Loganlea (Station Road) Stormwater Infrastructure Plan Review

*Logan City Council*
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<th>Document Information</th>
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1 Introduction

AquaIntel were commissioned in partnership with HydraLogic, to undertake a review and update of the stormwater infrastructure sizing which forms the basis of Logan Council’s Local Government Infrastructure Plan (LGIP) for the Loganlea Priority Infrastructure Plan Area (PIA).

A comprehensive investigation of the future trunk stormwater infrastructure requirements for the area was undertaken in December 2009 by EnGenY in the Station Road (Loganlea) Infill Study Stormwater Infrastructure Concept Plan.

The report and the associated modelling files were provided and are the basis of the review and update of the stormwater infrastructure provided within this document.

1.1 Scope

This project is aimed at reviewing and refining the previously sized infrastructure to ensure the planned elements are in line with and meet current best practices and legislative requirements. Elements (including detention basins, bioretention basins, constructed channels, and wetlands) are to be reviewed to ensure they mitigate ultimate peak catchment flows, meet water quality objectives, and make optimal use of land requirements.

The review process was structured to assess three elements:

- A review of the report methodology and tools used to plan and size the proposed infrastructure;
- A technical review of the models developed to size infrastructure; and
- A review and, where required, an update of the data and/or parameters used within the development of the infrastructure requirements.

The 2009 EnGenY report was reviewed with the intent of confirming:

- the appropriateness of the methodology,
- the basis of sizing and design being in accordance with contemporary best practice and legislative requirements, and
- the appropriate use of industry standard software.

The model files, provided by Logan City Council, on which the proposed infrastructure sizing was based, were reviewed for:

- appropriateness and currency of base model data;
- model construction and input parameters;
- model output and sizing of elements with respect to design standards; and
- identification of any shortfalls in performance or potential for reductions in requirements.
A review of the base data and parameters used to construct the models was undertaken to ensure currency and a sound basis on which to size the proposed infrastructure to inform a financial model of proposed stormwater quantity and quality infrastructure. This review focused primarily on aligning the financial model for stormwater infrastructure with the latest population projections presented in the Logan Development Projection Model (LDPM). To achieve this a procedure for deriving the impervious fractions of the catchments over each of the planning horizons was developed. The planning horizons being: the existing case; 2031; and the ultimate development time horizons.

2 Information Supplied

Information supplied by Logan City Council for use in the review included:

1. A copy of the Station Road (Loganlea) Infill Study Stormwater Infrastructure Concept Plan (EnGenY, 2009), (“the report”)
2. MUSIC model files from EnGeny
3. XP-Storm files from EnGeny
4. GIS base data including topography, landuse, stormwater infrastructure and planning scheme layers.

3 Base Data and Assumptions

3.1 Logan Development Projection Model (LDPM)

The key element of stormwater infrastructure planning is the fraction of the catchment that is impervious at each planning horizon. The 2009 EnGenY report was completed prior to the availability of the Logan Development Projection Model (LDPM) 2010 and thus the basis for the derivation of impervious catchment areas for use in both water quality and quantity modelling was a more traditional approach of estimating fraction impervious from aerial photography and landuse planning layers then applying a standard rate of impervious fraction to each landuse category.

The report outlines the adopted methodology for the derivation of impervious catchment area.

Logan City Council advised that in February 2015 the LDPM was revised. Advice received from Council and review of the LDPM data and summary tables contained within the planning scheme confirmed that within the Loganlea Projection Area the number of dwellings had been revised however the projected non-residential floor
area had not been revised. Review of the LDPM data revealed that within the Loganlea Projection Area the predicted total number of dwellings (consisting of attached, detached and other dwellings) had been revised down by some 59% at the ultimate development horizon and by up to 64% in the intervening time horizons. Review of the data also confirmed that the non-residential GFA remained consistent between the two LDPM revisions.

It is noted that the catchment areas defined within the study being reviewed do not align with or contain only lots that are classified as being within the Loganlea Projection Area of the LDPM. Figure 1 provides comparison of the catchment areas defined in the 2009 EnGenY study and the Loganlea Planning Area as classified in the LDPM. This is raised as direct comparison of dwellings and non-residential floor area between the planning scheme summary tables (based on the LDPM projection areas) and the areas contained within the study being reviewed cannot be made.

![Figure 1: Comparison of catchment boundary and planning scheme classifications](image)

As part of this review a consistent procedure to derive the impervious fraction for the study catchment areas from the revised LDPM (Feb 2015) data was developed. This procedure reflected a similar methodology to that contained within the Stormwater Planning Report for another PIA within the LCC area (Appendix B of Logan Village Stormwater Plan for Trunk Infrastructure, Water Quality and Flood Management Conceptual Design, DesignFlow 2011) with the addition of an impervious fraction for newly developed residential lots determined by utilising the Stormwater Demand Areas and associated factors contained within Map 3.00 of the PIP2. This procedure was developed to encourage consistency in the derivation of impervious fractions from the LDPM data between different Planning Areas within Logan City Council and was thus adopted in this review.

Comparison of the impervious fraction for each subcatchment area calculated from the LDPM with that reported and modelled within the 2009 EnGenY report
concluded that there were significant differences in the impervious fractions of the catchment as a result of the application of the adopted methodology utilising the LDPM and modified methodology. The EnGenY 2009 report only estimated impervious fraction and modelled two development horizons, being the existing and ultimate developed case (which assumed the entire catchment was redeveloped in line with the planning layer).

In the existing case, the impervious fraction of the catchment calculated with the use of the LDPM was found to be generally higher (that is, a greater impervious area within the catchment) than that estimated in the EnGenY 2009 report.

Analysis of the LDPM for the 2031 and ultimate development horizons indicated that for the Loganlea PIA approximately 27% of the lots were developed to 2031 with an additional 10% of the lots being developed to the ultimate planning horizon (i.e. approximately 37% of developed lot area in total in the ultimate case). This indicated the original assumption that the entire catchment would be re-developed by the ultimate planning horizon does not hold true based on the LDPM predications. This said, when the fraction impervious assumed within the EnGenY 2009 XP-Storm modelling was compared with the LDPM for the ultimate planning horizon it was found that impervious fractions of the subcatchment were in a similar order of magnitude. This is primarily due to the proportion of the catchment that is not redeveloped within the LDPM calculations to being estimated as having a relatively high impervious fraction.

Table 1 provides a summary of the impervious area estimates for each of the water quantity subcatchment as defined in the EnGenY 2009 report.

### Table 1: Summary of Impervious Areas calculated from LDPM

<table>
<thead>
<tr>
<th>Sub-catchment</th>
<th>Total Measured Area (ha)</th>
<th>Impervious Area 2014 (ha)</th>
<th>Impervious Area 2031 (ha)</th>
<th>Impervious Area Ult (ha)</th>
<th>% Impervious 2014</th>
<th>% Impervious 2031</th>
<th>% Impervious Ult</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.95</td>
<td>6.48</td>
<td>7.47</td>
<td>8.93</td>
<td>50%</td>
<td>58%</td>
<td>69%</td>
</tr>
<tr>
<td>2</td>
<td>71.79</td>
<td>24.98</td>
<td>27.92</td>
<td>29.33</td>
<td>35%</td>
<td>39%</td>
<td>41%</td>
</tr>
<tr>
<td>3</td>
<td>19.66</td>
<td>9.86</td>
<td>11.17</td>
<td>11.65</td>
<td>50%</td>
<td>57%</td>
<td>59%</td>
</tr>
<tr>
<td>4</td>
<td>3.39</td>
<td>1.99</td>
<td>2.55</td>
<td>2.55</td>
<td>59%</td>
<td>75%</td>
<td>75%</td>
</tr>
<tr>
<td>5</td>
<td>0.72</td>
<td>0.44</td>
<td>0.50</td>
<td>0.53</td>
<td>62%</td>
<td>69%</td>
<td>74%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>108.49</strong></td>
<td><strong>43.75</strong></td>
<td><strong>49.61</strong></td>
<td><strong>52.99</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Sub-catchment ID as per Appendix C Figure 2 of the EnGenY 2009 report (attached for reference). These catchment areas include some area outside of the PIA boundary but are included as they are contribute to proposed infrastructure.

Revision of both the water quality and XP-Storm modelling was found to be required due to the significant difference found between the assumed EnGenY 2009 impervious fractions of the catchments and those calculated using the LDPM and due to the need to size infrastructure reflective of the requirements at the 2031 planning horizon for the development of the financial model.
3.2 Water Quality Design Objectives

Review of the report concludes that the water quality objectives derived and which form the basis of infrastructure sizing are based on sound and acceptable guidelines. The selected water quality objectives remain consistent with the current legislative requirements of the SPP July 2014.

3.3 Water Quantity Design Objectives

Review of the report concludes that the flood management objectives derived and which form the basis of infrastructure sizing are based on sound and acceptable principles. The water quantity design objective was to, in effect, limit the post-development event discharge peaks to the pre-development peak discharges at the catchment outlets. In addition, the design objective sought to ensure that peak water levels in the post-development case were not increased compared to the pre-development case.

This objective is considered consistent with current best practice and the relevant planning policies.

4 Stormwater Quality Modelling

A technical review and revision of the provided water quality model files and sizing of trunk stormwater treatment infrastructure was undertaken. The following summarises the findings and provides recommendations and revisions to the infrastructure sizes to inform a financial model for stormwater quality infrastructure planning.

4.1 Software and Reference Basis

Water quality modelling was undertaken using the industry standard software package MUSIC. This package is accepted as an appropriate tool for conceptual sizing of stormwater quality treatment devices and appropriate for use in this level of investigation.

The 2009 EnGenY report notes that for MUSIC modelling “the Brisbane City Council (BCC) “Pollutant Export Modelling Guidelines” and Gold Coast City Council’s (GCCC) “MUSIC Modelling Guidelines 2006” was (were) used, in conjunction with the Healthy Waterways “Water Sensitive Urban Design Technical Design Guidelines for South East Queensland”. The stormwater quality treatment devices incorporated into the catchment model have been setup based on the design parameters recommended by the GCCC and Healthy Waterways Guidelines.”
These guidelines have now been superseded by the *MUSIC Modelling Guidelines (Water by Design, 2010)* and it is considered appropriate that the models be revised in accordance with the current guidelines.

It appears that the MUSIC modelling undertaken in the EnGenY 2009 investigation used a version of MUSIC that has been superseded (most likely v3), with the current version being MUSIC v6. Revisions of MUSIC since v3 have included alterations to algorithms, including those which calculate pollutant removal efficiencies within bioretention basins. On this basis, rerunning the original model files in MUSIC v6 and updating the setup to reflect current practice were expected to alter the results and required infrastructure sizes presented in the 2009 EnGenY report.

This review has adopted the current version of MUSIC (v6) for reviewing the sizing and conceptual performance of stormwater treatment infrastructure identified by the 2009 EnGenY report.

The *MUSIC Modelling Guidelines (Water by Design, 2010)* are accepted as current best practice for model construction and the selection of MUSIC input parameters. It is noted that since the above guidelines were published Water by Design have issued advice regarding the setup of bioretention nodes for models constructed in versions later than v5.

### 4.2 Methodology and Model Schematization

Review of the 2009 EnGenY study report, with particular reference to Section 5 – Stormwater Quality finds that the methodology for the derivation of a stormwater quality strategy at a catchment scale planning level is sound.

The methodology adopts an end-of-line catchment scale treatment train for the management of stormwater runoff from the entire contributing catchment at the ultimate development planning horizon. The sizing of infrastructure of the entire catchment, while sound in principle, is inconsistent with the objectives and use of the infrastructure plan (being the support of the development of a financial model to 2031). In order to maintain consistency in approach between the other PIA within LCC it has been advised by LCC and is considered appropriate to revise the MUSIC model to include only newly developed areas within the planning horizon. This is considered a reasonable approach for the purpose of development of a financial model for stormwater quality infrastructure planning. However, the future sizing and design of infrastructure for capital works should consider hydrologic aspects and inflow from both existing and future development areas.

Three catchment based MUSIC models were developed and provided for review. The presented delineation of catchments was based primarily on topography and drainage and is considered acceptable.
Catchments were represented as lumped source nodes for a range of landuse types present or proposed within the catchments. The use of the lumped catchment approach to the representation of the catchments is considered acceptable.

Treatment trains and the associated treatment nodes were accepted as being reasonable and within industry best practice. The selection of treatment node types within the catchments, for example selection of wetlands over bioretention, is considered appropriate and consideration of practicality and function within constraints such as topology and landuse is apparent.

Table 2 provides a summary of the review of methodology and model schematization.

Table 2: Review Summary - Methodology and Model Schematization

<table>
<thead>
<tr>
<th>Element</th>
<th>Input</th>
<th>Assessment</th>
<th>Recommendation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Management Strategy</td>
<td>Catchment level; end-of-line</td>
<td>Accepted</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Catchment Delineation</td>
<td>Whole of contributing catchment</td>
<td>Requires revision for consistency with other PIA</td>
<td>Revise models to include only newly developed lots within the contributing catchment to a proposed device for each planning horizon (2031, Ultimate)</td>
<td>The future sizing and design of infrastructure should consider hydrologic aspects of the whole of catchment.</td>
</tr>
<tr>
<td>Source Node Approach</td>
<td>'Lumped' catchment</td>
<td>Accepted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment Train</td>
<td>Includes GPT, wetlands and bioretention</td>
<td>Accepted</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.3 Input Parameters

The following table summaries the review of the model files and the input parameters. The table includes recommendations for revision based on current best practice where applicable.

Each model was reviewed individually and any issues that were identified only in a single model are identified in the comments column of Table 3.
Table 3: Review Summary – Input Parameters

<table>
<thead>
<tr>
<th>Element</th>
<th>Input</th>
<th>Assessment</th>
<th>Recommendation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climatic Data</td>
<td>40715 SHAILER - 21/1/1989-31/5/2006 6 min data</td>
<td>Accepted</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td>Based on outdated methodology and guideline values</td>
</tr>
<tr>
<td>Source Nodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>Impervious Fraction</td>
<td>Requires revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td>Based on outdated methodology and guideline values</td>
</tr>
<tr>
<td></td>
<td>Rainfall-Runoff Parameters</td>
<td>Requires Revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pollutant Export</td>
<td>Requires revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>Impervious Fraction</td>
<td>Requires revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td>Based on outdated methodology and guideline values</td>
</tr>
<tr>
<td></td>
<td>Rainfall-Runoff Parameters</td>
<td>Requires Revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pollutant Export</td>
<td>Requires revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>Impervious Fraction</td>
<td>Requires revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td>Based on outdated methodology and guideline values</td>
</tr>
<tr>
<td></td>
<td>Rainfall-Runoff Parameters</td>
<td>Requires Revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pollutant Export</td>
<td>Requires revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td></td>
</tr>
<tr>
<td>Vacant</td>
<td>Impervious Fraction</td>
<td>Requires revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td>Based on outdated methodology and guideline values</td>
</tr>
<tr>
<td></td>
<td>Rainfall-Runoff Parameters</td>
<td>Requires Revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pollutant Export</td>
<td>Requires revision</td>
<td>Update in accordance with the MUSIC Modelling Guidelines</td>
<td></td>
</tr>
<tr>
<td>Treatment Nodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetland</td>
<td></td>
<td>Accepted</td>
<td>Set up could be simplified for this level of investigation. Removal of GPT recommended.</td>
<td></td>
</tr>
<tr>
<td>Bioretention</td>
<td>V3 node type</td>
<td>Update to V6 with interim node values as per Water by Design advice</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is noted that an assessment of ‘accepted’ in Table 2 indicates that the model setup was in accordance with the recommended values contained within the MUSIC Modelling Guidelines (Water by Design, 2010)

4.4 Revised Model and Outcomes

The three MUSIC models were revised based on the recommendations contained within Table 4 and reanalysed in MUSIC v6. In summary the following modifications to each of the models were made:

1. Update of source nodes to be consistent with current MUSIC Guideline values;
2. Update of catchment areas and impervious fraction utilising the LDPM data and separating catchment areas to only include newly developed lots within the planning horizon;
3. Update of bioretention nodes to current version node;
4. Removal of GPT from wetland treatment train;
5. Reanalysis in MUSIC v6; and
6. Optimisation of treatment nodes to ensure Water Quality Objective were met with the above modifications.

A summary of the outcomes of the reanalysis is provided below:

Table 4: Modification to Infrastructure Resulting from Model Revision

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Original Area m²</th>
<th>Area Required at 2031 m²</th>
<th>Additional Area at Ultimate m²</th>
<th>Additional Area to treat Council Owned land m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catchment 1</td>
<td>Bioretention</td>
<td>1450</td>
<td>245</td>
<td>285</td>
<td>250</td>
</tr>
<tr>
<td>Outlet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catchment 2</td>
<td>Bioretention</td>
<td>680</td>
<td>90</td>
<td>130</td>
<td>85</td>
</tr>
<tr>
<td>(Outlet 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catchment 2</td>
<td>Wetland</td>
<td>33000</td>
<td>9000</td>
<td>2300</td>
<td>20000</td>
</tr>
<tr>
<td>(Outlet 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Areas indicated are treatment area, that is, filter area for bioretention and macrophyte zone area for wetlands. This area is reported as the cost estimates based on unit rate approach presented within this review are based on treatment areas.
2. MUSIC modelling was completed to determine treatment areas required for lots developed within a planning horizon (i.e. 2014 to 2013, 2031 to ultimate). Table 4 provides an area sufficient to treat runoff from only the lots developed up until 2031, an additional area which would treat lots developed up until the ultimate horizon and a total area that would be required to treat council owned roads and other Council land in total. There is no treatment areas provided for lots that are not predicted to be redeveloped within the LDPM prior to the ultimate planning horizon.
3. ID as per Appendix C Figure 2 of the EnGenY 2009 report (attached for reference).

As this PIA is an infill area a relatively large proportion of the catchment is road reserve and other Council owned land. Since the catchment areas were limited to only lots which are developed as per the LDPM within the planning horizon (i.e. 2014 to 2031, 2031 to ultimate) an estimate of the treatment area that would be required to treat road areas within the catchments is provided. If it was determined that, for the purposes of a financial model, a proportion of the current roads will be redeveloped within the planning horizon then a pro-rata allowance for required treatment area can be calculated from the total requirement in Table 4.
4.5 Assessment Summary

Review of the 2009 EnGenY report and associated MUSIC model files revealed that both the software and the guidelines on which models were constructed were outdated and required revision. In addition, it was found that the LDPM had become available since the completion of the EnGenY 2009 report and the assumed fraction impervious and resulting impervious areas within the EnGenY 2009 report required revision. Finally, a fundamental change in the sizing of infrastructure being the limiting of the contributing catchment to that which is developed within the planning horizon has resulted in significant reductions in the estimated sizes of water quality treatment infrastructure within the PIA.

5 Stormwater Quantity Modelling

5.1 Software and Reference Basis

Water quantity modelling was undertaken using the industry standard hydrologic/hydraulic modelling software package XP-STORM. This package is accepted as an appropriate tool for conceptual sizing of stormwater detention devices and other flood mitigation works and is appropriate for use in this level of investigation.

5.2 Methodology and Model Schematization

Review of the 2009 EnGenY study report, with particular reference to Section 4 – Stormwater Quantity, finds that the methodology for the derivation of a stormwater quantity management strategy at a catchment scale planning level is sound.

The reviewed investigation seeks to quantify the peak runoff for the major event from the delineated sub-catchments in an existing landuse case and under the projected development conditions at the ultimate (2051) planning horizons. Conceptual sizing of detention infrastructure and other mitigation works is then undertaken to mitigate peak flows from the catchment to the existing case condition.

Some level of calibration, or verification, of estimated peak flows is undertaken within the investigation in line with general industry practice.

The sub-catchment delineation is based upon topography is considered appropriate for this investigation.
5.3 Input Parameters

The construction of the XP-STORM models for each of the sub-catchments were found to be generally in accordance with technical guidelines including the software supplier reference manuals and industry best practice. No notable variances from industry best practice were identified.

Input parameters for sub-catchments including catchment areas and slope were considered to be reasonable on comparison with base topographical data and aerial photography.

As discussed in Section 4, impervious fractions adopted within the hydrological models were reviewed against the impervious fractions derived from the LDPM data and found to have some deviation. In particular the impervious fractions of the catchment in the EnGenY 2009 existing landuse case were found to be significantly lower than those calculated from the LDPM data. As a result it was decided that the XP-STORM model should be updated with the impervious fractions calculated through the LDPM data and the infrastructure sizing (in particular detention basins) be revised.

5.4 Hydraulic Modelling

As noted above modelling was undertaken in a combined hydrologic/hydraulic model within XP-STORM. The hydraulic attributes within the system were constructed based on Council GIS information (pipe networks and pit levels) and an ALS terrain model.

While it is likely there may have been some level of maintenance and repair of the pipe network since the EnGenY 2009 study was completed it was not felt that it would be significant enough to undertake a detailed review and revision of the construction of the model. Similarly while newer ALS data than that on which the model was constructed is likely to be available it was not felt that detailed review and revision of the model construction with respect to overland flow definition was warranted or necessary.

The construction of the hydraulic network was found to be detailed yet sound and sufficient for this level of planning investigation. Model construction should be reviewed prior to detailed planning and design of any infrastructure within the catchment. This hydraulic modelling should not be relied upon for the prediction of flood levels within the area or detailed costing or design of infrastructure.
5.5 Revised Model and Outcomes

The two XP-Storm models which contained detention basins (Catchment 1 and the combined Catchments 2 and 3) were revised only to update the fraction impervious for each of the sub-catchments defined within the model in line with the fraction impervious calculated through the use of the LDPM. The size of the proposed detention basins within the mitigated case models were then modified such that they were sized to ensure non-worsening of peak flows and flood levels within the catchment. No modification of other proposed works recommended within the EnGenY 2009 report was undertaken. It is assumed that these works will still be required to alleviate overland flow and localised flooding issues.

There was no detention basins proposed within the Combined Catchment 4 and 5 model and thus this model was not revised. It is assumed that the proposed works consistent of modifications to overland flow paths will still be required.

A summary of the outcomes of the reanalysis is provided below:

Table 5: Modification to Infrastructure Resulting from Model Revision

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Original Volume m$^3$</th>
<th>Volume Required at 2031 m$^3$</th>
<th>Additional Volume at Ultimate m$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catchment 1 Outlet</td>
<td>Detention</td>
<td>4000</td>
<td>-</td>
<td>1715</td>
</tr>
<tr>
<td>Catchment 2 (Outlet 2)</td>
<td>Detention</td>
<td>1300</td>
<td>190</td>
<td>35</td>
</tr>
</tbody>
</table>

Note: ID as per Appendix C Figure 2 of the EnGenY 2009 report (attached for reference).

It was found that within Catchment 1 the increase in impervious fraction calculated through the use of the LDPM resulted in an increase in peak flow from the system at 2031 of only 1.33% higher than the existing case. Predicted flood levels at 2031 within Catchment 1 were +/- 11 mm. It is recommended that this increase in peak flow would be considered insignificant and thus the construction of a detention facility to cater for redevelopment of the catchment to 2031 is not warranted.

Within Catchment 1 the increase in peak flow as a result of the redevelopment and increase in impervious area was estimated to be in the order of 10%. Therefore, the construction of a detention facility with a volume of 1715 m$^3$ was found to mitigate both peak flows and flood levels within the catchment back to or below pre-development levels.

The peak flow increases at Outlet 2 of Catchment 2 were found to increase by 9.1% as a result of redevelopment to 2031 and to increase by 12.7% compared to existing case flows at the ultimate planning horizon.

In order to mitigate peak flows at Outlet 2 of Catchment 2 to predevelopment flows it was found that a detention basin with a volume of 190 m$^3$ would be required at 2031 and a further 35 m$^3$ (a total volume of 225 m$^3$) at the ultimate horizon would
be required. It is noted that not alteration to the depth or outlet arrangements of the proposed basins in the EnGenY 2009 model were made.

The resulting detention volumes predicted to be necessary based on the revised impervious fractions of Catchment 1 and Catchments 2 and 3 were found to be significantly smaller than those presented in the EnGenY 2009 report.

5.6 Assessment Summary

Review of the EnGenY 2009 report and associated hydrologic and hydraulic model files concludes that the recommended conceptual sizing of detention within Catchments 1 and 2 (Outlet 2) can be significantly reduced based on the revision of the impervious fractions of the catchment based on the LDPM data. No revision of other flood management infrastructure recommended within the EnGenY 2009 has been undertaken.

6 Proposed Infrastructure

The 2009 EnGenY report provides conceptual infrastructure layouts within Appendices J to M. An assessment of key elements is provided below.

6.1 Location

Generally the selected location for proposed infrastructure is considered reasonable and practical. It appears, where possible, water quality and flood detention infrastructure has been co-located to minimize footprint.

No revision or modification to the location of infrastructure is recommended on the basis of informing a financial model for stormwater infrastructure planning.

6.2 Conceptual Layout

The conceptual layout of both water quality treatment devices (wetlands and bioretention) and detention infrastructure presented in the 2009 EnGenY report appears to be reasonable and in line with current industry practice.

It is noted however, that with the revision of infrastructure size, both water quality and quantity, the areas indicated within the EnGenY 2009 report can be reduced.

It is noted that the layouts presented should only be used for the purpose intended, this being the quantification and preliminary costing of trunk infrastructure to service projected development with the catchments. The presented conceptual designs are suitable for informing financial modelling of stormwater infrastructure however, should not relied upon for capital works estimates.
6.3 Land requirements

Review of the land acquisition GIS layer associated with the PIP2A (PIP2_Proposed_Land_Acquisition_polygon_LL) concludes that the areas align with the proposed conceptual layouts for infrastructure proposed within the 2009 EnGenY 2009 report.

It is noted that the areas may be reduced based on the revision of infrastructure size provided in this review document.

7 Costing

The 2009 EnGenY report presents cost estimates for each of the proposed elements of trunk infrastructure. Cost estimates have been reviewed based on any revision of the infrastructure requirements as a result of this review process and based on standardized unit cost rates for stormwater infrastructure as presented in a supplied reference document titled *Stormwater Management Unit Cost Rates for Logan – Park Ridge Priority Infrastructure Plan* (DesignFlow, 2014).

Revised cost estimates are provided in Table 6.
### Table 6: Cost estimates

<table>
<thead>
<tr>
<th>Item ID</th>
<th>Item</th>
<th>Original size m$^2$</th>
<th>Original size m$^3$</th>
<th>Original Cost 1.</th>
<th>2014 Unit Cost/m$^2$</th>
<th>2014 Unit Cost/m$^3$</th>
<th>2014 cost based on original size</th>
<th>Revised Size m$^2$</th>
<th>Revised Cost 3.</th>
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<td>Catchment 1</td>
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<td>$1,340,000</td>
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<td>0</td>
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Notes:
1. From EnGeny, 2009. Size of water quality treatment infrastructure is treatment area (i.e filter area of bioretention and macrophyte area of wetlands)
2. From Stormwater Management Unit Cost Rates for Logan (DesignFlow, 2014) – assumes constrained site conditions
3. Costs of works that are not included in the Unit Cost report (DesignFlow, 2014) have been increased by 9.5% based on an average of the cost index for Building and Construction and Roads and Bridges in Australia and Queensland from ABS data.
8 Conclusion

The review of the Station Road (Loganlea) Infill Study Stormwater Infrastructure Concept Plan completed by EnGeny in 2009 and the associated modelling files concludes that:

- The base data and assumptions on which the study was based were sound at the time of the study. However, the release of the LDPM and its revisions resulted in significant difference in the assumed fraction impervious of the catchments at both the existing and future planning horizons. This has resulted in the revision of the modelling and significant alteration to the infrastructure proposed.

- In general water quality modelling was found to be sound at the time of the study. However, both software and guidelines on which modelling was based have been superseded. This, in combination with revision to the assumption of contributing catchment delineation and impervious fraction, has required significant modification of the MUSIC models.

- Proposed detention infrastructure sizing and the construction of the water quantity (XP-STORM) model files was found to be sound. Revision of the assumed fraction impervious for the catchments was undertaken and this has resulted in a significant reduction in the volume of detention required in Catchments 1 and Catchment 2 (Outlet 2). It was assumed that no modification to the other proposed flood mitigation works was required and this infrastructure recommendation has remained unchanged from the EnGenY 2009 report.

- Update of cost estimates based on revision of the infrastructure requirements as a result of this review process and based on standardized unit cost rates for stormwater infrastructure resulted in the total cost of proposed infrastructure in the PIA falling from the original EnGenY 2009 estimate of $6.5 million to $3.8 million.
ATTACHMENT 1

CATCHMENT PLAN FROM ENGENY 2009 REPORT
Station Road Infill Study

Major Catchment Outlets Plan

Legend
- Cadastre
- Infill Area
- 1m Contour

Major Catchment Legend
- Catchment 4
- Catchment 5
- Catchment 3
- Catchment 1
- Catchment 2

Waterways
- Catchment Outlet Locations
- Catchment Boundary
- Existing Open Channel
- Existing Stormwater Pipe

Scale 1:4,000

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