Optimatics

optimizing water systems

Newcastle 10 Wastewater Catchment

Advantages of In-line Flow Control Facilities and Adaptive Planning Strategies

Developing effective collection system planning strategies requires careful consideration of total project costs, environmental impact, community impact and level of risk.

KEY POINTS

- Optimization of wet weather flow diversions, peak discharge to WWTPs, wet weather storage capacity, I/I reduction, pipe upgrades and operational control settings.
- Optimization scenarios completed to assist with engineering assessment of risk and environmental impact.

"An optimised decision support system is useful in pointing you in the right direction when developing wastewater catchment servicing strategies. Optimatics certainly have the tools and expertise to deliver in this regard." - *Leon Dawes, Hunter Water Corporation Network Planning Engineer*

INTRODUCTION

Seeking cost effective, practical solutions to eliminate wet weather sewage overflows for current and future design flows, Hunter Water Corporation (HWC) undertook detailed analyses of improvement options for the main pump station catchment serving western Newcastle, Australia.

The alternatives evaluated included inflow and infiltration (I/I) reduction, conveyance upgrades (pump station upgrades and sewer main augmentations), wastewater treatment plant (WWTP) expansion, wet weather flow diversions, above ground flow control facilities (i.e. attenuation storage) and inline flow control facilities (FCFs).

METHODOLOGY

Optimizer WCS was used by HWC to assist with the analysis of improvement options for the Newcastle 10 Wastewater Catchment.

Optimizer WCS uses a wastewater customized hybrid of genetic algorithm optimization and implicit linear programming optimization to automatically evaluate thousands of potential system improvement option configurations against hydraulic performance and total solution cost.

Cost-optimized planning solutions were developed for a range of different planning scenarios. This provided a portfolio of low-cost solutions which the engineering team could review with respect to non-cost objectives (environmental impact, community impact and level of risk) to determine the solution which best met the overall planning objectives for the catchment.

Several optimization scenarios and sensitivity analyses were completed to identify aspects of the Optimized Solution (Figure 1) which are sensitive to the estimated cost of WWTP expansion, the cost effectiveness of I/I reduction and the target level of service for allowable overflow frequency in the trunk sewer.

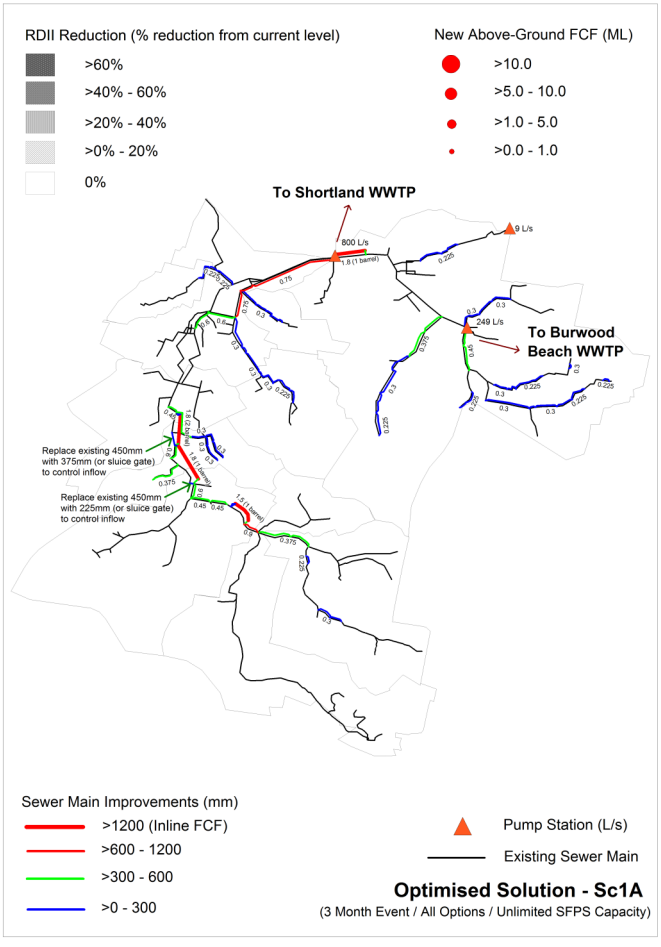

Figure 1.
Optimized Solution

OPTIMATICS

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Storage Location, Capacity and Control Settings Optimized

RESULTS

The optimization model formulated for the Newcastle 10 Wastewater Catchment was used to produce optimized solutions for different allowable peak flow to the WWTP. By switching off storage and I/I reduction options the optimization model was run to produce the Conveyance-Only Solution. By limiting the maximum allowable discharge to the WWTPs at 850 L/s an alternative optimization solution was produced.

The optimization scenario solutions are compared with the least-cost optimized solution on the cost effective analysis curve in Figure 3. The least-cost optimized solution represents a 45% saving when compared with the conveyance-only solution.

INLINE FLOW CONTROL FACILITES

The Optimized Solution included a total attenuation storage volume of 3.5 ML provided by four separate inline FCFs. The diameter, number of barrels, inflow weir height and drainage pipe configurations were optimized to determine the configuration which best utilises existing sewer capacity and achieves maximum hydraulic performance for the inline FCF without requiring mechanical components.

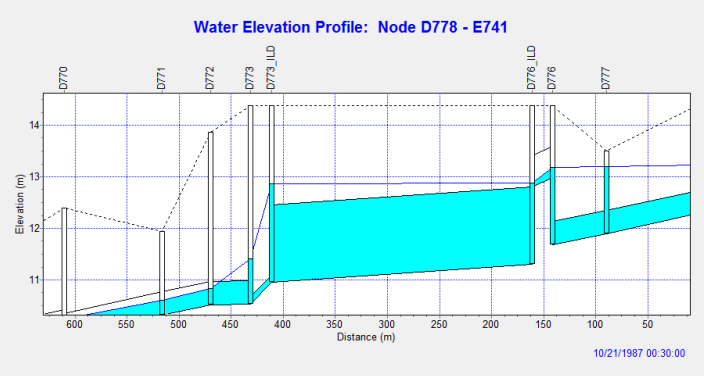

Figure 2.
Optimized Solution I/I Reduction Targets.

The optimization analysis showed that when compared with parallel sewer augmentations, inline FCFs reduced peak flows to the treatment plant, reduced total projects costs and provided greater flexibility with respect to construction staging and optional future duplication.

CONCLUSIONS

While there are number of potential variables in the upgrade of the system one solution that was consistently identified as a best value option was inline FCFs. The inclusion of FCFs is not only advantageous from a least cost perspective but there is added flexibility in staging the program of works to include other remedial strategies.

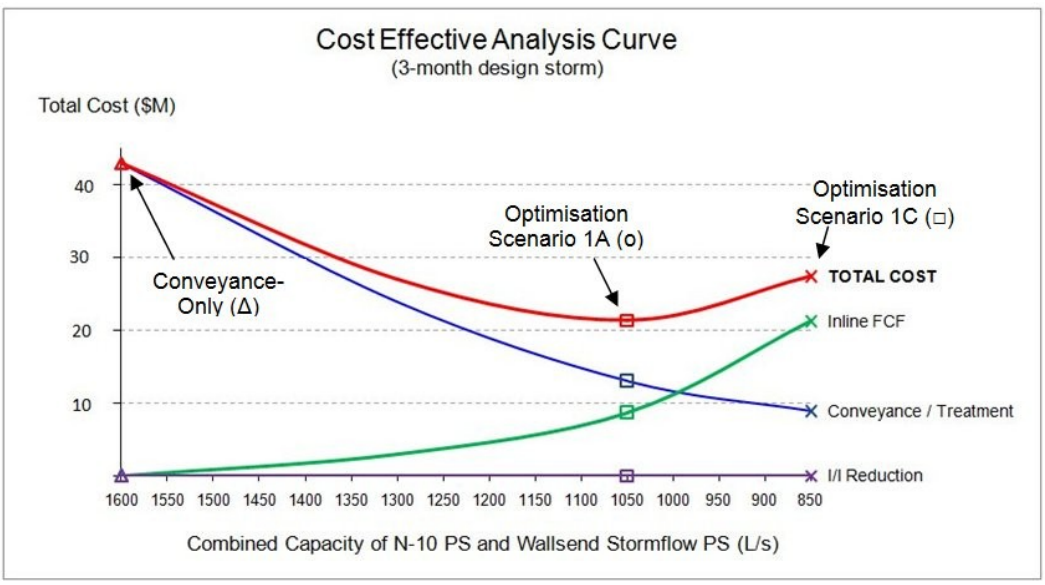

Figure 3,

Cost Effective Analysis Curve for the Newcastle 10 Wastewater Catchment