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City of Winnipeg Water and Waste Department Wastewater Hydraulic Modeling Guidelines

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Document History and Status

Revision	Prepared by	Date	Reviewed by	Date	Approved by	Date
1.0	SMG	03/20/2020	PTC/FL/IN	07/06/2020	PTC	07/07/2020

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1 Reference Guidelines

1.1.1 The following documents can be used as supplementary resources for modeling of hydraulic sewer systems.

1.1.1.1 Code of Practise for the Hydraulic Modelling of Urban Drainage Systems Version 01, 2017. CIWEM (Chartered Institution of Water Environmental Management)
https://www.ciwem.org/assets/pdf/Special%20Interest%20Groups/Urban%20Drainage%20Group/Code%20of%20Practice%20for%20the%20Hydraulic%20Modelling%20of%20Ur.pdf

1.1.1.2 Integrated Urban Drainage Modelling Guide, 2009. WaPUG (Wastewater Planning Users Group) & CIWEM (Chartered Institution of Water Environmental Management)
https://www.ciwem.org/assets/pdf/Special%20Interest%20Groups/Urban%20Drainage%20Group/Integrated-Urban-Drainage-Modelling-Guide.pdf

1.1.1.3 Guide to The Quality Modelling of Sewer Systems, 2006. WaPUG (Wastewater Planning Users Group)
https://www.ciwem.org/assets/pdf/Special%20Interest%20Groups/Urban%20Drainage%20Group/Guide-to-the-Quality-Modelling-of-Sewer-Systems.pdf

1.1.2 Where there is a discrepancy between what is stated in this guideline and what is stated in the documents above, the content of this guideline shall take precedence.

2 Definitions

2.1.1 Refer to Appendix A – Standard Database Contents for details on the hydraulic models, rainfall, river level and other files available within the model database utilized internally with the City of Winnipeg (City or CoW).

2.1.2 Flow Conditions Definitions

2.1.2.1 Figure 1 below shows the typical dry weather flow patterns in a sewer catchment, illustrating the definitions of average dry weather flow (ADWF), peak dry weather flow (PDWF), design dry weather flow (DDWF) and baseflow.

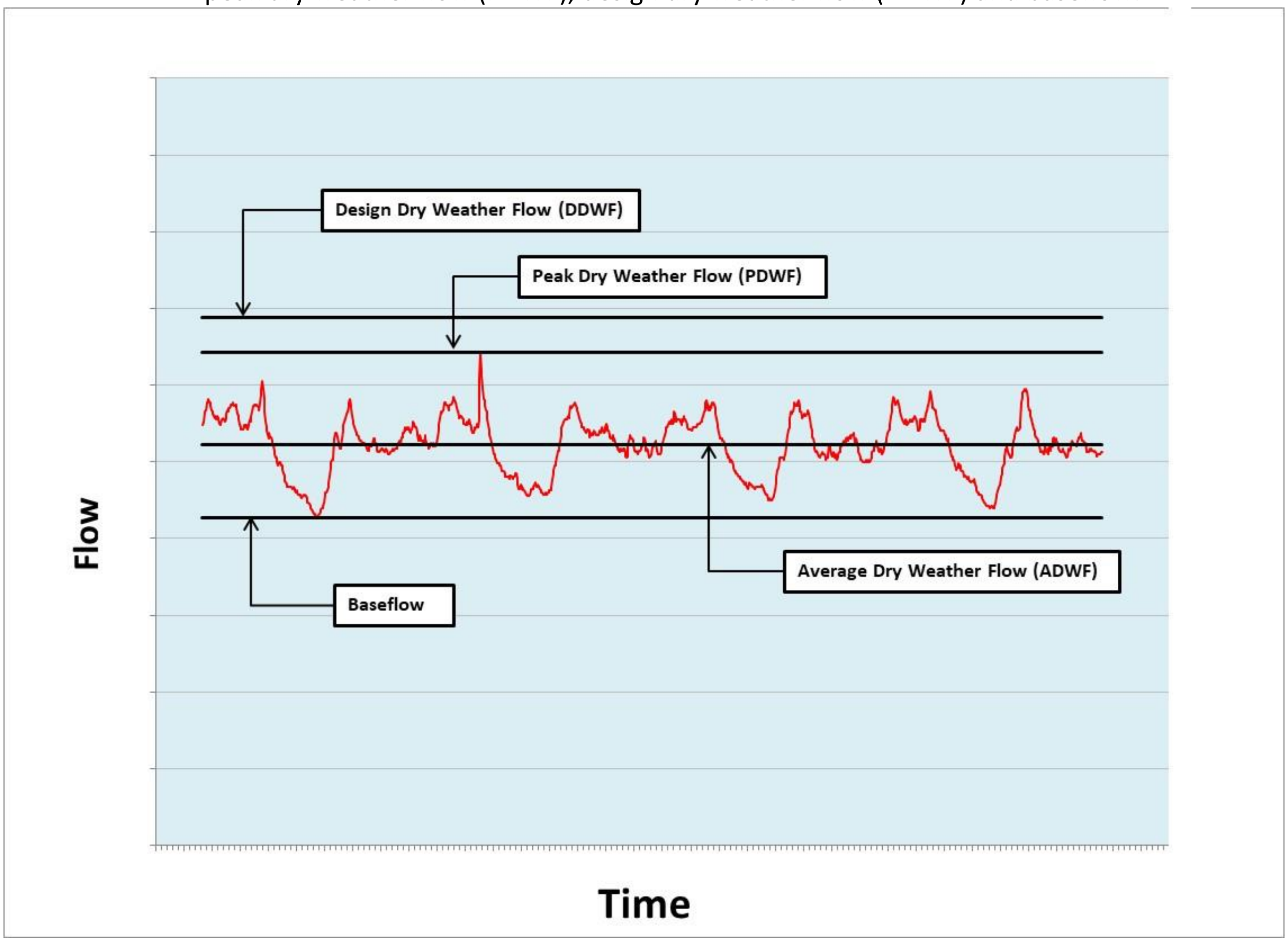

Figure 1: Dry Weather Flow Components

2.1.2.2 ***Average Dry Weather Flow (ADWF)*** – The average flow rate during dry weather flow conditions. The DWF values vary between winter and summer seasons, see Figure 1.

2.1.2.3 ***Baseflow*** – steady ground water infiltration from cracks in pipes, manholes, foundation drain connections and other sewer infrastructure. Also known as base infiltration, see Figure 1.

2.1.2.4 ***Design Dry Weather Flow (DDWF)*** – 2.75 x (ADWF – Baseflow) + Baseflow. Design dry weather flow is used to size and assess sewer infrastructure operation in DWF; it is DWF with a design factor of safety applied. The original diversion structures and interceptor sewers were based on 2.75XADWF. See Figure 1.

2.1.2.5 ***Inflow*** - steady inflow from cooling tower discharges, unknown connections or other sources.

2.1.2.6 ***Peak Dry Weather Flow (PDWF)*** – The typical maximum flow rate during dry weather flow conditions, see Figure 1.

2.1.3 Model Networks Definitions

2.1.3.1 ***Baseline Model Network*** - This is the City of Winnipeg Hydraulic model network developed during the CSO Master Plan Preliminary Proposal. It is utilized as the baseline sewer network performance and other network results are compared to track changes performance (e.g. changes in combined sewage volume capture as per the goals of the CSO Master Plan). This model network represents the sewer system as of 2013, and was completed in 2015. Various updates have been completed since this time during annual model maintenance work to improve the 2013 model representation.

This version of the Baseline Model Network is used for combined sewer and wastewater sewer evaluations.

2.1.3.2 ***Current Model Network*** – This is the City of Winnipeg Current Year Sewer Network representation developed up to the year in question. It provides the best available representation of the sewer network condition for that specific year.

2.1.3.3 ***Current Solution Model Network*** - This network is based on the Current Model with the proposed solution or solutions representations modelled by the Consultant as part of the work they are required to complete.

This Model Network is created by Consultants as part of Solution Development.

2.1.3.4 ***Future Model Network*** – This model network is created as part of Solution Development, and is compared against the Future Solution Model Network.

This is based on the Current Model Network with the future projected populations, and levels of development as part of a design horizon for the solution in question. The specific design horizon applied will be based on the design life of the specific solution components being evaluated.

This Model Network is created by Consultants as part of Solution Development.

2.1.3.5 ***Future Solution Model Network*** – This network is based on the Future Model Network with the proposed solution or solutions representations modelled by the Consultant as part of the work they are required to complete.

This Model Network is created by Consultants as part of Solution Development.

2.1.3.6 ***Global Model*** – This is also called the "all pipes model". This is a type II/III network and is typically used to assess basement flooding; it includes all combined and wastewater sewer pipes within the local and regional sewer systems and land drainage sewers which interact with the combined sewer system, private sewer service connection pipes are not included.

It should be agreed with the City PM the type of network is to be used to appraise system performance and develop solutions.

Global Model and Regional Model versions of networks are available within the City model database.

2.1.3.7 ***Regional Model*** – This is the "skeletonized model". This is a type I/II network and is used for planning and CSO performance. It has less sewers and manholes represented in comparison to the Global Model, while still providing similar bulk hydraulic performance. The Regional Model encompasses the entire sewer system, but does not include all of the local sewer details.

It should be agreed with the City PM the type of network is to be used to appraise system performance and develop solutions.

A version of the Global Model and Regional Model is available within the City model database.

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3 Guidelines Purpose

3.1.1 This document provides high level guidance as to the requirements expected of hydraulic model databases developed, updated or refined, to be submitted to the City of Winnipeg Water and Waste Department.

3.1.2 The intent is to ensure consistency of the modelling approaches utilized by different Consultants. This is to ensure components of Consultants model submissions can be effectively integrated into the City of Winnipeg Sewer System Hydraulic Model Database.

3.1.3 The guidelines are specific to hydraulic models developed using InfoWorks ICM SE or InfoWorks ICM Software. The City of Winnipeg requires all hydraulic models to be developed using InfoWorks ICM SE or InfoWorks ICM Software.

3.1.4 The guidelines are aligned with the development of models of the City of Winnipeg's sanitary sewer system, both separate and combined sewers.

3.1.5 The guidelines may be applied to development of models of the City of Winnipeg's land drainage sewer system, however, these guidelines were not developed specifically for this purpose.

3.1.6 This is a living document that will evolve over time to keep up with advances and lessons learned in the industry.

4 Data Collection

4.1 InfoWorks Version

4.1.1 The InfoWorks version applicable to the Hydraulic Model Database supplied to the Consultant must be utilized by the Consultant for the work. The Consultant must not use an updated version of the software with this database.

4.1.2 Further to 4.1.1, a different version of the software may be accepted only upon request.

4.2 Data Hierarchy

4.2.1 The following data sources shall be utilized by Consultants where available as part of Model Build or Model Maintenance work. Each of the data sources is ranked by priority in which they should be relied upon for hydraulic model updates:

i. Field Investigations/Survey Data
ii. As-Built Record Drawings
iii. Direct City of Winnipeg Advice or Statements
iv. Operating and Maintenance Manuals
v. Flood Manual Data
vi. Design Drawings
vii. GIS Data
viii. Sewer Management System (SMS) Data
ix. Interpolated data between known points
x. Inferred/assumed data based on best available knowledge

4.2.2 Where multiple data sources among those available in 4.2.1 are found in which conflicting data is noted, the data source of the higher priority ranking in 4.2.1 should be utilized. The rational for utilising a lower ranking data source should be documented.

4.3 Hydraulic Model Data Flagging

4.3.1 The consultant is to utilize the data flags shown in Table 1: City of Winnipeg Data Flags Master Table. These are the standardized data flag options used in the City of Winnipeg Hydraulic Model.

4.3.2 The Consultant shall not create new data flags as part of their work unless requested otherwise by the City, and they shall only apply the most appropriate data flag as indicated in Table 1: City of Winnipeg Data Flags Master Table below.

4.3.3 A Data Flag file containing these user defined data flags is provided with the City model database.

Table 1: City of Winnipeg Data Flags Master Table

Flag ID	Flag Description	Defunct	Colour ID
#A	Asset Data	0	13168840
#D	System Default	0	15780518
#G	Data from GeoPlan	0	65280
#I	Model Import	0	3981040
#V	CSV Import	0	33023
A1	Assumed/Estimated - best estimated (calcs and surveys)	0	255
A2	Assumed/Estimated - estimated (incomplete surveys and plans)	0	8421631
A3	Assumed/Estimated - estimation (engineering judgment)	0	13026812
AS	Ancillary Survey Data	0	13447873
CC	CCTV Data - measured survey data	0	37265
D1	Data From Other Sources - factual data	0	14276864
F1	Flow Survey Data - measured from site surveys	0	47360
F2	Flow Survey Data - adjusted from site surveys	0	60416
F3	Flow Survey Data - assumptions from observed data	0	9240460
GC	Growth - impermeable area	0	327679
GD	Growth - development data local plans	0	9699327
GH	Growth - climate change and design horizons	0	13041663
IA	IAS - impervious area survey	0	33023
IF	InfoWorks Inferred Data	0	16776960
IN	Instrumentation	0	8388863
MH	Manhole survey data	0	16059037
N1	COW GIS - As Built	0	10420383
N2	COW GIS - Cert Drawings and Surveys Outside COW Spec	0	12845252
N3	COW GIS - Archived Records and Drawings	0	15859954
N4	COW GIS - Extrapolation between equal values	0	16729855
N5	COW GIS - Extrapolation between unequal values	0	16747263
N6	COW GIS - Third Party Data	0	16749055
N7	COW GIS - COW Ops Verbal	0	16756991
N8	COW GIS - Third Party and Unknown Sources	0	16762623
O1	Option Development - detailed design	0	25284
O2	Option Development - pre-detailed design	0	29670
O3	Option Development - high level desktop options	0	6205183
PD	Population Data - address point and occupancy rate	0	5746176
R1	Record Plans - as-built drawings	0	12171705
R2	Record Plans - proposed scheme drawings	0	14737632

Flag ID	Flag Description	Defunct	Colour ID
S1	Survey Data - survey as per COW specification	0	16730698
S2	Survey Data - out with COW specification	0	16745090
S3	Survey Data - archived survey information	0	16761281
SM	SWMM Data	0	14492362
TC	Trade Flows - trade effluent register /measured data	0	8388863
PC	Population Data - 2011 Census	0	14737632

4.4 Geographic Information System Data

4.4.1 The following Geographic Information System (GIS) feature classes shown in Table 2 will be provided with the ***Baseline Model Network*** and ***Current Model Network***. These GIS feature classes are typically utilized by the City of Winnipeg within the hydraulic model:

Table 2: GIS Feature Classes Provided With Model Database

GIS Feature Class Name	Feature Class Description
AIRPORT	Display of property boundaries
BASE_ROW_OUTLINE	Outline of outside boundaries of roadways
BUILDING_OUTLINE	Roof outline of each residential and commercial property
CITY_LIMIT	Outline on extents of City of Winnipeg
GREENSPACE	Boundaries of green spaces such as parks, in the city.
ORTHO.IMG_[YEAR]_MOSAIC	High resolution aerial imagery of the city.
PARCEL_LINE	Boundaries of each property in the city.
RIVER LINE	Outer boundary of river reaches in the city.
SEWER_CB	Locations of catch basins throughout the city.
SEWER_CI	Location of major sewer catch basin inlets throughout the city.
SEWER_CIPP_LINE	Location and extents of CIPP lining work completed in existing sewer mains.
SEWER_CLEANOUT	Location of major sewer cleanout points in the collection system.
SEWER_COUPLER	Location of coupler connections within the collections system.
SEWER_CTRL_GATE	Locations of outfall flap or sluice gates throughout the city.
SEWER_CTRL_STRUCTURE	Outline of control gate chambers.
SEWER_DISTRICT	Outer boundaries of each combined and separate sewer district.
SEWER_LDS_AREA	Outer boundaries of each smaller LDS catchment area in the city.
SEWER_LDS_REGION	Outer boundaries of the larger LDS regions in the city.

GIS Feature Class Name	Feature Class Description
SEWER_MAIN	Linework to represent each combined or sewer in the city.
SEWER_PLUG	Locations of capped or plugged existing sewers.
SEWER_PUMP	Location of each pump within pump stations or other collections infrastructure in the city.
SEWER_PUMP_STATION	Building outline for each pump/lift station for the collection system in the city.
SEWER_REDUCER	Location of each sewer reducer in collection system.
SEWER_SRB	Outer boundary of each stormwater retention basin.
SEWER_TEE	Location of sewer tee connections.
SEWER_VALVE	Location of each major control valve through the collection system.
STREET	Street centerline, with street name attribute data.

4.4.2 Additional GIS feature class data is available within the City of Winnipeg corporate GIS system. Specific GIS data may be requested for availability and use by the Consultant.

5 Model Submissions

5.1 City of Winnipeg Hydraulic Model Database Request and Utilization

5.1.1 For each new project, the City model database may be requested by Consultants, either as part of the Tender phase of Consultant Services Request for Proposals (RFP) in which the hydraulic modelling is to be completed, or else upon award of an RFP for such works.

5.1.2 Consultants may not utilize the City model database provided for one specific City of Winnipeg project for any another project.

5.1.3 The model database provided for a specific project as per 5.1.1 should be used for the duration of the project. If an updated version of the model database is requested by the Consultant, appropriate justification should be provided.

5.2 General Model Submission Requirements

5.2.1 Refer to Appendix A – Standard Database Contents for details on the hydraulic models, rainfall, river level and other files available within the model database utilized internally with the City of Winnipeg (City or CoW). All models developed should follow the naming and file structure to that in the City Standard Database.

5.3 Mandatory Model Submission Stages

5.3.1 Updated versions of the ***Current Model Network***, ***Current Solution Model Network, Future Model Network,*** and ***Future Solution Model Network*** as applicable shall be required at the following design/development stages:

5.3.1.1 Prior to the Conceptual Design Report finalization, and prior to the Conceptual Design Report review meeting, if included as part of the Conceptual Design Phase.

5.3.1.2 Prior to the Preliminary Design Report finalization, and prior to the Preliminary Design Report review meeting, if included as part of the Preliminary Design Phase.

5.4 Discretionary Model Submission Stages

5.4.1 Updated versions of the ***Current Model Network***, ***Current Solution Model Network, Future Model Network,*** and ***Future Solution Model Network*** as applicable may be required at the following design/development stages:

5.4.1.1 Prior to the Detailed Design Report finalization, and prior to the Detailed Design Report review meeting, if included as part of the Detailed Design Phase. The resubmission of the hydraulic model during Detailed Design are required if there were changes made following the Preliminary Design Phase which impact hydraulic performance.

5.4.1.2 At specific points of the construction phase of specific solutions previously modelled. The timing of these model resubmissions shall be at the discretion of the City of Winnipeg.

5.4.1.3 The resubmission of the hydraulic model during the construction phase as per 5.4.1.2 would be requested if there are changes made during construction that impact the hydraulic performance of the solution modeled during detailed design.

5.5 Model Submission Requirements

5.5.1 This sub-section documents the minimum requirements when a model database is to be re-submitted to the City of Winnipeg during different stages of a project.

5.5.2 When the model is to be submitted back to the City of Winnipeg, the Consultant must create selection list files which select objects added/changed as part of the update work.

5.5.3 Submission documents may include sewer network maps illustrating the hydraulic condition of the ***Baseline Model Network*, *Current/Future Model Network***, and ***Current/Future Solution Model Network***.

5.5.3.1 The maps shall identify areas that are subject to basement flooding with flood depths shown at the corresponding nodes.

5.5.3.2 The maps shall identify areas that are subject to out of sewer flooding shown at the corresponding nodes.

5.5.3.3 The maps shall identify overflows with overflow volume and duration shown at the corresponding outfall nodes.

5.5.4 The sewer network maps referenced in 5.5.3 shall be required as part of the model submission under the following conditions:

5.5.4.1 Solution Development work has been completed using the hydraulic model and Detriment Analysis has been completed. See 8 Solution Development and Appendix C – Detriment Analysis Process & Level of Service Standards).

5.5.4.2 During the Detriment Analysis process where specific detriments were predicted, but are believed to not be relation to specific solution(s) developed.

5.5.4.3 The sewer network maps will be utilized to demonstrate the extent of detriments deemed acceptable by the Consultant.

5.5.4.4 A final "As-Built" version of the hydraulic model documenting the final sizing and configuration of a solution constructed may be requested by the City. This will be used to update the ***Current Model Network*.**

6 Model Build

6.1 General Model Build Parameters

6.1.1 Coordinate System Assignment

6.1.1.1 All models produced must be set to the following coordinate system:

UTM Zone 14 (NAD 83) [EPSG 26914]

6.1.2 System Type

6.1.2.1 Utilize the following convention in Table 3 for assigning the System type for all nodes, links, and subcatchments.

Table 3: *System Type* Naming Convention

Sewer Type	*System type* Parameter Entered
Combined Sewer (CS)	combined
Land Drainage Sewer (LDS)	storm
Wastewater Sewer (WWS)	sanitary
Storm Relief Sewer (SRS)	overland

6.2 Modeling Manhole Nodes

6.2.1 Naming

6.2.1.1 Ensure the *Node ID/Asset ID* corresponds with the existing Asset IDs from the GIS data. In the absence of GIS Asset IDs, a temporary sequential numbering system can be used.

6.2.2 Flood Type

6.2.2.1 Utilize the following convention in Table 4 for assigning the *Flood type*.

Table 4: Node *Flood Type* Naming Convention

Sewer Type	*Flood type* Parameter Entered
Wastewater Sewer (WWS)	For existing MH's, a *Flood type* of Lost is typically assigned. This is where any out of sewer flooding is not expected to return to the sewer system. For existing WWS systems where a volume of out of sewer flooding can return to the sewer system, a *Flood type* of Stored should be assigned.

Sewer Type	*Flood type* Parameter Entered
	A *Flood type* of Sealed is utilized for MHs where no out of sewer flooding can occur (like buried manholes).
Combined Sewer (CS) Land Drainage Sewer (LDS), and Storm Relief Sewer (SRS)	A *Flood type* of Stored should typically be assigned. This is where any out of sewer flooding is expected to return to the sewer system. A *Flood type* of Lost is assigned where any out of sewer flooding is not expected to return to the sewer system. A *Flood type* of Sealed is utilized for MHs where no out of sewer flooding can occur (like buried manholes).

6.2.3 Chamber Plan Area and Shaft Plan Area

6.2.3.1 Unless specific area dimensions are available via other data sources, the *Chamber plan area* and *Shaft plan area* must be assigned to #D Default flag. By assigning the #D Default flag to these values, the area values will automatically be calculated based on the upstream and downstream sewer links.

6.2.3.2 If the default area is less than the minimum (0.2 m2) required area as set out in the Simulation Parameter for the model database, manually input the required minimum area. Refer to Appendix B for the recommended Simulation Parameters.

6.3 Modelling Links

6.3.1 Naming

6.3.1.1 Ensure the *Link ID/Asset ID* corresponds with the existing Asset IDs within the GIS records. Ensure the Link ID and Asset ID are identical.

6.3.2 Sewer Reference

6.3.2.1 Utilize the following convention in Table 5 for assigning the *Sewer Reference*.

Table 5: Link *Sewer Reference* Naming Convention

Sewer Type	*Sewer Reference* Parameter Entered
Combined Sewer (CS)	CS
Land Drainage Sewer (LDS)	LDS
Wastewater Sewer (WWS)	WWS
Storm Relief Sewer (SRS)	SRS

6.3.3 Upstream and Downstream Headloss Inference

6.3.3.1 The Consultant must utilize the model inference tool to infer the *US headloss coefficient* and *DS headloss coefficient* for all new sewer links added to the model.

6.3.3.2 The Data Flag IF must be assigned to all *US headloss coefficient* and *DS headloss coefficient* values after they have been inferred in this manner.

6.3.3.3 The *US headloss type* and *DS headloss type* should both be assigned as Normal, unless otherwise required from the Consultant's analysis.

6.4 Modelling Subcatchments

6.4.1 Naming

6.4.1.1 In all model network scenarios, ensure the new *Sub-catchment ID* is named based on the *Node ID* that the subcatchment is assigned to direct flow.

6.4.2 Subcatchment Total Area

6.4.2.1 New subcatchments must be appropriately subdivided such that no subcatchment exceeds 2.0 hectares in total area.

6.4.3 Runoff Surface Types

6.4.3.1 Each subcatchment will be assigned three separate runoff surface area types:

- **i.** Runoff Surface 1: Road (Impervious with depression storage)
- **ii.** Runoff Surface 2: Roof (Impervious without depression storage)
- **iii.** Runoff Surface 3: Grass (Pervious with depression storage and infiltration)

6.4.3.2 Refer to Table 6 below for the specific values to utilize for each of the three runoff surface types by default. Deviations from these default values may be utilized by the Consultant with sufficient justification.

Table 6: Subcatchment Runoff Surfaces Data Fields & Default Values

Data Field Name	Roof Runoff Surface Field Values	Road Runoff Surface Field Values	Grass Runoff Surface Field Values
Description	Impervious surface without depression storage.	Impervious surface with depression storage.	Pervious surface with depression storage.
Routing Type	Absolute	Absolute	Absolute
Routing Value ("n")	0.015	0.015	0.25
Routing Volume Type	Fixed	Fixed	Fixed
Surface Type	Impervious	Impervious	Pervious
Ground Slope (m/m)	0.01	0.01	0.01
Initial Loss Type	Absolute	Absolute	Absolute

Data Field Name	Roof Runoff Surface Field Values	Road Runoff Surface Field Values	Grass Runoff Surface Field Values
Initial Loss Value (m)	0.000	0.002	0.005
Initial Abstraction	-	-	-
Routing Model	SWMM	SWMM	SWMM
Fixed Runoff Coefficient	1.0	1.0	-
Horton Initial (mm/hr)	-	-	75
Horton Limiting Rate (mm/hr)	-	-	13
Horton Decay Factor (1/hr)	-	-	4
Horton Recovery Factor	-	-	0.01
Initial Loss Porosity	1.0	1.0	1.0

6.4.4 Land Use IDs

6.4.4.1 If each subcatchment uses the same Road, Roof and Grass runoff surfaces there should only be one Land Use ID assigned to each of these subcatchments. The proportion of each runoff surface in the subcatchment must be entered within the Subcatchment properties, utilizing the *Surfaces as percentage* data field, as per Section 6.4.5.

6.4.5 Runoff Surface Proportions

6.4.5.1 The percentage of each runoff surface area in each subcatchment must be entered in the Subcatchment Object Properties, under the *Surfaces as percentage* data field.

6.4.5.2 Runoff surface proportions can alternatively be entered as an absolute area.

6.4.5.3 Where the proportion of each runoff surface in a subcatchments is entered using the percent measurement, the total percentage of each runoff area must sum to 100%.

6.4.5.4 Where the proportion of each runoff surface in a subcatchments is entered using the absolute measurement, the sum of each runoff area must be equal to the total area of the specific subcatchment.

6.4.5.5 Where the subcatchment is directed to a WWS node and not to a CS or LDS node, then the *Contributing Area* value must be reduced to reflect the reduced surface runoff to enter the system. The consultant is to utilize a contributing area of 4% of the total area for the specific subcatchment for an established existing or new proposed WWS networks.

6.4.5.6 Where the subcatchment is directed to a CS node or LDS node, but there is new WWS installed in the area as part of ongoing separation works, the contributing area for the subcatchments should be assigned as follows:

- **i.** Two subcatchments must be created superimposed on top of each other under this scenario. Each subcatchment will have the same breakdown of the three runoff surfaces.
- **ii.** One of the subcatchments will be assigned to the appropriate WWS node, and will utilize a contributing area of 4%. The population derived WW will be assigned to this subcatchment, assuming all sanitary sewer connections have or will be connected to this WWS as part of the modeling exercise.
- **iii.** The other subcatchment will be assigned to the appropriate CS or LDS node, and will utilize the remainder of the contributing area for the subcatchment, of approximately 96% of the total area of the subcatchment in question.
- iv. ***Baseflow*** values may be assigned to the CS node based on the Consultant's engineering judgement. See Section 6.4.6.

6.4.5.7 Where the subcatchment is directed to a CS node, and no partial separation has occurred within the subcatchment:

- **i.** A single subcatchment shall be utilized, with the contributing area equal to 100% of the total area of the subcatchment in question.

6.4.6 DWF Estimation (Wastewater Profile, Population, Baseflow, Trade Flows)

Wastewater Profile

6.4.6.1 All subcatchments assigned to WWS or CS nodes must have a Wastewater Profile and associated population assigned to it, to determine the population derived wastewater generated from that subcatchment.

6.4.6.2 Within the City model database provided to the Consultants, a design Wastewater Profile is included, with the appropriate per capita rate and diurnal profile to be used for typical residential, commercial and other development scenarios.

6.4.6.3 The Consultant must not account for ***Baseflow*** within the Wastewater profile.

Population

6.4.6.4 The Consultant may use historic population records, such as the most recent Census data to establish the appropriate population of the new model build subcatchments.

Baseflow

6.4.6.5 All ***Baseflow*** values must be assigned as constant values within the Subcatchment grid.

6.4.6.6 It is acceptable for the Consultant to utilize an initial model build assumption for ***Baseflow*** of 40% of the ***ADWF*** for a catchment area and proportionally distribute it to each subcatchment.

Additional Dry Weather Flows

6.4.6.7 Any additional specific DWF which occurs within specific subcatchments is to be assigned as Additional foul flow in the Subcatchments grid

Trade Flows

6.4.6.8 Any additional specific industry or commercial flow which occurs within specific subcatchments is to be assigned as Trade flow in the Subcatchments grid.

6.4.6.9 A corresponding trade profile then shall be assigned to represent the diurnal profile for the specific trade flows.

6.5 Selection Lists

6.5.1 After any model build updates are complete, the Consultant must create selection list files to identify any objects added/changed as part of the update work. The selection lists must be included as part of the submission process.

6.6 Model Stability Verification

6.6.1 Simulation Volume Imbalance

6.6.1.1 Following the completion of a simulation to verify performance of the *hydraulic model, review the New node results window. Review the Volume balance (%) for each node and sort the values ascending.*

6.6.1.2 There must be no greater than 3% volume balance for any node. If the volume balance values exceed this threshold, the model must be reviewed for instabilities and the simulation must be completed again.

7 Model Maintenance

7.1 Section Purpose

7.1.1 This section is to document the City of Winnipeg specific requirements for all work to change various aspects of the City model database, specifically to correct known errors, misrepresentations or lack of clarity within the model.

7.1.2 Model maintenance work can further sub-divided as follows:

7.1.2.1 Model maintenance which does not impact hydraulic performance of the model. This would include but not be limited to the following:

i. Amalgamating data flags.
ii. Making sure subcatchments are labeled correctly.
iii. Improve accuracy/organization of data within the model.
iv. Solving instability issues discovered in the model.

7.1.2.2 Model maintenance which may impact hydraulic performance of the model. This would include but not be limited to the following:

i. Amalgamating land use IDs from previous works.
ii. Amalgamating runoff surface types from previous works.
iii. Correcting specific parameters to model objects believed to be in error.
iv. Improving the representation of specific aspects of the model.

7.1.2.3 For all model maintenance work found to impact the hydraulic performance of the model as per 7.1.2.2, model calibration based on applicable observed flow monitoring data under dry weather flow and/or wet weather flow conditions shall also be required. The impacts of the model maintenance work on hydraulic performance need to be assessed and compared to the observed flow monitoring data.

7.1.2.4 Only once sufficient evidence that the hydraulic performance needs to be improved to reflect observed data shall the changes proposed from the specific model maintenance work be approved by the City of Winnipeg.

7.2 General Requirements For Model Maintenance

7.2.1 Refer to the specific requirements for section 4 **Data Collection**. The requirements for data flagging and data sources to be utilized must be considered as part of model maintenance.

7.2.2 Refer to the specific requirements for modeling new objects in the hydraulic model under 6 Model Build. The majority of these requirements should be met within the existing model objects, and should be modified to meet these requirements as part of model maintenance.

7.2.3 Ensure the appropriate naming conventions for *Object ID, Sewer Reference,* and *System Type* where applicable are utilized for all object within the extents of model maintenance. See 6.1.2, 6.2.1, 6.3.1, 6.3.2 and 6.4.1.

7.2.4 As part of model maintenance work to be completed by a Consultant, the extents of the model to which model maintenance is to take place should be established and agreed by both the Consultant and the City of Winnipeg.

7.2.4.1 Model maintenance may not be required to occur through the entire City of Winnipeg model database as part of any particular work.

7.2.4.2 During evaluations of existing pump stations, river crossings, or other ancillary structures, model maintenance should occur within the sewer district containing that particular structure(s) under evaluation, at minimum.

7.2.5 Specific requirements to evaluate and modify for model maintenance purposes can be found in Section 7.3 to Section 7.3.

7.3 Nodes Model Maintenance

7.3.1 Ensure that all manholes nodes within the model maintenance extents utilize the correct Flood Type as per 6.2.2.

7.3.2 Manhole Chamber Area

7.3.2.1 Where manholes are found along an egg shaped sewer, the manhole configuration should be verified using as-built drawings or field surveys, as applicable.

7.3.2.2 Where the conditions in 7.3.2.2 are identified, the existing manhole nodes within the model should be modified such that the manhole chamber volume aligns with the volume provided by the egg-shaped sewer, such that the manhole chamber does not provide additional storage volume. It is common for manholes connected to egg-shaped sewers to simply be provided as an opening near the obvert of the egg sewer. No separate chamber is typically provided within the egg-shaped sewer.

7.4 Links Model Maintenance

7.4.1 Upstream and Downstream Head Loss Inference

7.4.1.1 Where existing modelled manholes have been moved or links adjusted, the model inference tool should be used to infer head losses for all altered sewer links.

7.4.1.2 The Data Flag IF must be assigned to all *US headloss coefficient* and *DS headloss coefficient* value after they have been inferred in this manner.

7.4.1.3 The *US headloss type* and *DS headloss type* should both be assigned as Normal, unless otherwise required from the Consultant's analysis.

7.5 Subcatchment Model Maintenance

7.5.1 All existing subcatchments above 2.0 hectares in total area within the extents to which model maintenance is to be completed should be further sub-divided, such that no subcatchments exceed 2.0 hectares in total area.

7.5.2 Ensure each subcatchments utilizes the primary runoff surface types as per 6.4.3.

7.5.2.1 If multiple different naming conventions for the similar runoff surfaces are noted, efforts should be made to standardize the naming of similar runoff surfaces among multiple subcatchments.

7.5.3 The varying Land Use IDs used among multiple subcatchments should standardized such that duplicate Land Use IDs achieving identical results are removed.

7.5.4 Runoff Surface Proportions

7.5.4.1 The portion each runoff surface contributes to the total subcatchments should be reviewed as part of model maintenance as per 6.4.5.

7.5.4.2 The current use of the subcatchments for either WWS, LDS or CS flow generation should be considered as part of determining the appropriate *Contributing Area* value for each subcatchments.

7.5.5 A review of the current Wastewater Profile assigned to each subcatchment, and the determination whether or not there should be additional Trade flow assigned to the subcatchments, should be completed as part of model maintenance. See 6.4.6.

7.5.5.1 A specific review that ***Baseflow*** has not be accounted for within the Wastewater profile, should be included as part of model maintenance. The ***Baseflow*** associated with subcatchments may only assigned within the Subcatchment Properties.

7.5.5.2 A review of the population currently assigned to subcatchments within a sewer district may also be required as part of model maintenance, to confirm the current population assigned is still valid.

7.6 Selection Lists

7.6.1 After any model maintenance updates are complete and the model is to be submitted back to the City of Winnipeg, the Consultant must create selection list files which select the objects added/changed as part of the update work.

8 Solution Development

8.1 Section Purpose

8.1.1 This section is to document the City of Winnipeg specific requirements for the development of changes to the sewer system. The theoretical changes are typically modelled to evaluate potential solutions to upgrade the existing sewer system, or correct existing issues in the sewer system.

8.1.2 These theoretical changes must be confirmed to achieve the specific goals desired using the hydraulic model. It must also be confirmed that the solutions do not negatively alter the existing hydraulic function of the sewer system in any way.

8.1.3 The confirmation that the solution does not alter the existing hydraulic function of the sewer system occurs using the Detriment Analysis process. See Appendix C and Section 8.4 to 8.6.

8.2 Utilization of City of Winnipeg Hydraulic Model

8.2.1 In order to complete the Detriment Analysis process during Solution Development, the upgrades/solutions being designed by the Consultant must not be provided in a separate new database but be built into the database provided by the City.

8.3 Revising Model for Solution Development

8.3.1 Refer to the specific requirements for modeling new objects in the hydraulic model under section 6 Model Build. The majority of these requirements for modeling new objects will also apply to the modeling of solutions for evaluation purposes. The subclauses below document the deviations from the Model Build requirements, specifically for Solution Development.

8.3.2 Modelling Nodes For Solution Development

8.3.2.1 All manhole node proposed as part of solutions should be sized according to the City of Winnipeg Standard Details SD-010, SD-011, where applicable.

8.3.3 Modelling Links For Solution Development

8.3.3.1 Ensure *the Link ID/Asset ID* will use an appropriate name to describe the solution the links are attributable to.

8.3.1 Modelling Subcatchments For Solution Development

8.3.1.1 When developing subcatchments as part of the design of new or unknown future developments, the population should be estimated using the City of Winnipeg Wastewater Flow Estimation and Servicing Guidelines:

- https://winnipeg.ca/waterandwaste/dept/wastewaterFlow.stm

8.3.1.2 Where the specific diurnal profile or per capita wastewater generation rate to be used as part of solution development are anticipated to differ from the standardized wastewater profile provided in the City model database, the Consultant may create an alternate Wastewater Profile along with providing appropriate justification.

8.3.1.3 The wastewater profile utilized can be a standardized estimate of the typical diurnal profile based on the Consultant's engineering judgement and best practice for the use of the land contained in the subcatchment.

8.3.1.4 The design population per capita rate of 270 L/capita/day within the Wastewater Profile provided in the City model database shall be used for all simulations completed during Solution Development.

8.4 Detriment Analysis Spreadsheet Templates

8.4.1 The latest Detriment Analysis spreadsheets for the Spill Detriment Analysis, Flooding Detriment Analysis and Surcharging Detriment Analysis may be provided with the latest Hydraulic Model Database when the database, if available. These spreadsheets have the simulation results of both the ***Baseline Model Network*** and ***Current Model Network***, according to rainfall and river level conditions for each level of service condition, stated in Appendix C.

8.4.1.1 If the spreadsheets referred to in 8.4.1 are not available, the Consultant shall be required to populate these spreadsheets using City provided templates prior to the Detriment Analysis process.

8.4.2 Depending on the area of modelling work the Consultant is involved in, a "cut down" version of these Detriment Analysis spreadsheets may be returned, only showing nodes for one of the three sewage treatment plant service areas (NEWPCC, SEWPCC or WEWPCC Service Area).

8.5 Detriment Analysis Process – Solution Development

8.5.1 Refer to Appendix C for the specific requirements of the Detriment Analysis process.

8.5.2 If a solution or upgrade is being designed by the Consultant to improve the level of service of a specific area of the sewer system, the Detriment Analysis process may also be used to demonstrate that the level of service has been appropriately improved, without compromising the remainder of the sewer network.

8.5.3 The Detriment Analysis is to be completed by specifically comparing:

- The ***Current Solution Model Network*** to the ***Current Model Network***.
- The ***Future Solution Model Network*** to the ***Future Current Model Network***.

8.5.4 The Detriment Analysis may also be completed comparing the ***Current Solution Model Network*** to the ***Baseline Model Network***. This will be at the discretion of the City Project Manager.

8.5.5 Each of the comparisons listed in 8.5.3 shall utilize the appropriate rainfall and river level conditions for each level of service condition, stated in Appendix C. These results will be used to populate the Spill Detriment Analysis, Flooding Detriment Analysis and Surcharging Detriment Analysis spreadsheets.

8.5.6 Should there be any increased detriment between the ***Current Model Network*** and the ***Current Solution Model Network*** or between the ***Future Solution Model Network*** and the ***Future Current Model Network*** identified such that there is a reduction in the level of service, the specific solution/upgrades proposed will not be accepted. The solution developed must be altered, and the detriment analysis must be repeated. Only solutions which do not cause unacceptable detriment should be proposed to the City. The developed solution needs to address the project needs and should not cause a reduction of the current level of service.

8.5.7 If differences in level of services are identified between the ***Current Model Network*** and ***Current Solution Model Network*** or between the ***Future Solution Model Network*** and the ***Future Current Model Network*** during Detriment Analysis and that the Consultant does not believe that this will result in a reduction in the level of service, the Consultant must assess the significance of the level of impact and provide justification for the differences being accepted for the City's review. Otherwise, the solution must be changed such that these differences do not occur.

8.5.8 Under the scenario stated in 8.5.7 where differences between the ***Current Model Network*** and ***Current Solution Model Network*** or between the ***Future Solution Model Network*** and the ***Future Current Model Network*** are identified but the Consultant believes they are justified, the justification and acceptance of the differences must occur in advance of the formal design documentation review.

8.5.9 After it has been appropriately demonstrated that there is no reduction in the level of service as a result of the proposed solution when comparing the ***Current Model Network*** to the ***Current Solution Model Network*** or between the ***Future Solution Model Network*** to the ***Future Current Model Network,*** additional detriment analysis may be required documenting the differences between the ***Current Solution Model Network*** and the ***Baseline Model Network***.

8.5.9.1 The additional detriment analysis referenced in 8.5.9 will be at the discretion of the City of Winnipeg.

8.6 Recommended Design Phases for the Detriment Analysis Process

8.6.1 Detriment analysis may be completed during conceptual design as part of the alternative solutions analysis. It is an acceptable method to complete conceptual design, but the design iterations do not need to be documented as part of conceptual design. The final solution recommended for conceptual design should have no reduction in level of service found during the detriment analysis. The detriment analysis results are not required for the final conceptual design report, however, it should include a statement confirming the detriment checks were undertaken and that no unacceptable detriment was identified for the proposed solution.

8.6.2 Following the completion of the preliminary design phase, detriment analysis should be submitted showing no reduction in level of service comparing the ***Current Solution Model Network*** and ***Future Solution Model Network*** to the ***Current Model Network*** and ***Future Current Model Network***.

8.6.3 Following the completion of the detailed design phase, if changes have been made to the proposed solution updated detriment analysis should be submitted continuing to show no reduction in level of service comparing the ***Current Solution Model Network*** and ***Future Solution Model Network*** to the ***Current Model Network*** and ***Future Current Model Network***.

8.6.4 If during the solution development process there are changes to the design which may result in changes to the hydraulic performance following the Preliminary Design Phase approval of Detailed Design Phase approval, this must be raised with the City. Approval of these changes may require the Consultant to resubmit detriment assessments to ensure the proposed solution does not cause detriment.

Appendix A – Model Database Contents

Model Database Components	Notes
01 - Networks/Network Scenarios	
CoW Regional Model Baseline 2013	The original CSO MP Baseline 2013 Regional Network model. The best representation of the 2013 network at the time it was developed.
Network: Regional Model Base	The original CSO MP Baseline 2013 Regional Network model with minor changes to allow it to be run in ICM. The best representation of the 2013 network at the time it was developed.
Network: Regional Model Base 2013 Revised	The original CSO MP Baseline 2013 Regional Network model with model maintenance to achieve an improved representation of the 2013 sewer network. The network scenario is dated with year of the updates.
Network: Regional Model Current	The Current Year Regional Network model with model maintenance to achieve current sewer system representation based on the best available information. The network scenario is dated with year of the updates.
Network: CoW Regional Model Alternative_1	The original CSO MP Preliminary Proposal Control Option 1 Solution Regional Network model.
Network: CoW Regional Model Existing – Nov_2015 (Feb2019)	The original CSO MP Baseline 2013 Regional Network model with model maintenance to achieve an improved representation of the 2013 sewer network. The network originally completed in November 2015 was updated in February 2019.
Network: CoW Regional Model Alternative_CO1MP1_Aug2019	The updated CSO MP Control Option 1 Solution Regional Network model. The network was completed in August 2019.
City of Winnipeg Global Model Feb-Jun 2015 Version 1.2	2013 global all pipes version of the City Combined and Wastewater Sewer network created as part of the CSO MP modelling work.
Network: Base	2013 global all pipes version of the City Combined and Wastewater Sewer network created as part of the CSO MP modelling work with minor updates to use in ICM.
Network: Base 2103 Revised	The original CSO MP Baseline 2013 Global Network model with model maintenance to achieve an improved representation of the 2013 sewer network. The network scenario is dated with year of the updates.

Model Database Components	Notes
Network: Current Network	The Current Year Global Network model with model maintenance to achieve current sewer system representation based on the best available information. The network scenario is dated with year of the updates.
02 - Design Rainfall	
1992 - Full Year 1hr Timestep + EvapB	1992 typical Year - single rain gauge polygon
M5 Event MacLaren Summer	MacLaren Design Events - 5 year return period, single rain gauge polygon 24 hour duration
03 – Observed Rainfall (Historic Rainfall)	
Bi-Weekly Rainfall Data_16 RG_Template	16 CSD rain gauge template
04 – Design River Levels	
1992 NSWL Levels	1992 River level file
Design M5 Levels	1 in 5 year summer water level (11.5ft James)
05 – Observed River Levels	
Full_RLs_Primary & Secondary Outfalls UTC	River level file - validated data
Bi-Weekly_RLs_Primary & Secondary Outfalls Template	Bi-Weekly SCADA Data RL Template - Contains 39 Primary Outfalls where we have instrumentation
Bi-Weekly_RLs_Primary & Secondary Outfalls	Example
06 – Wastewater Group	
Regional Model WWG	Wastewater dry weather flow profiles
07 – Trade Wastewater Group	
Regional Model Trade	Commercial and Industrial flow profiles
08 – Ground Infiltration	
Regional Model Initial 20%	Ground Infiltration File
09- Real Time Control	

Model Database Components	Notes
RTC Controls	The original CSO MP Preliminary Proposal Control Option 1 Solution RTC file for the Regional Network model simulation
10 – Regulator Files	
Full Flood Pump Data UTC v4	All the available data from flood pump locations (78 pumps). V4, Replaced obsolete La Verendrye flood pump (S-MH50004115.1) with missing Mayfair flood pump (RIVER_GC1.2) using direct swap in Regulator file Fort Rouge Park FPS (FORT_ROUGE_PARK_FPS) SCADA data profile deleted
11 – Selection Lists	
NEWPCC Regional Model	Regional model cut down selection list NE
SEWPCC Regional Model	Regional model cut down selection list SE
WEWPCC Regional Model	Regional model cut down selection list WE
CSO Overflow Selection List 2017	CSO Outfall Selection List - contains both pumped and gravity links
West End Combined Sewer Overflows List	West End Combined Sewer Overflows List
West End Wastewater Sewer Overflows List	West End Wastewater Sewer Overflows List
West End Land Drainage Sewer Overflows List	West End Land Drainage Sewer Overflows List
12 – Dry Weather Flow Sims	
DWF 2019 Current Network Global Model!	DWF simulation example
13 – Combined Sewer Overflow Sims	
Baseline 2013 1992 Rep Yr Regional Model	Baseline CSO performance Regional Model. Also can be used for historical year analysis with appropriate network, or current year performance with appropriate rainfall and river level for that year.

Model Database Components	Notes
Baseline 2013 1992 Rep Yr Global Model	Baseline CSO performance Global Model. Also can be used for historical year analysis with appropriate network, or current year performance with appropriate rainfall and river level for that year.
Current Network (year) 1992 Rep Yr Regional Model!	Example: Regional Model CSO representative year run on a current network version
Bi-Weekly Simulation	Bi-weekly sim run example
14 – Flooding & Surcharge Sims	
Baseline 2013 5yr 24hr Global Model	Global Baseline Model basement flooding performance for the combined sewer system - out of sewer and surcharge within 2.4m of manhole ground level. Also can be used for historic or current basement flooding analysis with appropriate network or for an alternative event with the appropriate rainfall and river level data. Basement flooding analysis for wastewater sewer system out of sewer flooding and surcharge within 3 m of manhole ground level. Global all pipe model is required.
Current Network 2019 5yr 24hr Global Model v2	Example: Current Network Basement flooding performance
15 – Wastewater Sewer Overflow Sims	
16 – Statistical Templates	
ST 1992 Representative Year v10-24hr split-min vol 50_w/Pumps v2	For 1992 Typical Year and Annual Year Analysis of CSO results - baseline, Current and future models - gravity & pumped separation for calculation purposes
ST West End CS_WWS & LD Outfall Analysis 24hr split-min vol 50_w/Pump	For 1992 Typical Year and Annual Year Analysis of West End CSO, WWs and LDS performance results - baseline, Current and future models - gravity & pumped separation for calculation purposes
Bi-Weekly Template	Bi--weekly CSO Results stats template
17 – Ground Model	

Appendix B – Hydraulic Model Default Simulation Parameters

Sim parameters Object Properties			
Base flow			
Min base flow depth (m)	0.020		
Base flow factor	0.050		
Slope where base flow is doubled (m/i	0.0100		
Space step			
Min space step (m)	0.50		
Max space step (m)	100.00		
Conduit width multiplier	20.00		
Min number of computational nodes	5		
Preissmann slot			
Min slot width (m)	0.00100		
Celerity ratio	10.00		
Characteristic Froude numbers			
Lower Froude number	0.800		
Upper Froude number	1.000		
Initialisation			
Start timestep (s)	7.50		
Max timestep (s)	1920.00		
Phase-in time (min)	15.00		
Steady state flow tolerance (m3/s)	0.000500		
Steady state depth tolerance (m)	0.005000		
Max number of timestep halvings - init	10		
Max number of iterations - initialisatio	10		
Max number of iterations after doubli	7		
Tolerance for flow	0.0100		
Flow tolerance scaling factor - initialis	1.000		
Tolerance for depth	0.0100		
Depth tolerance scaling factor - initiali	1.000		
Tolerance for level	0.0100		
Level tolerance scaling factor - initialis	1.000		
Min depth in conduits - initialisation (	0.01000		
Min plan area at nodes - initialisation	0.200		
Time weighting factor	1.000		
Tolerance for volume balance	0.0100		
Volume balance tolerance scaling fact	1.000		
Relax tolerance from run t/s - initialisa	☒		
Simulation			
Max number of timestep halvings - sim	20		
Max number of iterations - simulation	20		
Max number of iterations after doubli	7		
Tolerance for flow - simulation	0.0100		
Flow tolerance scaling factor - simulat	1.000		
Tolerance for depth - simulation	0.0100		
Depth tolerance scaling factor - simula	1.000		
Tolerance for level - simulation	0.0100		
Level tolerance scaling factor - simulat	1.000		
Min depth in conduits - simulation (m)	0.01000		
Min plan area at nodes - simulation (m	0.200		
Time weighting factor - simulation	0.650		
Tolerance for volume balance - simulat	0.0100		
Volume balance tolerance scaling fact	1.000		
Relax tolerance from run t/s - simulatic	☒		
Variance			
Conduit and control			
Stay pressurised	☐		
Don't linearise conveyance	☐		
No. of geometry table entries	15		
Use full area for headloss calculations	☐		
Inflow is lateral	☐		
Bottom of headloss transition	0.000		
Top of headloss transition	0.000		
Use Villemonte equation	☐		
Drop inertia in pressure pipes	☒		
Drowned bank linearisation threshold	0.010		
2D parameters			
Inflow-based node-2d link	☒		
Use 2d elevations instead of depths	☐		

Appendix C – Detriment Analysis Process & Level of Service Standards

Process Summary

1. The Detriment Analysis Process has been adopted by the Wastewater Planning and Project Delivery to standardize the process to evaluate the detriments, or reduction in Level of Service, of the sewer system for the City of Winnipeg, caused by any model changes.
2. The intent of the Detriment Analysis process is to demonstrate using a City methodology that the existing level of service in the sewer system will not be compromised by proposed solutions.

Level of Service Standards

1. Included in Table 7 below are the Level of Service conditions which are evaluated as part of the Detriment Analysis process.
2. This table does not form a comprehensive list of the level of service conditions, but is meant to document the majority of level of service conditions to be evaluated.

Table 7: Level of Service Standards For Detriment Analysis

Level of Service Standard	Specific Detriment Analysis Spreadsheet Utilized	Summary	Rainfall and River Level Conditions Applied To Hydraulic Model
Combined Sewer Overflows	Spill Detriment Analysis	• The frequency of combined sewer overflow events at each overflow location must not increase. • The volume of combined sewer overflows at each overflow location during any specific event must not increase. • The duration of combined sewer overflows at each overflow location during any specific event must not increase.	1992 Representative Year Rainfall 1992 Representative Year River Levels
Sanitary Sewer Overflows	Spill Detriment Analysis	• The frequency of sanitary sewer overflow events at each overflow location must not increase. • The volume of sanitary sewer overflows at each overflow location during any specific event must not increase. • The duration of sanitary sewer overflows at each overflow location	10 Year MacLaren Design Storm 1 Year NSWL

Level of Service Standard	Specific Detriment Analysis Spreadsheet Utilized	Summary	Rainfall and River Level Conditions Applied To Hydraulic Model
		during any specific event must not increase.	
Combined Sewer Overland Flooding Level of Service	Flooding Detriment Analysis	• The number of CS nodes in which overland surface flooding is experienced under wet weather flow conditions must not increase.	5 Year MacLaren Design Storm 5 Year NSWL
Separate Sewer Overland Flooding Level of Service	Flooding Detriment Analysis	• The number of WWS nodes in which overland surface flooding is experienced under wet weather flow conditions must not increase.	10 Year MacLaren Design Storm 5 Year NSWL
Combined Sewer Basement Flooding Level of Service	Surcharge Detriment Analysis	• There must be no increase in the number of CS nodes in which surcharge levels exceed 2.4m below grade. • Increases in surcharging levels of CS nodes can be acceptable, as long as the surcharge levels do not exceed 2.4m below grade. • For CS nodes in the *Baseline Model Network* or *Current Model Network* with surcharge levels exceeding 2.4m below grade, no further increase in the specific surcharge level is allowed.	5 Year MacLaren Design Storm 5 Year NSWL
Separate Sewer Basement Flooding Level of Service	Surcharge Detriment Analysis	• There must be no increase in the number of WWS nodes in which surcharge levels exceed 2.4m[A] below grade. • Increases in surcharging levels of WWS nodes can be acceptable, as long as the surcharge levels do not exceed 2.4m[A] below grade. • For WWS nodes in the *Baseline Model Network* or *Current Model Network* with surcharge levels exceeding 2.4m[A] below grade, no further	10 Year MacLaren Design Storm 5 Year NSWL

Level of Service Standard	Specific Detriment Analysis Spreadsheet Utilized	Summary	Rainfall and River Level Conditions Applied To Hydraulic Model
		increase in the specific surcharge level is allowed.	

[A]At the discretion of the City of Winnipeg, this surcharging limit may be further restricted to 3.0m below grade for separate sewer district detriment analysis.