048 |
| NAU01/04 | 1.800 | 3.462 | 25 Min | 1.662 | 3.800 | - | 3.937 |
| NAU01/04A | 2.000 | 3.557 | 25 Min | 1.557 | 3.800 | - | 3.937 |
| NAU01/05 | 1.600 | 3.378 | 25 Min | 1.778 | 3.651 | - | 3.741 |
| NAU01/05A | 1.800 | 3.435 | 25 Min | 1.635 | 3.651 | - | 3.741 |
| NAU01/06 | 1.500 | 2.992 | 20 Min | 1.492 | 3.610 | - | 3.746 |
| NAU01/06A | 1.700 | 3.071 | 20 Min | 1.371 | 3.610 | - | 3.746 |
| NAU01/07 | 1.290 | 2.784 | 20 Min | 1.494 | 3.323 | - | 3.414 |
| NAU01/07A | 1.500 | 2.793 | 20 Min | 1.293 | 3.323 | - | 3.414 |
| NAU01/08 | 1.020 | 2.604 | 20 Min | 1.584 | 3.003 | - | 3.133 |
| NAU01/08A | 1.200 | 2.712 | 20 Min | 1.512 | 3.003 | - | 3.133 |
| NAU01/09 | 0.940 | 2.267 | 20 Min | 1.327 | 2.799 | - | 2.917 |
| NAU01/09A | 1.200 | 2.364 | 20 Min | 1.164 | 2.799 | - | 2.917 |
| NAU01/10 | 0.530 | 1.829 | 20 Min | 1.299 | 3.167 | - | 3.227 |
| NAU01/10A | 0.700 | 1.829 | 20 Min | 1.129 | 3.167 | - | 3.227 |
| NAU01/11 | 0.190 | 1.606 | 20 Min | 1.416 | 2.537 | - | 2.644 |
| NAU01/11A | 0.400 | 1.654 | 20 Min | 1.254 | 2.537 | - | 2.644 |
| NAU01/12 | 0.100 | 1.579 | 20 Min | 1.479 | 2.836 | - | 2.986 |
| NAU01/12A | 0.300 | 1.601 | 25 Min | 1.301 | 2.836 | - | 2.986 |
| NAU03/03 | 2.500 | 3.603 | 20 Min | 1.103 | 3.943 | - | 4.072 |
| NAU05/02 | 3.032 | 3.446 | 20 Min | 0.414 | 4.180 | - | 4.293 |
| NAU05/04 | 2.690 | 3.410 | 20 Min | 0.720 | 3.800 | - | 3.916 |
| NAU05/05 | 2.672 | 2.906 | 20 Min | 0.234 | 3.602 | - | 3.748 |
| NAU05/06 | 2.680 | 3.124 | 20 Min | 0.444 | 3.450 | - | 3.570 |
| NAU06/01 | 1.529 | 2.752 | 30 Min | 1.223 | 2.829 | <150 | 2.963 |
| NAU07/02 | 2.165 | 3.260 | 60 Min | 1.095 | 2.847 | SURCH | 3.260 |
| NAU07/03 | 2.021 | 3.156 | 60 Min | 1.135 | 2.971 | SURCH | 3.260 |
| NAU08/02 | 2.562 | 2.706 | 25 Min | 0.144 | 3.202 | - | 3.350 |
| NAU08/03 | 2.291 | 2.623 | 25 Min | 0.332 | 2.900 | - | 3.020 |
| NAU12/02 | 2.113 | 3.082 | 45 Min | 0.969 | 2.722 | SURCH | 3.093 |
| NAUOUT1 | 0.000 | 1.500 | 15 Min | 1.500 | | | |
| NAUOUT2 | 0.744 | 1.500 | 15 Min | 0.756 | | | |
| ***B- Pier Street*** | | | | | | | |
| NBU01/04 | 2.000 | 4.213 | 25 Min | 2.213 | 4.515 | - | 4.638 |
| NBU01/04A | 2.200 | 4.351 | 25 Min | 2.151 | 4.515 | - | 4.638 |
| NBU01/05 | 1.800 | 3.551 | 25 Min | 1.751 | 4.215 | - | 4.348 |
| NBU01/05A | 2.200 | 3.597 | 25 Min | 1.397 | 4.215 | - | 4.348 |
| NBU01/06 | 1.600 | 3.019 | 25 Min | 1.419 | | | |
| NBU01/07 | 1.500 | 2.767 | 25 Min | 1.267 | 3.755 | - | 3.864 |
| NBU01/07A | 2.200 | 2.821 | 20 Min | 0.621 | 3.755 | - | 3.864 |
| NBU01/08 | 1.000 | 2.368 | 20 Min | 1.368 | 3.080 | - | 3.190 |
| NBU01/08A | 1.300 | 2.395 | 20 Min | 1.095 | 3.080 | - | 3.190 |
| NBU01/10 | 0.700 | 2.196 | 20 Min | 1.496 | 2.827 | - | 2.935 |
| NBU01/10A | 1.000 | 2.214 | 20 Min | 1.214 | 2.827 | - | 2.935 |
| NBU01/11 | 0.500 | 2.087 | 20 Min | 1.587 | 2.357 | - | 2.477 |
| NBU01/11A | 0.800 | 2.097 | 20 Min | 1.297 | 2.357 | - | 2.477 |
| NBU01/12 | 0.190 | 1.706 | 20 Min | 1.516 | 2.036 | - | 2.203 |
| NBU01/12A | 0.250 | 1.816 | 20 Min | 1.566 | 2.036 | - | 2.203 |
| NBU04/02 | 1.853 | 2.120 | 20 Min | 0.267 | 3.173 | - | 3.433 |
| NBU05/01 | 2.300 | 2.354 | 15 Min | 0.054 | 4.040 | - | 4.089 |
| NBU1 | 0.378 | 2.627 | 30 Min | 2.249 | | | |
| NBUOUT1 | 0.350 | 1.500 | 15 Min | 1.150 | | | |
| NBUOUT2 | 1.100 | 1.500 | 15 Min | 0.400 | | | |
| NBUOUT2A | 0.100 | 1.500 | 15 Min | 1.400 | | | |

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***C- Pilot Street*** | | | | | | | |
| NCU01/04 | 2.979 | 3.750 | 30 Min | 0.771 | 3.589 | SURCH | 3.889 |
| NCU01/05 | 2.527 | 3.600 | 30 Min | 1.073 | 3.500 | SURCH | 3.822 |
| NCU01/05A | 2.554 | 3.800 | 20 Min | 1.246 | 3.500 | SURCH | 3.822 |
| NCU01/06 | 1.583 | 3.099 | 30 Min | 1.516 | 3.452 | - | 3.603 |
| NCU01/06A | 1.613 | 3.502 | 30 Min | 1.889 | 3.452 | SURCH | 3.603 |
| NCU01/07 | 1.310 | 2.940 | 30 Min | 1.630 | 3.403 | - | 3.534 |
| NCU01/08 | 1.270 | 2.776 | 30 Min | 1.506 | 3.134 | - | 3.332 |
| NCU01/09 | 0.850 | 2.488 | 30 Min | 1.638 | 3.050 | - | 3.131 |
| NCU01/09A | 2.230 | 2.493 | 30 Min | 0.263 | 3.050 | - | 3.131 |
| NCU01/11 | 0.270 | 2.102 | 30 Min | 1.832 | | | |
| NCU03/02 | 2.970 | 3.922 | 20 Min | 0.952 | 3.600 | SURCH | 3.972 |
| NCU04/02 | 2.370 | 3.479 | 60 Min | 1.109 | 3.175 | SURCH | 3.482 |
| NCU1 | 1.771 | 1.840 | 60 Min | 0.069 | | | |
| NCUOUT | 0.000 | 1.500 | 15 Min | 1.500 | | | |
| NCUOUT2 | 0.000 | 1.500 | 15 Min | 1.500 | | | |
| ***D- Guard Street*** | | | | | | | |
| NDU01/02 | 4.081 | 5.026 | 20 Min | 0.945 | 5.181 | - | 5.456 |
| NDU01/03 | 1.800 | 3.370 | 25 Min | 1.570 | 3.339 | SURCH | 3.441 |
| NDU01/04 | 0.500 | 2.080 | 25 Min | 1.580 | 2.159 | <150 | 2.361 |
| NDU01/04A | 0.551 | 2.353 | 30 Min | 1.802 | 2.159 | SURCH | 2.361 |
| NDU01/05 | 0.260 | 1.998 | 30 Min | 1.738 | 1.900 | SURCH | 2.259 |
| NDU01/05A | 0.300 | 2.094 | 30 Min | 1.794 | 1.900 | SURCH | 2.259 |
| NDU01/06 | 0.211 | 1.917 | 30 Min | 1.706 | 2.100 | - | 2.278 |
| NDU01/06A | 0.291 | 2.254 | 30 Min | 1.963 | 2.100 | SURCH | 2.278 |
| NDU01/07 | 0.152 | 1.796 | 25 Min | 1.644 | 2.200 | - | 2.357 |
| NDU01/07A | 0.178 | 2.312 | 25 Min | 2.134 | 2.200 | SURCH | 2.357 |
| NDU02/02 | 2.387 | 3.549 | 30 Min | 1.162 | 3.061 | SURCH | 3.549 |
| NDU02/03 | 1.954 | 3.161 | 30 Min | 1.207 | 3.294 | <150 | 3.543 |
| NDU02/04 | 2.511 | 3.541 | 30 Min | 1.030 | 3.151 | SURCH | 3.541 |
| NDU03/01 | 2.241 | 2.501 | 30 Min | 0.260 | 2.950 | - | 3.111 |
| NDU03/03 | 1.602 | 2.790 | 30 Min | 1.188 | 2.412 | SURCH | 2.775 |
| NDU04/01 | 10.173 | 10.188 | 15 Min | 0.015 | 10.873 | - | 10.902 |
| NDU04/02 | 8.950 | 9.119 | 90 Min | 0.169 | 9.750 | - | 9.888 |
| NDU04/03 | 4.533 | 4.774 | 15 Min | 0.241 | 6.041 | - | 6.184 |
| NDU04/03A | 4.733 | 4.896 | 15 Min | 0.163 | 6.041 | - | 6.184 |
| NDU04/04 | 2.821 | 3.700 | 15 Min | 0.879 | 3.481 | SURCH | 3.667 |
| NDU04/04A | 2.921 | 3.687 | 15 Min | 0.766 | 3.481 | SURCH | 3.667 |
| NDU04/05 | 1.845 | 2.736 | 20 Min | 0.891 | 2.226 | SURCH | 2.816 |
| NDU04/05A | 1.890 | 2.818 | 25 Min | 0.928 | 2.226 | SURCH | 2.816 |
| NDU05/01 | 9.571 | 9.890 | 15 Min | 0.319 | 10.341 | - | 10.585 |
| NDU06/03 | 2.054 | 2.357 | 30 Min | 0.303 | 2.653 | - | 2.982 |
| NDU07/01 | 1.222 | 2.709 | 30 Min | 1.487 | 2.392 | SURCH | 2.725 |
| NDU08/01 | 1.160 | 2.305 | 25 Min | 1.145 | 2.351 | <150 | 2.524 |
| NDU1 | 1.270 | 2.068 | 30 Min | 0.798 | | | |
| NDUOUT1 | 0.900 | 1.500 | 15 Min | 0.600 | | | |
| NDUOUT2 | 0.050 | 1.500 | 15 Min | 1.450 | | | |
| NDUOUT3 | 0.900 | 1.500 | 15 Min | 0.600 | | | |

TABLE C8
Peak Flows and Velocities- Surface Network- 10 Year Event

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| *A- Elizabeth Street* | | | | | | | |
| LAS01/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 |
| LAS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 |
| LAS01/03A1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 |
| LAS01/04 | 0.10 | 15 Min | 0.56 | 0.14 | 0.08 | 0.09 | 0.05 |
| LAS01/05 | -0.04 | 15 Min | -0.08 | 0.09 | -0.01 | 0.14 | -0.01 |
| LAS01/06 | 0.10 | 15 Min | 0.52 | 0.14 | 0.07 | 0.09 | 0.05 |
| LAS01/07 | 0.16 | 15 Min | 0.35 | 0.09 | 0.03 | 0.13 | 0.04 |
| LAS01/08 | 0.68 | 15 Min | 0.84 | 0.13 | 0.11 | 0.12 | 0.10 |
| LAS01/10 | 0.10 | 15 Min | 0.34 | 0.06 | 0.02 | 0.11 | 0.04 |
| LAS01/10A1 | 0.08 | 15 Min | 0.21 | 0.06 | 0.01 | 0.12 | 0.03 |
| LAS01/10A8 | 0.02 | 60 Min | 0.29 | 0.06 | 0.02 | 0.12 | 0.04 |
| LAS01/12A1 | 0.19 | 45 Min | 0.76 | 0.15 | 0.11 | 0.11 | 0.08 |
| LAS02/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 |
| LAS02/01B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LAS02/02 | 0.21 | 15 Min | 0.58 | 0.08 | 0.05 | 0.14 | 0.08 |
| LAS03/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 |
| LAS03/01B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LAS03/02 | 0.35 | 15 Min | 0.63 | 0.14 | 0.09 | 0.13 | 0.08 |
| LAS03/03 | 0.41 | 15 Min | 0.79 | 0.13 | 0.10 | 0.14 | 0.11 |
| LAS04/01A3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 |
| LAS04/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LAS05/01 | 0.00 | 15 Min | 0.02 | 0.01 | 0.00 | 0.11 | 0.00 |
| LAS05/01B2 | 0.00 | 15 Min | -0.07 | 0.01 | 0.00 | 0.04 | 0.00 |
| LAS05/02 | 0.08 | 15 Min | 0.45 | 0.11 | 0.05 | 0.09 | 0.04 |
| LAS05/03 | 0.15 | 15 Min | 0.36 | 0.09 | 0.03 | 0.12 | 0.04 |
| LAS05/04 | 0.24 | 20 Min | 0.38 | 0.12 | 0.04 | 0.15 | 0.06 |
| LAS05/05 | 0.29 | 20 Min | 0.72 | 0.15 | 0.10 | 0.12 | 0.09 |
| LAS05/06 | 0.32 | 20 Min | 0.59 | 0.12 | 0.07 | 0.13 | 0.08 |
| LAS06/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LAS06/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.41 | 0.00 |
| LAS07/01 | 0.14 | 15 Min | 0.32 | 0.05 | 0.02 | 0.41 | 0.13 |
| LAS07/03A2 | 0.22 | 15 Min | 0.44 | 0.29 | 0.13 | 0.41 | 0.18 |
| LAS07/04 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 |
| LAS07/04A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.29 | 0.00 |
| LAS08/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS08/02 | 0.15 | 25 Min | 0.76 | 0.15 | 0.11 | 0.12 | 0.09 |
| LAS09/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS10/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS10/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LAS11/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.29 | 0.00 |
| LAS11/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LAS12/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.37 | 0.00 |
| LAS12/03 | -0.18 | 45 Min | -0.14 | 0.14 | -0.02 | 0.37 | -0.05 |
| LAS12/03A1 | 0.18 | 45 Min | 0.52 | 0.14 | 0.07 | 0.15 | 0.08 |
| *B- Pier Street* | | | | | | | |
| LBS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LBS01/04 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LBS01/04B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LBS01/06 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| LBS01/06B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LBS01/07 | 0.14 | 15 Min | 0.72 | 0.11 | 0.08 | 0.11 | 0.08 |
| LBS01/09 | 0.08 | 15 Min | 0.78 | 0.12 | 0.10 | 0.11 | 0.08 |
| LBS01/09B1 | 0.11 | 15 Min | 0.64 | 0.12 | 0.08 | 0.11 | 0.07 |
| LBS01/10 | 0.10 | 15 Min | 0.63 | 0.11 | 0.07 | 0.12 | 0.08 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LBS01/11 | 0.09 | 15 Min | 0.29 | 0.12 | 0.03 | 0.17 | 0.05 |
| LBS02/01 | 0.01 | 60 Min | 0.27 | 0.04 | 0.01 | 0.11 | 0.03 |
| LBS02/01B5 | 0.05 | 15 Min | 0.33 | 0.04 | 0.01 | 0.05 | 0.02 |
| LBS03/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| LBS03/01C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LBS04/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 |
| LBS04/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 |
| LBS04/02B1 | 0.37 | 20 Min | 1.19 | 0.26 | 0.31 | 0.17 | 0.20 |
| LBS04/03 | -0.02 | 15 Min | -0.10 | 0.02 | 0.00 | 0.12 | -0.01 |
| LBS05/01 | 0.14 | 15 Min | 0.32 | 0.05 | 0.02 | 0.26 | 0.08 |
| LBS06/01 | 0.11 | 20 Min | 0.31 | 0.13 | 0.04 | 0.22 | 0.07 |
| LBS06/02 | 0.30 | 15 Min | 0.74 | 0.22 | 0.16 | 0.17 | 0.12 |
| ***C- Pilot Street*** | | | | | | | |
| LCS01/01 | 0.08 | 15 Min | 0.48 | 0.22 | 0.11 | 0.22 | 0.10 |
| LCS01/02 | 0.79 | 15 Min | 0.78 | 0.22 | 0.17 | 0.16 | 0.12 |
| LCS01/03 | 0.98 | 15 Min | 0.78 | 0.16 | 0.12 | 0.30 | 0.23 |
| LCS01/04 | 1.41 | 15 Min | 0.67 | 0.30 | 0.20 | 0.32 | 0.22 |
| LCS01/05 | 1.06 | 20 Min | 0.62 | 0.32 | 0.20 | 0.15 | 0.09 |
| LCS01/06 | 0.00 | 15 Min | 0.00 | 0.15 | 0.00 | 0.13 | 0.00 |
| LCS01/06D2 | 0.67 | 20 Min | 1.47 | 0.15 | 0.22 | 0.28 | 0.41 |
| LCS01/07 | 0.36 | 30 Min | 0.57 | 0.13 | 0.08 | 0.20 | 0.11 |
| LCS01/07D2 | -0.46 | 25 Min | -0.81 | 0.13 | -0.11 | 0.28 | -0.22 |
| LCS01/08 | 0.01 | 30 Min | 0.19 | 0.20 | 0.04 | 0.08 | 0.02 |
| LCS01/09D3 | 0.24 | 15 Min | 0.24 | 0.08 | 0.02 | 0.16 | 0.04 |
| LCS01/10C1 | 0.16 | 15 Min | 0.48 | 0.11 | 0.05 | 0.08 | 0.04 |
| LCS01/11 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 |
| LCS01/11B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LCS01/11C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 |
| LCS01/OUT | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.96 | 0.00 |
| LCS02/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 |
| LCS02/01C3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 |
| LCS03/01 | 0.42 | 15 Min | 0.26 | 0.05 | 0.01 | 0.37 | 0.10 |
| LCS03/01D1 | 0.02 | 15 Min | 0.23 | 0.05 | 0.01 | 0.05 | 0.01 |
| LCS03/02 | 0.46 | 20 Min | 0.37 | 0.37 | 0.14 | 0.30 | 0.11 |
| LCS04/01 | -0.03 | 45 Min | -0.03 | 0.03 | 0.00 | 0.31 | -0.01 |
| LCS04/01D8 | 0.02 | 60 Min | 0.17 | 0.03 | 0.01 | 0.17 | 0.03 |
| ***D- Guard Street*** | | | | | | | |
| LDS01/01 | 0.01 | 20 Min | 0.18 | 0.05 | 0.01 | 0.27 | 0.05 |
| LDS01/02 | 0.15 | 15 Min | 2.58 | 0.27 | 0.71 | 0.10 | 0.26 |
| LDS01/02D6 | 0.00 | 15 Min | 0.00 | 0.27 | 0.00 | 0.00 | 0.00 |
| LDS01/03 | 0.25 | 15 Min | 0.61 | 0.10 | 0.06 | 0.20 | 0.12 |
| LDS01/03D2 | -0.21 | 30 Min | -0.25 | 0.10 | -0.03 | 0.39 | -0.10 |
| LDS01/04 | 0.55 | 30 Min | 0.90 | 0.20 | 0.18 | 0.36 | 0.32 |
| LDS01/06 | 0.41 | 30 Min | 0.45 | 0.18 | 0.08 | 0.36 | 0.16 |
| LDS01/07 | 0.44 | 25 Min | 0.39 | 0.16 | 0.06 | 0.18 | 0.07 |
| LDS02/01 | -0.18 | 20 Min | 0.14 | 0.28 | 0.04 | 0.49 | 0.07 |
| LDS02/03 | -0.22 | 25 Min | 0.14 | 0.25 | 0.04 | 0.49 | 0.07 |
| LDS02/03D2 | -0.26 | 15 Min | 0.31 | 0.25 | 0.08 | 0.39 | 0.12 |
| LDS03/01 | 0.22 | 15 Min | 0.53 | 0.16 | 0.09 | 0.10 | 0.05 |
| LDS03/02 | 0.11 | 20 Min | 0.17 | 0.10 | 0.02 | 0.36 | 0.06 |
| LDS03/02D7 | 0.29 | 20 Min | 0.21 | 0.10 | 0.02 | 0.33 | 0.07 |
| LDS03/04 | -0.42 | 30 Min | -0.26 | 0.16 | -0.04 | 0.36 | -0.09 |
| LDS03/04D1 | 0.41 | 30 Min | 0.46 | 0.16 | 0.07 | 0.20 | 0.09 |
| LDS04/01 | 0.31 | 15 Min | 0.31 | 0.03 | 0.01 | 0.14 | 0.04 |
| LDS04/02 | 0.90 | 15 Min | 1.95 | 0.14 | 0.27 | 0.14 | 0.28 |
| LDS04/03 | 0.58 | 15 Min | 1.55 | 0.14 | 0.22 | 0.19 | 0.29 |
| LDS04/03D6 | 0.34 | 15 Min | 0.55 | 0.14 | 0.08 | 0.33 | 0.18 |
| LDS04/04 | 0.75 | 15 Min | 0.85 | 0.19 | 0.16 | 0.59 | 0.50 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LDS04/OUT | 0.08 | 25 Min | 1.19 | 0.59 | 0.70 | 0.96 | 1.14 |
| LDS05/01 | 0.55 | 15 Min | 1.69 | 0.24 | 0.41 | 0.14 | 0.23 |
| LDS06/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 |
| LDS06/02 | 0.35 | 15 Min | 0.57 | 0.24 | 0.14 | 0.33 | 0.19 |
| LDS06/03 | 1.13 | 20 Min | 0.94 | 0.33 | 0.31 | 0.36 | 0.34 |
| LDS07/02 | -0.29 | 30 Min | -0.16 | 0.16 | -0.03 | 0.33 | -0.05 |
| LDS07/02D1 | 0.26 | 30 Min | 0.65 | 0.16 | 0.10 | 0.18 | 0.12 |
| LDS08/02 | -0.02 | 15 Min | -0.05 | 0.02 | 0.00 | 0.17 | -0.01 |
| LDS08/02D1 | 0.01 | 20 Min | 0.02 | 0.02 | 0.00 | 0.16 | 0.00 |
| LDS09/01 | 0.68 | 25 Min | 0.81 | 0.21 | 0.17 | 0.16 | 0.13 |
| LDS09/01D4 | -0.69 | 25 Min | -0.20 | 0.21 | -0.04 | 0.59 | -0.12 |

## TABLE C9
## Peak Flows and Velocities- Underground Network- 10 Year Event

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| ***A- Elizabeth Street*** | | | |
| LAU01/02 | 0.13 | 20 Min | 0.83 |
| LAU01/04 | 0.25 | 25 Min | 0.88 |
| LAU01/04A | 0.21 | 25 Min | 0.86 |
| LAU01/05 | 0.39 | 25 Min | 1.38 |
| LAU01/05A | 0.15 | 15 Min | 0.85 |
| LAU01/06 | 0.84 | 25 Min | 1.31 |
| LAU01/06A | 0.34 | 20 Min | 0.98 |
| LAU01/07 | 0.85 | 25 Min | 1.34 |
| LAU01/07A | 0.02 | 20 Min | 0.22 |
| LAU01/08 | 1.19 | 20 Min | 1.87 |
| LAU01/08A | 0.15 | 20 Min | 0.67 |
| LAU01/09 | 2.01 | 20 Min | 1.57 |
| LAU01/09A | 0.86 | 20 Min | 0.67 |
| LAU01/10 | 2.29 | 20 Min | 1.20 |
| LAU01/10A | 0.02 | 90 Min | 0.06 |
| LAU01/11 | 2.67 | 20 Min | 0.76 |
| LAU01/11A | 0.41 | 20 Min | 0.47 |
| LAU01/12 | 2.74 | 20 Min | 0.80 |
| LAU01/12A | 0.08 | 45 Min | 0.34 |
| LAU03/03 | 0.12 | 20 Min | 1.11 |
| LAU05/02 | 0.04 | 20 Min | 0.68 |
| LAU05/04 | 0.09 | 20 Min | 0.90 |
| LAU05/05 | 0.06 | 20 Min | 0.90 |
| LAU05/06 | 0.14 | 15 Min | 1.40 |
| LAU07/02 | 0.15 | 20 Min | 0.98 |
| LAU07/03 | 0.17 | 15 Min | 1.16 |
| LAU08/02 | 0.02 | 25 Min | 0.66 |
| LAU08/03 | 0.27 | 25 Min | 1.25 |
| LAU12/02 | 0.14 | 45 Min | 1.97 |
| ***B- Pier Street*** | | | |
| LBU01/04 | 0.41 | 25 Min | 1.41 |
| LBU01/04A | 0.40 | 25 Min | 0.83 |
| LBU01/05 | 0.80 | 20 Min | 1.79 |
| LBU01/05A | 0.39 | 20 Min | 1.08 |
| LBU01/06 | 0.80 | 20 Min | 1.80 |
| LBU01/07 | 0.93 | 25 Min | 1.46 |
| LBU01/07A | 0.17 | 15 Min | 1.18 |
| LBU01/08 | 1.22 | 25 Min | 1.05 |
| LBU01/08A | 0.33 | 15 Min | 0.37 |
| LBU01/10 | 1.26 | 25 Min | 1.11 |
| LBU01/10A | 0.05 | 15 Min | 0.34 |
| LBU01/11 | 1.37 | 20 Min | 1.07 |
| LBU01/11A | 0.12 | 15 Min | 0.22 |
| LBU01/12 | 2.21 | 20 Min | 1.15 |
| LBU01/12A | 1.14 | 20 Min | 0.71 |
| LBU01/12LF | 0.39 | 20 Min | 0.87 |
| LBU04/02 | 0.09 | 20 Min | 1.04 |
| LBU05/01 | 0.01 | 15 Min | 0.42 |
| LBU06/01 | 0.19 | 30 Min | 1.15 |
| LBU1 | 0.19 | 30 Min | 2.56 |
| ***C- Pilot Street*** | | | |
| LCU01/04 | 0.18 | 90 Min | 1.04 |
| LCU01/05 | 0.61 | 90 Min | 2.09 |
| LCU01/05A | 0.47 | 15 Min | 1.46 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| LCU01/06 | 0.94 | 15 Min | 1.12 |
| LCU01/06A | 0.43 | 25 Min | 1.33 |
| LCU01/07 | 0.94 | 15 Min | 1.11 |
| LCU01/08 | 1.27 | 30 Min | 1.46 |
| LCU01/09 | 1.33 | 30 Min | 1.53 |
| LCU01/09A | 0.09 | 15 Min | 0.53 |
| LCU01/11 | 1.33 | 30 Min | 1.53 |
| LCU03/02 | 0.08 | 90 Min | 1.08 |
| LCU04/02 | 0.08 | 60 Min | 1.71 |
| LCU1 | 0.08 | 60 Min | 0.56 |
| ***D- Guard Street*** | | | |
| LDU01/02 | 0.33 | 20 Min | 1.74 |
| LDU01/03 | 0.35 | 20 Min | 2.16 |
| LDU01/04 | 0.59 | 30 Min | 1.10 |
| LDU01/04A | 0.37 | 30 Min | 1.65 |
| LDU01/05 | 2.12 | 30 Min | 0.94 |
| LDU01/05A | 1.58 | 30 Min | 0.70 |
| LDU01/06 | 2.49 | 30 Min | 1.10 |
| LDU01/06A | 0.37 | 25 Min | 1.16 |
| LDU01/07 | 2.95 | 25 Min | 1.28 |
| LDU01/07A | 0.47 | 25 Min | 1.45 |
| LDU02/02 | 0.08 | 15 Min | 1.14 |
| LDU02/03 | 0.33 | 30 Min | 1.16 |
| LDU02/04 | 0.08 | 15 Min | 1.20 |
| LDU03/01 | 0.03 | 15 Min | 0.50 |
| LDU03/03 | 0.27 | 90 Min | 0.96 |
| LDU04/01 | 0.00 | 15 Min | 0.34 |
| LDU04/02 | 0.17 | 15 Min | 3.05 |
| LDU04/03 | 0.20 | 15 Min | 2.42 |
| LDU04/03A | 0.04 | 15 Min | 0.62 |
| LDU04/04 | 0.18 | 15 Min | 1.65 |
| LDU04/04A | 0.07 | 15 Min | 0.63 |
| LDU04/05 | 0.19 | 20 Min | 1.67 |
| LDU04/05A | 0.04 | 15 Min | 1.32 |
| LDU05/01 | 0.13 | 15 Min | 1.46 |
| LDU06/03 | 0.07 | 60 Min | 0.87 |
| LDU07/01 | 0.42 | 25 Min | 1.49 |
| LDU08/01 | 0.57 | 25 Min | 2.01 |
| LDU1 | 0.09 | 15 Min | 0.77 |

**TABLE C10**
**Peak Water Levels- Surface Network- 20 Year Event**

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| **A- Elizabeth Street** | | | | |
| NAS01/01 | 4.655 | 4.655 | 15 Min | 0.000 |
| NAS01/02 | 4.000 | 4.052 | 15 Min | 0.052 |
| NAS01/03 | 4.194 | 4.194 | 15 Min | 0.000 |
| NAS01/04 | 3.800 | 3.966 | 20 Min | 0.166 |
| NAS01/05 | 3.651 | 3.832 | 20 Min | 0.181 |
| NAS01/06 | 3.610 | 3.813 | 20 Min | 0.203 |
| NAS01/07 | 3.323 | 3.456 | 20 Min | 0.133 |
| NAS01/08 | 3.003 | 3.228 | 25 Min | 0.225 |
| NAS01/09 | 2.799 | 3.230 | 25 Min | 0.431 |
| NAS01/10 | 3.167 | 3.234 | 15 Min | 0.067 |
| NAS01/11 | 2.537 | 2.673 | 30 Min | 0.136 |
| NAS01/12 | 2.836 | 3.018 | 45 Min | 0.182 |
| NAS02/01 | 4.745 | 4.745 | 15 Min | 0.000 |
| NAS02/02 | 4.377 | 4.467 | 15 Min | 0.090 |
| NAS03/01 | 4.368 | 4.368 | 15 Min | 0.000 |
| NAS03/02 | 4.110 | 4.265 | 15 Min | 0.155 |
| NAS03/03 | 3.943 | 4.089 | 15 Min | 0.146 |
| NAS04/01 | 4.373 | 4.373 | 15 Min | 0.000 |
| NAS05/01 | 4.310 | 4.327 | 15 Min | 0.017 |
| NAS05/02 | 4.180 | 4.304 | 15 Min | 0.124 |
| NAS05/03 | 4.100 | 4.198 | 15 Min | 0.098 |
| NAS05/04 | 3.800 | 3.927 | 20 Min | 0.127 |
| NAS05/05 | 3.602 | 3.758 | 20 Min | 0.156 |
| NAS05/06 | 3.450 | 3.584 | 20 Min | 0.134 |
| NAS06/01 | 4.066 | 4.066 | 15 Min | 0.000 |
| NAS07/01 | 3.270 | 3.364 | 90 Min | 0.094 |
| NAS07/02 | 2.847 | 3.364 | 90 Min | 0.517 |
| NAS07/03 | 2.971 | 3.364 | 90 Min | 0.393 |
| NAS07/04 | 3.426 | 3.426 | 15 Min | 0.000 |
| NAS08/01 | 3.833 | 3.833 | 15 Min | 0.000 |
| NAS08/02 | 3.202 | 3.354 | 25 Min | 0.152 |
| NAS08/03 | 2.900 | 3.171 | 30 Min | 0.271 |
| NAS09/01 | 3.917 | 3.917 | 15 Min | 0.000 |
| NAS10/01 | 3.288 | 3.288 | 15 Min | 0.000 |
| NAS11/01 | 3.506 | 3.506 | 15 Min | 0.000 |
| NAS12/01 | 3.250 | 3.250 | 15 Min | 0.000 |
| NAS12/02 | 2.722 | 3.131 | 45 Min | 0.409 |
| NAS12/03 | 2.935 | 3.100 | 45 Min | 0.165 |
| ***B- Pier Street*** | | | | |
| NBS01/03 | 4.915 | 4.915 | 15 Min | 0.000 |
| NBS01/04 | 4.515 | 4.704 | 25 Min | 0.189 |
| NBS01/04A | 4.715 | 4.715 | 15 Min | 0.000 |
| NBS01/05 | 4.215 | 4.365 | 20 Min | 0.150 |
| NBS01/06 | 4.415 | 4.415 | 15 Min | 0.000 |
| NBS01/07 | 3.755 | 3.875 | 15 Min | 0.120 |
| NBS01/08 | 3.080 | 3.202 | 15 Min | 0.122 |
| NBS01/09 | 3.406 | 3.536 | 15 Min | 0.130 |
| NBS01/10 | 2.827 | 2.948 | 15 Min | 0.121 |
| NBS01/11 | 2.357 | 2.722 | 30 Min | 0.365 |
| NBS01/12 | 2.036 | 2.720 | 30 Min | 0.684 |
| NBS02/01 | 4.300 | 4.345 | 15 Min | 0.045 |
| NBS03/01 | 4.090 | 4.090 | 15 Min | 0.000 |
| NBS04/01 | 3.620 | 3.620 | 15 Min | 0.000 |
| NBS04/02 | 3.173 | 3.431 | 20 Min | 0.258 |

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| NBS04/03 | 3.502 | 3.526 | 15 Min | 0.024 |
| NBS05/01 | 4.040 | 4.095 | 15 Min | 0.055 |
| NBS06/01 | 2.829 | 2.979 | 20 Min | 0.150 |
| NBS06/02 | 2.477 | 2.720 | 25 Min | 0.243 |
| ***C- Pilot Street*** | | | | |
| NCS01/01 | 6.275 | 6.517 | 20 Min | 0.242 |
| NCS01/02 | 5.088 | 5.322 | 15 Min | 0.234 |
| NCS01/03 | 4.607 | 4.775 | 15 Min | 0.168 |
| NCS01/04 | 3.589 | 3.928 | 20 Min | 0.339 |
| NCS01/05 | 3.500 | 3.871 | 20 Min | 0.371 |
| NCS01/06 | 3.452 | 3.644 | 20 Min | 0.192 |
| NCS01/07 | 3.403 | 3.599 | 30 Min | 0.196 |
| NCS01/08 | 3.134 | 3.597 | 30 Min | 0.463 |
| NCS01/09 | 3.050 | 3.150 | 45 Min | 0.100 |
| NCS01/10 | 3.366 | 3.492 | 15 Min | 0.126 |
| NCS01/11 | 3.665 | 3.665 | 15 Min | 0.000 |
| NCS01/12 | 0.544 | 2.400 | 15 Min | 1.856 |
| NCS02/01 | 5.750 | 5.750 | 15 Min | 0.000 |
| NCS03/01 | 5.520 | 5.578 | 15 Min | 0.058 |
| NCS03/02 | 3.600 | 4.002 | 20 Min | 0.402 |
| NCS04/01 | 3.447 | 3.498 | 60 Min | 0.051 |
| NCS04/02 | 3.175 | 3.499 | 60 Min | 0.324 |
| ***D- Guard Street*** | | | | |
| NDS01/01 | 5.500 | 5.559 | 20 Min | 0.059 |
| NDS01/02 | 5.181 | 5.506 | 15 Min | 0.325 |
| NDS01/03 | 3.339 | 3.475 | 30 Min | 0.136 |
| NDS01/04 | 2.159 | 2.798 | 60 Min | 0.639 |
| NDS01/05 | 1.900 | 2.798 | 60 Min | 0.898 |
| NDS01/06 | 2.100 | 2.798 | 60 Min | 0.698 |
| NDS01/07 | 2.200 | 2.799 | 60 Min | 0.599 |
| NDS02/01 | 3.273 | 3.615 | 30 Min | 0.342 |
| NDS02/02 | 3.061 | 3.615 | 30 Min | 0.554 |
| NDS02/03 | 3.294 | 3.604 | 30 Min | 0.310 |
| NDS02/04 | 3.151 | 3.601 | 30 Min | 0.450 |
| NDS03/01 | 2.950 | 3.134 | 45 Min | 0.184 |
| NDS03/02 | 2.690 | 2.811 | 60 Min | 0.121 |
| NDS03/03 | 2.412 | 2.811 | 60 Min | 0.399 |
| NDS03/04 | 2.582 | 2.799 | 60 Min | 0.217 |
| NDS04/01 | 10.873 | 10.905 | 15 Min | 0.032 |
| NDS04/02 | 9.750 | 9.895 | 15 Min | 0.145 |
| NDS04/03 | 6.041 | 6.196 | 15 Min | 0.155 |
| NDS04/04 | 3.481 | 3.688 | 15 Min | 0.207 |
| NDS04/05 | 2.226 | 2.845 | 20 Min | 0.619 |
| NDS04/06 | 0.545 | 2.400 | 15 Min | 1.855 |
| NDS05/01 | 10.341 | 10.602 | 15 Min | 0.261 |
| NDS06/01 | 4.000 | 4.000 | 15 Min | 0.000 |
| NDS06/02 | 3.114 | 3.370 | 15 Min | 0.256 |
| NDS06/03 | 2.653 | 2.960 | 15 Min | 0.307 |
| NDS07/01 | 2.392 | 2.808 | 60 Min | 0.416 |
| NDS07/02 | 2.554 | 2.799 | 60 Min | 0.245 |
| NDS08/01 | 2.351 | 2.799 | 60 Min | 0.448 |
| NDS08/02 | 2.500 | 2.799 | 60 Min | 0.299 |
| NDS09/01 | 2.588 | 2.820 | 20 Min | 0.232 |

**TABLE C11**
**Peak Water Levels- Underground Network- 20 Year Event**

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| NAU01/02 | 2.100 | 4.044 | 20 Min | 1.944 | 4.000 | SURCH | 4.052 |
| NAU01/04 | 1.800 | 3.904 | 20 Min | 2.104 | 3.800 | SURCH | 3.966 |
| NAU01/04A | 2.000 | 3.958 | 20 Min | 1.958 | 3.800 | SURCH | 3.966 |
| NAU01/05 | 1.600 | 3.829 | 20 Min | 2.229 | 3.651 | SURCH | 3.832 |
| NAU01/05A | 1.800 | 3.832 | 20 Min | 2.032 | 3.651 | SURCH | 3.832 |
| NAU01/06 | 1.500 | 3.647 | 25 Min | 2.147 | 3.610 | SURCH | 3.813 |
| NAU01/06A | 1.700 | 3.792 | 20 Min | 2.092 | 3.610 | SURCH | 3.813 |
| NAU01/07 | 1.290 | 3.446 | 25 Min | 2.156 | 3.323 | SURCH | 3.456 |
| NAU01/07A | 1.500 | 3.453 | 25 Min | 1.953 | 3.323 | SURCH | 3.456 |
| NAU01/08 | 1.020 | 3.273 | 25 Min | 2.253 | 3.003 | SURCH | 3.228 |
| NAU01/08A | 1.200 | 3.234 | 25 Min | 2.034 | 3.003 | SURCH | 3.228 |
| NAU01/09 | 0.940 | 3.081 | 25 Min | 2.141 | 2.799 | SURCH | 3.230 |
| NAU01/09A | 1.200 | 3.208 | 25 Min | 2.008 | 2.799 | SURCH | 3.230 |
| NAU01/10 | 0.530 | 2.706 | 30 Min | 2.176 | 3.167 | - | 3.234 |
| NAU01/10A | 0.700 | 2.706 | 30 Min | 2.006 | 3.167 | - | 3.234 |
| NAU01/11 | 0.190 | 2.511 | 30 Min | 2.321 | 2.537 | <150 | 2.673 |
| NAU01/11A | 0.400 | 2.614 | 30 Min | 2.214 | 2.537 | SURCH | 2.673 |
| NAU01/12 | 0.100 | 2.483 | 30 Min | 2.383 | 2.836 | - | 3.018 |
| NAU01/12A | 0.300 | 2.515 | 30 Min | 2.215 | 2.836 | - | 3.018 |
| NAU03/03 | 2.500 | 4.078 | 15 Min | 1.578 | 3.943 | SURCH | 4.089 |
| NAU05/02 | 3.032 | 4.014 | 20 Min | 0.982 | 4.180 | - | 4.304 |
| NAU05/04 | 2.690 | 3.914 | 20 Min | 1.224 | 3.800 | SURCH | 3.927 |
| NAU05/05 | 2.672 | 3.485 | 25 Min | 0.813 | 3.602 | <150 | 3.758 |
| NAU05/06 | 2.680 | 3.580 | 20 Min | 0.900 | 3.450 | SURCH | 3.584 |
| NAU06/01 | 1.529 | 2.974 | 25 Min | 1.445 | 2.829 | SURCH | 2.979 |
| NAU07/02 | 2.165 | 3.364 | 90 Min | 1.199 | 2.847 | SURCH | 3.364 |
| NAU07/03 | 2.021 | 3.295 | 90 Min | 1.274 | 2.971 | SURCH | 3.364 |
| NAU08/02 | 2.562 | 3.196 | 30 Min | 0.634 | 3.202 | <150 | 3.354 |
| NAU08/03 | 2.291 | 3.156 | 30 Min | 0.865 | 2.900 | SURCH | 3.171 |
| NAU12/02 | 2.113 | 3.126 | 45 Min | 1.013 | 2.722 | SURCH | 3.131 |
| NAUOUT1 | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| NAUOUT2 | 0.744 | 2.400 | 15 Min | 1.656 | | | |
| ***B- Pier Street*** | | | | | | | |
| NBU01/04 | 2.000 | 4.621 | 25 Min | 2.621 | 4.515 | SURCH | 4.704 |
| NBU01/04A | 2.200 | 4.698 | 25 Min | 2.498 | 4.515 | SURCH | 4.704 |
| NBU01/05 | 1.800 | 4.276 | 20 Min | 2.476 | 4.215 | SURCH | 4.365 |
| NBU01/05A | 2.200 | 4.341 | 20 Min | 2.141 | 4.215 | SURCH | 4.365 |
| NBU01/06 | 1.600 | 3.796 | 20 Min | 2.196 | | | |
| NBU01/07 | 1.500 | 3.566 | 20 Min | 2.066 | 3.755 | - | 3.875 |
| NBU01/07A | 2.200 | 3.675 | 20 Min | 1.475 | 3.755 | <150 | 3.875 |
| NBU01/08 | 1.000 | 3.126 | 20 Min | 2.126 | 3.080 | SURCH | 3.202 |
| NBU01/08A | 1.300 | 3.171 | 20 Min | 1.871 | 3.080 | SURCH | 3.202 |
| NBU01/10 | 0.700 | 2.903 | 25 Min | 2.203 | 2.827 | SURCH | 2.948 |
| NBU01/10A | 1.000 | 2.929 | 20 Min | 1.929 | 2.827 | SURCH | 2.948 |
| NBU01/11 | 0.500 | 2.776 | 25 Min | 2.276 | 2.357 | SURCH | 2.722 |
| NBU01/11A | 0.800 | 2.741 | 25 Min | 1.941 | 2.357 | SURCH | 2.722 |
| NBU01/12 | 0.190 | 2.517 | 30 Min | 2.327 | 2.036 | SURCH | 2.720 |
| NBU01/12A | 0.250 | 2.640 | 30 Min | 2.390 | 2.036 | SURCH | 2.720 |
| NBU04/02 | 1.853 | 2.886 | 25 Min | 1.033 | 3.173 | - | 3.431 |
| NBU05/01 | 2.300 | 2.887 | 25 Min | 0.587 | 4.040 | - | 4.095 |
| NBU1 | 0.378 | 2.916 | 25 Min | 2.538 | | | |
| NBUOUT1 | 0.350 | 2.400 | 15 Min | 2.050 | | | |
| NBUOUT2 | 1.100 | 2.400 | 15 Min | 1.300 | | | |
| NBUOUT2A | 0.100 | 2.400 | 15 Min | 2.300 | | | |

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***C- Pilot Street*** | | | | | | | |
| NCU01/04 | 2.979 | 3.875 | 20 Min | 0.896 | 3.589 | SURCH | 3.928 |
| NCU01/05 | 2.527 | 3.765 | 25 Min | 1.238 | 3.500 | SURCH | 3.871 |
| NCU01/05A | 2.554 | 3.860 | 20 Min | 1.306 | 3.500 | SURCH | 3.871 |
| NCU01/06 | 1.583 | 3.490 | 30 Min | 1.907 | 3.452 | SURCH | 3.644 |
| NCU01/06A | 1.613 | 3.635 | 25 Min | 2.022 | 3.452 | SURCH | 3.644 |
| NCU01/07 | 1.310 | 3.420 | 30 Min | 2.110 | 3.403 | SURCH | 3.599 |
| NCU01/08 | 1.270 | 3.343 | 30 Min | 2.073 | 3.134 | SURCH | 3.597 |
| NCU01/09 | 0.850 | 3.132 | 45 Min | 2.282 | 3.050 | SURCH | 3.150 |
| NCU01/09A | 2.230 | 3.143 | 45 Min | 0.913 | 3.050 | SURCH | 3.150 |
| NCU01/11 | 0.270 | 2.846 | 45 Min | 2.576 | | | |
| NCU03/02 | 2.970 | 3.952 | 20 Min | 0.982 | 3.600 | SURCH | 4.002 |
| NCU04/02 | 2.370 | 3.494 | 60 Min | 1.124 | 3.175 | SURCH | 3.499 |
| NCU1 | 1.771 | 2.421 | 60 Min | 0.650 | | | |
| NCUOUT | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| NCUOUT2 | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| ***D- Guard Street*** | | | | | | | |
| NDU01/02 | 4.081 | 5.334 | 25 Min | 1.253 | 5.181 | SURCH | 5.506 |
| NDU01/03 | 1.800 | 3.593 | 30 Min | 1.793 | 3.339 | SURCH | 3.475 |
| NDU01/04 | 0.500 | 2.701 | 60 Min | 2.201 | 2.159 | SURCH | 2.798 |
| NDU01/04A | 0.551 | 2.791 | 60 Min | 2.240 | 2.159 | SURCH | 2.798 |
| NDU01/05 | 0.260 | 2.659 | 60 Min | 2.399 | 1.900 | SURCH | 2.798 |
| NDU01/05A | 0.300 | 2.712 | 60 Min | 2.412 | 1.900 | SURCH | 2.798 |
| NDU01/06 | 0.211 | 2.616 | 60 Min | 2.405 | 2.100 | SURCH | 2.798 |
| NDU01/06A | 0.291 | 2.771 | 60 Min | 2.480 | 2.100 | SURCH | 2.798 |
| NDU01/07 | 0.152 | 2.553 | 60 Min | 2.401 | 2.200 | SURCH | 2.799 |
| NDU01/07A | 0.178 | 2.773 | 60 Min | 2.595 | 2.200 | SURCH | 2.799 |
| NDU02/02 | 2.387 | 3.615 | 30 Min | 1.228 | 3.061 | SURCH | 3.615 |
| NDU02/03 | 1.954 | 3.311 | 45 Min | 1.357 | 3.294 | SURCH | 3.604 |
| NDU02/04 | 2.511 | 3.602 | 30 Min | 1.091 | 3.151 | SURCH | 3.601 |
| NDU03/01 | 2.241 | 3.135 | 30 Min | 0.894 | 2.950 | SURCH | 3.134 |
| NDU03/03 | 1.602 | 2.840 | 60 Min | 1.238 | 2.412 | SURCH | 2.811 |
| NDU04/01 | 10.173 | 10.190 | 15 Min | 0.016 | 10.873 | - | 10.905 |
| NDU04/02 | 8.950 | 9.120 | 60 Min | 0.170 | 9.750 | - | 9.895 |
| NDU04/03 | 4.533 | 4.811 | 15 Min | 0.278 | 6.041 | - | 6.196 |
| NDU04/03A | 4.733 | 4.911 | 15 Min | 0.178 | 6.041 | - | 6.196 |
| NDU04/04 | 2.821 | 3.887 | 15 Min | 1.066 | 3.481 | SURCH | 3.688 |
| NDU04/04A | 2.921 | 3.848 | 15 Min | 0.927 | 3.481 | SURCH | 3.688 |
| NDU04/05 | 1.845 | 3.076 | 15 Min | 1.231 | 2.226 | SURCH | 2.845 |
| NDU04/05A | 1.890 | 2.855 | 20 Min | 0.965 | 2.226 | SURCH | 2.845 |
| NDU05/01 | 9.571 | 9.901 | 20 Min | 0.330 | 10.341 | - | 10.602 |
| NDU06/03 | 2.054 | 2.873 | 45 Min | 0.819 | 2.653 | SURCH | 2.960 |
| NDU07/01 | 1.222 | 2.814 | 60 Min | 1.592 | 2.392 | SURCH | 2.808 |
| NDU08/01 | 1.160 | 2.781 | 60 Min | 1.621 | 2.351 | SURCH | 2.799 |
| NDU1 | 1.270 | 2.701 | 60 Min | 1.431 | | | |
| NDUOUT1 | 0.900 | 2.400 | 15 Min | 1.500 | | | |
| NDUOUT2 | 0.050 | 2.400 | 15 Min | 2.350 | | | |
| NDUOUT3 | 0.900 | 2.400 | 15 Min | 1.500 | | | |

**TABLE C12**
**Peak Flows and Velocities- Surface Network- 20 Year Event**

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| LAS01/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 |
| LAS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 |
| LAS01/03A1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 |
| LAS01/04 | 0.21 | 20 Min | 0.59 | 0.17 | 0.10 | 0.18 | 0.11 |
| LAS01/05 | 0.23 | 20 Min | 0.21 | 0.18 | 0.04 | 0.20 | 0.04 |
| LAS01/06 | 0.33 | 20 Min | 0.65 | 0.20 | 0.13 | 0.13 | 0.09 |
| LAS01/07 | 0.37 | 20 Min | 0.44 | 0.13 | 0.06 | 0.22 | 0.10 |
| LAS01/08 | 1.24 | 20 Min | 0.84 | 0.22 | 0.19 | 0.43 | 0.36 |
| LAS01/10 | 0.12 | 15 Min | 0.35 | 0.07 | 0.02 | 0.14 | 0.05 |
| LAS01/10A1 | -0.11 | 25 Min | 0.21 | 0.07 | 0.01 | 0.43 | 0.09 |
| LAS01/10A8 | 0.02 | 15 Min | 0.29 | 0.07 | 0.02 | 0.27 | 0.08 |
| LAS01/12A1 | 0.37 | 45 Min | 0.87 | 0.18 | 0.16 | 0.14 | 0.12 |
| LAS02/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LAS02/01B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 |
| LAS02/02 | 0.26 | 15 Min | 0.59 | 0.09 | 0.05 | 0.17 | 0.10 |
| LAS03/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS03/01B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS03/02 | 0.44 | 15 Min | 0.65 | 0.15 | 0.10 | 0.15 | 0.09 |
| LAS03/03 | 0.55 | 15 Min | 0.81 | 0.15 | 0.12 | 0.20 | 0.16 |
| LAS04/01A3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS04/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| LAS05/01 | 0.00 | 15 Min | 0.03 | 0.02 | 0.00 | 0.12 | 0.00 |
| LAS05/01B2 | 0.00 | 15 Min | -0.09 | 0.02 | 0.00 | 0.05 | 0.00 |
| LAS05/02 | 0.11 | 15 Min | 0.47 | 0.12 | 0.06 | 0.10 | 0.05 |
| LAS05/03 | 0.19 | 15 Min | 0.38 | 0.10 | 0.04 | 0.13 | 0.05 |
| LAS05/04 | 0.32 | 20 Min | 0.42 | 0.13 | 0.05 | 0.16 | 0.07 |
| LAS05/05 | 0.38 | 20 Min | 0.76 | 0.16 | 0.12 | 0.13 | 0.10 |
| LAS05/06 | 0.47 | 20 Min | 0.58 | 0.13 | 0.08 | 0.22 | 0.13 |
| LAS06/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LAS06/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.52 | 0.00 |
| LAS07/01 | 0.16 | 15 Min | 0.31 | 0.09 | 0.03 | 0.52 | 0.16 |
| LAS07/03A2 | 0.21 | 15 Min | 0.41 | 0.39 | 0.16 | 0.52 | 0.21 |
| LAS07/04 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 |
| LAS07/04A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.39 | 0.00 |
| LAS08/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS08/02 | 0.21 | 25 Min | 0.77 | 0.15 | 0.12 | 0.27 | 0.21 |
| LAS09/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS10/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 |
| LAS10/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS11/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.39 | 0.00 |
| LAS11/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS12/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.41 | 0.00 |
| LAS12/03 | -0.34 | 45 Min | -0.20 | 0.17 | -0.03 | 0.41 | -0.08 |
| LAS12/03A1 | 0.34 | 45 Min | 0.52 | 0.17 | 0.09 | 0.18 | 0.09 |
| ***B- Pier Street*** | | | | | | | |
| LBS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 |
| LBS01/04 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LBS01/04B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 |
| LBS01/06 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LBS01/06B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LBS01/07 | 0.16 | 15 Min | 0.77 | 0.12 | 0.09 | 0.12 | 0.09 |
| LBS01/09 | 0.10 | 15 Min | 0.81 | 0.13 | 0.10 | 0.12 | 0.10 |
| LBS01/09B1 | 0.14 | 15 Min | 0.66 | 0.13 | 0.09 | 0.12 | 0.08 |
| LBS01/10 | 0.12 | 15 Min | 0.48 | 0.12 | 0.06 | 0.36 | 0.18 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LBS01/11 | 0.43 | 20 Min | 0.13 | 0.36 | 0.05 | 0.68 | 0.09 |
| LBS02/01 | 0.01 | 15 Min | 0.24 | 0.05 | 0.01 | 0.12 | 0.03 |
| LBS02/01B5 | 0.06 | 15 Min | 0.35 | 0.05 | 0.02 | 0.05 | 0.02 |
| LBS03/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LBS03/01C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 |
| LBS04/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 |
| LBS04/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LBS04/02B1 | 0.53 | 20 Min | 0.67 | 0.26 | 0.17 | 0.68 | 0.46 |
| LBS04/03 | -0.03 | 15 Min | -0.12 | 0.02 | 0.00 | 0.13 | -0.02 |
| LBS05/01 | 0.17 | 15 Min | 0.35 | 0.05 | 0.02 | 0.26 | 0.09 |
| LBS06/01 | 0.15 | 20 Min | 0.35 | 0.15 | 0.05 | 0.24 | 0.09 |
| LBS06/02 | 0.35 | 20 Min | 0.14 | 0.24 | 0.03 | 0.68 | 0.10 |
| ***C- Pilot Street*** | | | | | | | |
| LCS01/01 | 0.10 | 15 Min | 0.50 | 0.24 | 0.12 | 0.23 | 0.12 |
| LCS01/02 | 0.95 | 15 Min | 0.83 | 0.23 | 0.20 | 0.17 | 0.14 |
| LCS01/03 | 1.17 | 15 Min | 0.81 | 0.17 | 0.14 | 0.34 | 0.27 |
| LCS01/04 | 1.74 | 20 Min | 0.68 | 0.34 | 0.23 | 0.37 | 0.25 |
| LCS01/05 | 1.61 | 20 Min | 0.70 | 0.37 | 0.26 | 0.19 | 0.13 |
| LCS01/06 | 0.00 | 15 Min | 0.00 | 0.19 | 0.00 | 0.20 | 0.00 |
| LCS01/06D2 | 1.39 | 20 Min | 1.73 | 0.19 | 0.33 | 0.34 | 0.59 |
| LCS01/07 | 0.71 | 30 Min | 0.63 | 0.20 | 0.12 | 0.46 | 0.29 |
| LCS01/07D2 | -0.87 | 25 Min | -0.90 | 0.20 | -0.18 | 0.34 | -0.31 |
| LCS01/08 | 0.15 | 30 Min | 0.45 | 0.46 | 0.21 | 0.10 | 0.04 |
| LCS01/09D3 | 0.31 | 45 Min | 0.26 | 0.10 | 0.03 | 0.18 | 0.05 |
| LCS01/10C1 | 0.20 | 15 Min | 0.51 | 0.13 | 0.06 | 0.10 | 0.05 |
| LCS01/11 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.32 | 0.00 |
| LCS01/11B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.36 | 0.00 |
| LCS01/11C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LCS01/OUT | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 1.86 | 0.00 |
| LCS02/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.23 | 0.00 |
| LCS02/01C3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 |
| LCS03/01 | 0.50 | 15 Min | 0.28 | 0.06 | 0.02 | 0.40 | 0.11 |
| LCS03/01D1 | 0.02 | 15 Min | 0.26 | 0.06 | 0.01 | 0.06 | 0.02 |
| LCS03/02 | 0.59 | 20 Min | 0.37 | 0.40 | 0.15 | 0.34 | 0.12 |
| LCS04/01 | -0.05 | 30 Min | -0.05 | 0.05 | 0.00 | 0.32 | -0.02 |
| LCS04/01D8 | 0.04 | 60 Min | 0.02 | 0.05 | 0.00 | 0.45 | 0.01 |
| ***D- Guard Street*** | | | | | | | |
| LDS01/01 | 0.01 | 20 Min | 0.19 | 0.06 | 0.01 | 0.32 | 0.06 |
| LDS01/02 | 0.23 | 15 Min | 2.94 | 0.32 | 0.96 | 0.14 | 0.40 |
| LDS01/02D6 | 0.00 | 15 Min | 0.00 | 0.32 | 0.00 | 0.00 | 0.00 |
| LDS01/03 | 0.49 | 30 Min | 0.17 | 0.14 | 0.02 | 0.64 | 0.11 |
| LDS01/03D2 | -0.37 | 30 Min | -0.31 | 0.14 | -0.04 | 0.45 | -0.14 |
| LDS01/04 | 0.83 | 30 Min | 0.10 | 0.64 | 0.06 | 0.90 | 0.09 |
| LDS01/06 | -0.64 | 20 Min | -0.12 | 0.70 | -0.08 | 0.90 | -0.11 |
| LDS01/07 | -0.64 | 30 Min | -0.11 | 0.60 | -0.06 | 0.70 | -0.07 |
| LDS02/01 | 0.32 | 30 Min | 0.14 | 0.34 | 0.05 | 0.55 | 0.08 |
| LDS02/03 | -0.42 | 30 Min | -0.16 | 0.31 | -0.05 | 0.55 | -0.09 |
| LDS02/03D2 | -0.33 | 15 Min | -0.32 | 0.31 | -0.10 | 0.45 | -0.14 |
| LDS03/01 | 0.30 | 45 Min | 0.58 | 0.18 | 0.11 | 0.12 | 0.07 |
| LDS03/02 | 0.13 | 20 Min | 0.16 | 0.12 | 0.02 | 0.40 | 0.06 |
| LDS03/02D7 | 0.34 | 20 Min | 0.19 | 0.12 | 0.02 | 0.42 | 0.08 |
| LDS03/04 | -0.56 | 30 Min | -0.30 | 0.22 | -0.07 | 0.40 | -0.12 |
| LDS03/04D1 | 0.53 | 30 Min | 0.13 | 0.22 | 0.03 | 0.64 | 0.08 |
| LDS04/01 | 0.38 | 15 Min | 0.34 | 0.03 | 0.01 | 0.15 | 0.05 |
| LDS04/02 | 1.12 | 15 Min | 1.95 | 0.15 | 0.28 | 0.15 | 0.30 |
| LDS04/03 | 0.71 | 15 Min | 1.47 | 0.15 | 0.23 | 0.21 | 0.30 |
| LDS04/03D6 | 0.44 | 15 Min | 0.90 | 0.15 | 0.14 | 0.31 | 0.28 |
| LDS04/04 | 0.94 | 15 Min | 0.44 | 0.21 | 0.09 | 0.62 | 0.27 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LDS04/OUT | 0.14 | 20 Min | 1.37 | 0.62 | 0.85 | 1.86 | 2.55 |
| LDS05/01 | 0.69 | 15 Min | 1.76 | 0.26 | 0.46 | 0.15 | 0.26 |
| LDS06/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 |
| LDS06/02 | 0.44 | 15 Min | 0.59 | 0.26 | 0.15 | 0.31 | 0.18 |
| LDS06/03 | 1.30 | 15 Min | 0.34 | 0.31 | 0.10 | 0.90 | 0.30 |
| LDS07/02 | -0.55 | 45 Min | -0.23 | 0.25 | -0.06 | 0.42 | -0.09 |
| LDS07/02D1 | 0.51 | 45 Min | 0.13 | 0.25 | 0.03 | 0.70 | 0.09 |
| LDS08/02 | 0.31 | 30 Min | -0.16 | 0.30 | -0.05 | 0.45 | -0.07 |
| LDS08/02D1 | -0.80 | 30 Min | -0.12 | 0.30 | -0.03 | 0.60 | -0.07 |
| LDS09/01 | 0.89 | 20 Min | 0.26 | 0.23 | 0.06 | 0.60 | 0.16 |
| LDS09/01D4 | -0.94 | 20 Min | -0.25 | 0.23 | -0.06 | 0.62 | -0.16 |

**TABLE C13**
**Peak Flows and Velocities- Underground Network- 20 Year Event**

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| ***A- Elizabeth Street*** | | | |
| LAU01/02 | 0.12 | 60 Min | 0.73 |
| LAU01/04 | 0.24 | 45 Min | 0.84 |
| LAU01/04A | 0.22 | 15 Min | 0.68 |
| LAU01/05 | 0.33 | 60 Min | 1.13 |
| LAU01/05A | 0.15 | 15 Min | 0.53 |
| LAU01/06 | 0.83 | 15 Min | 1.30 |
| LAU01/06A | 0.47 | 15 Min | 0.81 |
| LAU01/07 | 0.87 | 15 Min | 1.35 |
| LAU01/07A | 0.04 | 15 Min | 0.35 |
| LAU01/08 | 0.95 | 15 Min | 1.49 |
| LAU01/08A | 0.13 | 25 Min | 0.56 |
| LAU01/09 | 1.87 | 25 Min | 1.46 |
| LAU01/09A | 1.18 | 25 Min | 0.92 |
| LAU01/10 | 2.16 | 25 Min | 1.12 |
| LAU01/10A | 0.03 | 15 Min | 0.08 |
| LAU01/11 | 2.72 | 30 Min | 0.80 |
| LAU01/11A | 0.58 | 30 Min | 0.67 |
| LAU01/12 | 2.81 | 30 Min | 0.82 |
| LAU01/12A | 0.08 | 60 Min | 0.37 |
| LAU03/03 | 0.11 | 30 Min | 1.01 |
| LAU05/02 | 0.05 | 20 Min | 0.70 |
| LAU05/04 | 0.09 | 20 Min | 0.84 |
| LAU05/05 | 0.06 | 20 Min | 0.58 |
| LAU05/06 | 0.12 | 30 Min | 1.04 |
| LAU07/02 | 0.08 | 45 Min | 0.50 |
| LAU07/03 | 0.14 | 90 Min | 0.84 |
| LAU08/02 | 0.03 | 15 Min | 0.44 |
| LAU08/03 | 0.28 | 25 Min | 0.97 |
| LAU12/02 | 0.10 | 45 Min | 1.33 |
| ***B- Pier Street*** | | | |
| LBU01/04 | 0.50 | 25 Min | 1.73 |
| LBU01/04A | 0.50 | 25 Min | 0.86 |
| LBU01/05 | 0.80 | 20 Min | 1.78 |
| LBU01/05A | 0.48 | 20 Min | 0.56 |
| LBU01/06 | 0.80 | 20 Min | 1.79 |
| LBU01/07 | 0.96 | 20 Min | 1.50 |
| LBU01/07A | 0.22 | 20 Min | 0.65 |
| LBU01/08 | 1.37 | 20 Min | 1.20 |
| LBU01/08A | 0.42 | 15 Min | 0.47 |
| LBU01/10 | 1.43 | 20 Min | 1.25 |
| LBU01/10A | 0.08 | 15 Min | 0.46 |
| LBU01/11 | 1.14 | 25 Min | 0.89 |
| LBU01/11A | -0.32 | 15 Min | -0.56 |
| LBU01/12 | 2.12 | 30 Min | 0.84 |
| LBU01/12A | 1.22 | 30 Min | 0.75 |
| LBU01/12LF | 0.29 | 30 Min | 0.65 |
| LBU04/02 | 0.09 | 20 Min | 0.83 |
| LBU05/01 | 0.01 | 15 Min | 0.08 |
| LBU06/01 | 0.13 | 25 Min | 0.79 |
| LBU1 | 0.13 | 25 Min | 1.73 |
| ***C- Pilot Street*** | | | |
| LCU01/04 | 0.16 | 90 Min | 1.05 |
| LCU01/05 | 0.47 | 90 Min | 1.64 |
| LCU01/05A | 0.34 | 30 Min | 1.05 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| LCU01/06 | 0.76 | 30 Min | 0.88 |
| LCU01/06A | 0.37 | 30 Min | 1.13 |
| LCU01/07 | 0.76 | 30 Min | 0.88 |
| LCU01/08 | 1.09 | 30 Min | 1.25 |
| LCU01/09 | 1.15 | 45 Min | 1.31 |
| LCU01/09A | 0.11 | 15 Min | 0.32 |
| LCU01/11 | 1.15 | 45 Min | 1.31 |
| LCU03/02 | 0.07 | 90 Min | 1.01 |
| LCU04/02 | 0.10 | 60 Min | 1.35 |
| LCU1 | 0.10 | 60 Min | 0.33 |
| ***D- Guard Street*** | | | |
| LDU01/02 | 0.34 | 20 Min | 1.52 |
| LDU01/03 | 0.30 | 20 Min | 1.85 |
| LDU01/04 | 0.41 | 30 Min | 0.75 |
| LDU01/04A | 0.16 | 60 Min | 0.72 |
| LDU01/05 | 1.55 | 60 Min | 0.68 |
| LDU01/05A | 1.21 | 60 Min | 0.53 |
| LDU01/06 | 1.80 | 60 Min | 0.79 |
| LDU01/06A | 0.26 | 60 Min | 0.79 |
| LDU01/07 | 2.11 | 60 Min | 0.93 |
| LDU01/07A | 0.32 | 60 Min | 0.97 |
| LDU02/02 | 0.07 | 90 Min | 0.92 |
| LDU02/03 | 0.38 | 30 Min | 1.33 |
| LDU02/04 | 0.07 | 15 Min | 1.00 |
| LDU03/01 | 0.02 | 15 Min | 0.20 |
| LDU03/03 | 0.14 | 90 Min | 0.48 |
| LDU04/01 | 0.00 | 15 Min | 0.31 |
| LDU04/02 | 0.17 | 15 Min | 3.05 |
| LDU04/03 | 0.21 | 15 Min | 2.53 |
| LDU04/03A | 0.04 | 15 Min | 0.63 |
| LDU04/04 | 0.16 | 15 Min | 1.44 |
| LDU04/04A | 0.07 | 15 Min | 0.63 |
| LDU04/05 | 0.14 | 15 Min | 1.23 |
| LDU04/05A | -0.03 | 15 Min | -0.93 |
| LDU05/01 | 0.13 | 15 Min | 1.50 |
| LDU06/03 | 0.06 | 15 Min | 0.58 |
| LDU07/01 | 0.19 | 90 Min | 0.68 |
| LDU08/01 | 0.39 | 60 Min | 1.38 |
| LDU1 | 0.06 | 15 Min | 0.57 |

**TABLE C14**
**Peak Water Levels- Surface Network- 50 Year Event**

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| **A- Elizabeth Street** | | | | |
| NAS01/01 | 4.655 | 4.655 | 15 Min | 0.000 |
| NAS01/02 | 4.000 | 4.072 | 25 Min | 0.072 |
| NAS01/03 | 4.194 | 4.194 | 15 Min | 0.000 |
| NAS01/04 | 3.800 | 4.002 | 20 Min | 0.202 |
| NAS01/05 | 3.651 | 3.888 | 20 Min | 0.237 |
| NAS01/06 | 3.610 | 3.870 | 20 Min | 0.260 |
| NAS01/07 | 3.323 | 3.495 | 20 Min | 0.172 |
| NAS01/08 | 3.003 | 3.332 | 25 Min | 0.329 |
| NAS01/09 | 2.799 | 3.333 | 25 Min | 0.534 |
| NAS01/10 | 3.167 | 3.315 | 30 Min | 0.148 |
| NAS01/11 | 2.537 | 2.921 | 30 Min | 0.384 |
| NAS01/12 | 2.836 | 3.027 | 30 Min | 0.191 |
| NAS02/01 | 4.745 | 4.773 | 30 Min | 0.028 |
| NAS02/02 | 4.377 | 4.483 | 15 Min | 0.106 |
| NAS03/01 | 4.368 | 4.424 | 25 Min | 0.056 |
| NAS03/02 | 4.110 | 4.283 | 15 Min | 0.173 |
| NAS03/03 | 3.943 | 4.116 | 15 Min | 0.173 |
| NAS04/01 | 4.373 | 4.373 | 15 Min | 0.000 |
| NAS05/01 | 4.310 | 4.331 | 15 Min | 0.021 |
| NAS05/02 | 4.180 | 4.314 | 15 Min | 0.134 |
| NAS05/03 | 4.100 | 4.217 | 15 Min | 0.117 |
| NAS05/04 | 3.800 | 3.940 | 20 Min | 0.140 |
| NAS05/05 | 3.602 | 3.778 | 20 Min | 0.176 |
| NAS05/06 | 3.450 | 3.604 | 20 Min | 0.154 |
| NAS06/01 | 4.066 | 4.066 | 15 Min | 0.000 |
| NAS07/01 | 3.270 | 3.458 | 90 Min | 0.188 |
| NAS07/02 | 2.847 | 3.456 | 90 Min | 0.609 |
| NAS07/03 | 2.971 | 3.457 | 90 Min | 0.486 |
| NAS07/04 | 3.426 | 3.457 | 90 Min | 0.031 |
| NAS08/01 | 3.833 | 3.833 | 15 Min | 0.000 |
| NAS08/02 | 3.202 | 3.369 | 20 Min | 0.167 |
| NAS08/03 | 2.900 | 3.323 | 30 Min | 0.423 |
| NAS09/01 | 3.917 | 3.917 | 15 Min | 0.000 |
| NAS10/01 | 3.288 | 3.288 | 15 Min | 0.000 |
| NAS11/01 | 3.506 | 3.506 | 15 Min | 0.000 |
| NAS12/01 | 3.250 | 3.250 | 15 Min | 0.000 |
| NAS12/02 | 2.722 | 3.166 | 30 Min | 0.444 |
| NAS12/03 | 2.935 | 3.126 | 30 Min | 0.191 |
| ***B- Pier Street*** | | | | |
| NBS01/03 | 4.915 | 4.915 | 15 Min | 0.000 |
| NBS01/04 | 4.515 | 4.773 | 30 Min | 0.258 |
| NBS01/04A | 4.715 | 4.765 | 30 Min | 0.050 |
| NBS01/05 | 4.215 | 4.434 | 25 Min | 0.219 |
| NBS01/06 | 4.415 | 4.433 | 25 Min | 0.018 |
| NBS01/07 | 3.755 | 3.886 | 15 Min | 0.131 |
| NBS01/08 | 3.080 | 3.289 | 20 Min | 0.209 |
| NBS01/09 | 3.406 | 3.543 | 15 Min | 0.137 |
| NBS01/10 | 2.827 | 2.966 | 20 Min | 0.139 |
| NBS01/11 | 2.357 | 2.818 | 30 Min | 0.461 |
| NBS01/12 | 2.036 | 2.816 | 30 Min | 0.780 |
| NBS02/01 | 4.300 | 4.352 | 15 Min | 0.052 |
| NBS03/01 | 4.090 | 4.090 | 15 Min | 0.000 |
| NBS04/01 | 3.620 | 3.620 | 15 Min | 0.000 |
| NBS04/02 | 3.173 | 3.462 | 20 Min | 0.289 |

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| NBS04/03 | 3.502 | 3.531 | 15 Min | 0.029 |
| NBS05/01 | 4.040 | 4.104 | 15 Min | 0.064 |
| NBS06/01 | 2.829 | 2.996 | 20 Min | 0.167 |
| NBS06/02 | 2.477 | 2.816 | 30 Min | 0.339 |
| ***C- Pilot Street*** | | | | |
| NCS01/01 | 6.275 | 6.533 | 20 Min | 0.258 |
| NCS01/02 | 5.088 | 5.345 | 15 Min | 0.257 |
| NCS01/03 | 4.607 | 4.795 | 15 Min | 0.188 |
| NCS01/04 | 3.589 | 3.976 | 15 Min | 0.387 |
| NCS01/05 | 3.500 | 3.921 | 20 Min | 0.421 |
| NCS01/06 | 3.452 | 3.698 | 30 Min | 0.246 |
| NCS01/07 | 3.403 | 3.673 | 30 Min | 0.270 |
| NCS01/08 | 3.134 | 3.673 | 30 Min | 0.539 |
| NCS01/09 | 3.050 | 3.185 | 30 Min | 0.135 |
| NCS01/10 | 3.366 | 3.508 | 15 Min | 0.142 |
| NCS01/11 | 3.665 | 3.665 | 15 Min | 0.000 |
| NCS01/12 | 0.544 | 2.400 | 15 Min | 1.856 |
| NCS02/01 | 5.750 | 5.750 | 15 Min | 0.000 |
| NCS03/01 | 5.520 | 5.588 | 15 Min | 0.068 |
| NCS03/02 | 3.600 | 4.042 | 20 Min | 0.442 |
| NCS04/01 | 3.447 | 3.539 | 60 Min | 0.092 |
| NCS04/02 | 3.175 | 3.541 | 60 Min | 0.366 |
| ***D- Guard Street*** | | | | |
| NDS01/01 | 5.500 | 5.581 | 15 Min | 0.081 |
| NDS01/02 | 5.181 | 5.571 | 15 Min | 0.390 |
| NDS01/03 | 3.339 | 3.502 | 30 Min | 0.163 |
| NDS01/04 | 2.159 | 2.906 | 60 Min | 0.747 |
| NDS01/05 | 1.900 | 2.906 | 60 Min | 1.006 |
| NDS01/06 | 2.100 | 2.907 | 60 Min | 0.807 |
| NDS01/07 | 2.200 | 2.908 | 60 Min | 0.708 |
| NDS02/01 | 3.273 | 3.684 | 30 Min | 0.411 |
| NDS02/02 | 3.061 | 3.683 | 30 Min | 0.622 |
| NDS02/03 | 3.294 | 3.671 | 45 Min | 0.377 |
| NDS02/04 | 3.151 | 3.666 | 45 Min | 0.515 |
| NDS03/01 | 2.950 | 3.168 | 30 Min | 0.218 |
| NDS03/02 | 2.690 | 2.912 | 60 Min | 0.222 |
| NDS03/03 | 2.412 | 2.913 | 60 Min | 0.501 |
| NDS03/04 | 2.582 | 2.909 | 60 Min | 0.327 |
| NDS04/01 | 10.873 | 10.910 | 15 Min | 0.037 |
| NDS04/02 | 9.750 | 9.908 | 15 Min | 0.158 |
| NDS04/03 | 6.041 | 6.214 | 15 Min | 0.173 |
| NDS04/04 | 3.481 | 3.714 | 15 Min | 0.233 |
| NDS04/05 | 2.226 | 2.907 | 60 Min | 0.681 |
| NDS04/06 | 0.545 | 2.400 | 15 Min | 1.855 |
| NDS05/01 | 10.341 | 10.627 | 15 Min | 0.286 |
| NDS06/01 | 4.000 | 4.000 | 15 Min | 0.000 |
| NDS06/02 | 3.114 | 3.391 | 15 Min | 0.277 |
| NDS06/03 | 2.653 | 2.990 | 15 Min | 0.337 |
| NDS07/01 | 2.392 | 2.912 | 60 Min | 0.520 |
| NDS07/02 | 2.554 | 2.909 | 60 Min | 0.355 |
| NDS08/01 | 2.351 | 2.909 | 60 Min | 0.558 |
| NDS08/02 | 2.500 | 2.908 | 60 Min | 0.408 |
| NDS09/01 | 2.588 | 2.908 | 60 Min | 0.320 |

## TABLE C15
## Peak Water Levels- Underground Network- 50 Year Event

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| NAU01/02 | 2.100 | 4.070 | 25 Min | 1.970 | 4.000 | SURCH | 4.072 |
| NAU01/04 | 1.800 | 3.949 | 20 Min | 2.149 | 3.800 | SURCH | 4.002 |
| NAU01/04A | 2.000 | 3.997 | 20 Min | 1.997 | 3.800 | SURCH | 4.002 |
| NAU01/05 | 1.600 | 3.883 | 20 Min | 2.283 | 3.651 | SURCH | 3.888 |
| NAU01/05A | 1.800 | 3.888 | 20 Min | 2.088 | 3.651 | SURCH | 3.888 |
| NAU01/06 | 1.500 | 3.704 | 25 Min | 2.204 | 3.610 | SURCH | 3.870 |
| NAU01/06A | 1.700 | 3.847 | 20 Min | 2.147 | 3.610 | SURCH | 3.870 |
| NAU01/07 | 1.290 | 3.507 | 25 Min | 2.217 | 3.323 | SURCH | 3.495 |
| NAU01/07A | 1.500 | 3.496 | 25 Min | 1.996 | 3.323 | SURCH | 3.495 |
| NAU01/08 | 1.020 | 3.354 | 25 Min | 2.334 | 3.003 | SURCH | 3.332 |
| NAU01/08A | 1.200 | 3.336 | 25 Min | 2.136 | 3.003 | SURCH | 3.332 |
| NAU01/09 | 0.940 | 3.171 | 30 Min | 2.231 | 2.799 | SURCH | 3.333 |
| NAU01/09A | 1.200 | 3.307 | 25 Min | 2.107 | 2.799 | SURCH | 3.333 |
| NAU01/10 | 0.530 | 2.797 | 30 Min | 2.267 | 3.167 | - | 3.315 |
| NAU01/10A | 0.700 | 2.897 | 30 Min | 2.197 | 3.167 | - | 3.315 |
| NAU01/11 | 0.190 | 2.564 | 30 Min | 2.374 | 2.537 | SURCH | 2.921 |
| NAU01/11A | 0.400 | 2.857 | 30 Min | 2.457 | 2.537 | SURCH | 2.921 |
| NAU01/12 | 0.100 | 2.522 | 30 Min | 2.422 | 2.836 | - | 3.027 |
| NAU01/12A | 0.300 | 2.555 | 30 Min | 2.255 | 2.836 | - | 3.027 |
| NAU03/03 | 2.500 | 4.109 | 15 Min | 1.609 | 3.943 | SURCH | 4.116 |
| NAU05/02 | 3.032 | 4.050 | 15 Min | 1.018 | 4.180 | <150 | 4.314 |
| NAU05/04 | 2.690 | 3.931 | 20 Min | 1.241 | 3.800 | SURCH | 3.940 |
| NAU05/05 | 2.672 | 3.594 | 25 Min | 0.922 | 3.602 | <150 | 3.778 |
| NAU05/06 | 2.680 | 3.603 | 20 Min | 0.923 | 3.450 | SURCH | 3.604 |
| NAU06/01 | 1.529 | 2.993 | 25 Min | 1.464 | 2.829 | SURCH | 2.996 |
| NAU07/02 | 2.165 | 3.457 | 90 Min | 1.292 | 2.847 | SURCH | 3.456 |
| NAU07/03 | 2.021 | 3.369 | 90 Min | 1.348 | 2.971 | SURCH | 3.457 |
| NAU08/02 | 2.562 | 3.333 | 30 Min | 0.771 | 3.202 | SURCH | 3.369 |
| NAU08/03 | 2.291 | 3.302 | 30 Min | 1.011 | 2.900 | SURCH | 3.323 |
| NAU12/02 | 2.113 | 3.161 | 30 Min | 1.048 | 2.722 | SURCH | 3.166 |
| NAUOUT1 | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| NAUOUT2 | 0.744 | 2.400 | 15 Min | 1.656 | | | |
| ***B- Pier Street*** | | | | | | | |
| NBU01/04 | 2.000 | 4.694 | 30 Min | 2.694 | 4.515 | SURCH | 4.773 |
| NBU01/04A | 2.200 | 4.766 | 30 Min | 2.566 | 4.515 | SURCH | 4.773 |
| NBU01/05 | 1.800 | 4.354 | 25 Min | 2.554 | 4.215 | SURCH | 4.434 |
| NBU01/05A | 2.200 | 4.416 | 25 Min | 2.216 | 4.215 | SURCH | 4.434 |
| NBU01/06 | 1.600 | 3.889 | 20 Min | 2.289 | | | |
| NBU01/07 | 1.500 | 3.669 | 20 Min | 2.169 | 3.755 | <150 | 3.886 |
| NBU01/07A | 2.200 | 3.818 | 20 Min | 1.618 | 3.755 | SURCH | 3.886 |
| NBU01/08 | 1.000 | 3.217 | 20 Min | 2.217 | 3.080 | SURCH | 3.289 |
| NBU01/08A | 1.300 | 3.275 | 20 Min | 1.975 | 3.080 | SURCH | 3.289 |
| NBU01/10 | 0.700 | 2.970 | 25 Min | 2.270 | 2.827 | SURCH | 2.966 |
| NBU01/10A | 1.000 | 2.968 | 25 Min | 1.968 | 2.827 | SURCH | 2.966 |
| NBU01/11 | 0.500 | 2.841 | 30 Min | 2.341 | 2.357 | SURCH | 2.818 |
| NBU01/11A | 0.800 | 2.829 | 30 Min | 2.029 | 2.357 | SURCH | 2.818 |
| NBU01/12 | 0.190 | 2.547 | 30 Min | 2.357 | 2.036 | SURCH | 2.816 |
| NBU01/12A | 0.250 | 2.709 | 30 Min | 2.459 | 2.036 | SURCH | 2.816 |
| NBU04/02 | 1.853 | 2.949 | 20 Min | 1.096 | 3.173 | - | 3.462 |
| NBU05/01 | 2.300 | 2.952 | 20 Min | 0.652 | 4.040 | - | 4.104 |
| NBU1 | 0.378 | 2.933 | 25 Min | 2.555 | | | |
| NBUOUT1 | 0.350 | 2.400 | 15 Min | 2.050 | | | |
| NBUOUT2A | 0.100 | 2.400 | 15 Min | 2.300 | | | |
| NBUOUT2 | 1.100 | 2.400 | 15 Min | 1.300 | | | |

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***C- Pilot Street*** | | | | | | | |
| NCU01/04 | 2.979 | 3.923 | 20 Min | 0.944 | 3.589 | SURCH | 3.976 |
| NCU01/05 | 2.527 | 3.813 | 20 Min | 1.286 | 3.500 | SURCH | 3.921 |
| NCU01/05A | 2.554 | 3.910 | 20 Min | 1.356 | 3.500 | SURCH | 3.921 |
| NCU01/06 | 1.583 | 3.537 | 30 Min | 1.954 | 3.452 | SURCH | 3.698 |
| NCU01/06A | 1.613 | 3.688 | 30 Min | 2.075 | 3.452 | SURCH | 3.698 |
| NCU01/07 | 1.310 | 3.465 | 30 Min | 2.155 | 3.403 | SURCH | 3.673 |
| NCU01/08 | 1.270 | 3.386 | 30 Min | 2.116 | 3.134 | SURCH | 3.673 |
| NCU01/09 | 0.850 | 3.167 | 30 Min | 2.317 | 3.050 | SURCH | 3.185 |
| NCU01/09A | 2.230 | 3.180 | 30 Min | 0.950 | 3.050 | SURCH | 3.185 |
| NCU01/11 | 0.270 | 2.868 | 30 Min | 2.598 | | | |
| NCU03/02 | 2.970 | 3.992 | 20 Min | 1.022 | 3.600 | SURCH | 4.042 |
| NCU04/02 | 2.370 | 3.537 | 60 Min | 1.167 | 3.175 | SURCH | 3.541 |
| NCU1 | 1.771 | 2.422 | 45 Min | 0.651 | | | |
| NCUOUT | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| NCUOUT2 | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| ***D- Guard Street*** | | | | | | | |
| NDU01/02 | 4.081 | 5.413 | 25 Min | 1.332 | 5.181 | SURCH | 5.571 |
| NDU01/03 | 1.800 | 3.657 | 30 Min | 1.857 | 3.339 | SURCH | 3.502 |
| NDU01/04 | 0.500 | 2.773 | 60 Min | 2.273 | 2.159 | SURCH | 2.906 |
| NDU01/04A | 0.551 | 2.898 | 60 Min | 2.347 | 2.159 | SURCH | 2.906 |
| NDU01/05 | 0.260 | 2.726 | 60 Min | 2.466 | 1.900 | SURCH | 2.906 |
| NDU01/05A | 0.300 | 2.794 | 60 Min | 2.494 | 1.900 | SURCH | 2.906 |
| NDU01/06 | 0.211 | 2.672 | 60 Min | 2.461 | 2.100 | SURCH | 2.907 |
| NDU01/06A | 0.291 | 2.871 | 60 Min | 2.580 | 2.100 | SURCH | 2.907 |
| NDU01/07 | 0.152 | 2.593 | 60 Min | 2.441 | 2.200 | SURCH | 2.908 |
| NDU01/07A | 0.178 | 2.874 | 60 Min | 2.696 | 2.200 | SURCH | 2.908 |
| NDU02/02 | 2.387 | 3.684 | 30 Min | 1.297 | 3.061 | SURCH | 3.683 |
| NDU02/03 | 1.954 | 3.448 | 45 Min | 1.494 | 3.294 | SURCH | 3.671 |
| NDU02/04 | 2.511 | 3.667 | 45 Min | 1.156 | 3.151 | SURCH | 3.666 |
| NDU03/01 | 2.241 | 3.168 | 30 Min | 0.927 | 2.950 | SURCH | 3.168 |
| NDU03/03 | 1.602 | 2.945 | 60 Min | 1.343 | 2.412 | SURCH | 2.913 |
| NDU04/01 | 10.173 | 10.192 | 15 Min | 0.019 | 10.873 | - | 10.910 |
| NDU04/02 | 8.950 | 9.121 | 15 Min | 0.171 | 9.750 | - | 9.908 |
| NDU04/03 | 4.533 | 4.845 | 15 Min | 0.312 | 6.041 | - | 6.214 |
| NDU04/03A | 4.733 | 4.931 | 15 Min | 0.198 | 6.041 | - | 6.214 |
| NDU04/04 | 2.821 | 3.981 | 15 Min | 1.160 | 3.481 | SURCH | 3.714 |
| NDU04/04A | 2.921 | 3.937 | 15 Min | 1.016 | 3.481 | SURCH | 3.714 |
| NDU04/05 | 1.845 | 3.122 | 15 Min | 1.277 | 2.226 | SURCH | 2.907 |
| NDU04/05A | 1.890 | 2.916 | 60 Min | 1.026 | 2.226 | SURCH | 2.907 |
| NDU05/01 | 9.571 | 9.903 | 30 Min | 0.332 | 10.341 | - | 10.627 |
| NDU06/03 | 2.054 | 2.906 | 30 Min | 0.852 | 2.653 | SURCH | 2.990 |
| NDU07/01 | 1.222 | 2.919 | 60 Min | 1.697 | 2.392 | SURCH | 2.912 |
| NDU08/01 | 1.160 | 2.886 | 60 Min | 1.726 | 2.351 | SURCH | 2.909 |
| NDU1 | 1.270 | 2.758 | 60 Min | 1.488 | | | |
| NDUOUT1 | 0.900 | 2.400 | 15 Min | 1.500 | | | |
| NDUOUT2 | 0.050 | 2.400 | 15 Min | 2.350 | | | |
| NDUOUT3 | 0.900 | 2.400 | 15 Min | 1.500 | | | |

**TABLE C16**
**Peak Flows and Velocities- Surface Network- 50 Year Event**

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| LAS01/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 |
| LAS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 |
| LAS01/03A1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 |
| LAS01/04 | 0.32 | 20 Min | 0.61 | 0.20 | 0.12 | 0.24 | 0.14 |
| LAS01/05 | 0.36 | 20 Min | 0.23 | 0.24 | 0.05 | 0.26 | 0.06 |
| LAS01/06 | 0.71 | 20 Min | 0.76 | 0.26 | 0.20 | 0.17 | 0.13 |
| LAS01/07 | 0.81 | 20 Min | 0.48 | 0.17 | 0.08 | 0.33 | 0.16 |
| LAS01/08 | 1.99 | 20 Min | 0.86 | 0.33 | 0.28 | 0.53 | 0.46 |
| LAS01/10 | 0.59 | 30 Min | 0.37 | 0.15 | 0.05 | 0.38 | 0.14 |
| LAS01/10A1 | -0.79 | 25 Min | 0.22 | 0.15 | 0.03 | 0.53 | 0.12 |
| LAS01/10A8 | -0.09 | 30 Min | 0.23 | 0.15 | 0.03 | 0.42 | 0.10 |
| LAS01/12A1 | 0.55 | 30 Min | 0.89 | 0.19 | 0.17 | 0.38 | 0.34 |
| LAS02/01 | 0.03 | 30 Min | 0.17 | 0.03 | 0.00 | 0.11 | 0.02 |
| LAS02/01B1 | -0.05 | 30 Min | -0.06 | 0.03 | 0.00 | 0.26 | -0.02 |
| LAS02/02 | 0.32 | 15 Min | 0.61 | 0.11 | 0.06 | 0.20 | 0.12 |
| LAS03/01 | 0.07 | 25 Min | 0.22 | 0.06 | 0.01 | 0.17 | 0.04 |
| LAS03/01B1 | -0.09 | 25 Min | -0.14 | 0.06 | -0.01 | 0.22 | -0.03 |
| LAS03/02 | 0.58 | 15 Min | 0.66 | 0.17 | 0.11 | 0.17 | 0.11 |
| LAS03/03 | 0.77 | 15 Min | 0.85 | 0.17 | 0.15 | 0.26 | 0.22 |
| LAS04/01A3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 |
| LAS04/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| LAS05/01 | 0.01 | 15 Min | 0.03 | 0.02 | 0.00 | 0.13 | 0.00 |
| LAS05/01B2 | -0.01 | 15 Min | -0.10 | 0.02 | 0.00 | 0.05 | -0.01 |
| LAS05/02 | 0.15 | 15 Min | 0.48 | 0.13 | 0.06 | 0.12 | 0.06 |
| LAS05/03 | 0.25 | 15 Min | 0.40 | 0.12 | 0.05 | 0.14 | 0.06 |
| LAS05/04 | 0.45 | 20 Min | 0.47 | 0.14 | 0.07 | 0.18 | 0.08 |
| LAS05/05 | 0.56 | 20 Min | 0.82 | 0.18 | 0.14 | 0.15 | 0.13 |
| LAS05/06 | 0.68 | 20 Min | 0.63 | 0.15 | 0.10 | 0.33 | 0.21 |
| LAS06/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 |
| LAS06/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.61 | 0.00 |
| LAS07/01 | 0.21 | 15 Min | 0.34 | 0.19 | 0.06 | 0.61 | 0.20 |
| LAS07/03A2 | 0.23 | 15 Min | 0.43 | 0.49 | 0.21 | 0.61 | 0.26 |
| LAS07/04 | 0.03 | 90 Min | 0.26 | 0.03 | 0.01 | 0.15 | 0.04 |
| LAS07/04A7 | -0.05 | 90 Min | -0.02 | 0.03 | 0.00 | 0.49 | -0.01 |
| LAS08/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 |
| LAS08/02 | 0.27 | 20 Min | 0.77 | 0.17 | 0.13 | 0.42 | 0.33 |
| LAS09/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 |
| LAS10/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 |
| LAS10/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 |
| LAS11/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.49 | 0.00 |
| LAS11/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 |
| LAS12/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.44 | 0.00 |
| LAS12/03 | -0.50 | 30 Min | -0.24 | 0.19 | -0.05 | 0.44 | -0.11 |
| LAS12/03A1 | 0.49 | 30 Min | 0.59 | 0.19 | 0.11 | 0.19 | 0.11 |
| ***B- Pier Street*** | | | | | | | |
| LBS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 |
| LBS01/04 | 0.10 | 30 Min | 0.20 | 0.05 | 0.01 | 0.22 | 0.04 |
| LBS01/04B1 | -0.10 | 30 Min | -0.12 | 0.05 | -0.01 | 0.26 | -0.03 |
| LBS01/06 | 0.02 | 25 Min | 0.12 | 0.02 | 0.00 | 0.13 | 0.02 |
| LBS01/06B1 | -0.03 | 25 Min | -0.06 | 0.02 | 0.00 | 0.22 | -0.01 |
| LBS01/07 | 0.26 | 15 Min | 0.77 | 0.13 | 0.10 | 0.21 | 0.16 |
| LBS01/09 | 0.13 | 15 Min | 0.82 | 0.14 | 0.11 | 0.14 | 0.11 |
| LBS01/09B1 | 0.18 | 15 Min | 0.69 | 0.14 | 0.09 | 0.21 | 0.14 |
| LBS01/10 | 0.19 | 20 Min | 0.50 | 0.14 | 0.07 | 0.46 | 0.23 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LBS01/11 | 0.59 | 20 Min | 0.13 | 0.46 | 0.06 | 0.78 | 0.10 |
| LBS02/01 | 0.02 | 15 Min | 0.24 | 0.05 | 0.01 | 0.13 | 0.03 |
| LBS02/01B5 | 0.07 | 15 Min | 0.39 | 0.05 | 0.02 | 0.06 | 0.02 |
| LBS03/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LBS03/01C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.27 | 0.00 |
| LBS04/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.29 | 0.00 |
| LBS04/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 |
| LBS04/02B1 | 0.71 | 20 Min | 0.78 | 0.29 | 0.22 | 0.78 | 0.61 |
| LBS04/03 | -0.04 | 15 Min | -0.13 | 0.03 | 0.00 | 0.14 | -0.02 |
| LBS05/01 | 0.22 | 15 Min | 0.38 | 0.06 | 0.02 | 0.29 | 0.11 |
| LBS06/01 | 0.20 | 20 Min | 0.36 | 0.17 | 0.06 | 0.34 | 0.12 |
| LBS06/02 | 0.50 | 15 Min | 0.15 | 0.34 | 0.05 | 0.78 | 0.12 |
| ***C- Pilot Street*** | | | | | | | |
| LCS01/01 | 0.14 | 15 Min | 0.54 | 0.26 | 0.14 | 0.26 | 0.14 |
| LCS01/02 | 1.23 | 15 Min | 0.89 | 0.26 | 0.23 | 0.19 | 0.17 |
| LCS01/03 | 1.52 | 15 Min | 0.83 | 0.19 | 0.16 | 0.39 | 0.32 |
| LCS01/04 | 2.44 | 15 Min | 0.69 | 0.39 | 0.27 | 0.42 | 0.29 |
| LCS01/05 | 2.33 | 20 Min | 0.79 | 0.42 | 0.33 | 0.25 | 0.20 |
| LCS01/06 | 0.00 | 15 Min | 0.00 | 0.25 | 0.00 | 0.27 | 0.00 |
| LCS01/06D2 | 2.13 | 20 Min | 1.84 | 0.25 | 0.45 | 0.41 | 0.76 |
| LCS01/07 | 0.92 | 20 Min | 0.63 | 0.27 | 0.17 | 0.54 | 0.34 |
| LCS01/07D2 | -1.30 | 20 Min | -1.00 | 0.27 | -0.27 | 0.41 | -0.41 |
| LCS01/08 | 0.24 | 30 Min | 0.52 | 0.54 | 0.28 | 0.13 | 0.07 |
| LCS01/09D3 | 0.48 | 30 Min | 0.33 | 0.13 | 0.04 | 0.22 | 0.07 |
| LCS01/10C1 | 0.26 | 15 Min | 0.55 | 0.14 | 0.08 | 0.13 | 0.07 |
| LCS01/11 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.37 | 0.00 |
| LCS01/11B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.46 | 0.00 |
| LCS01/11C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 |
| LCS01/OUT | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 1.86 | 0.00 |
| LCS02/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 |
| LCS02/01C3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 |
| LCS03/01 | 0.64 | 15 Min | 0.30 | 0.07 | 0.02 | 0.44 | 0.13 |
| LCS03/01D1 | 0.03 | 15 Min | 0.30 | 0.07 | 0.02 | 0.08 | 0.02 |
| LCS03/02 | 0.84 | 20 Min | 0.39 | 0.44 | 0.17 | 0.39 | 0.15 |
| LCS04/01 | -0.11 | 45 Min | -0.07 | 0.09 | -0.01 | 0.37 | -0.03 |
| LCS04/01D8 | 0.09 | 60 Min | 0.04 | 0.09 | 0.00 | 0.56 | 0.02 |
| ***D- Guard Street*** | | | | | | | |
| LDS01/01 | -0.04 | 15 Min | 0.18 | 0.08 | 0.01 | 0.39 | 0.07 |
| LDS01/02 | 0.37 | 15 Min | 3.34 | 0.39 | 1.30 | 0.16 | 0.54 |
| LDS01/02D6 | 0.00 | 15 Min | 0.00 | 0.39 | 0.00 | 0.00 | 0.00 |
| LDS01/03 | 0.86 | 30 Min | 0.21 | 0.16 | 0.03 | 0.75 | 0.16 |
| LDS01/03D2 | -0.67 | 45 Min | -0.38 | 0.16 | -0.06 | 0.52 | -0.20 |
| LDS01/04 | 1.16 | 30 Min | 0.11 | 0.75 | 0.08 | 1.01 | 0.11 |
| LDS01/06 | -1.09 | 25 Min | -0.13 | 0.81 | -0.10 | 1.01 | -0.13 |
| LDS01/07 | -1.06 | 30 Min | -0.11 | 0.71 | -0.08 | 0.81 | -0.09 |
| LDS02/01 | 0.58 | 30 Min | 0.13 | 0.41 | 0.05 | 0.62 | 0.08 |
| LDS02/03 | -0.70 | 30 Min | -0.19 | 0.38 | -0.07 | 0.62 | -0.12 |
| LDS02/03D2 | 0.47 | 30 Min | -0.34 | 0.38 | -0.13 | 0.52 | -0.17 |
| LDS03/01 | 0.53 | 45 Min | 0.64 | 0.22 | 0.14 | 0.22 | 0.14 |
| LDS03/02 | 0.18 | 20 Min | 0.16 | 0.22 | 0.04 | 0.50 | 0.08 |
| LDS03/02D7 | 0.45 | 25 Min | 0.20 | 0.22 | 0.04 | 0.52 | 0.10 |
| LDS03/04 | -0.71 | 25 Min | -0.34 | 0.33 | -0.11 | 0.50 | -0.17 |
| LDS03/04D1 | 0.63 | 30 Min | 0.14 | 0.33 | 0.04 | 0.75 | 0.10 |
| LDS04/01 | 0.49 | 15 Min | 0.37 | 0.04 | 0.01 | 0.16 | 0.06 |
| LDS04/02 | 1.47 | 15 Min | 1.95 | 0.16 | 0.31 | 0.17 | 0.34 |
| LDS04/03 | 0.92 | 15 Min | 1.55 | 0.17 | 0.27 | 0.23 | 0.36 |
| LDS04/03D6 | 0.59 | 15 Min | 0.96 | 0.17 | 0.17 | 0.34 | 0.32 |
| LDS04/04 | 1.21 | 15 Min | 0.49 | 0.23 | 0.11 | 0.68 | 0.33 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LDS04/OUT | 0.37 | 60 Min | 1.66 | 0.68 | 1.13 | 1.86 | 3.08 |
| LDS05/01 | 0.91 | 15 Min | 1.86 | 0.29 | 0.53 | 0.16 | 0.29 |
| LDS06/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.28 | 0.00 |
| LDS06/02 | 0.58 | 15 Min | 0.64 | 0.28 | 0.18 | 0.34 | 0.21 |
| LDS06/03 | 1.72 | 15 Min | 0.39 | 0.34 | 0.13 | 1.01 | 0.39 |
| LDS07/02 | -0.75 | 30 Min | -0.26 | 0.36 | -0.09 | 0.52 | -0.14 |
| LDS07/02D1 | 0.65 | 30 Min | 0.14 | 0.36 | 0.05 | 0.81 | 0.12 |
| LDS08/02 | 0.46 | 30 Min | -0.17 | 0.41 | -0.07 | 0.56 | -0.09 |
| LDS08/02D1 | -1.39 | 25 Min | -0.15 | 0.41 | -0.06 | 0.71 | -0.11 |
| LDS09/01 | 1.24 | 20 Min | 0.28 | 0.32 | 0.09 | 0.71 | 0.20 |
| LDS09/01D4 | -1.26 | 20 Min | -0.29 | 0.32 | -0.09 | 0.68 | -0.20 |

## TABLE C17
## Peak Flows and Velocities- Underground Network- 50 Year Event

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| ***A- Elizabeth Street*** | | | |
| LAU01/02 | 0.12 | 90 Min | 0.73 |
| LAU01/04 | 0.24 | 60 Min | 0.84 |
| LAU01/04A | 0.22 | 20 Min | 0.69 |
| LAU01/05 | 0.33 | 90 Min | 1.13 |
| LAU01/05A | 0.15 | 15 Min | 0.54 |
| LAU01/06 | 0.83 | 15 Min | 1.30 |
| LAU01/06A | 0.47 | 15 Min | 0.82 |
| LAU01/07 | 0.87 | 15 Min | 1.35 |
| LAU01/07A | 0.04 | 15 Min | 0.39 |
| LAU01/08 | 0.96 | 20 Min | 1.49 |
| LAU01/08A | 0.17 | 20 Min | 0.73 |
| LAU01/09 | 1.89 | 20 Min | 1.47 |
| LAU01/09A | 1.22 | 20 Min | 0.95 |
| LAU01/10 | 2.37 | 25 Min | 1.23 |
| LAU01/10A | 0.21 | 30 Min | 0.64 |
| LAU01/11 | 3.32 | 30 Min | 0.97 |
| LAU01/11A | 0.99 | 30 Min | 1.15 |
| LAU01/12 | 3.41 | 30 Min | 1.00 |
| LAU01/12A | 0.08 | 90 Min | 0.37 |
| LAU03/03 | 0.11 | 45 Min | 1.01 |
| LAU05/02 | 0.06 | 15 Min | 0.73 |
| LAU05/04 | 0.09 | 25 Min | 0.84 |
| LAU05/05 | 0.06 | 20 Min | 0.57 |
| LAU05/06 | 0.12 | 60 Min | 1.05 |
| LAU07/02 | 0.08 | 60 Min | 0.50 |
| LAU07/03 | 0.15 | 90 Min | 0.90 |
| LAU08/02 | 0.03 | 20 Min | 0.51 |
| LAU08/03 | 0.30 | 20 Min | 1.04 |
| LAU12/02 | 0.10 | 30 Min | 1.37 |
| ***B- Pier Street*** | | | |
| LBU01/04 | 0.53 | 30 Min | 1.84 |
| LBU01/04A | 0.53 | 30 Min | 0.91 |
| LBU01/05 | 0.84 | 15 Min | 1.88 |
| LBU01/05A | 0.53 | 15 Min | 0.61 |
| LBU01/06 | 0.84 | 15 Min | 1.89 |
| LBU01/07 | 0.99 | 20 Min | 1.53 |
| LBU01/07A | 0.26 | 15 Min | 0.77 |
| LBU01/08 | 1.45 | 15 Min | 1.27 |
| LBU01/08A | 0.49 | 15 Min | 0.55 |
| LBU01/10 | 1.49 | 15 Min | 1.31 |
| LBU01/10A | 0.08 | 15 Min | 0.49 |
| LBU01/11 | 1.22 | 25 Min | 0.95 |
| LBU01/11A | -0.35 | 15 Min | -0.61 |
| LBU01/12 | 2.38 | 30 Min | 0.94 |
| LBU01/12A | 1.40 | 30 Min | 0.86 |
| LBU01/12LF | 0.33 | 30 Min | 0.73 |
| LBU04/02 | 0.10 | 20 Min | 0.88 |
| LBU05/01 | 0.01 | 15 Min | 0.10 |
| LBU06/01 | 0.13 | 45 Min | 0.80 |
| LBU1 | 0.13 | 25 Min | 1.76 |
| ***C- Pilot Street*** | | | |
| LCU01/04 | 0.16 | 60 Min | 1.05 |
| LCU01/05 | 0.46 | 90 Min | 1.61 |
| LCU01/05A | 0.34 | 60 Min | 1.05 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| LCU01/06 | 0.76 | 60 Min | 0.88 |
| LCU01/06A | 0.37 | 60 Min | 1.13 |
| LCU01/07 | 0.76 | 60 Min | 0.88 |
| LCU01/08 | 1.12 | 45 Min | 1.28 |
| LCU01/09 | 1.18 | 30 Min | 1.35 |
| LCU01/09A | 0.14 | 15 Min | 0.40 |
| LCU01/11 | 1.18 | 30 Min | 1.35 |
| LCU03/02 | 0.07 | 90 Min | 1.01 |
| LCU04/02 | 0.10 | 60 Min | 1.37 |
| LCU1 | 0.10 | 60 Min | 0.34 |
| ***D- Guard Street*** | | | |
| LDU01/02 | 0.35 | 20 Min | 1.53 |
| LDU01/03 | 0.30 | 15 Min | 1.86 |
| LDU01/04 | 0.44 | 45 Min | 0.81 |
| LDU01/04A | 0.19 | 45 Min | 0.81 |
| LDU01/05 | 1.74 | 60 Min | 0.76 |
| LDU01/05A | 1.37 | 60 Min | 0.60 |
| LDU01/06 | 2.02 | 60 Min | 0.89 |
| LDU01/06A | 0.29 | 60 Min | 0.90 |
| LDU01/07 | 2.37 | 60 Min | 1.04 |
| LDU01/07A | 0.36 | 60 Min | 1.09 |
| LDU02/02 | 0.06 | 15 Min | 0.91 |
| LDU02/03 | 0.40 | 25 Min | 1.40 |
| LDU02/04 | 0.07 | 15 Min | 1.00 |
| LDU03/01 | 0.02 | 25 Min | 0.20 |
| LDU03/03 | 0.14 | 90 Min | 0.49 |
| LDU04/01 | 0.00 | 15 Min | 0.28 |
| LDU04/02 | 0.18 | 15 Min | 3.05 |
| LDU04/03 | 0.21 | 15 Min | 2.56 |
| LDU04/03A | 0.04 | 15 Min | 0.65 |
| LDU04/04 | 0.17 | 15 Min | 1.48 |
| LDU04/04A | 0.07 | 15 Min | 0.64 |
| LDU04/05 | 0.14 | 15 Min | 1.27 |
| LDU04/05A | 0.03 | 60 Min | 0.96 |
| LDU05/01 | 0.13 | 15 Min | 1.51 |
| LDU06/03 | 0.06 | 15 Min | 0.58 |
| LDU07/01 | 0.19 | 90 Min | 0.68 |
| LDU08/01 | 0.45 | 60 Min | 1.56 |
| LDU1 | 0.06 | 15 Min | 0.57 |

## TABLE C18
## Peak Water Levels- Surface Network- 100 Year Event

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| **A- Elizabeth Street** | | | | |
| NAS01/01 | 4.655 | 4.655 | 15 Min | 0.000 |
| NAS01/02 | 4.000 | 4.086 | 30 Min | 0.086 |
| NAS01/03 | 4.194 | 4.194 | 15 Min | 0.000 |
| NAS01/04 | 3.800 | 4.021 | 20 Min | 0.221 |
| NAS01/05 | 3.651 | 3.910 | 20 Min | 0.259 |
| NAS01/06 | 3.610 | 3.892 | 20 Min | 0.282 |
| NAS01/07 | 3.323 | 3.517 | 20 Min | 0.194 |
| NAS01/08 | 3.003 | 3.377 | 25 Min | 0.374 |
| NAS01/09 | 2.799 | 3.378 | 25 Min | 0.579 |
| NAS01/10 | 3.167 | 3.353 | 30 Min | 0.186 |
| NAS01/11 | 2.537 | 3.116 | 30 Min | 0.579 |
| NAS01/12 | 2.836 | 3.114 | 30 Min | 0.278 |
| NAS02/01 | 4.745 | 4.795 | 30 Min | 0.050 |
| NAS02/02 | 4.377 | 4.492 | 15 Min | 0.115 |
| NAS03/01 | 4.368 | 4.454 | 30 Min | 0.086 |
| NAS03/02 | 4.110 | 4.295 | 15 Min | 0.185 |
| NAS03/03 | 3.943 | 4.131 | 15 Min | 0.188 |
| NAS04/01 | 4.373 | 4.373 | 15 Min | 0.000 |
| NAS05/01 | 4.310 | 4.334 | 15 Min | 0.024 |
| NAS05/02 | 4.180 | 4.320 | 15 Min | 0.140 |
| NAS05/03 | 4.100 | 4.225 | 15 Min | 0.125 |
| NAS05/04 | 3.800 | 3.949 | 15 Min | 0.149 |
| NAS05/05 | 3.602 | 3.790 | 15 Min | 0.188 |
| NAS05/06 | 3.450 | 3.615 | 20 Min | 0.165 |
| NAS06/01 | 4.066 | 4.066 | 15 Min | 0.000 |
| NAS07/01 | 3.270 | 3.498 | 90 Min | 0.228 |
| NAS07/02 | 2.847 | 3.497 | 90 Min | 0.650 |
| NAS07/03 | 2.971 | 3.497 | 90 Min | 0.526 |
| NAS07/04 | 3.426 | 3.496 | 90 Min | 0.070 |
| NAS08/01 | 3.833 | 3.833 | 15 Min | 0.000 |
| NAS08/02 | 3.202 | 3.379 | 25 Min | 0.177 |
| NAS08/03 | 2.900 | 3.357 | 25 Min | 0.457 |
| NAS09/01 | 3.917 | 3.917 | 15 Min | 0.000 |
| NAS10/01 | 3.288 | 3.288 | 15 Min | 0.000 |
| NAS11/01 | 3.506 | 3.506 | 15 Min | 0.000 |
| NAS12/01 | 3.250 | 3.250 | 15 Min | 0.000 |
| NAS12/02 | 2.722 | 3.189 | 30 Min | 0.467 |
| NAS12/03 | 2.935 | 3.144 | 30 Min | 0.209 |
| ***B- Pier Street*** | | | | |
| NBS01/03 | 4.915 | 4.915 | 15 Min | 0.000 |
| NBS01/04 | 4.515 | 4.798 | 30 Min | 0.283 |
| NBS01/04A | 4.715 | 4.786 | 30 Min | 0.071 |
| NBS01/05 | 4.215 | 4.472 | 30 Min | 0.257 |
| NBS01/06 | 4.415 | 4.458 | 30 Min | 0.043 |
| NBS01/07 | 3.755 | 3.892 | 15 Min | 0.137 |
| NBS01/08 | 3.080 | 3.358 | 25 Min | 0.278 |
| NBS01/09 | 3.406 | 3.546 | 15 Min | 0.140 |
| NBS01/10 | 2.827 | 2.980 | 25 Min | 0.153 |
| NBS01/11 | 2.357 | 2.877 | 30 Min | 0.520 |
| NBS01/12 | 2.036 | 2.874 | 30 Min | 0.838 |
| NBS02/01 | 4.300 | 4.356 | 15 Min | 0.056 |
| NBS03/01 | 4.090 | 4.090 | 15 Min | 0.000 |
| NBS04/01 | 3.620 | 3.620 | 15 Min | 0.000 |
| NBS04/02 | 3.173 | 3.479 | 20 Min | 0.306 |

| Node Name | Invert Level (m AHD) | Peak Level (m AHD) | Critical Duration | Maximum Depth (m) |
|---|---|---|---|---|
| NBS04/03 | 3.502 | 3.534 | 15 Min | 0.032 |
| NBS05/01 | 4.040 | 4.109 | 15 Min | 0.069 |
| NBS06/01 | 2.829 | 3.006 | 20 Min | 0.177 |
| NBS06/02 | 2.477 | 2.874 | 30 Min | 0.397 |
| ***C- Pilot Street*** | | | | |
| NCS01/01 | 6.275 | 6.539 | 15 Min | 0.264 |
| NCS01/02 | 5.088 | 5.358 | 15 Min | 0.269 |
| NCS01/03 | 4.607 | 4.806 | 15 Min | 0.199 |
| NCS01/04 | 3.589 | 4.004 | 15 Min | 0.415 |
| NCS01/05 | 3.500 | 3.950 | 15 Min | 0.450 |
| NCS01/06 | 3.452 | 3.733 | 30 Min | 0.281 |
| NCS01/07 | 3.403 | 3.711 | 45 Min | 0.308 |
| NCS01/08 | 3.134 | 3.711 | 45 Min | 0.577 |
| NCS01/09 | 3.050 | 3.200 | 30 Min | 0.150 |
| NCS01/10 | 3.366 | 3.518 | 15 Min | 0.152 |
| NCS01/11 | 3.665 | 3.665 | 15 Min | 0.000 |
| NCS01/12 | 0.544 | 2.400 | 15 Min | 1.856 |
| NCS02/01 | 5.750 | 5.750 | 15 Min | 0.000 |
| NCS03/01 | 5.520 | 5.595 | 15 Min | 0.075 |
| NCS03/02 | 3.600 | 4.066 | 15 Min | 0.466 |
| NCS04/01 | 3.447 | 3.563 | 60 Min | 0.116 |
| NCS04/02 | 3.175 | 3.566 | 60 Min | 0.391 |
| ***D- Guard Street*** | | | | |
| NDS01/01 | 5.500 | 5.601 | 15 Min | 0.101 |
| NDS01/02 | 5.181 | 5.598 | 15 Min | 0.417 |
| NDS01/03 | 3.339 | 3.520 | 30 Min | 0.181 |
| NDS01/04 | 2.159 | 2.970 | 60 Min | 0.811 |
| NDS01/05 | 1.900 | 2.970 | 60 Min | 1.070 |
| NDS01/06 | 2.100 | 2.971 | 60 Min | 0.871 |
| NDS01/07 | 2.200 | 2.971 | 60 Min | 0.771 |
| NDS02/01 | 3.273 | 3.721 | 45 Min | 0.448 |
| NDS02/02 | 3.061 | 3.720 | 45 Min | 0.659 |
| NDS02/03 | 3.294 | 3.708 | 45 Min | 0.414 |
| NDS02/04 | 3.151 | 3.702 | 45 Min | 0.551 |
| NDS03/01 | 2.950 | 3.182 | 30 Min | 0.232 |
| NDS03/02 | 2.690 | 2.975 | 60 Min | 0.285 |
| NDS03/03 | 2.412 | 2.974 | 60 Min | 0.562 |
| NDS03/04 | 2.582 | 2.972 | 60 Min | 0.390 |
| NDS04/01 | 10.873 | 10.913 | 15 Min | 0.040 |
| NDS04/02 | 9.750 | 9.915 | 15 Min | 0.165 |
| NDS04/03 | 6.041 | 6.225 | 15 Min | 0.184 |
| NDS04/04 | 3.481 | 3.726 | 15 Min | 0.245 |
| NDS04/05 | 2.226 | 2.970 | 60 Min | 0.744 |
| NDS04/06 | 0.545 | 2.400 | 15 Min | 1.855 |
| NDS05/01 | 10.341 | 10.643 | 15 Min | 0.302 |
| NDS06/01 | 4.000 | 4.000 | 15 Min | 0.000 |
| NDS06/02 | 3.114 | 3.403 | 15 Min | 0.289 |
| NDS06/03 | 2.653 | 3.008 | 15 Min | 0.355 |
| NDS07/01 | 2.392 | 2.974 | 60 Min | 0.582 |
| NDS07/02 | 2.554 | 2.971 | 60 Min | 0.417 |
| NDS08/01 | 2.351 | 2.972 | 60 Min | 0.621 |
| NDS08/02 | 2.500 | 2.972 | 60 Min | 0.472 |
| NDS09/01 | 2.588 | 2.971 | 60 Min | 0.383 |

**TABLE C19**
**Peak Water Levels- Underground Network- 100 Year Event**

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| NAU01/02 | 2.100 | 4.084 | 30 Min | 1.984 | 4.000 | SURCH | 4.086 |
| NAU01/04 | 1.800 | 3.969 | 20 Min | 2.169 | 3.800 | SURCH | 4.021 |
| NAU01/04A | 2.000 | 4.016 | 20 Min | 2.016 | 3.800 | SURCH | 4.021 |
| NAU01/05 | 1.600 | 3.905 | 20 Min | 2.305 | 3.651 | SURCH | 3.910 |
| NAU01/05A | 1.800 | 3.910 | 20 Min | 2.110 | 3.651 | SURCH | 3.910 |
| NAU01/06 | 1.500 | 3.729 | 25 Min | 2.229 | 3.610 | SURCH | 3.892 |
| NAU01/06A | 1.700 | 3.868 | 20 Min | 2.168 | 3.610 | SURCH | 3.892 |
| NAU01/07 | 1.290 | 3.537 | 25 Min | 2.247 | 3.323 | SURCH | 3.517 |
| NAU01/07A | 1.500 | 3.518 | 20 Min | 2.018 | 3.323 | SURCH | 3.517 |
| NAU01/08 | 1.020 | 3.391 | 25 Min | 2.371 | 3.003 | SURCH | 3.377 |
| NAU01/08A | 1.200 | 3.379 | 25 Min | 2.179 | 3.003 | SURCH | 3.377 |
| NAU01/09 | 0.940 | 3.214 | 30 Min | 2.274 | 2.799 | SURCH | 3.378 |
| NAU01/09A | 1.200 | 3.350 | 30 Min | 2.150 | 2.799 | SURCH | 3.378 |
| NAU01/10 | 0.530 | 2.845 | 30 Min | 2.315 | 3.167 | - | 3.353 |
| NAU01/10A | 0.700 | 3.087 | 30 Min | 2.387 | 3.167 | <150 | 3.353 |
| NAU01/11 | 0.190 | 2.590 | 30 Min | 2.400 | 2.537 | SURCH | 3.116 |
| NAU01/11A | 0.400 | 2.983 | 30 Min | 2.583 | 2.537 | SURCH | 3.116 |
| NAU01/12 | 0.100 | 2.542 | 30 Min | 2.442 | 2.836 | - | 3.114 |
| NAU01/12A | 0.300 | 2.578 | 30 Min | 2.278 | 2.836 | - | 3.114 |
| NAU03/03 | 2.500 | 4.124 | 15 Min | 1.624 | 3.943 | SURCH | 4.131 |
| NAU05/02 | 3.032 | 4.065 | 15 Min | 1.033 | 4.180 | <150 | 4.320 |
| NAU05/04 | 2.690 | 3.940 | 15 Min | 1.250 | 3.800 | SURCH | 3.949 |
| NAU05/05 | 2.672 | 3.643 | 25 Min | 0.971 | 3.602 | SURCH | 3.790 |
| NAU05/06 | 2.680 | 3.617 | 20 Min | 0.937 | 3.450 | SURCH | 3.615 |
| NAU06/01 | 1.529 | 3.004 | 25 Min | 1.475 | 2.829 | SURCH | 3.006 |
| NAU07/02 | 2.165 | 3.497 | 90 Min | 1.332 | 2.847 | SURCH | 3.497 |
| NAU07/03 | 2.021 | 3.402 | 90 Min | 1.381 | 2.971 | SURCH | 3.497 |
| NAU08/02 | 2.562 | 3.356 | 25 Min | 0.794 | 3.202 | SURCH | 3.379 |
| NAU08/03 | 2.291 | 3.335 | 25 Min | 1.044 | 2.900 | SURCH | 3.357 |
| NAU12/02 | 2.113 | 3.184 | 30 Min | 1.071 | 2.722 | SURCH | 3.189 |
| NAUOUT1 | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| NAUOUT2 | 0.744 | 2.400 | 15 Min | 1.656 | | | |
| ***B- Pier Street*** | | | | | | | |
| NBU01/04 | 2.000 | 4.722 | 30 Min | 2.722 | 4.515 | SURCH | 4.798 |
| NBU01/04A | 2.200 | 4.791 | 30 Min | 2.591 | 4.515 | SURCH | 4.798 |
| NBU01/05 | 1.800 | 4.393 | 30 Min | 2.593 | 4.215 | SURCH | 4.472 |
| NBU01/05A | 2.200 | 4.454 | 30 Min | 2.254 | 4.215 | SURCH | 4.472 |
| NBU01/06 | 1.600 | 3.938 | 25 Min | 2.338 | | | |
| NBU01/07 | 1.500 | 3.720 | 25 Min | 2.220 | 3.755 | <150 | 3.892 |
| NBU01/07A | 2.200 | 3.864 | 25 Min | 1.664 | 3.755 | SURCH | 3.892 |
| NBU01/08 | 1.000 | 3.272 | 25 Min | 2.272 | 3.080 | SURCH | 3.358 |
| NBU01/08A | 1.300 | 3.340 | 25 Min | 2.040 | 3.080 | SURCH | 3.358 |
| NBU01/10 | 0.700 | 3.016 | 30 Min | 2.316 | 2.827 | SURCH | 2.980 |
| NBU01/10A | 1.000 | 2.986 | 25 Min | 1.986 | 2.827 | SURCH | 2.980 |
| NBU01/11 | 0.500 | 2.888 | 30 Min | 2.388 | 2.357 | SURCH | 2.877 |
| NBU01/11A | 0.800 | 2.882 | 30 Min | 2.082 | 2.357 | SURCH | 2.877 |
| NBU01/12 | 0.190 | 2.564 | 30 Min | 2.374 | 2.036 | SURCH | 2.874 |
| NBU01/12A | 0.250 | 2.751 | 30 Min | 2.501 | 2.036 | SURCH | 2.874 |
| NBU04/02 | 1.853 | 2.989 | 20 Min | 1.136 | 3.173 | - | 3.479 |
| NBU05/01 | 2.300 | 2.994 | 20 Min | 0.694 | 4.040 | - | 4.109 |
| NBU1 | 0.378 | 2.943 | 25 Min | 2.565 | | | |
| NBUOUT1 | 0.350 | 2.400 | 15 Min | 2.050 | | | |
| NBUOUT2 | 1.100 | 2.400 | 15 Min | 1.300 | | | |
| NBUOUT2A | 0.100 | 2.400 | 15 Min | 2.300 | | | |

| Node Name | Invert Level (m AHD) | Peak Level m AHD | Critical Duration | Maximum Depth (m) | Surface IL (m AHD) | Surcharge? | Surface Water Lvl (m AHD) |
|---|---|---|---|---|---|---|---|
| ***C- Pilot Street*** | | | | | | | |
| NCU01/04 | 2.979 | 3.947 | 20 Min | 0.968 | 3.589 | SURCH | 4.004 |
| NCU01/05 | 2.527 | 3.839 | 20 Min | 1.312 | 3.500 | SURCH | 3.950 |
| NCU01/05A | 2.554 | 3.938 | 15 Min | 1.384 | 3.500 | SURCH | 3.950 |
| NCU01/06 | 1.583 | 3.560 | 30 Min | 1.977 | 3.452 | SURCH | 3.733 |
| NCU01/06A | 1.613 | 3.720 | 30 Min | 2.107 | 3.452 | SURCH | 3.733 |
| NCU01/07 | 1.310 | 3.486 | 30 Min | 2.176 | 3.403 | SURCH | 3.711 |
| NCU01/08 | 1.270 | 3.405 | 30 Min | 2.135 | 3.134 | SURCH | 3.711 |
| NCU01/09 | 0.850 | 3.183 | 30 Min | 2.333 | 3.050 | SURCH | 3.200 |
| NCU01/09A | 2.230 | 3.196 | 30 Min | 0.966 | 3.050 | SURCH | 3.200 |
| NCU01/11 | 0.270 | 2.877 | 30 Min | 2.607 | | | |
| NCU03/02 | 2.970 | 4.013 | 20 Min | 1.043 | 3.600 | SURCH | 4.066 |
| NCU04/02 | 2.370 | 3.561 | 60 Min | 1.191 | 3.175 | SURCH | 3.566 |
| NCU1 | 1.771 | 2.423 | 45 Min | 0.652 | | | |
| NCUOUT | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| NCUOUT2 | 0.000 | 2.400 | 15 Min | 2.400 | | | |
| ***D- Guard Street*** | | | | | | | |
| NDU01/02 | 4.081 | 5.454 | 25 Min | 1.373 | 5.181 | SURCH | 5.598 |
| NDU01/03 | 1.800 | 3.691 | 45 Min | 1.891 | 3.339 | SURCH | 3.520 |
| NDU01/04 | 0.500 | 2.817 | 60 Min | 2.317 | 2.159 | SURCH | 2.970 |
| NDU01/04A | 0.551 | 2.959 | 60 Min | 2.408 | 2.159 | SURCH | 2.970 |
| NDU01/05 | 0.260 | 2.765 | 60 Min | 2.505 | 1.900 | SURCH | 2.970 |
| NDU01/05A | 0.300 | 2.843 | 60 Min | 2.543 | 1.900 | SURCH | 2.970 |
| NDU01/06 | 0.211 | 2.705 | 60 Min | 2.494 | 2.100 | SURCH | 2.971 |
| NDU01/06A | 0.291 | 2.929 | 60 Min | 2.638 | 2.100 | SURCH | 2.971 |
| NDU01/07 | 0.152 | 2.616 | 60 Min | 2.464 | 2.200 | SURCH | 2.971 |
| NDU01/07A | 0.178 | 2.933 | 60 Min | 2.755 | 2.200 | SURCH | 2.971 |
| NDU02/02 | 2.387 | 3.721 | 45 Min | 1.334 | 3.061 | SURCH | 3.720 |
| NDU02/03 | 1.954 | 3.513 | 45 Min | 1.559 | 3.294 | SURCH | 3.708 |
| NDU02/04 | 2.511 | 3.703 | 45 Min | 1.192 | 3.151 | SURCH | 3.702 |
| NDU03/01 | 2.241 | 3.182 | 30 Min | 0.941 | 2.950 | SURCH | 3.182 |
| NDU03/03 | 1.602 | 3.005 | 60 Min | 1.403 | 2.412 | SURCH | 2.974 |
| NDU04/01 | 10.173 | 10.194 | 15 Min | 0.020 | 10.873 | - | 10.913 |
| NDU04/02 | 8.950 | 9.123 | 15 Min | 0.173 | 9.750 | - | 9.915 |
| NDU04/03 | 4.533 | 4.865 | 15 Min | 0.332 | 6.041 | - | 6.225 |
| NDU04/03A | 4.733 | 4.942 | 15 Min | 0.209 | 6.041 | - | 6.225 |
| NDU04/04 | 2.821 | 4.024 | 15 Min | 1.203 | 3.481 | SURCH | 3.726 |
| NDU04/04A | 2.921 | 3.978 | 15 Min | 1.057 | 3.481 | SURCH | 3.726 |
| NDU04/05 | 1.845 | 3.143 | 15 Min | 1.298 | 2.226 | SURCH | 2.970 |
| NDU04/05A | 1.890 | 2.978 | 60 Min | 1.088 | 2.226 | SURCH | 2.970 |
| NDU05/01 | 9.571 | 9.900 | 15 Min | 0.329 | 10.341 | - | 10.643 |
| NDU06/03 | 2.054 | 2.931 | 60 Min | 0.877 | 2.653 | SURCH | 3.008 |
| NDU07/01 | 1.222 | 2.980 | 60 Min | 1.758 | 2.392 | SURCH | 2.974 |
| NDU08/01 | 1.160 | 2.947 | 60 Min | 1.787 | 2.351 | SURCH | 2.972 |
| NDU1 | 1.270 | 2.799 | 60 Min | 1.529 | | | |
| NDUOUT1 | 0.900 | 2.400 | 15 Min | 1.500 | | | |
| NDUOUT2 | 0.050 | 2.400 | 15 Min | 2.350 | | | |
| NDUOUT3 | 0.900 | 2.400 | 15 Min | 1.500 | | | |

**TABLE C20**
**Peak Flows and Velocities- Surface Network- 100 Year Event**

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| ***A- Elizabeth Street*** | | | | | | | |
| LAS01/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LAS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 |
| LAS01/03A1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 |
| LAS01/04 | 0.39 | 20 Min | 0.62 | 0.22 | 0.14 | 0.26 | 0.16 |
| LAS01/05 | 0.44 | 20 Min | 0.23 | 0.26 | 0.06 | 0.28 | 0.07 |
| LAS01/06 | 0.96 | 20 Min | 0.81 | 0.28 | 0.23 | 0.19 | 0.16 |
| LAS01/07 | 1.09 | 20 Min | 0.49 | 0.19 | 0.09 | 0.37 | 0.18 |
| LAS01/08 | 2.43 | 20 Min | 0.86 | 0.37 | 0.32 | 0.58 | 0.50 |
| LAS01/10 | 1.05 | 30 Min | 0.38 | 0.19 | 0.07 | 0.58 | 0.22 |
| LAS01/10A1 | -1.27 | 25 Min | -0.29 | 0.19 | -0.05 | 0.58 | -0.17 |
| LAS01/10A8 | -0.14 | 25 Min | 0.23 | 0.19 | 0.04 | 0.46 | 0.11 |
| LAS01/12A1 | 0.99 | 30 Min | 0.90 | 0.28 | 0.25 | 0.58 | 0.52 |
| LAS02/01 | 0.07 | 30 Min | 0.30 | 0.05 | 0.01 | 0.11 | 0.03 |
| LAS02/01B1 | -0.08 | 30 Min | -0.09 | 0.05 | 0.00 | 0.28 | -0.02 |
| LAS02/02 | 0.36 | 15 Min | 0.62 | 0.11 | 0.07 | 0.22 | 0.14 |
| LAS03/01 | 0.14 | 30 Min | 0.34 | 0.09 | 0.03 | 0.18 | 0.06 |
| LAS03/01B1 | -0.17 | 30 Min | -0.19 | 0.09 | -0.02 | 0.26 | -0.05 |
| LAS03/02 | 0.66 | 15 Min | 0.67 | 0.18 | 0.12 | 0.19 | 0.13 |
| LAS03/03 | 0.90 | 15 Min | 0.86 | 0.19 | 0.16 | 0.28 | 0.24 |
| LAS04/01A3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 |
| LAS04/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 |
| LAS05/01 | 0.01 | 15 Min | 0.04 | 0.02 | 0.00 | 0.14 | 0.01 |
| LAS05/01B2 | -0.01 | 15 Min | -0.11 | 0.02 | 0.00 | 0.06 | -0.01 |
| LAS05/02 | 0.19 | 15 Min | 0.48 | 0.14 | 0.07 | 0.13 | 0.06 |
| LAS05/03 | 0.31 | 15 Min | 0.43 | 0.13 | 0.05 | 0.15 | 0.06 |
| LAS05/04 | 0.54 | 15 Min | 0.49 | 0.15 | 0.07 | 0.19 | 0.09 |
| LAS05/05 | 0.67 | 15 Min | 0.85 | 0.19 | 0.16 | 0.16 | 0.14 |
| LAS05/06 | 0.81 | 20 Min | 0.65 | 0.16 | 0.11 | 0.37 | 0.24 |
| LAS06/01A5 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LAS06/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.65 | 0.00 |
| LAS07/01 | 0.23 | 15 Min | 0.35 | 0.23 | 0.08 | 0.65 | 0.23 |
| LAS07/03A2 | 0.24 | 15 Min | 0.44 | 0.53 | 0.23 | 0.65 | 0.28 |
| LAS07/04 | 0.12 | 90 Min | 0.51 | 0.07 | 0.04 | 0.19 | 0.09 |
| LAS07/04A7 | -0.14 | 90 Min | -0.05 | 0.07 | 0.00 | 0.53 | -0.02 |
| LAS08/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 |
| LAS08/02 | 0.31 | 20 Min | 0.76 | 0.18 | 0.14 | 0.46 | 0.35 |
| LAS09/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 |
| LAS10/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.28 | 0.00 |
| LAS10/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 |
| LAS11/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.53 | 0.00 |
| LAS11/01B6 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 |
| LAS12/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.47 | 0.00 |
| LAS12/03 | -0.61 | 30 Min | -0.26 | 0.21 | -0.05 | 0.47 | -0.12 |
| LAS12/03A1 | 0.60 | 30 Min | 0.60 | 0.21 | 0.13 | 0.28 | 0.17 |
| ***B- Pier Street*** | | | | | | | |
| LBS01/03 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.28 | 0.00 |
| LBS01/04 | 0.17 | 30 Min | 0.24 | 0.07 | 0.02 | 0.26 | 0.06 |
| LBS01/04B1 | -0.18 | 30 Min | -0.17 | 0.07 | -0.01 | 0.28 | -0.05 |
| LBS01/06 | 0.11 | 30 Min | 0.38 | 0.04 | 0.02 | 0.14 | 0.05 |
| LBS01/06B1 | -0.11 | 30 Min | -0.13 | 0.04 | -0.01 | 0.26 | -0.03 |
| LBS01/07 | 0.31 | 15 Min | 0.76 | 0.14 | 0.10 | 0.28 | 0.21 |
| LBS01/09 | 0.15 | 15 Min | 0.83 | 0.14 | 0.12 | 0.15 | 0.13 |
| LBS01/09B1 | 0.19 | 15 Min | 0.70 | 0.14 | 0.10 | 0.28 | 0.19 |
| LBS01/10 | 0.25 | 25 Min | 0.52 | 0.15 | 0.08 | 0.52 | 0.27 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LBS01/11 | 0.65 | 20 Min | 0.13 | 0.52 | 0.07 | 0.84 | 0.11 |
| LBS02/01 | 0.02 | 15 Min | 0.23 | 0.06 | 0.01 | 0.14 | 0.03 |
| LBS02/01B5 | 0.08 | 15 Min | 0.41 | 0.06 | 0.02 | 0.07 | 0.03 |
| LBS03/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 |
| LBS03/01C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 |
| LBS04/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 |
| LBS04/01A7 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.23 | 0.00 |
| LBS04/02B1 | 0.81 | 20 Min | 0.83 | 0.31 | 0.25 | 0.84 | 0.70 |
| LBS04/03 | -0.04 | 15 Min | -0.13 | 0.03 | 0.00 | 0.14 | -0.02 |
| LBS05/01 | 0.24 | 15 Min | 0.40 | 0.07 | 0.03 | 0.31 | 0.12 |
| LBS06/01 | 0.23 | 20 Min | 0.35 | 0.18 | 0.06 | 0.40 | 0.14 |
| LBS06/02 | 0.54 | 25 Min | 0.16 | 0.40 | 0.06 | 0.84 | 0.14 |
| ***C- Pilot Street*** | | | | | | | |
| LCS01/01 | 0.16 | 15 Min | 0.55 | 0.26 | 0.15 | 0.27 | 0.15 |
| LCS01/02 | 1.40 | 15 Min | 0.91 | 0.27 | 0.25 | 0.20 | 0.18 |
| LCS01/03 | 1.72 | 15 Min | 0.84 | 0.20 | 0.17 | 0.41 | 0.35 |
| LCS01/04 | 2.88 | 15 Min | 0.70 | 0.41 | 0.29 | 0.45 | 0.32 |
| LCS01/05 | 2.79 | 15 Min | 0.84 | 0.45 | 0.38 | 0.28 | 0.24 |
| LCS01/06 | 0.00 | 15 Min | 0.00 | 0.28 | 0.00 | 0.31 | 0.00 |
| LCS01/06D2 | 2.60 | 15 Min | 1.88 | 0.28 | 0.53 | 0.45 | 0.84 |
| LCS01/07 | 1.00 | 15 Min | 0.61 | 0.31 | 0.19 | 0.58 | 0.35 |
| LCS01/07D2 | -1.56 | 20 Min | -1.05 | 0.31 | -0.32 | 0.45 | -0.47 |
| LCS01/08 | 0.29 | 30 Min | 0.56 | 0.58 | 0.32 | 0.15 | 0.08 |
| LCS01/09D3 | 0.59 | 30 Min | 0.36 | 0.15 | 0.05 | 0.23 | 0.08 |
| LCS01/10C1 | 0.30 | 15 Min | 0.57 | 0.15 | 0.09 | 0.15 | 0.09 |
| LCS01/11 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.39 | 0.00 |
| LCS01/11B1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.52 | 0.00 |
| LCS01/11C1 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 |
| LCS01/OUT | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 1.86 | 0.00 |
| LCS02/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.27 | 0.00 |
| LCS02/01C3 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 |
| LCS03/01 | 0.75 | 15 Min | 0.32 | 0.07 | 0.02 | 0.47 | 0.15 |
| LCS03/01D1 | 0.03 | 15 Min | 0.30 | 0.07 | 0.02 | 0.10 | 0.03 |
| LCS03/02 | 1.01 | 15 Min | 0.42 | 0.47 | 0.19 | 0.41 | 0.17 |
| LCS04/01 | -0.16 | 45 Min | -0.08 | 0.12 | -0.01 | 0.39 | -0.03 |
| LCS04/01D8 | 0.13 | 60 Min | 0.04 | 0.12 | 0.01 | 0.62 | 0.03 |
| ***D- Guard Street*** | | | | | | | |
| LDS01/01 | -0.09 | 15 Min | 0.18 | 0.10 | 0.02 | 0.42 | 0.08 |
| LDS01/02 | 0.45 | 15 Min | 3.51 | 0.42 | 1.46 | 0.18 | 0.64 |
| LDS01/02D6 | 0.00 | 15 Min | 0.00 | 0.42 | 0.00 | 0.00 | 0.00 |
| LDS01/03 | 1.13 | 30 Min | 0.23 | 0.18 | 0.04 | 0.81 | 0.18 |
| LDS01/03D2 | -0.89 | 45 Min | -0.42 | 0.18 | -0.08 | 0.55 | -0.23 |
| LDS01/04 | 1.56 | 30 Min | 0.12 | 0.81 | 0.10 | 1.07 | 0.13 |
| LDS01/06 | -1.36 | 20 Min | -0.13 | 0.87 | -0.11 | 1.07 | -0.14 |
| LDS01/07 | -1.37 | 20 Min | -0.13 | 0.77 | -0.10 | 0.87 | -0.12 |
| LDS02/01 | 0.73 | 30 Min | -0.13 | 0.45 | -0.06 | 0.66 | -0.09 |
| LDS02/03 | -0.89 | 30 Min | -0.21 | 0.41 | -0.09 | 0.66 | -0.14 |
| LDS02/03D2 | 0.65 | 30 Min | -0.34 | 0.41 | -0.14 | 0.55 | -0.19 |
| LDS03/01 | 0.65 | 30 Min | 0.67 | 0.23 | 0.15 | 0.29 | 0.19 |
| LDS03/02 | 0.22 | 20 Min | 0.14 | 0.29 | 0.04 | 0.56 | 0.08 |
| LDS03/02D7 | 0.52 | 20 Min | 0.21 | 0.29 | 0.06 | 0.58 | 0.12 |
| LDS03/04 | -0.79 | 20 Min | -0.36 | 0.39 | -0.14 | 0.56 | -0.20 |
| LDS03/04D1 | 0.72 | 25 Min | 0.14 | 0.39 | 0.05 | 0.81 | 0.11 |
| LDS04/01 | 0.55 | 15 Min | 0.39 | 0.04 | 0.02 | 0.17 | 0.06 |
| LDS04/02 | 1.70 | 15 Min | 1.96 | 0.17 | 0.32 | 0.18 | 0.36 |
| LDS04/03 | 1.06 | 15 Min | 1.57 | 0.18 | 0.29 | 0.25 | 0.39 |
| LDS04/03D6 | 0.69 | 15 Min | 0.98 | 0.18 | 0.18 | 0.35 | 0.35 |
| LDS04/04 | 1.41 | 15 Min | 0.52 | 0.25 | 0.13 | 0.74 | 0.39 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) | U/S Node Depth (m) | U/S Node v.d ($m^2/s$) | D/S Node Depth (m) | D/S Node v.d ($m^2/s$) |
|---|---|---|---|---|---|---|---|
| LDS04/OUT | 0.75 | 60 Min | 1.88 | 0.74 | 1.40 | 1.86 | 3.50 |
| LDS05/01 | 1.07 | 15 Min | 1.92 | 0.30 | 0.58 | 0.17 | 0.32 |
| LDS06/01 | 0.00 | 15 Min | 0.00 | 0.00 | 0.00 | 0.29 | 0.00 |
| LDS06/02 | 0.67 | 15 Min | 0.66 | 0.29 | 0.19 | 0.35 | 0.23 |
| LDS06/03 | 1.98 | 15 Min | 0.41 | 0.35 | 0.15 | 1.07 | 0.44 |
| LDS07/02 | -0.86 | 25 Min | -0.28 | 0.42 | -0.12 | 0.58 | -0.16 |
| LDS07/02D1 | 0.71 | 45 Min | 0.16 | 0.42 | 0.07 | 0.87 | 0.14 |
| LDS08/02 | 0.58 | 20 Min | -0.17 | 0.47 | -0.08 | 0.62 | -0.11 |
| LDS08/02D1 | -1.76 | 20 Min | -0.18 | 0.47 | -0.08 | 0.77 | -0.14 |
| LDS09/01 | 1.45 | 20 Min | 0.30 | 0.38 | 0.12 | 0.77 | 0.23 |
| LDS09/01D4 | -1.46 | 20 Min | -0.32 | 0.38 | -0.12 | 0.74 | -0.24 |

**TABLE C21**
**Peak Flows and Velocities- Underground Network- 100 Year Event**

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| ***A- Elizabeth Street*** | | | |
| LAU01/02 | 0.12 | 30 Min | 0.75 |
| LAU01/04 | 0.24 | 90 Min | 0.84 |
| LAU01/04A | 0.22 | 25 Min | 0.69 |
| LAU01/05 | 0.32 | 90 Min | 1.10 |
| LAU01/05A | 0.14 | 60 Min | 0.50 |
| LAU01/06 | 0.83 | 15 Min | 1.30 |
| LAU01/06A | 0.47 | 15 Min | 0.82 |
| LAU01/07 | 0.87 | 15 Min | 1.35 |
| LAU01/07A | 0.05 | 15 Min | 0.40 |
| LAU01/08 | 0.96 | 25 Min | 1.49 |
| LAU01/08A | 0.17 | 15 Min | 0.73 |
| LAU01/09 | 1.90 | 20 Min | 1.48 |
| LAU01/09A | 1.22 | 15 Min | 0.95 |
| LAU01/10 | 2.47 | 30 Min | 1.28 |
| LAU01/10A | 0.33 | 30 Min | 1.00 |
| LAU01/11 | 3.58 | 30 Min | 1.05 |
| LAU01/11A | 1.16 | 30 Min | 1.34 |
| LAU01/12 | 3.66 | 30 Min | 1.07 |
| LAU01/12A | 0.09 | 30 Min | 0.39 |
| LAU03/03 | 0.11 | 60 Min | 1.01 |
| LAU05/02 | 0.06 | 15 Min | 0.75 |
| LAU05/04 | 0.09 | 45 Min | 0.84 |
| LAU05/05 | 0.07 | 25 Min | 0.58 |
| LAU05/06 | 0.12 | 60 Min | 1.04 |
| LAU07/02 | 0.08 | 60 Min | 0.50 |
| LAU07/03 | 0.15 | 90 Min | 0.92 |
| LAU08/02 | 0.03 | 15 Min | 0.51 |
| LAU08/03 | 0.30 | 15 Min | 1.04 |
| LAU12/02 | 0.10 | 30 Min | 1.39 |
| ***B- Pier Street*** | | | |
| LBU01/04 | 0.53 | 60 Min | 1.84 |
| LBU01/04A | 0.53 | 60 Min | 0.91 |
| LBU01/05 | 0.86 | 25 Min | 1.91 |
| LBU01/05A | 0.54 | 25 Min | 0.62 |
| LBU01/06 | 0.86 | 25 Min | 1.92 |
| LBU01/07 | 0.99 | 15 Min | 1.54 |
| LBU01/07A | 0.27 | 15 Min | 0.79 |
| LBU01/08 | 1.49 | 20 Min | 1.31 |
| LBU01/08A | 0.51 | 20 Min | 0.57 |
| LBU01/10 | 1.51 | 15 Min | 1.32 |
| LBU01/10A | 0.08 | 15 Min | 0.50 |
| LBU01/11 | 1.27 | 30 Min | 0.99 |
| LBU01/11A | -0.36 | 15 Min | -0.62 |
| LBU01/12 | 2.52 | 30 Min | 0.99 |
| LBU01/12A | 1.50 | 30 Min | 0.92 |
| LBU01/12LF | 0.35 | 30 Min | 0.77 |
| LBU04/02 | 0.10 | 20 Min | 0.91 |
| LBU05/01 | 0.01 | 15 Min | 0.13 |
| LBU06/01 | 0.13 | 25 Min | 0.81 |
| LBU1 | 0.13 | 25 Min | 1.78 |
| ***C- Pilot Street*** | | | |
| LCU01/04 | 0.16 | 90 Min | 1.05 |
| LCU01/05 | 0.45 | 90 Min | 1.60 |
| LCU01/05A | 0.34 | 60 Min | 1.05 |

| Link Name | Maximum Flow ($m^3/s$) | Critical Duration | Maximum Velocity (m/s) |
|---|---|---|---|
| LCU01/06 | 0.76 | 60 Min | 0.88 |
| LCU01/06A | 0.37 | 60 Min | 1.13 |
| LCU01/07 | 0.76 | 60 Min | 0.88 |
| LCU01/08 | 1.13 | 45 Min | 1.30 |
| LCU01/09 | 1.19 | 30 Min | 1.36 |
| LCU01/09A | 0.15 | 15 Min | 0.43 |
| LCU01/11 | 1.19 | 30 Min | 1.36 |
| LCU03/02 | 0.07 | 90 Min | 1.01 |
| LCU04/02 | 0.10 | 60 Min | 1.39 |
| LCU1 | 0.10 | 60 Min | 0.34 |
| ***D- Guard Street*** | | | |
| LDU01/02 | 0.35 | 20 Min | 1.54 |
| LDU01/03 | 0.30 | 20 Min | 1.86 |
| LDU01/04 | 0.45 | 60 Min | 0.83 |
| LDU01/04A | 0.20 | 60 Min | 0.87 |
| LDU01/05 | 1.84 | 60 Min | 0.81 |
| LDU01/05A | 1.46 | 60 Min | 0.64 |
| LDU01/06 | 2.14 | 60 Min | 0.94 |
| LDU01/06A | 0.31 | 60 Min | 0.95 |
| LDU01/07 | 2.51 | 60 Min | 1.10 |
| LDU01/07A | 0.38 | 60 Min | 1.16 |
| LDU02/02 | 0.06 | 15 Min | 0.91 |
| LDU02/03 | 0.40 | 25 Min | 1.41 |
| LDU02/04 | 0.07 | 15 Min | 1.01 |
| LDU03/01 | 0.02 | 30 Min | 0.20 |
| LDU03/03 | 0.14 | 90 Min | 0.48 |
| LDU04/01 | 0.00 | 15 Min | 0.26 |
| LDU04/02 | 0.18 | 15 Min | 3.06 |
| LDU04/03 | 0.22 | 15 Min | 2.59 |
| LDU04/03A | 0.04 | 15 Min | 0.65 |
| LDU04/04 | 0.17 | 15 Min | 1.50 |
| LDU04/04A | 0.07 | 15 Min | 0.65 |
| LDU04/05 | 0.15 | 15 Min | 1.29 |
| LDU04/05A | 0.03 | 60 Min | 1.02 |
| LDU05/01 | 0.14 | 15 Min | 1.50 |
| LDU06/03 | 0.06 | 15 Min | 0.58 |
| LDU07/01 | 0.19 | 90 Min | 0.68 |
| LDU08/01 | 0.47 | 60 Min | 1.65 |
| LDU1 | 0.06 | 15 Min | 0.57 |

# APPENDIX D

## Estimated Construction Costs

### List of Tables

**TABLE D1**
**Typical Construction Costs**

| Item | Unit | Cost ($) |
|---|---|---|
| ***Pipes*** | | |
| 300 dia RCP | /m | 90 |
| 375 dia RCP | /m | 110 |
| 450 dia RCP | /m | 135 |
| 525 dia RCP | /m | 155 |
| 600 dia RCP | /m | 180 |
| 675 dia RCP | /m | 215 |
| 750 dia RCP | /m | 250 |
| 825 dia RCP | /m | 270 |
| 900 dia RCP | /m | 320 |
| 1050 dia RCP | /m | 405 |
| 1200 dia RCP | /m | 520 |
| 1350 dia RCP | /m | 635 |
| ***Manholes*** | | |
| 1,050 dia manhole | item | 1800 |
| Multi pipe manhole | item | 10000 |
| ***Gully Pits*** | | |
| 1 Bay SEP | item | 1500 |
| 2 Bay SEP | item | 1600 |
| 3 Bay SEP | item | 1900 |
| 4 Bay SEP | item | 2200 |
| ***Roadworks*** | | |
| Road replacement | $/m^2$ | 65 |

*Note Figures for 2003*